IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
(EXTRA-ORDINARY ORIGINAL JURISDICTION)
WRIT PETITION (CIVIL) NO. _____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. **PETITIONERS**

VERSUS

GOVERNMENT OF NCT OF DELHI & ANR. **RESPONDENTS**

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FILED THROUGH

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI
MAYANK KHAITAN
[D3104/2009/D5080/2017/D10269/2025]
ADVOCATES FOR THE PETITIONERS
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E-MAIL: dasgupta.manjira@gmail.com / bhargav@chambersofbhargavthali.com

NEW DELHI
DATE: 15**.11.2025**

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1

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VERSUS	
GOVERNMENT OF NCT OF DELHI & ANR.	**RESPONDENTS**

NOTICE OF MOTION

Sir,

Kindly take note that the aforementioned Petition, a copy of which is enclosed, will be listed for hearing before the Hon'ble Delhi High Court on 19**.11.2025** or on such other day as may be convenient to the Court.

Thanking you,



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MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI
MAYANK KHAITAN
[D3104/2009/D5080/2017/D10269/2025]
ADVOCATES FOR THE PETITIONERS
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NEW DELHI
DATE: 15**.11.2025**

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NYSA BEDI & ORS.	**PETITIONERS**
VERSUS	
GOVERNMENT OF NCT OF DELHI & ANR.	**RESPONDENTS**

URGENT APPLICATION

The Registrar,
High Court of Delhi at New Delhi,
Sher Shah Suri Road,
New Delhi – 110 001

Sir,

Will you kindly treat the present writ petition with affidavits in support as an urgent one in accordance with the rules of the Hon'ble Court as urgent orders/directions are prayed for in the petition.

Thanking you,

FILED THROUGH



MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI
MAYANK KHAITAN
[D3104/2009/D5080/2017/D10269/2025]
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NEW DELHI
DATE: 15 **.11.2025**

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
(EXTRA-ORDINARY ORIGINAL JURISDICTION)
WRIT PETITION (CIVIL) NO. _____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. **PETITIONERS**

VERSUS

GOVERNMENT OF NCT OF DELHI & ANR. **RESPONDENTS**

SYNOPSIS

The Petitioners are minor school children and actively participate in state scheduled sports tournaments, camps, trials etc. The Petitioners are constrained to file the present Writ Petition praying *inter alia* that the Respondents be directed to, henceforth, schedule the annual outdoor sports calendar in a manner so as to avoid scheduling of trials, zonal tournaments, inter-zonal tournaments, state tournaments, national tournaments and coaching camps etc. for school children (across multiple outdoor sports and disciplines) in Delhi during the months of November to January, when the air quality in the Delhi is verifiably and foreseeably 'Severe' and 'Hazardous'.

It is the case of the Petitioners that the repeated scheduling of such outdoor sports events, by the Respondents in the months of November to January of each school calendar is arbitrary, unreasonable, and negligent. This (in)action of the Respondents violate the Petitioners'

Fundamental Right to Life, Health and Education under Articles 21 & 21A of the Constitution of India.

It is a matter of fact and record that each year, Delhi undergoes a massive public health crisis in the period between November to January where the air pollution levels in Delhi are highly toxic. In fact, even as on date of filing of the instant Petition, the AQI in Delhi is consistently in the 'Severe' category; the statutory GRAP-III emergency plan has been put in force; and there remains every likelihood of the same further being upgraded to a GRAP-IV level emergency.

The Petitioners submit that the scheduling of state sanctioned sports tournaments, trials, camps etc. in this period, forces them, and lakhs of other children, who are recognized as “vulnerable group”, to perform strenuous physical activities in a highly toxic environment. The risk posed to this vulnerable section of the society, as a result of the same, is not hypothetical, but is a known annual, and predictable predicament. Overwhelming medical evidence and expert warnings, including from medical experts, Ministry of Health and Family Welfare, World Health Organization confirm that exposure to such highly toxic airborne particulate pollutants is poisonous to children, causes irreversible harm, including “diminished growth of lungs”, cognitive impairment, and acute cardiovascular strain.

The arbitrariness and negligence of the Respondents' in the present Petition is writ large. The repeated annual nature of toxic rise in air

pollution levels in the months of November to January is a known fact. It is also a matter of fact that the same is within the contemplation of the Respondents. Furthermore, the Respondents are acutely aware that the environmental factors during this time are not suitable, and are in fact, extremely hazardous to children. The same is *inter alia* demonstrable from the fact that in November 2023, Respondent No. 1 was compelled to *suspend* all sports, issuing an order that explicitly admitted a threat to the "*health and security of students/children*". However, the Respondents thereafter shockingly revoked the suspension and; in a grossly negligent manner carried on with scheduling sporting events in this exact same period year after year.

The repeated scheduling of sporting events at this time of the year is a flagrant violation of the Petitioners' Fundamental Rights under Article 21 of the Constitution of India. It is submitted that sports and physical literacy is a very fundamental and important part of a child's upbringing, and play a vital part in ensuring a good life for them. Similarly, it is trite that right to clean air, environment and health are also a vital part of a child's fundamental right to life. At present, children across Delhi are being compelled to choose between participating in such state-scheduled sports events (at the cost of permanent irreparable damage to their physical health), or remain indoors to mitigate and prevent such harm.

It is most respectfully submitted that the same is against the constitutional ethos. The Respondents actions in constantly scheduling outdoor sporting activities in this period violates their constitutional mandate to ensure that such rights are harmonized, which fundamental rights do not operate in the alternative. Furthermore, the (in)actions of the Respondents are in direct contravention of the constitutional directives under Articles 39 and 47, binding directives from the MOHFW, global standards from the WHO and national policies like the NEP.

Hence, the present petition.

LIST OF DATES

DATE	PARTICULARS
November 2022 – January 2023	The NCT of Delhi experienced a well-documented and severe public health emergency, with the AQI remaining in the "Very Poor" and "Severe" categories for extended periods. Despite this known hazard, the Respondents, in disregard of the danger, scheduled and conducted their full annual outdoor sports calendar, exposing thousands of children to toxic air.
03.11.2023	As the AQI in Delhi again plummeted to "Severe" levels, Respondent No. 1 was compelled to issue an Order suspending all Zonal sports tournaments. The order itself contains a categorical admission of the danger, stating the suspension was "keeping in view the health and security of students/children of Delhi due to poor air quality."
18.11.2023	In a complete non-application of mind and demonstrating an arbitrary, ad-hoc approach, Respondent No. 1 issued another Order *revoking* the suspension and resuming all sports, despite the air quality remaining "hazardous" and "poor".

November 2023 - January 2024	The Respondents, in complete disregard for the "Very Poor" and "Severe" air quality, continued to conduct their remaining sports calendar for the 2023-24 season. This continued exposure, as evidenced by CPCB data demonstrates that the brief suspension was an ad-hoc measure and not a systemic solution, as children were permitted to compete in hazardous air for the remainder of the season.
November 2024 - January 2025	The Respondents once again proceeded with the full sports schedule for the 2024-25 season. This period predictably saw high AQI levels, continuing the multi-year pattern of knowingly exposing children to foreseeable harm.
11.11.2025	As the AQI predictably entered the "Severe" category , the Commission for Air Quality Management (CAQM) invoked the emergency measure, Stage-III of the Graded Response Action Plan (GRAP) even though the news articles suggest otherwise that AQI has crossed 500 and GRAP IV ought to invoked. GRAP IV order explicitly directs that children "*avoid outdoor activities"*.

November 2025	As of the date of filing, despite the "Severe" AQI the sports camps scheduled by Respondents are *actively ongoing*. This constitutes a wilful, *per se* illegal, and ongoing violation of the Petitioners' fundamental rights.

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VERSUS

GOVERNMENT OF NCT OF DELHI & ANR. **RESPONDENTS**

MEMO OF PARTIES

NYSA BEDI **Petitioner No.1**
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REYANSH PODDAR **Petitioner No.2**
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AARAV PUNJ TRIPATHI **Petitioner No.3**
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Ph: +91 9999973508
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ABHIVEER GULATI **Petitioner No.5**
Minor through His Father
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aged about 52 years,
S/o, Shri Yogesh Gulati
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ZOYA SAHNI **Petitioner No.6**
Minor through her father
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99990 16684

LUKSHYA ARORA **Petitioner No.7**
Minor through his mother
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D/o Late Shri Yogendra Singh
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SHIRIN SHAW **Petitioner No.8**
Minor through her mother

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COCO SHIRALI BOSE **Petitioner No.9**
Minor through her mother
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NAYONIKA MATHUR **Petitioner No. 10**
Minor through her Mother
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ZORAWAR **Petitioner No.11**
Minor through his mother Ms Ritu,
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Versus

GOVERNMENT OF NCT OF DELHI **Respondent No.1**
Through Directorate of Education Secretary
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Email: secyedu@nic.in

SCHOOL **Respondent No.2**
FEDERATION OF INDIA GAMES

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FILED THROUGH



MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/
MAYANK KHAITAN
[D3104/2009/D5080/2017/D10269/2025]
ADVOCATES FOR THE PETITIONERS
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NEW DELHI
DATE: 15 **.11.2025**

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
(EXTRA-ORDINARY ORIGINAL JURISDICTION)
WRIT PETITION (CIVIL) NO. _____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. **PETITIONERS**

VERSUS

GOVERNMENT OF NCT OF DELHI & ANR. **RESPONDENTS**

A WRIT PETITION UNDER ARTICLE 226 OF THE CONSTITUTION OF INDIA

1. The Petitioners are minor school children who actively participate in state scheduled sports tournaments, camps, trials etc in Delhi and India. The Petitioners are constrained to file the present Writ Petition praying *inter alia* that the Respondents be directed to, henceforth, schedule the annual outdoor sports calendar in a manner so as to avoid scheduling of zonal tournaments, inter-zonal tournaments, state tournaments, national tournaments and coaching camps, trials etc. for school children (across multiple outdoor sports and disciplines) during the months of November to January, when the air quality in Delhi is verifiably and foreseeably 'Severe' / 'Hazardous'. It is the case of the Petitioners that the manner in which Respondents are scheduling sports tournaments, trials, camps etc., across Delhi demonstrates non application of mind against overwhelming scientific and empirical data available in the public domain, violates the Petitioners' Fundamental Right to Life,

Health and Education under Articles 21 & 21A of the Constitution of India

PARTIES

Petitioners

2. The Petitioners are young passionate athletes who take keen interest in various sports disciplines. Details of the Petitioners are provided hereinbelow:

a. Petitioner No.1 is Nysa Bedi who plays Football and Cricket. Petitioner No.1 participated in Respondent No.1's U19 Girls Football on 10.11.2025 to 14.11.2025 and will participate in Respondent No.2's Football Nationals Selection and Training Camp starting from the week commencing 17.11.2025 and Respondent No.1's U19 Cricket Girls Inter Zonals starting end of November 2025. She also participated in the trials on 13.11.2025 for the upcoming Respondent No.1's U19 Cricket Girls Inter Zonals.

b. Petitioner No.2 is Reyansh Poddar who plays Football and participates in Athletics events. Petitioner No.2 participated in the Athletic CBSE Cluster games organised by CBSE Board in October 2025 and in Respondent No.2's Inter-Zonal Athletic event.

c. Petitioner No.3 is Aarav Punj Tripathi who plays Cricket. Petitioner No.3 participated in the Regional Zonals for Cricket on 06.11.2025 organised by Respondent No.1.

d. Petitioner No.4 is Yuvan Prasad who plays Football and participates in Athletic events. Petitioner No.4 participated in Respondent No.1' s Inter Zonal Athletics on 11.11.2025 to 17.11.2025 in U14 High Jump and U14 4x100m Relay.

e. Petitioner No.5 is Abhiveer Gulati who plays Football and Cricket.

f. Petitioner No. 6 is Zoya Sahni who plays football. Petitioner No.6 participated in the Respondent No.1's U-19 Girls Football on 10.11.2025 and 11.11.2025.

g. Petitioner No.7 is Lukshya Arora who plays Football and participates in Athletic events. Petitioner No. 7 participated in (a) CBSE Athletics Cluster Meet in August 2025; (b) CBSE Football Tournament in August and Zonals Trials in September.

h. Petitioner No. 8 is Shirin Shaw who plays Football and participates in Athletic events. Petitioner No. 8 participated in the U19 Inter Zonal Football in October 2025 and U19 Football Zonals in November 2025.

i. Petitioner No. 9 is Coco Shirali Bose who plays Football and participates in Athletic events. Petitioner No. 9 has

participated in Athletics U14 (a) 400 mts, (b) 600 mts, (c) 4 x 100 mts relay and (d) Long jump in Respondent No.1's Inter-zonals Delhi School Games 2025.

j. Petitioner No. 10 is Nayonika Mathur who plays Basketball and participates in Athletic events. Petitioner No.10 attended trials for Inter Zonal Basketball on 03.112025 to 05.11.2025. She has also participated in Inter Zonal Athletics on 12.11.2025.

k. Petitioner No.11 is Zorawar who plays Football and participates in Athletic events.

3. Petitioners and thousands of other similarly situated children are directly and adversely affected by the impugned (in) actions of the Respondents, who are constrained to choose between their fundamental right to health & safety on the one hand; and their right to participate in sports which forms part of their vital fundamental right to life and education. This petition is filed for the protection of the fundamental rights of the Petitioners and all other students under the charge of the Respondents.

Respondents

4. The Respondent No. 1 is the Government of NCT of Delhi ["**GNCTD**"] through the Directorate of Education. The Directorate of Education, a nodal body of the Govt. of NCT of Delhi, is responsible for administering school education and all related activities, including

scheduling and execution of all zonal, inter-zonal, and state-level competitions in Delhi. Further, Respondent No. 1 also schedules coaching camps and trials for selection of teams for participation in the national level school games under the aegis of Respondent No.2.

5. The Respondent No. 2 is the School Games Federation of India ["**SGFI**"], which is the sole national school games federation recognized by the Government of India for organizing the National School Games, including those within Delhi. The Respondent No 1 is affiliated with the Respondent No 2.

6. The Respondents No. 1 and 2 are "State" within the meaning of Article 12 of the Constitution of India. They exercise a fiduciary duty of care over the students under their charge, which includes a non-negotiable duty to protect their health and safety.

FACTS

SCHEDULING OF SCHOOL SPORTS CALENDARS

7. Respondent No. 1 is responsible for scheduling the annual sports calendar, and organizing state level school competitions across age-groups for multiple school level sports disciplines within Delhi. Respondent No. 2 prepares its own calendar for scheduling national level school games. Respondent No. 1 organises national school sports tournaments (in Delhi) under the aegis of Respondent No. 2. These games are scheduled on the basis of the sports calendar approved by the General Body of the Respondent No. 2.

8. It is a well-known fact that each year, the school sports calendar is scheduled in a manner, by both Respondent Nos. 1 and 2 respectively and several school level sporting events are held in Delhi in the period between October to January. *Particularly*, each year, Respondent No. 1 organizes state-level school competitions in Delhi in the period between Mid-October to end December. Further, Respondent No. 2's calendar also calls for national school tournaments to be held in the same period. In addition to the state-level school competitions, Respondent No. 1 conducts trials and coaching camps in Delhi, between November to December to select teams which participate in the National School Games of Respondent No. 2 (whether being held in Delhi, or outside).

ANNUAL RISE IN AIR POLLUTION LEVELS IN DELHI

9. It is a scientifically established, and judicially noticed fact that Delhi faces an annual public health emergency during the winter months, particularly between November to January. This is not a *force majeure* event, but a *predictable, annual, and scientifically* documented phenomenon. The past 10 years has seen a repeated cycle of toxic air pollution in Delhi in this period. The scheduling of the school level zonal, inter-zonal and state level, national level sporting events in Delhi around this period, while not a new phenomenon, is increasingly becoming a major health issue for children participating in such events.

10. During the winter of 2022, Delhi experienced prolonged air pollution crisis. The AQI for PM 2.5 consistently remained in the "Very Poor" and "Severe" categories for a prolonged period. The average AQI for this period in Delhi for (i) November 2022 was 323; (ii) December 2022 was 279; and (iii) January 2023 was 315. Despite this, the Respondents, in complete disregard of the hazard, scheduled and conducted their full annual outdoor sports calendar (across multiple sports), exposing thousands of children, including the Petitioners, to toxic air.

> Copy of Newspaper reports showing severe AQI in the month of November 2022 to January 2023 are annexed **Annexure 1.**
>
> Copy of relevant Central Pollution Control Board ["**CPCB**"] data on Air Quality Index for the month of November 2022 to January 2023 are annexed as **Annexure 2**.

11. In the face of the above, the Respondents yet again scheduled school level sporting events in Delhi for the period between November 2023 to January 2024. *Predictably*, the AQI in Delhi plummeted in November 2023 to "Severe" and "Hazardous" categories. Faced with a health crisis, Respondent No. 1 was compelled to take cognizance of the extreme and grim situation.

12. To this effect, on 03.11.2023, Directorate of Education ["**DoE**"] issued an Order suspending all Zonal sports tournaments and Delhi State School Games/events. The reason stated in the order itself is a categorical admission of the danger posed by the Respondents' own

schedule, "*...keeping in view the health and security of students/children of Delhi due to poor air quality...*".

Copy of the Order dated 03.11.2023 issued by DoE is annexed as **Annexure 3.**

13. However, in a shocking display of ad-hocism, non-application of mind and negligence, Respondent No. 1 failed to use this crisis as an opportunity for reform. Instead, on 18.11.2023, DoE issued another Office Order revoking the suspension and resumed all sports, forcing children back into a hazardous and volatile environment. The non-application of mind is evident from data available on the website of the Central Pollution Control Board ["**CPCB**"] from this period which confirms that the AQI for the month of November 2023 to January 2024 was consistently in the "very poor" category

Copy of the Officer Order dated 18.11.2023 issued by DoE is annexed as **Annexure 4.**

Copy of the Office Order dated 22.11.2023 issued by DoE is annexed as **Annexure 5**.

Copy of relevant CPCB data on Air Quality Index for the month of November 2023 to January 2024 are annexed as **Annexure 6.**

14. The Petitioners submits that it was incumbent upon the Respondents to learn from the ongoing crisis of 2023. A reasonable, prudent, and non-arbitrary authority, acting in the interest of children, would have permanently rescheduled the outdoor sports calendar for all future years to avoid this predictable hazard which is recurring every year without

fail. However, shockingly, and yet again, state-sanctioned outdoor sporting events across disciplines were scheduled for the very same period of November 2024 to January 2025 in Delhi.

Copy of relevant CPCB data on Air Quality Index for the month of November 2024 to January 2025 are annexed as **Annexure 7.**

15. Yet again, this year, the Respondents have, acting in a completely negligent manner, scheduled school level sporting tournaments (state level school games), trials, and coaching camps etc. in this period of November 2025 to January 2026. *Illustratively*, the schedule of the recent Delhi State School Games at under 14 years, 16 years, 17 years and 19 years levels across some sports are being set out below:

Sports	**Dates/Category**
Athletics	11.11.2025 to 17.11.2025 for under 14 years, under 17 years & under 19 years [Boys & Girls]
Football	28.10.2025 to 01.11.2025 for under 14 years [Boys] 03.11.2025 to 08.11.2025 for under 19 years [Boys] 10.11.2025 to 14.11.2025 for under 19 years [Girls]

Copy of the Circular issued by DoE in relation to the Delhi State School Games for Athletics are annexed as **Annexure 8.**

Copy of the Circular issued by DoE in relation to the Delhi State School Games for Football are annexed as **Annexure 9.**

Copy of the Circular issued by DoE in relation to the Delhi State School Games for Cricket are annexed as **Annexure 10.**

Copy of the Circular issued by DoE in relation to the Delhi State School Games for Volleyball are annexed as **Annexure 11.**

Copy of the Circular issued by DoE in relation to the Delhi State School Games for Tennis are annexed as **Annexure 12.**

Copy of the Circular issued by DoE in relation to the coaching for National School Games for Basketball are annexed as **Annexure 13**.

16. In addition to the above, Respondent No. 1 has also scheduled trials and coaching camps in this period across various sports for selection of state teams to participate in the national school games to be organized by the Respondent No 2. *Illustratively*, the schedule of the recent coaching camps and trials for national school games at under 14 years, 16 years, 17 years and 19 years levels across some sports are being set out below:

Sports	**Dates/Category**
Volley Ball	31.10.2025 to 09.11.2025 for under 17 years [Boys & Girls]

Copy of the Circular issued by Respondent No.2 in relation to coaching camps and trial for Volleyball are annexed as **Annexure 14.**

17. Therefore, even if the sporting tournament itself is not scheduled in this period, the Petitioners and thousands of children like them are, at the very least, required to train for events which are scheduled to be held later in the school calendar.

18. While things stand thus, it is a matter of fact that the air pollution in Delhi is grim. The Petitioners, and several thousand children in Delhi, being avid sports lovers, are being constrained to choose between their fundamental right to health & safety on the one hand; and their right to participate in sports which forms part of their vital fundamental right to

life and education. The latter compelling them to participate in competitive outdoor sporting events and/or train for the same (given its scheduling) in such highly toxic environment.

19. As of the date of filing of this Petition, the predictable consequences have materialized. The Air Quality Index ["**AQI**"] in Delhi is in the 'Severe' category (above 400), and the Commission for Air Quality Management ["**CAQM**"] has invoked Graded Response Action Plan ["**GRAP**"] Stage-III [i.e., AQI ranging between 401-450] of by an Order dated 11.11.2025. It is submitted that news articles suggest otherwise that AQI has crossed 400 and GRAP IV ought to invoked. The schedule direction for AQI above 450 under GRAP IV explicitly suggests that "*Children, elderly and those with respiratory, cardiovascular, cerebrovascular or other chronic diseases to avoid outdoor activities and stay indoors, as much as possible. If required to move outdoors, they are advised to wear mask*".

Copy of the GRAP for NCR is annexed as **Annexure 15.**

Copy of the GRAP Order dated 11.11.2024 is annexed as **Annexure 16**.

Copy of Newspaper articles suggesting that AQI has crossed 400 are annexed as **Annexure 17.**

20. Thus, the Petitioners and thousands of children are performing strenuous physical activities in 'Severe' AQI levels, which hampers their fundamental right to life. It is pertinent to note that these sporting events form a crucial part of the lives of these children. They not only

provide a platform for the Petitioners, and similarly placed children to make a career in such sporting activities; but also form a very important part of their upbringing. Sports, in general, form a crucial part in ensuring children have a good quality of life and play a vital role in improving their physical fitness, cognitive abilities, social skills etc.

21. Petitioners further submits that the toxic air condition at this time of the year is not a new or recent discovery. The hazardous impact of Delhi's air on its children has been a matter of official, scientific record for over a decade. The CPCB itself, in its 2012 report titled "*Study On Ambient Air Quality, Respiratory Symptoms And Lung Function Of Children In Delhi*", conducted an extensive study and concluded that poor ambient air quality was directly associated with a higher prevalence of respiratory symptoms and, most critically, reduced lung function in the children of Delhi. This study by the government's own apex pollution control body establishes that the State has been on notice for more than a decade about the fact that its air is causing permanent pulmonary damage to its children.

> Copy of the CPCB study titled as "*Study On Ambient Air Quality, Respiratory Symptoms And Lung Function Of Children In Delhi"* is annexed as **Annexure 18.**

22. Thus, this hazardous scheduling is not an isolated incident but a continuous and wilful pattern of negligence by the Respondents, which has been recurring annually for many years.

23. As stated above, every year, including in 2022, 20223, and 2024, Delhi has faced a documented public health emergency due to 'Very Poor' and 'Severe' AQI levels during the winter months, as widely reported in the media and in publicly available data. Despite this predictable and widely known crisis, the Respondents have, in gross non-application of mind, mechanically scheduled and conducted their full annual outdoor sports calendars during these very months. This has constrained thousands of children, including the Petitioners, to compete in toxic air, year after year, in complete disregard for their health and safety.

THE CATASTROPHIC & IRREVERSIBLE HEALTH IMPACT

24. The danger posed to the Petitioners and other children is not trivial, hypothetical, or remote. It is immediate and severe. As per expert medical opinion and publicly available data, the city's air quality remains in the “Severe” category, forcing an emergency response.

25. As established by numerous medical experts, athletes and children are "especially vulnerable". During strenuous exercise, their air intake is significantly higher than at rest, and they often breathe through the mouth, bypassing the nasal filtration system. This results in a much larger and deeper dose of pollutants like PM2.5 penetrating the lungs.

26. The medical consequences, as warned by experts, are severe and potentially irreversible, including but not limited to:

a. Acute Effects- giddiness, chest pain, chest constriction, and irritation in eyes.

b. Pulmonary Effects- inflammation, reduced lung function, asthma, bronchitis, and diminished growth of lungs.

c. Cardiovascular Effects- The strain of exercise in high pollution affects heart and lungs, causing cardiovascular strain.

d. Neurological Effects- Global studies on PM2.5 exposure in children have shown a direct link to cognitive and neuro developmental impairment.

Copy of an Expert Medical Opinion by Dr. Arvind Kumar, Chairman of "Doctors for Clean Air" and senior practicing pulmonologist in New Delhi is annexed as **Annexure 19**.

27. It is submitted that this is also a matter of global scientific consensus. The International Olympic Committee ["**IOC**"] in its Report on Acute Respiratory Illness in Athletes has provided an "evidence-based assessment of the risks for acute respiratory conditions affecting athletes" confirming that air pollution impairs performance and health. The Respondents are acting in defiance of global sporting and medical standards.

Copy of the IOC Report on Acute Respiratory Illness in Athletes is annexed as **Annexure 20.**

28. It is matter of scientific record that athletes are especially susceptible to health risks from air pollution, which can hinder their performance and elevate their risk of disease. Pollutants such as PM2.5, carbon monoxide, sulphur dioxide, poses significant health threats to athletes, leading to respiratory, cardiovascular, and neurological issues.

29. There are enough scientific evidence to suggest that specific pollutants like PM2.5 and ozone can prolong race times and increase dropout rates in endurance sports. Children and young adults are especially at risk , their developing bodies are more susceptible to harmful effects of air pollution , potentially affecting their growth and overall health

THE NATIONAL/INTERNATIONAL POLICY AND PARAMOUNT IMPORTANCE OF SPORTS

30. The Petitioner submits that the UN Convention on the Rights of the Child ["**UNCRC**"] recognizes the right of the child to "play" and India is a signatory to the UNCRC.

> Copy of the UN Convention on the Rights of the Child is annexed as **Annexure 21**.
>
> Copy of the UNICEF "Children's Rights in Sport Principles" is annexed as **Annexure 22**.

31. Infact, Government of India has, as a matter of national policy, recognized that sports are not just "extra-curricular" but are essential for holistic development. The National Education Policy ["NEP"], 2020, mandates sports-integrated learning to build character, discipline, and fitness in students.

> Copy of the the NEP is annexed as **Annexure 23.**

32. Furthermore, the Government of India's flagship "Khelo Bharat Niti" (*also called National Sports Policy 2025*) programme was launched with the specific objective of developing India into a "sporting superpower" and fostering a culture of fitness.

Copy of the Khelo Bharat Niti policy is annexed as **Annexure 24.**

33. The Petitioners, as young athletes, are actively seeking to participate in the sporting events. However, the (in) actions of the Respondents directly frustrate and undermine these national policies. The Petitioners and other young athletes are being constrained to choose between their fundamental right to health & safety on the one hand; and their right to participate in sports which forms part of their vital fundamental right to life and education. The latter compelling them to compete in hazardous air. It is submitted that the Respondents are making participation in sports a dangerous activity, thereby sabotaging the very goals of the NEP and Khelo Bharat Niti.

THE CONSTITUTIONAL MANDATE FOR CLEAN AIR AND CHILD HEALTH

34. The Petitioner most respectfully submits that the Right to Life under Article 21 of the Constitution of India is the most fundamental of all rights. The Hon'ble Supreme Court of India has, in a catena of judgments, interpreted Article 21 of the Constituion of India to include the Right to Health and, *critically*, the Right to a Clean and Healthy Environment**.**

35. The Hon'ble Supreme Court, has repeatedly affirmed that the Right to Life includes the right to be free from the “adverse effects of pollution” and that the State has an absolute, non-negotiable duty to protect the health of its citizens, especially children, from this known menace. This

fundamental right is further strengthened by the Directive Principles in Article 39(f) which says that "*children are given opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment*" and Article 47 which casts a duty upon the state to *"raise the level of nutrition and the standard of living and to improve public health.*

VIOLATION OF BINDING GLOBAL AND NATIONAL DIRECTIVES

36. The Respondents' (in)actions are not only contrary to Indian advisories but are in breach of the global scientific consensus on air quality and health. The World Health Organisation ["**WHO**"], in its Advisory of Air Pollution for NCR region, has established the scientific benchmark for activities considered unsafe for human health, including for children. These guidelines are the global standard which should be incorporated for our policy-making.

Copy of the WHO Global Air Quality Guidelines is annexed as **Annexure 25.**

37. The AQI levels of 400+ ("Severe") currently being witnessed in Delhi are manifold and in the case of PM2.5, often hundreds of times worse than the safe limits prescribed by the heath authorities. By scheduling events during November to January when the pollution levels are at its worse, Petitioners are being compelled to perform strenuous activity

and the Respondents are demonstrating a shocking disregard for the bare minimum standard for child health and safety.

38. Further, the Respondents are in flagrant and direct violation of the binding advisories issued by the Government of India's own expert bodies. The "Health Advisory on Air Pollution" issued by the National Centre for Disease Control ["**NCDC**"] under Ministry of Health & Family Welfare ["**MOHFW**"], *inter-alia* provides that with ***a)*** AQI of 201-300, the vulnerable population is advised to avoid outdoor physical activities and ***b)*** AQI of 301-400, the vulnerable population is advised to remain indoors and keep activity levels low. The same is not merely suggestive but is an explicit directive for health departments and, by extension, other state bodies like Respondent No. 1, on how to manage this specific health crisis.

> Copy of the Health Advisory on Air Pollution issued by the National Centre for Disease Control is annexed as **Annexure 26**.

39. This MOHFW advisory, directs that for school children, "*Physical activities like running, jogging, playing may be avoided or postponed*" when the AQI is "Poor" or above. By scheduling and conducting the entire outdoor sports calendar when the AQI is consistently "Very Poor" and "Severe", the Respondents are acting in direct, conscious, and wilful contravention of this primary health directive.

40. Furthermore, the Respondents are in open defiance of a binding statutory emergency protocol. This not a mere policy but a set of

emergency measures invoked by the Commission for Air Quality Management (CAQM). This act of scheduling sporting events during "severe" or "poor" AQI levels is not just negligent scheduling, it is an active and live contravention of a binding statutory order i.e., GRAP, a specialist health advisory under MOHFW, and global health standards.

GROUNDS

A. **BECAUSE** repeated scheduling of outdoor sports events, by the Respondents in the months of November to January of each school calendar is arbitrary, unreasonable, and negligent. This (in)action of the Respondents violate the Petitioners' fundamental right to life, health and education under Articles 21 & 21A of the Constitution of India.. It is a matter of fact, scientific data and empirical data that each year, Delhi undergoes a massive public health crisis in the period between November to January where the air pollution levels in Delhi are highly toxic. In fact, even as on date of filing of the instant Petition, the AQI in Delhi is consistently in the 'Severe' category; the statutory GRAP-III emergency plan has been put in force; and there remains every likelihood of the same further being upgraded to a GRAP-IV level emergency.

B. **BECAUSE** scheduling of state sanctioned sports tournaments, trials, camps etc. in this period, forces them, and lakhs of other

children, who are recognized as “vulnerable group”, to perform strenuous physical activities in a toxic highly environment. The risk posed to this vulnerable section of the society, as a result of the same, is not hypothetical, but is a known annual, and predictable predicament. Overwhelming medical evidence and expert warnings, including from medical experts, Ministry of Health and Family Welfare, World Health Organization confirm that exposure to such highly toxic airborne particulate pollutants is poisonous to children, causes irreversible harm, including “diminished growth of lungs”, cognitive impairment, and acute cardiovascular strain.

C. **BECAUSE** arbitrariness and negligence of the Respondents' in the present Petition is writ large. The repeated annual nature of toxic rise in air pollution levels in the months of November to January is a known fact. It is also a matter of fact that the same is within the contemplation of the Respondents. The Respondents are acutely aware that the environmental factors during this time are not suitable, and are in fact, extremely hazardous to children. The same is *inter alia* demonstrable from the fact that in November 2023, Respondent No. 1 was compelled to *suspend* all sports, issuing an order that explicitly admitted a threat to the “*health and security of students/children*”. However, the Respondents thereafter

shockingly revoked the suspension and; in a grossly negligent manner carried on with scheduling sporting events in this exact same period year after year.

D. BECAUSE repeated scheduling of sporting events at this time of the year is a flagrant violation of the Petitioners' fundamental rights under Article 21 of the Constitution of India. It is submitted that sports and physical literacy is a very fundamental and important part of a child's upbringing, and play a vital part in ensuring a good life for them. Similarly, it is trite that right to clean air, environment and health are also a vital part of a child's fundamental right to life. At present, children across Delhi are being compelled to choose between participating in such state-scheduled sports events (at the cost of permanent irreparable damage to their physical health), or remain indoors to mitigate and prevent such harm.

E. BECAUSE the action of the Respondents in scheduling outdoor sports tournaments, trials, camps etc., during 'Severe' air quality is a direct and foreseeable infringement of the fundamental right to life of the Petitioners. This right, guaranteed under Article 21 of the Constitution of India, is not mere animal existence but includes the right to health and the right to a clean and healthy environment, as repeatedly held by the Hon'ble Supreme Court of India.

F. BECAUSE the Respondents' actions are in direct contravention of the Directive Principles of State Policy, which are fundamental to the governance of the country and within the ambit of Article 21 of the Constitution of India. The Respondents, as "State" under Article 12 of the Constitution of India, are violating the specific constitutional mandate of a) Article 39(f), which directs the State to ensure that "*children are given opportunities and facilities to develop in a healthy manner".* Compelling them to inhale toxic air that stunts lung growth is the very antithesis of development in a healthy manner and b) Article 47, which imposes a primary duty on the State to *"raise the level of nutrition and the standard of living and to improve public health".* The current sports calendar/schedule actively degrades public health rather than improving it.

G. BECAUSE the inaction of the Respondents are manifestly arbitrary, unreasonable, and irrational, and thus violative of the Constitution of India. The Respondents' (in) action demonstrates non application of mind, unreasonableness, arbitrariness, when possessed of scientific and historic data on the worsening AQI levels in Delhi. The arbitrariness is proven by the fact that the Respondents are wilfully ignoring (a) their own categorical admission from 2023 when they suspended all gaming activities citing that such activity is a threat to child "health and security"

(b) all available, overwhelming medical and scientific advice from global and national experts (IOC, WHO, Medical Experts) (c) binding directives from the MOHFW and a statutory order under GRAP (d) a safe, viable, reasonable, and obvious alternative (i.e., rescheduling).

H. BECAUSE the Respondents are in flagrant violation of the global minimum standard for child health set by the World Health Organisation. The AQI levels of 400+ are manifold times higher than the WHO's prescribed safe limits for PM2.5. By continuing to hold sports tournaments, trials, camps etc., in such toxic air quality, the Respondents are breaching the most basic, globally-accepted health benchmarks.

I. BECAUSE the Respondents are in direct contravention of a binding national health policy issued by the Government of India's own expert body. The MOHFW Health Advisory which identifies “Children” as a “Vulnerable Population”, issues an unambiguous mandate to “avoid or postpone” this very activity at AQI level of 201 onwards. The Respondents' current scheduling is in open defiance of this specialist directive.

J. BECAUSE the Respondents as educational authorities have a heightened, non-delegable duty of care towards the children under their charge. Instead of protecting them, they are actively

endangering them, by scheduling the events during November to January when the scientific evidence suggests otherwise.

K. BECAUSE the Respondents are knowingly inflicting specific, acute, and irreversible medical injury upon a uniquely vulnerable group. They are exposing the young children to a) acute effects- giddiness, chest pain, chest constriction, and irritation in eyes, b) pulmonary effects- inflammation, reduced lung function, asthma, bronchitis, and diminished growth of lungs, c) cardiovascular effects i.e., the strain of exercise in high pollution affects heart and lungs, causing cardiovascular strain, d) neurological effects i.e., global studies on PM2.5 exposure in children have shown a direct link to cognitive and neurodevelopmental impairment. This constitutes an imminent and grave threat to the bodily integrity of the Petitioners.

L. BECAUSE the Respondents' policy (or lack thereof) is hit by non-application of mind. The winter pollution crisis is a predictable, annual phenomenon, not a *force majeure* event. The Respondents' failure to create a permanent, safe sports calendar, and their specific failure to learn from the 2023 crisis demonstrates administrative failure and arbitrary ad-hocism.

M. BECAUSE the Respondents' negligence actively sabotages and frustrates stated national policy. The Government of India promotes sports as essential for development through the

National Education Policy and the “Khelo Bharat Niti” policy. By making sports a hazardous, life-threatening activity, the Respondents are undermining this national goal.

N. BECAUSE the Respondents' actions violate India's international commitments under the UN Convention on the Rights of the Child [“**UNCRC**”] which provides the "Right to Play" under Article 31. Compelling a child to play in air that is medically unfit and can cause serious irreparable injury is a perversion and abuse of this right.

O. BECAUSE the Petitioners and thousands of children are performing strenuous physical activities in 'Severe' AQI levels, which hampers their fundamental right to life. These sporting events form a crucial part of the lives of these children. They not only provide a platform for the Petitioners, and similarly placed children to make a career in such sporting activities; but also form a very important part of their upbringing.

P. BECAUSE every year Delhi has faced a documented public health emergency due to 'Very Poor' and 'Severe' AQI levels during the winter months, as widely reported in the media and in publicly data. Despite this predictable and widely known crisis, the Respondents have, in gross non-application of mind, mechanically scheduled and conducted their full annual outdoor sports calendars during these very months. This has constrained

thousands of children, including the Petitioners, to compete in toxic air, year after year, in complete disregard for their health and safety.

Q. BECAUSE the importance of sports in the life of any person cannot be sufficiently emphasized. Participation in sporting activities is a building block in bringing in habits of discipline, rectitude, perseverance, commitment and most importantly developing an ability to work in teams. It provides a critical outlet for the energy possessed by young children and the youth. Participation in healthy sporting and gaming activity facilitates sharing of skills, differential abilities as well as creativity. It contributes to building a more sensitive, innovative, equitable, fair community and world.

R. BECAUSE the Hon'ble Supreme Court in the case of ***Association of Medical Super Speciality Aspirants and Residents v. Union of India, (2019) 8 SCC 607*** has recognized the right to health to be an integral part of Article 21 of the Constitution of India.

S. BECAUSE the Hon'ble Supreme Court in the case of ***Navtej Singh Johar & Ors. v. Union of India, (2018) 10 SCC 1*** emphasized the positive obligation on the State to secure the right to health.

T. BECAUSE the Hon'ble Supreme Court of India in the case of ***Consumer Education & Research Centre & Ors.. v. Union of India & Ors., 1995 AIR 922*** held that the right to life envisaged under Article 21 encompasses human personality in its full blossom with invigorated health and does not connote a mere animal existence or continued drudgery through life.

U. BECAUSE the Hon'ble Supreme Court of India in the case of ***Subhash Kumar vs. State of Bihar, 1991 1 SCC 598*** held that right to live is a fundamental right under Art 21 of the Constitution and it includes the right of enjoyment of pollution free water and air for full enjoyment of life.

V. BECAUSE the Hon'ble Supreme Court of India in the case of ***Virender Gaur & Ors. vs. State of Haryana & Ors., 1995 2 SCC 577*** held that hygienic environment is an integral facet of right to healthy life and it would be impossible to live with human dignity without a humane and healthy environment.

W. The Petitioner reserves the right to urge additional grounds at the time of hearing, with the leave of this Hon'ble Court.

JURISDICTION

41. This Hon'ble Court has territorial jurisdiction under Article 226 of the Constitution of India, as the Petitioners are students of schools in Delhi and the cause of action arises in Delhi where the tournaments are being conducted. The Respondent No. 1 is the Govt. of NCT of Delhi through

Directorate of Education having its offices in Delhi. The Respondent No. 2, is the sole national school games federation recognized by the Government of India for organizing the National School Games, including those within Delhi.

42. This Hon'ble Court also possesses the jurisdiction under Article 226 of the Constitution of India to issue prerogative writs, orders, and directions for the enforcement of the fundamental rights guaranteed under Part III of the Constitution of India. The present petition seeks the enforcement of the Petitioners' fundamental right to life and health under Article 21, which is being directly, imminently, and gravely violated by the arbitrary and (in) actions of the Respondents, who are "State" within the meaning of Article 12.

CAUSE OF ACTION

43. The cause of action for filing the present petition is recurring, continuous, and presently subsisting. The cause of action first is recurring annually when the Respondents have, in a gross non-application of mind, schedule their outdoor sports calendars during the peak pollution months, despite full knowledge of the hazardous air quality. The cause of action is live and accrues on a day to day basis, as on the date of filing this petition, the 'Severe' AQI conditions persist, the GRAP-III order is in force and the Respondents are actively conducting the sports tournaments, trials and camps, thereby continuing to violate the Petitioners' fundamental rights.

44. No other proceedings concerning the subject matter of this petition are pending or have been filed by the Petitioners before any judicial or quasi-judicial authority in India.

PRAYER

In light of the aforesaid facts and circumstances, it is most humbly prayed that this Hon'ble Court may be pleased to-

a. Issue a Writ in the nature of Mandamus or any other appropriate writ, order, or direction, directing the Respondents to henceforth schedule the annual sports calendar (including all Zonal, Inter-Zonal, State, and National tournaments, trials, and coaching camps) for all outdoor sports in the National Capital Territory of Delhi, during safer and less susceptible months with verifiably better ambient air quality.

b. Pass any such other or further order(s) as this Hon'ble Court may deem fit and proper in the facts and circumstances of the case and in the interest of justice.

AND FOR THIS ACT OF KINDNESS, THE PETITIONERS AS IN DUTY BOUND SHALL EVER PRAY.

1. 10. 11.

PETITIONERS

2. 8. 3. 5. 6. 4. 9. 7.

FILED THROUGH

MANJIRA DASGUPTA D3104/2009	BHARGAV RAVINDRAN THALI D5080/2017	MAYANK KHAITAN D10269/2025

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NEW DELHI
DATE:15.11.2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS.
....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Sarah Bedi, D/o Late Vinod Kapoor, aged about 46 years, resident of 412P, Sector 21, Gurugram - 122016, Haryana do hereby solemnly affirm and state as under, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 1, Nysa Bedi, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom. That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.
4. That the annexures filed alongwith the writ petition are true copies of their respective originals.
5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

Verified at Gurugram on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

NOTARY
SAJJAN SINGH
GURGAON
Regd. No. 1652
Exp. 24-4-2030
GOVT. OF INDIA

ATTESTED

SAJJAN SINGH
ADVOCATE & NOTARY
GURGAON

15 NOV 2025

This document has been registered
at Sr. No 957 Book No. 3
Page No 287 On Dated 20
15-11-2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Renuka Raichand Poddar, D/o General Shri Ravi Raichand, aged about 48 years, resident of 6, A.P.J. Abdul Kalam Road, New Delhi – 110011, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 2, Master Reyansh Poddar, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Ramkrishna Baijnath Podalar
S/o, W/o, D/o Late Shri Ramji Raichand
R/o ....
Identified By Shri/Smt. ....
has solemnly affirmed before me at Delhi
on.....at Sl. No.....
that the contents of the affidavit which
have been read & explained to him are
true and Correct to his knowledge

Notary Delhi, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Shweta Punj, D/o Shri Balbir Punj, aged about 46 years, resident of W143, 1st Floor, Greater Kailash I, New Delhi – 110048, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 3, Master Aarav Punj Tripathi, (minor), aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Deponent who has Signed in my Presence.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Sunita Kumari
S/o, W/o, D/o Baldev Singh
R/o
Identified By Sh./Smt. Ratan Lodhara
has solemnly affirmed before me at Delhi
on at Sl. No. 3
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

15 NOV 2025

Notary Public, Delhi (INDIA)

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Rachna Prasad, D/o Shri Chandru Motwani, aged about 49 years, resident of H52/2, Lane W10F, Western Avenue, Sainik Farms, New Delhi – 110062, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 4, Master Yuvan Prasad, (minor), aged about 13 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION: 15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Ram Pal Singh
S/o, W/o, D/o Chandra Mohan
R/o
Identified By Sh./Shri Rohan Poddar Adv.
has solemnly affirmed before me at Delhi
on ..... at Sl. No. 7
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Gaurav Gulati, S/o Shri Yogesh Gulati, aged about 52 years, resident of 10, Paschimi Marg, Ground Floor, Vasant Vihar, New Delhi - 110057, do hereby solemnly affirm and state as under:

1. That I am the father of Petitioner No. 5, Master Abhiveer Gulati Prasad, (minor), aged about 15 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT Shri/Smt./Km. ... S/o, W/o, D/o ... R/o ... Identified By Sh./Shri ... has solemnly affirmed before me at Delhi on ... at Sl. No. ... that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

15 NOV 2025

Notary Public, Delhi (INDIA)

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

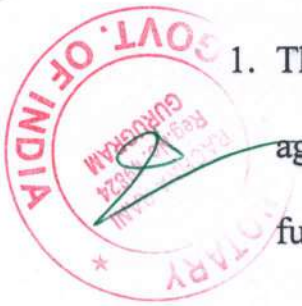
NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Pankaj Sahni, S/o Late Shri Pavan Prakash Sahni, aged 48 about years, resident of B-6, Greater Kailash I, New Delhi – 110048, presently in Gurugram, do hereby solemnly affirm and state as under:



1. That I am the father of Petitioner No. 6, Zoya Sahni, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

ATTESTED

RACHNA RANI
ADVOCATE & NOTARY
DISTT. COURT GURUGRAM (HR)

VERIFICATION:

Verified at Gurugram on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

This document has been registered at
Book No. 1
Sr. No. 460
Date 15/11/25
Sign

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Aakansha Singh Arora, D/o Late Shri Yogendra Singh, aged about 51 years, resident of 212A, Tower 2, DLF Magnolias, Golf Course Road, Sector 42, Gurugram – 122009, presently in New Delhi, do hereby solemnly affirm and state as under:

1. That I am the father of Applicant/Petitioner No. 7, Master Lukshya Arora, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.

2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.

3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

of it is false and nothing material has been concealed therefrom. That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Arakamalaa Singh Arora
S/o, W/o, D/o Lt. Sh. Yogendra Singh
R/o .....
Identified By Sh./Shri ..... Rohan Poddar, Adv.
has solemnly affirmed before me at Delhi
on.....at Sl. No.....9.
that the contents of the affidavit which
have been read & explained to him are
and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Mehboob Shaw, D/o Md. Hussain, aged about 52 years, resident of W15A, Western Avenue, House J206, Sainik Farms, New Delhi – 110062, do hereby solemnly affirm and state as under:

1. That I am the father of Petitioner No. 8, Shirin Shaw, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

NOTARY RAM PAL SINGH DELHI Regd. No. 16973 Valid upto 02-02-2030 GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. ...
S/o, W/o, D/o ...
R/o ...
Identified By Sh./Shri ...
has solemnly affirmed before me at Delhi
on.....at Sl. No.....
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI& ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Shipra Kukreja Bose, D/o Shri GD Kukreja, aged about 47 years, resident of C-9/9563, Vasant Kunj, New Delhi, do hereby solemnly affirm and state as under

1. That I am the mother of Petitioner No.१, Coco Shirali Bose, (minor), aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom. That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.
4. That the annexures filed alongwith the writ petition are true copies of their respective originals.
5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARIAL REGISTER
Entry No 2/2025
Date 15/11/2025

Shipra
DEPONENT

VERIFICATION:

15 NOV 2025

Verified atNew Delhi on this day 15th November 2025,that thecontents of the above affidavit are true and correct to the best ofmy personal knowledge and belief, and nothing has been concealed therefrom.

Shipra
DEPONENT

NOTARY PUBLIC
AJAY KUMAR
Advocate
Regn No. 42033/2025
DELHI
Expiry Year 2030
GOVT. OF INDIA

ATTESTED
NOTARY PUBLIC
Govt. of India

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Dimple Mathur, D/o Shri Deepak Sangwan, aged about 40 years, resident of C-36, Nangal Dewat, Vasant Kunj, New Delhi, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 10, Nayonika Mathur, aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.
3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY
OMBIR SANGWAN
AREA-NCT DELHI
REGD. NO. 10665
EXP. DT.-26/06/2029
GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

Dimple Mathur

DEPONENT

VERIFICATION:

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

NOTARY
OMBIR SANGWAN
AREA-NCT DELHI
REGD. NO. 10665
EXP. DT.-26/06/2029
NOTARIAL
GOVT. OF INDIA

Dimple Mathur

DEPONENT

Solemnly Affirmed Sworn Before Me
ATTESTED
OMBIR SANGWAN NOTARY PUBLIC DELHI
Regd. No. 10665, Govt. of India
Ch. No.: 5, Patiala House Court, N. Delhi-110001
Book No. 03 PG No. 45 SL No. 3218/2025
15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Ritu, D/o Shri Jai Narayan Kadyan, aged about 43 years, resident of JVD Homes, Nangal Dewat, New Delhi, do hereby solemnly affirm and state as under:

1. That I am the mother of Petitioner No. 11, Master Zorawar, aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.

2. That the accompanying writ petition has been drafted under my instructions and I have gone through the contents thereof.

3. That the contents of the said writ petition in para 1 to 40 are true and correct to my knowledge and belief, no part of it is false and nothing material has been concealed therefrom.

NOTARY A.C. TIWARI Regn. No. 2162 GOVT. OF INDIA

That the contents of para A-W to 41-44 are believed by me to be true, based on legal advice.

4. That the annexures filed alongwith the writ petition are true copies of their respective originals.

5. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

Identify the deponent who has signed in my presence

Ritu
DEPONENT

VERIFICATION: 15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

NOTARY
A.C TIWARI
Regn. No. 2162
GOVT. OF INDIA

ATTESTED
NOTARY PUBLIC
(DELHI INDIA)
15 NOV 2025

Ritu
DEPONENT

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Thick layer of smog shrouds Delhi-NCR as pollution worsens again, air quality remains very poor

The Centre's air quality panel may take a call on revoking the curbs in Delhi-NCR under the third stage of the Graded Response Action Plan (GRAP) as air quality improves, but remains in 'very poor' category.

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A worker walks in an open field area shrouded in smog in New Delhi. (Photo: PTI)

India Today Web Desk
New Delhi, UPDATED: Nov 11, 2022 14:52 IST

Delhi's air quality entered 'very poor' category with an overall Air Quality Index (AQI) of 303 at 6:30 am on Friday after two days of remaining 'poor'. With the air pollution levels in the national capital coming down in the last few days, the Commission for Air Quality Management (CAQM) said it will review the situation today.

According to data by SAFAR, AQI is presently at 280 in Dhirpur, 303 at IGI Airport (T3), 337 at Delhi University, 329 at Noida and 239 at Gurugram. An AQI between 201 and 300 is considered 'poor', 301 and 400 'very poor', and 401 and 500 'severe'.

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As a thick layer of smog shrouded the national capital, Delhi International Airport Limited (DIAL) issued a passenger advisory due to low visibility.

"Low visibility procedures are in progress at Delhi airport. All flight operations are presently normal. Passengers are requested to contact the airline concerned for updated flight information," the advisory read.

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The Centre's air quality panel may take a call on revoking the curbs in place in Delhi-NCR under the third stage of the Graded Response Action Plan (GRAP), PTI reported.

READ | Delhi Gas Chamber Season 6 just dropped. Are you ready?

All construction and demolition work, except for essential projects, is banned in Delhi-NCR under the third stage of the GRAP. The curbs were imposed when the air quality was severe in the first week of November.

PM 2.5 are fine particles that are 2.5 microns or less in diameter and can travel deep into the respiratory tract, reaching the lungs and entering the bloodstream. An AQI of above 400 is considered 'severe' and can affect healthy people and seriously impact those with existing illnesses.

ALSO READ | Delhi air pollution: The real cause and solutions we need

Transport-level winds blow in the lowest two layers of the atmosphere -- the troposphere and stratosphere -- and carry smoke from farm fires from neighbouring states to the national capital region. Stubble burning and vehicular emissions are the major reasons for air pollution in Delhi-NCR.

Farm fires in Punjab increased from 605 on Tuesday to 1,778 on Wednesday. However, their share in Delhi's PM2.5 pollution dipped from 9 per cent on Tuesday to 5 per cent on Wednesday, according to data from the Indian Agricultural Research Institute and SAFAR.

(With PTI inputs)

ALSO READ /[**Pollution on wheels: India Today nails illegal buses operating with impunity in smog-choked Delhi**]

Published By: Srishti Jha

Published On: Nov 11, 2022

--- ENDS ---

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Air quality in Delhi remains very poor at 320, stubble burning figure jumps

The Air Quality Index in Delhi and the surrounding area remained in the very poor category on Sunday. However, according to SAFAR, the air quality is likely to improve from tomorrow.

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According to SAFAR, the air is likely to improve from November 14 with a decrease in the speed of surface winds.

India Today Web Desk
New Delhi, UPDATED: Nov 13, 2022 09:10 IST

Air quality in Delhi on Sunday continued to remain in the 'very poor' category, with the overall Air Quality Index (AQI) at 320, according to the System of Air Quality and Weather Forecasting and Research (SAFAR).

Delhi Airport on Sunday recorded AQI of 315, IIT Delhi 349, Guguram 324, whereas Noida 341 - all in the "very poor" category according to SAFAR.

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cases between September 15 and November 12 to jump to 43,144. However, the cases were 27 per cent less compared to 58,976 crop residue burning incidents that were reported last year in the same month.

ALSO WATCH | Thick layer of smog shrouds Delhi-NCR as pollution worsens again, air quality remains very poor

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According to SAFAR, the air is likely to improve from November 14 with a decrease in the speed of surface winds, and the share of stubble smoke coming from the north-west direction will reduce the pollution of Delhi-NCR.

All construction and demolition work, except for essential projects, is banned in Delhi-NCR under the third stage of the GRAP. The curbs were imposed when the air quality was severe in the first week of November.

PM 2.5 are fine particles that are 2.5 microns or less in diameter and can travel deep into the respiratory tract, reaching the lungs and entering the bloodstream. An AQI of above 400 is considered 'severe' and can affect healthy people and seriously impact those with existing illnesses.

Transport-level winds blow in the lowest two layers of the atmosphere -- the troposphere and stratosphere -- and carry smoke from farm fires from neighbouring states to the national capital region. Stubble burning and vehicular emissions are the major reasons for air pollution in Delhi-NCR.

(With input from PTI)

ALSO READ | From the India Today archives (2015) | Air pollution: Why Delhi is choking

Published By: Adarsh T R

Published On: Nov 13, 2022

--- ENDS ---

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Delhi pollution: Delhiites continue to suffer as air quality remains 'poor'; overall AQI stands at 286

Mirror Now | 22 Nov 2022, 10:26 AM IST

he air quality in the national capital improved from the 'Very poor' category yesterday to the 'Poor' category on Tuesday morning with an overall Air Quality Index (AQI) of 286. as per the System of Air Quality and Weather Forecasting And Research (SAFAR).
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Delhi

Delhi: Most polluted December in national capital annals

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This December saw the longest spell of bad air since air qua maintained in the national capital.



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THE NEW INDIAN EXPRESS

Updated on: 01 Jan 2022, 9:12 am · 2 min read

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NEW DELHI: This December saw the longest spell of bad air since air quality records are being maintained in the national capital.

While there were six consecutive days of 'severe' air quality --- the most hazardous for health, half of the month saw air quality in the 'very poor' range --- the highest in five years.

Data maintained by the Central Pollution Control Board (CPCB) showed that the city saw a total of seven 'severe' air quality days this month while six of them were in a row (from December 21-26) --- the longest smog episode since 2015, since when air quality records are being kept in Delhi.

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THE NEW INDIAN EXPRESS

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Also, December this year saw 15 days in the 'very poor' category --- the highest since 2017 when 19 days were recorded in this category, data shows.

However, unlike over the past five years when the month saw at least one or two and in some cases three 'moderate' air quality days, this December did not record a single day in the moderate range. On Friday, Delhi's overall AQI was 321 in the 'very poor' zone after improving to 'poor' over the past two days.

On a scale of 0-500, a value of 0-50, the air quality is considered go (minimal health risk), 51-100 is satisfactory (minor discomfort to sensitive people), 100-200 is moderate (breathing discomfort to people with lungs and heart disease), 200-300 is poor (breathing discomfort to most people on

The long pollution spell started soon after the slew of curbs put in place to curb the growing pollution levels by the Commission for Air Quality Management (CAQM) for NCR and as the weather conditions took a turn for the worse.

The CAQM had on December 20 lifted all the curbs including ban on entry of trucks in the city and construction activities considering an improvement in air quality owing to high speed winds, which died down soon.

According to weather officials and experts, the city saw cold wave conditions right after the curbs were withdrawn when stable weather conditions did not allow dispersion.

This was followed by two successive Western disturbances, with which the wind direction changed and moisture content increased further allowing accumulation of pollutants.

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THIS STORY IS FROM DECEMBER 11, 2022

Delhi air quality remains 'very poor' at 337 AQI

ANI / Updated: Dec 11, 2022, 09:30 IST

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The air quality in the national capital remained in the 'very poor category' with AQI recorded at 337.



Image used for representational purpose only

NEW DELHI: The air quality in the national capital remained in the 'very poor category' with AQI recorded at 337.

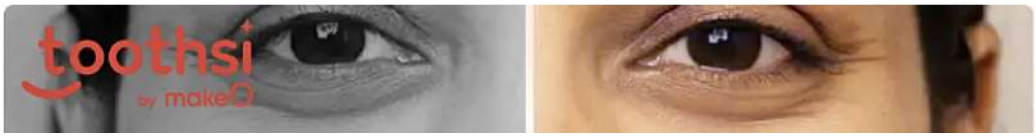
"It becomes very difficult for the sportspersons to breathe in this air quality. Whenever we go running and cycling, it becomes very difficult to breathe," said Suraj from Palam.

Track the pollution level in your city

He also added, "Every year after Diwali, the pollution increases but the Delhi govt is not taking any necessary measures."

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Hindustan Times

Delhi breathes toxic January air, pollution on cusp of 'severe'

By **HT Correspondent**

Published on: Jan 07, 2023 12:09 am IST

The grim forecasts prompted the Commission for Air Quality Management (CAQM) hold an emergency meeting and subsequently impose measures under Stage III of the Graded Response Action Plan (Grap), under which all private construction activities are banned in NCR, among other curbs

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Delhi's pollution levels on Friday spiked to an Air Quality Index (AQI) reading of 400 (very poor), the daily 4pm national bulletin released by the Central Pollution Control Board (CPCB) stated, with forecasts showing that the air quality is likely to deteriorate further in the coming days.

Hindustan Times



Other restrictions under Stage III of Grap include the closure of all brick kilns and hot mix plants not operating on clean fuels, closure of all stone crushers in NCR and a ban on mining and its associated activities, CAQM's order on Friday said. (Reuters)

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The grim forecasts prompted the Commission for Air Quality Management (CAQM) hold an emergency meeting and subsequently impose measures under Stage III of the Graded Response Action Plan (Grap), under which all private construction activities are banned in NCR, among other curbs.

"While assessing the overall air quality parameters, the sub-Committee noted that the air quality has suddenly and unexpectedly deteriorated, owing to dense fog without much

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NCR in an effort to steer clear of further deterioration of air quality in the region," the committee said in a statement.

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The CPCB classifies an AQI between 0-50 as 'good', between 51 and 100 as 'satisfactory', between 101 and 200 as 'moderate', between 201 and 300 as 'poor', between 301 and 400 as 'very poor' and over 400 as 'severe'.

Friday's AQI reading for Delhi was a sharp deterioration from Thursday, when the reading was 340 (very poor), an improvement on Wednesday's AQI of 343 (very poor).

CAQM had last imposed Stage III measures on December 30, lifting them only on Wednesday.

Stage III of Grap says states also have the option to enforce a ban on BS-III petrol and BS-IV diesel vehicles, but Delhi's transport department said a decision on imposing such a

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Other restrictions under Stage III of Grap include the closure of all brick kilns and hot mix plants not operating on clean fuels, closure of all stone crushers in NCR and a ban on mining and its associated activities, CAQM's order on Friday said.

However, under Stage III, all projects related to rail services or rail operations, metro projects, airport projects, ISBT projects, projects related to national security or defence, projects of national importance and healthcare facilities are exempted. Linear projects such as highways, roads, flyovers, over bridges, power transmission and pipeline laying is also allowed, in addition to sanitation projects.

Delhi's AQI had last touched the 'severe' zone on December 19. However, the CAQM had decided against invoking Stage III measures on that day as forecasts had showed that Delhi's pollution levels would improve the very next day.

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LEAD + WON : 243/243
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DELHI NEWS

Air quality plunges in Delhi, AQI in severe category for third consecutive day

Authored by: Ajmal Abbas Updated Jan 11, 2023, 06:34 IST

Air quality in the national capital deteriorated further on Wednesday as the AQI recorded 421.



Delhi's air quality in severe category. Photo : PTI

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New Delhi: The air quality in the national capital worsened significantly on Wednesday as it continued in the severe category for the third consecutive day. The overall Air Quality Index on Wednesday morning was recorded at 421, according to the SAFAR monitoring system. On Tuesday evening, the AQI was recorded at 407 in the severe category.

The pollution level in Noida was worse than in Delhi. The AQI stood at 458 in Noida in the severe category. In Gurugram, the

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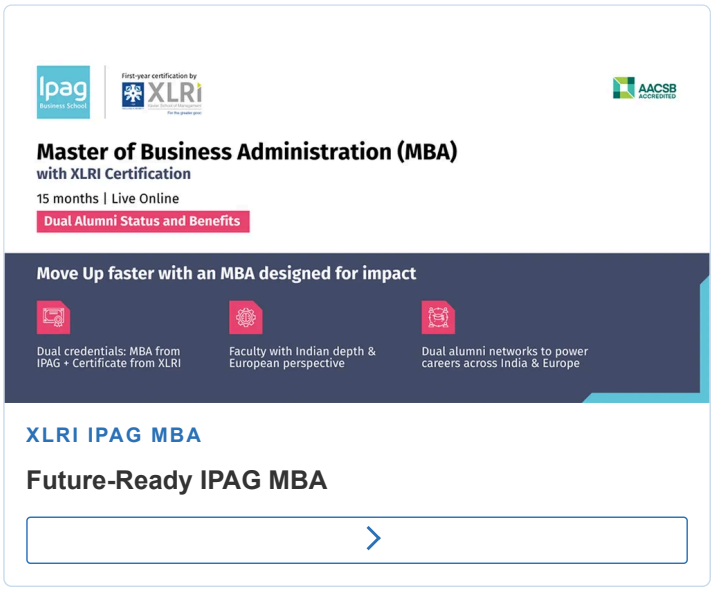


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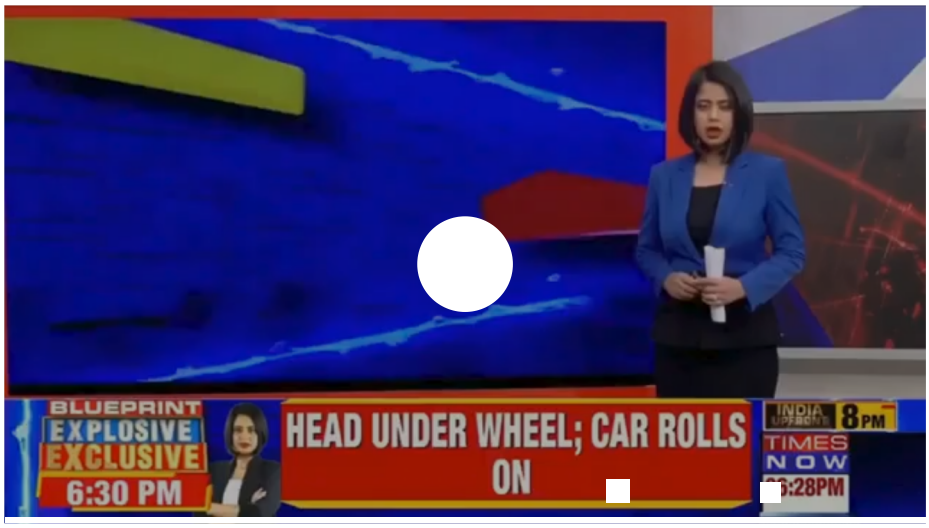
index recorded 529.

All monitoring stations in the city also registered a fall in air quality and continued in the severe category. In Pusa, the AQI was 425 while Delhi University recorded it at 410. The index in the Airport region touched 434 and for Mathura Road, it was 488. Ayanagar also was in the severe category at 416. Lodhi Road and IIT Delhi remained in the 'very poor' category with AQI 410 and 402 respectively at 6:30 am on Wednesday.

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The city's air quality index had deteriorated to the severe category on Monday after a gap of around two months. Subsequently, the Commission for Air Quality Management (CAQM) directed all NCR states to implement anti-pollution curbs including the ban on polluting vehicles in the city.



The Delhi government on Monday announced that it will be implementing a temporary ban on entry vehicles with BS-III petrol and BS-IV diesel engines starting Tuesday. As per a transport department official, for now, the ban is likely to be in place till Friday.

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Last week, the CAQM directed the city authorities to place a ban on all private construction and demolition work in the national capital.

According to IMD officials, the severe air quality conditioning in the national capital is likely to ameliorate in the coming days and the AQI is likely to improve to the poor category.

An AQI between 201 and 300 is considered "poor", 301 and 400 "very poor", and 401 and 500 "severe".

Dense Fog

Meanwhile, the IMD predicted a dense fog condition for all areas in the city. The city will have a "partly cloudy sky on Wednesday. Moderate to dense fog will experience in the morning," the weather officials said.

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AJMAL ABBAS AUTHOR

Ajmal Abbas is Senior Special Correspondent with Times Network and has over 7 years of experience. For Times Now Digital, he covers urban governance, ...View More

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Air Quality Index on Nov 07, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Chennai	Moderate	105	$PM_{2.5}$	6
38	Chhapra	Poor	265	$PM_{2.5}$	1
39	Chikkaballapur	Moderate	113	PM_{10}	1
40	Chikkamagaluru	Satisfactory	57	PM_{10}	1
41	Coimbatore	Satisfactory	80	CO	1
42	Damoh	Moderate	141	$PM_{2.5}$	1
43	Darbhanga	Poor	206	PM_{10}	1
44	Davanagere	Satisfactory	71	PM_{10}	1
45	Delhi	Very Poor	354	$PM_{2.5}$	35
46	Dewas	Moderate	180	PM_{10}	1
47	Dharuhera	Poor	250	$PM_{2.5}$	1
48	Dindigul	Good	46	PM_{10}	1

Possible Health Impacts

Good	Minimal Impact
Satisfactory	Minor breathing discomfort to sensitive people
Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Poor	Breathing discomfort to most people on prolonged exposure
Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

Notes:

* AQI is not calculated for today's bulletin for Amaravati, Ambala, Aurangabad, Aurangabad, Bhilai, Bidar, Brajrajnagar, Buxar, Chengalpattu, Dehradun, Ernakulam, Gummidipoondi, Hapur, Hosur, Jorapokhar, Kollam, Korba, Kota, Kozhikode, Manglore, Manguraha, Naharlagun, Nandesari, Palwal, Panchkula, Pune, Raichur, Raipur, Surat, Thrissur, Udupi, Vapi, Vatva, Vijayapura, vellore as data was not available.

Some stations have data available at 3PM

* In case of a city with multiple monitoring locations, average value is used to indicate air quality. Air quality may show variations across locations, and averaging is not a scientifically sound approach. However, for the sake of simplicity this method is being followed. For AQI of monitoring locations, website(http://cpcb.nic.in) website may be referred.

* The data available at the portal is provided by different agencies. Any use of this data in research publication or any other form of publication shall duly acknowledge the contribution of respective agencies in generating the data.

Air Quality Index on Nov 14, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Chennai	Good	43	CO	7
38	Chhapra	Very Poor	335	$PM_{2.5}$	1
39	Chikkaballapur	Good	29	CO	1
40	Chikkamagaluru	Good	28	O_3	1
41	Damoh	Moderate	104	$PM_{2.5}$	1
42	Darbhanga	Very Poor	360	$PM_{2.5}$	1
43	Delhi	Poor	294	PM_{10}, $PM_{2.5}$	37
44	Dewas	Moderate	124	PM_{10}	1
45	Dharuhera	Poor	278	$PM_{2.5}$	1
46	Dindigul	Good	42	SO_2	1
47	Durgapur	Moderate	146	PM_{10}	1
48	Eloor	Satisfactory	62	PM_{10}	1

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Notes:

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Air Quality Index on Nov 21, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Charkhi Dadri	Poor	237	$PM_{2.5}$	1
38	Chennai	Satisfactory	84	$PM_{2.5}$, PM_{10}	7
39	Chhapra	Very Poor	319	$PM_{2.5}$	1
40	Chikkaballapur	Moderate	163	$PM_{2.5}$	1
41	Chikkamagaluru	Good	48	PM_{10}	1
42	Coimbatore	Moderate	109	$PM_{2.5}$	1
43	Damoh	Moderate	120	$PM_{2.5}$	1
44	Darbhanga	Very Poor	376	PM_{10}	1
45	Davanagere	Moderate	146	$PM_{2.5}$	1
46	Dehradun	Satisfactory	68	PM_{10}	1
47	Delhi	Very Poor	310	$PM_{2.5}$	36
48	Dewas	Moderate	140	PM_{10}	1

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Notes:

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Air Quality Index on Nov 28, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Chandrapur	Moderate	111	$PM_{2.5}$	1
38	Charkhi Dadri	Moderate	200	PM_{10}	1
39	Chennai	Moderate	120	$PM_{2.5}$	8
40	Chikkaballapur	Moderate	135	PM_{10}	1
41	Chikkamagaluru	Satisfactory	92	PM_{10}	1
42	Chittoor	Moderate	114	$PM_{2.5}$	1
43	Davanagere	Satisfactory	69	PM_{10}	1
44	Delhi	Very Poor	333	$PM_{2.5}$, PM_{10}	35
45	Dewas	Satisfactory	90	PM_{10}	1
46	Dharuhera	Very Poor	331	$PM_{2.5}$	1
47	Dindigul	Satisfactory	69	$PM_{2.5}$	1
48	Durgapur	Moderate	122	PM_{10}	1

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Notes:

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Air Quality Index on Dec 07, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Davanagere	Moderate	134	$PM_{2.5}$	1
50	Dehradun	Moderate	131	$PM_{2.5}$	1
51	Delhi	Very Poor	304	$PM_{2.5}$	36
52	Dharuhera	Moderate	180	$PM_{2.5}$	1
53	Durgapur	Moderate	159	PM_{10}	1
54	Eloor	Satisfactory	67	PM_{10}	1
55	Faridabad	Poor	255	$PM_{2.5}$	3
56	Fatehabad	Moderate	170	$PM_{2.5}$	1
57	Firozabad	Satisfactory	100	$PM_{2.5}$	2
58	Gadag	Satisfactory	78	PM_{10}	1
59	Gandhinagar	Satisfactory	94	PM_{10}	1
60	Gangtok	Good	29	O_3	1

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Notes:

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Air Quality Index on Dec 14, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Davanagere	Good	31	PM_{10}	1
50	Dehradun	Satisfactory	86	PM_{10}	1
51	Delhi	Moderate	163	$PM_{2.5}$	37
52	Dewas	Satisfactory	79	PM_{10}	1
53	Dharuhera	Moderate	163	PM_{10}	1
54	Durgapur	Moderate	148	PM_{10}	1
55	Faridabad	Moderate	157	$PM_{2.5}$, PM_{10}	4
56	Fatehabad	Satisfactory	90	PM_{10}	1
57	Firozabad	Satisfactory	87	PM_{10}	2
58	Gadag	Moderate	142	PM_{10}	1
59	Gandhinagar	Satisfactory	57	PM_{10}	1
60	Gangtok	Satisfactory	100	$PM_{2.5}$	1

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Notes:

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Air Quality Index on Dec 21, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Chandrapur	Moderate	190	$PM_{2.5}$	2
38	Charkhi Dadri	Moderate	190	$PM_{2.5}$	1
39	Chengalpattu	Moderate	111	PM_{10}	1
40	Chennai	Moderate	120	$PM_{2.5}$, PM_{10}	7
41	Chhapra	Severe	402	PM_{10}	1
42	Chikkaballapur	Satisfactory	87	PM_{10}	1
43	Chikkamagaluru	Good	42	O_3	1
44	Darbhanga	Severe	433	$PM_{2.5}$	1
45	Davanagere	Satisfactory	78	PM_{10}	1
46	Delhi	Very Poor	328	$PM_{2.5}$	38
47	Dewas	Moderate	104	PM_{10}	1
48	Dharuhera	Poor	297	$PM_{2.5}$	1

Possible Health Impacts

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Satisfactory	Minor breathing discomfort to sensitive people
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Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

Notes:

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Some stations have data available at 3PM

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Air Quality Index on Dec 28, 2022 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Delhi	Very Poor	321	$PM_{2.5}$	39
50	Dewas	Moderate	144	$PM_{2.5}$	1
51	Dharuhera	Poor	299	$PM_{2.5}$	1
52	Durgapur	Moderate	160	PM_{10}	1
53	Faridabad	Poor	248	$PM_{2.5}$	4
54	Fatehabad	Very Poor	307	$PM_{2.5}$	1
55	Firozabad	Satisfactory	87	PM_{10}	2
56	Gadag	Good	36	O_3	1
57	Gandhinagar	Moderate	108	PM_{10}	1
58	Gangtok	Moderate	140	$PM_{2.5}$	1
59	Gaya	Poor	242	$PM_{2.5}$	3
60	Ghaziabad	Poor	269	$PM_{2.5}$	4

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(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Darbhanga	Very Poor	358	$PM_{2.5}$	1
50	Davanagere	Satisfactory	89	PM_{10}	1
51	Delhi	Very Poor	377	PM_{10}, $PM_{2.5}$	38
52	Dewas	Moderate	117	$PM_{2.5}$	1
53	Dharuhera	Very Poor	339	$PM_{2.5}$	1
54	Dindigul	Poor	229	NO_2	1
55	Durgapur	Moderate	148	PM_{10}	1
56	Eloor	Satisfactory	68	PM_{10}	1
57	Faridabad	Very Poor	359	$PM_{2.5}$	4
58	Firozabad	Moderate	134	$PM_{2.5}$	2
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60	Gangtok	Good	30	O_3	1

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Some stations have data available at 3PM

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* The data available at the portal is provided by different agencies. Any use of this data in research publication or any other form of publication shall duly acknowledge the contribution of respective agencies in generating the data.

Air Quality Index on Jan 14, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Davanagere	Satisfactory	91	PM_{10}	1
50	Delhi	Very Poor	353	$PM_{2.5}$	30
51	Dewas	Moderate	162	PM_{10}	1
52	Dharuhera	Very Poor	323	$PM_{2.5}$	1
53	Dindigul	Poor	202	NO_2	1
54	Eloor	Satisfactory	69	PM_{10}	1
55	Faridabad	Very Poor	337	$PM_{2.5}$	4
56	Fatehabad	Moderate	157	$PM_{2.5}$	1
57	Firozabad	Moderate	138	$PM_{2.5}$	2
58	Gadag	Satisfactory	71	O_3	1
59	Gandhinagar	Moderate	132	$PM_{2.5}$, PM_{10}	3
60	Gangtok	Satisfactory	82	$PM_{2.5}$	1

Possible Health Impacts

Good	Minimal Impact
Satisfactory	Minor breathing discomfort to sensitive people
Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Poor	Breathing discomfort to most people on prolonged exposure
Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

Notes:

* AQI is not calculated for today's bulletin for Ankleshwar, Baghpat, Bettiah, Bihar Sharif, Bilaspur, Buxar, Chhal, Damoh, Dehradun, Dharwad, Durgapur, Ernakulam, Hisar, Jabalpur, Jind, Kanchipuram, Katni, Kozhikode, Pali, Pune, Rupnagar, Silchar, Solapur, Srinagar, Tensa, Tumakuru, Udupi as data was not available.

Some stations have data available at 3PM

* In case of a city with multiple monitoring locations, average value is used to indicate air quality. Air quality may show variations across locations, and averaging is not a scientifically sound approach. However, for the sake of simplicity this method is being followed. For AQI of monitoring locations, website(http://cpcb.nic.in) website may be referred.

* The data available at the portal is provided by different agencies. Any use of this data in research publication or any other form of publication shall duly acknowledge the contribution of respective agencies in generating the data.

Air Quality Index on Jan 21, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
37	Chikkamagaluru	Satisfactory	53	PM_{10}	1
38	Coimbatore	Moderate	142	$PM_{2.5}$	1
39	Damoh	Satisfactory	81	$PM_{2.5}$	1
40	Davanagere	Satisfactory	69	PM_{10}	1
41	Delhi	Poor	294	$PM_{2.5}$	36
42	Dewas	Moderate	129	PM_{10}	1
43	Dharuhera	Poor	236	$PM_{2.5}$	1
44	Durgapur	Poor	262	$PM_{2.5}$	1
45	Faridabad	Poor	279	$PM_{2.5}$	4
46	Fatehabad	Moderate	158	$PM_{2.5}$	1
47	Firozabad	Moderate	149	$PM_{2.5}$	2
48	Gadag	Good	44	O_3	1

Possible Health Impacts

Good	Minimal Impact
Satisfactory	Minor breathing discomfort to sensitive people
Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Poor	Breathing discomfort to most people on prolonged exposure
Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

Notes:

* AQI is not calculated for today's bulletin for Anantapur, Ankleshwar, Ariyalur, Baghpat, Baripada, Bathinda, Begusarai, Bhilai, Bihar Sharif, ~~Bilaspur, Bileipada, Buxar, Byrnihat, Chengalpattu, Chhal, Chittoor,~~ Darbhanga, Dehradun, Dharwad, Dindigul, Eloor, Ernakulam, Hassan, Hosur, Jind, Kanchipuram, Katni, Keonjhar, Khurja, Korba, Kunjemura, Manguraha, Nagpur, Nalbari, Nandesari, Nayagarh, Ooty, Raichur, Raipur, Rairangpur, Ramanathapuram, Rohtak, Rourkela, Sagar, Salem, Silchar, Sivasagar, Sonipat, Suakati, Surat, Tensa, Tirupur, Tumakuru, Tumidih, Vijayawada, vellore as data was not available.

Some stations have data available at 3PM

* In case of a city with multiple monitoring locations, average value is used to indicate air quality. Air quality may show variations across locations, and averaging is not a scientifically sound approach. However, for the sake of simplicity this method is being followed. For AQI of monitoring locations, website(http://cpcb.nic.in) website may be referred.

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Air Quality Index on Jan 28, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	Based on Number of Monitoring Stations
49	Davanagere	Satisfactory	67	PM_{10}	1
50	Delhi	Poor	236	$PM_{2.5}$	37
51	Dewas	Moderate	133	$PM_{2.5}$	1
52	Dharuhera	Moderate	184	$PM_{2.5}$	1
53	Durgapur	Satisfactory	84	$PM_{2.5}$	1
54	Eloor	Satisfactory	92	PM_{10}	1
55	Faridabad	Poor	232	$PM_{2.5}$	4
56	Fatehabad	Moderate	199	$PM_{2.5}$	1
57	Firozabad	Satisfactory	100	PM_{10}, $PM_{2.5}$	2
58	Gadag	Good	45	O_3	1
59	Gandhinagar	Moderate	134	$PM_{2.5}$, SO_2	3
60	Gangtok	Satisfactory	95	$PM_{2.5}$	1

Possible Health Impacts

Good	Minimal Impact
Satisfactory	Minor breathing discomfort to sensitive people
Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Poor	Breathing discomfort to most people on prolonged exposure
Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

Notes:

* AQI is not calculated for today's bulletin for Baddi, Bathinda, Bihar Sharif, Bilaspur, Buxar, Chhal, Chittoor, Darbhanga, Dehradun, Dharwad, Dindigul, Ernakulam, Haldia, Hosur, Katni, Kunjemura, Mandi Gobindgarh, Milupara, Rairangpur, Salem, Silchar, Singrauli, Sivasagar, Sonipat, Thane, Tumakuru, Tumidih, Udupi, Vijayawada as data was not available.

Some stations have data available at 3PM

* In case of a city with multiple monitoring locations, average value is used to indicate air quality. Air quality may show variations across locations, and averaging is not a scientifically sound approach. However, for the sake of simplicity this method is being followed. For AQI of monitoring locations, website(http://cpcb.nic.in) website may be referred.

* The data available at the portal is provided by different agencies. Any use of this data in research publication or any other form of publication shall duly acknowledge the contribution of respective agencies in generating the data.

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI – 110009

DE/41/(36)/Sports/2022/Part- II/ 5051-64 Dated :- 03/11/23

ORDER

In compliance of order no. 120017/27/GRAP/2021/CAQM dated 02.11.2023 issued by Commission of Air Quality Management in National Capital Region & Adjoining Areas regarding implementation of action under Stage III of the Graded Response Action plan and keeping in view the health and security of students/children of Delhi due to poor air quality, all the Zonal sports tournaments and Delhi State School Games/events are suspended with immediate effect till further orders.

Non-compliance of the order shall be viewed seriously.

This is issued with the prior approval of Competent Authority.

03/11/23
Section Officer
Sports Branch

DE/41/(36)/Sports/2022/Part- II/ 5051-64 Dated :- 03/11/23

Copy to:-

1. The Secretary to Hon'ble Lt. Governor, Govt. of NCT of Delhi
2. Addl. Secretary to Hon'ble Chief Minister, Govt. of NCT of Delhi
3. The Secretary to Hon'ble Minister of Education, Govt. of NCT of Delhi.
4. The OSD to Hon'ble Chief Secretary, Govt. of NCT of Delhi.
5. PS to Secretory Education, Govt. of NCT of Delhi.
6. PS to Director (Education), Old Sectt, Delhi - 110054
7. PA to Addl. Director of Education, GNCTD.
8. All Regional Directors, DoE, Delhi/New Delhi
9. All District/Zone DDEs Dte. Of Education, Delhi/New Delhi for strict compliance.
10. All Zonal SPEs/Conveners/Secretaries, Dte. Of Education, Delhi/New Delhi for strict compliance.
11. All In-charges of Stadiums/Sports Complexes/Sports Centres, Dte. Of Education Delhi for strict compliance.
12. All Coaches & In-charges of Zonal Sports tournaments and Delhi State School Games/events for strict compliance.
13. All HOS of Govt. Schools/Govt. Aided Schools/Private recognized Schools, Dte. Of Education, Delhi/New Delhi for strict compliance.
14. OS(IT) with the request to place the circular on edudel.nic.in
15. Guard file.

03/11/23
Section Officer
Sports Branch

Annexure-4

GOVERNMENT ON NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI-110009

No.DE.41/(12)/Sports/Admn./2023/ 5423-37 Dated:- 18.11.23

OFFICE ORDER

In pursuance to Order No. 120017/27/GRAP/2021/CAQM dated 18/11/2023 issued by the Sub Committee on GRAP revoking their order dated 05/11/2023 vide which action under Stage-IV of GRAP had been invoked as the Air Quality Index has improved (AQI down from >450 to 322) and on the basis of the forecast made by IMD/IITM that there is no indication of any sharp degradation in Air Quality of Delhi in near future and Director (Education), GNCTD's Order No. PS/DE/2023/341 dated 18/11/2023, it is hereby ordered that the Order No. DE.41(12)/Sports/Admn/2023/5112-25 dated 06/11/2023 to suspend the physical practices/training in all the stadiums/sports complexes/sports centres private clubs and Academies under DoE, Govt. of NCT of Delhi is hereby revoked w.e.f. 20/11/2023.

The extensive outdoor physical training must be avoided for next one week from the issuance of this order.

This issues with prior approval of the Competent Authority.

SECTION OFFICER (ADMN)
(SPORTS BRANCH)

No.DE.41/(12)/Sports/Admn./2023 / 5423-37 Dated:- 18.11.23

Copy for information & necessary action to:

1. The Secretary to Hon'ble Lt. Governor, Govt. of NCT of Delhi.
2. Addl. Secretary to Hon'ble Chief Minister, Govt. of NCT of Delhi.
3. The Secretary to Hon'ble Minister of Education, Govt. of NCT of Delhi
4. The OSD to Hon'ble Chief Secretary, Govt. of NCT of Delhi.
5. PS to Secretary (Education), Govt. of NCT of Delhi.
6. PS to Director (Education), Govt. of NCT of Delhi, Old Secretariat, Delhi.
7. PA to Addl. Director of Education (Sports/Admn.), Govt. of NCT of Delhi.
8. All Regional Directors, DoE, Govt. of NCT of Delhi.
9. All District/Zone DDEs, Govt. of NCT of Delhi for strict compliance.
10. All Zonal SPEs /Convenors/Secretaries, Govt. of NCT of Delhi for strict compliance.
11. All In-Charges of Stadium/Sport Complexes/Centres, Private Academies and Clubs under Govt. of NCT of Delhi for strict compliance.
12. All Coaches/In-Charges of zonal sports tournaments and Delhi State School Games /Events for strict compliance.
13. All HOS of Govt. Schools/Govt. Aided Schools/ Private recognized Schools, Govt. of NCT of Delhi for strict compliance.
14. OS (IT) with request to place the circular on edudel.nic.in
15. Guard file.

SECTION OFFICER (ADMN)
(SPORTS BRANCH)

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI – 110009

DE/41/(36)/Sports/2022/Part- II/ 5417-22. Dated :- 22/11/23.

CORRIGENDUM

Sub:-Revised schedule of Delhi State School Games (Athletics Meet) for the year 2023-24

This is with reference to Circular No. DE/41/(36)/Sports/2022/Part – II/4599-4604 dated 19.10.2023 regarding organization of Delhi State School Games(Athletic Meet) 2023-24 from 16.11.23 to 20.11.23.

However, in compliance of order No. 120017/27//GRAP/2021/CAQM dated 02.11.23 issued by Commission of Air Quality Management in National Capital Region & Adjoining Areas, a letter dated 03.11.23 was issued by this office vide which all the Zonal sports tournaments and Delhi State School Games/events were suspended with immediate effect.

Now, in view of order No. PS/DE/2023/341 dated 18.11.23 issued by Director of Education, GNCT of Delhi, the revised Schedule/Fixture for Delhi State School Games 2022-23 in the discipline of Athletics Meet(Under – 14,17 & 19 year(Boys & Girls) is as under:-

S. No.	Name of the game	Age categories	Dates	Venue
1	Athletics	Under - 14,17 & 19 year (Boys & Girls)	01.12.23 to 05.12.2023	Chhatrasal Stadium

Rest of the content of the circular dated 19.10.23 shall remain same.

(YOGESH PAL SINGH)
DEPUTY DIRECTOR OF EDUCATION(SPORTS)

DE/41/(36)/Sports/2022/Part- II/ 5417-22. Dated :- 22/11/23

Copy to:-

1. PS to Secy. (Education), Old Sectt, Delhi – 110054.
2. PA to Director(Education), Old Sectt, Delhi - 110054
3. All Regional Directors, DoE, Delhi/New Delhi
4. All District DDEs Dte. Of Education, Delhi/New Delhi
5. All Zonal SPEs/Conveners/Secretaries, Dte. Of Education, Delhi/New Delhi
6. OS(IT) with the request to place the circular on edudel.nic.in

(YOGESH PAL SINGH)
DEPUTY DIRECTOR OF EDUCATION(SPORTS)

Govt. of National Capital Territory of Delhi
Directorate of Education: Sports Branch
Chhatrasal Statdium, Model Town Delhi

Delhi State School Games: - 2023-24
ATHLETIC MEET
PROGRAMME

1st DAY 01.12.2023

S.N	Event	Age – Group	Heats – Final	Delhi State School Games	Year
1	1500 mtrs	U -17 Jr. Boys	Final	4:07.05 sec	2018
2	1500 mtrs	U – 17 Jr. Girls	Final	4:57.85 sec	2018
3	High Jump	U – 19 Sr. Girls	Final	1.64 mtrs	2018
4	Shotput (3.00kg)	U – 14 Sub Jr. Girls	Final	8.65 mtrs	2018
5	Long jump	U – 14 Sub Jr. Girls	Final	4.71 mtrs.	2006
6	Triple jump	U – 17 Jr. Girls	Final	10.40 mrts	2018
7	100 mtrs.	U – 19 Sr. Boys	Heats	10.70 sec.	2001
8	100 mtrs.	U- 19 Sr. Girls	Heats	12.37 sec.	2019
9	100 mtrs.	U-17 Jr. Boys	Heats	10.81 sec.	2018
10	100 mtrs.	U-17 Jr. Girls	Heats	12.48 sec.	2019
11	100 mtrs.	U-14 Sub Jr. Boys	Heats	11.24 sec.	2015
12	100 mtrs.	U-14 Sub Jr. Girls	Heats	13.22 sec.	2019
13	Hight Jump	U-19 Sr. Boys	Final	2.05 mtrs.	2015
14	Shotput (4.00kg)	U-14Sub Jr. Boys	Final	16.53 mtrs.	2012
15	Long Jump	U-14 Sub Jr. Boys	Final	6.26 mtrs.	2015
16	Triple jump	U-17 Jr. Boys	Final	14.38 mtrs.	2013
17	4x100 relay	U-17 Jr. Boys	Heats/Final	44.75 sec.	2018
18	4x100 relay	U-17 Jr. Girls	Heats/Final	52.90 sec.	2019

Note:- All the Quarter final, semi-final and final in the track events will be held in the same manner same day.

Convenor:
Sh. Yogesh Pal Singh
(DDE Sports)

Sunita Rai

Org. Secretary
Sunita Rai, (Mb. 9891438386)

Govt. of National Capital Territory of Delhi
Directorate of Education: Sports Branch
Chhatrasal Statdium, Model Town Delhi

Delhi State School Games: - 2023-24
ATHLETIC MEET
PROGRAMME

2nd DAY 02.12.2023

S.N	Event	Age – Group	Heats – Final	Delhi State School Games	Year
1	3000 mtrs.	U – 17 Jr. Boys	Final	9:04.70 sec.	2001
2	3000 mtrs.	U – 17 Jr. Girls	Final	10:51.22 sec.	2022
3	High Jump	U – 17 Jr. Girls	Final	1.50 mtrs	2018
4	Shotput (3.00kg)	U – 17 Jr. Girls	Final	13.62 mtrs.	2019
5	Long Jump	U – 19 Sr. Girls	Final	5.40 mtrs	2018
6	200 mtrs.	U – 19 Sr. Boys	Heats	21.70 mtrs	2004
7	200 mtrs.	U – 19 Sr. Girls	Heats	24.97 sec.	2018
8	200 mtrs.	U – 17 Jr. Boys	Heats	21.97 sec.	2018
9	200 mtrs.	U -17 Jr. Boys	Heats	25.68 sec.	2018
10	200 mtrs.	U – 14 Sub Jr. Boys	Heats	23.19 sec	2015
11	200 mtrs.	U -14 Sub Jr. Girls	Heats	26.96 sec.	2019
12	800 mtrs	U – 17 Jr. Boys	Heats/Final	1:55.04 sec.	2014
13	800 mtrs	U -17 Jr. Girls	Heats/Final	2:12.18 sec.	2014
14	800 mtrs	U – 19 Sr. Boys	Heats/Final	1:56.51 sec	2015
15	800 mtrs	U – 19 Sr. Girls	Heats/Final	2:12.18 sec.	2018
16	600 mtrs	U – 14 Sub Jr. Boys	Heats/Final	1:24.52 sec.	2017
17	600 mtrs	U -14 Sub Jr. Girls	Heats/Final	1:43.20 sec.	1194
18	Hight Jump	U – 17 Jr. Boys	Final	1.95 mtrs.	2015
19	Shotput (5.00kg)	U – 17 Jr. Boys	Final	16.81 mtrs.	2019
20	Long jump	U – 19 Sr. Boys	Final	7.18 mtrs.	1999
21	4x100 Relay	U -19 Jr. Boys	Heats/Final	43.95sec.	2011
22	4x100 Relay	U -19 Jr. Boys	Heats/Final	53.96sec.	2011

Note:- All the Quarter final, semi final and final in the track events will be held in the same manner same day.

Convenor:
Sh. Yogesh Pal Singh
(DDE Sports)

Sunita Rai
Org. Secretary
Sunita Rai, (Mb. 9891438386)

Govt. of National Capital Territory of Delhi
Directorate of Education: Sports Branch
Chhatrasal Statdium, Model Town Delhi

Delhi State School Games: - 2023-24
ATHLETIC MEET
PROGRAMME

3nd DAY 04.12.2023

S.N	Event	Age – Group	Heats – Final	Delhi State School Games	Year
1	3000 mtrs.	U – 19 Sr. Boys	Final	8:56.43 sec	2018
2	3000 mtrs.	U – 19 Sr. Girls	Final	10:45.1sec	1992
3	High Jump	U – 14 Sub Jr. Girls	Final	1.44 mtrs	2018
4	Shotput (3.00kg)	U – 19 Sr. Girls	Final	12.22 mtrs	2018
5	Long Jump	U – 17 Jr. Girls	Final	5.23 mtrs	2012
6	Triple jump	U – 19 Sr. Girls	Final	10.99 mtrs	2018
7	400 mtrs	U – 19 Sr. Boys	Heats	49.07 sec	2019
8	400 mtrs	U – 19 Sr. Girls	Heats	57.38 sec	2018
9	400 mtrs	U -17 Jr. Boys	Heats	49.38 sec	2018
10	400 mtrs	U – 17 Jr. Girls	Heats	56.41 sec	2019
11	400 mtrs	U -14 Sub Jr. Boys	Heats	50.63 sec	2017
12	400 mtrs	U – 17 Sub Jr. Girls	Heats	1:01.44 sec	2019
13	High jump	U – 14 Sub Jr. Boys	Final	1.85 mtrs	2007
14	Shotput (5.00kg)	U – 19 Sr. Boys	Final	15.77 mtrs	2018
15	Long jump	U -17 Jr. Boys	Final	6.77 mtrs	2018
16	Triple jump	U – 19 Sr. Boys	Final	14.57 mtrs	2018
17	4x100 Relay	U – 14 sub Jr. Boys	Heats/Final	46.15 sec	2013
18	4x100 Relay	U – 14 Sub Jr. Girls	Heats/Final	56.48 sec	2019
19	4x100 Relay	U -19 Jr. Girls	Heats/Final	4:31.03 sec	2019
20	4x100 Relay	U -19 Jr. Boys	Heats/Final	3:30.00 sec	2018

Note:- All the Quarter final, semi final and final in the track events will be held in the same manner same day.

Convenor:
Sh. Yogesh Pal Singh
(DDE Sports)

Sunita Rai
Org. Secretary
Sunita Rai, (Mb. 9891438386)

Govt. of National Capital Territory of Delhi
Directorate of Education: Sports Branch
Chhatrasal Statdium, Model Town Delhi

Delhi State School Games: - 2023-24
ATHLETIC MEET
PROGRAMME

4th DAY 05.12.2023

S.N	Event	Age – Group	Heats – Final	Delhi State School Games	Year
1	Discus (1.00kg)	U – 17 Jr. Girls	Final	46.16 mtrs.	2005
2	Discus (1.50 kg)	U – 17 Jr. Boys	Final	45.44 mtrs.	2019
3	Discus (1.00 kg)	U – 14 Sub Jr. Girls	Final	32.28 mtrs	2013
4	Discus (1.00 kg)	U – 14 Sub Jr. Boys	Final	52.68 mtrs.	2019
5	Discus (1.00 kg)	U – 19 Sr. Girls	Final	40.50 mtrs.	2001
6	Discus (1.50kg)	U – 19 Sr. Boys	Final	47.90 mtrs.	2018
7	Javelin (500 gms)	U – 17 Jr. Girls	Final	34.95 mtrs.	2022
8	Javelin (700 gms)	U – 17 Jr. Boys	Final	64.66 mtrs.	2022
9	Javelin (500 gms	U – 19 Sr. Girls	Final	35.81 mtrs.	2022
10	Javelin (700 gms	U – 19 Sr. Boys	Final	62.57 mtrs.	2019

Convenor:
Sh. Yogesh Pal Singh
(DDE Sports)

Sunita Rai
Org. Secretary
Sunita Rai, (Mb. 9891438386)

Air Quality Index on Nov 07, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chennai	Good	49	CO	7/9
62	Chhal	Satisfactory	63	PM_{10}	1/1
63	Chhapra	Very Poor	348	$PM_{2.5}$	1/1
64	Chikkamagaluru	Good	44	CO	1/1
65	Chittoor	Good	34	$PM_{2.5}$	1/1
66	Chittorgarh	Moderate	181	$PM_{2.5}$	1/1
67	Churu	Poor	243	$PM_{2.5}$	1/1
68	Cuddalore	Good	34	NO_2	2/2
69	Cuttack	Poor	214	$PM_{2.5}$	1/1
70	Dausa	Poor	298	$PM_{2.5}$	1/1
71	Davanagere	Good	20	O_3	1/1
72	Dehradun	Moderate	104	$PM_{2.5}$	1/1
73	Delhi	Very Poor	395	$PM_{2.5}$, PM_{10}	31/40
74	Dewas	Moderate	140	$PM_{2.5}$	1/1
75	Dharuhera	Very Poor	320	$PM_{2.5}$	1/1
76	Dharwad	Satisfactory	56	CO	1/1
77	Dholpur	Very Poor	386	PM_{10}	1/1
78	Dhule	Poor	276	$PM_{2.5}$	1/1
79	Durgapur	Moderate	150	$PM_{2.5}$	1/1
80	Eloor	Satisfactory	58	PM_{10}	1/1

Air Quality Index on Nov 14, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chhapra	Very Poor	386	$PM_{2.5}$	1/1
62	Chikkaballapur	Moderate	166	$PM_{2.5}$	1/1
63	Chikkamagaluru	Satisfactory	92	$PM_{2.5}$	1/1
64	Chittoor	Moderate	125	$PM_{2.5}$	1/1
65	Chittorgarh	Poor	245	$PM_{2.5}$	1/1
66	Churu	Very Poor	346	$PM_{2.5}$	1/1
67	Cuddalore	Satisfactory	77	$PM_{2.5}$, NO_2	2/2
68	Cuttack	Poor	249	$PM_{2.5}$	1/1
69	Damoh	Satisfactory	55	PM_{10}	1/1
70	Dausa	Poor	294	$PM_{2.5}$	1/1
71	Davanagere	Moderate	137	$PM_{2.5}$	1/1
72	Dehradun	Moderate	150	$PM_{2.5}$	1/1
73	Delhi	Very Poor	397	$PM_{2.5}$, PM_{10}	35/40
74	Dewas	Moderate	151	$PM_{2.5}$	1/1
75	Dhanbad	Poor	246	NO_2	1/1
76	Dharuhera	Very Poor	375	$PM_{2.5}$	1/1
77	Dharwad	Moderate	104	PM_{10}	1/1
78	Dholpur	Very Poor	381	$PM_{2.5}$	1/1
79	Dhule	Poor	209	$PM_{2.5}$	1/1
80	Durgapur	Satisfactory	99	PM_{10}	1/1

Air Quality Index on Nov 21, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chikkaballapur	Good	48	$PM_{2.5}$	1/1
62	Chikkamagaluru	Good	45	PM_{10}	1/1
63	Chittoor	Good	46	O_3	1/1
64	Chittorgarh	Poor	294	$PM_{2.5}$	1/1
65	Churu	Severe	404	$PM_{2.5}$	1/1
66	Coimbatore	Satisfactory	73	PM_{10}	1/2
67	Cuddalore	Satisfactory	54	PM_{10}, $PM_{2.5}$	2/2
68	Cuttack	Satisfactory	75	PM_{10}	1/1
69	Damoh	Satisfactory	80	PM_{10}	1/1
70	Dausa	Very Poor	322	$PM_{2.5}$	1/1
71	Davanagere	Satisfactory	88	$PM_{2.5}$	1/1
72	Dehradun	Satisfactory	92	$PM_{2.5}$	1/1
73	Delhi	Very Poor	372	$PM_{2.5}$	36/40
74	Dewas	Poor	201	$PM_{2.5}$	1/1
75	Dhanbad	Poor	269	NO_2	1/1
76	Dharuhera	Very Poor	328	$PM_{2.5}$	1/1
77	Dharwad	Satisfactory	96	PM_{10}	1/1
78	Dholpur	Very Poor	373	$PM_{2.5}$	1/1
79	Durgapur	Satisfactory	99	PM_{10}	1/1
80	Eloor	Satisfactory	69	PM_{10}	1/1

Air Quality Index on Nov 28, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chikkaballapur	Good	32	$PM_{2.5}$	1/1
62	Chikkamagaluru	Good	32	PM_{10}	1/1
63	Chittoor	Good	42	O_3	1/1
64	Chittorgarh	Satisfactory	64	PM_{10}	1/1
65	Churu	Poor	262	$PM_{2.5}$	1/1
66	Coimbatore	Satisfactory	60	CO	1/2
67	Cuddalore	Good	29	PM_{10}, $PM_{2.5}$	2/2
68	Cuttack	Poor	246	$PM_{2.5}$	1/1
69	Dausa	Moderate	129	$PM_{2.5}$	1/1
70	Davanagere	Satisfactory	56	$PM_{2.5}$	1/1
71	Dehradun	Moderate	154	$PM_{2.5}$	1/1
72	Delhi	Very Poor	312	$PM_{2.5}$	36/40
73	Dewas	Moderate	129	$PM_{2.5}$	1/1
74	Dhanbad	Poor	233	NO_2	1/1
75	Dharuhera	Moderate	168	$PM_{2.5}$	1/1
76	Dharwad	Satisfactory	77	PM_{10}	1/1
77	Dholpur	Poor	265	$PM_{2.5}$	1/1
78	Dhule	Moderate	170	$PM_{2.5}$	1/1
79	Durgapur	Moderate	126	PM_{10}	1/1
80	Eloor	Good	39	CO	1/1

Air Quality Index on Dec 07, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chittoor	Satisfactory	78	PM_{10}	1/1
62	Chittorgarh	Poor	227	$PM_{2.5}$	1/1
63	Churu	Moderate	181	O_3	1/1
64	Coimbatore	Satisfactory	69	$PM_{2.5}$	1/2
65	Cuddalore	Good	31	$PM_{2.5}$, PM_{10}	2/2
66	Cuttack	Satisfactory	58	$PM_{2.5}$	1/1
67	Damoh	Good	27	PM_{10}	1/1
68	Dausa	Moderate	160	$PM_{2.5}$	1/1
69	Davanagere	Satisfactory	92	PM_{10}	1/1
70	Dehradun	Good	50	PM_{10}	1/1
71	Delhi	Very Poor	320	$PM_{2.5}$	33/40
72	Dewas	Moderate	116	$PM_{2.5}$	1/1
73	Dharuhera	Poor	255	$PM_{2.5}$	1/1
74	Dharwad	Satisfactory	72	PM_{10}	1/1
75	Dholpur	Very Poor	346	$PM_{2.5}$	1/1
76	Dhule	Moderate	130	$PM_{2.5}$	1/1
77	Durgapur	Good	34	SO_2	1/1
78	Faridabad	Poor	265	$PM_{2.5}$	4/4
79	Fatehabad	Moderate	121	$PM_{2.5}$	1/1
80	Firozabad	Moderate	121	PM_{10}, $PM_{2.5}$	2/2

Air Quality Index on Dec 14, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chengalpattu	Moderate	112	$PM_{2.5}$	1/1
62	Chennai	Satisfactory	87	PM_{10}, $PM_{2.5}$	6/9
63	Chhal	Satisfactory	63	PM_{10}	1/1
64	Chhapra	Very Poor	327	$PM_{2.5}$	1/1
65	Chikkaballapur	Satisfactory	89	$PM_{2.5}$	1/1
66	Chikkamagaluru	Satisfactory	53	PM_{10}	1/1
67	Chittoor	Satisfactory	81	O_3	1/1
68	Chittorgarh	Moderate	137	$PM_{2.5}$	1/1
69	Churu	Poor	215	$PM_{2.5}$	1/1
70	Cuddalore	Moderate	108	PM_{10}, $PM_{2.5}$	2/2
71	Cuttack	Poor	212	$PM_{2.5}$	1/1
72	Damoh	Satisfactory	70	PM_{10}	1/1
73	Dausa	Moderate	192	PM_{10}	1/1
74	Davanagere	Satisfactory	69	$PM_{2.5}$	1/1
75	Dehradun	Satisfactory	96	$PM_{2.5}$	1/1
76	Delhi	Very Poor	326	$PM_{2.5}$	37/40
77	Dewas	Moderate	103	PM_{10}	1/1
78	Dhanbad	Moderate	164	PM_{10}	1/1
79	Dharuhera	Poor	213	PM_{10}	1/1
80	Dharwad	Satisfactory	77	CO	1/1

Air Quality Index on Dec 21, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chengalpattu	Poor	213	$PM_{2.5}$	1/1
62	Chennai	Moderate	140	$PM_{2.5}$	8/9
63	Chhal	Satisfactory	76	PM_{10}	1/1
64	Chhapra	Poor	300	$PM_{2.5}$	1/1
65	Chikkaballapur	Moderate	138	$PM_{2.5}$	1/1
66	Chikkamagaluru	Satisfactory	61	PM_{10}	1/1
67	Chittoor	Moderate	152	$PM_{2.5}$	1/1
68	Chittorgarh	Poor	249	$PM_{2.5}$	1/1
69	Churu	Moderate	179	$PM_{2.5}$	1/1
70	Cuddalore	Moderate	170	$PM_{2.5}$	1/2
71	Cuttack	Poor	269	$PM_{2.5}$	1/1
72	Damoh	Satisfactory	70	PM_{10}	1/1
73	Dausa	Moderate	191	PM_{10}	1/1
74	Davanagere	Moderate	130	$PM_{2.5}$	1/1
75	Dehradun	Moderate	186	$PM_{2.5}$	1/1
76	Delhi	Very Poor	361	$PM_{2.5}$	37/40
77	Dewas	Moderate	106	PM_{10}	1/1
78	Dhanbad	Moderate	148	NO_2	1/1
79	Dharuhera	Moderate	192	PM_{10}	1/1
80	Dharwad	Moderate	109	PM_{10}	1/1

Air Quality Index on Dec 28, 2023 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chittoor	Satisfactory	66	O_3	1/1
62	Chittorgarh	Poor	264	$PM_{2.5}$	1/1
63	Churu	Poor	267	$PM_{2.5}$	1/1
64	Coimbatore	Satisfactory	61	$PM_{2.5}$	1/2
65	Cuttack	Poor	296	$PM_{2.5}$	1/1
66	Damoh	Satisfactory	69	PM_{10}	1/1
67	Dausa	Poor	224	$PM_{2.5}$	1/1
68	Davanagere	Satisfactory	65	PM_{10}	1/1
69	Dehradun	Moderate	133	$PM_{2.5}$	1/1
70	Delhi	Very Poor	358	$PM_{2.5}$	38/40
71	Dewas	Moderate	185	$PM_{2.5}$	1/1
72	Dhanbad	Poor	234	PM_{10}, NO_2	2/2
73	Dharuhera	Satisfactory	73	PM_{10}	1/1
74	Dharwad	Satisfactory	78	CO	1/1
75	Dholpur	Very Poor	341	$PM_{2.5}$	1/1
76	Dhule	Poor	223	$PM_{2.5}$	1/1
77	Durgapur	Moderate	143	$PM_{2.5}$	1/1
78	Eloor	Satisfactory	55	PM_{10}	1/1
79	Faridabad	Poor	293	$PM_{2.5}$	3/4
80	Fatehabad	Moderate	155	$PM_{2.5}$	1/1

Air Quality Index on Jan 07, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chhal	Moderate	102	$PM_{2.5}$	1/1
62	Chhapra	Very Poor	307	$PM_{2.5}$	1/1
63	Chikkaballapur	Satisfactory	58	$PM_{2.5}$	1/1
64	Chikkamagaluru	Good	47	PM_{10}	1/1
65	Chittoor	Satisfactory	58	O_3	1/1
66	Chittorgarh	Poor	216	$PM_{2.5}$	1/1
67	Churu	Moderate	116	$PM_{2.5}$	1/1
68	Coimbatore	Satisfactory	71	$PM_{2.5}$	1/2
69	Cuddalore	Good	33	PM_{10}	1/2
70	Cuttack	Very Poor	320	$PM_{2.5}$	1/1
71	Damoh	Good	50	PM_{10}	1/1
72	Dausa	Moderate	196	$PM_{2.5}$	1/1
73	Davanagere	Good	48	$PM_{2.5}$	1/1
74	Dehradun	Poor	225	$PM_{2.5}$	1/1
75	Delhi	Very Poor	333	$PM_{2.5}$	38/40
76	Dewas	Moderate	121	$PM_{2.5}$	1/1
77	Dhanbad	Moderate	114	SO_2	1/2
78	Dharuhera	Moderate	185	PM_{10}	1/1
79	Dharwad	Satisfactory	60	CO	1/1
80	Dholpur	Very Poor	337	$PM_{2.5}$	1/1

Air Quality Index on Jan 14, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chhal	Satisfactory	59	CO	1/1
62	Chhapra	Poor	261	$PM_{2.5}$	1/1
63	Chikkaballapur	Moderate	137	$PM_{2.5}$	1/1
64	Chikkamagaluru	Satisfactory	67	PM_{10}	1/1
65	Chittoor	Moderate	166	$PM_{2.5}$	1/1
66	Churu	Poor	261	$PM_{2.5}$	1/1
67	Coimbatore	Moderate	177	$PM_{2.5}$	1/2
68	Cuddalore	Poor	241	$PM_{2.5}$	2/2
69	Cuttack	Poor	294	$PM_{2.5}$	1/1
70	Damoh	Satisfactory	86	PM_{10}	1/1
71	Dausa	Poor	237	$PM_{2.5}$	1/1
72	Davanagere	Satisfactory	86	PM_{10}	1/1
73	Dehradun	Poor	260	$PM_{2.5}$	1/1
74	Delhi	Severe	447	$PM_{2.5}$	37/40
75	Dewas	Moderate	104	PM_{10}	1/1
76	Dhanbad	Moderate	147	PM_{10}	2/2
77	Dharuhera	Poor	247	$PM_{2.5}$	1/1
78	Dharwad	Satisfactory	77	PM_{10}	1/1
79	Dholpur	Very Poor	318	$PM_{2.5}$	1/1
80	Dhule	Moderate	113	PM_{10}	1/1



Air Quality Index on Jan 21, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Charkhi Dadri	Moderate	176	$PM_{2.5}$	1/1
62	Chennai	Satisfactory	79	PM_{10}	7/9
63	Chhal	Satisfactory	80	CO	1/1
64	Chhapra	Poor	294	$PM_{2.5}$	1/1
65	Chikkaballapur	Satisfactory	98	$PM_{2.5}$	1/1
66	Chikkamagaluru	Satisfactory	71	$PM_{2.5}$	1/1
67	Chittoor	Good	48	$PM_{2.5}$	1/1
68	Chittorgarh	Moderate	165	PM_{10}	1/1
69	Churu	Poor	226	$PM_{2.5}$	1/1
70	Coimbatore	Moderate	101	$PM_{2.5}$	1/2
71	Cuddalore	Good	39	$PM_{2.5}$	1/2
72	Cuttack	Very Poor	311	$PM_{2.5}$	1/1
73	Damoh	Moderate	131	PM_{10}	1/1
74	Dausa	Moderate	200	PM_{10}	1/1
75	Davanagere	Satisfactory	83	$PM_{2.5}$	1/1
76	Dehradun	Poor	228	$PM_{2.5}$	1/1
77	Delhi	Very Poor	349	$PM_{2.5}$	36/40
78	Dhanbad	Very Poor	361	PM_{10}	1/2
79	Dharuhera	Moderate	191	$PM_{2.5}$	1/1
80	Dharwad	Satisfactory	78	PM_{10}	1/1

Air Quality Index on Jan 28, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chhal	Moderate	134	PM_{10}	1/1
62	Chhapra	Very Poor	329	$PM_{2.5}$	1/1
63	Chikkaballapur	Satisfactory	54	$PM_{2.5}$	1/1
64	Chikkamagaluru	Satisfactory	54	PM_{10}	1/1
65	Chittoor	Satisfactory	62	O_3	1/1
66	Chittorgarh	Poor	226	$PM_{2.5}$	1/1
67	Churu	Moderate	124	$PM_{2.5}$	1/1
68	Coimbatore	Satisfactory	71	CO	1/2
69	Cuddalore	Good	46	PM_{10}, $PM_{2.5}$	2/2
70	Cuttack	Poor	287	$PM_{2.5}$	1/1
71	Dausa	Moderate	164	PM_{10}	1/1
72	Davanagere	Satisfactory	60	PM_{10}	1/1
73	Dehradun	Poor	296	$PM_{2.5}$	1/1
74	Delhi	Very Poor	365	PM_{10}, $PM_{2.5}$	37/40
75	Dewas	Satisfactory	84	PM_{10}	1/1
76	Dhanbad	Moderate	146	$PM_{2.5}$	1/2
77	Dharuhera	Poor	255	PM_{10}	1/1
78	Dharwad	Satisfactory	93	PM_{10}	1/1
79	Dholpur	Poor	215	$PM_{2.5}$	1/1
80	Dhule	Moderate	117	PM_{10}	1/1

Air Quality Index on Nov 07, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chandigarh	Poor	290	$PM_{2.5}$	3/3
62	Chandrapur	Moderate	165	PM_{10}	1/2
63	Charkhi Dadri	Moderate	160	PM_{10}	1/1
64	Chengalpattu	Satisfactory	63	PM_{10}	1/1
65	Chennai	Satisfactory	51	CO, PM_{10}	8/9
66	Chhal	Satisfactory	88	O_3	1/1
67	Chhapra	Moderate	162	$PM_{2.5}$	1/1
68	Chikkaballapur	Moderate	110	PM_{10}	1/1
69	Chikkamagaluru	Good	47	PM_{10}	1/1
70	Chittoor	Satisfactory	84	PM_{10}	1/1
71	Chittorgarh	Moderate	172	PM_{10}	1/1
72	Churu	Poor	239	PM_{10}	1/1
73	Coimbatore	Moderate	115	$PM_{2.5}$, PM_{10}	2/2
74	Cuddalore	Good	38	$PM_{2.5}$	1/2
75	Cuttack	Moderate	136	$PM_{2.5}$	1/1
76	Damoh	Satisfactory	58	PM_{10}	1/1
77	Dausa	Moderate	182	PM_{10}	1/1
78	Davanagere	Moderate	112	$PM_{2.5}$	1/1
79	Dehradun	Moderate	154	$PM_{2.5}$	1/1
80	Delhi	Very Poor	377	$PM_{2.5}$, PM_{10}	40/40

Air Quality Index on Nov 14, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chennai	Good	44	$PM_{2.5}$, CO	8/9
62	Chhal	Satisfactory	78	O_3	1/1
63	Chikkaballapur	Good	24	O_3	1/1
64	Chikkamagaluru	Good	34	O_3	1/1
65	Chittoor	Satisfactory	55	O_3	1/1
66	Chittorgarh	Moderate	173	O_3	1/1
67	Churu	Poor	249	$PM_{2.5}$	1/1
68	Coimbatore	Good	34	$PM_{2.5}$, PM_{10}	2/2
69	Cuddalore	Good	30	$PM_{2.5}$	1/2
70	Cuttack	Moderate	158	$PM_{2.5}$	1/1
71	Dausa	Moderate	143	PM_{10}	1/1
72	Davanagere	Good	34	O_3	1/1
73	Dehradun	Poor	258	$PM_{2.5}$	1/1
74	Delhi	Severe	424	$PM_{2.5}$	39/39
75	Dewas	Moderate	113	$PM_{2.5}$	1/1
76	Dharuhera	Poor	292	$PM_{2.5}$	1/1
77	Dharwad	Satisfactory	73	PM_{10}	1/1
78	Dholpur	Moderate	107	O_3	1/1
79	Dhule	Moderate	187	$PM_{2.5}$	1/1
80	Dindigul	Good	34	PM_{10}	1/1

Air Quality Index on Nov 21, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
81	Delhi	Very Poor	371	$PM_{2.5}$	35/39
82	Dewas	Moderate	188	$PM_{2.5}$	1/1
83	Dharuhera	Very Poor	324	$PM_{2.5}$	1/1
84	Dharwad	Satisfactory	86	PM_{10}	1/1
85	Dhule	Poor	206	$PM_{2.5}$	1/1
86	Dindigul	Moderate	137	PM_{10}	1/1
87	Dungarpur	Moderate	173	O_3	1/1
88	Durgapur	Poor	252	$PM_{2.5}$	3/3
89	Faridabad	Poor	243	$PM_{2.5}$	3/4
90	Fatehabad	Poor	230	$PM_{2.5}$	1/1
91	Firozabad	Satisfactory	85	PM_{10}	2/2
92	Gadag	Satisfactory	77	PM_{10}	1/1
93	Gandhinagar	Moderate	137	PM_{10}, $PM_{2.5}$	3/3
94	Gaya	Poor	216	$PM_{2.5}$	2/3
95	Ghaziabad	Poor	291	$PM_{2.5}$	4/4
96	Gorakhpur	Moderate	176	PM_{10}	1/1
97	Greater Noida	Poor	212	$PM_{2.5}$	2/2
98	Gummidipoondi	Moderate	159	$PM_{2.5}$	1/1
99	Gurugram	Poor	298	$PM_{2.5}$	4/4
100	Guwahati	Satisfactory	76	PM_{10}, $PM_{2.5}$	3/4

Air Quality Index on Nov 28, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Charkhi Dadri	Poor	225	$PM_{2.5}$	1/1
62	Chengalpattu	Satisfactory	81	PM_{10}	1/1
63	Chennai	Moderate	134	$PM_{2.5}$	8/9
64	Chhal	Moderate	113	O_3	1/1
65	Chhapra	Poor	260	$PM_{2.5}$	1/1
66	Chikkaballapur	Moderate	147	PM_{10}	1/1
67	Chikkamagaluru	Satisfactory	58	$PM_{2.5}$	1/1
68	Chittoor	Moderate	122	$PM_{2.5}$	1/1
69	Chittorgarh	Moderate	159	PM_{10}	1/1
70	Churu	Moderate	151	PM_{10}	1/1
71	Coimbatore	Moderate	106	$PM_{2.5}$	2/2
72	Cuttack	Poor	233	$PM_{2.5}$	1/1
73	Damoh	Moderate	148	PM_{10}	1/1
74	Dausa	Moderate	120	PM_{10}	1/1
75	Davanagere	Moderate	125	$PM_{2.5}$	1/1
76	Dehradun	Satisfactory	87	$PM_{2.5}$	1/1
77	Delhi	Very Poor	325	PM_{10}, $PM_{2.5}$	39/39
78	Dewas	Moderate	102	NO_2	1/1
79	Dhanbad	Poor	286	PM_{10}	1/2
80	Dharwad	Satisfactory	85	PM_{10}	1/1

Air Quality Index on Dec 07, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chandrapur	Moderate	137	PM_{10}	1/2
62	Charkhi Dadri	Moderate	134	$PM_{2.5}$	1/1
63	Chengalpattu	Satisfactory	66	PM_{10}	1/1
64	Chennai	Good	44	CO, PM_{10}	8/9
65	Chhal	Satisfactory	56	PM_{10}	1/1
66	Chikkaballapur	Satisfactory	73	PM_{10}	1/1
67	Chikkamagaluru	Good	32	O_3	1/1
68	Chittorgarh	Moderate	142	PM_{10}	1/1
69	Churu	Moderate	164	PM_{10}	1/1
70	Coimbatore	Good	44	$PM_{2.5}$, PM_{10}	2/2
71	Cuddalore	Good	30	$PM_{2.5}$, NO_2	2/2
72	Cuttack	Moderate	196	$PM_{2.5}$	1/1
73	Damoh	Moderate	115	PM_{10}	1/1
74	Dausa	Moderate	196	$PM_{2.5}$	1/1
75	Davanagere	Good	46	PM_{10}	1/1
76	Dehradun	Satisfactory	88	$PM_{2.5}$	1/1
77	Delhi	Poor	233	$PM_{2.5}$, PM_{10}	38/39
78	Dewas	Moderate	108	NO_2	1/1
79	Dhanbad	Very Poor	301	PM_{10}	1/2
80	Dharuhera	Moderate	123	$PM_{2.5}$	1/1

Air Quality Index on Dec 14, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
81	Dehradun	Moderate	104	$PM_{2.5}$	1/1
82	Delhi	Moderate	193	$PM_{2.5}$	32/39
83	Dewas	Satisfactory	99	PM_{10}	1/1
84	Dhanbad	Moderate	134	PM_{10}	1/2
85	Dharwad	Satisfactory	77	PM_{10}	1/1
86	Dholpur	Satisfactory	94	$PM_{2.5}$	1/1
87	Dhule	Moderate	105	PM_{10}	1/1
88	Dungarpur	Moderate	185	O_3	1/1
89	Durgapur	Very Poor	322	$PM_{2.5}$	3/3
90	Faridabad	Satisfactory	90	$PM_{2.5}$, PM_{10}	3/4
91	Fatehabad	Satisfactory	99	PM_{10}	1/1
92	Firozabad	Satisfactory	62	PM_{10}	2/2
93	Gadag	Moderate	102	PM_{10}	1/1
94	Gandhinagar	Satisfactory	79	PM_{10}	3/3
95	Gangtok	Satisfactory	63	$PM_{2.5}$	1/1
96	Gaya	Moderate	175	$PM_{2.5}$, PM_{10}	3/3
97	Ghaziabad	Moderate	103	PM_{10}	4/4
98	Gorakhpur	Moderate	135	PM_{10}	1/1
99	Greater Noida	Moderate	134	PM_{10}	2/2
100	Gummidipoondi	Moderate	197	$PM_{2.5}$	1/1

Air Quality Index on Dec 21, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Churu	Very Poor	335	$PM_{2.5}$	1/1
62	Coimbatore	Satisfactory	86	$PM_{2.5}$	2/2
63	Cuddalore	Satisfactory	71	PM_{10}	1/2
64	Cuttack	Satisfactory	79	PM_{10}	1/1
65	Damoh	Poor	218	$PM_{2.5}$	1/1
66	Dausa	Moderate	176	$PM_{2.5}$	1/1
67	Davanagere	Moderate	145	$PM_{2.5}$	1/1
68	Dehradun	Moderate	117	$PM_{2.5}$	1/1
69	Delhi	Very Poor	370	$PM_{2.5}$	33/39
70	Dewas	Poor	231	$PM_{2.5}$	1/1
71	Dhanbad	Poor	240	PM_{10}	1/2
72	Dharwad	Satisfactory	75	PM_{10}	1/1
73	Dholpur	Moderate	130	$PM_{2.5}$	1/1
74	Dhule	Moderate	143	$PM_{2.5}$	1/1
75	Dungarpur	Poor	282	$PM_{2.5}$	1/1
76	Durgapur	Very Poor	313	$PM_{2.5}$	2/3
77	Eloor	Satisfactory	81	$PM_{2.5}$	1/1
78	Faridabad	Moderate	194	PM_{10}, $PM_{2.5}$	3/4
79	Firozabad	Satisfactory	91	PM_{10}, $PM_{2.5}$	2/2
80	Gadag	Satisfactory	59	PM_{10}	1/1

Air Quality Index on Dec 28, 2024 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chittorgarh	Moderate	165	$PM_{2.5}$	1/1
62	Churu	Moderate	132	$PM_{2.5}$	1/1
63	Coimbatore	Good	39	$PM_{2.5}$	1/2
64	Cuttack	Moderate	184	O_3	1/1
65	Damoh	Satisfactory	73	$PM_{2.5}$	1/1
66	Dausa	Moderate	164	$PM_{2.5}$	1/1
67	Davanagere	Good	39	PM_{10}	1/1
68	Delhi	Moderate	139	$PM_{2.5}$	28/39
69	Dhanbad	Poor	205	PM_{10}	1/2
70	Dharwad	Satisfactory	57	PM_{10}	1/1
71	Dhule	Moderate	107	$PM_{2.5}$	1/1
72	Dungarpur	Poor	294	$PM_{2.5}$	1/1
73	Durgapur	Moderate	160	O_3, $PM_{2.5}$, PM_{10}	3/3
74	Faridabad	Satisfactory	88	PM_{10}	2/4
75	Firozabad	Satisfactory	61	PM_{10}	2/2
76	Gadag	Good	33	CO	1/1
77	Gandhinagar	Moderate	146	$PM_{2.5}$, PM_{10}	3/3
78	Gaya	Moderate	197	$PM_{2.5}$, PM_{10}	3/3
79	Ghaziabad	Satisfactory	76	$PM_{2.5}$	4/4
80	Gorakhpur	Moderate	109	PM_{10}	1/1

Air Quality Index on Jan 07, 2025 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chennai	Moderate	144	$PM_{2.5}$	8/9
62	Chhal	Satisfactory	98	$PM_{2.5}$	1/1
63	Chikkaballapur	Satisfactory	70	$PM_{2.5}$	1/1
64	Chikkamagaluru	Satisfactory	56	PM_{10}	1/1
65	Chittoor	Moderate	117	$PM_{2.5}$	1/1
66	Chittorgarh	Moderate	174	$PM_{2.5}$	1/1
67	Churu	Poor	201	$PM_{2.5}$	1/1
68	Coimbatore	Moderate	122	$PM_{2.5}$	2/2
69	Cuddalore	Satisfactory	87	$PM_{2.5}$	2/2
70	Cuttack	Poor	210	O_3	1/1
71	Damoh	Moderate	123	PM_{10}	1/1
72	Dausa	Moderate	108	$PM_{2.5}$	1/1
73	Davanagere	Satisfactory	95	PM_{10}	1/1
74	Dehradun	Moderate	111	$PM_{2.5}$	1/1
75	Delhi	Poor	296	$PM_{2.5}$	34/39
76	Dewas	Poor	210	$PM_{2.5}$	1/1
77	Dhanbad	Poor	244	PM_{10}	1/2
78	Dharwad	Satisfactory	70	PM_{10}	1/1
79	Dholpur	Moderate	170	PM_{10}	1/1
80	Dhule	Satisfactory	80	PM_{10}	1/1

Air Quality Index on Jan 14, 2025 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chikkamagaluru	Good	50	PM_{10}	1/1
62	Chittorgarh	Moderate	172	O_3	1/1
63	Churu	Moderate	132	$PM_{2.5}$	1/1
64	Coimbatore	Good	44	$PM_{2.5}$	2/2
65	Cuddalore	Satisfactory	55	$PM_{2.5}$	2/2
66	Cuttack	Moderate	185	O_3	1/1
67	Damoh	Moderate	112	$PM_{2.5}$	1/1
68	Dausa	Moderate	153	$PM_{2.5}$	1/1
69	Davanagere	Satisfactory	60	$PM_{2.5}$	1/1
70	Dehradun	Satisfactory	87	$PM_{2.5}$	1/1
71	Delhi	Poor	275	$PM_{2.5}$	35/39
72	Dewas	Poor	202	$PM_{2.5}$	1/1
73	Dhanbad	Poor	280	PM_{10}	1/2
74	Dharwad	Satisfactory	61	PM_{10}	1/1
75	Dhule	Moderate	124	$PM_{2.5}$	1/1
76	Dindigul	Satisfactory	73	PM_{10}	1/1
77	Dungarpur	Satisfactory	95	PM_{10}	1/1
78	Durgapur	Poor	211	$PM_{2.5}$, O_3	3/3
79	Faridabad	Moderate	118	$PM_{2.5}$, PM_{10}	3/4
80	Firozabad	Satisfactory	78	PM_{10}	2/2

Air Quality Index on Jan 21, 2025 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
41	Bulandshahr	Moderate	154	$PM_{2.5}$	1/1
42	Bundi	Moderate	188	$PM_{2.5}$	1/1
43	Buxar	Moderate	155	$PM_{2.5}$	1/1
44	Byrnihat	Severe	418	$PM_{2.5}$	1/1
45	Chamarajanagar	Good	43	PM_{10}	1/1
46	Chandigarh	Moderate	188	$PM_{2.5}$	3/3
47	Chandrapur	Moderate	104	PM_{10}	2/2
48	Charkhi Dadri	Poor	230	$PM_{2.5}$	1/1
49	Chennai	Moderate	112	$PM_{2.5}$	6/9
50	Chhal	Satisfactory	56	PM_{10}	1/1
51	Chhapra	Moderate	150	$PM_{2.5}$	1/1
52	Chikkaballapur	Satisfactory	86	$PM_{2.5}$	1/1
53	Chikkamagaluru	Good	44	PM_{10}	1/1
54	Chittorgarh	Moderate	181	$PM_{2.5}$	1/1
55	Churu	Poor	206	$PM_{2.5}$	1/1
56	Coimbatore	Satisfactory	80	$PM_{2.5}$, O_3	2/2
57	Cuddalore	Satisfactory	98	$PM_{2.5}$	1/2
58	Dausa	Moderate	160	$PM_{2.5}$	1/1
59	Dehradun	Moderate	116	$PM_{2.5}$	1/1
60	Delhi	Poor	289	$PM_{2.5}$	30/39

Air Quality Index on Jan 28, 2025 @ 4 PM

(Average of past 24 hours)

S.No	City	Air Quality	Index Value	Prominent Pollutant	No. of Stations Participated/ Total Stations
61	Chhapra	Moderate	152	$PM_{2.5}$	1/1
62	Chikkaballapur	Satisfactory	82	$PM_{2.5}$	1/1
63	Chikkamagaluru	Good	43	PM_{10}	1/1
64	Chittorgarh	Moderate	123	PM_{10}	1/1
65	Churu	Moderate	193	PM_{10}	1/1
66	Coimbatore	Satisfactory	80	$PM_{2.5}$	2/2
67	Cuddalore	Moderate	123	$PM_{2.5}$	1/2
68	Cuttack	Moderate	152	O_3	1/1
69	Damoh	Satisfactory	62	PM_{10}	1/1
70	Davanagere	Satisfactory	77	PM_{10}	1/1
71	Dehradun	Moderate	139	PM_{10}	1/1
72	Delhi	Poor	276	$PM_{2.5}$	31/39
73	Dewas	Satisfactory	78	NO_2	1/1
74	Dhanbad	Moderate	186	PM_{10}	1/2
75	Dharwad	Satisfactory	67	PM_{10}	1/1
76	Dholpur	Moderate	154	PM_{10}	1/1
77	Dhule	Satisfactory	78	$PM_{2.5}$	1/1
78	Dindigul	Moderate	159	PM_{10}	1/1
79	Dungarpur	Satisfactory	100	PM_{10}	1/1
80	Durgapur	Poor	213	PM_{10}, $PM_{2.5}$	3/3

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 4606-12 Dated: 22/10/25

CIRCULAR

Sub: - Organization of Delhi State School Games **ATHLETICS** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **ATHLETICS** from 11.11.2025 to 17.11.2025. The **ATHLETICS** tournament will be conducted in Under-14, 17 & 19 years (Boys & Girls) age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa **(Event Entry List)**, duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 03.11.2025 (4:00 PM) **at Chhatrasal Stadium, Model Town, Delhi.**

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys & Girls)	Eligibility
Under 14 years	Should be born on or after 01.01.2012
Under 17 years	Should be born on or after 01.01.2009
Under 19 years	Should be born on or after 01.01.2007

Sh. Sharad Kumar-9999346396, Assistant Director (Sports) will be overall In-charge of the Athletics Meet 2025-26 and Sh. Shiv Lochan Prasad -9810989896 (In-charge East Vinod Nagar Sports Complex), Sh. Mukesh Vats- 9711286318 (In-charge Prahaladpur Sports Complex) & Sh. Raman Jha- 9871933217 (Athletics Coach/PET) will assist In-charge Athletic Meet 2025-26.

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

Note:

1. All Zonal Athletes will be provided BIB Numbers **(List enclosed)** on 06.11.2025 by Sports Branch Chhatrasal Stadium, Model Town, Delhi-110009
2. BIB Number only given to the Zonal Secty. Or authorized person authorized by Zonal SPE/ Convenor
3. Entry List will be submitted at Chhatrasal Stadium till 03.11.2025.
4. BIB Numbers are separate for Boys (Blue/White) and Girls (Red/White).
5. Athletes participate in any three events & two relays extra.
6. Two Athletes participate in One event.
7. Four Athletes participate in relay race.
8. Six Athletes participate in Cross Country race..

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 4606-12 Dated: 22/10/25

Copy to:-

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

DELHI STATE SCHOOL GAMES 2025 (ATHLETICS)

LIST OF EVENTS

U-14		U-17		U-19	
BOYS	**GIRLS**	**BOYS**	**GIRLS**	**BOYS**	**GIRLS**
100 mtr	100 mtr	100 mtr	100 mtr	100 mtr	100 mtr
200 mtr	200 mtr	200 mtr	200 mtr	200 mtr	200 mtr
400 mtr	400 mtr	400 mtr	400 mtr	400 mtr	400 mtr
600 mtr	600 mtr	800 mtr	800 mtr	800 mtr	800 mtr
80 mtr (H)	80 mtr (H)	1500 mtr	1500 mtr	1500 mtr	1500 mtr
4x100 mtr	4x100 mtr	3000 mtr	3000 mtr	3000 mtr	3000 mtr
Long Jump	Long Jump	5000 mtr Race walk	3000 mtr Race walk	5000 mtr Race walk	3000 mtr Race walk
High Jump	High Jump	110 mtr Hurdle	100 mtr Hurdle	110 mtr Hurdle	100 mtr Hurdle
Shotput	Shotput	400 mtr Hurdle	400 mtr Hurdle	400 mtr Hurdle	400 mtr Hurdle
Discus Throw	Discus Throw	4x100 mtr	4x100 mtr	4x100 mtr	4x100 mtr
		4x400 mtr	4x400 mtr	4x400 mtr	4x400 mtr
		Long Jump	Long Jump	Long Jump	Long Jump
		High Jump	High Jump	High Jump	High Jump
		Triple Jump	Triple Jump	Triple Jump	Triple Jump
		Shotput	Shotput	Shotput	Shotput
		Discus Throw	Discus Throw	Discus Throw	Discus Throw
		Javelin Throw	Javelin Throw	Javelin Throw	Javelin Throw
		Hammer Throw	Hammer Throw	Hammer Throw	Hammer Throw
				6 Km Cross Country	4 Km Cross Country

DELHI STATE SCHOL GAMES (ATHLETICS) 2025-26
At Chhatrasal Stadium, Model Town, Delhi-110009
ENTRY PROFORMA

Zone:

U-14,17,19 BOYS/GIRLS

Bib No.	Name of Event	Name of the Athlete	Father,s Name	Class & Sec.	D.O.B	School Name & School ID	Photograph
		1.					
		2.					
		1.					
		2.					

Signature of
Zonal Secretary

Signature of
SPE

Signature of
Zonal Secretary

Annexure-9

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41.(431)/ Sports/ 2025-26/3535-41 Dated: 16/9/25

CIRCULAR

Subject: Organization of Delhi State School Games (Football) 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 Dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will organize Delhi State School Games for the year 2025-26 in the discipline of Football from **22.09.2025 to 26.09.2025.** (Fixture enclosed). The Football tournament will be organized in U-17 (Boys) age group.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Boys entries in the prescribed Performa (Annexure-II), duly attested by the concerned SPEs/Convener/Secretaries/HoS.

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa.

Age Group (Boys)	**Eligibility**
Under 17 years	Should be born on or after 01.01.2009

The players have to report in the proper playing kit. The fixture for Football is enclosed herewith for ready reference. Sh. Sanjay Singh, (9625090359 - Football Coach) will be In-charge of the game.

S. O. (SPORTS)

No. DE 41.(431)/ Sports/ 2025-26/3535-41 Dated: 16/9/25

Section Officer
Chhatrasal Stadium, Model Town
Directorate of Education, Old Sectt.
Delhi-110009

Copy to:-

1. All Regional Directors, DoE, Delhi
2. All District DDEs, Dte. of Education, Delhi
3. PS to Secy.(Education), Old Sectt, Delhi
4. PPS to Director(Education), DoE, Old Sectt, Delhi
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi
7. OS (IT) with the request to place the circular on **edudel.nic.in**

S.O. (SPORTS)

Section Officer
Chhatrasal Stadium, Model Town
Directorate of Education, Old Sectt.
Delhi-110009

VERNMENT OF NCT OF DELHI, DIRCT. OF EDU. (SPORTS BRANCH)

CHHATRASAL STADIUM, MODEL TOWN, DELHI

DELHI STATE SCHOOL GAMES, FOOTBALL TOURNAMENT 2025-26

133

Venue: Kohat Enclave, Lok Vihar, (Pitampura), Delhi

FIXTURE: ***FOOTBALL (BOYS U-17)*** ***Match Start On: 22-09-2025 to 26-09-2025***

1	Zone 20
2	Bye
3	Zone 17
4	Zone 16
5	Zone 27
6	Zone 02
7	Zone 19
8	Zone 22
9	Zone 01
10	Zone 08
11	Zone 04
12	Zone 28
13	Zone 23
14	Zone 24
15	Zone 15
16	Zone 03
17	Zone 26
18	Bye
19	Zone 29
20	Zone 05
21	Zone 21
22	Zone 12
23	Zone 07
24	Zone 10
25	Zone 11
26	Zone 13
27	Zone 14
28	Zone 25
29	Zone 09
30	Zone 06
31	Bye
32	Zone 18

22.09.25 (9:00)
22.09.25 (9:30)
22.09.25 (10:00)
22.09.25 (10:30)
22.09.25 (11:00)
22.09.25 (11:30)
22.09.25 (12:00)
23.09.25 (9:00)
23.09.25 (9:30)
23.09.25 (10:00)
23.09.25 (10:30)
23.09.25 (11:00)
23.09.25 (11:30)

24.09.2025 (8:00AM)
24.09.2025 (8:45AM)
24.09.2025 (9:30AM)
24.09.2025 (10:15AM)
24.09.2025 (11:00AM)
24.09.2025 (11:45AM)
24.09.2025 (12:30PM)
24.09.2025 (1:00PM)

25.09.2025 (9:00AM)
25.09.2025 (9:45AM)
25.09.2025 (10:30AM)
25.09.2025 (11:15PM)

26.09.2025 (9:00AM)
26.09.25 (10:00)

Final
26.09.2025 (12:00)
Hard Line Match 26.09.25

Note : (i) All teams must bring their I-Card with duly signed by H.O.S. with their eligibility performa and counter signature by Zonal Convener/Secretary.
(ii) All team coming in proper kit.
(iii) All teams shall report at venue 15 Minutes before the schedule time in proper kit.
(iv) Without proper kit and T-Shirt/ Shirt No. no team will be entertained.
(v) List of the players of the team should be submitted to ground In-Charge having all particulars (Name, Father's Name, School Name, D.O.B.and Admission No. Etc. of the player as per school record)
(vi) Ground In-Charge has all rights to change schedule under unforeseen circumstances.

Org. Secretary
Sh. S. Sunil
(DDE, Sports)

Football Coach
Sanjay Singh
(9625090359)

Football Coach
Shahid Akhtar
(7503616611)

TEAM EVENTS

Annexure-II

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

134

Zone No._____Game_____Event_____

S. No	Name of the Student	D.O.B	Class	Father's Name	Name of School with School ID	Admission No. of Student	Aadhar No of Student	Photo (Attested by HOS)
1								
2								
3								
4								
5								
6								

I hereby certify that I have personally checked all the documents submitted by school for above mentioned students and the same are found in order.

Convenor
Name, Seal & Mob. No

Supervisor
Name, Seal & Mob. No

Game In-charge
Name, Seal & Mob. No

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 4490-96 Dated: 17/10/25

CIRCULAR

Sub:- Organization of Delhi State School Games **FOOTBALL** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **FOOTBALL** from **28.10.2025 Onwards**. The **FOOTBALL** tournament will be conducted in Under– 14 & 19 years (Boys) & U-19 (Girls) age groups.

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys & Girls)	Eligibility
Under 14 years (Boys)	Should be born on or after 01.01.2012
Under 19 years (Boys)	Should be born on or after 01.01.2007
Under 19 Years (Girls)	Should be born on or after 01.01.2007

The players will have to report in the proper playing kit. **Sh Sanjay Chaudhary (9625090359) will be In-charge of the game.**

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 4490-96 Dated: 17/10/25

Copy to:-

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

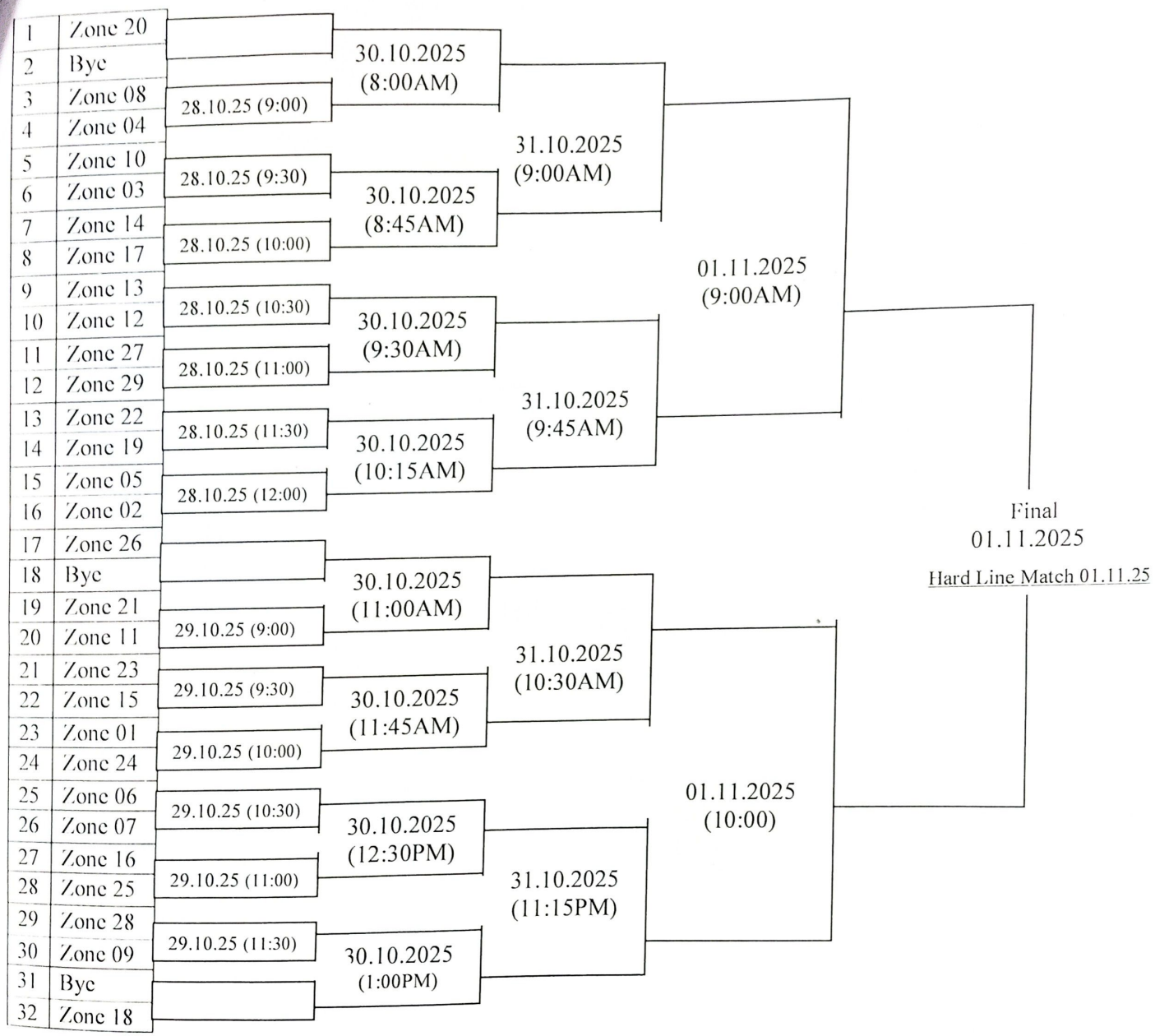
GOVERNMENT OF NCT OF DELHI, DIRCT. OF EDU. (SPORTS BRANCH)

CHHATRASAL STADIUM, MODEL TOWN, DELHI

DELHI STATE SCHOOL GAMES, FOOTBALL TOURNAMENT 2025-26

Venue: Kohat Enclave, Lok Vihar, (Pitampura), Delhi

FIXTURE: ***FOOTBALL (BOYS U-14)*** ***Match Start On: 28-10-2025 to 01-11-2025***



Note : (i) All teams must bring their I-Card with duly signed by H.O.S. with their eligibility performa and counter signature by Zonal Convener/Secretary.
(ii) All team coming in proper kit.
(iii) All teams shall report at venue 15 Minutes before the schedule time in proper kit.
(iv) Without proper kit and T-Shirt/ Shirt No. no team will be entertained.
(v) List of the players of the team should be submitted to ground In-Charge having all particulars (Name, Father's Name, School Name, D.O.B.and Admission No. Etc. of the player as per school record)
(vi) Ground In-Charge has all rights to change schedule under unforeseen circumstances.

Org. Secretary
Sh. S. Sunil
(DDE, Sports)

Football Coach
Sanjay Singh
(9625090359)

Football Coach
Shahid Akhtar
(7503616611)

GOVERNMENT OF NCT OF DELHI, DIRCT. OF EDU. (SPORTS BRANCH)

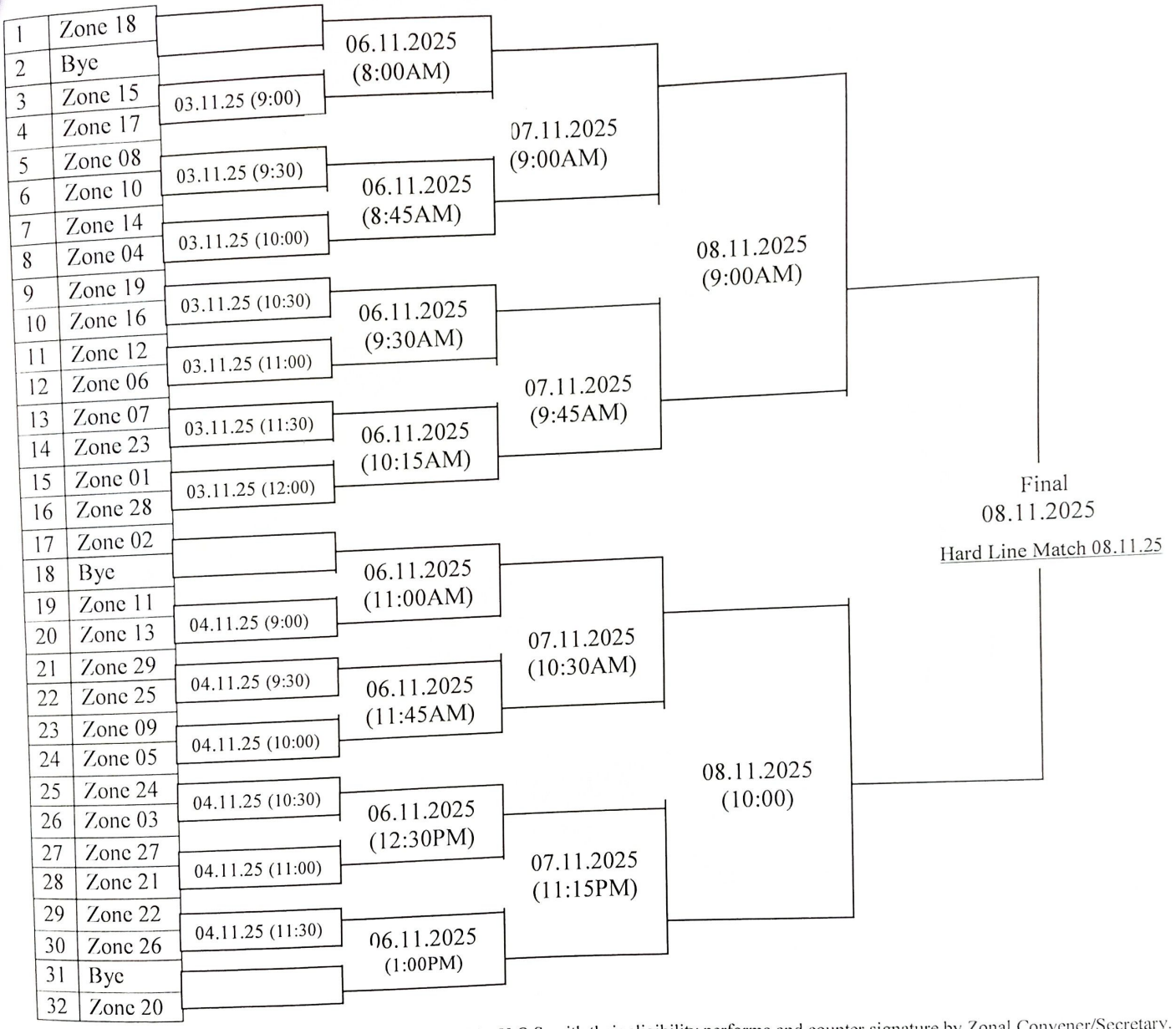
CHHATRASAL STADIUM, MODEL TOWN, DELHI

DELHI STATE SCHOOL GAMES, FOOTBALL TOURNAMENT 2025-26

Venue: Kohat Enclave, Lok Vihar, (Pitampura), Delhi

FIXTURE: ***FOOTBALL (BOYS U-19)***

Match Start On: 03-11-2025 to 08-11-2025



Note : (i) All teams must bring their I-Card with duly signed by H.O.S. with their eligibility performa and counter signature by Zonal Convener/Secretary.
(ii) All team coming in proper kit.
(iii) All teams shall report at venue 15 Minutes before the schedule time in proper kit.
(iv) Without proper kit and T-Shirt/ Shirt No. no team will be entertained.
(v) List of the players of the team should be submitted to ground In-Charge having all particulars (Name, Father's Name, School Name, D.O.B.and Admission No. Etc. of the player as per school record)
(vi) Ground In-Charge has all rights to change schedule under unforeseen circumstances.

Org. Secretary
Sh. S. Sunil
(DDE, Sports)

Football Coach
Sanjay Singh
(9625090359)

Football Coach
Shahid Akhtar
(7503616611)

GOVERNMENT OF NCT OF DELHI, DIRCT. OF EDU. (SPORTS BRANCH)

CHHATRASAL STADIUM, MODEL TOWN, DELHI

DELHI STATE SCHOOL GAMES, FOOTBALL TOURNAMENT 2025-26

Venue: Kohat Enclave, Lok Vihar, (Pitampura), Delhi

FIXTURE: ***FOOTBALL (GIRLS U-19)***

Match Start On: 10-11-2025 to 14-11-2025

1	Zone 26		11.11.2025 (8:00AM)				
2	Bye						
3	Zone 14	10.11.25		12.11.2025 (9:00AM)			
4	Zone 19						
5	Zone 08	10.11.25	11.11.2025 (8:45AM)				
6	Zone 05						
7	Zone 09	10.11.25			13.11.2025 (9:00AM)		
8	Zone 20						
9	Zone 25	10.11.25	11.11.2025 (9:30AM)				
10	Zone 13			12.11.2025 (9:45AM)			
11	Zone 02	10.11.25					
12	Zone 21						
13	Zone 07	10.11.25	11.11.2025 (10:15AM)				
14	Zone 11						
15	Zone 18	10.11.25				Final 14.11.2025	
16	Zone 27						
17	Zone 29		11.11.2025 (11:00AM)				Hard Line Match 14.11.25
18	Bye						
19	Zone 24	10.11.25		12.11.2025 (10:30AM)			
20	Zone 12						
21	Zone 01	10.11.25	11.11.2025 (11:45AM)				
22	Zone 06						
23	Zone 16	10.11.25			13.11.2025 (10:00)		
24	Zone 03						
25	Zone 28	10.11.25	11.11.2025 (12:30PM)				
26	Zone 17			12.11.2025 (11:15PM)			
27	Zone 10	10.11.25					
28	Zone 04						
29	Zone 15	10.11.25	11.11.2025 (1:00PM)				
30	Zone 22						
31	Bye						
32	Zone 23						

Note : (i) All teams must bring their I-Card with duly signed by H.O.S. with their eligibility performa and counter signature by Zonal Convener/Secretary.
(ii) All team coming in proper kit.
(iii) All teams shall report at venue 15 Minutes before the schedule time in proper kit.
(iv) Without proper kit and T-Shirt/ Shirt No. no team will be entertained.
(v) List of the players of the team should be submitted to ground In-Charge having all particulars (Name, Father's Name, School Name, D.O.B.and Admission No. Etc. of the player as per school record)
(vi) Ground In-Charge has all rights to change schedule under unforeseen circumstances.
(VII) All the teams are hereby directed to report at 09.00 AM

Org. Secretary
Sh. S. Sunil
(DDE, Sports)

Football Coach
Sanjay Singh
(9625090359)

Football Coach
Shahid Akhtar
(7503616611)

Annexure-10

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 5243-49 Dated: 13/11/25

ORDER

Sub:- Organization of Delhi State School Games **CRICKET** Girls (U-17) 2025-26.

The Sports Branch, Directorate of Education, is organizing the **Delhi State School Games (Cricket) U-17 Girls** for the year **2025-26**. All Zonal SPEs are hereby requested to send the **entries of selected teams** from their respective zones which **intend to participate in** Delhi State School Games **CRICKET** Girls (U-17) 2025-26.

All concerned are requested to ensure that entries reach Sh. Vinod Matta (9990440004) at G Block, Vikas Puri Cricket Center by 20.11.2025 (04:00 PM), positively. Entries received after the due date shall not be entertained under any circumstances.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 5243-49 Dated: 13/11/25
Copy to: -

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy. (Education), Old Sectt, Delhi-110054.
4. PPS to Director (Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/4838-44 Dated: 29/10/25

ORDER

Sub:- Organization of Delhi State School Games **CRICKET** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, and its subsequent circular No. DE.41(431)/Sports/2025-26/4439-45 dated 15.10.2025 Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **CRICKET**.

In this regard, it is informed that the fixture in r/o under-19 Boys only, issued vide the above-mentioned circular dated 15.10.2025 has been revised and attached with the circular.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/4838-44 Dated: 29/10/25

Copy to: -

- All Regional Directors, DoE, Delhi / New Delhi.
- All District DDEs, Dte. of Education, Delhi / New Delhi.
- PS to Secy. (Education), Old Sectt, Delhi-110054.
- PPS to Director (Education), DoE, Old Sectt, Delhi.
- PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
- All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
- OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

Delhi State Cricket Tournament U-19 Boys Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - BHARAT NAGAR CRICKET CENTER ASHOK VIHAR PHASE 3 NEAR L.B COLLEGE

1	Zone-26
2	BYE
3	Zone-15
4	Zone-11
5	Zone-10
6	Zone-17
7	Zone-06
8	Zone-14
9	Zone-08
10	Zone-18
11	Zone-16
12	Zone-24
13	Zone-12
14	Zone-27
15	Zone-20
16	Zone-19
17	Zone-22
18	BYE
19	Zone-07
20	Zone-13
21	Zone-09
22	Zone-04
23	Zone-29
24	Zone-21
25	Zone-05
26	Zone-02
27	Zone-01
28	Zone-25
29	Zone-03
30	Zone-23
31	Zone-28
32	BYE

04/11/25 7.30 A.M.
04/11/25 11.15 A.M.
06/11/25 7.30 A.M.
06/11/25 11.15 A.M.
07 /11/25 7.30 A.M.
07/11/25 11.15 A.M.
10/11/25 7.30 A.M.
10 /11/25 11.15 A.M.
11/11/25 07.30 A.M.
11/11/25 11.15 A.M.
12/11/25 07.30 A.M.
12/11/25 11.15 A.M.
13/11/25 07.30 A.M.

13/11/25 11.15 A.M.
14/11/257.30 A.M.
14/11/2511.15 A.M.
15/11/25 07.30 A.M.
15/11/2511.15 A.M.
17/11/25 7.30 A.M.
17/11/2511.15 A.M.
18/11/257.30 A.M.

18/11/25
11.15 A.M.
19/11/25
07.30 A.M.
19/11/25
11.15 A.M.
20/11/25
07.30 A.M.

20/11/25
11.15
A.M.
21/11/25
8.00 A.M

22/11/25
7.30 A.M.
3RD PLACE

11.30 A.M.
FINAL

28.10.25
Vinod Mutta

Venue Incharge: - Sh. Rohit Yadav (9811699824)

RULES & REGULATION

1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.
5. Only 2 Official (1 Coach & 1 Manager) is allowed with the team. No Parents is allowed in the ground.

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 4547-53 Dated: 22/10/2025

CIRCULAR

Sub: Organization of Delhi State School Games **CRICKET** Boys U-14 and Girls U-19 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **CRICKET** tournament will be conducted in Under- 14 years (Boys) 04/11/2025 (New Date) and Under-19 (Girls) 25/11/2025 age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa **(Fixture (U-14 Boys & U-19 Girls) and Annexure-II enclosed)**, duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 29.10.2025 (4:00 PM) **at Govt. Co-ed SSS Sector-6 Site-II Dwarka Cricket Coaching Center (U-14 Boys) & G-Block, Vikaspuri Cricket Centre (U-19 Girls) .**

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys)	Eligibility
Under 14 years	Should be born on or after 01.01.2012
Under 19 years	Should be born on or after 01.01.2007

CRITERIA FOR SCHOOL NATIONAL GAMES

Under-14 (Boys)

1. Batsman – 35 Run in particular match in with good strike rate.
2. All Rounder – 20 Run and two wicket in particular match.
3. Bowler – 3 Wicket in particular match with good economic.

Under-19 (Girls)

1. Batsman – 35 Run in particular match in with good strike rate.
2. All Rounder – 20 Run and two wicket in particular match.
3. Bowler – 2 Wicket in particular match with good economic.

The players will have to report in the proper playing kit. **Sh. Vinod Matta (9990440004) (U-19 Girls) & Sh. Pawan Bhardwaj (9896721272) (U-14 Boys) will be In-charge of the game.**

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

Note: Attention of all the HOS DoE GNCT of Delhi is hereby requested to make necessary compliance of the Circular No. DE 5/43/04/Exam/Part-II/2024/858-863 Dated 22/09/2025 and its point no 3 of section C issued by Exam Branch (HQ) DOE GNCT Delhi regarding Guidelines for linkage of subject teachers & uploading the marks of Mid Term Exam 2025-26.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION
Dated: 22/10/2025

No. DE 41(431)/ Sports/ 2025-26/ 4547-53
Copy to:-

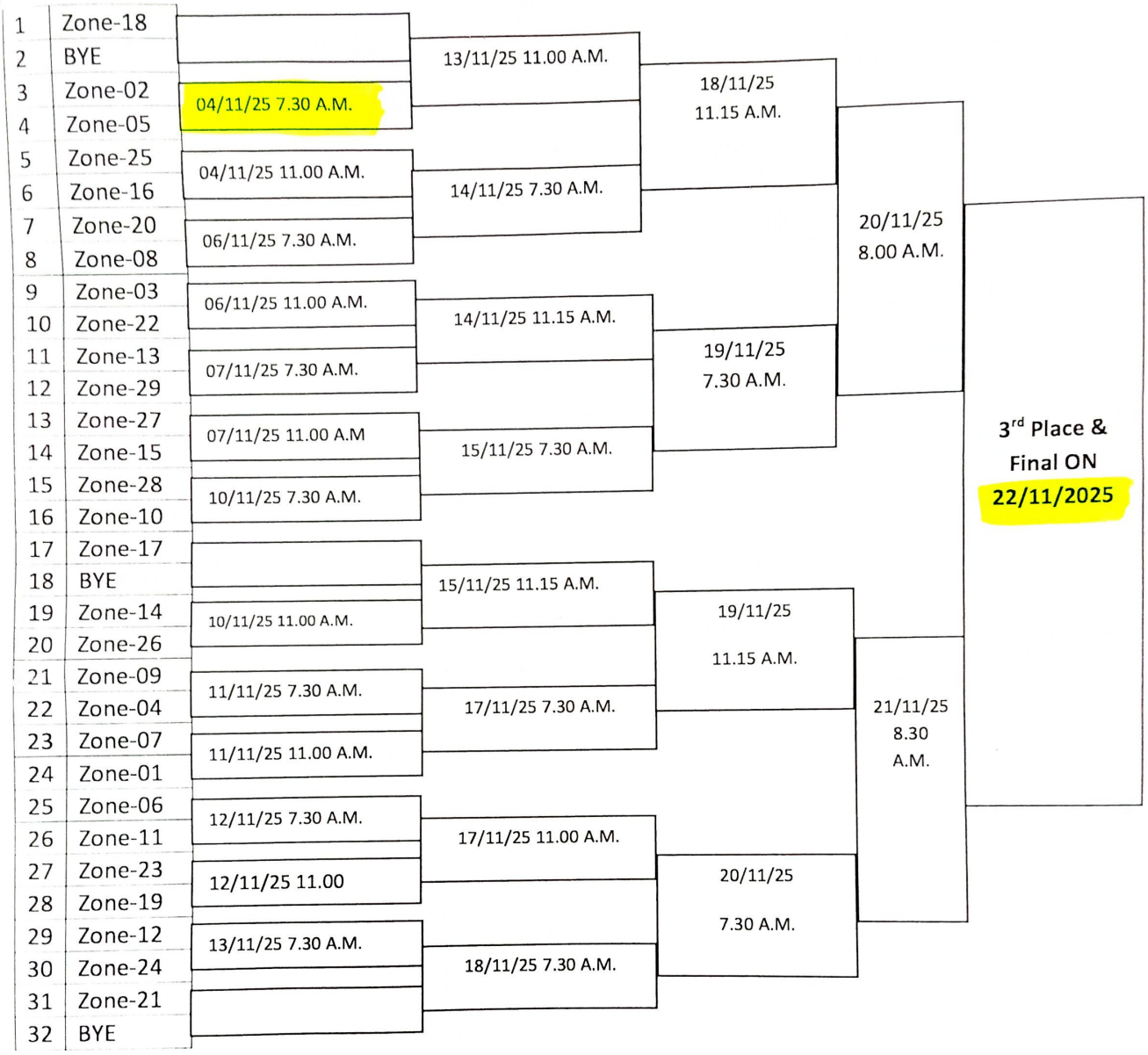
1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

Delhi State Cricket Tournament U-14 Boys Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - DWARKA CRICKET COACHING CENTER GOVT. (Co-ed) SSS Sector -6 Dwarka Site-II



Venue In charge: - Sh. Pawan Bhardwaj (9896721272)

RULES & REGULATION

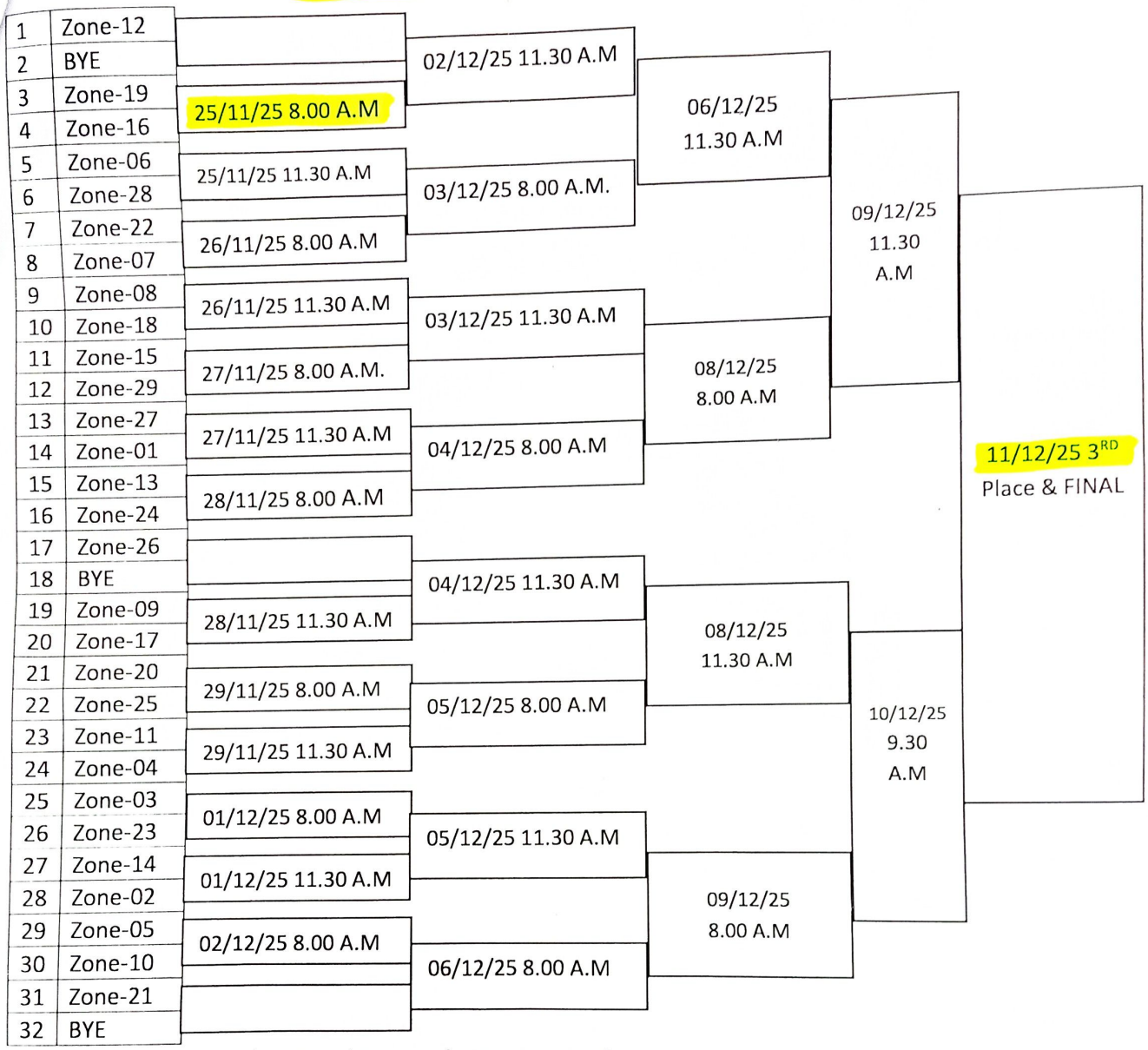
1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.
5. Only 2 Official (1 Coach & 1 Manager) is allowed with the team. No Parents is allowed in the ground.

Vinod Matta

Delhi State Cricket Tournament U-19 Girls Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - VIKASPURI COACHING CENTER G BLOCK



Venue Incharge: - Sh. Vinod Matta (9990440004)

RULES & REGULATION

1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.

Vinod Matta

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

Zone No._____ Game_____ Event_____

S. No	Name of the Student	D.O.B	Class	Father's Name	Name of School with School ID	Admission No. of Student	Aadhar No of Student	Photo (Attested by HOS)
1								
2								
3								
4								
5								
6								

I hereby certify that I have personally checked all the documents submitted by school for above mentioned students and the same are found in order.

Convenor
Name, Seal & Mob. No

Supervisor
Name, Seal & Mob. No

Game In-charge
Name, Seal & Mob. No

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/4498-4504 Dated: 17/10/2025

CIRCULAR

Please refer circular no D.E 41(431)/Sports/2025-26 dated 15/10/2025 vide which the Delhi state cricket tournament for age category U- 14,17& 19 (Boys & Girls) was scheduled to be held w.e.f. 24/10/2025.

In this regard it is informed the Delhi State Cricket 2025-26 for category U-14 Boys is hereby postponed till further order, rest of the contents of the circular dated 15/10/2025 will remain unchanged.

S.O.(SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/4498-4504 Dated: 17/10/2025

Copy to:-

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PA to Secy. (Education), Old Sectt, Delhi-110054.
4. PPS to Director (Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convener's/Secretaries, Dte of Education, Delhi/New Delhi
7. MIS in-charge with the request to upload the circular on the website.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

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GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 4439-45 Dated: 15/10/25

CIRCULAR

Sub:- Organization of Delhi State School Games **CRICKET** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **CRICKET** from 24.10.2025 onwards. The **CRICKET** tournament will be conducted in Under– 14, 17 & 19 years (Boys) and Under-19 (Girls) age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa **(Fixture and Annexure-II enclosed)**, duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 23.10.2025 (4:00 PM) **at Bharat Nagar Cricket Ground & G-Block, Vikaspuri Cricket Centre.**

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys)	Eligibility
Under 14 years	Should be born on or after 01.01.2012
Under 17 years	Should be born on or after 01.01.2009
Under 19 years	Should be born on or after 01.01.2007

CRITERIA FOR SCHOOL NATIONAL GAMES

Under-14 (Boys)

1. Batsman – 35 Run in particular match in with good strike rate.
2. All Rounder – 20 Run and two wicket in particular match.
3. Bowler – 3 Wicket in particular match with good economic.

Under-17 & 19 (Boys)

1. Batsman – 40 Run in particular match in with good strike rate.
2. All Rounder – 25 Run and two wicket in particular match.
3. Bowler – 3 Wicket in particular match with good economic.

The players will have to report in the proper playing kit. **Sh. Vinod Matta (9990440004) & Sh. Rohit Yadav (9811699824) will be In-charge of the game.**

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

Note: Attention of all the HOS DoE GNCT of Delhi is hereby requested to make necessary compliance of the Circular No. DE 5/43/04/Exam/Part-II/2024/858-863 Dated 22/09/2025 and its point no 3 of section C issued by Exam Branch (HQ) DOE GNCT Delhi regarding Guidelines for linkage of subject teachers & uploading the marks of Mid Term Exam 2025-26.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 4439-45 Dated: 15/10/25

Copy to:-

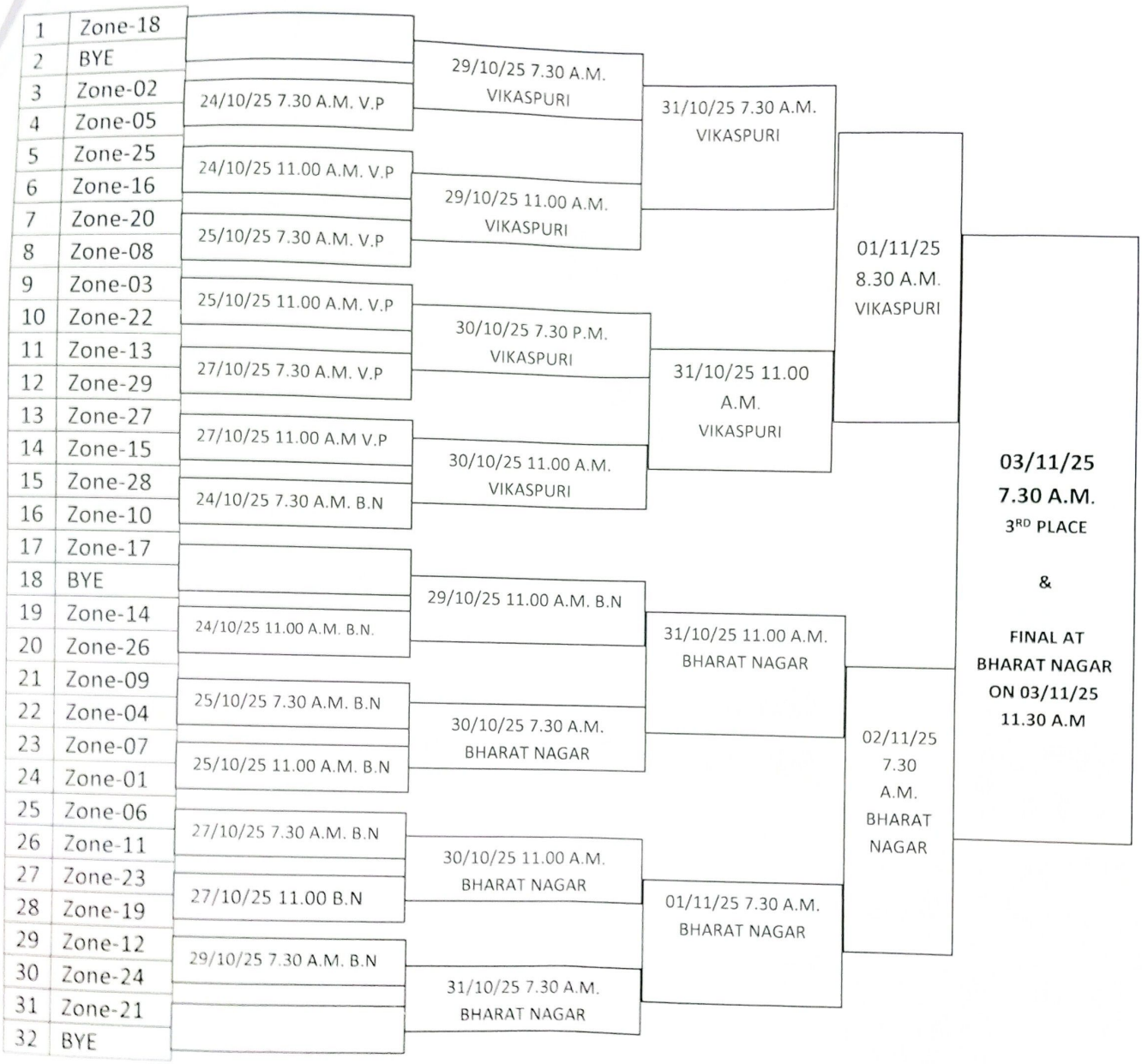
1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

Delhi State Cricket Tournament U-14 Boys Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - VIKASPURI G BLOCK CRICKET GROUND & BHARAT NAGAR CRICKET COACHING CENTER



Venue In charge: - Sh. Vinod Matta (Vikaspuri) (9990440004) & Sh. Rohit Yadav (Bharat Nagar) (9811699824)

RULES & REGULATION

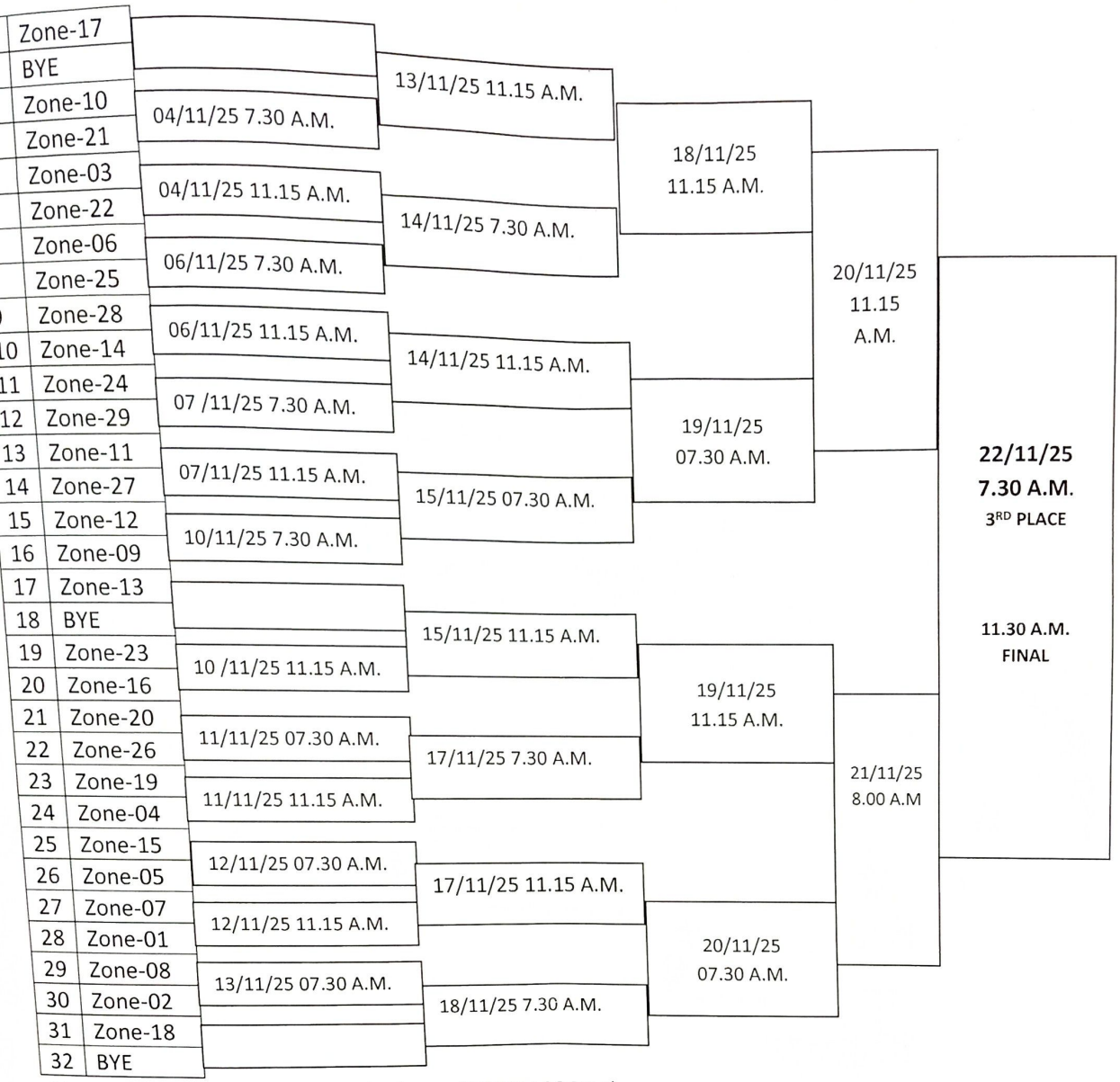
1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.
5. Only 2 Official (1 Coach & 1 Manager) is allowed with the team. No Parents is allowed in the ground.

Vinod Kumar Matta Ryadav

Delhi State Cricket Tournament U-17 Boys Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - G BLOCK VIKASPURI CRICKET COACHING CENTER



Venue Incharge: - Sh. Vinod Matta (9990440004)

RULES & REGULATION

1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.
5. Only 2 Official (1 Coach & 1 Manager) is allowed with the team. No Parents is allowed in the ground.

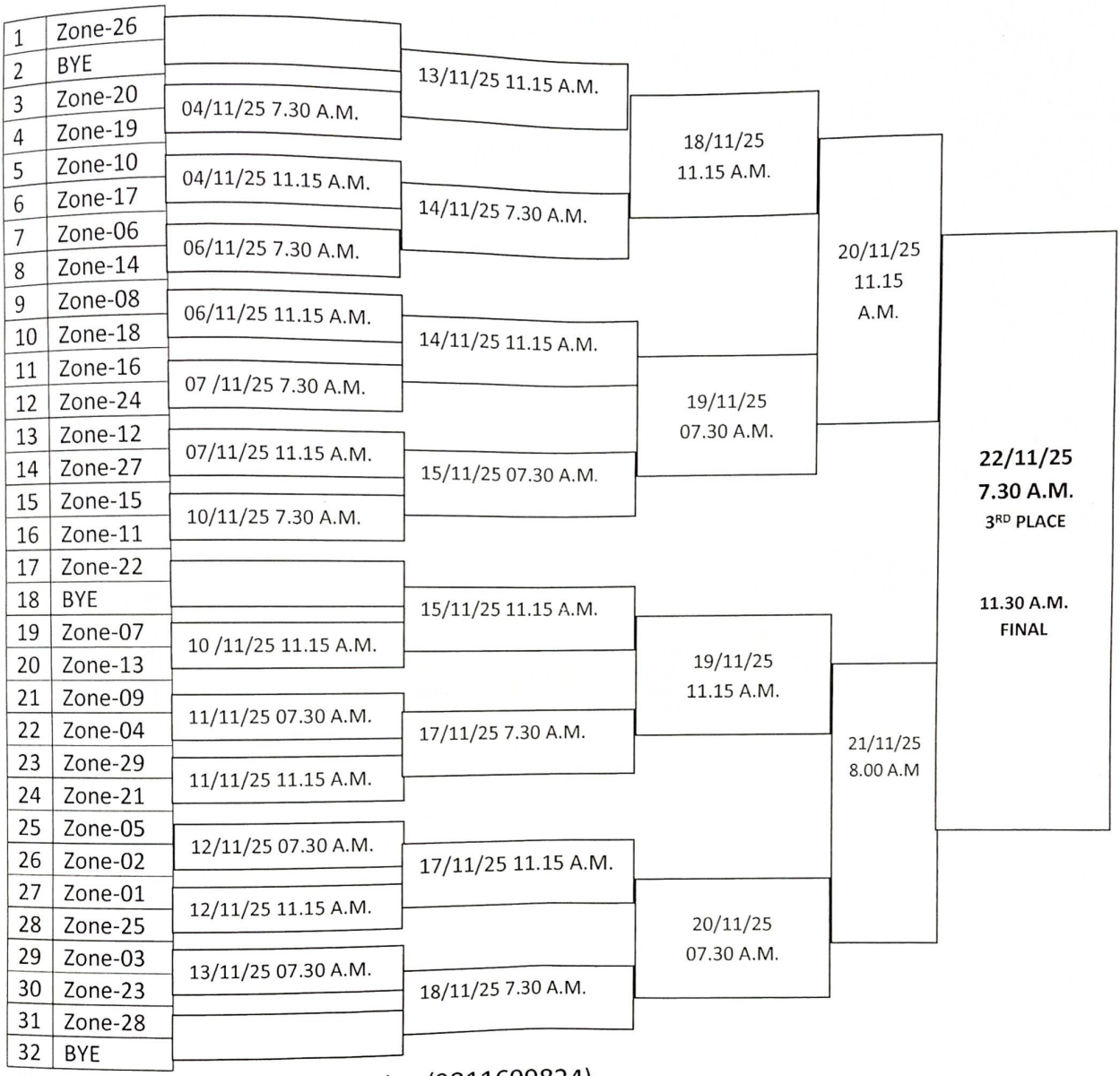
Vinod Kumar Matta

Jyadav

Delhi State Cricket Tournament U-19 Boys Fixture 2025-2026

Organized By Directorate of Education (Sports Branch)

VENUE: - BHARAT NAGAR CRICKET CENTER ASHOK VIHAR PHASE 3 NEAR L.B COLLEGE



Venue Incharge: - Sh. Rohit Yadav (9811699824)

RULES & REGULATION

1. All Matches will play on T-20 knockout basic as per BCCI Rules (No Impact Player allowed)
2. Official & balls provided by Sports Department.
3. All teams must reach half an Hour before at the given venue with complete Entry form & I D Card.
4. Umpire decision is final. Any dispute Technical Committee will take final decision.
5. Only 2 Official (1 Coach & 1 Manager) is allowed with the team. No Parents is allowed in the ground.

Vinod Kumar Matta

Annexure-II

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

Zone No._____Game_____Event_____

S. No	Name of the Student	D.O.B	Class	Father's Name	Name of School with School ID	Admission No. of Student	Aadhar No of Student	Photo (Attested by HOS)
1								
2								
3								
4								
5								
6								

I hereby certify that I have personally checked all the documents submitted by school for above mentioned students and the same are found in order.

Convenor
Name, Seal & Mob. No

Supervisor
Name, Seal & Mob. No

Game In-charge
Name, Seal & Mob. No

Annexure-11

GOVERNMENT OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI-110009

No. DE.41/Sports/69th NSG/Circulars/2025/4589-94 Dated: 22/10/25

CIRCULAR

Subject: Coaching Camp for 69thNational School Games 2025-26 for Volleyball U-19y Boys and Girls from 25 October to 09 November 2025 and U-17y from 31 October to 09 November 2025 at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi.

The Sports Branch, Directorate of Education, Govt. of NCT Delhi is going to conduct coaching camp for Volleyball U-19y Boys and Girls from 25 October to 09 November 2025 and U-17y Boys and Girls from 31 October to 09 November 2025 at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi.

The school students of the U-19y, who have been directly selected from the Delhi State School Games, are invited to participate in the coaching camp. Additionally, U-17y students will be selected trough the Delhi State School Games. All Selected students are directed to report at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi at 02:00 pm every day for camp. The list of U-19y B & G selected players is attached with this circular.

The selected student/player will represent Delhi in 69th National School Games 2025-26 in Volleyball (U-17y) Boys and Girls category to be held at Bareilly Uttar Pradesh w.e.f. 11 to 15 November, 2025 and Volleyball (U-19y Boys & Girls) to be held at Narsinghpur (Madhya Pradesh) from 13 to 17 November, under the aegis of SGFI.

In this regard reference is invited towards the invitation letter dated 08.11.2025 & 25.09.2025 issued from the office of the President SGFI.

For further enquiry, and redressal of grievances please contact the in-charge of the game Sh. Vijay Chaudhary (In charge) (9555362436).

S.Sunil
DEPUTY DIRECTOR OF EDUCATION
(SPORTS)

No. DE.41/Sports/69th NSG/Circulars/2025/4589-94 Dated: 22/10/25

Copy forwarded to for information of necessary action: -

1. PS to Secretary (Education), Govt. of NCT of Delhi.
2. PS to Director (Education), Govt. of NCT of Delhi.
3. All DDEs (District/ Zone), DoE Govt. of NCT of Delhi.
4. All HOSs, DoE, Govt. of NCT of Delhi.
5. Concerned person(s) mentioned in the circular.
6. OS (IT) with the request to place the circular on website.

S.Sunil
DEPUTY DIRECTOR OF EDUCATION
(SPORTS)

Volleyball Boys U-19

1)	VARDAAN	ZONE - 13
2)	AGRIM	ZONE - 13
3)	ABHISHK	ZONE - 23
4)	ADITYADI	ZONE - 6
5)	PRABHAT	ZONE - 19
6)	SUBHAM	ZONE - 11
7)	RALHIT	ZONE - 11
8)	HARSHIT	ZONE - 11
9)	ARYAN TALYAN	ZONE - 11
10)	ARYAN	ZONE - 11
11)	KINSHUHK	ZONE 11
12)	YASH KARAN	ZONE 09
13)	BHUPENDER	ZONE 09
14)	HARSH	ZONE 09
15)	UJJWAL	ZONE 09
16)	SARTHAK	ZONE 09
17)	MOHIT	ZONE 09
18)	AKASH	ZONE - 09
19)	ROHIT	ZONE - 10
20)	ADITIYA	ZONE - 14
21)	ANKUSH	ZONE - 11
22)	YASH RAJ	ZONE - 20
23)	TUSHAR DAGAR	ZONE - 11
24)	KARTIK	ZONE - 18
25)	YASH	ZONE - 21
26)	VAIBHAV	ZONE - 44

VIJAY CHAUDHARY
INCHARGE
DELHI SCHOOL STATE LEVEL

RAMAN
ASSTT. COACH
(VOLLEYBALL)

AASISH TOMAR
ASSTT. COACH
VOLLEYBAL

GIRLS U-19 (2025-26)

1)	NISHU	ZONE - 12
2)	SONAM	ZONE - 02
3)	BHUMI	ZONE - 02
4)	BHAVNEET KAUR	ZONE - 15
5)	ISHA	ZONE - 29
6)	NISHATA	ZONE - 03
7)	PAYAL	ZONE - 11
8)	AVNI	ZONE - 11
9)	AKANSHA	ZONE - 21
10)	RIYA	ZONE - 21
11)	SUHANI	ZONE - 21
12)	SWATI	ZONE - 21
13)	SHURUTI	ZONE - 28
14)	RIDHIMA	ZONE - 28
15)	VAISHALI	ZONE - 13
16)	NIDHI	ZONE - 13
17)	LAKSHITA	ZONE - 19
18)	HARSHMEET KAUR	ZONE - 19
19)	ANKITA	Zone - 23
20)	ANJLI	ZONE - 10
21)	KHUSHI	ZONE - 10
22)	SONAKSHI	ZONE - 07
23)	VANEE	Zone - 03
24)	Joohita	Zone - 09
25)	Gulabsha	Zone - 09
26)	Shakshi	Zone - 28
27)	Srishti	Zone - 07

VIJAY CHAUDHARY
INCHARGE
DELHI SCHOOL STATE CAMP

RAMAN
ASSTT. COACH
(VOLLEYBALL)

ASHISH TOMAR
ASSTT. COACH
VOLLEYBALL

3GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/4317-23 Dated: 10/10/25

CIRCULAR

Sub:- Organization of Delhi State School Games **VOLLEYBALL** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **VOLLEYBALL** from 25.10.2025 Onwards. The **VOLLEYBALL** tournament will be conducted in Under– 14 & 17 years (Boys & Girls) age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa **(Fixture and Annexure-II enclosed)**, duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 23.10.2025 (4:00 PM) **at SU Block, Pitampura, Delhi.**

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys & Girls)	Eligibility
Under 14 years	Should be born on or after 01.01.2012
Under 17 years	Should be born on or after 01.01.2009

The players will have to report in the proper playing kit. **Sh. Vijay Chaudhary (9555362436) will be In-charge of the game & & Dr. Sandeep Kumari (8800120022)** Volleyball Coach.

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

Note: Attention of all the HOS DoE GNCT of Delhi is hereby requested to make necessary compliance of the Circular No. DE 5/43/04/Exam/Part-II/2024/858-863 Dated 22/09/2025 and its point no 3 of section C issued by Exam Branch (HQ) DOE GNCT Delhi regarding Guidelines for linkage of subject teachers & uploading the marks of Mid Term Exam 2025-26.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/4317-23 Dated: 10/10/25

Copy to:-

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

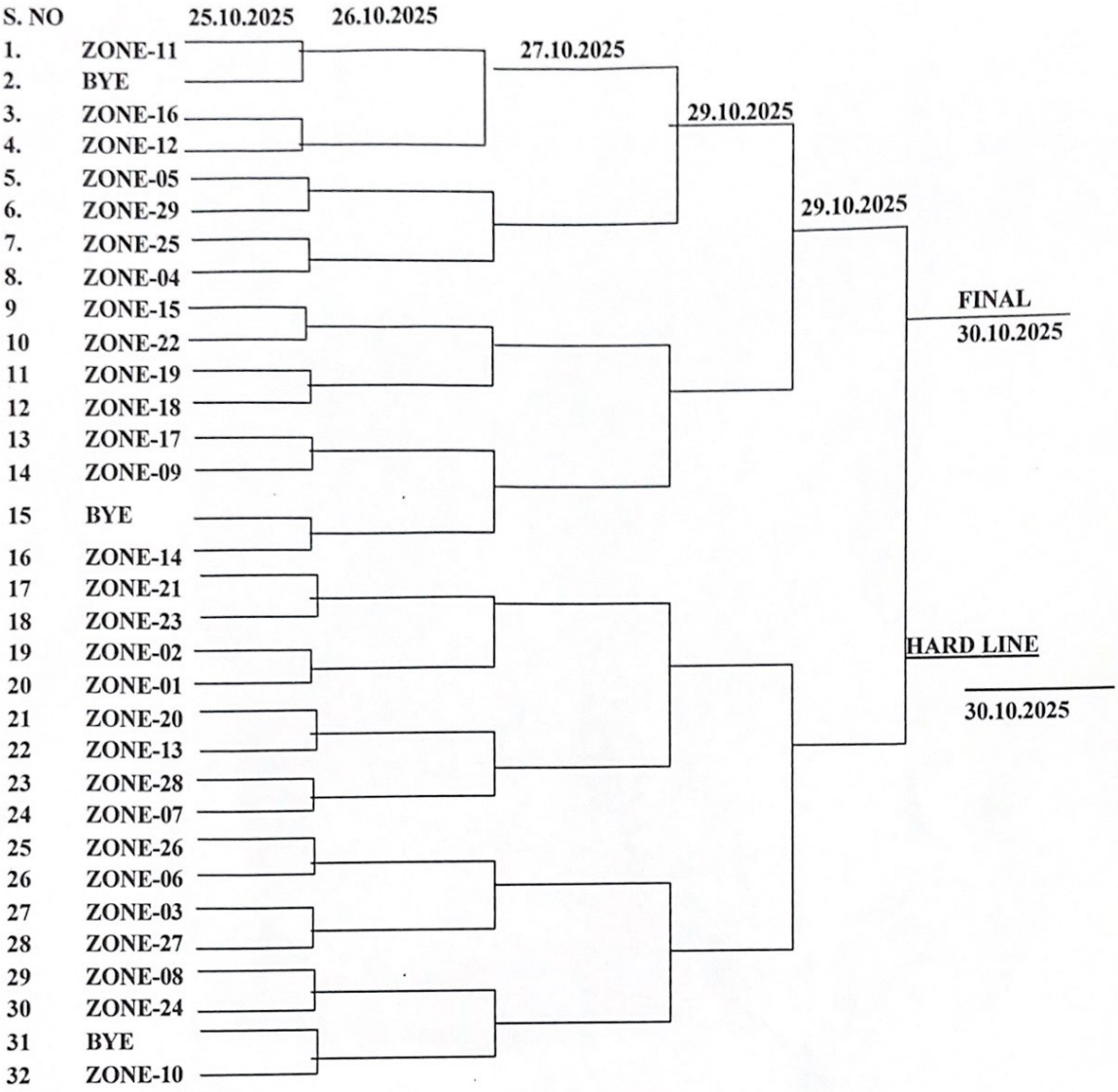
GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI

DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (BOYS U-17)

DATE: 25.10.2025 TO 30.10.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

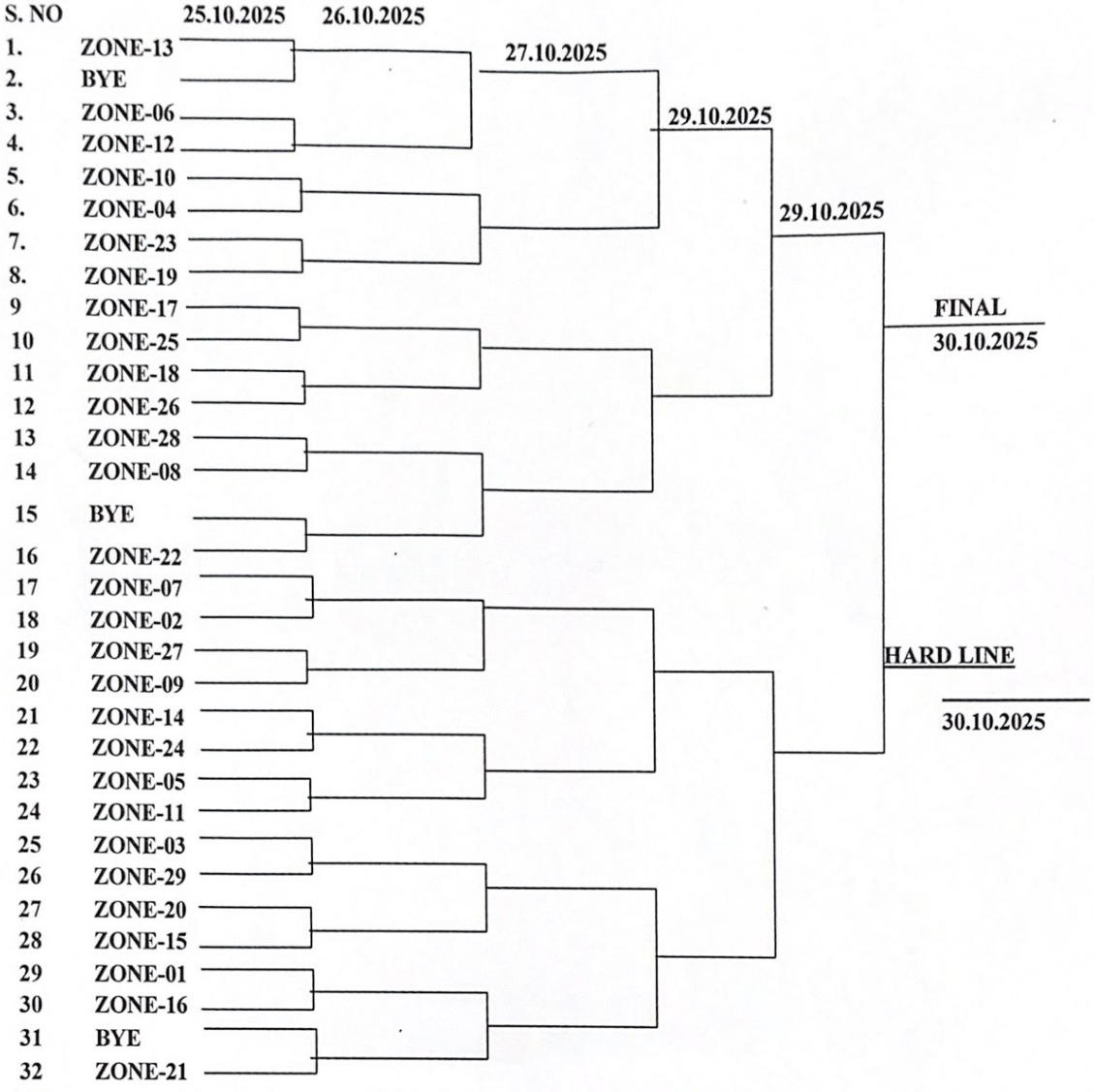
GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI

DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (GIRLS U-17)

DATE: 25.10.2025 To 30.10.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

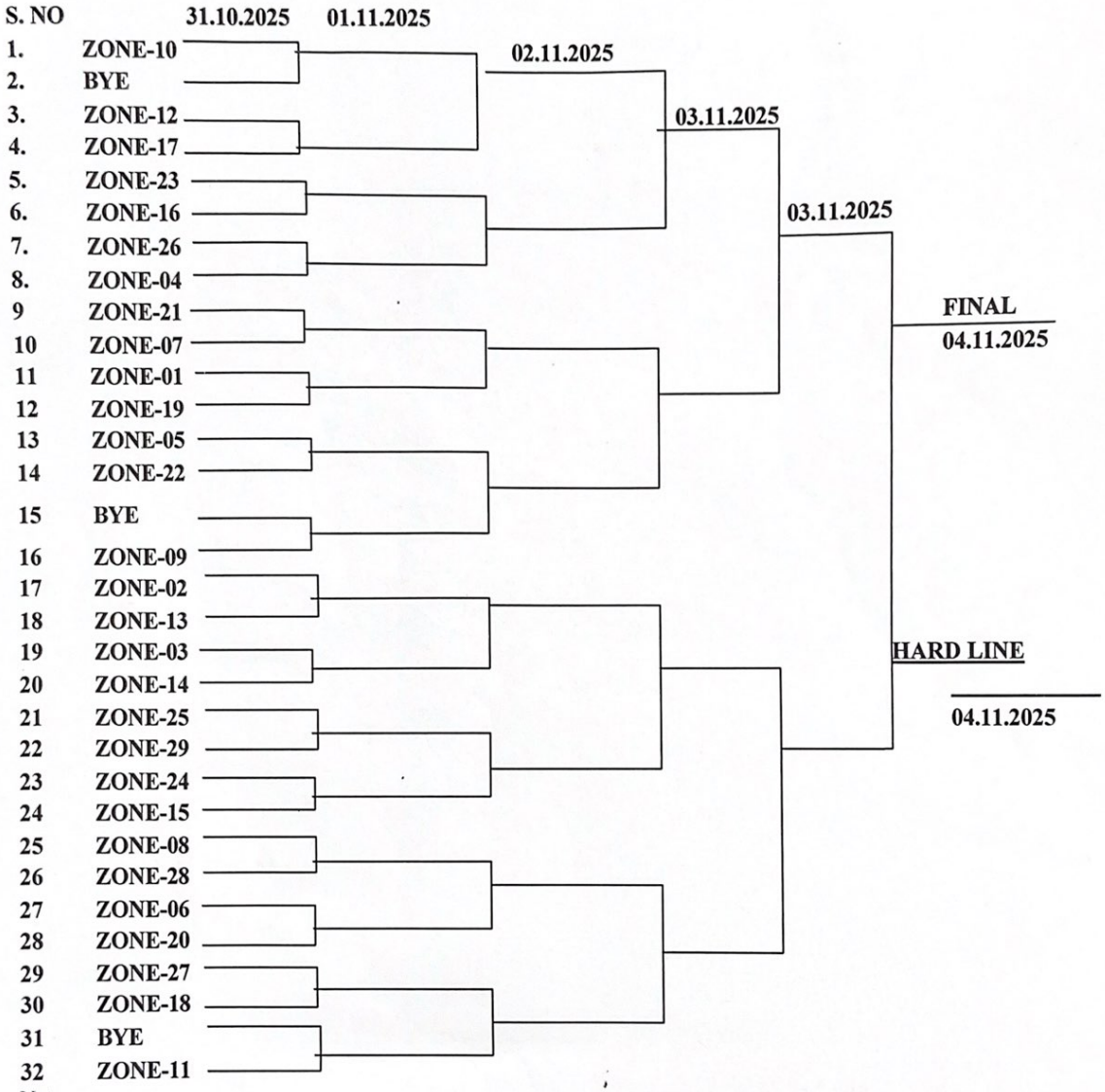
GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI

DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (BOYS U-14)

DATE: 31.10.2025 TO 04.11.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

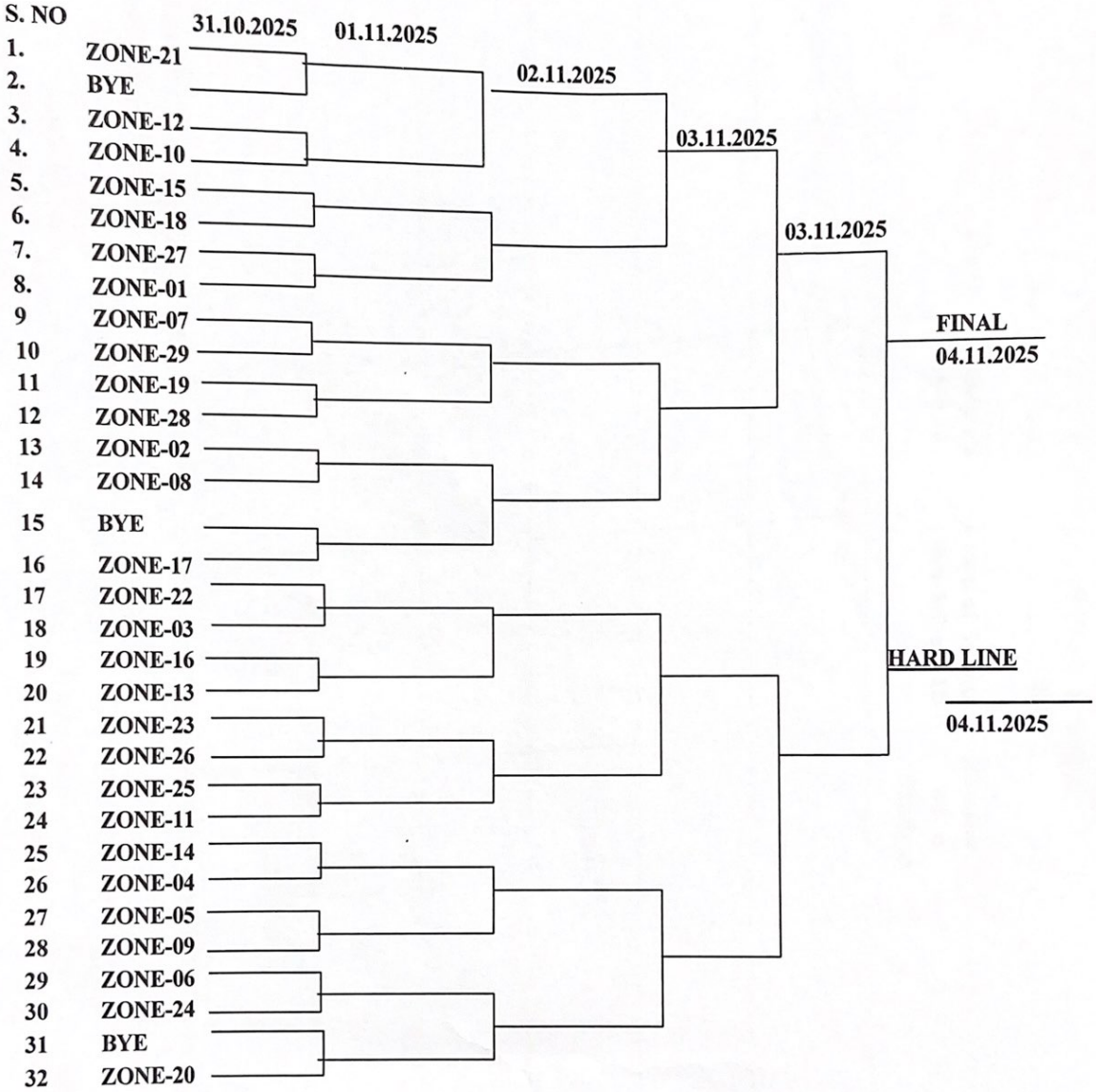
GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI

DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (GIRLS U-14)

DATE: 31.10.2025 TO 04.11.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

TEAM EVENTS

Annexure-II

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

Zone No._____Game_____Event_____

S. No	Name of the Student	D.O.B	Class	Father's Name	Name of School with School ID	Admission No. of Student	Aadhar No of Student	Photo (Attested by HOS)
1								
2								
3								
4								
5								
6								

I hereby certify that I have personally checked all the documents submitted by school for above mentioned students and the same are found in order.

Convenor
Name, Seal & Mob. No

Supervisor
Name, Seal & Mob. No

Game In-charge
Name, Seal & Mob. No

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/3555-61 Dated: 16/09/25

CIRCULAR

Sub:- Organization of Delhi State School Games Volleyball Boys and Girls U-19, 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of Volleyball from 22.09.2025 to 26.09.2025. The Volleyball tournament will be conducted in Under–19 years (Boys & Girls) age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa (Annexure-II), duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 20.09.2025 (04:00 PM) **at SU, Block, Pitampura Sports Complex**.

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys & Girls)	Eligibility
Under 19 years	Should be born on or after 01.01.2007

The players will have to report in the proper playing kit. The fixture for Volleyball is enclosed herewith for ready reference. Sh. Vijay Chaudhary (9555362436) (Volleyball Coach) will be In-charge of the game. He will be assisted by Ms. Sandeep Kumari (8800120022) (Volleyball Coach).

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 3555- 61 Dated: 16/09/25

Copy to:-

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

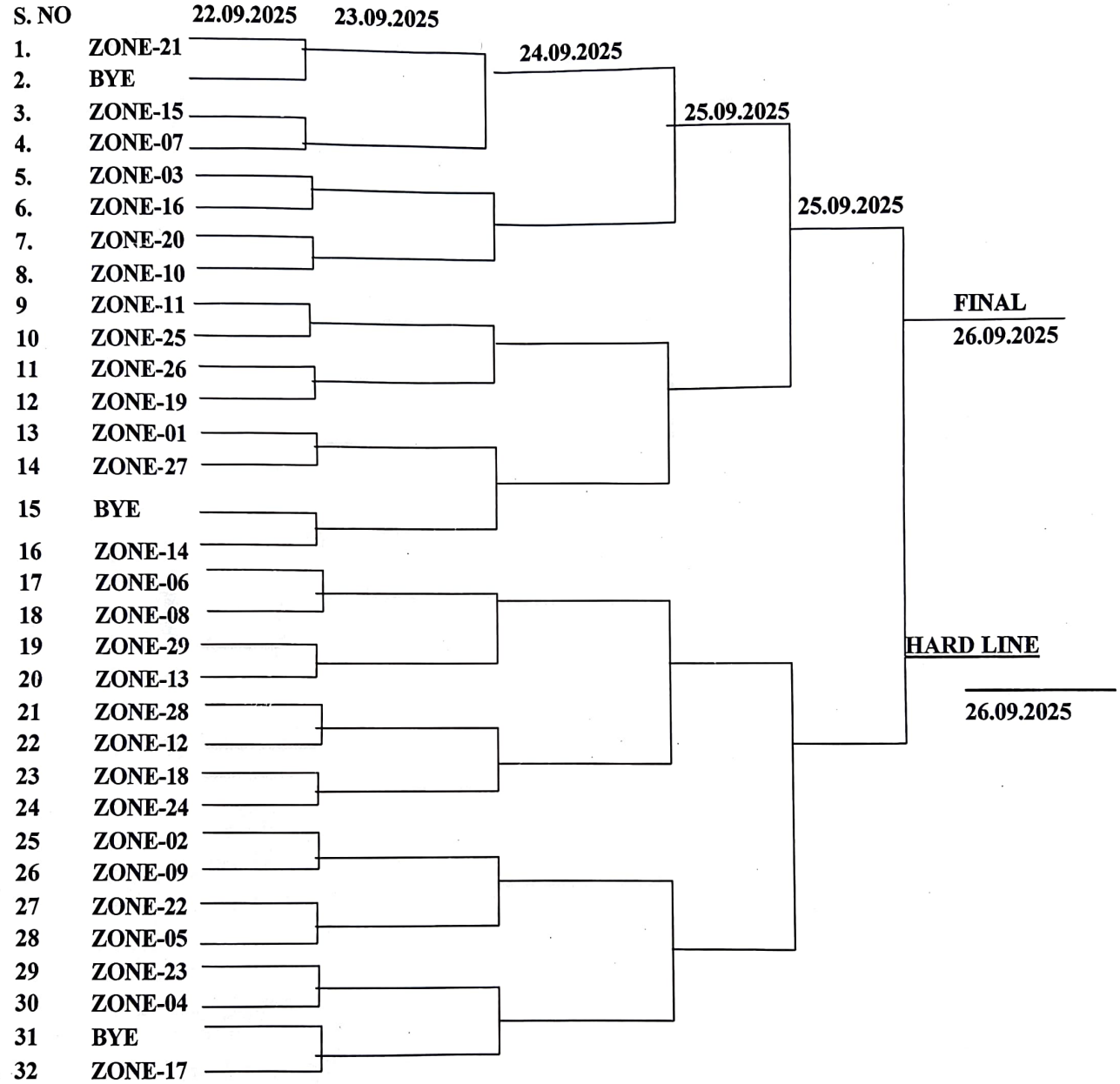
S. O. (SPORTS)
DIRECTORATE OF EDUCATION

GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI
DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (GIRLS U-19)

DATE: 22.09.2025 To 26.09.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

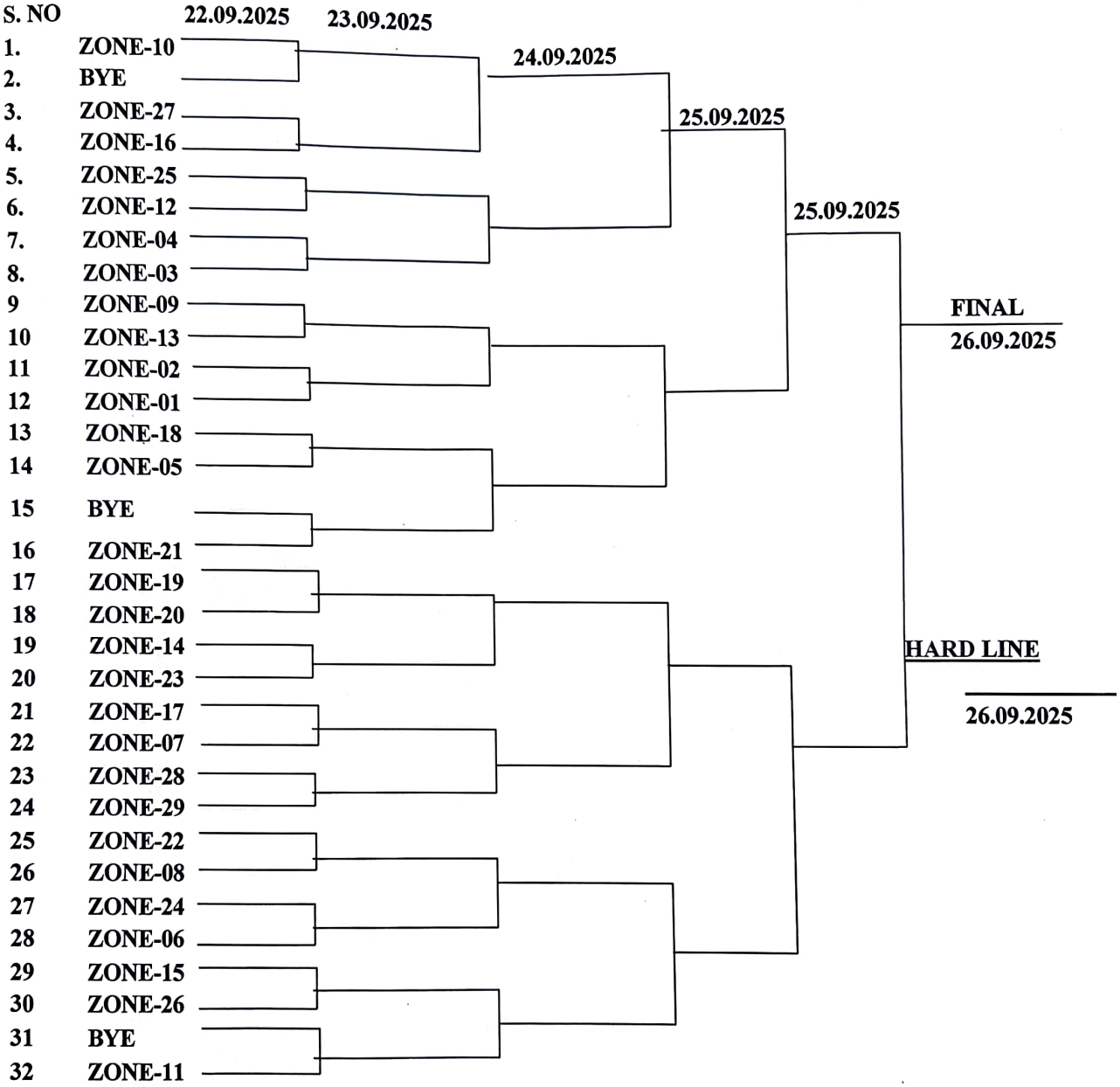
GOVERNMENTOFNCTOFDELHI,DIRCT.OFEDU(SPORTSBRANCH)CHHATRASAL STADIUM, MODAL TOWN, DELHI

DELHISCHOOLSTATEVOLLEYBALLTOURNAMENT(2025-26)

VENUE:-VOLLEYBALLSU-BLOCK,PITAMPURA,NEWDELHI

FIXTURE: VOLLEYBALL (BOYS U-19)

DATE: 22.09.2025 TO 26.09.2025
REPORTING TIME: 09:00 AM



Note:-

1. All team must bring their id cards with duly signed by HOS with their eligibility performa and counter signature by Zonal Convener/ Secretary.
2. All teams shall report at venue 15 minutes before the schedule time in proper kit.
3. List of the players of the team should be submitted to game in-charge having all particulars (Name, Father's Name, School name, D.O.B Class and admission no. Etc. of the player as per school record.
4. Matches will be played according tom the VFI Rules.
5. The Game in-charge has all rights to changed schedule under unforeseen circumstances.

Convener:
Sh. S Sunil
DDE,SPORTS)

Org. Secretary
Sh.Vijay Chaudhary
(9555362436)

TEAM EVENTS

Annexure-II

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

Zone No._____Game_____Event_____

S. No	Name of the Student	D.O.B	Class	Father's Name	Name of School with School ID	Admission No. of Student	Aadhar No of Student	Photo (Attested by HOS)
1								
2								
3								
4								
5								
6								

I hereby certify that I have personally checked all the documents submitted by school for above mentioned students and the same are found in order.

Convenor
Name, Seal & Mob. No

Supervisor
Name, Seal & Mob. No

Game In-charge
Name, Seal & Mob. No

Annexure-12

GOVT. OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI - 110009

No. DE 41(431)/ Sports/ 2025-26/ 4695-4701 Dated: 24/10/25

CIRCULAR

Sub: - Organization of Delhi State School Games **TENNIS** Boys and Girls 2025-26.

In continuation of Circular No.DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025, Sports Branch, Directorate of Education, Govt. of NCT of Delhi will conduct Delhi State School Games for the year 2025-26 in the discipline of **TENNIS** from 30/10/2025 to 12.11.2025 onwards. The **TENNIS** tournament will be conducted in Under– 14 & 17 years (Boys & Girls) age groups.

All the zonal SPEs/Convener/Secretaries are hereby directed to send Girls and Boys entries in the prescribed Performa **(Annexure-I enclosed)**, duly attested by the concerned SPEs/Convener/Secretaries/HoS, till 30.10.2025 (10:00 AM to 03:00 PM) **Tyagraj Stadium.**

The stamp of the Head of the school on the Performa should be clearly visible and legible. The stamp on the photo of the student should have been affixed in such a manner that half of it should be on the photo and half on the Performa. The players will have to report in the proper playing kit.

Age Group (Boys & Girls)	Eligibility
Under 14 years	Should be born on or after 01.01.2012
Under 17 years	Should be born on or after 01.01.2009

The players will have to report in the proper playing kit. **Sh. Vishwajeet (9899183401) will be In-charge of the game.**

For detailed instructions refer circular no. DE.41(431)/Sports/2025-26/3039-46 dated 15.09.2025 issued by Sports Branch.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

No. DE 41(431)/ Sports/ 2025-26/ 4695-4701 Dated: 24/10/25

Copy to: -

1. All Regional Directors, DoE, Delhi / New Delhi.
2. All District DDEs, Dte. of Education, Delhi / New Delhi.
3. PS to Secy.(Education), Old Sectt, Delhi-110054.
4. PPS to Director(Education), DoE, Old Sectt, Delhi.
5. PA to Addl. Director (Sports), DoE, Old Sectt, Delhi.
6. All Zonal DDEs/SPEs/Convenors/Secretaries, Dte of Education, Delhi/New Delhi
7. OS (IT) with the request to place the circular on Edudel.

S. O. (SPORTS)
DIRECTORATE OF EDUCATION

Zone: _____

Annexure

INDIVIDUALS EVENTS

ENTRY FORM FOR DELHI STATE SCHOOL GAMES 2025-26

UNDER -11/14/17/19 (Boys & Girls)

Game/Event _____

Name of the School, School Id with Complete Address: _____

Name of Student _____

Student ID _____

DOB _____

Adhaar Card No. _____

Father's Name _____

School Admission No. _____

Class in which studying _____

FIDE Rating (if Applicable) _____

Weight category (if Applicable) _____

Contact No. _____

Attested P
By H.O

(Signature of Student)

I hereby certify that I have personally checked the details of the above-mentioned student as per school record and is true to best of my knowledge. In case of furnishing false information, action as per rules may be initiated against the defaulter.

(Head of School)
Name, Seal & Mob. No.

Game In-charge
Name, Seal & Mob No.

Convener/SPE
Name, Seal & Mob. No

Annexure-13

GOVERNMENT OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI-110009

No. DE.41/Sports/68th NSG/Circulars/Pt File/2024/4305-10 Dated: 27.12.24.

CIRCULAR

Subject: Coaching Camp for 68th National School Games 2024-25 for Basketball U-17y Girls, from 30 December 2024 to 12 January 2025 at Basketball Indoor Stadium, Anandwas (Lok Vihar), Pitampura, New Delhi.

The Sports Branch, Directorate of Education, Govt. of NCT Delhi is going to conduct coaching camp for Basketball U- 17y Girls, from 30 December 2024 to 12 January 2025 at Basketball Indoor Stadium, Anandwas (Lok Vihar), Pitampura, New Delhi.

The following school students who got selected directly from Delhi State School Games have been selected to attend the coaching camp and are directed to report Basketball Indoor Stadium, Anandwas (Lok Vihar), Pitampura, New Delhi at 08:00 am every day for camp. The list of selected players is attached with this circular.

The selected student/player will represent Delhi in 68th National School Games 2024-25 in Basketball (U-17years) Girls category to be held at Chennai, Tamil Nadu w.e.f. 15 to 19 January 2025 under the aegis of SGFI.

In this regard reference is invited towards the invitation letter dated 06.11.2024 issued from the office of the President SGFI.

For further enquiry, and redressal of grievances please contact the in-charge of the game Sh. B.S. Hooda, Coach (9868033677), Sh. Naveen Hooda, coach (9873997548).

Yogesh Kumar
Section Officer (Sports)

No. DE.41/Sports/68th NSG/Circulars/Pt File/2024/4305-10 Dated: 27.12.24.

Copy forwarded to for information of necessary action: -

1. PS to Secretary (Education), Govt. of NCT of Delhi.
2. PS to Director (Education), Govt. of NCT of Delhi.
3. All DDEs (District/ Zone), DoE Govt. of NCT of Delhi.
4. All HOSs, DoE, Govt. of NCT of Delhi.
5. Concerned person(s) mentioned in the circular.
6. OS (IT) with the request to place the circular on website.

Yogesh Kumar
Section Officer (Sports)

Short Listed Players for N.S.G. U-17 (Girls) 2024-25

Sr No.	NAME	ZONE No.	CONT. No.
1.	Shradha Sharma	11	9818554411
2.	Rhythm Chawla	11	〃
3.	Parnika Sharma	11	〃
4.	Niyati Dahiya	21	9210483777
5.	Sheryl Pradhan	21	〃
6.	Khushi Kumari	07	8388964189
7.	Zainab	07	9319388095
8.	Rudranshi Mann	13	9582508639
9.	Diksha Yadav	21	9210483777
10.	Aarna Gulati	13	9582508639
11.	Rushti Gupta	15	8076075507
12.	Saranya	18	9650369324
13.	Tvisha Dahiya	11	9818554411
14.	Sambhavi Rai	23	9891108914
15.	Deeksha Rawat	23	9891108914
16.	Shinjini Mann	26	9999770427
17.	Hera	12	8882223199
18.	Soni	12	8882223199
19.	Ayengein	18	9650369324
20.	Bhavya	18	〃
21.	Aashi	18	〃
22.	Alisha Luthra	18	〃
23.	Twisha Gupta	13	9582508639
24.	Sara	20	9810971427
25.	Ananya Hooda	17	9811377647

Sonu (SONU K.R.)

Gaurav (GOURAV MALIK)

Hooda
Navinder

(N.S. Hooda)

Annexure-14

GOVERNMENT OF NATIONAL CAPITAL TERRITORY OF DELHI
DIRECTORATE OF EDUCATION: SPORTS BRANCH
CHHATRASAL STADIUM: MODEL TOWN: DELHI-110009

No. DE.41/Sports/69th NSG/Circulars/2025/4589-94 Dated: 22/10/25

CIRCULAR

Subject: Coaching Camp for 69thNational School Games 2025-26 for Volleyball U-19y Boys and Girls from 25 October to 09 November 2025 and U-17y from 31 October to 09 November 2025 at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi.

The Sports Branch, Directorate of Education, Govt. of NCT Delhi is going to conduct coaching camp for Volleyball U-19y Boys and Girls from 25 October to 09 November 2025 and U-17y Boys and Girls from 31 October to 09 November 2025 at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi.

The school students of the U-19y, who have been directly selected from the Delhi State School Games, are invited to participate in the coaching camp. Additionally, U-17y students will be selected trough the Delhi State School Games. All Selected students are directed to report at Volleyball Complex, GBSSS, SU Block Pitampura, New Delhi at 02:00 pm every day for camp. The list of U-19y B & G selected players is attached with this circular.

The selected student/player will represent Delhi in 69th National School Games 2025-26 in Volleyball (U-17y) Boys and Girls category to be held at Bareilly Uttar Pradesh w.e.f. 11 to 15 November, 2025 and Volleyball (U-19y Boys & Girls) to be held at Narsinghpur (Madhya Pradesh) from 13 to 17 November, under the aegis of SGFI.

In this regard reference is invited towards the invitation letter dated 08.11.2025 & 25.09.2025 issued from the office of the President SGFI.

For further enquiry, and redressal of grievances please contact the in-charge of the game Sh. Vijay Chaudhary (In charge) (9555362436).

S.Sunil
DEPUTY DIRECTOR OF EDUCATION
(SPORTS)

No. DE.41/Sports/69th NSG/Circulars/2025/4589-94 Dated: 22/10/25

Copy forwarded to for information of necessary action: -

1. PS to Secretary (Education), Govt. of NCT of Delhi.
2. PS to Director (Education), Govt. of NCT of Delhi.
3. All DDEs (District/ Zone), DoE Govt. of NCT of Delhi.
4. All HOSs, DoE, Govt. of NCT of Delhi.
5. Concerned person(s) mentioned in the circular.
6. OS (IT) with the request to place the circular on website.

S.Sunil
DEPUTY DIRECTOR OF EDUCATION
(SPORTS)

COMMISSION FOR AIR QUALITY MANAGEMENT IN NATIONAL CAPITAL REGION AND ADJOINING AREAS

GRADED RESPONSE ACTION PLAN (GRAP) FOR THE NATIONAL CAPITAL REGION (NCR)

(Revision: 13.12.2024)

1. The GRAP for the entire NCR has been classified under 4 different stages of adverse air quality in Delhi viz. Stage – I 'Poor' (AQI 201 – 300), Stage – II 'Very Poor (AQI 301-400), Stage – III 'Severe' (AQI 401-450) and Stage – IV 'Severe +' (AQI >450) respectively.

2. Based on the dynamic model and weather/ meteorological forecast by IMD / IITM on a day-to-day basis, actions under Stages I, II, III and IV of the GRAP shall be invoked in advance of the AQI of Delhi reaching to the projected levels of that stage, also provided that the higher projected AQI levels are likely to sustain for longer period.

3. Even if the AQI forecasts do not indicate the AQI of Delhi to be breaching a particular threshold and under extreme meteorological conditions or due to any episodic event the AQI breaches the threshold, that particular stage of the GRAP shall be invoked with immediate effect in respect of actions / measures that can be invoked immediately.

4. Restrictive actions undertaken as per previous stages shall be continued, in addition to the air pollution stage under which the restrictive actions are envisaged to be taken. For example, restrictive actions under the Stage III category, whenever invoked, shall be in addition to those under Stage I and II respectively and so on and so forth.

5. The Sub-Committee on GRAP constituted by the Commission shall meet frequently to plan for advance action and issue necessary orders for invoking various provisions of the GRAP, based on the prevalent air quality and the AQI forecast to be provided by IMD from time to time. The Sub-Committee shall also review the actions taken by various agencies responsible towards effective implementation of the GRAP.

6. The Chief Secretaries of NCR States and GNCTD shall frequently review the actions and implementation of the GRAP especially when the air quality falls or is likely to fall in the 'Severe' or 'Severe +' category (Stage III and beyond).

7. The Commission may decide upon any exceptions and additional measures to the schedule of the GRAP, under different air pollution categories i.e., Stages I to IV, as per the prevalent AQI and weather forecast.

Schedule under the GRAP for NCR

Stage I – 'Poor' Air Quality (DELHI AQI ranging between 201-300)	
Actions	**Agencies responsible / Implementing Agencies**
1. Ensure proper implementation of Directions/ Rules/ guidelines on dust mitigation measures in Construction and Demolition (C&D) activities and sound environmental management of C&D waste. 2. Ensure strict compliance of Direction Nos. 11-18 dated 11.06.2021 and do not permit C&D activities in respect of such projects with plot size equal to or more than 500 sqm which are not registered on the 'web portal' of the respective state / GNCTD and / or which do not fulfil the other requirements as per the above noted statutory directions, for remote monitoring of dust mitigation measures.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - Construction agencies and plot owners (both public & private).
3. Ensure regular lifting of Municipal Solid Waste (MSW), Construction & Demolition (C&D) waste, and Hazardous wastes from dedicated dump sites and ensure that no waste is dumped illegally in open land areas.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies - Construction agencies (both public & private).
4. Carry out periodic mechanized sweeping and water sprinkling on roads and ensure scientific disposal of the dust collected in designated sites/landfills.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - Chief Executives of all road owning and maintaining agencies.

5. Ensure that C&D materials & waste are properly stored/ contained, duly covered in the premises. Ensure transportation of C&D materials and C&D waste only through covered vehicles. 6. Strictly enforce the statutory directions and yardsticks for use of anti-smog guns at C&D sites, in proportion to the total built-up area of the project under construction. 7. Intensify use of anti-smog guns, water sprinkling and dust suppression measures in road construction / widening / repair projects and maintenance activities.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All construction agencies and plot owners (both public & private). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All construction agencies and plot owners (both public & private). - All road owning / maintenance agencies in NCR.
8. Stringently enforce prohibition on open burning of bio-mass and municipal solid waste. Impose maximum EC upon violations in accordance with Hon'ble NGT's orders dated 04.12.2014 and 28.04.2015 in OA 21/2014. 9. Strict vigil to ensure that there are no burning incidents in the landfill sites / dumpsites.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies.
10. Deploy traffic police for smooth traffic flow at all identified corridors with heavy traffic and congestion prone intersections.	- Commissioner or Head of Traffic Police in Delhi and NCR towns.
11. Strict vigilance and enforcement of PUC norms for vehicles. 12. No tolerance for visible emissions – Stop visibly polluting vehicles by impounding and / or levying maximum penalty.	- Commissioner or Head of Transport Department of Delhi and NCR States - Commissioner or Head of Traffic Police of Delhi and NCR towns.
13. Strictly enforce the Hon'ble Supreme Court order on diversion of non- destined truck traffic for Delhi, through Eastern and Western Peripheral Expressways.	- Head of Traffic Police of NCT of Delhi and NCR towns. - DMs /Dy Commissioners of NCT of Delhi / NCR towns - Municipal Commissioner of Corporations of NCT of Delhi and NCR towns.

14. Strictly enforce NGT / Hon'ble SC's order on overaged diesel / petrol vehicles and as per extant statutes.	- Commissioner or Head of Transport Department of Delhi and NCR States - Commissioner or Head of Traffic Police of Delhi and NCR towns.
15. Ensure strict penal/ legal action against non-compliant and illegal industrial units. 16. Stringently enforce all pollution control regulations in Industries, brick kilns and hot mix plants etc. - strict compliance of the prescribed standards of emissions. 17. Ensure that only approved fuels are used by the industries in NCR including in brick kilns and hot mix plants and enforce closure in case of violations, if any.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - District Magistrates / Deputy Commissioners of NCT of Delhi / NCR Towns - Commissioners of Urban Local Bodies in Delhi and NCR towns.
18. Stringently enforce emission norms in thermal power plants and strict actions be taken against non-compliance.	- Plant in- charge of Power Plants located within 300 km radius of Delhi. - Chairpersons – CPCB, DPCC, SPCBs (NCR).
19. Strictly enforce Hon'ble Courts / Tribunal orders regarding ban on firecrackers.	- Commissioner of Police of Delhi & IG / DIG / SP of NCR towns or Officer In charge of Licensing. - DMs/ DCs of respective districts in NCR. - Chief controller of Explosives, Petroleum and Explosive Safety Organizations (PESO).
20. Ensure regular lifting and proper disposal of industrial waste from industrial and non-development areas.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners/ Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies. - District Magistrate / Deputy Commissioners in NCR.
21. DISCOMs to minimise power supply interruptions in NCR.	- Head of Power distribution companies in NCR.
22. Ensure that diesel generator sets are not used as regular source of power supply.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - DMs/ DCs of respective districts of NCR.

23. Strictly enforce the extant ban on coal / firewood as fuel in Tandoors in Hotels, Restaurants and open eateries. 24. Ensure hotels, restaurants and open eateries use only electricity / gas-based / clean fuel - based appliances.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns. - Chairpersons – CPCB, DPCC, SPCBs (NCR).
25. Information dissemination including through social media and bulk SMS etc. Mobile Apps to be used to inform people about the pollution levels, contact details of control room, enable them to report polluting activities / sources to the concerned authorities and inform them about actions that would be taken by Government.	- ACS/ Pr. Secretary/ Secretary, Dept. of Environment, GNCTD and NCR States. - Chairpersons – CPCB, DPCC, SPCBs (NCR).
26. Ensure quick actions for redressal of complaints on 311 APP, Green Delhi App, SAMEER App and other such social media platforms to curb polluting activities.	- Head of Urban Local Bodies in NCR towns. - Chairpersons – CPCB, DPCC, SPCBs (NCR). - Construction agencies, land owning agencies, Development agencies and all other concerned implementing agencies.
27. Encourage offices to start unified commute for employees to reduce traffic on road.	- State Governments in NCR and GNCTD.

CITIZEN CHARTER	• Keep engines of your vehicles properly tuned. • Maintain proper tyre pressure in vehicles. • Keep PUC certificates of your vehicles up to date. • Do not idle your vehicle, also turn off the engine at red lights. • Prefer hybrid vehicles or EVs to control vehicular pollution. • Do not litter / dispose wastes, garbage in open spaces. • Report air polluting activities through 311 App, Green Delhi App, SAMEER App etc. • Plant more trees. • Celebrate festivals in an eco-friendly manner – avoid firecrackers. • Do not drive/ply end of life/ 10/15 years old Diesel/Petrol vehicles.

Stage II – 'Very Poor' Air Quality (DELHI AQI ranging between 301-400)	
Actions	**Agencies responsible / Implementing Agencies**
1. Carry out mechanical/ vacuum sweeping and water sprinkling of the identified roads on a daily basis. Enhance the number of shifts / hours of deployment of such machines to further intensify mechanised sweeping. 2. Ensure daily water sprinkling along with dust suppressants, preferably before peak traffic hours, on roads and right of ways especially at hotspots, heavy traffic corridors and ensure proper disposal of the collected dust in designated sites/ landfills.	– Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns – Chief Executives of all road owning and maintaining agencies. – Commissioner of Traffic Police of Delhi & NCR towns to identify roads with heavy traffic and provide information to respective Municipal Commissioners / Head of Municipal Bodies.
3. Intensify inspections for strict enforcement of dust control measures at C&D sites.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.
4. Ensure focussed and targeted action for abatement of air pollution in all identified hotspots in NCR. Intensify remedial measures for the predominant sector(s) contributing to adverse air quality in each of such hotspots.	- State Govts. in NCR and GNCTD. - Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.
5. Ensure uninterrupted power supply to discourage use of alternate power Generating sets/ equipment (DG sets etc.).	- Additional Chief Secretary / Principal Secretary (Power), NCR State Governments / GNCTD - Head of Power Distribution Companies of Delhi and NCR Districts.

6. **Strictly implement the following Schedule for regulated operations of DG sets across all sectors in the NCR including Industrial, Commercial, Residential etc. in accordance with Direction No. 76 dated 29.09.2023.**

Capacity Range of DG sets	System to be adopted for control of emissions	Regulations for use
Power generating sets of all capacities running on LPG/ Natural Gas/ Bio-gas/Propane/Butane	None	No restrictions
Power generating sets up to 800 kW (1000 kVA) capacity to standards as per MoEFCC notification No. GSR 804 (E) dated 03.11.2022	None	No restrictions.
DG sets to older specifications / standards		
800 kW (1000 kVA) and above	Any emission control system/mechanism, however subject to compliance of the prescribed emission standards in Direction no. 76	No restrictions
41 kW (51 kVA) to less than 800 kW (1000 kVA)	Dual fuel mode **OR** Retro-fitted ECDs through certified agencies	No restrictions
19 kW (23 kVA) to less than 41 kW (51 kVA)	Dual fuel mode	No restrictions **Note:** DG Sets not working in a dual fuel mode, only owing to non-availability of gas infrastructure and supply, shall be permitted only for prescribed emergency services. *
Portable DG sets below 19kW (23 kVA)	Presently no specific means of emission control are available in this category / capacity range of DG sets.	Not to be generally permitted. Permitted only for the prescribed emergency services. *

- Chairpersons – CPCB, DPCC, SPCBs (NCR).
- Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.
- District Magistrates / Deputy Commissioners of NCR States and GNCTD.

***** Emergency services: (i) Only for operating elevators / Escalators / travelators (ii) Medical Services (Hospital / Nursing Home/ Health care facilities). (iii) Railway Services / Railway Stations. (iv) Metro Rail Corporation & MRTS Services. (v) Airports and Inter-State Bus Terminals. (vi) Sewage Treatment Plants. (vii) Water pumping Stations. (viii) Projects related to national security, defence & of national importance. (ix) Telecommunications and IT/ data services.	
7. Synchronize traffic movements and deploy adequate personnel at intersections / traffic congestion points for smooth flow of traffic.	- Commissioner or Officer in charge - Traffic Police of Delhi and NCR towns.
8. Alert in newspapers / TV / radio to advise people about air pollution levels and Do's and Don'ts for minimizing polluting activities.	- Chairpersons – CPCB, DPCC, SPCBs (NCR).
9. Enhance vehicle parking fees to discourage private transport.	- Chief Secretary and Principal Secretary, Urban Local Bodies of NCR States and GNCTD. - Commissioners of Urban Local Bodies in Delhi and NCR towns.
10. Augment public transport services through CNG/ electric buses and metro services by inducting additional fleet and increasing the frequency of service. Introduce differential rates to encourage off – peak travel.	- NCR State Governments. - Principal Secretary, Department of Transport. of NCT of Delhi and NCR State Govts. - Delhi Transport Corporation (DTC). - State Transport Corporation in NCR towns. - Delhi Integrated Multi – Model Transit System Ltd. (DIMTS). - Delhi Metro Rail Corporation (DMRC).
11. Resident Welfare Associations to necessarily provide electric heaters to staff engaged in security, sanitation, horticulture and other miscellaneous services to avoid	- Resident Welfare Associations.

open Bio-Mass/ MSW burning during winters.	
12. Do not permit inter-state buses from NCR states, other than EVs / CNG / BS-VI Diesel, to enter Delhi (excluding buses / Tempo Travellers operated with All India Tourist Permit).	- Commissioners or head of Transport Department in GNCTD/ NCR States - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
CITIZEN CHARTER	• People to use public transport and minimize use of personal vehicles. • Use technology, take less congested route even if slightly longer. • Regularly replace air filters at recommended intervals in your automobiles. • Avoid dust generating construction activities during months of October to January. • Avoid open burning of solid waste and bio-mass.

Stage III – 'Severe' Air Quality (DELHI AQI ranging between 401-450)	
Actions	**Agencies responsible / Implementing Agencies**
1. **Construction & Demolition activities:** (i) Enforce strict restrictions on the following categories of dust generating/ air pollution causing C&D activities in the entire NCR: • Earthwork for excavation and filling including boring & drilling works. • Piling works. • All demolition works. • Laying of sewer line, water line, drainage and electric cabling etc. by open trench system. • Brick / masonry works. • Operation of RMC batching plant. • Major welding and gas-cutting operations. *Minor welding activities for MEP works (Mechanical, Electrical and Plumbing) to be, however, permitted*. • Painting, polishing and varnishing works etc. • Cement, Plaster / other coatings, except for minor indoor repairs/maintenance. • Cutting / grinding and fixing of tiles, stones and other flooring materials, except for minor indoor repairs/maintenance. • Road construction activities and major repairs. • Transfer, loading / unloading of dust generating materials like cement, fly-ash, bricks, sand, murram, pebbles, crushed stone etc. anywhere within / outside the project sites. • Movement of vehicles carrying construction materials on unpaved roads. • Any transportation of demolition waste.	- NCR State Governments and GNCTD - Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.

(ii) All construction related activities, **other than those listed under 1(i) above**, which are relatively less polluting / less dust generating shall be permitted to be continued in the NCR, subject to strict compliance of the C&D Waste Management Rules, dust prevention/ control norms including compliance with the directions of the Commission issued from time to time. (iii) All C&D related activities, including those under 1(i) above, shall be continued to be permitted only for the following categories of projects, however subject to strict compliance of the C&D Waste Management Rules, dust prevention/ control norms including compliance with the directions of the Commission issued from time to time: (a) Projects for Railway services and stations (b) Projects for Metro Rail Services and stations (c) Airports and Inter State Bus Terminals (d) National security/ defence related activities/ projects of national importance; (e) Hospitals/ health care facilities (f) Linear public projects such as highways, roads, flyovers, over bridges, power transmission/ distribution, pipelines, tele-communication services etc. (g) Sanitation projects like sewage treatment plants and water supply projects etc. (h) Ancillary activities, specific to and supplementing the above project categories.	
2. Close down operations of stone crushers in the entire NCR.	- Chairpersons – CPCB, DPCC, SPCBs (NCR) - Commissioner of Police - Delhi and DG of Police of NCR States - District Magistrates / Deputy Commissioners of respective districts in Delhi and NCR States.

3. Close down all mining and associated activities in the entire NCR.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - District Magistrates / Deputy Commissioners of respective districts in NCR. - Commissioner of Police - Delhi and IG / DIG / SP of NCR towns.
4. NCR State Govts. / GNCTD to impose strict restrictions on plying of BS III petrol and BS IV diesel LMVs (4 wheelers) in Delhi and in the districts of Gurugram, Faridabad, Ghaziabad and Gautam Budh Nagar. **Note:** Persons with Disabilities shall be permitted to ply BS – III Petrol / BS – IV Diesel LMVs, provided that these are specifically adopted for them and are run only for their personal use.	- State Governments in NCR and GNCTD. - Commissioner or Head of Transport Department - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
5. GNCTD to impose strict restrictions on plying of Delhi - registered Diesel operated Medium Goods Vehicles (MGVs) to BS-IV standards or below, in Delhi, except those vehicles carrying essential commodities / providing essential services.	- State Governments in NCR and GNCTD. - Commissioner or Head of Transport Department - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
6. GNCTD to not permit BS-IV and below diesel operated LCVs (goods carriers), registered outside Delhi, to enter Delhi, except those carrying essential commodities / providing essential services.	- State Governments - Transport Commissioners, GNCTD/ NCR States - Commissioners / Head of Urban Local Bodies in Delhi-NCR towns. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
7. (i) State Govts. in the NCR and the GNCTD to mandatorily conduct classes in schools for children up to class V in a “Hybrid” mode i.e., both in physical and online mode (wherever online mode is feasible) in the territorial jurisdiction of the NCT of Delhi and in the districts of Gurugram,	- State Governments of NCR & GNCTD.

Faridabad, Ghaziabad and Gautam Buddh Nagar. (ii) The NCR State Governments may also consider conducting classes for students up to Class V in a "Hybrid" mode as above in other areas in NCR. **Note:** The option to exercise the online mode of education, wherever available, shall vest with the students and their guardians.	
8. (i) GNCTD and NCR State Governments to stagger timings for public offices and municipal bodies in the National Capital Territory of Delhi and the districts of Gurugram, Faridabad, Ghaziabad and Gautam Buddh Nagar. (ii) State Governments may take a decision to stagger timings for public offices and municipal bodies in other areas of NCR.	- NCR State Governments and Central Government
9. Central Government may take a decision on staggering of timings of Central Government offices in Delhi – NCR.	- Central Government
CITIZEN CHARTER	• Walk or use cycles for small distances. • Choose a cleaner commute. Share a ride to work or use public transport. • People, whose positions allow working from home, may work from home. • Do not use coal and wood for heating purpose. • Individual house owners may also provide electric heaters to security / other staff employed by them to avoid open burning of bio-mass / wood / MSW. • Combine errands and reduce trips.

Stage IV – 'Severe +' Air Quality (DELHI AQI > 450)	
Actions	**Agencies responsible / Implementing Agencies**
1. Stop entry of truck traffic into Delhi (except for trucks carrying essential commodities/ providing essential services. All LNG/ CNG / Electric/ BS-VI Diesel trucks) shall however be permitted to enter Delhi.	- State Governments - Transport Commissioners, GNCTD/ NCR States - Commissioners / Head of Urban Local Bodies in Delhi-NCR towns. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
2. Enforce strict ban on plying of Delhi - registered diesel operated BS-IV and below Heavy Goods Vehicles (HGVs) in Delhi, except those carrying essential commodities / providing essential services.	- State Governments of NCR & GNCTD - Transport Commissioners, GNCTD/ NCR States. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
3. Ban C&D activities, as in the GRAP Stage- III, also for linear public projects such as highways, roads, flyovers, overbridges, power transmission, pipelines, tele-communication etc.	- Chairpersons – CPCB, DPCC, SPCBs - Commissioners / Chief Engineers of Urban Local Bodies in Delhi - NCR towns. - Nodal officers of road owning agencies (dust control and management cells).
4. (i) State Govts. in the NCR and the GNCTD to mandatorily conduct classes in schools for children even for higher classes i.e. from class VI to IX and XI in a "Hybrid" mode i.e., both in physical and online mode (wherever online mode is feasible) in the territorial jurisdiction of the NCT of Delhi and in the districts of Gurugram, Faridabad, Ghaziabad and Gautam Buddh Nagar.	- State Governments of NCR & GNCTD.

(ii) The NCR State Governments may also consider conducting classes for students as above in a "Hybrid" mode in other areas in NCR. **Note:** The option to exercise the online mode of education, wherever available, shall vest with the students and their guardians.	
5. NCR State Governments / GNCTD to take a decision on allowing public, municipal and private offices to work on 50% strength and the rest to work from home.	- State Governments of NCR & GNCTD.
6. Central Government may take appropriate decision on permitting work from home for employees in central government offices.	- Central Government (DoPT).
7. State Governments may consider additional emergency measures like closure of colleges/ educational institutions and closure of non-emergency commercial activities, permitting running of vehicles on odd-even basis of registration numbers etc.	- State Governments of NCR & GNCTD.
CITIZEN CHARTER	• Children, elderly and those with respiratory, cardiovascular, cerebrovascular or other chronic diseases to avoid outdoor activities and stay indoors, as much as possible. If required to move outdoors, they are advised to wear mask.

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सत्यमेव जयते

राष्ट्रीय राजधानी क्षेत्र और निकटवर्ती क्षेत्र
वायु गुणवत्ता प्रबंधन आयोग
Commission for Air Quality Management ir
National Capital Region and
Adjoining Areas

CAQM

No.120017/27/GRAP/2021/CAQM-1445-DT 11th November, 2025

Clarification/ Modification to invocation order for Stage-III of GRAP

Sub.: Clarification to Order dated 11.11.2025 for invocation of actions under Stage III of extant schedule of GRAP (13.12.2024)

In continuation to invocation order for Stage-III of GRAP vide even no. 1444-DT dated 11.11.2025, it is clarified that:-

2. Direction No. 88 dated 03.06.2025 as amended on 17.10.2025 allows all BS-IV commercial goods vehicle to enter Delhi for a limited period up to 31.10.2026 and restricts entry of all BS-III and below commercial good vehicle (registered outside Delhi) into Delhi w.e.f. 01.11.2025.

3. As GRAP is an emergency measure, it shall prevail as far as restrictions on entry of BS-IV diesel operated LCVs (goods carriers) are concerned. Therefore, Action Point No. 6 of Stage-III of GRAP schedule is modified and may be read as under:-

"GNCTD to not permit BS-IV diesel operated LCVs (goods carriers), registered outside Delhi, to enter Delhi, except those carrying essential commodities / providing essential services"

4. It is further clarified that in terms of Direction No. 88, as amended, all BS-III and below diesel operated LCVs (goods carriers), registered outside Delhi, are already not permitted to enter Delhi, even if they are carrying essential commodities / providing essential services.

11/11/25

(R.K. Agrawal)
Director (Technical)
(Member Convenor of Sub-Committee on GRAP)

To: All Concerned

सत्यमेव जयते

राष्ट्रीय राजधानी क्षेत्र और निकटवर्ती क्षेत्र
वायु गुणवत्ता प्रबंधन आयोग
Commission for Air Quality Management in
National Capital Region and
Adjoining Areas

CAQM

No.120017/27/GRAP/2021/CAQM-1444-DT 11th November, 2025

ORDER

Sub.: Invocation of actions under Stage III ('Severe' Air Quality) of extant schedule of GRAP (December, 2024) – steps to be taken

The Commission for Air Quality Management in NCR and adjoining areas, in pursuance of the Hon'ble Supreme Court directions, issued a comprehensively revised the schedule of GRAP vide its order dated 13.12.2024 for implementation with immediate effect by all concerned (available on CAQM website i.e., caqm.nic.in).

2. As of now, Stage- I & II of extant schedule of GRAP are in force vide order dated 14.10.2025 & 19.10.2025.

3. Noting a sharp increase in AQI levels of Delhi, the Sub-Committee on GRAP in its urgent meeting held today, reviewed the air quality scenario in the region as well as the IMD/IITM forecasts and observed as under:

The AQI of Delhi which was recorded as 362 for 10.11.2025 ('Very Poor' Category), exhibited a sharp increasing trend and has been recorded 425 ('Severe' Category) at 9:00 AM on 11.11.2025 owing to calm winds, stable atmosphere and unfavourable meteorological conditions.

4. Accordingly, in an effort to prevent further deterioration of the air quality, the Sub Committee on GRAP hereby decide to **invoke all actions under Stage-III ('Severe' Air Quality of Delhi)** of extant schedule of GRAP, with immediate effect in right earnest by all the agencies concerned in Delhi-NCR, in addition to the Stage-I and II actions already in force.

5. Actions under Stage-I, II & III of the revised GRAP shall be implemented, monitored and reviewed by all the agencies concerned in the entire NCR to ensure that the AQI levels do not slip further. All implementing agencies shall keep strict vigil and intensify measures of the extant schedule of GRAP. Citizens are requested to strictly adhere to the citizen charter under GRAP Stage-III.

6. The Sub-Committee, shall be keeping a close watch on the air quality scenario and review the situation from time to time for further appropriate decision depending upon the Air Quality in Delhi and forecast made by IMD/IITM.

11/11/25

(R.K. Agrawal)
Director (Technical)
(Member Convenor of Sub-Committee on GRAP)

To:

1. The Chief Secretary, Government of Uttar Pradesh, 101, Lok Bhawan, U. P. Civil Secretariat, Vidhan Sabha Marg, Lucknow – 226 001.
2. The Chief Secretary, Government of Rajasthan, Government Secretariat, Jaipur, Rajasthan – 302 005.
3. The Chief Secretary, Government of Haryana, 4th Floor, Civil Secretariat, Sector – 1, Chandigarh.
4. The Chief Secretary, Government of NCT of Delhi, 3rd Floor, Delhi Secretariat, I. P. Estate, New Delhi – 110 002.
5. Additional Chief Secretary/Principal Secretary, Department of Environment, Uttar Pradesh.
6. Additional Chief Secretary, Department of Environment, Room No. 335, 3rd Floor, Haryana New Secretariat, Sector 17, Chandigarh.
7. Additional Chief Secretary / Principal Secretary, Department of Environment, Government of NCT of Delhi, Room No. 801, 8th Floor, B Wing, Delhi Secretariat, Delhi - 110002.
8. Principal Secretary, Department of Environment, Room No. 4224, 2nd Floor, Main Building, Government of Rajasthan Sectt. Jaipur.
9. Principal Secretary, Department of Transport, Government of Uttar Pradesh, Room No. 701, Bapu Bhawan, Hazratganj, Lucknow, Uttar Pradesh
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4. The Additional Chief Secretary, Health Department, Govt. of Haryana
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6. The Principal Secretary, Medical Health & Family Welfare, Govt. of Uttar Pradesh
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7. The Chairperson and all Members (including Associate Members), CAQM

(R.K. Agrawal)
Director (Technical)
(Member Convenor of Sub-Committee on GRAP)

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Annexure-17

Delhi chokes as air quality plummets to ‘hazardous’ levels; AQI touches almost 600

The air quality deterioration coincides with a sharp rise in stubble burning across neighbouring states. 351 instances of stubble burning were recorded in Punjab on the Thursday— the second-highest daily count this pre-winter season, taking the AQI to "very poor" category.

By: Express Web Desk
New Delhi | Updated: November 7, 2025 07:53 AM IST
3 min read

As Trusted Source on



A building in Noida barely visible under a thick blanket of smog on Friday morning (Express Photo/ Abhishek Chakraborty)

As cooler days settle over the national capital, Delhi’s air quality has once again plunged to alarming levels. On Friday, the AQI in Delhi was recorded at 591, according to private air

quality monitor and forecaster AQI.in. However, the Air Quality Early Warning System (EWS) pegged the AQI much lower, at 310. Visuals show thick smog blanketing the skyline, leaving buildings and roads barely visible from a distance.

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Stubble burning continues

The air quality deterioration coincides with a **sharp rise in stubble burning across neighbouring states**. At least 351 instances of stubble burning were recorded in Punjab on the Thursday— the second-highest daily count this pre-winter season, taking the AQI to "very poor" category. The highest was observed on November 1, when Punjab witnessed 442 such incidents.

Other states also witnessed cases of stubble burning, with 35 incidents in Haryana, 83 in Rajasthan, 354 in Madhya Pradesh, and none in Delhi.

October among the worst in recent years

In October, Delhi recorded an average Air Quality Index (AQI) of 223, the second-worst for October in five years. Nearly two-thirds of the month was spent breathing 'poor' air or worse — 11 days in the 'poor' category, seven in 'very poor,' and none in the 'good' category.

According to AQI.in, breathing air in this location is as harmful as smoking 10.2 cigarettes a day. This estimate is based on the average PM2.5 concentration over the past 24 hours, assuming continuous exposure during that time.

The PM2.5 concentration on Monday was measured at 360 µg/m³, far exceeding the World Health Organization (WHO) limit of 15 µg/m³. The current PM2.5 level in New Delhi is 24 times above the recommended guideline. According to the WHO, "exposure to PM2.5 can cause diseases affecting both the cardiovascular and respiratory systems, including stroke, lung cancer, and chronic obstructive pulmonary disease (COPD)."

Among the most polluted areas were **Ghazipur** (812), **I P Extension** (700), **Maharam Mohalla** (710), **Mayur Vihar Station 1** (802), **New Ashok Nagar** (760), and **South Sainik Farm** (740) — all recording hazardous levels of pollution.

Pollution levels were nearly as bad in neighbouring cities, with **Ghaziabad (629), Noida (663), Greater Noida (634), and Gurugram (523)** also experiencing unhealthy air quality.

Weather and health advisory

The temperature in Delhi on Friday was 19 degrees Celsius with a humidity of 18 per cent.

Experts have advised residents to avoid outdoor exercise or commuting during peak pollution hours, use N95 masks when outside, and run air purifiers indoors to minimise exposure to fine particulate matter.

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Business Standard

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Doctors warn of surge in chest ailments due to air pollution in Delhi-NCR

According to a Chest Surgeon, people have resorted to the usage of Nebulisers, which help patients inhale medicine directly into their lungs

ANI



Several parts of the city registered alarming pollution levels with AQI readings crossing the 400-mark. (Photo: PTI)

Medical specialists have warned residents of Delhi-NCR about a severe health crisis triggered by the high air pollution in the region. Dr Arvind Kumar, Thoracic (Chest) Surgeon & Lung Health Specialist, Medanta Hospital, said that hospitals are seeing a spike in cases related to effect of pollution

The NCR Region faces poor air quality with the Air Quality Index (AQI) recorded at 345 at 8 a.m. on Monday, placing the national capital firmly in the 'very poor' category.

While talking to ANI, Dr Arvind Kumar described how hospitals are overwhelmed with respiratory cases, especially among children, due to air pollution. It includes symptoms like cough, cold, fever and difficulty breathing.

"There are patients all around. Everywhere, children are being brought to hospitals coughing, sneezing, having a runny nose, breathing fast, and having a fever. We have

patients who are coming back with a cough or pneumonia. There is a huge spike in the number of chest cases. It's all the doctors across the city," said Dr Arvind Kumar.

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While addressing the result of growing concerns among the national capital's population due to air pollution, the Chest Surgeon said that people have resorted to the usage of Nebulisers, which help patients inhale medicine directly into their lungs.

"The most common thing being used today is the nebuliser. Many of my friends have bought the machine. It is actually wrong because self-administration of medicine can be harmful. Once you are breathing in air with AQI of 700, there is no way that you can avoid these diseases," said Arvind Kumar.

The Thoracic (Chest) Surgeon & Lung Health Specialist of Medanta Hospital advises people to "stay indoors" and avoid going to "crowded areas" to keep themselves safe from the high air pollution.

"Stay indoors as much as you can. Avoid going to crowded areas. Take medicines regularly. Keep yourself well hydrated. Avoid fatty foods. If you develop redness or itchiness in the eyes, you can put ice-cold water," added Dr Arvind Kumar.

Meanwhile, the air quality in the national capital plunged into the 'severe' category on Sunday, with the overall Air Quality Index (AQI) recorded at 391 at 7 am, according to data from the Central Pollution Control Board (CPCB).

Several parts of the city registered alarming pollution levels with AQI readings crossing the 400-mark.

As per CPCB data, Anand Vihar recorded an AQI of 412, Alipur reported 415, and Bawana registered the highest level at 436.

Chandni Chowk recorded an AQI of 409, while RK Puram and Patparganj logged 422 and 425, respectively. Sonia Vihar also recorded a 'severe' AQI of 415, indicating hazardous air conditions across the city.

Since Diwali, the Air Quality Index (AQI) in Delhi and the National Capital Region (NCR) has been reeling under the 'poor' and 'very poor' categories in several areas, even as Stage 2 of the Graded Response Action Plan (GRAP) remains in effect.

The New Delhi Municipal Council (NDMC) has already announced the doubling of parking fees across the national capital after the Graded Response Action Plan (GRAP) Stage II was invoked due to deteriorating air quality.

According to CPCB, an AQI between 0 and 50 is considered 'good', 51-100 'satisfactory', 101-200 'moderate', 201-300 'poor', 301-400 'very poor', and 401-500 'severe'.

(Only the headline and picture of this report may have been reworked by the Business Standard staff; the rest of the content is auto-generated from a syndicated feed.)

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Delhi AQI spikes sharply to 700+; dust and toxic smog envelop capital

By HT News Desk

Updated on: Nov 07, 2025 11:29 am IST

Air quality in the national capital logged a sharp dip following Diwali last month, coupled with farm fires in the neighbouring states and low wind activity.

Advertisement

Delhi's air quality plunged to "hazardous" levels on Friday morning, with the city recording an overall Air Quality Index (AQI) of 727, according to data from Swiss monitor IQ Air. The national capital has been struggling with worsening air conditions since Diwali, as a combination of post-festival pollution, farm fires in neighbouring states, and low wind activity continues to trap pollutants over the city.

Stubble burning is predicted to be the highest contributor to Delhi's PM2.5 concentration as the air quality is expected to deteriorate to the 'very poor' category, according to the Air Quality Early Warning System.

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Officials, however, have said that a marginal improvement is expected later in the day as wind speeds pick up



Screengrab of AQI reading in IQAir.com

On Thursday, Delhi's air quality plunged into the 'very poor' category with an overall AQI recorded at 4pm as 311, placing Delhi in the 'red zone', according to data from the Central Pollution Control Board (CPCB).

Delhi 4th among most-polluted Indian cities

Delhi ranked fourth among the most polluted cities, while Rohtak topped the list in the ‘very poor’ category with an AQI of 348 out of 254 cities, according to the CPCB.



CPCB's Sameer App.

Stubble burning major contributor

Stubble burning is predicted to be the highest contributor to Delhi's PM2.5 concentration as the air quality is expected to deteriorate to the 'very poor' category from Thursday onwards, according to the Air Quality Early Warning System. The daily mean of local and non-local fractional contribution to PM2.5 in Delhi by the DSS predicted that the contribution of stubble burning to Delhi's PM2.5 is estimated to be 21.5 per cent on Thursday, rising to 36.9 per cent on Friday, and 32.4 per cent on Saturday, up from just 1.2 per cent on Wednesday.

Also read: As Delhi breathes 'poor' air, China offers help to tackle pollution crisis

Satellite data showed that on Wednesday, 94 stubble-burning cases were detected in Punjab, 13 in Haryana, and 74 in Uttar Pradesh, PTI reported.

Thick smog engulfed the national capital with AQI peaking at 700+. (Vipin Kumar (HT Photos))

Transport is expected to be the second-highest contributor, accounting for 16.2 per cent on Thursday, 11.2 per cent on Friday, and 12.3 per cent on Saturday.

barely see the sun

Over 80 protesters holding posters and banners participated in the demonstration organised by Scientists for Society and the Campaign for Right to Public Health.

The protest also saw participation from students, activists, journalists, artists and representatives of organisations such as Naujawan Bharat Sabha and Disha Students' Organisation and others.

(With inputs from PTI)

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Next Story

Doctor warns that people with underlying heart conditions should avoid energy drinks, explains why: 'Raise heart rate...'

By Eshana Saha

Published on: Nov 15, 2025 08:13 pm IST

If you are relying on energy drinks to power through deadlines, you might want to exercise some moderation. Dr Sood explains how they affect the heart.

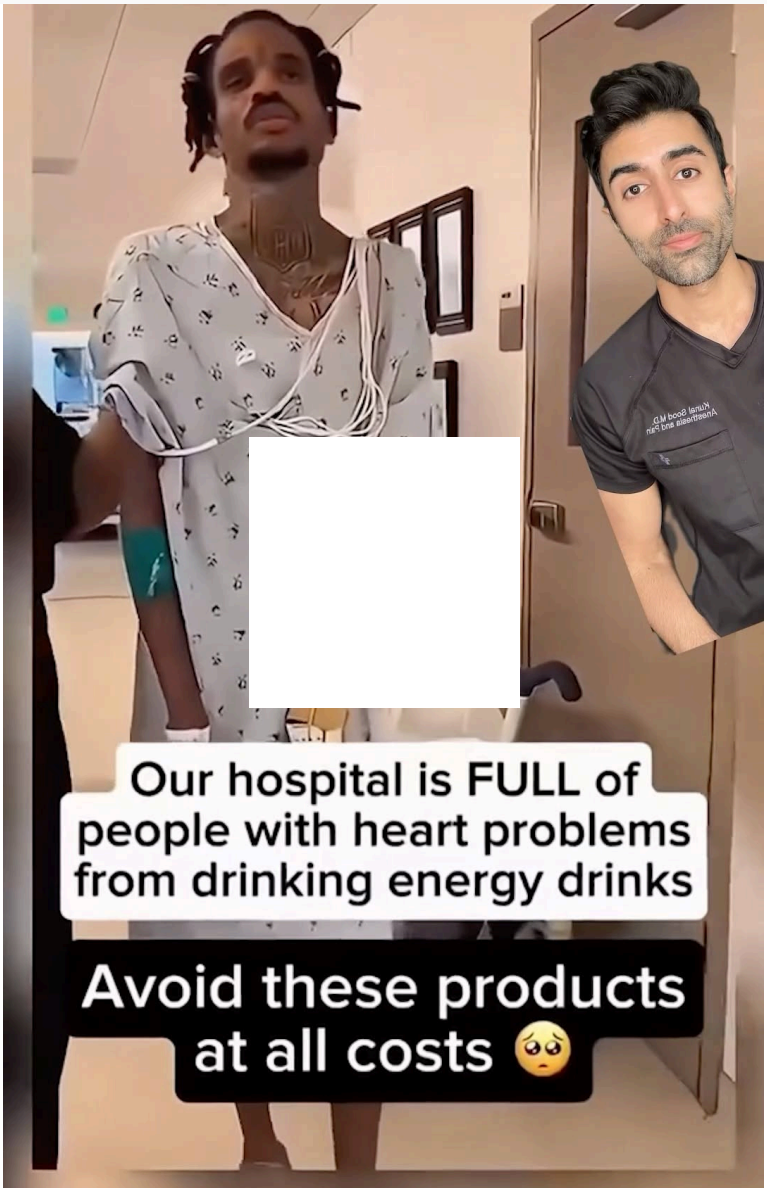
When exhaustion hits and deadlines pile up, it's tempting to crack open yet another energy drink for that instant burst of alertness. But while the boost may feel harmless, it can come at a serious cost - especially if you have an underlying heart condition. The



Dr Sood emphasises that energy drinks strain the heart more than you realise.(Unsplash)

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Dr Kunal Sood, an anesthesiologist and interventional pain medicine physician has revealed why it is best for people with heart conditions to avoid energy drinks. In an Instagram video posted on November 15, the doctor explains how these stimulant-packed beverages impact the heart and, in the worst cases, can even trigger cardiac arrest.



How do energy drinks affect the heart?

Many people reach for energy drinks to get a quick boost from their high caffeine content, but that sudden rush can pose serious risks to the heart in certain individuals. Dr Sood explains, “Drinks like Celsius, Red Bull, and Monster contain high doses of caffeine along with other stimulants such as taurine and guarana. Together, these compounds raise heart rate and blood pressure for hours after you drink them. And in some people, they can disrupt normal heart rhythm.”

Energy drinks can trigger cardiac arrests in worst case scenarios, according to Dr Sood.(Image generated via ChatGPT)

Recommended caffeine limit

Dr Sood highlights, “Experts generally recommend keeping caffeine intake under 400 milligrams per day. That's about four small cups of coffee. They also recommend avoiding energy drinks entirely if you have any heart rhythm issues or sensitivity to stimulants.”

The doctor emphasises that these caffeine-packed energy drinks might help you power through a workout or late nights, but they also burden your heart with more strain than you realise. “Sometimes the best energy comes from hydration, nutrition, and recovery. Not another can,” says Dr Sood.”

Note to readers: This article is for informational purposes only and not a substitute for professional medical advice. It is based on user-generated content from social media. HT.com has not independently verified the claims and does not endorse them.

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BBC News, Delhi



India's AQI (air quality index) readings can be much higher than 500 on private monitors

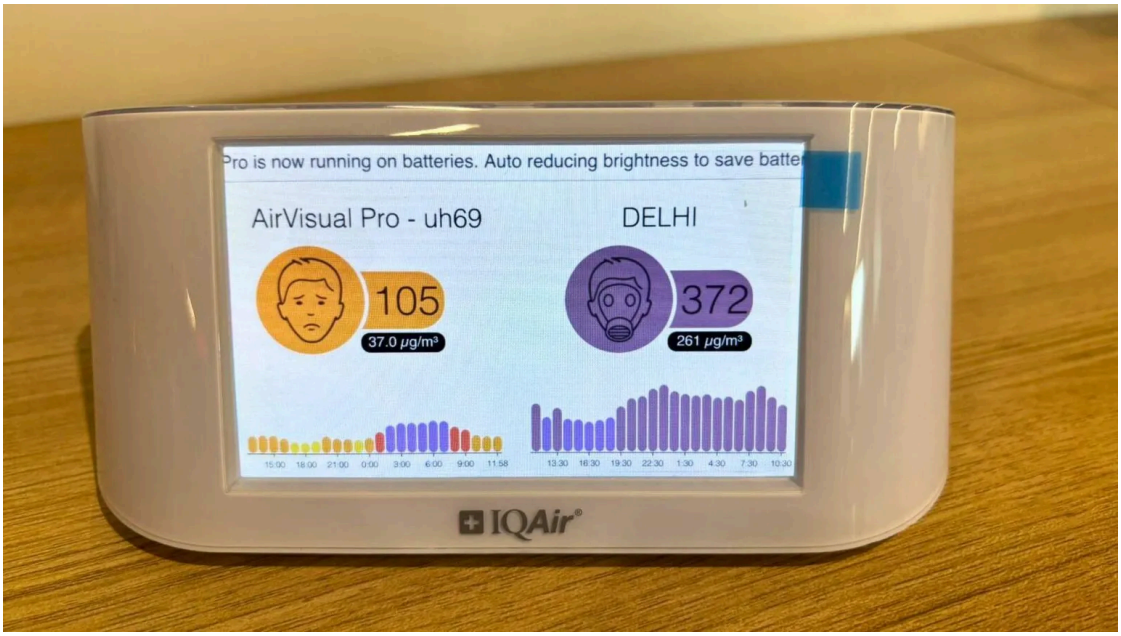
For millions across northern India, the November air tastes ashy, the sky looks visibly hazy and merely stepping outside feels like a challenge.

For many, their morning routine starts with checking how bad the air is. But what they see depends entirely on which monitor they use.

Government-backed apps like SAFAR and SAMEER top out at 500 - the upper limit of India's AQI (air quality index) scale, which converts complex data on various pollutants such as PM2.5, PM10, nitrogen dioxide, sulphur dioxide, carbon monoxide and ozone, into a single number.

But private and international trackers such as IQAir and open-source monitoring platform AQI routinely show far higher numbers, often shooting past 600 and even crossing 1,000 on some days.

This contradiction leaves people asking the same question every year: Which numbers should they trust? And why doesn't India officially report air quality beyond 500?



Comparing India's AQI to WHO or US standards can be misleading, say experts

India's official air-quality scale shows readings above 200 pose clear breathing discomfort to most people on prolonged exposure.

Readings above 400 and up to 500 are classified as "severe" and affect healthy people while also seriously impacting those with existing diseases.

The scale however does not go beyond 500 - a cap set more than a decade ago when the **National Air Quality Index was launched.**

So why was that threshold introduced?

"It was assumed that the health impact would be the same no matter how much higher it goes because we had already hit the worst," says Gufran Beig, founder director of SAFAR.

He admits that the 500 cap was originally set to avoid creating panic as crossing that mark signalled an alarming situation requiring immediate mitigation.

But this approach effectively flattens the data - anything above 500 is treated the same on official monitors, even if the real concentration is far higher.

"International organisations and portals don't impose such a cap," says Mr Beig. "That's why we see numbers going much higher on global platforms."

The BBC has reached out to India's pollution control board for a comment.

Beyond the artificially imposed threshold, there's also a difference in defining hazardous air.

For example, the World Health Organization (WHO) guidelines classify PM2.5 levels - particulate matter smaller than 2.5 micrometers - above 15 micrograms per cubic

metre in a 24-hour period as hazardous, while in India, the threshold is 60 micrograms.

Experts say that globally, there's no universal AQI formula. US, China and the European Union each apply their own pollutant thresholds.

"WHO provides guidelines and every country has built its index based on its own adaptability, weather and local environment," says Mr Beig. Comparing India's AQI to WHO or US standards can thus be misleading.

Then there is also a difference in the instruments used.

The Indian pollution control board uses Beta Attenuation Monitors (BAMs), which physically measure the mass of particles in the air and are calibrated to strict, standardised metrics for every reading.

In contrast, portals like IQAir rely on sensor-based monitors, says Abhijeet Pathak, a scientist who formerly worked for India's pollution control board.



Doctors recommend wearing masks when going outdoors

Sensor-based monitors use laser scattering and electrochemical methods to estimate the number of particles suspended in the air.

"The sensor is a different tool and it is not possible to calibrate them for every run," says Mr Pathak, adding that "sensor-based air quality monitoring has not yet been approved by the Indian government".

According to him, India's air quality framework hasn't been comprehensively revised since 2009, and he, along with other environmental scientists and activists have called for recalibrating the scale based on the latest technology.

"National Air Quality index will need to be revised if we want to include the sensor-based data," says Mr Pathak.

Removing the upper cap is also crucial says Mr Beig, "now that most literature available shows health symptoms keep on worsening as the pollution levels increase".

In the end, India's AQI doesn't stop at 500 because the pollution stops there. It stops at 500 because the system was built with a ceiling.

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FOREWORD

Rapid urbanization and economic growth has led to growth of vehicles in India, which has serious implication on the air quality. The substantial increase in number of vehicles has resulted in increased emission of air pollutants, specially the particulate matter which exceeds the prescribed standards in many cities. Particulate matter is associated with mortality and morbidity. Fine particles on their own or in combination with other air pollutants are linked to number of health problems. For rational planning of pollution control strategies, scientific information is needed on nature, magnitude and adverse health effects of air pollution.

To assess the impact of air pollution on human health (children), CPCB initiated an Epidemiological study in Delhi in 2003 with the help of Chittaranjan National Cancer Institute, Kolkata. The study was carried out over a period of three years during which several health camps were organized in different seasons, covering different parts of the city. The study included questionnaire survey as well as clinical examination.

The findings of the study were Peer reviewed by Indian Council for Medical Research (ICMR), New Delhi and All India Institute of Medical Sciences (AIIMS), New Delhi. The report was updated based on Peer review comments. Dr. Sanghita Roychoudhury, Research Associate, Sh. Tarun Darbari, Scientist B, Dr. Sanjeev Agrawal, Scientist D, have finalized the report under the supervision of Dr. D.D. Basu, Scientist E, and guidance Sh. J.S. Kamyotra, Member Secretary.

I hope the findings of the Report would be useful to all concerned.

(Mira Mehrishi)

3rd July, 2012

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EXECUTIVE SUMMARY

Central Pollution Control Board had sponsored the epidemiological studiy '**Study on Ambient Air Quality, Respiratory Symptoms and Lung Function of Children in Delhi**' carried out during March 2003–August 2005 and conducted by Chittranjan National Cancer Institute, Kolkata. The findings of these studies are as follows:

A. Objectives

- Assessment of the respiratory health status of school children chronically exposed to ambient air pollution of Delhi
- Assessment of degree of lung function impairment among children of Delhi

B. Study details

- 11,628 school-going children (7757 boys and 3871 girls) from 36 schools in different parts of Delhi in different seasons were included in the study
- Control: 4536 children, boys 2950 and girls 1586, from 15 schools of rural West Bengal and 2 schools from Khirsu and Kotdwar in Uttaranchal.
- Overall, the age of the children was between 4 to 17 years.
- Study was carried out between December 2002 – August 2005
- Pulmonary function tests (PFT) was conducted in 5718 participants of Delhi and 2270 control children by electronic, battery-operated spirometer

C. Study protocol

- Assessment of respiratory health by questionnaire survey and clinical examination
- Pulmonary function test (PFT) by spirometry
- Assessment of childhood obesity
- Examination of cellular lung reaction to inhaled pollutants by sputum cytology and cytochemistry
- Assessment of hematological and vascular changes associated with air pollution exposure following standard hematological procedure
- Assessment of behavioral characteristics

D. Findings

1. Respiratory and associated symptoms

- Compared to control, Delhi's children had 1.80 times more Upper respiratory symptoms (sinusitis, running or stuffy nose, sneezing, sore throat and common cold with fever) and two times more Lower respiratory symptoms (frequent dry cough, sputum-producing cough, wheezing breath, breathlessness on exertion, chest pain or tightness and disturbed sleep due to breathing problems) suggesting higher prevalence of underlying respiratory diseases.
- Respiratory and associated symptoms were most prevalent in children from low socio- economic status, and least in children from families with high socio-economic background.

- The symptoms were more prevalent in children during winter when PM_{10} level in air is highest in a year, and lowest during monsoon when particulate air pollution level is lowest, suggesting a positive association with particulate air pollution.

2. Lung function

- The results showed reduction of lung function in 43.5% schoolchildren of Delhi compared with 25.7% in control group. Delhi's children had increased prevalence of restrictive (20.3% vs 14.3% in control), obstructive (13.06% vs. 8% in control), as well as combined (both restrictive and obstructive) type of lung functions deficits (9.6% vs. 3.5% in control). After controlling potential confounders like season, socioeconomic conditions and ETS, PM_{10} level in ambient air was found to be positively associated with types of lung function
- Lung function reduction was more prevalent in girls than the boys both in rural and urban settings.
- Based on BMI data, 5.4% children of Delhi enrolled in this study were overweight against 2.4% children in control ($p<0.001$). Overweight and underweight children had poor lung function than children with normal weight.

3. Cellular lung reaction to air pollution

- The mean number of alveolar macrophages (AM) per high power field in Delhi's Children was 5.2 in contrast to 1.7 AM per hpf in control. Hence, school children of Delhi had 3.1 times more AM in their sputum. Marked increase in AM number signifies greater exposure to particulate pollution as AM represents the first line of cellular defence against inhaled pollutants.
- Sputum of Delhi's children contained 4-times more iron-laden macrophages (siderophages) than controls indicating convert pulmonary hemorrhage.
- Changes in the sputum cytology among the school children of Delhi positively correlated with ambient PM_{10} level.

4. Hematological and vascular changes

- The prevalence of hypertension in children was 6.2% in Delhi compared with 2.1% in control. Hypertension was more prevalent among girls than the boys and increased progressively with age, highest being in the age group of 15 – 17 years.
- 'Target' cells in 9.8% of Delhi's children against 4.3% of controls, implying a greater risk of liver problem.
- Higher prevalence of toxic granulation in neutrophils (21.0% vs. 8.7%) and circulating immature neutrophils (11.3% vs. 6.5%) was found among the children of Delhi, which suggests greater risk of infection and inflammation.

5. Behavior

- Delhi's schoolchildren had 2.5-times more Attention-Deficit Hyperactivity Disorder (ADHD) prevalence than age-and sex-matched controls (6.7% vs.2.7%, $p<0.05$). Boys had a remarkably higher prevalence than the girls. Besides air pollution, the stress of urban living could have played a role in eliciting greater prevalence of ADHD among the schoolchildren of Delhi

CHAPTER-1.0

BACKGROUND AND OBJECTIVE OF THE STUDY

Epidemiological studies have established a close relationship between exposure to ambient air pollution and morbidity and mortality from cardio-pulmonary diseases (Dockery et al., 1993, Samet et al., 2000, Schwela, 2000). Air pollution is a complex mixture of various gases, particulates, hydrocarbons, and transition metals. Of all these pollutants, the association between air pollution and adverse health conditions was the strongest and most consistent for respirable suspended particulate matters (RSPM) with an aerodynamic diameter of less than 10 micrometer (PM10). Health risk from particulate pollution is especially high for some susceptible groups such as the children and the elderly persons, and those with diseases of the heart and lungs (Ulrich et al., 2002).

(a) Children, the soft target

Children are more susceptible to environmental pollutants than the adults. The special vulnerability of children to air pollution exposure is related to several differences between children and the adults (Gilliland et al., 1999):

1. Children generally spend more time and are also more active outdoors than the adults. They are active outdoors during midday when air pollution levels tend to be higher. They have significantly higher oxygen demands so their respiration rates are higher and they inhale more air per unit of body weight than adults.

2. Because of their smaller stature their breathing zone is lower, so they inhale air loaded with more particles.

3. Diameters of their airways are smaller and therefore more likely to be affected by inflammation produced by air pollution

4. Their lungs are still developing and hence are more vulnerable to airborne insults. The efficiency of detoxification system of the body develops in time-dependent pattern. This in part accounts for increased susceptibility of children at critical points of time, and finally

5. Their immune defense is immature and hence less active against inhaled pathogens.

In essence, children represent the largest subgroup of the population susceptible to the adverse health effects of air pollution (Dockery et al., 2005). Damage to the respiratory system in children can be devastating and permanent and the adverse effects of air pollution may be obvious in adult life owing to the long latent periods for several chronic diseases.

Some children are more susceptible than others. Individuals with underlying chronic lung disease are at a greater risk than those not having such conditions. Polymorphic variations in genes involved in protecting against tissue injury or regulating tissue repair may explain some of the variations in individual susceptibility to adverse effects of air pollution on health. Furthermore, pattern and magnitude of exposure to indoor air pollution vary among children; those receiving higher exposures

indoor for example from parental smoking and cooking fuel emissions are at greater risk of being affected by outdoor pollutants.

(b) Health effects of air pollution in children

In the early part of this century, severe air pollution episodes of Meuse Valley, Belgium in 1930, Donora, Pennsylvania in 1948, New York in 1953 and 1962 and in London 1948, 1952 and 1956 were associated with excess deaths primarily from pneumonia and cardiovascular diseases (reviewed by Graham, 1990). Since 1960s studies on health effects of air pollution had shifted focus from mortality to morbidity as more and more emphasis were given to the effects of chronic, low level exposures of air pollution that the people in general experience in real life. Low-level air pollution in Japan was found to be associated with higher respiratory morbidity in all ages, and lung function were poorer in children residing in highly polluted cities compared with non-polluted rural areas (Toyama, 1964). A subsequent study in the United Kingdom revealed a relationship between exposure to high levels of particulates and sulphur dioxide in air and repeated episodes of acute upper and lower respiratory tract illness in children, after adjusting for socio-economic status (Lunn et al., 1967, 1970).

Acute exacerbations of chronic bronchitis were related to daily variations in smog and sulphur dioxide (Lawther et al., 1970). However, these adverse effects are only apparent above a moderately high threshold level (120 $\mu g/m^3$ of smoke in children). Successive studies have examined the health effects of air pollution at much lower levels than earlier works and they specifically addressed the question as to which component(s) of air pollution is the most important. It was found that a mean annual difference of 80 $\mu g/m^3$ of particulates between the cities doubled the risk of acute cough, bronchitis and other lower respiratory illness in children (Ware et al., 1986). In another study, 24-hour fine particulate levels as low as 15$\mu g/m^3$ were associated with significantly increase rates of hospitalization both in children and adults for respiratory diseases (Pope, 1989). The association between particulates and hospitalization was stronger for bronchitis and asthma than for pneumonia and pleurisy, and the association persisted after adjustment for meteorological variables. Other studies have confirmed the importance of the association between particulates and respiratory symptoms in children (Dockery et al., 1989, Dales et al., 1989). Ozone exposures below the US ambient air quality standards have been found to be associated with increased risk of cough and lower respiratory illness (Schwartz et al., 1989), and reduction in lung function (Kinney, 1989). Overall, the available evidence supports the hypothesis that particulate air pollution significantly increases the risk of morbidity from acute respiratory illness in children as well as in adults. However, it is not clear whether this morbidity is caused primarily by bronchial reactivity and respiratory tract irritation or by the effects of infection.

In both children and adults, upper respiratory illness is mainly caused by viral agents especially the rhinoviruses, coronaviruses, influenza and parainfluenza virus, adenovirus and respiratory syncytial virus. Viral infection often leads to bacterial infection such as pneumonia in the developing countries (Graham, 1990). On the other hand, respiratory syncytial virus, parainfluenza virus type I, II and III, influenza virus type A and B, adenoviruses and enteroviruses mainly cause lower respiratory illness in children, (Graham, 1990). In the developed world most causes of lower respiratory infection in

children are viral, but in developing countries mortality from bacterial pneumonia is the major problem (Glezen et al., 1973). Respiratory infection by agents other than bacteria and virus can be associated with respiratory infection in children. For example, *Mycoplasma pneumonae* and *Pneumocystis carinii* are important cause of pneumonia and acute bronchitis in both children and adults (Denny and Clyde, 1986). A large number of studies have shown that the incidence of viral respiratory illness peaks in infancy and early childhood and steadily reduces with age (Fox et al., 1972). This trend is generally attributed to changing pattern of exposure and the acquisition of specific immunity to the increasingly large array of virus types occurring with age. Respiratory illness have increased in recent years and the change has been attributed to changing virulence of respiratory pathogens and increased cumulative exposures to air pollution (Graham, 1990). Incident rates of acute respiratory infections also vary between sexes, higher rates have been found in males under the age of nine years, and the reverse pattern over that age (van Volkenburgh and Froast, 1933). In support of this, Gwaltney et al. (1966) reported more upper respiratory tract illness in females aged 16 to 24 years than males of similar age even after controlling confounders.

The accumulated evidence indicates that children's health is adversely affected by air pollution levels currently experienced in Europe and the United States. Evidence is sufficient to infer a causal relationship between exposures to ambient air pollution and adverse effects on lung function development in children. Chronic exposure to particulate matter (PM) in ambient air has been shown to cause lung function impairment (Hoek and Brunekreef, 1994, Schwartz and Neas, 2000), diminished birth weight and reduced growth of airways in children (Avol et al., 2001; Horak et al., 2002; Gauderman et al., 2002; Yang et al., 2003).

Studies have also revealed that diminished growth of airways in childhood increases the probability of subnormal lung function and risk of cardio-pulmonary diseases in adulthood (Gilliland et al., 1999; Schunemann et al., 2000).

1.2 AIR POLLUTION AND ADVERSE HEALTH EFFECTS: MODIFYING FACTORS

(a) Indoor air pollution

Environmental tobacco smoke (ETS) i.e. passive smoking, nitrogen dioxide from gas cooking / heating and smoke from biomass fuels are the three potential sources of indoor air pollution that may modify health effects of ambient air pollution. ETS increases the risk of respiratory symptoms and lung function reduction in children (Ware et al., 1984). Natural gas cooking and heating stoves increase exposure of family members to nitrogen dioxide (Melia et al., 1978). Children who are exposed to gas heating in their homes are more likely to be prone to respiratory illness than those with electric heating, but the level of significance was only marginal (Graham, 1990). In a study in Nepal, Pandey et al. (1989), found a relation between hours per day spent near a stove and acute lower respiratory illness in children.

(b) Housing and family size

Respiratory illnesses caused by respiratory infections are contagious diseases. Overcrowding favor their propagation. As early as in 1927, Woods reported a highly significant correlation between

overcrowded houses and pneumonia mortality in England and Wales. Payling-Wright, and Payling-Wright (1945) confirmed this finding by reporting a strong correlation between person per room and number of children per family and mortality from broncho pneumonia in children. Pneumonia epidemics have also been observed in crowded living conditions in South African mining camps, and during the construction of the Panama Canal (Finland, 1982).

(c) Nutrition

Malnutrition is generally regarded as a risk factor for respiratory infection. However, malnutrition is closely correlated with crowding, poverty, poor education and poor housing in developing countries. Its independent effect on risk of respiratory infection is rather difficult to assess. Malnourished children have been shown to experience 2.7 times more bronchitis and 19 times more pneumonia than normal-weight properly nourished children (James, 1972). A significant relation between malnutrition and pneumonia but not bronchitis has been reported (Berman et al., 1983). Vitamin A deficiency in children is associated with increased morbidity from respiratory infection and increased overall mortality. Breast-feeding reduce mortality in children in the developing countries (Victora et al., 1987). Whether the protective effect from breast milk is from its conferred anti-infective properties (Saarinen, 1982) or from nutritional factors *per se* is not clear. Conversely, obesity was reported to be associated with increased incidence of respiratory illness in infants (Tracey, 1971).

(d) Age

Some studies have observed a relationship between acute lower respiratory tract infection in the first two years of life and chronic respiratory disease in later life. For example, acute lower respiratory infection in childhood has been related to chronic cough in young adults (Colley et al., 1973), adult mortality from bronchitis (Barker and Osmond, 1986), reduced lung function and increased bronchial reactivity (Mok and Simpson, 1984).

(e) Psychosocial factor

Early cross sectional studies reported relations between anxiety and upper respiratory illness (Belfer et al., 1968), and between life changes, maladaptive coping, social isolation, unresolved role crises with respiratory infections (Jacobs et al., 1970). Other cross sectional studies have found relations between maternal stress and bronchitis in children (Hart et al., 1984); and poor family functioning with doctor visits for respiratory infection in children (Foulke et al., 1988). Stressful life events in families are four times more likely to precede an episode of streptococcal pharyngitis (Meyer and Haggerty, 1962). Stress and anxiety might predispose to respiratory infection by two mechanism: first, high stress levels may lead to disruption of normal hygiene measures that reduce transmission of respiratory viruses; second, since psychological stress and other psychological factors suppress body's defense against infection (Kieolt-Glaser and Glaser, 1986), this may lead to increased susceptibility to increased respiratory infection.

(f) Socio-economic status

Socio-economic status (SES) is usually measured in terms of level of income, education and occupational prestige. Low SES has been associated with increased mortality from bronchitis and

pneumonia in children (Collins et al., 1971). Social class is also related to respiratory morbidity from predominantly lower respiratory tract infections (Colley and Reid, 1970, Colley et al., 1973). Tupasi et al., (1988) confirmed that SES within developing countries strongly predicts risk of acute respiratory infection. Question has been raised about the key component of the low SES that increases the risk of respiratory infection. Poverty and lower social status are associated with large family size, crowded living conditions, poorer access to medical care, higher smoking rates, nutritional deficits and exposure to environmental pollutants including urban air pollution and stressful living environments. These factors may contribute individually or perhaps interact between themselves to increase the susceptibility to respiratory diseases.

(g) Meteorological factors

Low temperatures are usually associated with increase in mortality from pneumonia and bronchitis (Yang, 1924). However, the association could be explained by high PM level because peak levels of respirable particles occurred in mid winter presumably due to condensation, cloud cover and precipitation that prevent dispersal (Graham, 1990). Humidity might play a role in respiratory illness; for example, rhinoviruses survive better at higher humidity implying greater transmission during high humidity periods (Gwaltney, 1980). In temperate and warm climates, however, high humidity is often associated with the monsoon when people spent more time indoors. Therefore it remains a matter of conjecture whether the association was due to humidity or indoor air pollution.

(h) Low birth weight

It has been hypothesized that low birth weight could lead to more respiratory infections (Pio et al., 1985). Low birth weight (< 2 kg) is associated with chronic cough but not wheeze (Chan et al., 1989). A study in India by Datta et al., (1987) revealed that low birth weight infants (<2.5 kg) experienced the same respiratory illness prevalence as normal weight infants in the first year of life (4.65 vs. 4.56 episodes), but had a much higher death rate (24.6 vs. 3.2 per 100 episodes of moderate to severe respiratory illness). Increased mortality from respiratory infection in low birth weight children has also been reported by Victora et al., (1989) and this relationship persisted after adjustment for parental income and education. These studies suggest that low birth weight children do not experience higher rates of respiratory illness, but do experience more severe infections. Confounding factors for low birth weight such as overcrowding, poverty and poor nutrition make it difficult to ascertain whether the association is causal or not.

(i) Particle size, chemical composition and source

It is now well recognized that particulate matter (PM) with aerodynamic diameter of less than 10 mm (PM_{10}) and less than 2.5 mm ($PM_{2.5}$) are the primary mediators of toxicity in the lungs and the airways, while fine ($PM_{2.5}$) and ultrafine particles (UFP, aerodynamic diameter less than 0.1 mm) generally mediate toxicity on the heart and blood vessels (Pope 2004, Brook et al., 2004). It was also observed that exposures to fine particles from outdoor sources of combustion and from tobacco smoke invoke similar pathophysiological processes. Indeed, airway inflammation, an important factor in mediating air pollution effects on the lungs, is a common finding among smokers as well as in persons who have lived for long in a polluted environment (Gauderman et al., 2004).

There are increasing evidences that mass concentration of PM may not be the most relevant measure of PM standards to protect respiratory health. In general, relatively large and therefore heavier particles contribute more than smaller particles to ambient PM concentration. However, the smaller particles, such as PM2.5 and UFP are considered more harmful than larger particles (Peters et al., 1997; Schwartz and Neas, 2000; Diociaiuti et al., 2001; Huang et al., 2003; Li et al., 2003). Besides size, the chemical composition of the PM may determine its harmfulness. Several PM components like transition metals such as iron, copper, nickel and chromium (Campen et al., 2001; Aust et al., 2002; Gavett et al., 2003; Okesen et al., 2003), quinoid structures (Li et al., 2000), and aromatic hydrocarbons (Pacheco et al., 2001; Vassilev et al., 2001) are known to exert severe toxicity on exposed tissues. Moreover, PM from specific sources such as diesel exhaust (Hiura et al., 1999; Li et al., 2002) and residual oil fly ashes (ROFA) (Lambert, 2000) are highly toxic for airway cells probably because of their high organic aromatic and metal contents respectively (Hogervorst et al., 2006).

(j) Toxic effects of airborne pollutants

Based on findings of laboratory investigations, the consensus opinion is that exposures to particulate air pollution elicit adverse health effects through generation of reactive oxygen species (ROS) (Marano et al., 2002; Roberts et al., 2003). ROS can induce airway cell damage by inducing apoptosis (programmed cell death) and necrosis of airway cells and thereby increasing airway permeability which allows airborne allergens and pathogens to penetrate the airways more effectively, and by enhancing transcription of pro-inflammatory mediators including several cytokines and chemokines including tumor necrosis factor-alpha (TNF-±) and interleukin-8 (IL-8) (Samet et al., 1998; van Eeden and Hogg, 2002). These processes can ultimately lead to lung function reduction in children (Hogervorst et al., 2006). More importantly, it can lead to reduction in lung growth if the exposure to high level of air pollution is chronic (Hogervorst et al., 2006).

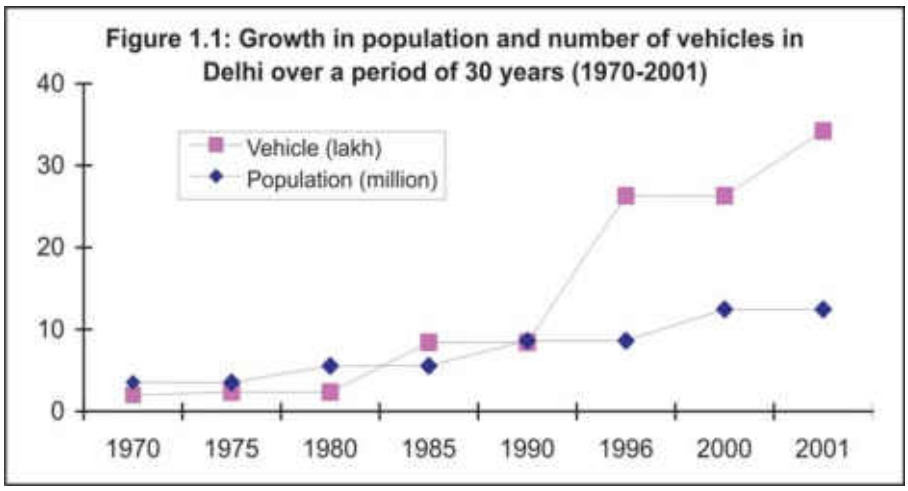
1.3 AIR POLLUTION AND ITS SOURCES IN DELHI

According to 2001 census, 13.8 million people lived in the Delhi within an area of 1483 km^2. Due to relatively high employment opportunities and better living conditions, Delhi has attracted millions of people from rural areas in neighbouring states. Currently Delhi and its surrounding suburbs is the third largest metropolitan area in the country after Mumbai and Kolkata. There are 827 women per 1000 men, and the literacy rate is 78.5%. Approximately 90% of the population is urban.

(a) Vehicular source of air pollution: motor vehicles in Delhi

Motor vehicles are responsible for a substantial part of Delhi's air pollution. The motor vehicle fleet of Delhi presently stands at 4.2 million, which is more than Mumbai, Kolkata and Chennai put together (Badami, 2005). Delhi alone with only a little over 1% of India's population accounts for 1/8th of national vehicle population (Badami, 2005). In 1975, the number of vehicles in Delhi and Mumbai was almost the same. Today Delhi has 3 times more vehicles than Mumbai, although Mumbai has 4 million more inhabitants than Delhi. While Delhi's population has grown about 5% per annum over the last three decades motor vehicles grew 20% per annum in the 1970s and 1980s and 10% per annum in the 1990s (Fig.1.1). They are still growing at a current rate of 7% per

annum (DDA 1996; Mohon et al., 1997). Vehicular particulate emissions are especially harmful for human health, because they are small and numerous, and occur near ground level where people live and work.

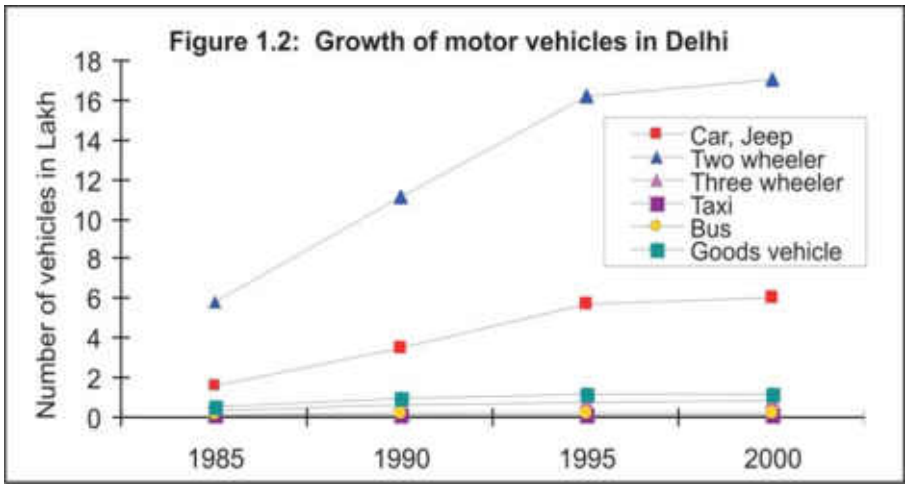


(i) Road transportation in Delhi

Delhi's road transport includes private vehicles such as 2-wheelers, cars, Jeeps etc.; public transport vehicles, such as bus, taxi, and autorickshaws; and goods transport vehicles such as trucks and tempos.

(ii) Bus

Delhi's buses constitute only small percentage of city's vehicular population, but they cater to maximum of the total traffic load. Although personal vehicles such as cars and two wheelers represent nearly 94% of the total number of vehicles of the city, they cater to only 30% of the travel demand (Deptt. of Transport, Govt. of Delhi). Growth of motor vehicles in Delhi is depicted in Fig. 1.2. Delhi Transport Corporation operates large fleet of compressed natural gas (CNG)-fueled buses. Besides, there are a large number of private-owned CNG-fueled buses plying in Delhi. Delhi's buses pollute much less than diesel-fueled buses of most other cities in India.



(iii) Taxi and Auto rickshaw

Compared to Mumbai and Kolkata, taxis are fewer in Delhi as people rely more on their own cars. However, Delhi's auto rickshaws provide a very important contribution in mass transport. Because they are CNG-powered, emissions are much less compared to pre-CNG era.

(iv) Goods transport vehicles

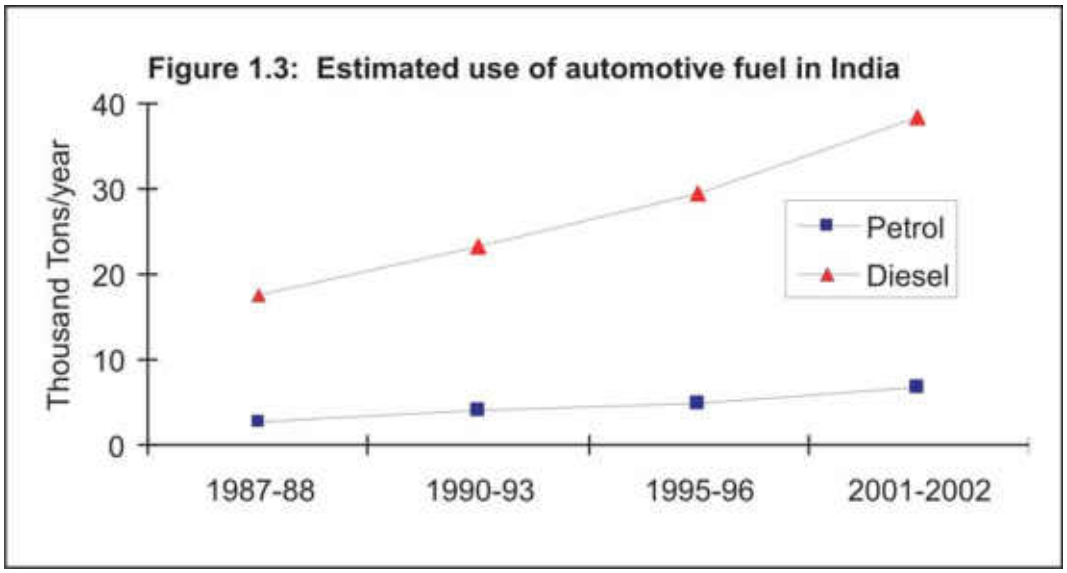
Lorries and trucks plying on Delhi roads including those coming with goods from adjoining states constitute small percentage of city's vehicular population. They are a significant source of air pollution, because the vehicles are run by diesel-powered engines.

(v) Private vehicles

Private vehicles, such as cars, scooters and motor bikes, constitute 94% of Delhi's vehicular population. The numbers of 2-wheelers and cars have increased exponentially in recent times in Delhi, although the number of public transport vehicles has increased only marginally. About two-third of the total vehicular population of Delhi is two wheelers. Currently the city has 2.7 million two wheelers which was 1.4 million in 1993 - 1.5 times more than the combined number of two wheelers in three other metros of India – Mumbai 2.4 lakh, Kolkata 2.2 lakh and Chennai 4.6 lakh.

(vi) Automotive fuel

Diesel and petrol (gasoline) were the principal automotive fuels till the introduction of compressed natural gas (CNG) for public transport vehicles in 2001. There has been a steady increase in vehicle number and automotive fuel consumption, especially diesel, in Delhi in the last three decades. Estimated use of automotive use is depicted in Fig.1.3. Diesel is considered more polluting fuel than petrol, because it emits more particulates, especially of fine and ultrafine categories, than petrol during combustion. Petrol, on the other hand, releases more volatile organic compounds, particularly benzene, during combustion and also due to evaporation.



Compared with diesel and petrol, CNG is a cleaner fuel as it emits substantially lower amount of particulates carbon monoxide and oxides of nitrogen as detailed in Table 1.1. Moreover, these vehicles have low vibrations and fewer odors than diesel engines.

Table 1.1: Emission comparison of diesel and CNG-powered buses

	Diesel	CNG	% reduction
CO	2.4 g/km	0.4 g/km	83
NOx	21 g/km	8.9 g/km	58
PM	380 mg/km	12 mg/km	97

Source: Frailey et al., 2000

(b) Industrial source of air pollution in Delhi

There are three thermal power plants at Indraprastha, Badarpur and Rajghat. The industries emit suspended particulate matter, hydrocarbons, sulphur dioxide, oxides of nitrogen and carbon monoxide. The emissions from power plants include sulphur dioxide, oxides of nitrogen and suspended particulate matter.

(c) Domestic source

Pollution from household sources is mainly due to the use of coal, kerosene and unprocessed solid biomass like firewood, cow dung and agricultural refuse like hay, husk, dried leaves etc.

(d) Climate and Natural Sources

Climate and natural sources also play an important role in contributing to the pollution levels of Delhi in addition to man-made sources. The region has a semi-arid climate. A sporadic pre-monsoon feature is dust storms when winds from the west deposit large concentrations of suspended particulate matter in the atmosphere of Delhi. Pre-monsoon calms contribute to increased pollution loads due to lack of mixing between different atmospheric levels. In winter, ground-based temperature inversions constrain dispersal of pollutants.

1.4 ECONOMIC ASPECT OF AIR POLLUTION IN INDIA

Improvement of air quality is associated with reduction in the number of premature deaths, episodes of acute illness such as asthma attacks and the number of chronic respiratory illness cases. The economists evaluate the value of avoiding an illness episode as

a. The value of work time lost due to the illness by the patient or the caregiver, or both
b. The medical cost of treatment
c. The amount paid to avoid the pain and suffering associated with the illness, and
d. The value of leisure time lost due to the illness by the patient or caregiver.

1.5 SCOPE OF THE WORK AND OBJECTIVES

Air pollution is considered as the most important contributing factor for respiratory illnesses. Considering these, it is important to assess the respiratory health of children in Delhi. Accordingly, the present study was undertaken in 2003 to study the respiratory health of children in Delhi.

Objective of the Study

The objective of this study was as follows:

- Assessment of the respiratory health status of school children chronically exposed to ambient air pollution of Delhi
- Establishment of a database relating to pollution related respiratory problems among children of the city.

This will serve as the reference data for all future monitoring studies of city's air quality with respect to health. Also, it will help to adopt and monitor intervention policies for betterment of the situation.

CHAPTER-2.0

MEASUREMENT OF AMBIENT AIR QUALITY OF DELHI

2.1 AMBIENT AIR QUALITY MONITORING IN DELHI

Data on the concentration of ambient air pollutants with respect to RSPM (respirable particulate matter with an aerodynamic diameter of less than 10 µm, i.e. PM_{10}), carcinogenic organic compounds like polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs), oxides of nitrogen (NOx), sulfur dioxide (SO_2), suspended particulate matter (SPM) and ozone in study areas during and preceding months of this study were obtained from different air quality monitoring stations operated under National Air Quality Monitoring Programme (NAMP). Central Pollution Control Board and National Environmental Engineering Research Institute (NEERI) operate these stations under NAMP at the following locations as mentioned in Table 2.1.

Table 2.1: Air Quality Monitoring Stations in Delhi

	Name	Area	Operated by
1	Ashok Vihar	North	CPCB
2	ITO	Central	CPCB
3	Nizamuddin	South-east	CPCB
4	Shahadara	North-east	CPCB
5	Janak Puri	West	CPCB
6	Shahzada Bagh	North	CPCB
7	Siri Fort	South	CPCB
8	Sarojini Nagar	South	NEERI
9	Town Hall Library	North	NEERI
10	Mayapuri Industrial Area	West	NEERI

(a) Air quality measurements in control areas

Air quality data of rural areas of West Bengal were obtained from monitoring stations of the West Bengal State Pollution Control Board. Additionally, real-time particulate pollutant concentration in air by portable, battery-operated laser photometer (DustTrak™ Aerosol monitor, model 8520, TSI Inc., MN, USA) were measured, particularly for those areas where monitoring stations were absent. The instrument contains 10-mm nylon Dor-Oliver cyclone, operates at a flow rate of 1.7 liter/min and measures particle load in the concentration range of 1µg-100 µg/m^3. PM was measured with the aerodynamic diameter of less than 10 µm (PM_{10}), less than 2.5µm ($PM_{2.5}$) and les than 1.0 µm (PM_1). The monitor was calibrated to the standard ISO 12103-1 A1 test dust. The monitor was placed in open space at least 30 feet away from the roads, 3 feet above the ground level on a wooden stool. The monitoring was carried out 8 hours/day (07:30 –15:30 hours) for three consecutive days in a week and 3 alternate weeks in a season (summer, monsoon, and winter seasons). Monitor could not be used for longer periods due to the limitation of battery power.

(b) Efficiency of real-time aerosol monitor and reliability of data

Real-time Dust Trak monitors of TSI, USA was experimentally used in California, USA in late 90's simultaneously with traditional monitors using filter-based gravimetric method. Researchers of Harvard School of Public Health have reported satisfactory performance (Kim et al., 2004). They measured $PM_{2.5}$ simultaneously by DustTrak direct-reading aerosol monitor Model 8520 (which was used in this study) and filter-based gravimetric method. Spearman correlation proved the two methods as highly correlated. A subsequent study in Canada by Zhu et al., (2005) confirmed the reliability of data generated by real-time monitor. They monitored concentrations of fine particles in diesel exhausts with Dust Trak real-time monitors, and recorded the measured data every 5 seconds. Test variation of real-time monitoring in different test days was found similar to that measured by filter-based traditional gravimetric method, whereas the repeatability of the monitored data within the same day was better than that of gravimetric method (Zhu et al., 2005).

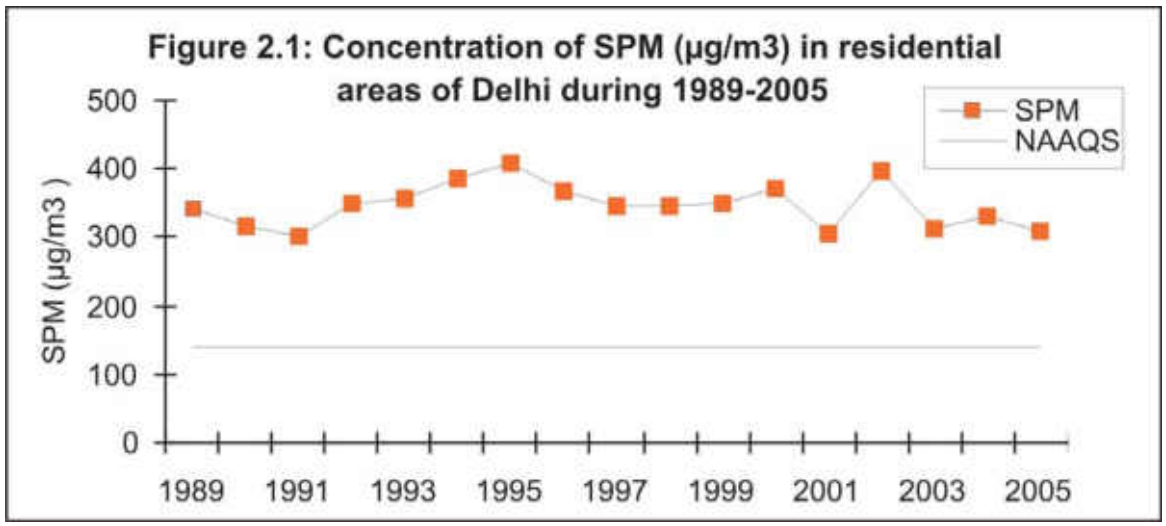
(c) Statistical analysis

The results are expressed as mean ± Standard Deviation (SD). The data were statistically analyzed by student 't' test and $p<0.05$ was considered significant.

2.2 RESULTS

(a) Suspended Particulate Matter (SPM)

The data shows that the concentration of SPM in Delhi's air had varied between 300 and 409 µg/m^3 from 1989 to 2005. All through these years the SPM level exceeded National Ambient Air Quality Standards (NAAQS) in residential areas as depicted Figure 2.1 and 2.2. SPM levels at various monitoringstations in Delhi is given in Table 2.2.



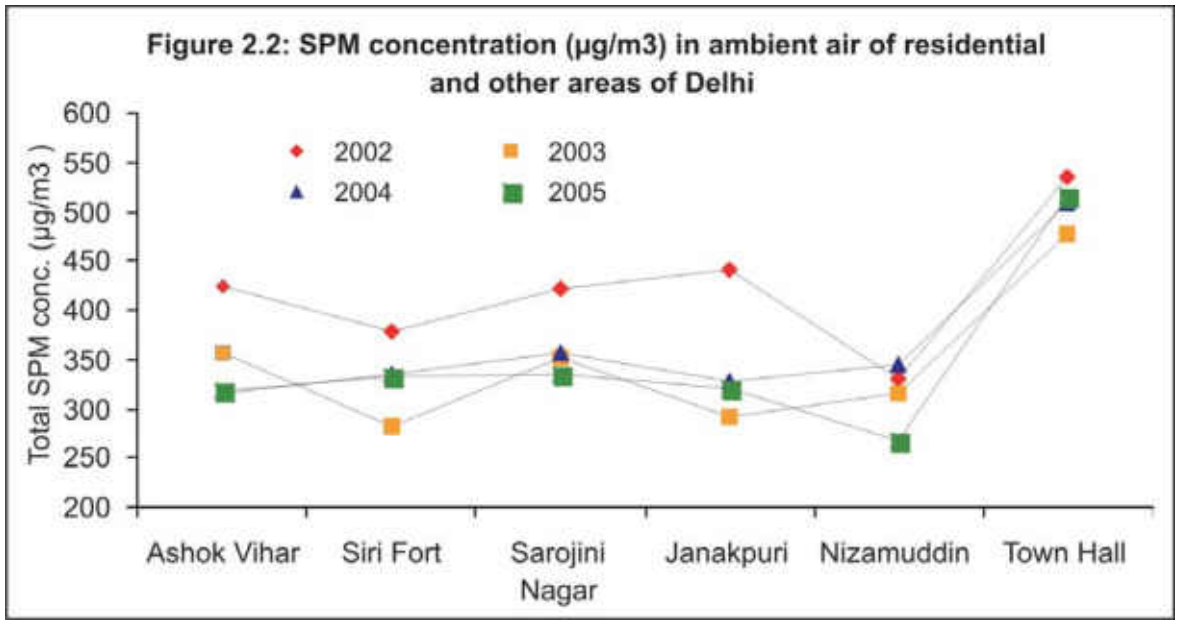
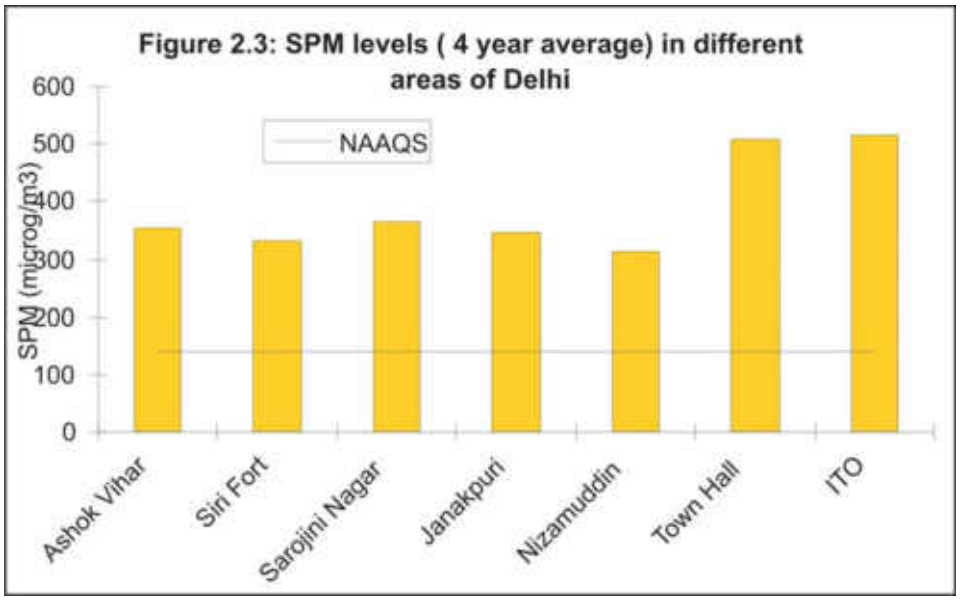


Table 2.2: Suspended Particulate Matter concentrations (in µg/m³) in Delhi's air during 2002-2005

Area	2002	2003	2004	2005	4-yr (Mean ± SD)
Residential areas					
Ashok Vihar	425	356	315	318	354 ± 51
Siri Fort	378	281	334	333	332 ± 40
Sarojini Nagar	421	352	356	335	366 ± 38
Janakpuri	442	291	328	320	345 ± 66
Nizamuddin	329	315	345	268	314 ± 33
Town Hall	534	478	508	516	509 ± 23
Mean ± SD	422 ± 69	346 ± 72	364 ± 72	348 ± 86	370 ± 35
Industrial area					
Mayapuri	NA	425	484	523	477 ± 49
Shahzada Bagh	468	354	338	308	367 ± 70
Shahdara	415	343	357	300	354 ± 47
Mean ± SD	442 ± 37	374 ± 45	393 ± 79	377 ± 127	396 ± 31
Traffic intersection					
ITO	533	509	500	512	514 ± 14
Overall	438 ± 67	370 ± 77	387 ± 78	373 ± 101	392 ± 32

*Source, CPCB, Delhi ; NA, data not available; *p<0.05 compared with residential area*

During 2002-2005, Delhi had an average concentration of 392 ± 32 µg/m³ (mean ± SD) of SPM in ambient air. Average SPM concentration in residential areas was 370 ± 35 µg/m³, which was higher than the National Standard for SPM in residential areas. Among the residential areas monitored during this period, highest SPM level was found in Town Hall (4-year average 509 µg/m³) in northeast Delhi, followed by Sarojini Nagar (366 µg/m³) and Ashok Vihar (354 µg/m³) in northern part of the city. During this period, the average concentration of SPM n residential areas declined from 422 to 348 µg/m³, showing a reduction of 18%. SPM levels (4 year average) at various monitoring statons in Delhi is deopicted in Figure 2.3.



In Industrial area, mean SPM concentrations (4 year average) was 396 µg/m³. However, highest SPM level of the city was found in traffic intersection point at ITO (514 ± 14 µg/m³, 4-year average).

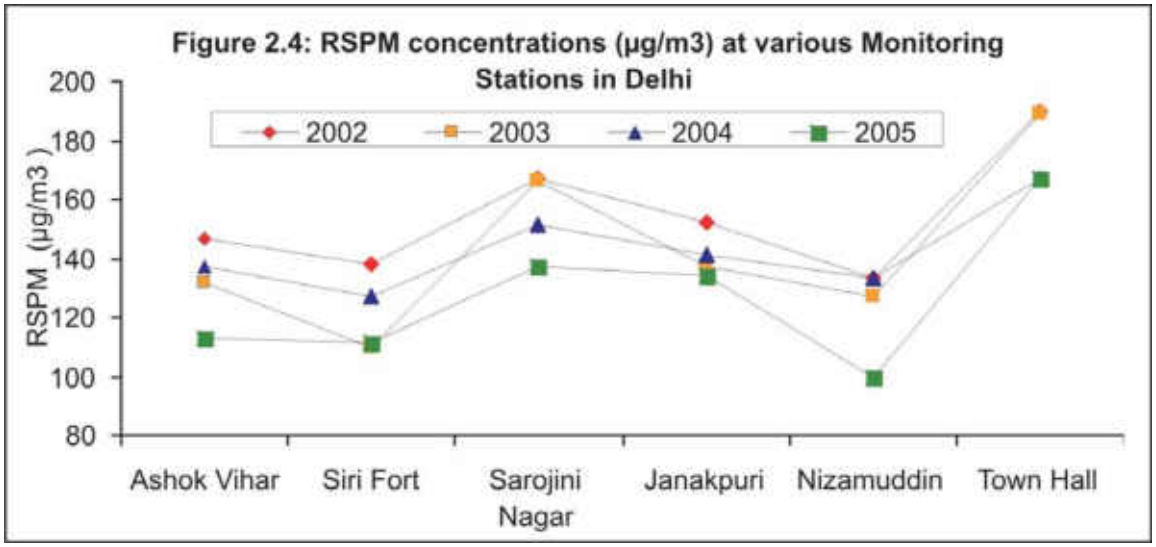
(b) Respirable Suspended Particulate Matter (RSPM/PM_{10})

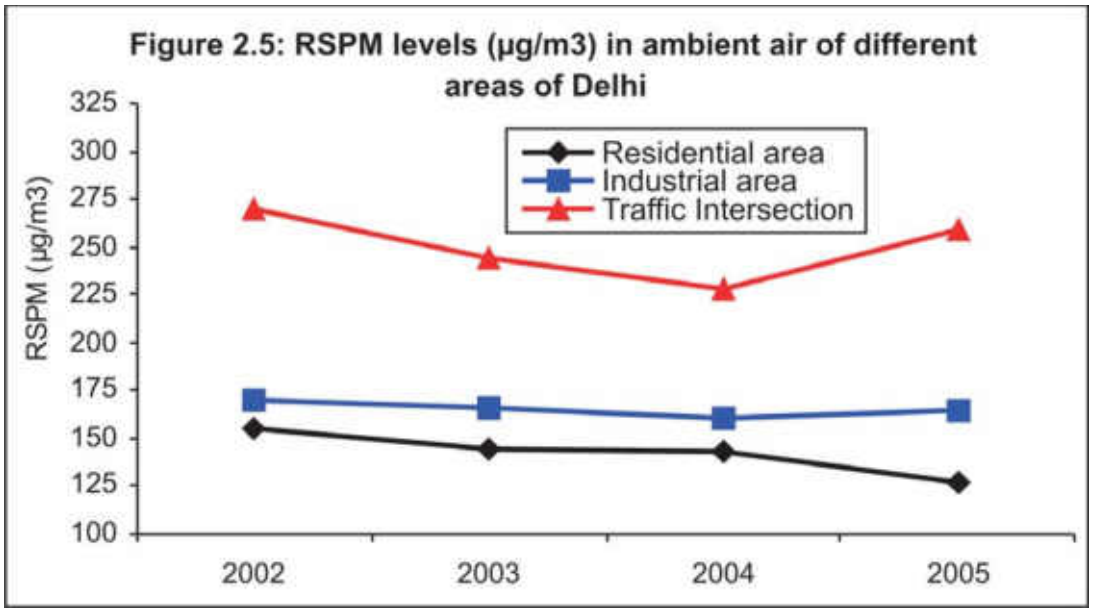
RSPM levels at various monitoring stations are given in Table 2.3. Out of the 10 air quality monitoring stations operative in Delhi, 6 were located in residential areas. The mean annual average respirable suspended particulate matter (RSPM) level during 2002-2005 in these areas of Delhi was 142 µg/m^3, which exceeded NAAQS. RSPM levels at various monitoring stations and areas are depicted in Figure 2.4 and 2.5 respectively. Among the residential areas, highest RSPM concentration was reported at Town Hall (4-year mean 178 µg/m^3), followed by Sarojini Nagar (155 µg/m^3) and Janakpuri (141 µg/m^3).

Table 2.3: Respirable suspended particulate matter (RSPM) concentrations (µg/m^3) in Delhi's air during 2002-2005

Area	2002	2003	2004	2005	4-yr (Mean ± SD)
Residential and other areas					
Ashok Vihar	147	132	137	113	132 ± 14
Siri Fort	138	110	127	111	122 ± 13
Sarojini Nagar	167	166	151	137	155 ± 14
Janakpuri	152	137	141	134	141 ± 8
Nizamuddin	133	127	133	100	123 ± 16
Town Hall	190	189	167	167	178 ± 13
Mean ± SD	155 ± 21	144 ± 29	143 ± 14	127 ± 24	142 ± 11
Industrial area					
Mayapuri	NA	212	213	233	219 ± 12
Shahzada Bagh	186	151	138	130	151 ± 25
Shahdara	153	136	131	131	138 ± 10
Mean ± SD	170 ± 23	166 ± 40	161 ± 45	165 ± 59	165 ± 4
Traffic intersection					
ITO	270	244	228	259	250 ± 18
Overall	171 ± 42	160 ± 42	157 ± 36	152 ± 53	160 ± 8

*Note:- NA- Data not available; *p<0.05 compared with residential area*





There was a declining trend in RSPM level in residential areas in the preceding four years. Compared with 2002 average (155 µg/m^3), the RSPM level has been decreased by 18% in 2005 (127µg/m^3).Industrial areas had a 4-year mean of 165 µg/m^3 of RSPM, which was higher than the NAAQS. At ITO crossing, the 4-year annual average RSPM concentration was 250 µg/m^3, the highest in Delhi. Taking 2000 data as the baseline, a sharp decline in RSPM level was recorded in 2001, the year in which CNG was introduced for public transport vehicles in Delhi. However, in the subsequent years the benefit was diluted perhaps due to the rise in the number of personal vehicles. The concentration was highest in traffic intersection point at ITO, followed by industrial areas and residential areas. RSPM level was lowest in residential areas. PM_{10} distribution in Delhi is depicted in Figure 2.6.

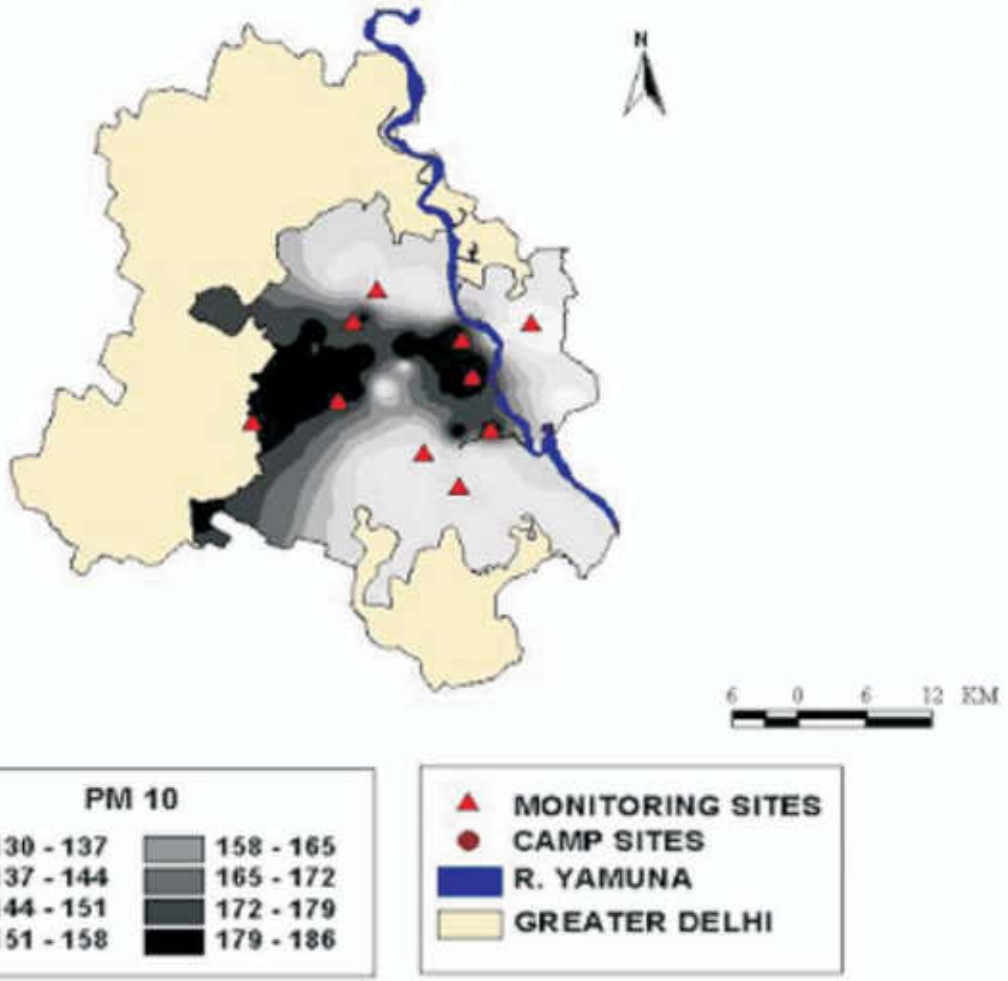


Figure 2.6: Pattern of PM10 Distribution in Delhi (2002-2005)

RSPM to SPM ratios are given in Table 2.4. RSPM:SPM ratio was appreciably higher at traffic intersection areas (0.49) than that of residential (0.39) and industrial areas (0.39), suggesting that the proportion of respirable particles in SPM was higher at traffic intersection.

Table 2.4: Four-year (2002-05) average SPM and RSPM concentrations at different areas of Delhi

Area	SPM (µg/m³)	RSPM (µg/m³)	RSPM/SPM ratio
Residential and other areas			
Ashok Vihar	354	132	0.37
Siri Fort	332	122	0.37
Sarojini Nagar	366	155	0.42
Janakpuri	345	141	0.41
Nizamuddin	314	123	0.39
Town Hall	509	178	0.35
Industrial area			
Mayapuri Industrial Area	477	219	0.46
Shahzada Bagh	367	151	0.41
Shahdara	354	138	0.39
Traffic intersection			
ITO	514	250	0.49

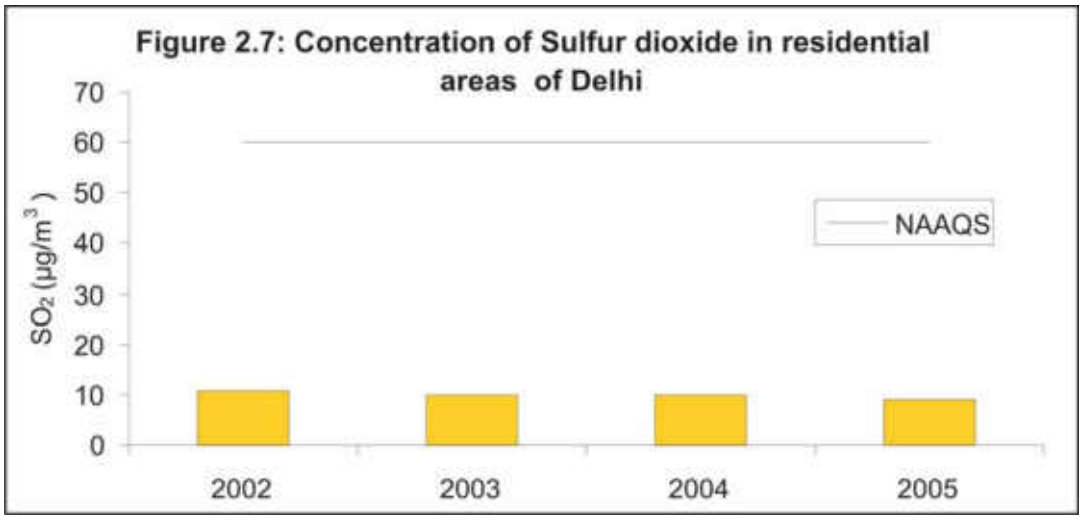
(c) Sulfur dioxide (SO_2)

The concentrations of SO_2 in Delhi's air were within the NAAQS during 2002-2005. The ambient SO_2 levels are given in Table 2.5. The 4-year (2002-05) average concentration of SO_2 in residential areas was 10µg/m³. SO_2 levels at ITO and industrial areas were 9 and 11 µg/m³ respectively. Trend in ambient SO_2 (4 year average) levels in residential areas is depicted in Figure 2.7. SO_2 levels were within the prescribed NAAQS during all the years.

Table 2.5: Concentration of Sulfur dioxide (µg/m³) in ambient air in different areas of Delhi during 2002- 2005

Area	2002	2003	2004	2005	4-yr mean±SD
Residential and other areas					
Ashok Vihar	6	6	10	8	8 ± 2
Siri Fort	12	9	8	9	10 ± 2
Sarojini Nagar	7	7	7	5	7 ± 1
Janakpuri	14	12	10	11	12 ± 2
Nizamuddin	13	12	11	10	12 ± 1
Town Hall	12	12	11	8	11 ± 2
Mean ± SD	11 ± 3	10 ± 3	10 ± 2	9 ± 2	10 ± 1
Industrial area					
Mayapuri	NA	13	12	14	13 ± 1
Shahzada Bagh	10	7	10	8	9 ± 2
Shahdara	17	11	10	9	12 ± 4
Mean±SD	14 ± 5	10 ± 3	11 ± 1	10 ± 3	11 ± 2
Traffic intersection					
ITO	10	9	8	9	9 ± 1
Overall	11 ± 3	10 ± 3	10 ± 2	9 ± 2	10 ± 1

Note:- NA- data not available



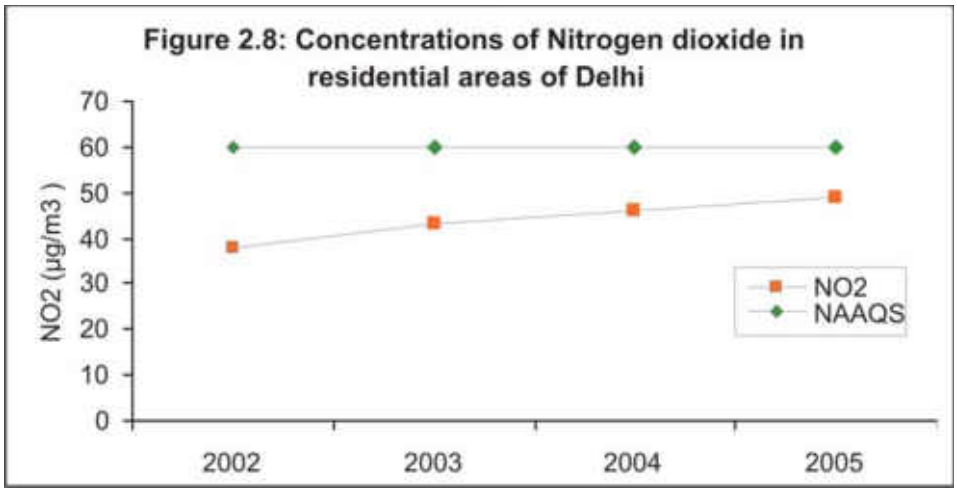
(d) Nitrogen dioxide (NO_2)

The ambient NO_2 levels are given in Table 2.6. NO_2 levels in Delhi's air in residential areas varied between 32 and 59 µg/m³ during 2002-2005. The 4-year average in residential areas was 44 µg/m³. NO2 levels at ITO was higher than other locations. NO_2 levels at ITO ranged from 75 µg/m³ in 2002 and 83 µg/m³ in 2005. Trend in ambient NO_2 (4 year average) levels inresidential areas is depicted in Figure 2.8.

Table 2.6: Concentrations of nitrogen dioxide (µg/m³) in ambient air of different areas of Delhi during 2002- 2005

Area	2002	2003	2004	2005	4-yr (Mean±SD)
Residential and other areas					
Ashok Vihar	26	32	39	49	37± 10
Siri Fort	27	32	35	35	32 ± 4
Sarojini Nagar	43	46	53	54	49 ± 5
Janakpuri	40	44	41	48	43 ± 4
Nizamuddin	39	43	45	45	43 ± 3
Town Hall	53	59	60	64	59 ± 5
Mean±SD	38 ± 10	43 ± 10	46 ± 9	49 ± 10	44 ± 5
Industrial area					
Mayapuri	NA	45	56	49	50 ± 6
Shahzada Bagh	34	39	47	46	42 ± 6
Shahdara	36	33	39	36	36 ± 2
Mean±SD	35 ± 1	39 ± 6	47 ± 9	44 ± 7	41 ± 5
Traffic intersection					
ITO	75	94	89	83	85 ± 8
Overall	41 ± 15	47 ± 19	50 ± 16	51 ± 14	47 ± 4

Source, CPCB and NEERI, Delhi; NA, data not available



The annual average concentration of NO_2 in ambient air of Delhi's was within the NAAQS at most of the locations.

(e) Polycyclic aromatic hydrocarbons (PAHs)

(i) Total PAHs

SPM-laden PAH concentrations in air of Delhi in winter (December 2004 and January 2005) are presented in Table 2.7. The mean value of PAHs in residential areas of the city during this period was 23.8ng/m^3. PAH concentration was highest in ITO traffic intersection area (54.4 ng/m^3), followed by Shahdara (44.4 ng/ m^3) and Nizamuddin (42.6 ng/ m^3). Lowest PAH level (10.8 ng/ m^3) was recorded in Siri Fort in South Delhi. Ashok vihar and Shahzada Bagh both in North Delhi had 18.0 and 17.0 ng / m^3 of PAHs (2-month average) respectively.

Table 2.7: Concentration of SPM-laden total polycyclic aromatic hydrocarbons (ng/m^3) in Delhi's air

Location	December 2004	January 2005	Mean
Residential Areas			
Siri Fort	6.6	14.9	10.8
Ashok Vihar	27.9	8.1	18.0
Nizamuddin	65.2	20.0	42.6
Residential areas, mean	33.2	14.3	23.8
Industrial Areas			
Shahzada Bagh	22.7	11.3	17.0
Shahdara	72.3	16.5	44.4
Industrial areas , mean	47.5	13.9	30.7
Traffic Intersection			
ITO	41.8	66.9	54.4
Overall	39.4	23.0	31.2

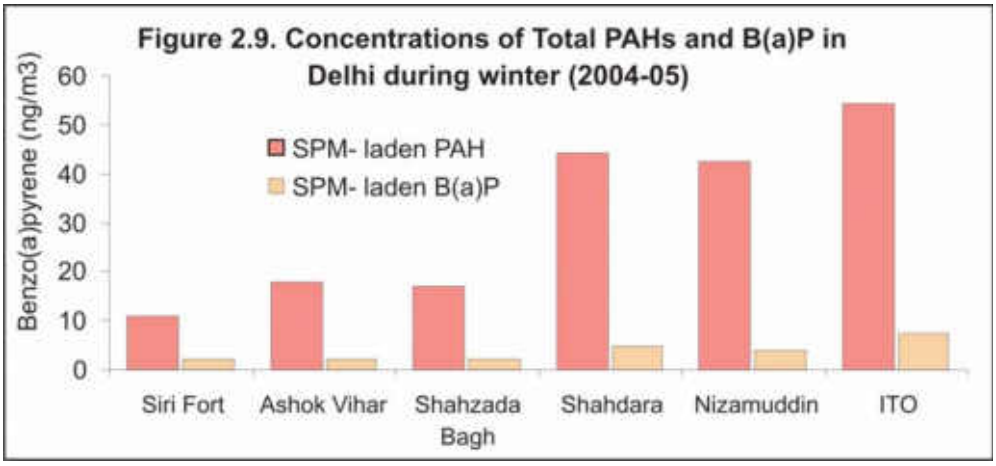
(ii) Benzo(a)pyrene (B(a)P)

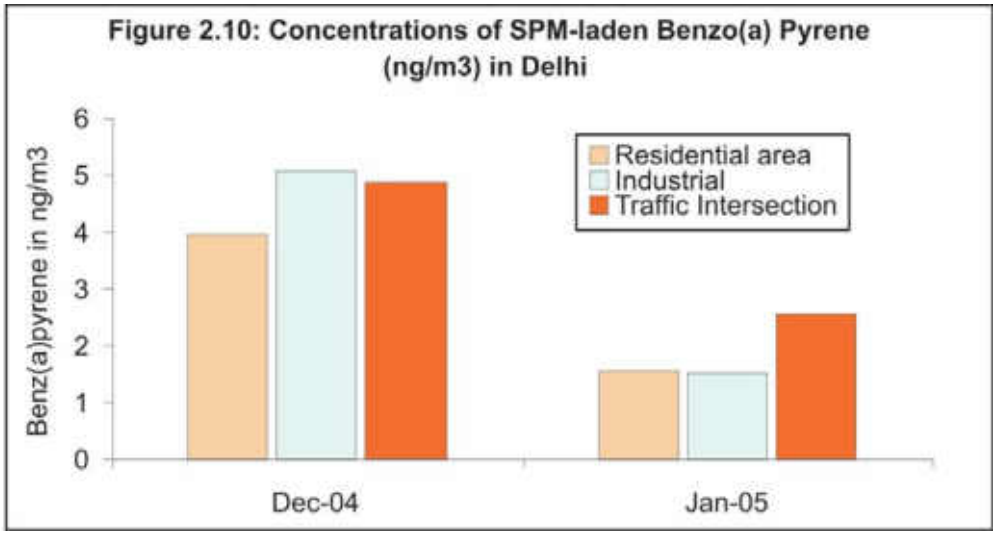
B(a)P is a potential carcinogenic PAH. B(a) P levels in Delhi are presented in Table 2.8. Its concentration was highest in traffic intersection area of ITO (7.3 ng/m^3), and mean value in residential area was 2.77 ng/ m^3 in three residential areas monitored. Among the residential areas, Nizamuddin had highest level of this carcinogen in its air (3.96 ng/m^3), followed by Siri Fort (2.30 ng/m^3) in southeast. The lowest B(a)P level (1.98 ng/m^3) was found in Shahzada Bagh in north Delhi.

Concentration of Total PAHs and B(a)P is depicted in Figure 2.9. B(a)P levels in residential and industrial areas are depicted in Figure 2.10. Pattern of B(a)P distribution in Delhi is depicted in Figure 2.11.

Table 2.8: Concentrations of SPM-laden Benzo(a)pyrene (ng/m³) in Delhi's air

Location	December 2004	January 2005	Mean
Residential areas			
Siri Fort	2.74	1.87	2.30
Ashok Vihar	3.34	0.78	2.06
Nizamuddin	5.86	2.07	3.96
Residential areas, mean	3.98	1.57	2.77
Industrial areas			
Shahzada Bagh	2.74	1.22	1.98
Shahdara	7.41	1.80	4.60
Industrial areas, mean	5.08	1.51	3.29
Traffic intersection			
ITO (SPM)	7.04	7.58	7.31
Overall	4.86	2.55	3.70





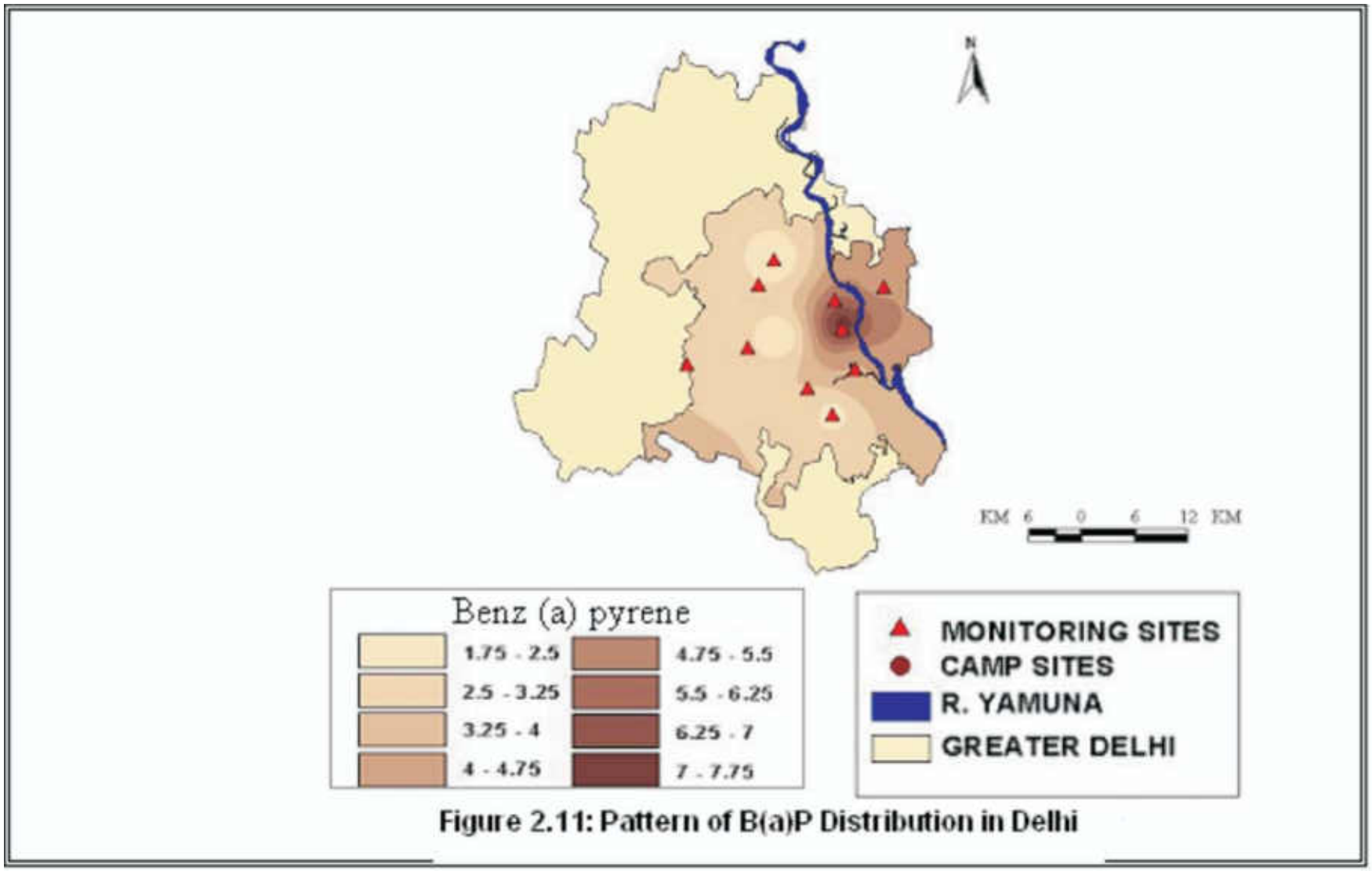


Figure 2.11: Pattern of B(a)P Distribution in Delhi

(f) Volatile organic compounds (VOCs): Benzene and toluene

VOCs contain several organic chemicals like benzene, toluene, xylene (BTX), formaldehyde etc. Out of these, benzene and toluene levels have been measured in some selected areas of Delhi by CPCB. Benzene is a highly toxic compound for human health. Sustained exposure to benzene may cause damage to the bone marrow that may lead to life-threatening diseases like aplastic anemia and leukemia.

(i) Benzene

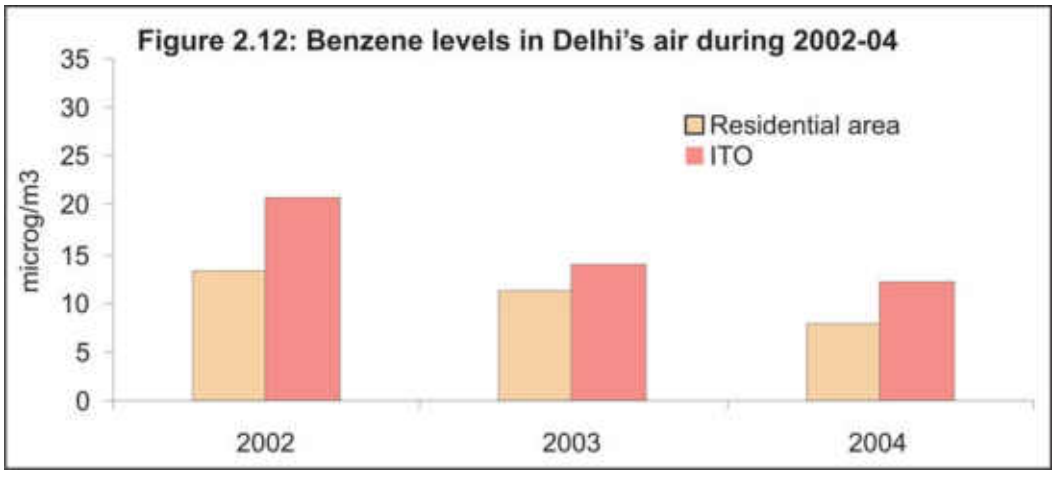
Benzene (mg/m^3) level in Delhi during 2002-2004 are presented in Table 2.9. Analysis of benzene data for the past four years (2002-05) shows a slow but steady decline in airborne benzene level till 2004 in residential localities and traffic intersection area of ITO. Benzene data of residential areas shows that north Delhi (Ashok Vihar and Moti Nagar) had higher benzene level in air than that of east (East Arjun Nagar) and JNU, south Delhi. JNU area had the lowest benzene level in the city. Benzene levels in residential areas and ITO are presented in Figure 2.12.

Table 2.9: Benzene (mg/m^3) level in Delhi during 2002-2004

Area	2002	2003	2004
Traffic intersection area			
ITO crossing	20.7	14.0	12.3
Residential and other areas			
Siri Fort	10.9	11.0	8.1
Ashok Vihar	NA	13.0	8.1
Moti Nagar	NA	13.0	9.5
East Arjun Nagar	NA	11.0	7.3
JNU	NA	6.0	4.7
Town Hall	15.8	13.0	8.8
Residential and other area, mean	13.4	11.2	7.8
Overall	**15.8**	**11.6**	**8.4**

Note: NA- Data not available

Compared with the residential areas, however, benzene concentration was higher in traffic intersection area of ITO. Pattern of Bezene distribution in Delhi is depicted in Figure 2.13.



(ii) Toluene

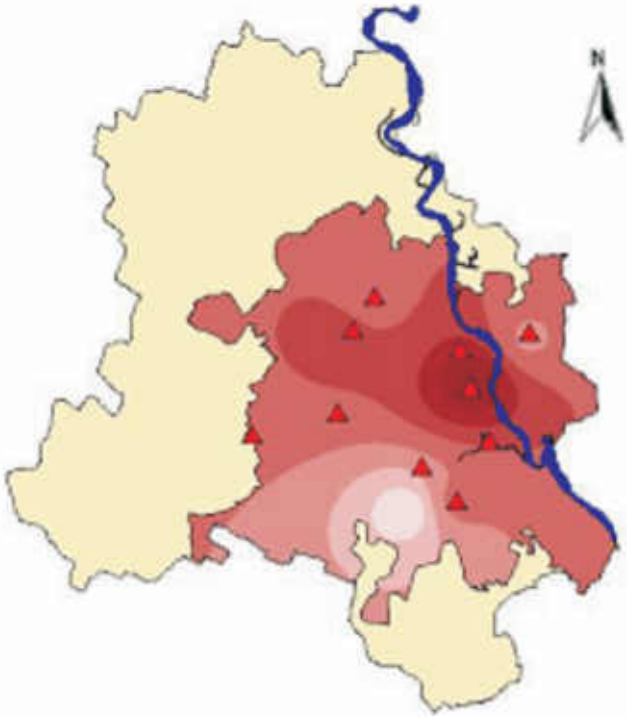
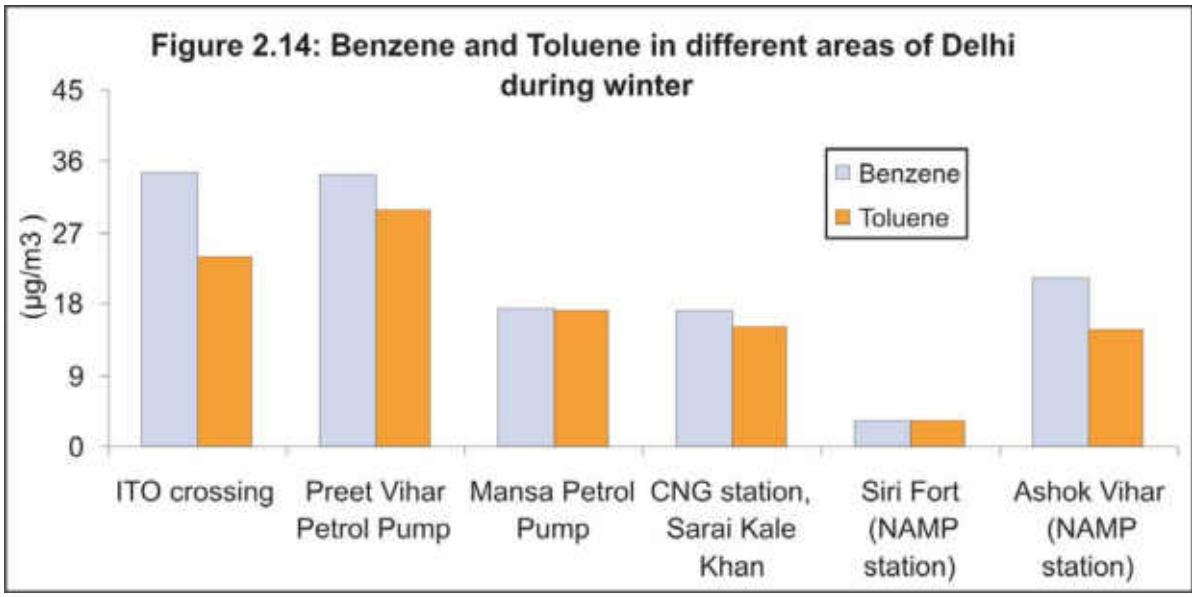


Figure 2.13: Pattern of Benzene Distribution in Delhi

Benzene and Toluene levels in Delhi are presented in Table 2.10. Toluene level was relatively low in residential areas, and higher in traffic intersection area of ITO, and petrol/CNG refueling stations of the city. The petrol pump and CNG refueling stations had benzene: toluene ratio of 1.01-1.15. In contrast, roadside measurements at ITO showed a higher ratio of 1.44. Benzene and Toluene levels in different areas of Delhi are presented in Figure 2.14.

Table 2.10: Volatile organic compound in ambient air in Delhi during winter (Feb 3-10, 2005)

Location	Benzene(mg/m^3)	Toluene(mg/m^3)	Benzene: Toluene
Residential areas			
Siri Fort (NAMP station)	3.39	3.13	1.08
Ashok Vihar (NAMP station)	21.44	14.82	1.45
Petrol Pump			
Preet Vihar Petrol Pump	34.38	29.81	1.15
Mansa Petrol Pump	17.40	17.21	1.01
CNG refueling station			
Sarai Kale Khan	17.15	15.15	1.13
Traffic intersection area			
ITO crossing	34.57	24.02	1.44



(g) Meteorological Data

Meteorological data of Delhi such as temperature, relative humidity, wind speed, wind direction and visibility during the study period was obtained from Indian Meteorological Department at Mausam Bhawan, Lodhi Road, New Delhi and the website wunderground.com and the meteorological data are presented in Table 2.11. For the rural areas of West Bengal data supplied by the regional Meteorological office at Alipore, Kolkata was used.

Table 2.11: Meteorological data of Delhi during 2004-2005.

	Summer(Mar-Jun)	Monsoon(Jul-Oct)	Winter(Nov-Feb)
Temperature (^{0}C)			
Minimum	17.5	22.2	9.7
Maximum	42.6	36.5	26.0
Average	31.4	28.2	18.3
Relative humidity (%)			
Minimum	14.2	47.6	29.0
Maximum	72.9	94.8	97.0
Average	38.7	63.6	64.2
Wind speed (km/h)			
Maximum	29.3	31.5	38.3
Average	5.9	4.6	3.4
Wind direction	WNW / W / WSW	WSW /ENE/ ESE	WSW / ENE
Visibility (km)	3.1	3.3	2.1

Source: wunderground.com

(h) Air Quality of Control Areas

The mean (SD) concentrations of SPM and PM_{10} in air of the control areas of West Bengal were 179.8±24.7 and 82.5±14.2 µg/m^3 respectively. Mean $PM_{2.5}$ concentration of these areas was 45.8±5.9 µg/m^3. Concentrations of SO_2 and NO_2 in these areas during the study period were 5.6± 2.2 and 30.3±5.2 µg/m^3 respectively.

Comparison of the air quality of residential areas of Delhi with that of control areas during 2002-2005 revealed significantly higher levels of all the pollutants in residential areas as compared to control areas. Concentrations of SO_2 and NO_2 were within standards in Delhi as well as in control areas, but Delhi had a substantially higher level as compared with control.

2.3 FINDINGS

1. Mean concentration of total suspended particular matter (SPM) in Delhi's air during 2002-2005 was 370 µg/m^3 in residential areas, 396 µg/m^3 in industrial areas, and 514 µg/m^3 in traffic intersection point at ITO.
2. Mean concentrations of the respirable suspended particulate matter (RSPM, particulate matter with less than 10 µm diameter, PM_{10}) during this period were 142, 165, and 250 µg/m^3 in residential, industrial, and traffic intersection point respectively.
3. Mean concentrations of sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) in Delhi's air during 2002-2005 were 10 and 47 µg/m^3 respectively. In the control areas the concentrations of SO_2 and NO_2 were 5.6 and 30.3 µg/m^3 respectively. The levels of these two pollutants were within the Standard in Delhi as well as in control areas.
4. A small decline in the concentrations of SPM and RSPM in ambient air has been recorded in residential areas of Delhi during 2002-05.
5. The average concentration of benzo(a)pyrene in ambient air of Delhi was 3.70 ng/m^3 during December 2004 and January 2005. The concentration was highest at ITO (7.31 ng/m^3).
6. Benzene levels were 7.8 µg/m^3 in residential areas of Delhi in 2004. Highest concentration was found in traffic intersection point at ITO.

CHAPTER-3.0

PREVALENCE OF RESPIRATORY AND ASSOCIATED SYMPTOMS

3.1 INTRODUCTION

Air pollution is recognized as a major contributor to several respiratory problems. Diseases of the lungs and the airways are often manifested by one or more symptoms that can be easily recognized. Thus, the presence of a particular symptom or a group of symptoms can confirm the presence of an underlying disease in the upper or lower airways. This has been utilized by several epidemiological studies in which the prevalence of respiratory symptoms has been assessed in order to get an insight into the occurrence of a disease in the airways and the lungs. In view of this, prevalence of upper and lower respiratory symptoms in children was assessed through questionnaire survey. Questionnaires are the most commonly used subjective instrument of measurement in respiratory epidemiology. They represent a convenient tool of investigating large sample population owing to low cost, easy to use by the investigator, and good compliance of the subjects (Liard and Neukirch, 2000).

3.2 MATERIALS AND METHODS

(a) Subjects

The study was conducted between December 2002 and August 2005. The sample areas were divided into different homogeneous strata based on air pollution level. Then sampling was done from each stratum randomly. Thus stratified random sampling procedure was followed under the general plan of Simple Random Sampling Without Replacement method (Rao, 1989). A total number of 16,164 children aged between 4-17 years participated in this study.

(i) Urban children

Among the participants, 11,628 school-going children were enrolled from 36 schools situated in different parts of Delhi. Out of the 11,628 participants from Delhi, 7757 (66.7%) were boys and 3,871 (33.3%) were girls. Thus, boys: girls ratio was 2.00.

The schools were selected on the basis of following considerations:

- Located within 3 km radius of the air quality monitoring stations of Central Pollution Control Board (CPCB) and National Environmental Engineering Research Institute (NEERI), so that health data of the children could be analyzed vis-à-vis air quality.

- Represent every section of the people with comparable representations of children from low, medium and high socio-economic status.

The list of the schools and number of children examined are presented in Table 3.1.

Table. 3.1: Number of children and Names of the Schools of Delhi where the study has been conducted

S.No.	Name of the School	Area	No.
1	Sarvodaya Vidayalaya, Shakti Nagar	North	64
2	Andhra Education Society, New Ashok Nagar *	North	127
3	Mahaveer Sr. Model School, Sangam Park Ext. *	North	240
4	Montfort S.S. School, Ashok Vihar *	North	602
5	Bengali S.S. School, Civil Lines *	North	670
6	Mata Saheb Kaur Public Shool, Kalyan Vihar *	North	65
7	Siwan Public School, Jawahar Nagar *	North	21
8	Nagar Nigam School, Sec. 7, Rohini *	North	25
9	Maharaja Agrasain Public School, Ashok Vihar *	North	385
10	N.P.Bengali Girls' S.S. School, Gol Market	Central	345
11	D. A. V. Boys S.S. School, Chitragupta Road	Central	303
12	S.G.T.B. Khalsa Boys School, Dev Nagar	Central	446
13	Govt. Boys S.S. School, Rani Jhansi Road	Central	246
14	DAV Sr. Secondary School, Pusa Road	Central	364
15	Ramjas School, Pusa Road *	Central	284
16	Guru Harkishan S.S. School, Karol Bagh *	Central	335
17	Ramjas Girls' School, Daryaganj	Central	133
18	Ramjas Boys', School, Daryaganj	Central	408
19	Bal Bharati Public School, Sir Ganga Ram Road *	Central	449
20	M.B.D.AV. S.S. School, Yusuf Sarai *	South	666
21	Navyug School, Sarojini Nagar *	South	362
22	St. Pauls School, Hauz Khas *	South	103
23	Cambridge School, Srinivas Puri *	South	117
24	St. Mary's School, Safdarjung Enclave *	South	213
25	Delhi Police Public School, Safdarjung Enclave *	South	256
26	Bidhan Chandra Vidyalaya, Moti Bagh-I *	South	349
27	Ramjas School, R.K. Puram *	South	312
28	Gyan Bharati School, Saket *	South	435
29	Kendriya Vidyalaya, East Arjun nagar *	East	730
30	Sarvodaya Vidyalaya, Gandhi Nagar *	East	37
31	Lakshmi Public School, East Arjun Nagar *	East	971
32	Tagore Public School. Naraina Vihar *	West	202
33	J.L.D.A.V. Public School, Paschim Vihar *	West	410
34	Blooming Buds Public School, New Moti Nagar *	West	245
35	Shivmandir S.B Vidyalaya, Jaidev Park *	West	106
36	Sukho Khalsa S.S. School, Janak Puri *	West	602
	Total	**Delhi**	**11, 628**

** Co-educational school*

(ii) Rural children (control)

A total number of 4536 children from 17 schools of rural areas of Uttaranchal and West Bengal where the level of ambient air pollution was much less for the absence of air polluting industries and lesser number of motor vehicles were enrolled in this study as control. There were 2 schools in Khirsu and Kotdwar in Pauri-Garhwal district of Uttaranchal, and 15 schools in Cooch Behar, South Dinajpur, Maldah, North and South 24-Parganas, and West Medinipur districts of west Bengal. To make the urban (Delhi) and control children comparable with respect to fuel use at home,

children from LPG-using homes were preferred. Boys constituted 65.0% (2950 of 4536) and girls 35.0% (1586 of 4536) of the control group. The boys: girls' ratio was 1.86. Name of the schools are presented in Table 3.2.

Table 3.2: Names of the schools of Uttaranchal (UT) and West Bengal (WB) from where the children of control group were examined.

S.No.	Name of the School	District	State	No.
1	Govt. Inter College, Khirsu *	Pauri-Garhwal	UT	171
2	Motherland Academy, Kotdwar *	Pauri-Garhwal	UT	127
3	Manikchak Shiksha Niketan, Manikchak *	Maldah	WB	450
4	Gourio High School, Gour *	Maldah	WB	343
5	Kaliaganj Parbati Sundari High School *	North Dinajpur	WB	438
6	Prachya Bharati Vidyapith, Balurghat *	South Dinajpur	WB	145
7	Khadimpur Girls High School, Balurghat	South Dinajpur	WB	173
8	Sunity Academy, Cooch Behar	Cooch Behar	WB	256
9	Maharaja N.N.High School, Cooch Behar	Cooch Behar	WB	179
10	Toofanganj Ila Devi Girls' High Schol	Cooch Behar	WB	200
11	Dinhata Girls' High School, Dinhata	Cooch Behar	WB	257
12	Dinhata High School, Dinhata	Cooch Behar	WB	167
13	Taki Govt High School, Taki *	N. 24-Parganas	WB	190
14	Taki S.L. Girls' High School, Taki	N. 24-Parganas	WB	200
15	Sundarban JKS School, Rudranagar, Sagar Island*	S. 24-Parganas	WB	315
16	N.N. High School, Natendrapur, Sagar Is*	S. 24-Parganas	WB	488
17	Mohar Brahmamoyee H.S., Sabang *	West Medinipur	WB	437
	Total	**Control**		**4536**

** Co-educational school*

Photographs of schools where health camps were conducted are presented in Figure 3.1 and 3.2.

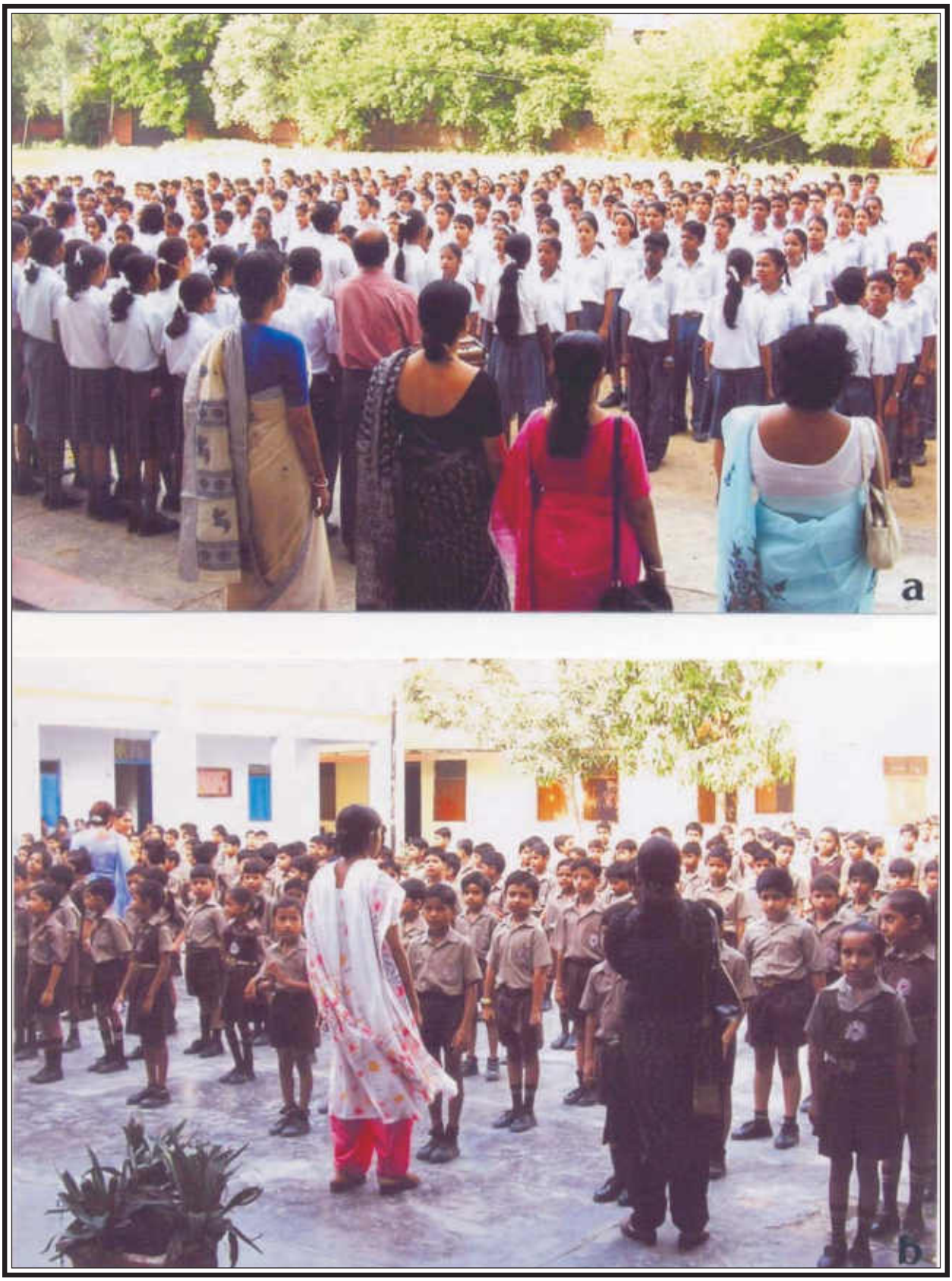


Figure 3.1: Chilren Health Camp in (a) Bidhan Chandra Vidyalaya, Moti Bagh, New Delhi and (b) D.A.V. Senior Secondary School, Pusa Road, New Delhi

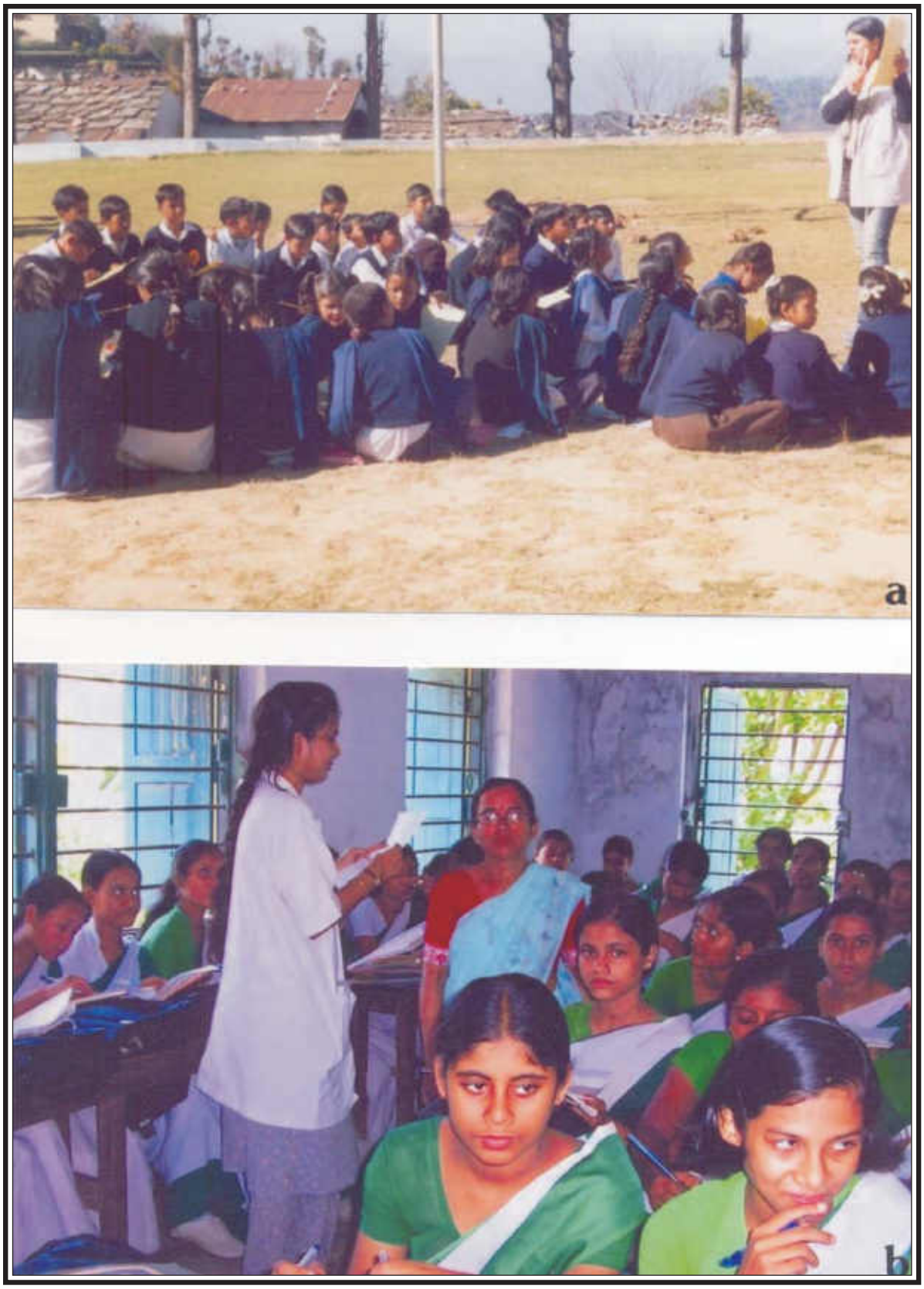


Figure 3.2: Children Health Camp at (a) Government Inter College, Khirsu, Uttaranchal and at (b) Taki S.L. Girls School, 24 Paraganas (N), West Bengal.

(b) Questionnaire Survey for Respiratory Symptoms

Respiratory health of the children has been assessed by idetermining the prevalence of respiratory symptoms; by measuring the lung function and by evaluating the cellular lung response through sputum cytology and cytochemistry. Respiratory symptoms prevalence was determined through a structured respiratory symptomlogy questionnaire based on the questionnaire developed by the British Medical Research Council (BMRC) Cotes, 1987, American Thoracic Society (ATS) and National Heart and Lung Institute (NHLI) Division of Lung Diseases (DLD) questionnaire (ATS-DLD-78-C; Ferris, 1978), and the International Union Againt Tuberculosis and Lung Disease (IUATLD) bronchial symptoms questionnaire (1984) [Burney et al., 1989]. The questions mainly addressed respiratory symptoms, such as attacks of shortness of breath, wheezing, dry or wet cough and chest tightness. The questions were generally formulated to elicit information covering the last 12-month period of life of the child. It also included extended items on asthma, asthma-like symptoms, and allergies.

After obtaining consent from the school Principal, respiratory health questionnaires were distributed among the school children. The children were instructed through class teachers to take home the questionnaire and ask their parents or guardians to fill these up. Filled up questionnaire forms signed by the parent or guardian and countersigned by the class teacher were collected from the respective schools. Information was obtained regarding:

- Age, sex, height and weight, calculated body mass index in kg/m^2
- Prevalence of upper respiratory symptoms (URS) like sinusitis, rhinitis (running or stuffy nose), common cold and fever and sore throat and in past 3 months and one year
- Prevalence of lower respiratory symptoms (LRS) like chronic wet or dry cough, wheeze, heaviness in chest or chest pain, disturbed sleep due to breathing problem in past three months and one year
- Prevalence of asthma symptoms such as history of dispend attacks associated with wheezy breathing at any time in the last twelve months (Golshan et al., 2002) and medically diagnosed asthma established from parents' answer to the questions "Has a doctor ever told you that your child had asthma?" (Eisner, 2002).
- Prevalence of symptoms related to carbon monoxide exposure like headache, dizziness and eye irritation
- Information was also collected for congenital abnormalities, recent illness and history of medication, if any.
- Schools' proximity to main road
- Type of cooking fuel use at home, education level of the parents, average family income, passive smoking as defined by number of smokers at home
- The amount of time the child spends outside, their overall activity and behavior like responsiveness, physical activity, memory, aptitude for sports, music, and reading; personality, hobby etc.

(i) Establishment of socio-economic status

Socio-economic status (SES) of the child's family was ascertained following the procedure of Srivastava (1978) and Tiwari et al., (2005) by scoring 0 to 10 of seven indicators: house, material possession (household gadgets, conveyance etc.), education of the parent or guardian (score 0

for illiterate, 10 for Ph.D., M.D, M.E. etc.), occupation of the parents/guardian (0 for no gainful employment, and 10 for Class I or equivalent jobs), monthly income of the family (per capita income of the family Rs.500/- and below got a score of 2, and >15,000 in urban and >10,000 in rural got a score of 10), cost of the land/house possessed by the family (0 for no land/house, 10 for costing >50 lakh), social participation and understanding. Scores of seven profiles were added and classified into 3 categories-low, medium and high.

(ii) Statistical analysis

The collected data were processed and analyzed in EPI info 6.0 and SPSS (Statistical Package for Social Sciences) software. Chi-square test was done for dichotomous or multinomial qualitative variables, and the Student's t-test for quantitative variables of normal distribution and homogeneous variances. A descendant stepwise logistic regression adjusted over potential confounding variables was carried out for multivariate analysis.

(iii) Ethical clearance

Institutional Ethics Committee of Chittaranjan National Cancer Institute (CNCI), Kolkata approved the study protocol.

3.3 RESULTS

(a) Response to questionnaire survey

12,754 questionnairs were filled by the parents, but 1126 were not accepted due to incomplete filling, resulting in 11,628 completely filled in questionnaires.

For the control group of children in rural areas of West Bengal and Uttaranchal, altogether 4875 questionnaires were filled but 339 were excluded due to incomplete filling, resulting in 4536 completely filled in questionnaires.

(b) Demographic characteristics

The characteristics of both groups of children are presented in Table 3.3. It is evident that the children of Delhi (case) and rural areas of Uttaranchal and West Bengal (control) were comparable ($p>0.05$) with respect to age, gender, BMI, parental smoking, religion and food habit. However, the control group had lower parental education and family income than that of Delhi's ($p<0.05$). Moreover, a substantially increased number of households of control children ($p<0.05$) used biomass fuel such as dung, firewood and agricultural refuse (dried leaves, hay, jute stick etc.) for domestic cooking

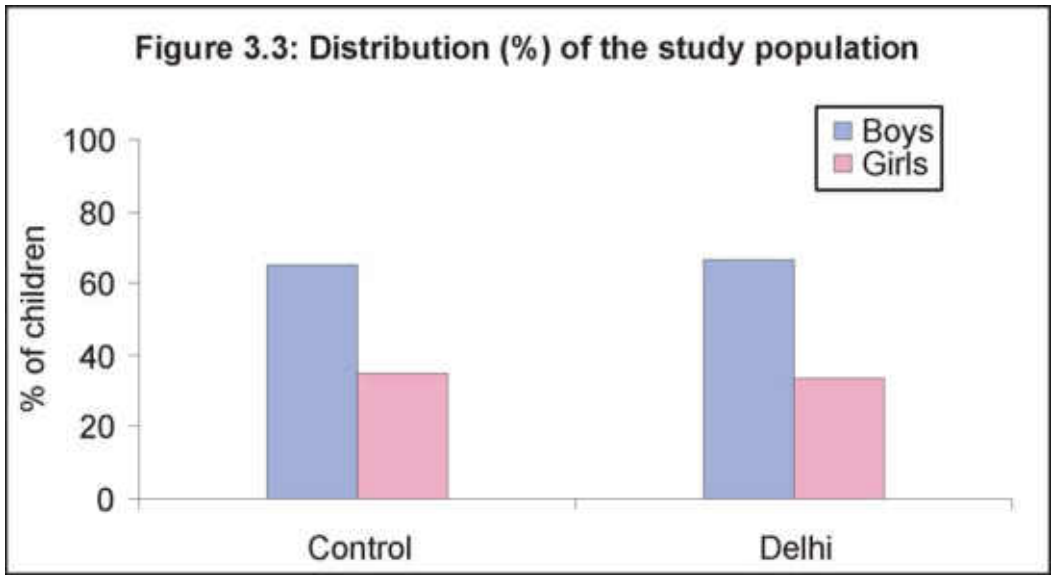
Table 3.3: Demographic Characteristics of the Children.

Characteristics	Control(n=4536)	Delhi (n=11628)	p-value
Median age in years	13.2	13.0	NS
Boys: Girls	1.86	2.0	NS
Height in cm ± SD	149.5 ± 10.5	151.5 ± 11.3	NS
Mean body weight in kg ± SD	38.0 ± 10.3	42.5± 12.9	NS
Mean BMI in kg/m^2 ± SD	16.8 ± 3.8	18.2± 3.9	NS
Parental smoking (%)	28.2	26.8	NS
Parents' education (%)			
Up to 5 years of schooling	11.8	9.8	<0.05
10 years of schooling	37.1	30.8	<0.05
Graduate	47.0	52.7	<0.05
Postgraduate	3.6	6.1	<0.05
Professional	0.5	0.6	NS
Religion (%)			
Hindu	88.6	87.8	NS
Muslim, Sikh, Jain and others	11.4	12.2	NS
Food habit (%)			
Vegetarian	4.7	6.4	NS
Mixed	95.3	93.6	NS
Cooking fuel use at home (%)			
LPG	94.8	99.4	<0.05
Kerosene	0.5	0.4	NS
Biomass	4.7	0.2	<0.05
Average family income/month (Rs.)	4700	9800	<0.05

NS, statistically not significant

(c) Gender

Among the 11,628 school-going children participated in this study, 7757 were boys (66.7%) and 3871 were girls (33.7%). In 4536 control children, 2950 (65%) were boys and 1586 (35%) were girls as depicted in Figure 3.3.



(d) Age

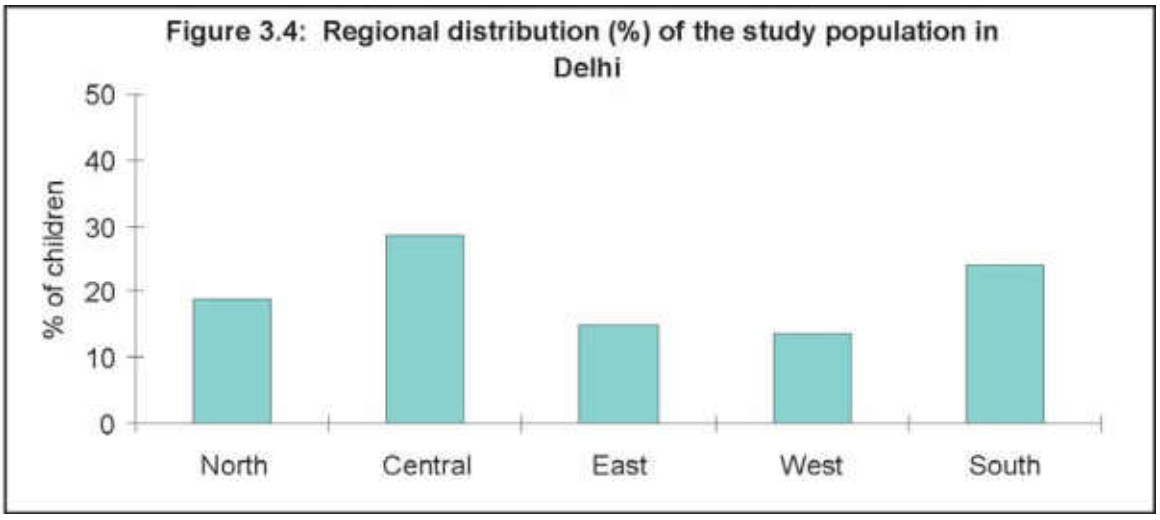
The age of the children varied between 4 and 17 years. Majority of these children (around 55%) both in urban and rural groups were 12 to 14 years old as presented in Table 3.4.

Table 3.4: Distribution (%) of children in different age groups

Age in years	Control	Delhi
4-5	0.1	0.1
6 - 8	0.9	1.2
9 - 11	14.0	15.3
12 – 14	55.7	54.2
15 – 17	29.2	29.2

(e) Regional distribution in Delhi

About 28% of children were from central Delhi, and 24% was from southern part of the city. Children from north, east and west Delhi constituted 18.9%, 14.9%, and 13.5% respectively of the study group as depicted in Figure 3.4.



(f) Seasonal distribution

The study was conducted in all three seasons i.e. summer, monsoon and winter. Out of the total 11628 participants in Delhi, 26.1% children were examined in winter, 19.6% in summer and 54.3% in monsoon. To minimize the impact of seasonal variation on health outcome, the rural children were examined simultaneously and the proportion of children examined in each season was made comparable with that of urban group. For instance, 20.8% of rural children were examined in summer, 27% in winter, and 51.1% in monsoon.

(g) Socio-economic status (SES)

About 32% of urban children participated in this study (3702 out of 11628) belonged to families of high SES. In contrast, only 14% rural children (647 out of 4536) had high SES ($p<0.05$). On the other hand, 35.3% (1604 of 4536) of control children were from families that had low social and

economic status against 21.2% participants in Delhi (2463 out of 11628) with similar background. About half of the children in control and 47% in Delhi belonged to medium SES.

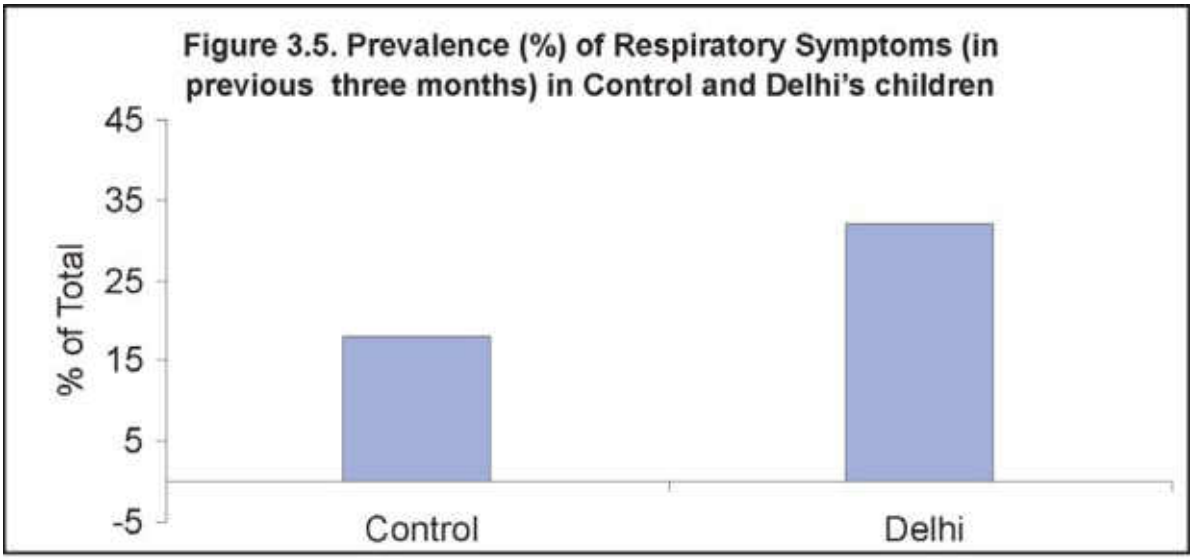
3.3.1 Prevalence of Respiratory Symptoms

The prevalence of respiratory symptoms was recorded through questionnaire survey and personal interview by the researchers. One or more respiratory symptoms were present in the past 3 months in nearly one-third (32.1%) of Delhi's children (3732 out of 11628). In contrast, 18.2% of rural children (827 out of 4536) had experienced respiratory symptoms (Table 3.5, Fig. 3.5). The difference in period prevalence (in 3 months) of respiratory symptoms between urban (Delhi) and rural (Control) children was highly significant ($p<0.05$) in Chi- square test.

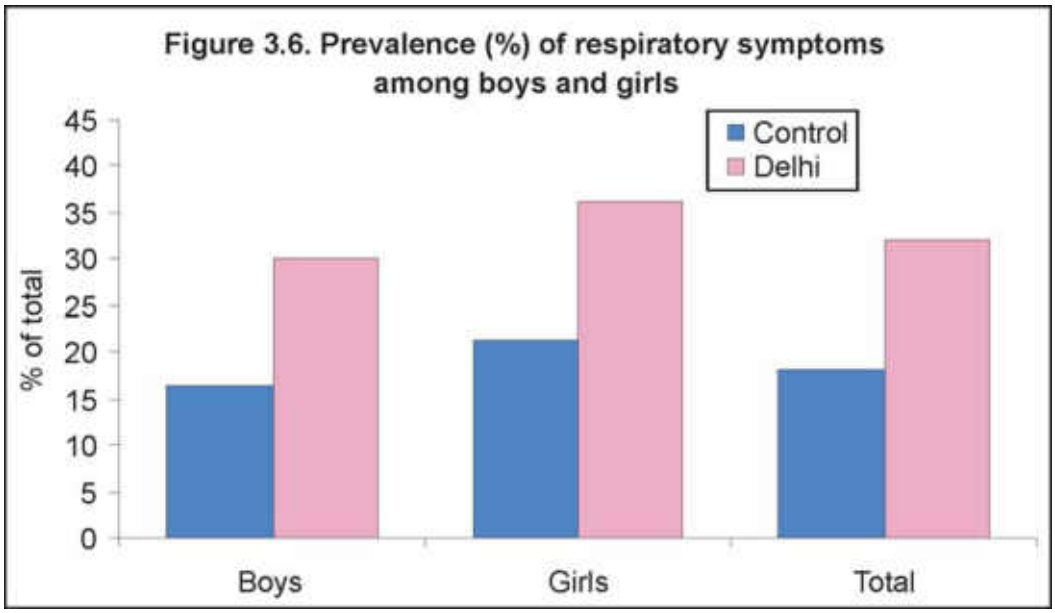
Table 3.5: Prevalence (%) of respiratory symptoms in children in past three months

Group	Control	Delhi
Boys	16.3	30.0*
Girls	22.4	36.3*
Overall	18.2	32.1*

*Many children had more than one symptom; *p<0.05 compared with control in Chi- square test*



The respiratory symptoms were more prevalent in girls than in boys. This is true both in rural and urban settings. For example, respiratory symptoms were present in 36.3% of girls in Delhi against 30% of the city's boys. Similarly, 21.2% of girls from rural areas had respiratory symptoms compared with 16.3% of rural boys (Fig. 3.6). The girls: boys ratio in symptom prevalence was 1.21 in Delhi and 1.3 in rural areas included in this study. Thus, the gender difference in the prevalence of respiratory symptoms was wider in rural areas. The prevalence of respiratory symptoms in children of Delhi also correlated with the PM_{10} level. In summary, respiratory symptoms were significantly more prevalent among the children of Delhi compared with their rural counterparts, and girls suffered more than the boys in both rural and urban settings.



Respiratory symptoms were broadly classified into two: upper respiratory symptoms (URS) and lower respiratory symptoms (LRS). Delhi's children exhibited greater prevalence of both URS (23.1 vs. 14.6%) and LRS (17.0 vs. 8.0%) than the controls (Fig. 3.7). The prevalence of respiratory symptoms (RSC) varied in different parts of the city. It was maximum in the residents of Central Delhi where the level of particulate pollution was also high. The concentration of PM_{10} was least in South Delhi and this reflected in the prevalence of RSC in the residents of this part of the city; prevalence being the lowest. Respiratory symptoms, both URS as well as LRS, was more prevalent during winter followed by summer and monsoon, corresponding with the concentration of particulate matter, concentration being highest during winter and lowest during monsoon (Table 3.6; Fig. 3.8).

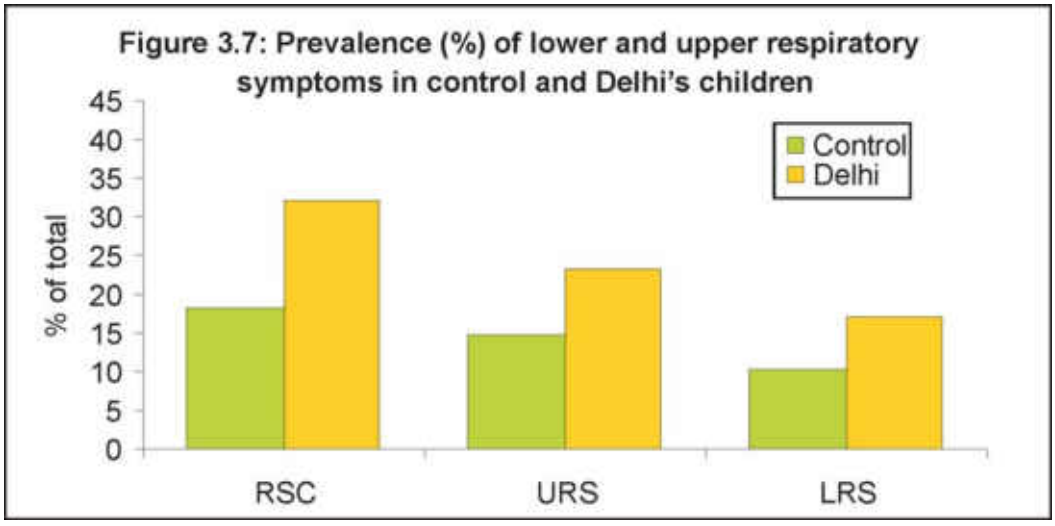
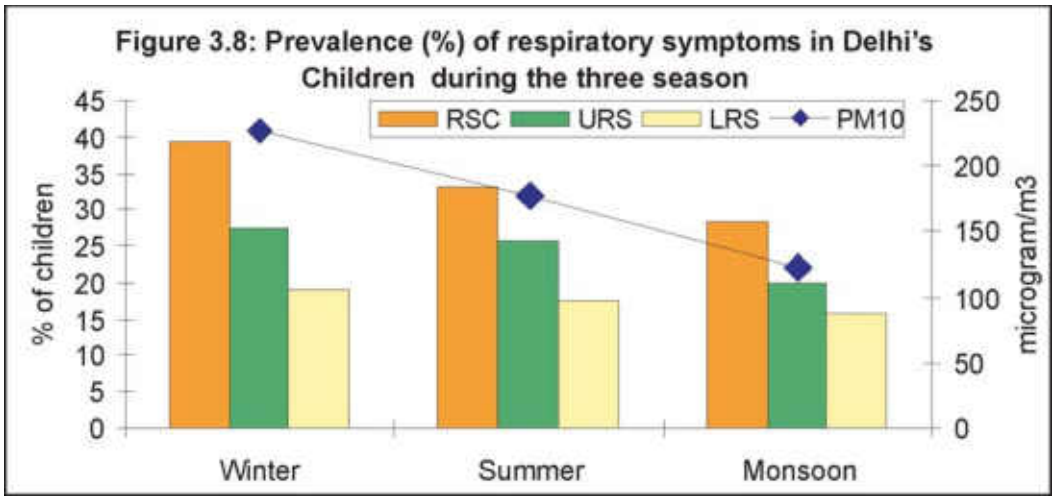


Table 3.6: Prevalence (%) of respiratory symptoms in different seasons

	Winter(3035)	Summer(2279)	Monsoon(6314)
Respiratory symptoms (RSC)	39.3	33.0	28.3
Upper respiratory symptoms (URS)	27.5	25.5	20.1
Lower respiratory symptoms (LRS)	19.2	17.5	15.8



(a) Prevalence of Upper Respiratory Symptoms (URS)

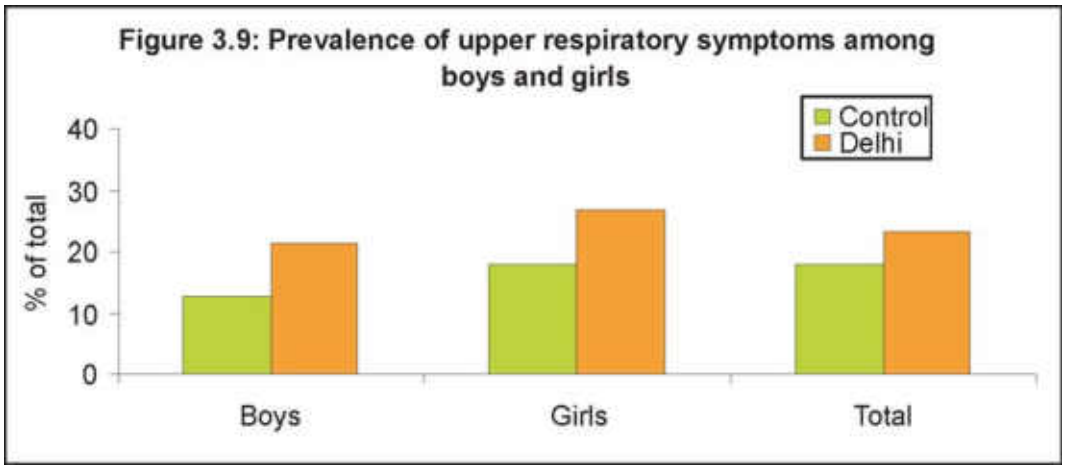
The prevalence of five URS -sinusitis, rhinitis (running or stuffy nose), sneezing, sore throat and common cold with fever were the most prevalent examined in this study. In general, 23.1% children of Delhi had experienced one or more of these URS in the past 3 months. In comparison, 14.6% of control children had URS. The difference in the prevalence of URS between Delhi and control group was significant ($p < 0.05$) in Chi-square test (Table 3.7).

Table 3.7: Prevalence (%) of upper respiratory symptoms in past three months

Group	Control	Delhi	P value
Boy	12.8	21.4	<0.001
Girl	18.0	26.5	<0.01
Overall	14.6	23.1	<0.001

Many children had more than one symptom

URS was more prevalent in girls than in boys in Delhi (26.5 vs. 21.4%) as well as in control group (18.0 vs. 12.8%, $p<0.05$). The boys: girls ratio of URS prevalence was 1.24 in Delhi and 1.40 in control, implying that URS had female predominance especially in rural areas (Fig. 3.9).



(i) Prevalence of Sinusitis

Sinusitis is an inflammation of one or more of the paranasal sinuses. The symptoms are nasal congestion, facial pain, headache, fever, cough and purulent discharge. Sinusitis can be subdivided into acute (symptoms present for less than 4 weeks), sub acute (symptoms for 4-8 week), chronic (symptoms for 8 week or longer of varying severity) and recurrent (3 or more episodes of acute sinusitis per year). The diagnosis is based on symptoms, clinical history and physical examination of the child. Sinusitis was present in 3.4% children of Delhi compared with 3.2% of control children (Table 3.8), suggesting little difference between Delhi and control groups.

Table 3.8: Prevalence of sinusitis among schoolchildren

Group	Prevalence in past 3 months (%)		
	Boys	Girls	Total
Control (n=4536)	3.2	3.1	3.2
Delhi (n=11628)	3.5	3.2	3.4

Sinusitis prevalence was slightly higher in boys than in girls both in Delhi and control groups, but the difference were not significant. Children from west Delhi showed remarkably higher prevalence of sinusitis (5.8%) compared with children from north (3.0%), south (2.9%), east (3.0%) and central Delhi (3.6%). The symptom was more common during monsoon (3.9% against 3.0% in winter and 2.6% during summer). Children from middle (3.8%) and low SES (3.7%) had greater prevalence of sinusitis than children from high SES (2.6%). The prevalence of sinusitis increased progressively with age (Table 3.13, Fig. 3.13).

(ii) Running or stuffy nose

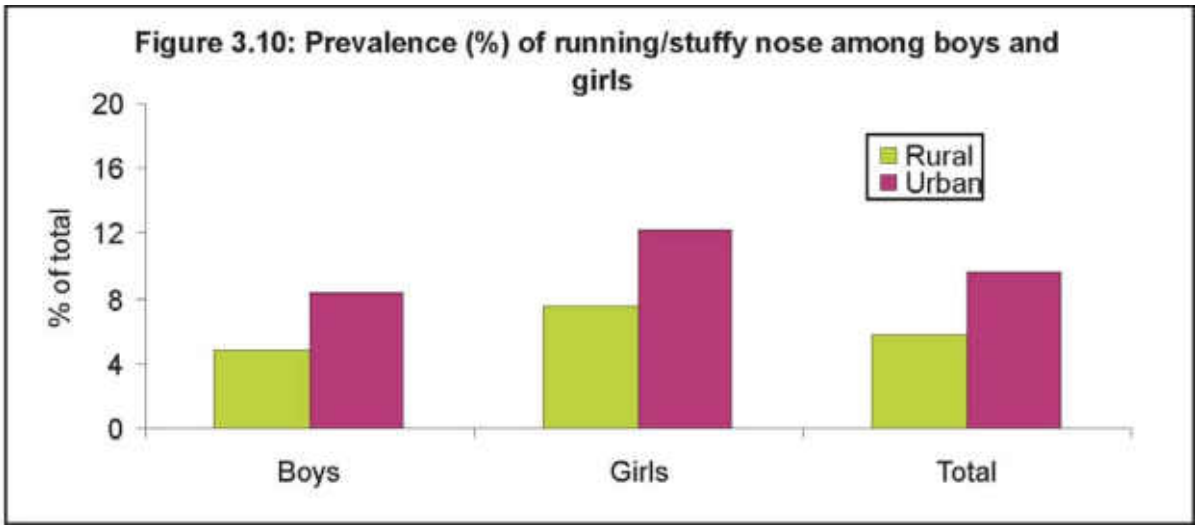
Running or stuffy nose is associated with rhinitis. In nearly 90% cases rhinitis in children is caused by hypersensitivity i.e. allergic reactions to a host of environmental allergens. The symptom was present in 9.6% children of Delhi (1116 out of 11628) compared with 5.8% (263 out of 4536) in control, and the difference was highly significant ($p<0.05$, Table 3.9).

Table 3.9: Prevalence of running or stuffy nose among children in past three months

Group	Prevalence (%)		
	Boys	Girls	Total
Control	4.8	7.5	5.8
Delhi	8.3*	12.2*	9.6*

**p<0.05 compared with respective control in Chi-square test*

Girls suffered more from this problem than the boys both in Delhi and in rural areas. The affected girls: boys ratio was 1.56 in control and 1.47 in Delhi (Fig. 3.10).



Children from west (12.9%), east (12.5%) and central Delhi (11.2%) suffered more from running or stuffy nose than children from north (8.5%) and south Delhi (4.8). The symptom was most prevalent during winter (10.3%) but the prevalence declines in summer (9.2%) and especially during monsoon (7.2%; OR= 1.85 and 95% CI, 1.28 – 2.46 for winter vs. summer). Children from low SES had highest prevalence of running nose both in Delhi (14.6%) and in control group (7.0%), while children from high SES had lowest prevalence (6.5% in Delhi and 3.8% in control). Its prevalence was more in younger age group especially in 6-8 (12.5%) and 9-11 years (11.3%) of age (Table 3.13, Fig. 3.13).

(iii) Sneezing

Sneezing, a respiratory allergy was found in 1058 children of Delhi (9.1%) and 236 in control group (5.2%). Thus, Delhi's children had 1.7-times more prevalence of sneezing than control, and the difference was highly significant ($p<0.001$). Like running or stuffy nose, sneezing was more prevalent in girls both in rural and urban settings (Table 3.10). In control group, 6.4% of the girls (102/1586) had this symptom compared with 132 (4.5%) of the boys ($p<0.05$). In Delhi, 426 girls (11%) and 632 boys (8.1%) had this symptom ($p<0.05$).

Table 3.10: Prevalence of sneezing among children in past three months

Group	Prevalence (%)		
	Boys	Girls	Total
Control	4.5	6.4	5.2
Delhi	8.1*	11.0*	9.1*

**p<0.05 compared with respective control in Chi-square test*

Prevalence of sneezing was highest in children of the age group age group of 9 – 11 (11.2%) and 6-8 years (9.3%, Table 3.13, Fig. 3.13), those residing in west Delhi, and during winter (9.4%) and monsoon (9.0%, Fig. 3.14). Frequency of the symptom was identical in children belonging to low and medium SES (9.2%) and lightly lowers in high SES (8.9%, Figure 3.14).

(iv) Sore throat

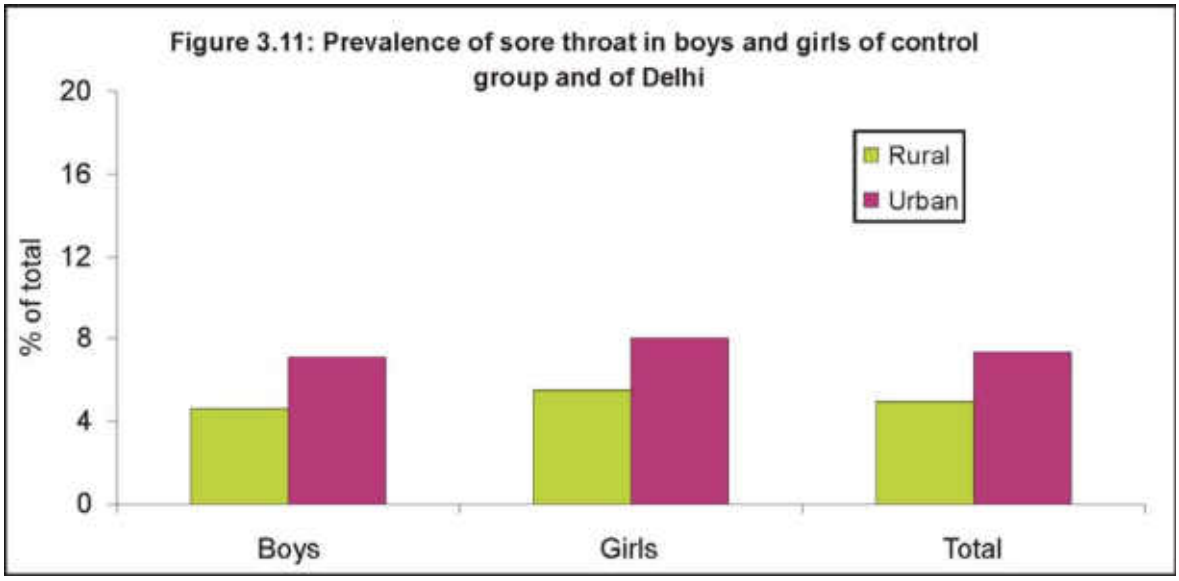
Sore throat was reported by 861 (7.4%) children of Delhi compared with 223 (4.9%) of controls (Table 3.11). The difference between Delhi and control group in this regard was significant ($p<0.05$).

Table 3.11: Prevalence of sore throat among children in past three months

Group	Prevalence (%)		
	Boys	Girls	Total
Control	4.6	5.5	4.9
Delhi	7.1*	8.0*	7.4*

**p<0.05 compared with respective control in Chi-square test*

Sore throat was slightly more prevalent among girls, but the difference was not significant (Fig. 3.11). The prevalence was highest during winter (9.3%), followed by summer (7.2%) and monsoon (5.9%). and children from west (6.7%) and east Delhi (6.3%) had higher prevalence than did children from rest of the city.



Children belonging to the age group of 12 – 14 years showed highest prevalence (8.6%) of sore throat (Table 3.13, Fig. 3.13). The symptom was most prevalent in children from low SES both in Delhi (9.1%) and control group (6.4%), while lowest prevalence was found in high SES (2.0% in control and 5.8% in Delhi).

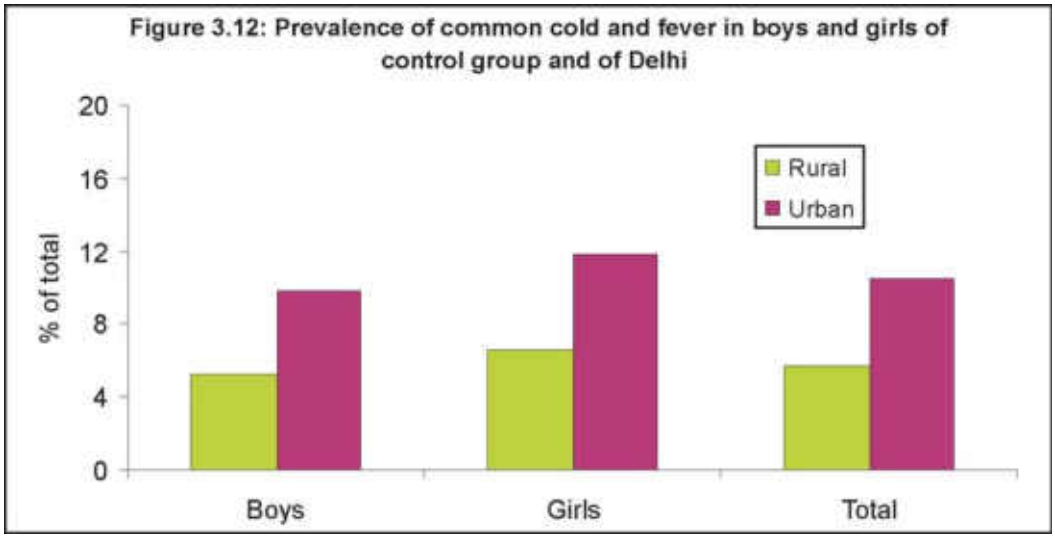
(v) Common cold and fever

More than ten per cent children of Delhi (1221/11628) suffered from common cold and fever in the past 3 months compared with 259/4536 (5.2%) in control ($p<0.01$, Table 3.12). The symptom was more prevalent among girls than in boys (Fig. 3.12). Children from west (14.4%) and East Delhi (11.4%) had relatively higher prevalence while the symptom was least prevalent among the children from Central Delhi (4.5%).

Table 3.12: Prevalence of common cold and fever among children in past three months

Group	Prevalence (%)		
	Boys	Girls	Total
Control	5.2	6.6	5.2
Delhi	9.8*	11.8*	10.5*

**p<0.05 compared with respective control in Chi-square test*



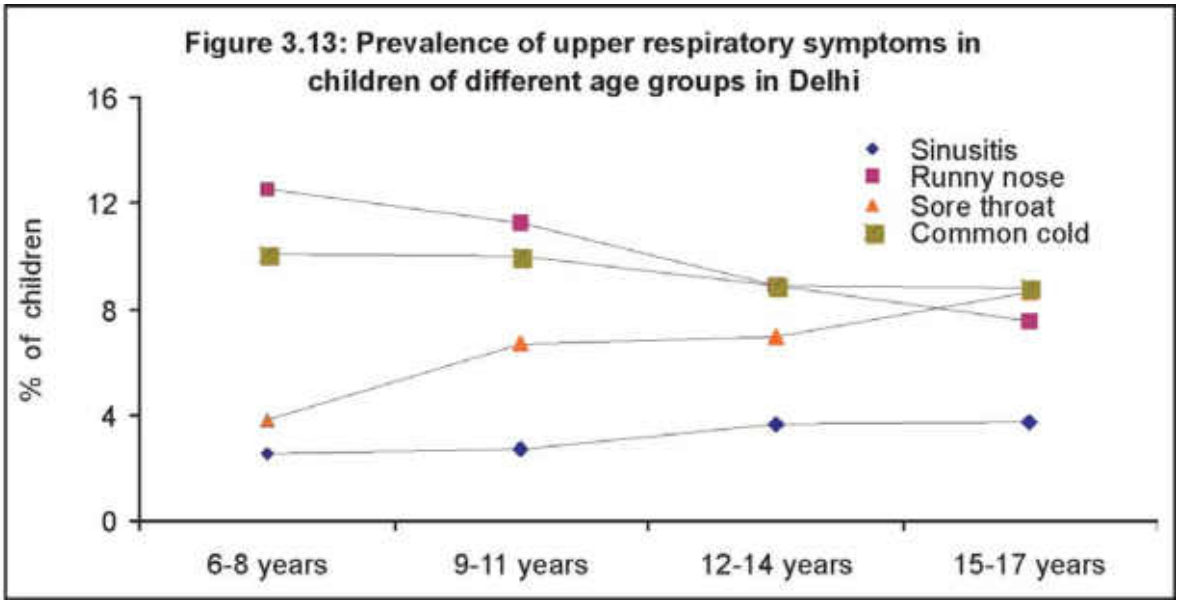
The symptom was highest during the winter months (12.2%) when the PM_{10} level in ambient air was highest. The prevalence declined to some extent in summer (8.9%) and more so in monsoon (7.7%, Fig. 3.14). Children of younger age group (6-11 years) had more symptoms than 12-17 year-old children. For example, 13.2 and 12.5% children had common cold in previous three months compared with 9.9 and 9.4% children aged 12-14 and 15-17 years respectively (Table 3.13, Fig. 3.13). Prevalence of common cold and fever was inversely associated with socio-economic conditions as children from low (10.7%) and medium SES in Delhi (10.0%) suffered more than children belonging to high SES (8.1%; Fig. 3.15). Similarly, in the control group, the symptom was highest in low (6.6%) and lowest in high (2.6%) SES.

(vi) URS in different age groups among the children of Delhi

In general, children belonging to younger age groups (6-11 yr) suffered more from running/stuffy nose and common cold, while children aged more than 11 years had greater prevalence of sinusitis and sore throat (Fig. 3.13, Table 3.13).

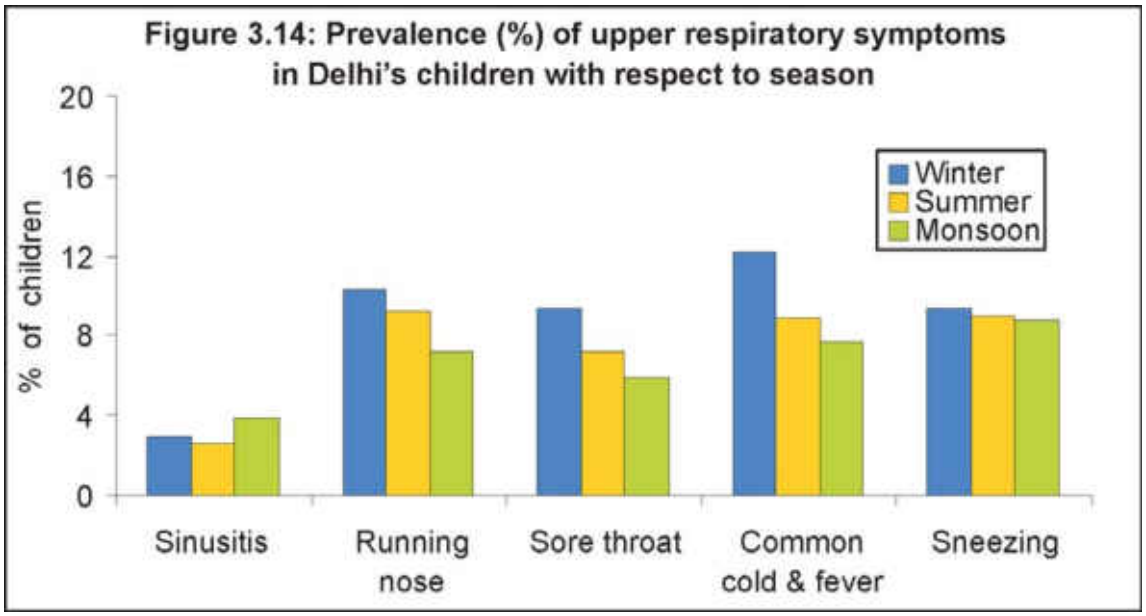
Table 3.13: Prevalence (%) of URS in different age groups of Delhi's children

Symptoms	6-8 years	9-11 years	12 – 14 years	15 – 17 years
Sinusitis	2.5	2.7	3.6	3.7
Running nose	12.5	11.3	8.9	7.5
Sore throat	6.7	6.9	8.6	7.3
Sneezing	9.3	11.2	8.3	5.5
Common cold	13.2	12.5	9.9	9.4



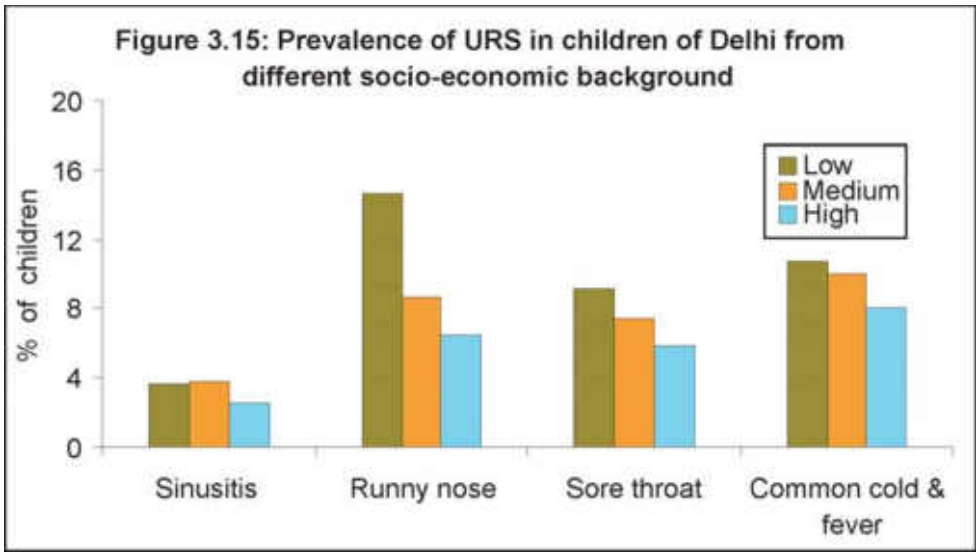
(vii) Prevalence of URS in Delhi in relation to season

Except for sinusitis which was most prevalent during monsoon, the remaining four symptoms under URS viz. running/stuffy nose, sore throat, sneezing and common cold were more prevalent in children during winter (Fig. 3.14).



(viii) Prevalence of URS in Delhi in relation to socio-economic status

URS was more prevalent in children from families with low SES both in Delhi and control group (Fig. 3.15).



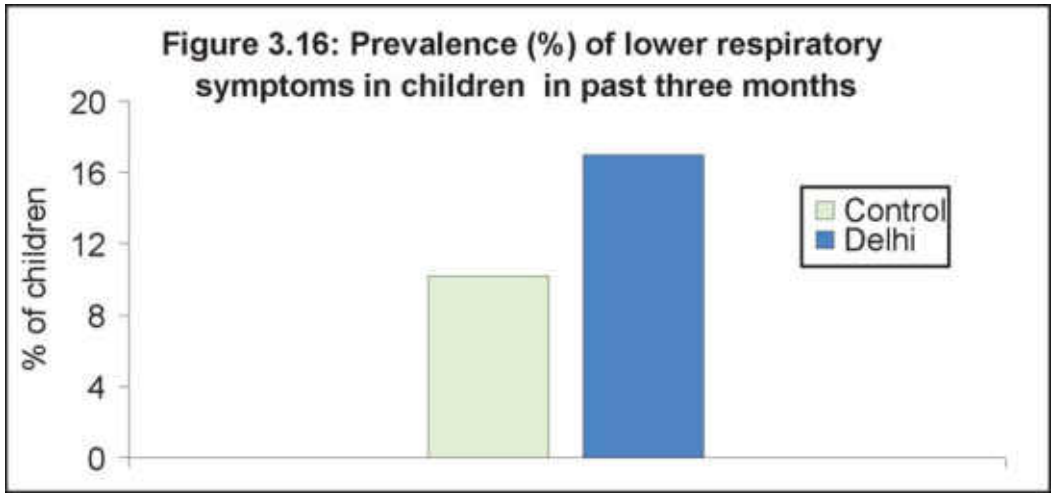
(b) Prevalence of lower respiratory symptoms (LRS)

The prevalence of six LRS, viz. dry cough, cough with phlegm, wheeze, breathlessness on exertion, chest discomfort and sleep disturbance due to breathing problem in past three months was examined by questionnaire survey.

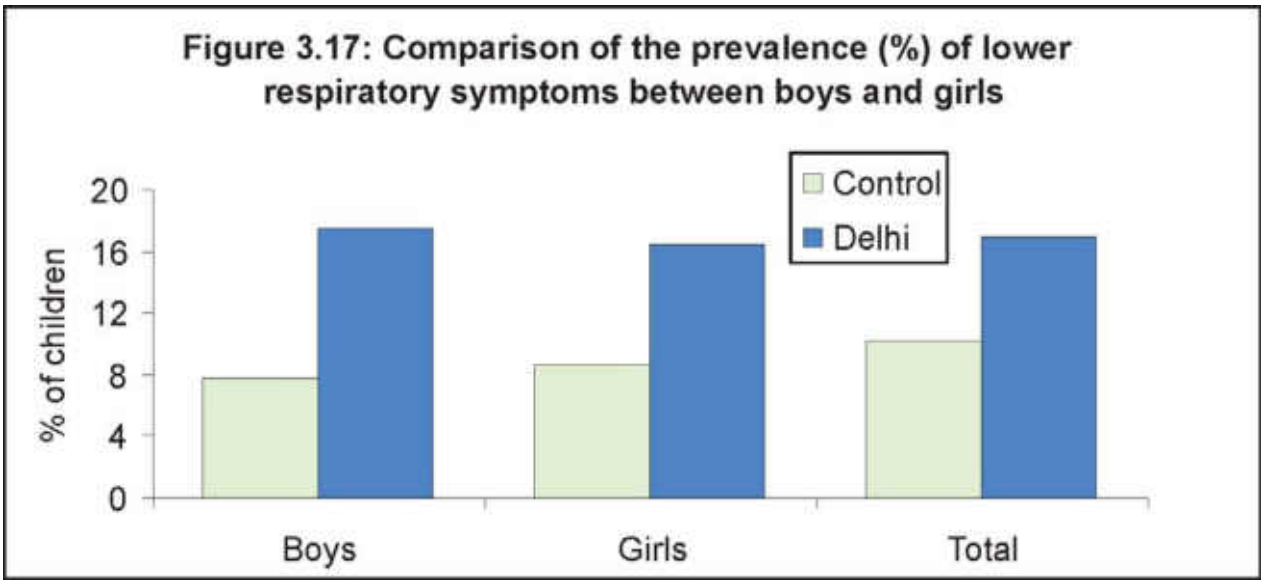
The overall prevalence of LRS was significantly higher ($p<0.001$) among children residing in Delhi when compared with their rural counterparts (control). For example, 17% participants from Delhi (1986 out of 11628) had one or more LRS in contrast to 8% children in control (363 out of 4536, Table 3.14, Fig. 3.16).

Table 3.14: Prevalence (%) of lower respiratory symptoms in children in past three months

Group	Control (n=4536)	Delhi (n=11628)	p
Boy	7.7	17.4	<0.001
Girl	8.5	16.4	<0.001
Overall	8.0	17.0	<0.001



Delhi's boys had a slightly greater prevalence of LRS than city's girls (17.4 vs. 16.4%), whereas it was just the opposite in control: the girls had greater prevalence of LRS than the boys (8.5 vs. 7.7%) in control group (Table 3.14, Fig. 3.17).



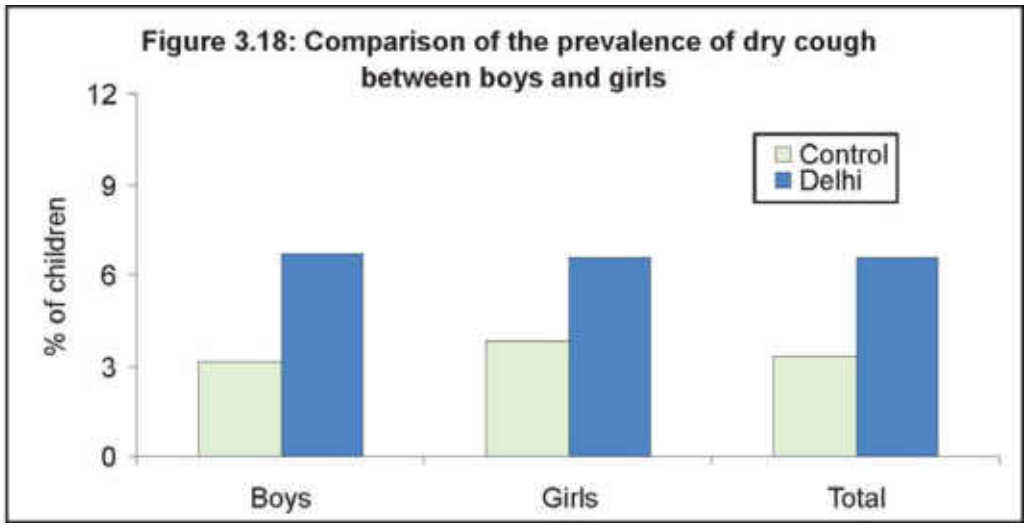
(i) Prevalence of dry cough

Dry cough was present in 773 (6.6%) children of Delhi and 3.3% children of control group ($p<0.05$, Table 3.15). The symptom was more or less similar among boys (6.7%) and girls (6.6%) of Delhi, but girls in the control group had greater prevalence than the boys (3.8 vs. 3.1%, Table 3.15, Fig. 3.18).

Table 3.15: Prevalence (%) of dry cough

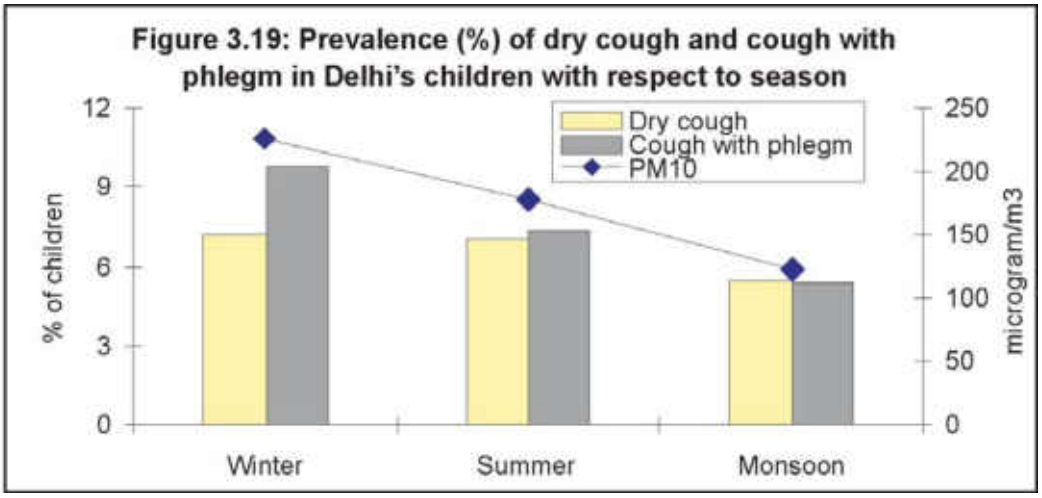
Group	Boys	Girls	Total
Control	3.1	3.8	3.3
Delhi	6.7*	6.6*	6.6*

**p<0.05 compared with control in Chi-square test*



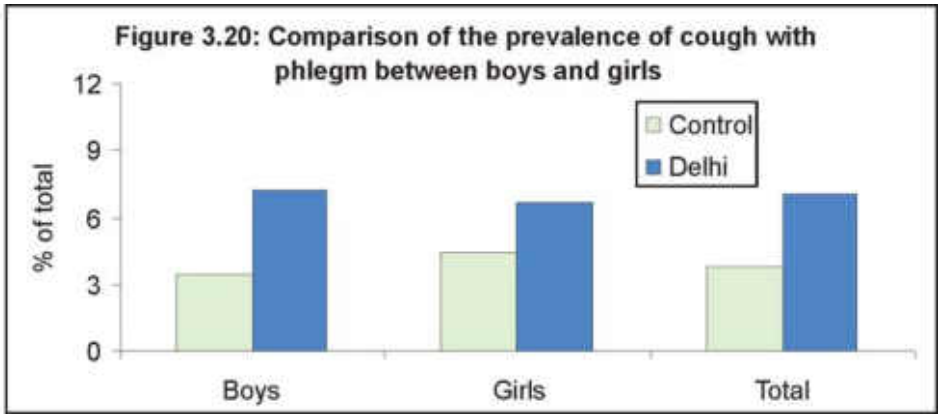
Children from north and central Delhi (7.2 % each) suffered most from this problem while the prevalence was lowest in south Delhi (4.1%).

The problem of dry cough was more frequent in children of Delhi during winter (7.2%) and summer (7.0%) than in monsoon (5.5%; Fig. 3.19). In control group also, dry cough was most prevalent during winter. Children from families with low SES (8.2% in Delhi and 4.5% in control) and in the 6-8 year age group (7.8% and 4.2% in Delhi and control group respectively) suffered most both in urban and rural settings. After controlling potential confounders, dry cough was found to be positively associated with Delhi's air pollution (OR=1.48, 95% CI 1.24 – 1.67).

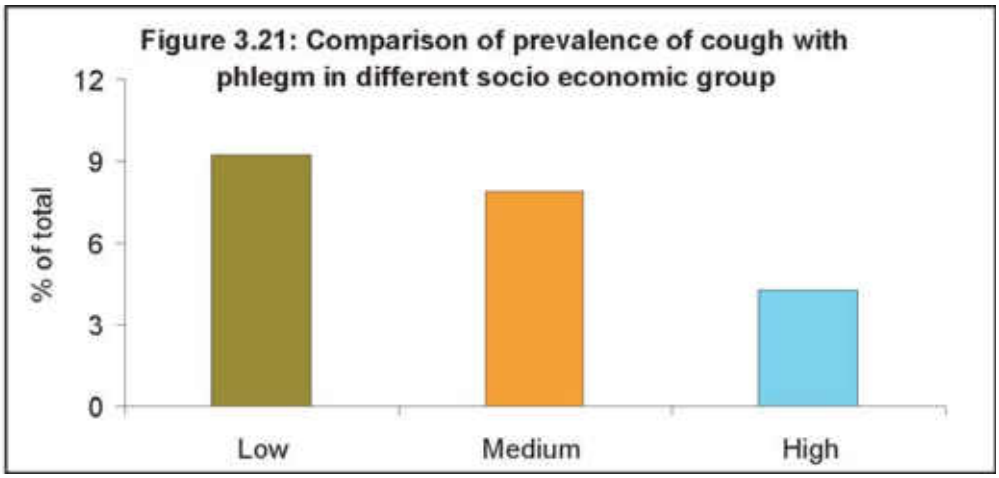


(ii) Prevalence of cough with phlegm: 7% in Delhi compared with 3.8% in control

Cough with phlegm (sputum production) or wet cough was present in 7.0% (817 0f 11628) of Delhi's children. In contrast, only 3.8% of children in control group had this symptom ($p<0.001$). Wet cough was more prevalent in boys (7.2%) than in girls (6.7%) in Delhi, whereas girls experienced more symptoms than the boys in control group (4.4 vs. 3.4%, Fig. 3.20).



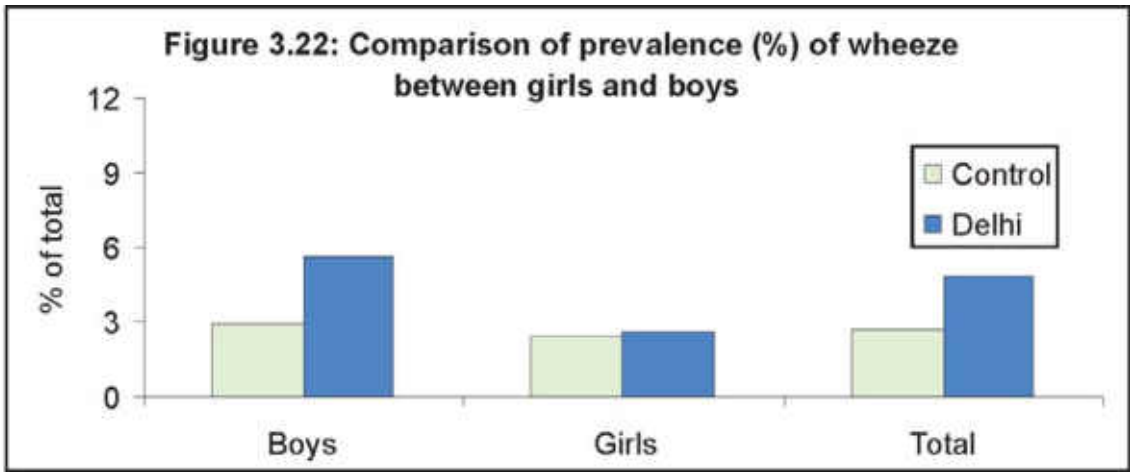
Children from north (8.9%), west (8.7%) and central (8.0%) Delhi suffered more from this symptom did children from east (6.0%) and south (4.0%) Delhi. The problem was more prevalent during winter (9.8%) than in summer (7.4%) and monsoon (5.4%, Fig. 3.19). The differences in prevalence between winter vs. summer (OR = 1.98; 95% CI: 1.34 – 2.71) and winter vs. monsoon (OR= 2.23, 95%CI: 1.55-2.95) were significant. The symptom was less common in children aged 6-8 years (5.8%) compared with those aged 9 years or more (7.6%). Children with low and middle SES were more susceptible to cough with phlegm both in Delhi and control group (Table 3.20). For example, the symptom was present in 9.2% children of Delhi with low SES, 7.9% in medium against 4.3% children from high SES (Fig. 3.21). After controlling potential confounders, cough with phlegm was found to be positively associated with urban life (OR=1.33, 95% CI 1.12 – 1.56) and PM_{10}.

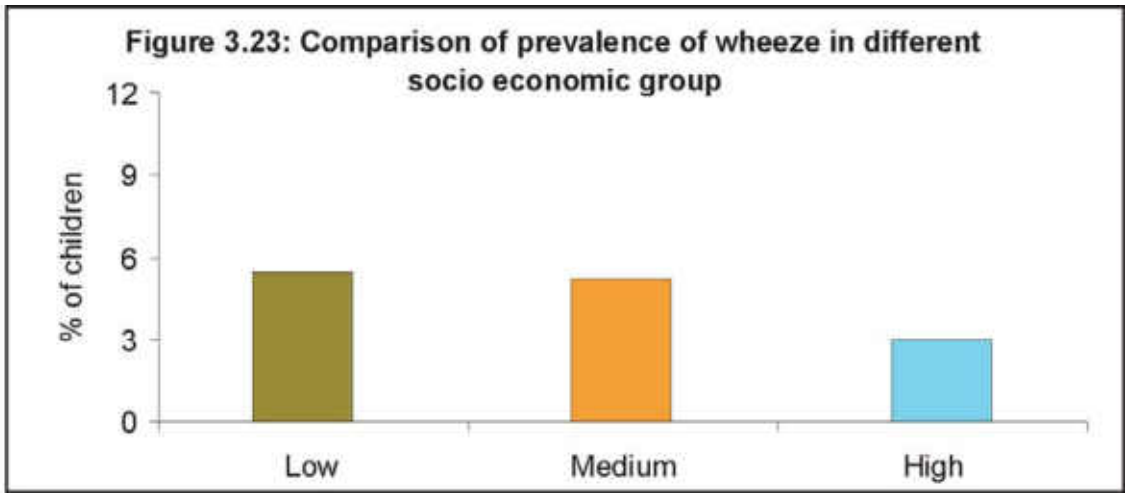


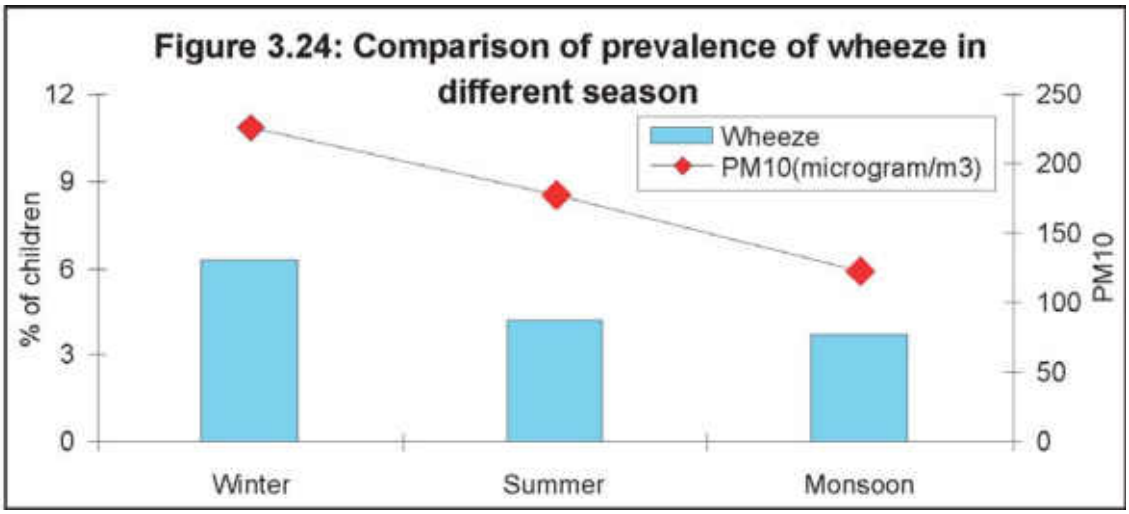
(iii) Wheezing breath

Wheeze i.e. whistling sound during breathing was present in 4.8% of Delhi's children (535 of 11628) in past three months compared with 2.7% children with this symptom in control (123/4536, Fig. 3.22). Thus, Delhi's children had 1.8-times more wheeze prevalence than the controls, and the difference was highly significant ($p<0.01$). We found marked difference in the prevalence of wheeze in past three months between boys and girls both in rural and urban settings. In both cases, boys had greater prevalence than the girls. For example, 5.6% of the boys experienced wheeze in Delhi compared with 2.6% of the girls ($p<0.05$). In controls also, boys suffered more from wheezing breath than the girls (2.9 vs. 2.4 %, Fig. 3.22). It was also seen that children from

the lower socio economic status suffered most from this problem (Fig. 3.23). Prevalence of wheeze was higher during winter and lowest during monsoon (Fig. 3.24). After controlling potential confounders, wheeze was found to be positively associated with particulate air pollution (OR= 1.87, 95% CI, 1.52-2.31).

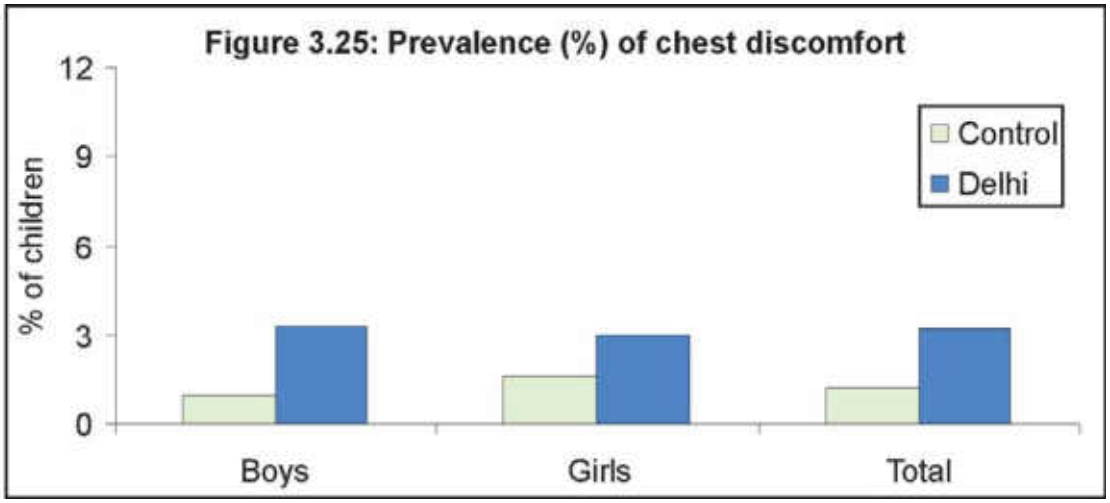






(iv) Chest discomfort and pain: 3.2% in Delhi against 1.2% in control

Pain or tightness of the chest was present in 3.3% of the boys and 3% of the girls of Delhi in previous three months, with an overall prevalence of 3.2%. In contrast, 1.2 % of control children, 1% of boys and 1.6% of girls, had this symptom (Fig. 3.25). The difference between Delhi's and control children in this regard was highly significant ($p<0.001$). The symptom was more frequent in Delhi's children belonging to 9 – 11 year age group. The prevalence was highest during winter when the PM_{10} level in air is highest and lowest during monsoon when the PM_{10} level is lowest. After controlling potential confounders, logistic regression analysis showed that chest discomfort and pain was positively associated with PM_{10} level in breathing air (OR=1.44, 95% CI 1.18 – 1.76).

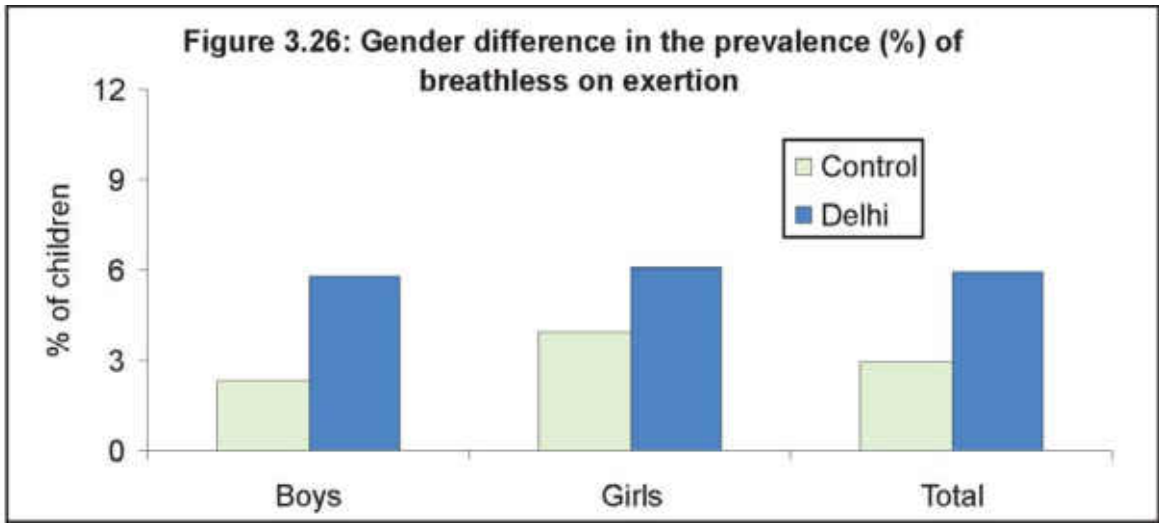


(v) Shortness of breath on exertion: 5.9% in Delhi compared with 2.9% in control

Out of breathe or breathless on exertion was reported by 5.9% children of Delhi compared with 2.9% children in control group ($p<0.001$; Table 3.16). Its prevalence was higher in girls than in boys both in urban and control groups (Fig. 3.26). Children from north and west Delhi suffered most from this problem, and it was more common in 9 – 11 year age group, As in the case of other symptoms, breathlessness was most prevalent during winter and least common during monsoon (OR = 1.93; 95% C.I.: 1.71 – 2.19, winter vs. monsoon), suggesting a positive association between particulate pollution and breathlessness. Indeed, logistic regression analysis has shown such an association between PM_{10} level in breathing air and breathlessness (OR=1.37, 95% CI 1.15 – 1.63). Children from lower SES suffered most from this symptom (Table 3.21).

Table 3.16: Prevalence (%) of breathless on exertion

Group	Boys	Girls	Total
Control	2.3	3.9	2.9
Delhi	5.8*	6.1*	5.9*



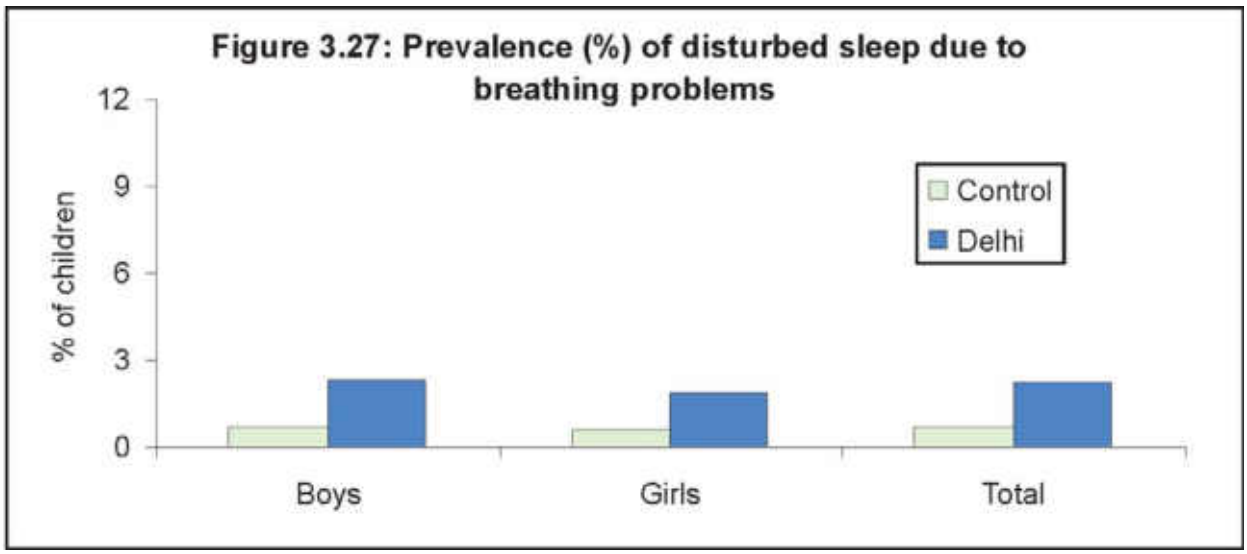
(vi) Disturbed sleep due to breathing problem

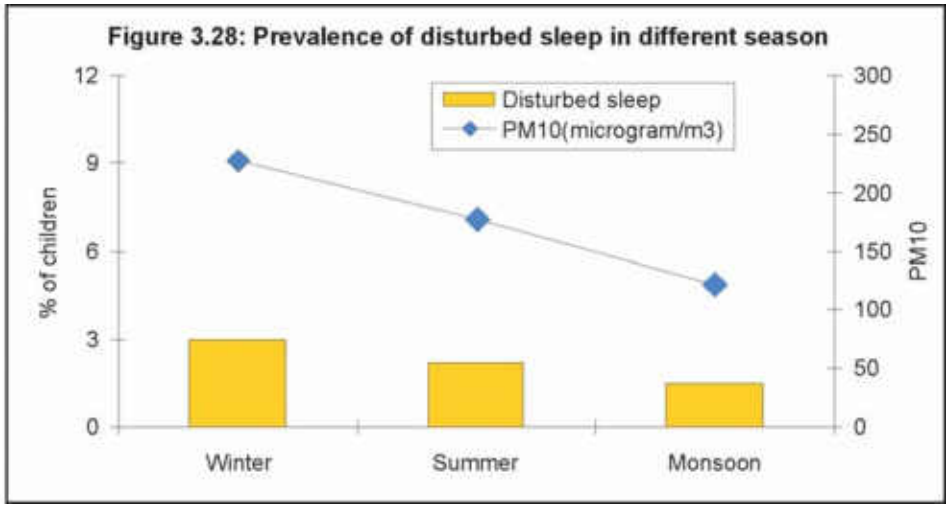
Disturbed sleep due to breathing problem was reported by 2.2% children of Delhi compared with 0.7% of rural children ($p<0.001$, Table 3.17). The prevalence was slightly higher in boys than in girls both in Delhi and control group, but the difference was not statistically significant ($p>0.05$, Fig. 3.27). The problem was most prevalent during winter and least in monsoon, implying a positive association with air pollution (Fig. 3.28). After controlling potential confounders, the symptom was indeed found to be positively associated with PM_{10} level (OR=1.68, 95% CI 1.35 – 2.26).

Table 3.17: Prevalence (%) of disturbed sleep due to breathing problems

Group	Boys	Girls	Total
Control	0.7	0.6	0.7
Delhi	2.3*	1.9*	2.2*

**, p<0.001 compared with control in Chi-square test*





Children in the age group of 9 – 11 years and those belonging to low SES suffered most from disturbed sleep owing to breathing problems both in rural and urban settings (Table 3.18).

Table 3.18: Prevalence (%) of disturbed sleep in children from different socio-economic background

Group	Low SES	Medium SES	High SES
Control	1.0	0.6	0.3
Delhi	3.1*	2.1*	1.7*

**, p<0.05 compared with corresponding control*

(c) Statistical evaluation of the data

(i) Inverse relationship between SES and prevalence of URS and LRS

We found an inverse relationship between SES and the prevalence of all the respiratory symptoms: lower the SES greater the prevalence. Keeping the prevalence of individual symptoms in high SES constant (OR=1), conditional logistic regression analysis showed the prevalence of URS and LRS increased remarkably in children from families belonging to low SES (Table 3.19, 3.20).

Table 3.19: Conditional logistic regression analysis for association between upper respiratory symptoms and socioeconomic status (SES)

SES	Sinusitis	Running nose	Sneezing	Common cold	Sore throat
High	1	1	1	1	1
Medium	1.26* (1.05-1.52)	1.82* (1.56-2.12)	1.65* (1.35-2.18)	2.06* (1.84-2.34)	1.44* (1.25-1.66)
Low	1.22* (1.07-1.65)	2.34* (2.01-2.73)	2.16* (1.52-2.80)	2.07* (1.82-2.34)	1.93* (1.67-2.23)

*Results are expressed as odds ratio with 95% confidence interval in parentheses; *, p<0.05*

Table 3.20: Conditional logistic regression analysis for association between lower respiratory symptoms and socioeconomic status (SES)

SES	Dry cough	Wet cough	Wheeze	Chest discomfort	Breathless-ness	Disturbed sleep
High	1	1	1	1	1	1
Medium	2.31* (1.96-2.73)	1.72* (1.48-2.01)	0.97 (0.79-1.21)	1.89* (1.55-2.30)	1.80* (1.52-2.13)	1.85* (1.44-2.24)
Low	3.34* (2.83-3.95)	2.20* (1.89-2.57)	1.24* (1.04-1.64)	2.43* (1.99-2.96)	2.09* (1.76-2.49)	2.05* (1.56-2.81)

*Results are expressed as odds ratio with 95% confidence interval in parentheses; *, p<0.05*

3.3.2 Prevalence of childhood asthma

(a) Asthma: more prevalent in Delhi

The prevalence of current asthma (dyspnea and wheeze at any time in the last twelve months), and physician-diagnosed asthma among the children of Delhi were 4.6% and 1.7 % respectively, which were significantly higher than the corresponding values in control group- 2.5% 1.1% respectively (p<0.001 in Chi-square test, Table 3.21).

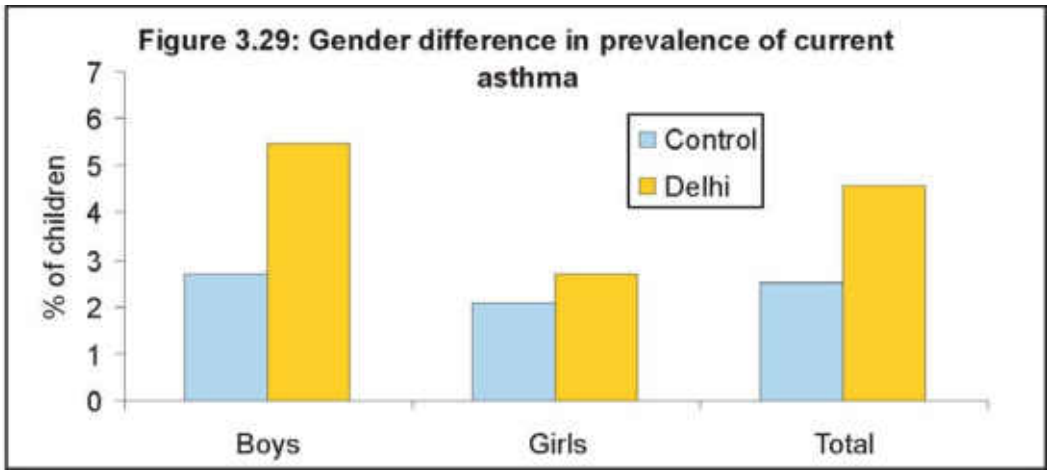
Table 3.21: Prevalence of bronchial asthma in rural and urban children

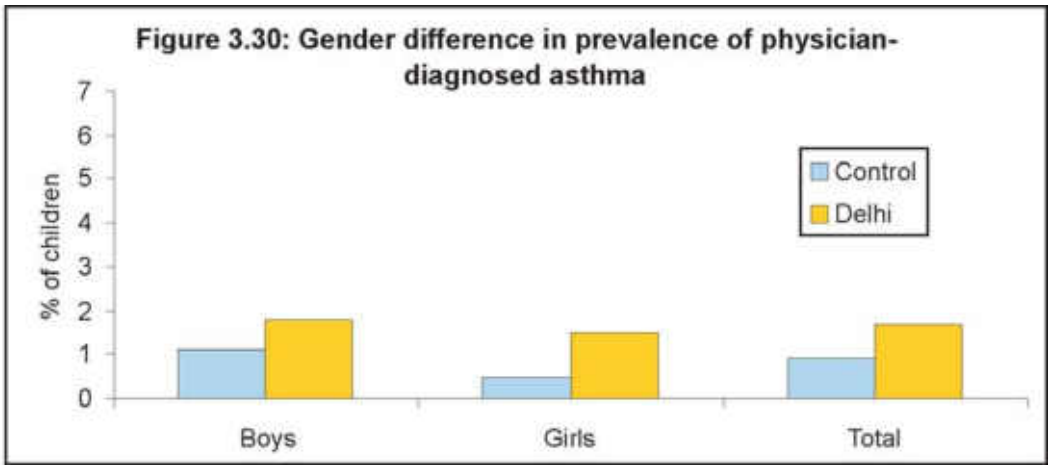
Type of asthma	Control(n=4536)	Delhi(n=11628)	p
Current asthma			
Boys	2.7	5.5	<0.001
Girls	2.1	2.7	>0.05
Total	2.5	4.6	<0.001
Physician-diagnosed asthma			
Boys	1.1	1.7	<0.05
Girls	0.5	1.5	<0.01
Total	0.9	1.7	<.001

Results are expressed as number of affected children with the percentage in parentheses

(b) Boys suffer more than the girls

Physician-diagnosed asthma and current asthma were more prevalent in boys than in girls both in rural and urban areas. The prevalence of asthma symptoms was 2-times more in boys than age-matched girls (5.5 vs.2.7%) in Delhi, and the gender difference was highly significant (p<0.001, Fig. 3.29). Delhi's boys also had greater prevalence of physician-diagnosed asthma than the girls (1.8 vs. 1.5%). Like the urban children, boys in the control group had greater prevalence of current asthma (2.7 vs. 2.1, p<0.05), and physician-diagnosed asthma (1.1 vs. 0.5%, p<0.001) than the girls (Fig. 3.30).





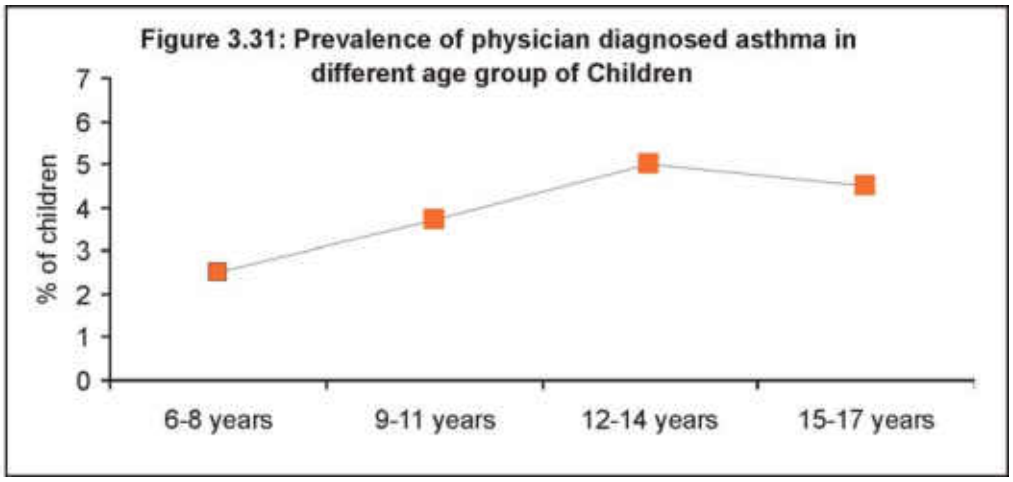
(c) Highest asthma prevalence in 12-14 year old children

Prevalence of current asthma in control children increased progressively up to the age of 14 years, and then a substantial fall in asthma prevalence was observed. A similar pattern was recorded in case of children of Delhi for current asthma, as well as for physician-diagnosed asthma. In essence, the prevalence of asthma is high in childhood, and then it declines substantially when the children enter their late teens and adolescence (Table 3.22; Fig. 3.31).

Table 3.22: Prevalence (%) of current asthma and physician-diagnosed asthma in relation to age

Age (yr)	Control		Delhi	
	Current asthma	Physician-diagnosed asthma	Current asthma	Physician-diagnosed asthma
6-8	2.0	2.0	2.5	1.3
9-11	2.5	1.1	3.7*	1.5
12-14	3.1	1.0	5.0*	1.9*
15-17	1.3	0.6	4.5*	1.4*

**, p<0.05 compared with respective control group in Chi-square test*



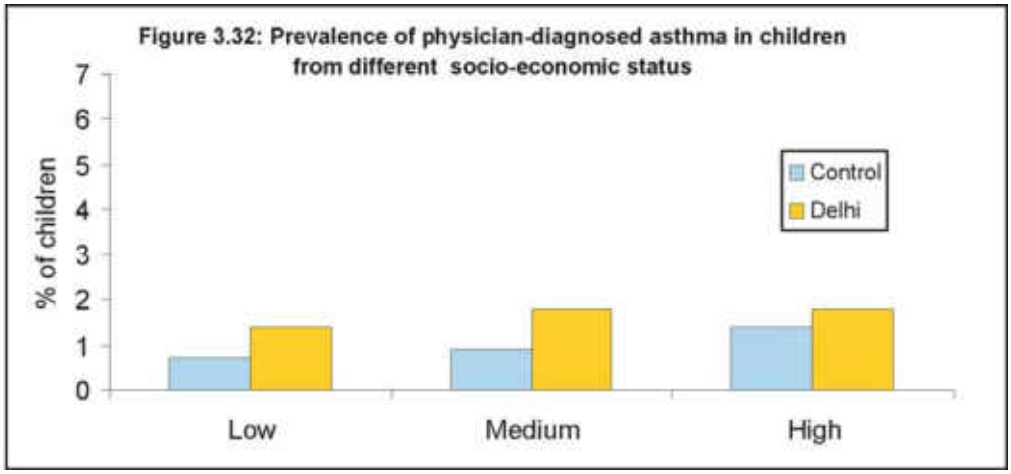
(d) Prevalence of asthma in children from different socio-economic background

Prevalence of asthma in different SES is presented in Table 3.23. In control group, asthma was slightly more prevalent in children from medium and high SES, especially in case of physician-diagnosed asthma (Fig. 3.31). In Delhi, children from lower and medium SES had a greater prevalence of asthma symptoms, while children from medium and high SES had higher prevalence of physician-diagnosed asthma (Fig. 3.32).

Table 3.23: Prevalence (%) of current asthma in different socio-economic status (SES)

Group	Low SES	Medium SES	High SES
Current asthma			
Control	2.4	2.6	2.5
Delhi	4.6*	4.8*	4.3*
Physician-diagnosed asthma			
Control	0.7	0.9	1.4
Delhi	1.4*	1.8*	1.8

**, p<0.05 compared with corresponding control group*



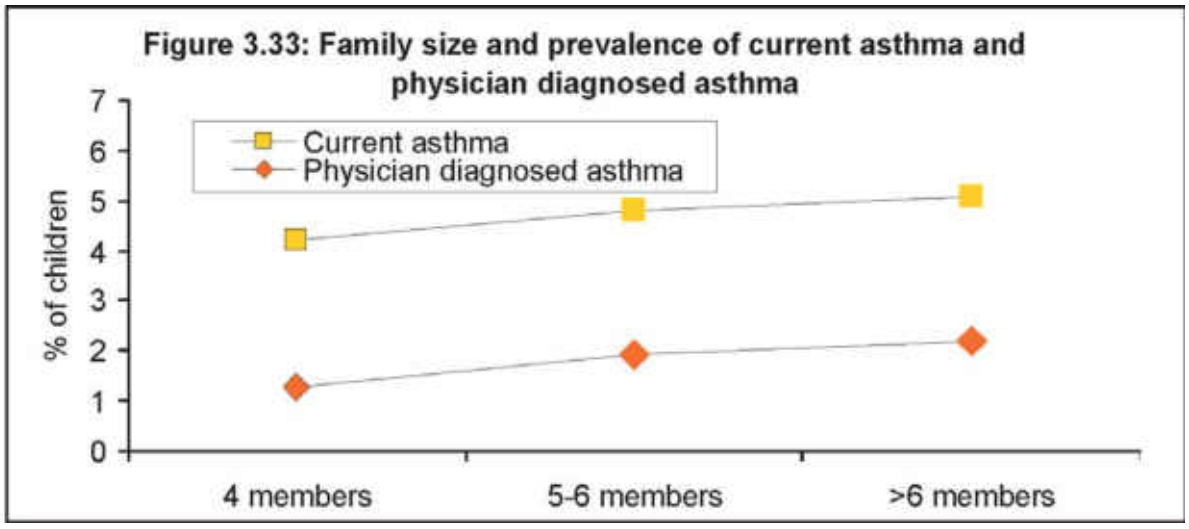
(e) Higher prevalence of asthma in large-sized families

Numbers of children from small (upto 4 members), medium (5-6 members) and large (>6 members) families were 5481, 4007, 2203 respectively in Delhi and 841, 1843 and 1852 in control. Asthma was found more prevalent in children from medium- and large-sized families particularly the latter, compared with children from small families. This was valid both for rural and urban settings (Table 3.24; Fig. 3.33). For example 2.2% from large families had physician-diagnosed asthma compared with 1.3% children from small families in Delhi, and the difference was statistically significant ($p<0.05$). Similarly 1.1% of control children from large families had physician-diagnosed asthma in contrast to 0.6% children from small sized families ($p<0.05$). In essence, large family size was more common among asthmatic children and the association was significant ($p<0.05$).

Table 3.24: Family size and asthma prevalence (%)

Members in family	Current asthma		Physician-diagnosed asthma	
	Control	Delhi	Control	Delhi
Up to 4	1.7	4.2*	0.6	1.3*
5-6	2.6	4.8*	0.9	1.9*
>6	2.8	5.1*	1.1	2.2*

**, p<0.05 compared with control in Chi-square test*



(f) Risk factors for asthma

There was a strong association between current asthma in children and parental smoking, and similar illness in father and / or other members of the family. History of bronchial asthma was present in families of 40.4% of asthmatic children in Delhi, and 46.4% in rural areas. Asthma attacks were most prevalent in children during winter (2.0%) when the air pollution level was highest. Controlling potential confounders, logistic regression analysis suggests positive association between particulate pollution and asthma attacks (OR=1.28; 95% CI 1.07-1.42), but not the prevalence of asthma (OR = 1.05, 95% CI 0.87-1.15, Fig. 3.34).

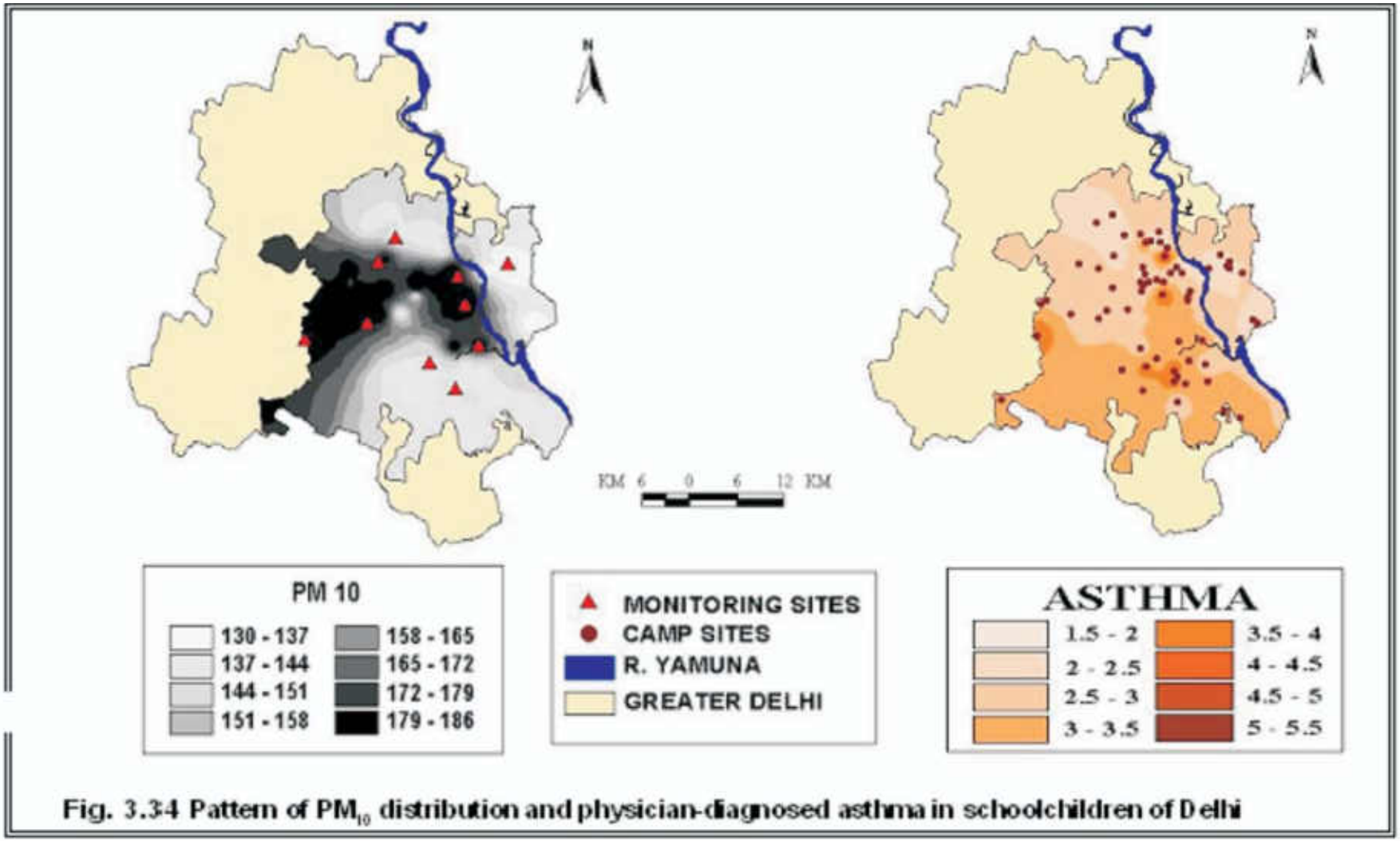


Fig. 3.34 Pattern of PM_{10} distribution and physician-diagnosed asthma in schoolchildren of Delhi

3.3.3 Prevalence of associated symptoms

(a) Recurrent headache

Recurrent headache during past three months was reported by 27.4% children of Delhi in contrast to 11.8% children of control group. The difference between these two groups was highly significant ($p<0.001$, Table 3.25, Fig. 3.35). Headache was more prevalent in girls than in boys in control (19.0 vs. 7.9% in boys, $p<0.001$) as well as in Delhi (36.0 vs. 23.1%, $p<0.01$). Highest prevalence of headache was found in adolescents in the age group of 15-17 years (33.4%; Table 3.25, Fig. 3.36). Like respiratory symptoms, headache was most prevalent among children and adolescents with low SES (Fig. 3.37). The symptom among the children of Delhi was most prevalent during winter months (40.8%) followed by summer (29.6%) and monsoon (20.2%, Fig. 3.38).

Table 3.25: Prevalence (%) of respiratory-associated symptom in children

Symptom	Control	Delhi
Recurring headache	11.8	27.4*
Eye irritation	4.2	14.7*
Nausea	5.6	11.2*
Palpitation	3.3	7.2*
Fatigue	6.7	12.9*

**, p<0.05 compared with control in Chi-square test*

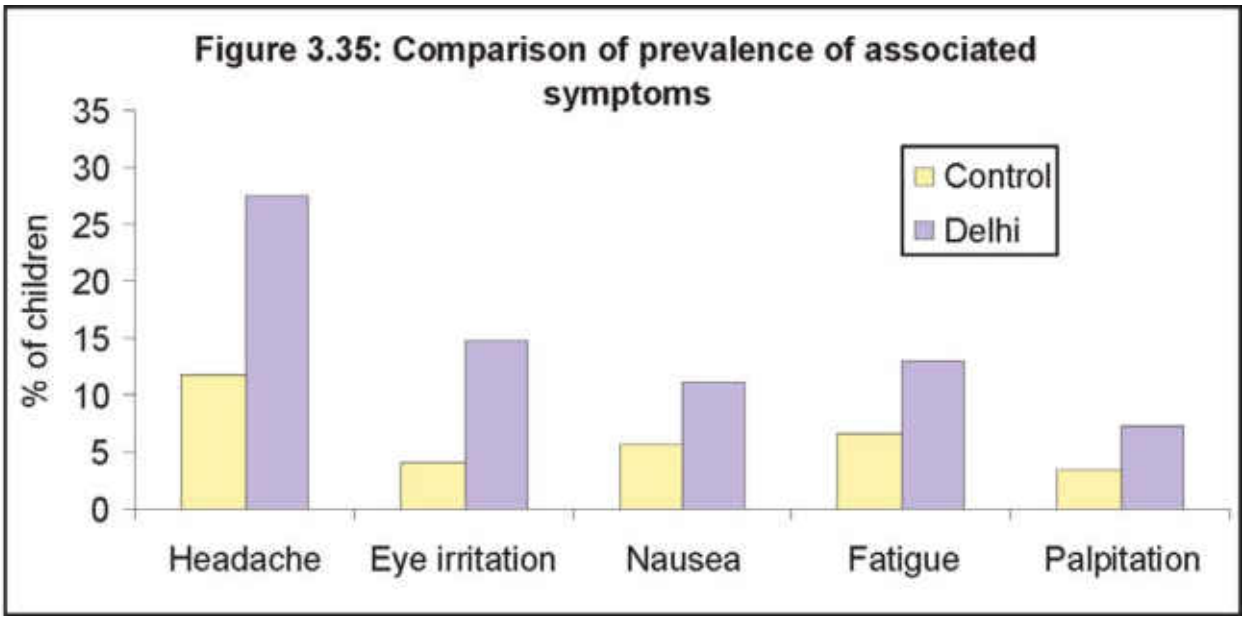


Figure 3.36: Prevalence of associated symptoms in different age group

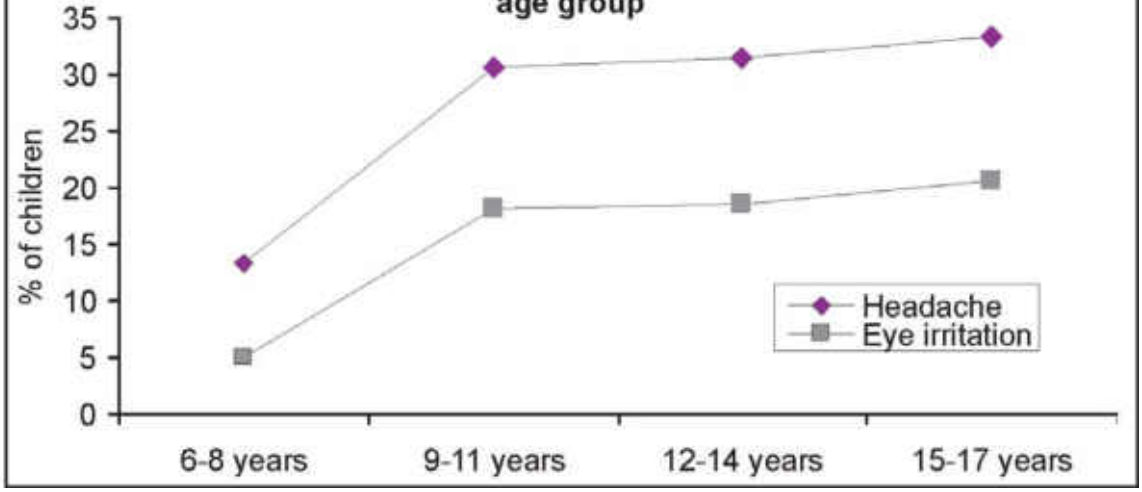


Figure 3.37: Comparison of associated symptoms in different socio economic status

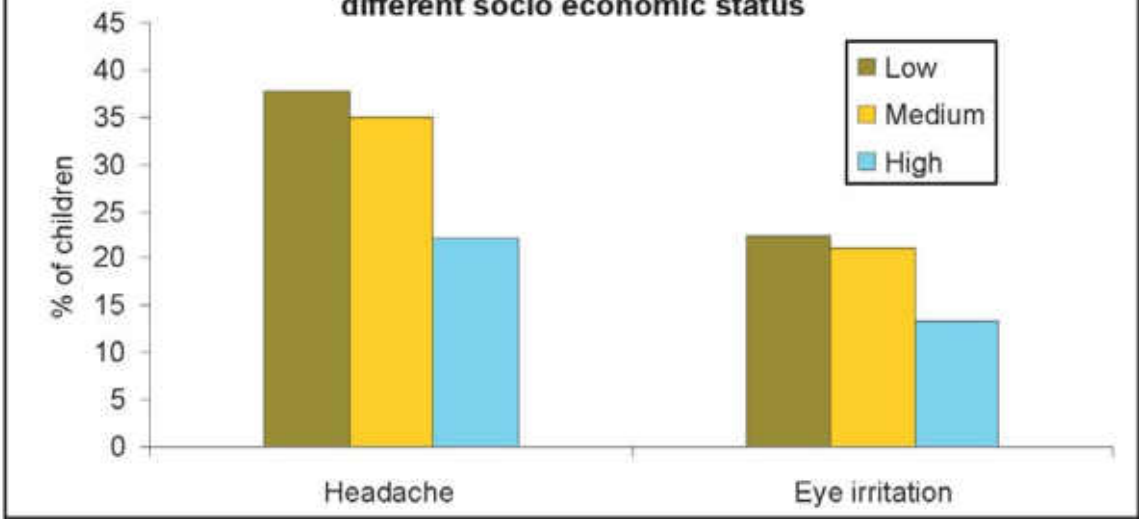
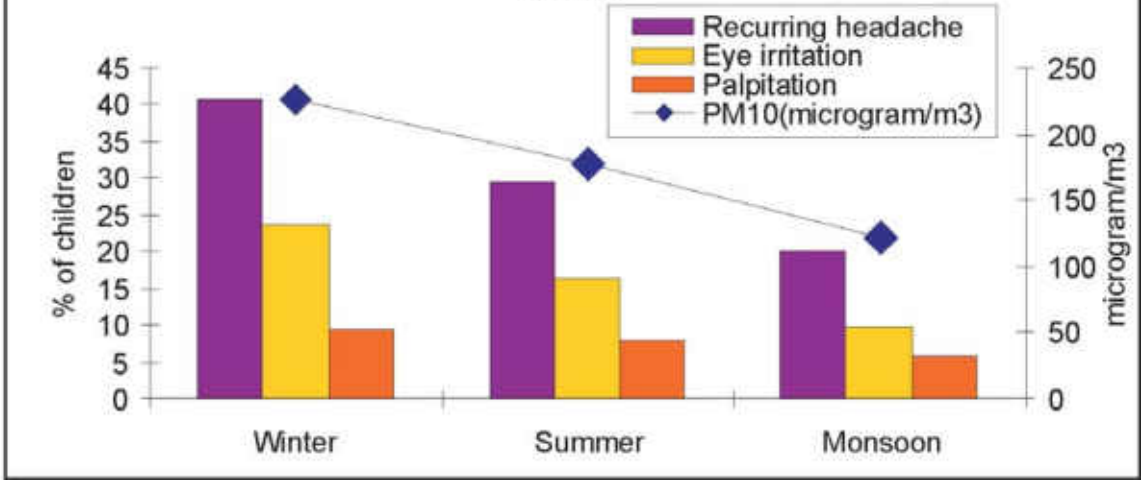


Figure 3.38: Prevalence of associated symptoms in different season



(b) Eye irritation

Irritation and watering of the eyes were reported by 14.7% of the children of Delhi, compared with 4.2% of controls ($p<0.001$, Table 3.25, Fig. 3.35). Its prevalence in Delhi was marginally higher in girls (15.8% vs. 14.2% in boys), and the problem was more frequent during winter as 23.8% of examined children during November-February complained of eye irritation compared with 9.8% in monsoon (Fig. 3.38). Adolescents in the age group of 15-17 years (20.6%, Fig. 3.36) and those from North, Central and West Delhi showed higher prevalence of eye problem. Compared with children from high SES, the prevalence eye irritation was found doubled in children from low SES (Fig. 3.38).

(c) Nausea

Nausea, i.e. vomiting tendency, was present in nearly 11.2 % children of Delhi against 5.6% of controls (Table 3.25, Fig. 3.35). The prevalence was similar in girls and boys. Children suffered from this problem most during winter (15.1%), compared with 6.5% in summer. Its incidence was highest in children of the age group of 9 – 11 years (13.4%; Table 3.26, Fig. 3.36).

Table 3.26: Prevalence (%) of respiratory-associated symptom in different age group

Symptoms	6-8 years	9-11 years	12-14years	15-17years
Recurring headache	13.3	30.7	31.4	33.4
Eye irritation	5.1	18.2	18.5	20.6
Nausea	12.7	13.4	8.6	6.6
Palpitation	1.9	13.1	10.2	7.2
Fatigue	15.8	18.9	13.6	12.7

(d) Palpitation

Palpitation was prevalent among 8.0% of the boys and 5.6% of the girls of Delhi, with an overall prevalence of 7.2%. In contrast, 3.3% of control children had this problem (Table 3.25, Fig. 3.35). Its prevalence was highest in children of North (8.6%) and Central Delhi (8.5%) and lowest in children of South Delhi (4.5%). The prevalence of palpitation was greatest in winter (9.4 %; Table 3.27, Fig. 3.38) and in children of 9 – 11 year age group (13.1%; Table 3.26, Fig. 3.36).

Table 3.27: Prevalence (%) of respiratory-associated symptom in different season

Symptom	Summer	Monsoon	Winter
Recurrent headache	29.6	20.2	40.8
Eye irritation	16.3	9.8	23.8
Nausea	6.5	11.0	15.1
Palpitation	8.0	5.9	9.4
Fatigue	13.2	9.0	20.7

(e) Fatigue

About 12.9% of the examined children of Delhi reported of getting tired easily, of which 12.5% were girls and 13.2% were boys. Fatigue was found in 6.7% of control children ($p<0.001$, Table 3.25, Fig. 3.35). Its prevalence was highest during winter (20.7%) followed by summer (13.2%) and monsoon (9.0%; Table 3.26), and in children of the 9 – 11 year age group (18.9%; Table 3.27, Fig. 3.36). Children from the higher socio economic status suffered least from this problem as only 10.3% of children complained of getting tired easily as compared to 17.1% of children coming from the low socio economic status (Table 3.28; Fig. 3.37).

Table 3.28: Prevalence (%) of respiratory-associated symptom in different socio economic status (SES)

Symptom	Low SES	Medium SES	High SES
Recurring headache	37.8	34.9	22.0
Eye irritation	22.4	21.0	13.2
Nausea	8.2	11.1	6.5
Palpitation	11.7	11.2	5.8
Fatigue	17.1	15.3	10.3

3.3.4 Association between ambient air pollution (PM_{10} level) and prevalence of respiratory symptoms

(a) Weak positive association between PM_{10} level in breathing air and prevalence of URS

In univariate analysis the prevalence of upper respiratory symptoms excepting sinusitis were significantly elevated ($p<0.05$) in Delhi's children when the potential confounders like socio economic conditions, parental smoking, age and gender were controlled in multivariate logistic regression analysis, only sore throat (OR=1.25, 95% CI 1.03-1.52, $p<0.05$, Table 3.29) and common cold with fever (OR=1.35, 95% CI 1.12 – 1.65, $p<0.05$, Table 3.30) were found to be positively associated with particulate pollution (PM_{10}). PM_{10} level was also found to have a significant positive association with URS prevalence in general (OR=1.24, 95% CI 1.02-1.47). The association between PM_{10} and URS was further strengthened by conditional logistic analysis. The association was weakly positive and non-significant upto a PM_{10} level of 125 $\mu m/m^3$. A strong positive association between PM_{10} and sore throat and common cold was found thereafter. All symptoms except sinusitis positively correlated with PM_{10} when the ambient level reaches above 150 $\mu m/m^3$ (Table 3.29).

Table 3.29: Conditional logistic regression analysis of the association between particulate air pollution and upper respiratory symptoms

PM_{10} level(μg/m³)	Sinusitis	Running nose	Sneezing	Common cold	Sore throat
50-75	1	1	1	1	1
76-100	1.03 (0.75-1.43)	0.43 (0.31-0.61)	1.03 (0.81-1.21)	0.34 (0.26-0.44)	1.02 (0.57-1.26)
101-125	1.28 (0.94-1.60)	1.06 (0.81-1.20)	1.06 (0.78-1.33)	1.01 (0.88-1.16)	1.22 (0.69-1.43)
126-150	1.15 (0.91-1.45)	1.12 (0.83-1.20)	1.33 (0.87-1.53)	1.23 (1.07-1.43)*	1.33 (1.03-1.62)*
>150	1.09 (0.87-1.37)	2.60* (2.19-3.07)	2.60 (2.19-3.07)*	2.09 (1.82-2.40)*	1.74 (1.48-2.05)*

*Results are presented as odds ratio with 95% confidence interval in parentheses; *, p<0.05*

Table 3.30: Logistic regression analysis of the association between particulate air pollution (PM_{10}) and URS after adjustment for potential confounders.

Symptom	Control(n=4536)	Delhi(n=11628)	Odds Ratio (95% CI)
Sinusitis	3.2	3.4	1.06 (0.87 – 1.34)
Running or stuffy nose	5.8	9.6	1.22 (0.95 – 1.49)
Sore throat	4.9	7.4	1.25 (1.03 – 1.52)*
Sneezing	5.2	9.1	1.09 (0.86-1.22)
Common cold and fever	5.7	10.5	1.35 (1.12 – 1.65)*
Total URS	**14.6**	**23.1**	1.24 (1.02-1.47)*

*The results are expressed as percentage of affected children; *p<0.05*

(b) Strong positive association between PM_{10} level in breathing air and prevalence of LRS in children

Unlike URS, a strong, statistically significant positive association was observed between PM_{10} level in Delhi's air and the prevalence of six symptoms under LRS in children in past three months. Taking the prevalence of individual symptoms during low pollution level (PM_{10} 50-70μg/m³) as constant (OR=1) in conditional regression analysis (Table 3.31), prevalence of LRS symptoms was found doubled or tripled when particulate pollution level was elevated (PM_{10} >125 μg/m³).

Logistic regression analysis after controlling potential confounders like parental smoking and SES particulate pollution was found to be positively associated with all six symptoms of LRS (Table 3.32). The association was strongest for sleep disturbance due to breathing trouble and dry cough, followed by chest pain or discomfort, breathlessness on exertion, cough with sputum production, and wheeze. In essence, the prevalence of LRS increases with increasing concentration of particulate pollution in breathing air.

Table 3.31: Conditional logistic regression analysis of the association between chronic exposure to PM_{10} and lower respiratory symptoms

PM_{10} (µg/m^3)	Dry cough	Wet cough	Wheeze	Breathless-ness	Chest discomfort	Sleep disturbance
50-75	1	1	1	1	1	1
76-100	1.22* (1.04-1.47)	1.06 (0.84-1.29)	0.97 (0.76-1.14)	1.12* (1.02-1.44)	1.13* (1.02-1.34)	1.26* (1.10-1.48)
101-125	1.86* (1.54-2.24)	1.29* (1.06-1.57)	1.04 (0.72-1.38)	1.34* (1.14-1.83)	1.66* (1.27-2.14)	1.64* (1.25-2.13)
126-150	2.20* (1.81-2.68)	1.30* (1.09-1.56)	1.43* (1.12-1.77)	1.51* (1.22-1.78)	1.94* (1.53-2.44)	1.78* (1.33-2.27)
>150	3.12* (2.36-3.75)	3.03* (2.53-3.62)	1.67* (1.19-2.36)	2.84* (2.31-3.47)	2.65* (2.09-3.37)	2.73* (1.89-4.32)

*Results are presented as odds ratio with 95% confidence interval in parentheses; *, p<0.05*

Table 3.32: Logistic regression analysis of association between PM_{10} and lower respiratory symptoms in children

LRS	Control	Delhi	OR (95% CI)
Dry cough	3.3	6.6	1.48 (1.24 – 1.67)*
Cough with phlegm	3.8	7.0	1.33 (1.12 – 1.56)*
Wheeze	2.7	4.8	1.23 (1.04 – 1.45)*
Breathlessness on exertion	2.9	5.9	1.37 (1.15 – 1.63)*
Chest discomfort	1.2	3.2	1.44 (1.18 – 1.76)*
Sleep disturbance due to breathing problem	0.7	2.2	1.68(1.35– 1.96)*
LRS, total	**8.0**	**17.0**	**1.42 (1.19 – 1.83)***

*The results are expressed as percentage of children with symptom; *p<0.05*

(c) Strong positive association between PM_{10} and eye irritation, but not with asthma or headache

Conditional and multivariate logistic regression analyses showed a weak association between PM_{10} level in Delhi's air and the prevalence of medically diagnosed asthma and headache in city's children. However, a strong, statistically significant ($p<0.05$) positive association was found between PM_{10} level and eye irritation (Table 3.33). Nausea, palpitation and fatigue were also found to be significantly associated with particulate air pollution exposure (Table 3.34).

Table 3.33: Conditional logistic regression analysis for medically-diagnosed asthma, headache and eye irritation

PM_{10} level(μg/m^3)	Medically- diagnosed asthma	Headache	Eye irritation
50-75	1	1	1
76-100	0.31 (0.09-1.04)	0.59 (0.47-0.73)	1.18* (1.05-1.32)
101-125	1.41 (0.88-2.27)	1.19 (1.05-1.35)	1.27* (1.12-1.56)
126-150	1.22 (0.72-2.07)	1.11 (0.96-1.27)	1.30* (1.11-1.51)
>150	1.55* (1.05-2.56)	1.89* (1.66-2.16)	2.35* (1.54-2.82)

*Results are expressed as odds ratio with 95% CI in parenthesis; * p<0.05*

Table 3.34: Logistic regression analysis of association between air pollution PM_{10} and asthma and other symptoms

	Control	Delhi	OR (95% CI)
Medically-diagnosed asthma	0.9	1.7	1.08 (0.87-1.42)
Recurring headache	11.8	27.4	1.22 (0.98-1.65)
Eye irritation	4.2	14.7	2.45 (1.56-3.74)*
Nausea	5.6	11.2	1.44 (1.12-2.25)*
Palpitation	3.3	7.2	1.20 (1.07-1.73)*
Fatigue	6.7	12.9	1.21 (1.07-1.53)*

*The results are expressed as percentage of affected children; *p<0.05*

3.4 FINDINGS/

(a) The prevalence of respiratory and associated symptoms was investigated in 11,628 children from 36 schools in Delhi and 4536 control children from two schools in Uttaranchal and 15 from rural West Bengal. The children were aged between 4 and 17 years, and 55% of them were 12-14 year old. Two-third of the children was boys, and one-third was girls. Respiratory symptom data were collected through specially designed structured questionnaire based on three validated questionnaires of BMRC, ATS-DLD-78-C and IUATALD.

(b) Upper respiratory symptoms (URS) like sinusitis, running or stuffy nose, sneezing, sore throat and common cold with fever were 1.8-times more (23.1% vs. 14.6%) prevalent in Delhi than in controls, and the girls suffered more than the boys.

(c) Children in Delhi had 2-times more (17 % vs. 8%) lower respiratory symptoms (LRS) such as frequent dry cough, sputum-producing cough, wheezing breath, breathlessness on exertion, chest pain or tightness and disturbed sleep due to breathing problems. Thus, compared with

control, Delhi's children had 1.8- times more URS and 2-times more LRS suggesting higher prevalence of underlying respiratory diseases.

(d) Prevalence of current asthma was present in 4.6% children of Delhi against 2.5% of controls. Similarly, the instance of physician-diagnosed asthma was 2 times more in Delhi (1.7 vs. 0.9%). The difference in asthma prevalence between control and Delhi's school children was significant ($p<0.001$).

(e) About 15% of Delhi's children had frequent eye irritation compared with only 4% in controls. Similarly, Delhi's children had significantly higher prevalence of frequent headache (27.4 vs. 11.8%), nausea (11.2 vs. 5.6%), and palpitation (7.2 vs. 3.3%) and fatigue (12.9 v. 6.7%).

(f) Respiratory and associated symptoms were most prevalent in children from low socio-economic status, and least in children from families with high socio-economic background.

(g) The symptoms were more prevalent in children during winter when PM_{10} level in air is highest in a year, and lowest during monsoon when particulate air pollution level is lowest, suggesting a positive association with particulate air pollution. Conditional and multivariate logistic regression analysis confirmed the association between exposure to particulate air pollution and the prevalence of respiratory and associated symptoms in school children, excepting sinusitis, running nose, sneezing, asthma and headache.

CHAPTER-4.0

EFFECT OF DELHI'S AIR POLLUTION ON CHILDREN'S LUNG FUNCTION

4.1 INTRODUCTION

Since lung is the primary target organ for the health effects of air pollution, respiratory health is commonly assessed by measurements of mechanics of breathing referred to collectively as lung function. Pulmonary function test is one of the basic tools for evaluating a person's respiratory status.

Rapid lung growth begins *in utero* and continues until the late teens in girls and early 20s in boys. Lung function reaches a maximum by 18-20 years of age in females and 22-25 years in males (Tager et al., 1988). Some males may show a small increment in lung function into their mid –20's. Lung function varies widely among adults. The big difference in lung function in adults are due to attained lung function at maturity, which can differ by a factor of two for individuals of the same age, sex, height, weight and race (Dockery et al., 2005). Thus, factors that can affect growth of lung function in childhood are important in determining the level of lung function in adulthood.

Several factors can be responsible for disruption of normal lung development and growth, leading to reduced lung function. These include intrauterine growth retardation, viral infections, premature birth, inflammatory conditions, genetic changes and environmental toxicants. A child inhales large volumes of air daily, and in polluted environments substantial amounts of air toxics are deposited into the airways and air exchange surfaces. This may impair the lung defense. If lung defense is compromised, normal developmental and homeostatic process can be disrupted, leading to disturbances in lung development, organ damage, and consequent chronic reduction in lung function (Dockery et al., 2005).

Lung function of a child at any age is the result of cumulative lung growth up to that age. It is generally believed that children with highest lung function had the highest lung growth (Dockery et al., 2005). Exposure to environmental toxicants, such as ambient air pollutants, can handicap a child prenatally (before birth), because these pollutants can impair lung development pre- as well as postnatally. Even maternal smoking during pregnancy reduces lung development of the fetus *in utero* (Tager et al., 1995). Reduced prenatal or postnatal growth rates prevents lung from reaching their optimum developmental potential. Thus, exposure to air pollution even when the baby is in mother's womb may affect the development of the lungs, which are the last organs to develop and are not fully developed at birth.

A large number of pollutants have the potential to impair growth of the lung, and impairment of lung function. In this context, time of exposure is most critical, because susceptibility is highest during the fetal and childhood periods, than in adulthood when lung activity is declining. Abient air pollution in California increase the risk of low birth weight and preterm birth (Ritz and Fu, 1999). Premature birth can result in severe lung damage in neonatal periods.

A summary of the literature on epidemiological studies of air pollution and children's lung function (Dockery et al. 2005) reveals that: i. living in areas of high air pollution is associated with lower lung function, ii. chronic exposure to elevated level of air pollution is associated with lower rates of

lung function growth, iii. improvement in air quality leads to improvement in lung function level and/ or growth rate, and iv. children who spend a significant amount of time outdoors in polluted environments or those with poor nutrition may be more strongly affected by air pollution.

Lung function is assessed using a broad array of tests that measure lung volume, airflow and gas diffusion. The most convenient test procedure is spirometry that measures how well the lung functions in exhaling air. Maximal forced expiratory volume maneuvers and spirometers are used to assess forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), maximum mid-expiratory flow (MMEF), and peak expiratory flow rate (PEFR). The information gathered using spirometry is useful in assessing airway obstruction and functional lung capacity. Poor cooperation limits the use of these tests in children less than five years of age.

In view of these reports, is necessary to examine the level of lung function and its growth rate among the school children of Delhi who were chronically exposed to elevated levels of air pollution relative to control children.

4.2 MATERIALS AND METHODS

(a) Subjects

Out of the 11,628 children enrolled for this study in Delhi, pulmonary function test (PFT) was carried out in 5718 children, of which 3730 (65.2%) were boys and 1988 ((34.8%) were girls. In control, 2270 children participated for PFT by spirometry: 1449 (63.8%) were boys and 821 (36.2%) were girls. The age of the children who participated in PFT in Delhi and in control group ranged between 9 and 17 years, with a median of 13.5 years. Altogether, PFT was done on a total number of 7988 children (5179 boys and 2809 girls).

(b) Pulmonary function test (PFT) procedure

PFT was carried out following the guideline of American Thoracic Society (ATS, 1995) using a portable, electronic spirometer (Spirovit SP-1, Schiller, Switzerland) with disposable filters (SP-150), designed for ambulatory pulmonary function measurements. The device measures actual respiratory flow at a precision of 2%, in addition to predicted values according to age, sex, height, weight and race.

Trained research scholars with the permission of school authority did lung function tests at the school premises usually in the medical room. Before performing the PFT, the height and weight of the child was measured with shoes removed (Fig. 4.1). Each child performed forced expiratory maneuvers while sitting with free mobility and nose closed with a nose clip to prevent passage of air through the nose (Fig. 4.2, 4.3). Each spirometric test was repeated 3 times to allow the choice of the best values, and 2 values of FEV_1 should not differ by more than 5% according to the ATS criteria. Using a computer assisted quantitative assessment the best maneuver for acceptance was determined.



Figure 4.1: Students lined up with shoes removed for height and weight measurement at Sukho Khalsa Senior Secondary School, Janak Puri, New Delhi (a) and Kendriya Vidyalaya, East Arjun Nagar, New Delhi (b)



Figure 4.2: Pulmonary function test of students at Government Inter College, Khirsu, Uttaranchal (a) and Sukho Khalsa Senior Secondary School, Janak Puri, New Delhi (b)



Figure 4.3: Lung function test of a student of (a) New Delhi's Guru Harkrishan Public School at Karol Bagh and (b) Motherland Academy, Kotdwar, Uttaranchal

The data were compared with predictive values based on age, sex, height and ethnic group. Flow was plotted against volume to display a continuous loop from inspiration to expiration, as the overall shape of the flow volume loop is important for interpreting spirometric results. The following spirometric parameters (absolute and relative values such as ratio of actual and predicted values) were recorded for analysis:

- Forced vital capacity (FVC), i.e. the volume of air in liters that can be maximally forcefully exhaled
- Forced expiratory volume at 1 second (FEV_1), i.e. volume of air (in liter) that is forcefully exhaled in one second
- Ratio of FEV_1 to FVC (FEV_1/FVC), expressed as percentage
- Forced expiratory flow at 25-75% ($FEF_{25-75\%)}$ or maximal mid-expiratory flow rate (MMFR), which is the average expiration flow rate during the middle 50% of the FVC.
- Peak expiratory flow rate (PEFR) – the peak flow rate during expiration

(i) Diagnosis of functional impairment of the lung

Decrement of lung function detected by spirometry could be generally of two types: Obstructive type and Restrictive types of impairment. In some cases combined (both obstructive and restrictive) type of lung function impairment could be encountered.

Obstructive type of lung function impairment

In obstructive type of lung function deficits such as emphysema or chronic bronchitis the FEV_1 is reduced disproportionately more than the FVC, resulting in an FEV_1/FVC ratio less than 70%. Thus, FEV_1/FVC <70% diagnoses airway obstruction. Subjects with obstructive lung had a rapid peak expiratory flow but the curve descends more quickly than normal and takes on a concave shape, reflected by a marked decrease in the $FEF_{25-75\%.}$ With more severe obstruction, the peak becomes sharper and the expiratory flow rate drops precipitously.

Restrictive type of lung function impairment

In restrictive lung type of lung function decrement, the FVC is reduced below 80% of predicted value. The shape of the flow volume loop is relatively unaffected in restrictive disease, but the overall size of the curve appears smaller when compared to normal on the same scale.

Combined type of lung function impairment

In combined type of lung function impairment, both FVC and FEV_1/FVC ratio are appreciably decreased. Subjects having this problem had FVC less than 80% of predicted value and FEV_1/FVC ratio < 70%.

(ii) Age for spirometry

It has been reported that schoolchildren who are 9 years of age can perform forced expiratory spirometric maneuvers well enough to meet currently established adult-based maneuver acceptability criteria (Enright et al. 2000). Accordingly, children aged 9 years and above were enrolled for PFT.

(iii) Calibration and quality control

In epidemiological studies in which spirometry results are primary outcome measurements, the results depend not only on the true lung function of the subject population, but also on quality of their test performance. Factors related to age, gender, size, ethnicity, and subject-technician affinity can influence the performance. But their overall effect is small with well-trained, experienced technicians/researchers (Enright et al., 2000). The spirometers were calibrated using a 2.0 liter syringe in each morning before the tests. The instrument was calibrated again after measurements in 50 children.

(c) Calculation of body mass index (BMI)

BMI is calculated by dividing the body weight in kilogram by the square of the standing height in meter. The value is expressed a kg/m^2. It is a reliable indicator of body fatness for most children. Although BMI does not measure body fat directly, but it correlates to body fat (Mei et.al, 2002). Moreover, BMI is an inexpensive and easy to perform method of screening for weight categories that may lead to health problems.

Although the BMI number is calculated the same way for children and adults, the criteria used to interpret the meaning of the BMI number for children are different from those used for adults. For children, BMI age- and sex-specific percentiles are used, because the amount of body fat changes with age, and the amount of body fat differs between girls and boys of the same age. Separate BMI- for- age growth charts for girls or boys formulated by the Center for Disease Control (CDC) take into account these differences and allow translation of a BMI number into a percentile for a child's sex and age (Fig. 4.4, 4.5).

After BMI calculation, the value of each child was plotted on to obtain a percentile ranking. The percentile indicates the relative position of the child's BMI number among children of the same sex and age. The body weight status of individual child was ascertained as belonging to either of the four categories 'underweight', 'healthy', 'at risk of overweight', or 'overweight' from the BMI percentile by the following procedure (Table 4.1):

Table 4.1: BMI calculation of children

Weight status category	BMI Percentile
Underweight	< 5th percentile
Healthy weight	5th to 85th percentile
At risk of overweight	85th to < 95th percentile
Overweight	≥95th percentile

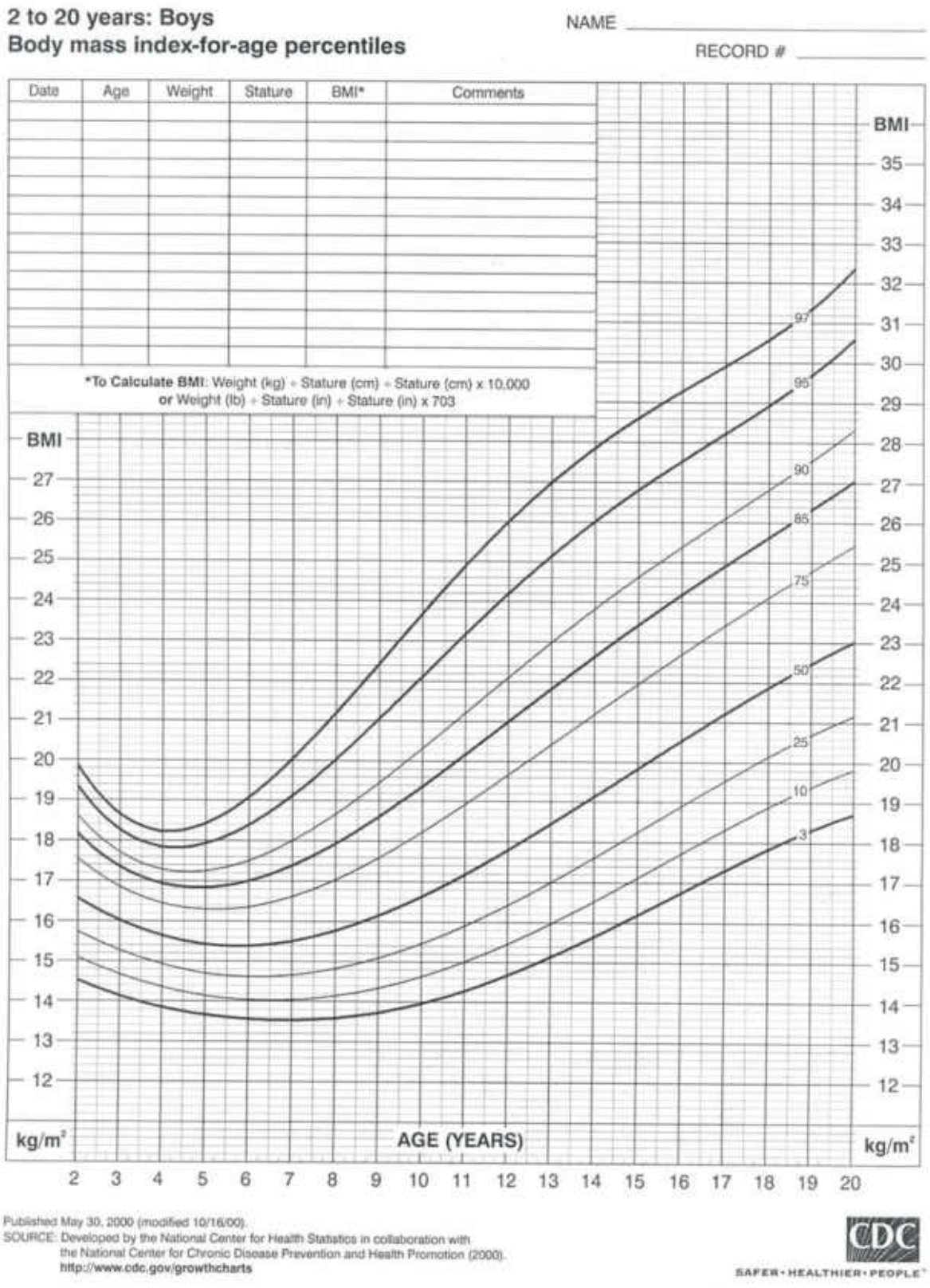


Figure 4.4: BMI- for- age growth charts for boys formulated by the Center for Disease Control (CDC)

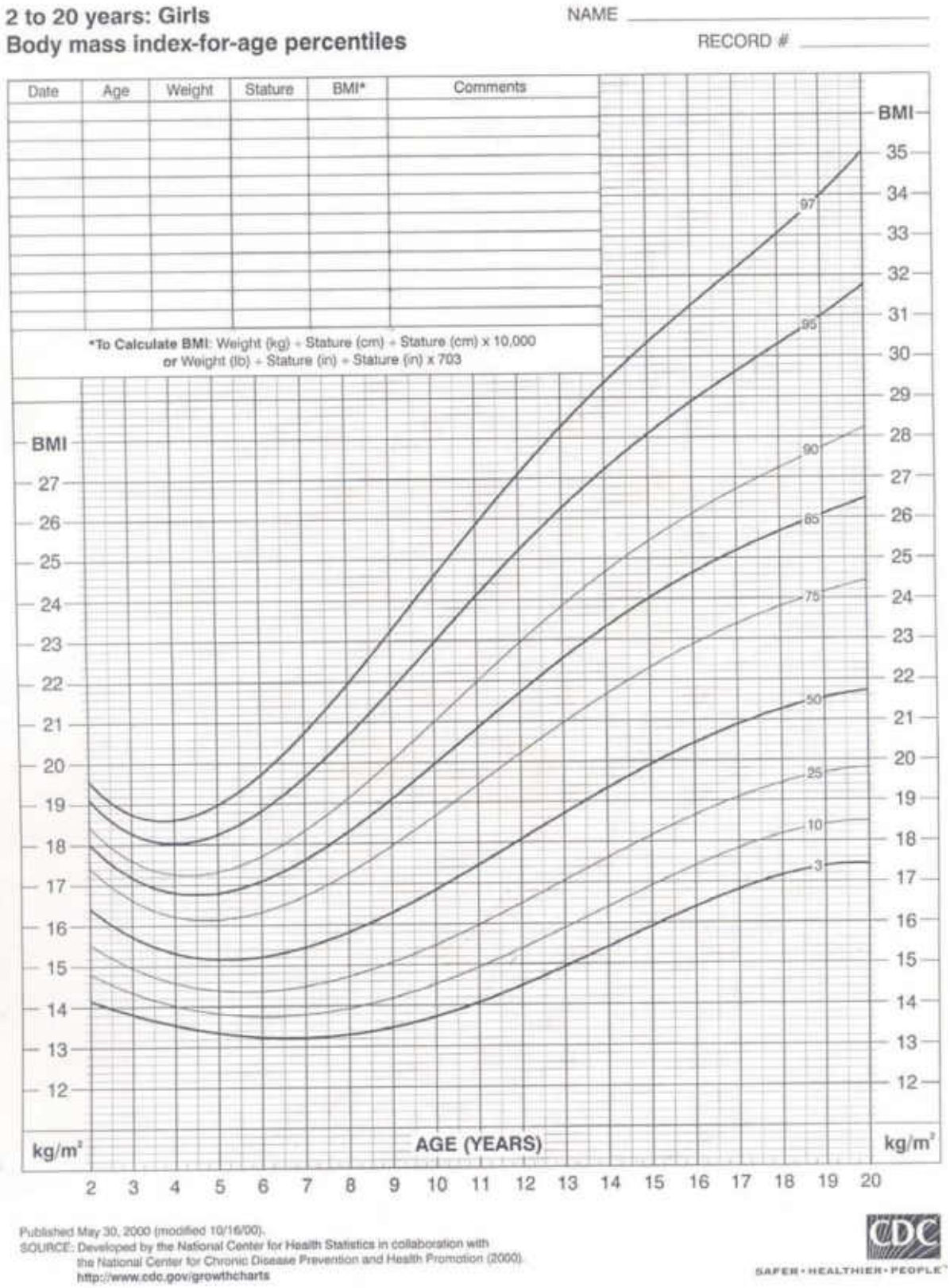


Figure 4.5: BMI- for- age growth charts for girls formulated by the Center for Disease Control (CDC)

(d) Statistical analysis

Bilateral statistical tests were used as follows: the Chi-square test for dichotomous or multinomial qualitative variables, the Mann Whitney U-test for quantitative variables with non-homogeneous variances or non-normal distribution and the Student's t-test for quantitative variables of normal distribution and homogeneous variances. A descendant stepwise logistic regression adjusted over potential confounding variables was carried out for multivariate analysis.

The collected data were processed and analyzed in EPI info 6.0 and SPSS (Statistical Package for Social Sciences) software. Logistic regression analysis using generalized estimating equations (GEEs) was used to examine the relationship between respiratory symptoms and RSPM levels.

4.3 RESULTS

(a) Successful pulmonary function tests (PFT): 5671 in Delhi and 2245 in controls

Forty-five children of Delhi (0.8%), 22 boys and 25 girls, failed to do PFT satisfactorily after repeated attempts (Table 4.2). In the control group 25 participants (1.1%), 11 boys and 14 girls failed to do the tests. Hence, these 70 children were excluded from the study. Therefore, lung function was successfully measured in 7916 children-5671 in Delhi and 2245 in control group. Out of these 5671 children of Delhi who successfully performed pulmonary function test, 3708 (65.4%) were boys and 1963 (34.6%) were girls. In the control group of 2245 successful performers, 1438 (64.1%) were boys and 807 (35.9%) were girls (Table 4.2).

Table 4.2: Participants in pulmonary function test (PFT) by spirometry

PFT	Boys	Girls	Total
Number of participants	5179	2809	7988
Delhi	3730	1988	5718
Control	1449	821	2270
Unsuccessful performers	33	39	70
Delhi	22	25	47
Control	11	14	25
Successful performers	5146	2770	7916
Delhi	3708	1963	5671
Control	1438	807	2245

(b) Age of the examined children

Age distribution of successful performers of spirometry in Delhi showed that 28.6% children belonged to 9-11 year of age, 38.7% aged 12-14 years and 32.7 % children were 15-17-year old. In control, 23.5% children were 9-11 years of age, 48.8% belonged to 12-14 year age group and 27.7% children were 15-17 years of age (Table 4.3).

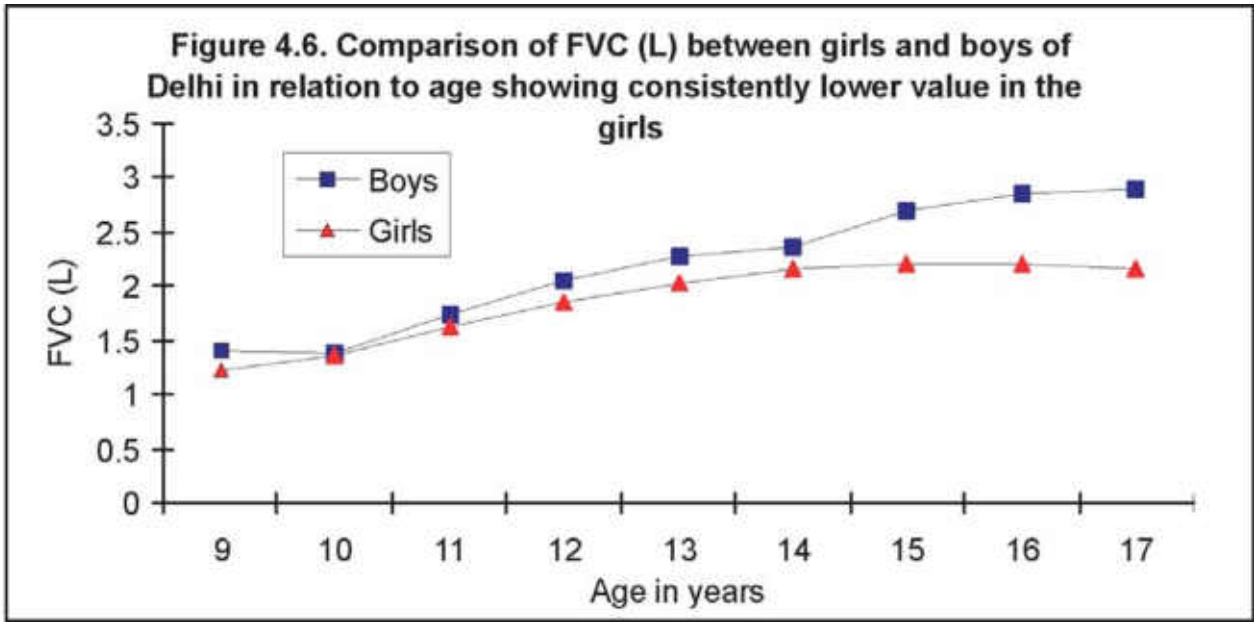
Table 4.3: Age distribution of children whose lung function was measured by spirometry

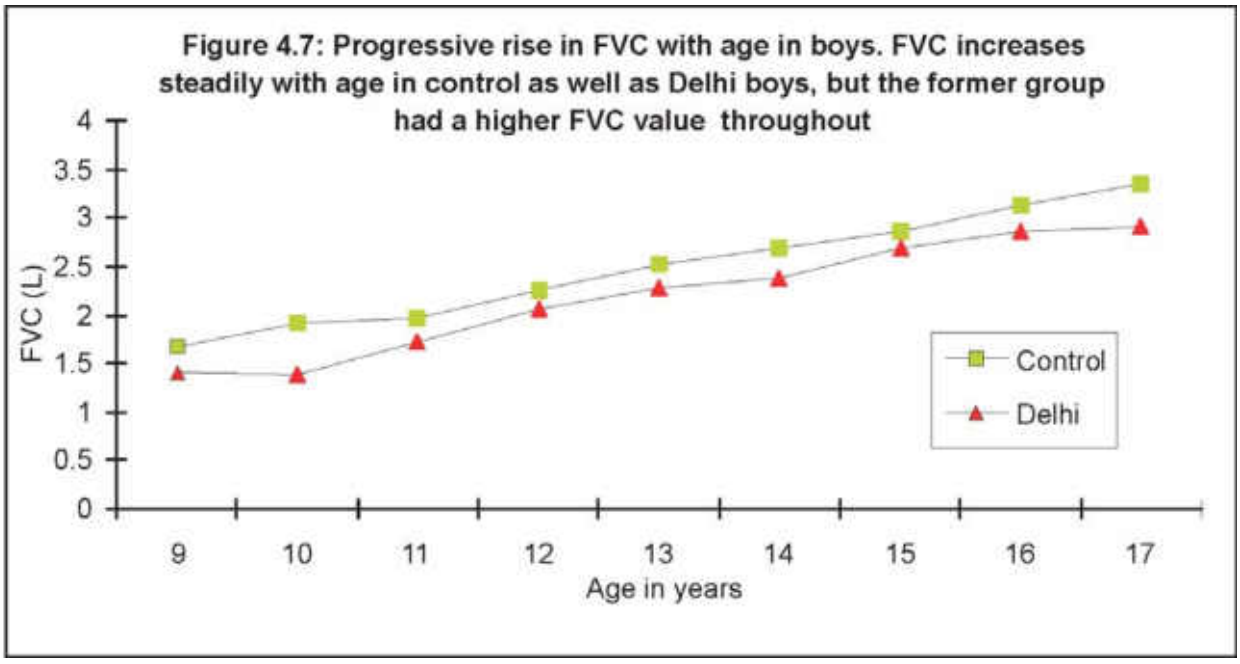
Age	Control(n=2245)	Delhi(n=5671)
9-11 year	527 (23.5)	1623 (28.6)
12-14 year	1095 (48.8)	2195 (38.7)
15-17 year	623 (27.7)	1853 (32.7)

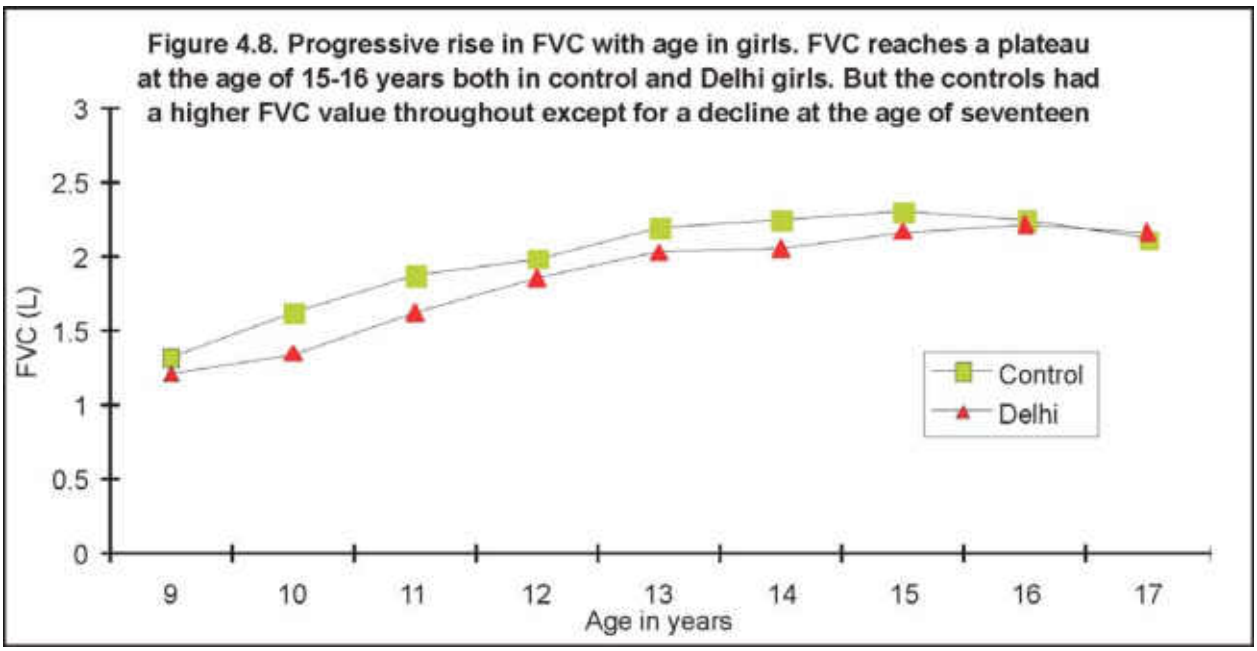
The results are expressed as number of children in each age group with percentage in parentheses

4.3.1. Changes in forced vital capacity (FVC) with age in control and Delhi's children

The mean FVC value in boys aged 9 years was 1.41 liters in Delhi and 1.68 liters in control group. Girls of similar age in control and in Delhi had FVC values of 1.32 and 1.22 liters respectively. FVC values increased progressively with age reaching a plateau at the age of 16-17 years in girls (Fig. 4.6), but the increase continued till 19-20 years in boys (Fig. 4.6). Comparison of rising trend of FVC in relation to age between control and Delhi boys revealed a lower value in the latter group throughout (Fig.4.7). On the other hand, control girls had appreciably higher FVC till 16 years of age, thereafter a modest fall in FVC was recorded (Fig. 4.8).







(a) Lower FVC values in girls

FVC differed significantly between the girls and the boys. The measured as well as the predicted value of FVC was significantly lower ($p<0.05$) in the girls (Table 4.4). The male: female ratio of measured FVC was 1.28:1 in control and 1.26:1 in Delhi. A comparison of FVC between boys and girls of Delhi of similar age revealed a consistently lower value in girls.

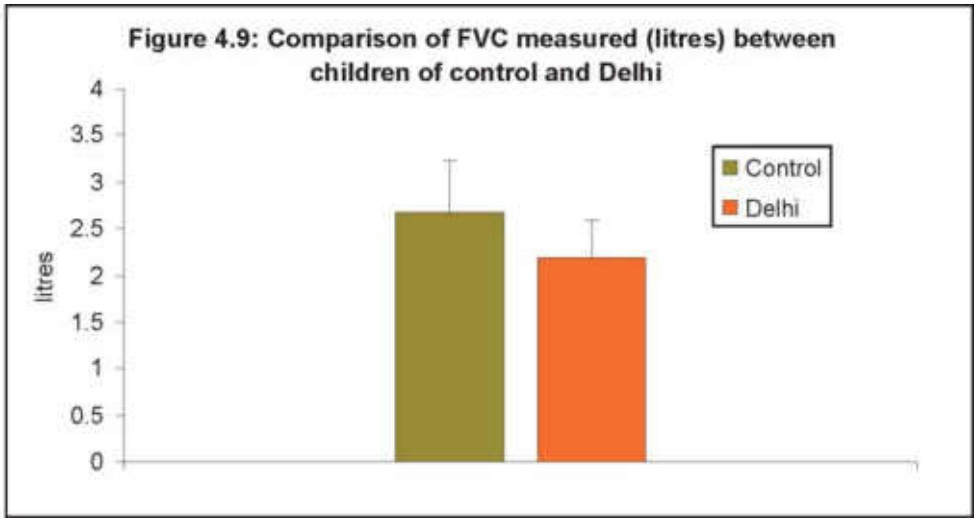
Table 4.4: Comparison of FVC between girls and boys

FVC (liter)	Boys		Girls		Total	
	Control (n=1438)	Delhi (n=3708)	Control (n=807)	Delhi (1963)	Control (n=2245)	Delhi (n=5671)
Measured	2.90 ± 0.73	2.38 ± 0.48*	2.24± 0.48	1.85 ± 0.35*	2.67± 0.55	2.19 ± 0.45*
Predicted	2.76± 0.49	2.81± 0.69	2.19 ± 0.24	2.26 ± 0.35	2.55± 0.42	2.62 ± 0.39
% predicted	105.1	84.7**	102.2	81.8**	104.7	83.6**

**, p<0.05 compared with respective control in Student's 't'-test; **p<0.05 compared with control in Chi-square test*

(b) Reduction of FVC in Delhi

Overall, the school children examined in Delhi had 2.19 ± 0.45 (SD) liters FVC that was 83.6 % of the predicted value based on age, weight, height and ethnicity. In contrast, school children in control group had 2.67± 0.55 liter FVC, which was 104.7% of the predicted value. Thus, Delhi's children showed a significant 480 ml reduction (p<0.001) in mean FVC (Table 4.4, Fig. 4.9). Compared with controls, boys in Delhi illustrated 520 ml reduction (-18%) in mean FVC, while in case of girls the deficit was 390 ml (-17%).



(c) Restrictive type of lung function deficits: 17.8% in control and 29.9% in Delhi's children

Restrictive type of lung function decrement (FVC<80% of predicted value) was recorded in 247 boys (17.2%) and 152 girls (18.8%) of control group (Table 4.3). Overall, 399 control children (17.8%) had restrictive type of lung function deficits. In contrast, 34.8% of the girls of Delhi (683 out of 1963) and 27.3% of the boys (1013 out of 3708) of the city had FVC less than 80% of predicted value, confirming the diagnosis of restrictive type of lung function impairment. Overall, 29.9% children of Delhi (1696 of 5671) had restrictive type of lung function decrement compared with 17.8% of controls, and the difference was highly significant (p<0.001, Table 4.5).

Table 4.5. Gender difference in the prevalence (%) of restrictive type of lung function deficits

Group	Boys	Girls	Total
Control	17.2	18.8	17.8
Delhi	27.3*	34.8*	29.9*

**, p<0.05 compared with respective control in Chi-square test*

(d) Girls suffered more than the boys

Girls had greater prevalence of restrictive type of lung function deficits than the boys both in control group and in Delhi (Table 4.5). For example, 18.8% and 34.8% of the girls in control group and Delhi respectively had restrictive type of lung function reductions compared with 17.2% and 27.3% of the boys in these two groups respectively, and the gender difference in this regard was significant ($p<0.05$).

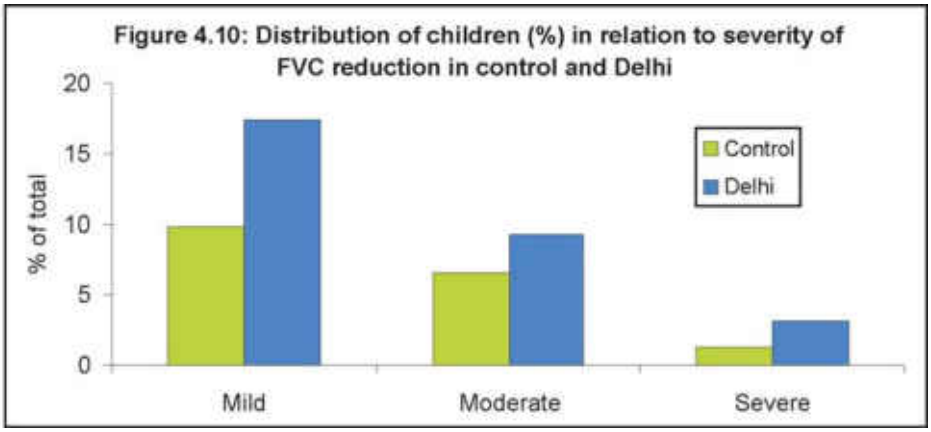
(e) Severe lung restriction in 3.1% children of Delhi compared with 1.3% of control

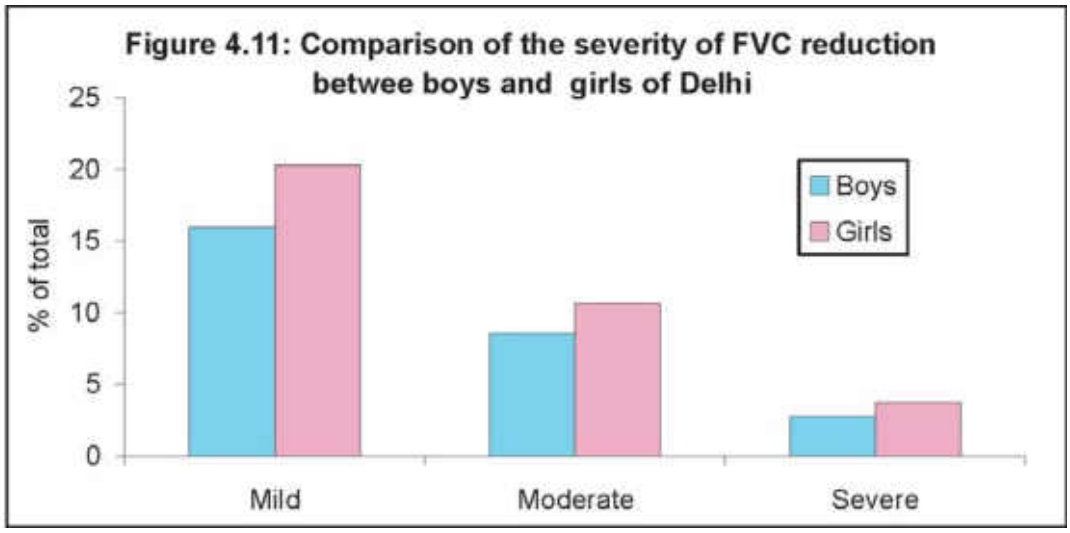
The magnitude of FVC decrement was classified into 3 categories: mild (FVC 60-79% of predicted value), moderate (FVC 40-59% of predicted) and severe (FVC<40% of predicted). A majority of children with restrictive type of lung function deficits had mild restriction both in control and Delhi. For example, 9.8% control and 17.5% Delhi children had mild restriction, 6.6% and 9.3% had moderate restriction, and 1.3% and 3.1% children of control group and Delhi respectively had severe restriction (Table 4.6; Fig. 4.10 & 4.11). The difference in the prevalence of mild, moderate and severe restriction between control and Delhi children was significant ($p<0.001$). The prevalence of severe restriction was more in girls both in control areas and in Delhi.

Table 4.6. Comparison of the severity of FVC reduction between boys and girls

FVC (% predicted)	Boys		Girls		Total	
	Control (n= 1438)	Delhi (n=3708)	Control (n=807)	Delhi (1963)	Control (n=2245)	Delhi (n=5671)
60-79 (Mild reduction)	8.0	15.9*	13.1	20.4*	9.8	17.5*
40-59 (Moderate)	8.0	8.6*	4.2	10.7*	6.6	9.3*
<40 (Severe)	1.2	2.8*	1.5	3.7*	1.3	3.1*

*Results are expressed as percentage of children; *, p<0.05 compared with respective control group in Chi-square test*





(f) Combined type of lung function reduction: 9.6% in Delhi against 3.5% in control

A section of children with restrictive lung also had obstructive type of lung function reduction (FEV_1/FVC <70%). These children are groped under 'combined' type (both restrictive and obstructive) of lung function reduction. The number of such children was 79 (3.5%) in control and 9.6% in Delhi. In the control group, 34 girls (4.2%) and 45 boys (3.1%) had combined type of lung function deficits. Similar problem was recorded in 200 girls (10.2%) and 344 boys (9.3%) of Delhi who participated in this study. Thus, combined type of lung function deficits was also more common in girls.

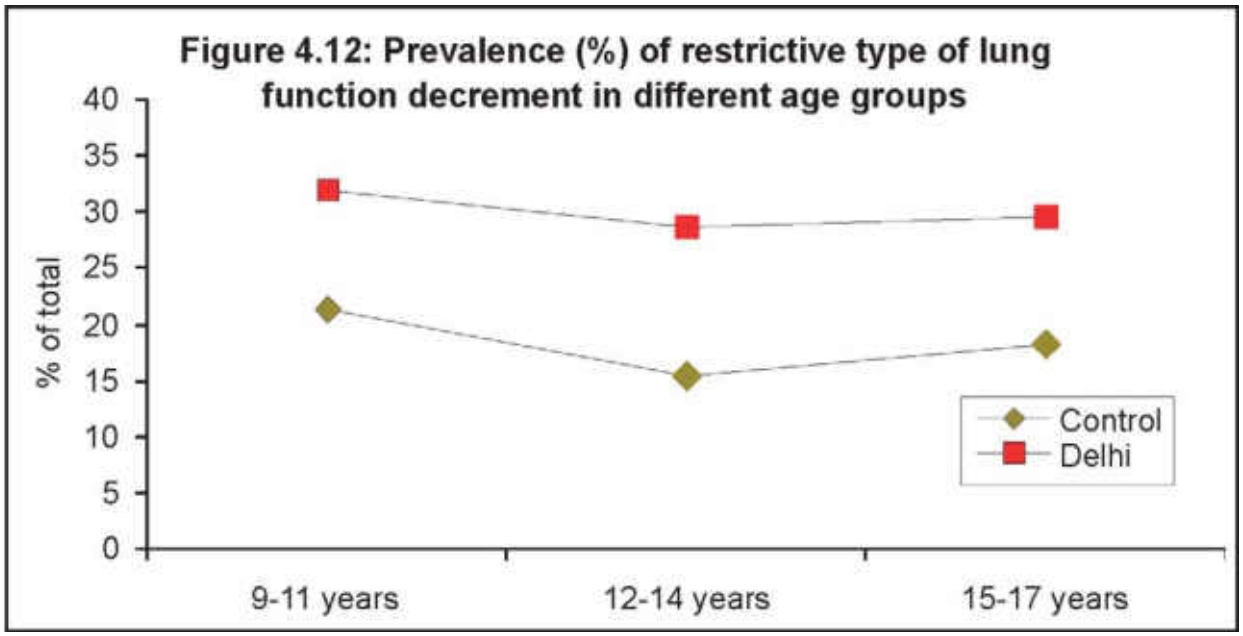
(g) 9-11 year-old children suffered most

The fall in FVC below 80% of predicted value was found in 32.0% of 9-11 year-old children of Delhi compared with 29.5% and 28.7% children in 15-17 year and 12-14 year age groups respectively. Similarly, 21.4% of control children aged 9-11 years had reduced lung function of restrictive type, compared with 15.3% and 18.3% children in 12-14 year and 15-17 year age groups respectively. Therefore, restrictive type of lung function decrement was most prevalent among children aged 9-11 years, and least prevalent in 12-14 year-old children (Table 4.7; Fig. 4.12).

Table 4.7: Prevalence (%) of restrictive type of lung function decrement in different age groups

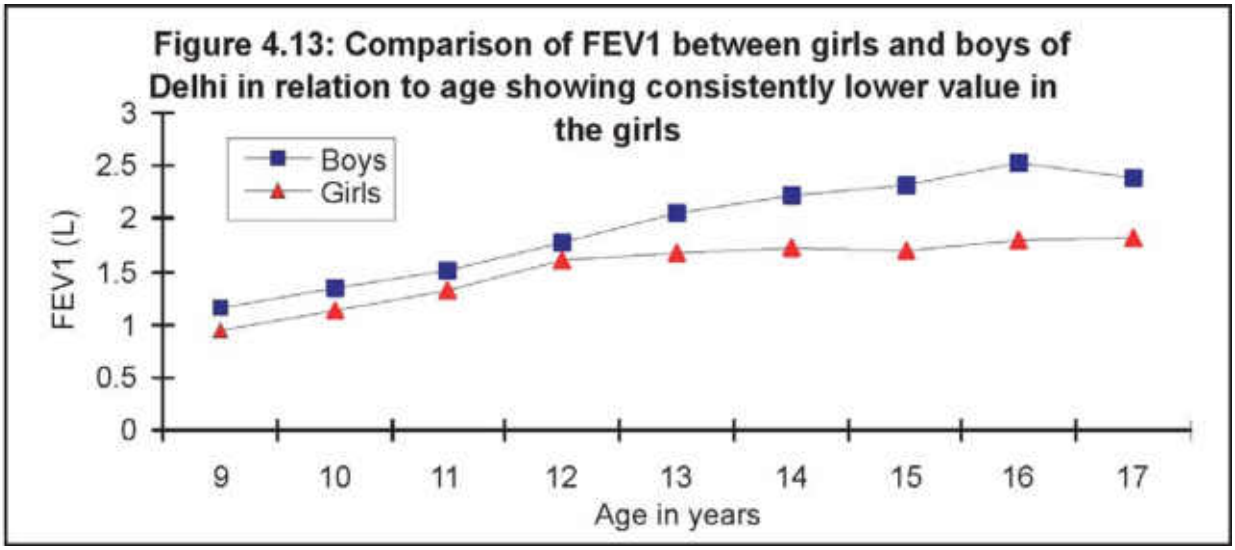
Age (year)	Percentage of children with FVC <80% of predicted value	
	Control	Delhi
9-11	21.4	32.0*
12-14	15.3	28.7*
15-17	18.3	29.5*

**, p<0.05 compared with respective control group in Chi-square test*



4.3.2. Reduction in FEV_1 in Delhi's children

The mean FEV_1 value in boys aged 9 years was 1.15 liters in Delhi and 1.32 liters in control group. Girls of similar age in Delhi and control had FVC values of 0.95 and 1.13 liters respectively. FEV_1 values increased progressively with age reaching a plateau at the age of 16-17 years in girls (Fig. 4.13), but the increase continued till 19-20 years in boys (Fig. 4.13), as in case of FVC. Comparison of the rising trend in FEV_1 in relation to age between control and Delhi boys and girls revealed a lower value in Delhi in all the age groups (Fig. 4.14 & 4.15).



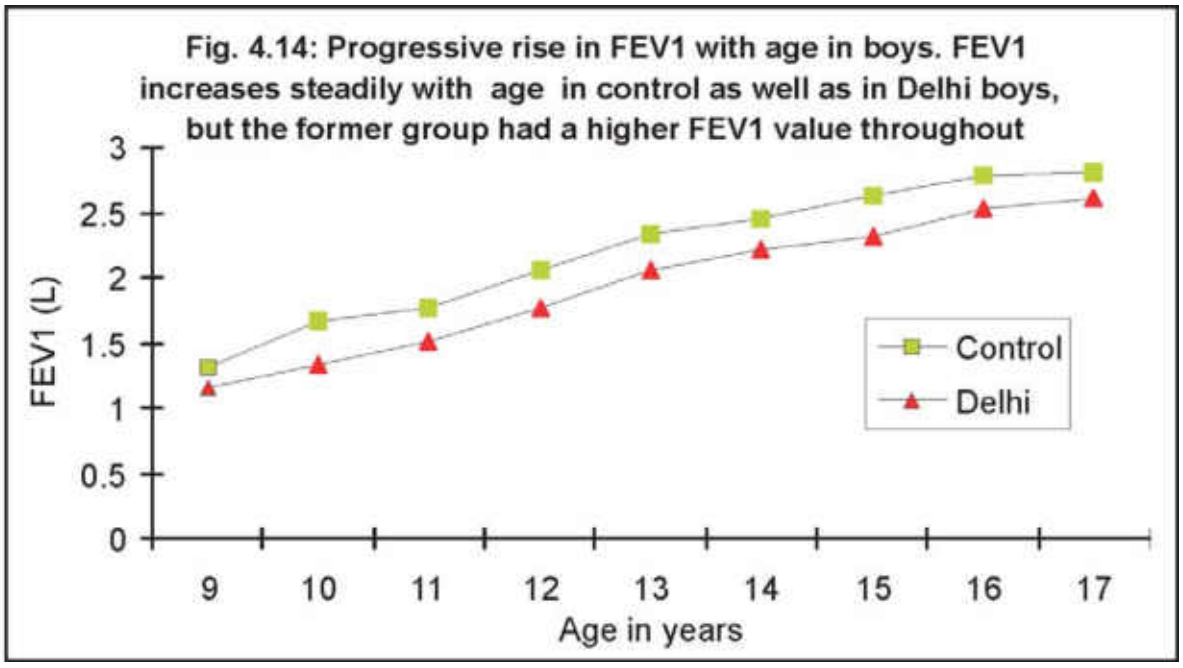


Fig. 4.14: Progressive rise in FEV1 with age in boys. FEV1 increases steadily with age in control as well as in Delhi boys, but the former group had a higher FEV1 value throughout

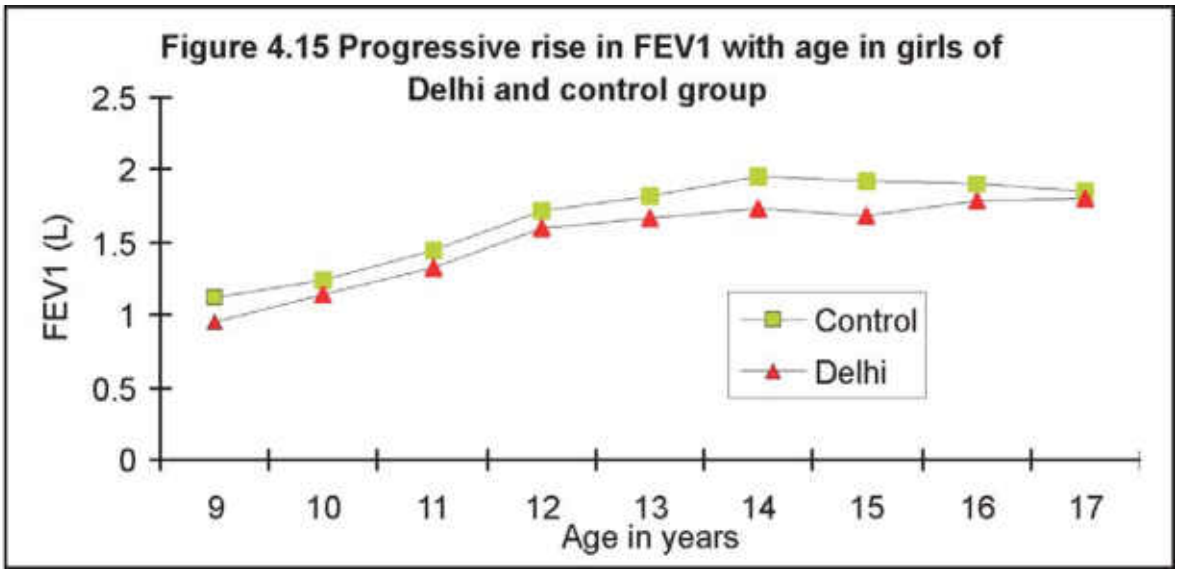


Figure 4.15 Progressive rise in FEV1 with age in girls of Delhi and control group

(a) Lower FEV_1 values in girls

FEV_1 differed significantly between the girls and the boys. The measured as well as the predicted value of FEV_1 was significantly lower ($p<0.05$) in the girls.

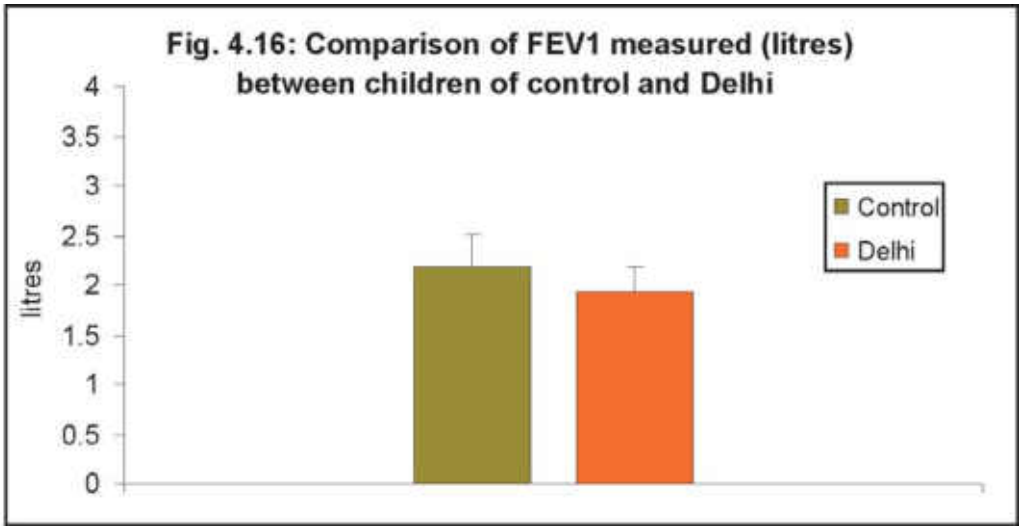
(b) Mean FEV_1

Mean measured forced expiratory volume in one second (FEV_1) was 1.93± 0.25 liter in Delhi compared with 2.19± 0.36 in control group, thereby showing a reduction of 12% in mean FEV_1 in Delhi's children ($p<0.05$, Table 4.8, Fig. 4.16). Compared with respective controls, the decline in mean FEV_1 in Delhi's children was 11% in boys and 14% in girls.

Table 4.8. Comparison of FEV_1 between control and Delhi's children

FEV_1 (liter)	Boys		Girls		Total	
	Control (n=1438)	Delhi (n=3708)	Control (n=807)	Delhi (1963)	Control (n=2245)	Delhi (n=5671)
Measured	2.31 ± 0.58	2.05 ± 0.44*	2.01± 0.41	1.72± 0.37*	2.19± 0.36	1.93± 0.25*
Predicted	2.36± 0.38	2.38 ± 0.45	2.01± 0.22	2.03 ± 0.40	2.23± 0.38	2.25 ± 0.33
% predicted	97.9	86.1**	100.0	84.7**	98.2	85.8**

**, p<0.05 compared with respective control in Student's 't'-test; **p<0.05 compared with control in Chi-square test*



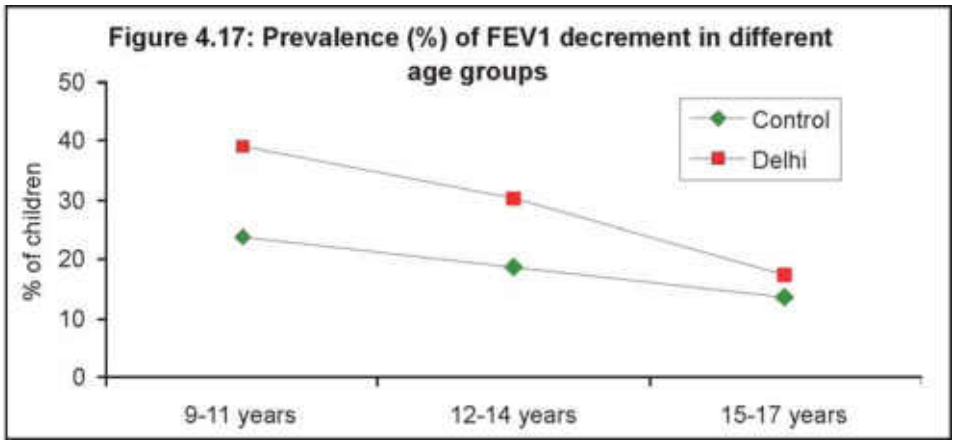
(c) Reduction of FEV_1 in younger age groups

The reduction in FEV_1 below 80% of predicted value was most prevalent among children in 9-11 year age group, and least prevalent in adolescents aged 15-17 years both in rural and urban settings (Table 4.9; Fig. 4.17). However, Delhi's children had reduced FEV_1 in all the age groups when compared with that of controls. Altogether, 28.6% children of Delhi had FEV_1<80% of predicted compared with 18.5% of controls (p<0.001).

Table 4.9: Prevalence of FEV_1 decrement in different age groups

Age group (yr)	% of children with FEV_1 <80% of predicted	
	Control (n=2245)	Delhi (n=5671)
9-11	23.7	39.1*
12-14	18.7	30.4*
15-17	13.6	17.4*
Total	18.5	28.6*

**p<0.05 compared with respective control groups in Chi-square test*



Like FVC, the magnitude of FEV_1 reduction was classified into 3 categories. Mild decrement (FEV_1 60-79% of predicted value) was present in 9.8% of control and 14.9% of Delhi's schoolchildren. Moderate (FEV_1 40-59% of predicted value) and severe (FEV_1<40% of predicted value) reductions were present in 6.6% vs. 9.8% and 2.0% vs. 3.9% schoolchildren of control and Delhi respectively ($p<0.05$). Therefore, the magnitude of FEV_1 reduction was much more in Delhi's schoolchildren compared with rural controls.

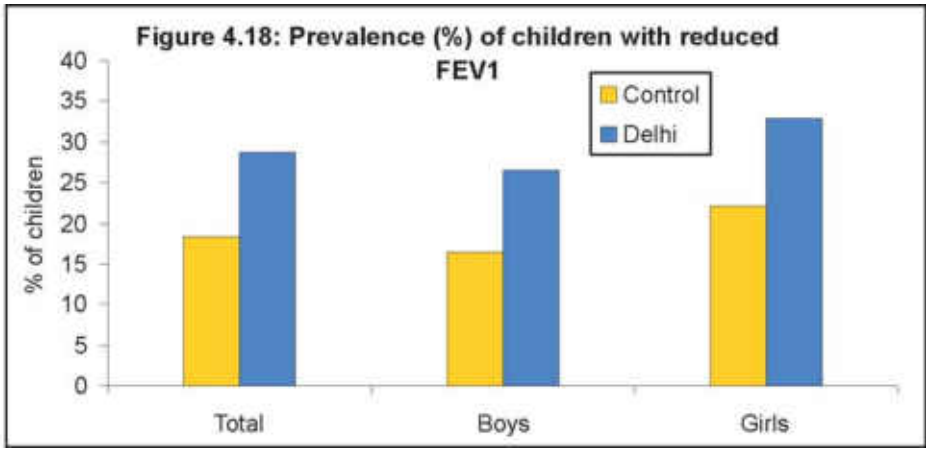
(d) Girls had greater prevalence of reduced FEV_1

Girls showed greater prevalence of reduced FEV_1 than did the boys. For example, 22% of control girls had FEV_1<80% predicted against 16.5% of boys. Similarly, 33% of girls in Delhi had lowered FEV_1 compared with 26.4% of the city's boys (Table 4.10; Fig. 4.18).

Table 4.10: Percentage of children with reduced FEV_1

FEV_1 < 80% predicted	Boys	Girls	Total
Control	16.5	22.1	18.5
Delhi	26.4*	32.9*	28.6*

**, p<0.05 compared with respective control in Chi-square test*



4.3.3. Reduction in FEV_1 /FVC ratio in Delhi's children

The FEV_1/FVC ratio was reduced in Delhi's schoolchildren compared with that of controls. The city's children had a mean FEV_1/FVC ratio of 91.4% (92% in boys and 90.4% in girls) in contrast to 94.3% (95.6% n boys and 92.1% in girls) in controls.

(a) Obstructive type of lung function reduction: 23.2% in Delhi and 11.5% in controls

The hallmark of obstructive type of lung function decrement is reduction in FEV_1/FVC ratio to less than 70%. This type of lung function deficits was found in 1316 (23.2%) schoolchildren of Delhi and 258 (11.5%) children of control group (Table 4.11), and the difference between these two groups in this regard was highly significant ($p<0.001$).

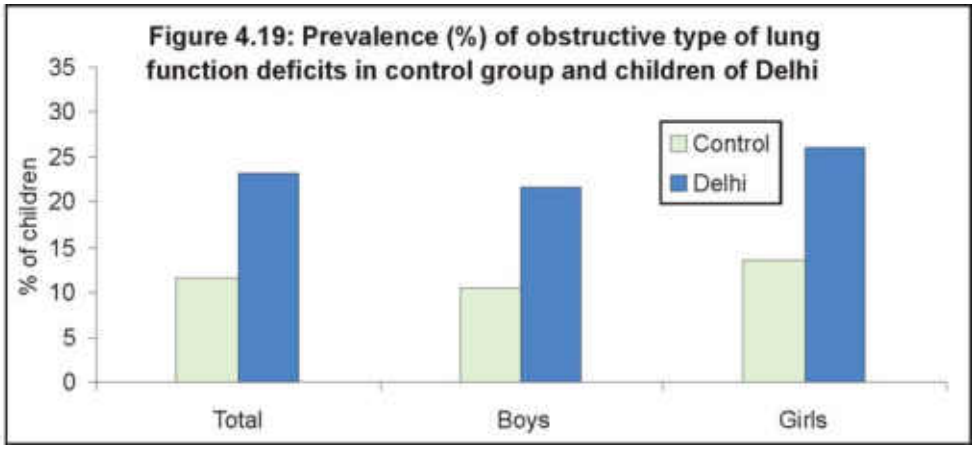
Table 4.11: Prevalence of obstructive type of lung function deficits in children

Group	% of children with FEV_1/FVC <70%	
	Control	Delhi
Boys	10.4	21.7*
Girls	13.5	26.0*
Total	11.5	23.2*

**, p<0.05 compared with control in Chi-square test*

(b) Girls are more affected than the boys

Girls in general had greater prevalence of obstructive lung than the boys both in Delhi and in control group. For example, 26.0% girls of Delhi (510 out of 1963) had obstructive lung compared with 21.7% of city's boys (806/3708). Similarly, 13.5% of control girls (109/807) had lung obstruction compared with 10.4% of control boys (149/1438, Table 4.11; Fig. 4.19).



(c) More severe obstruction in lungs of Delhi' children

After establishing greater prevalence of obstructive type of lung function impairment in Delhi's children the severity of the problem was examined. The magnitude of lung obstruction was classified into three categories on the basis of FEV_1/FVC values: mild (FEV_1/FVC 50-69%), moderate (FEV_1/

FVC 30-49%) and severe (FEV_1/FVC <30%). It was found that Delhi's schoolchildren had 5-times more severe type of lung obstruction than the controls (5.2% in Delhi vs. 1% in control, p<0.001, Fig. 4.20). The change was more noticeable in boys (8-times more than control boys) than in girls (3-time more than control girls, Table 4.12; Fig. 4.21).

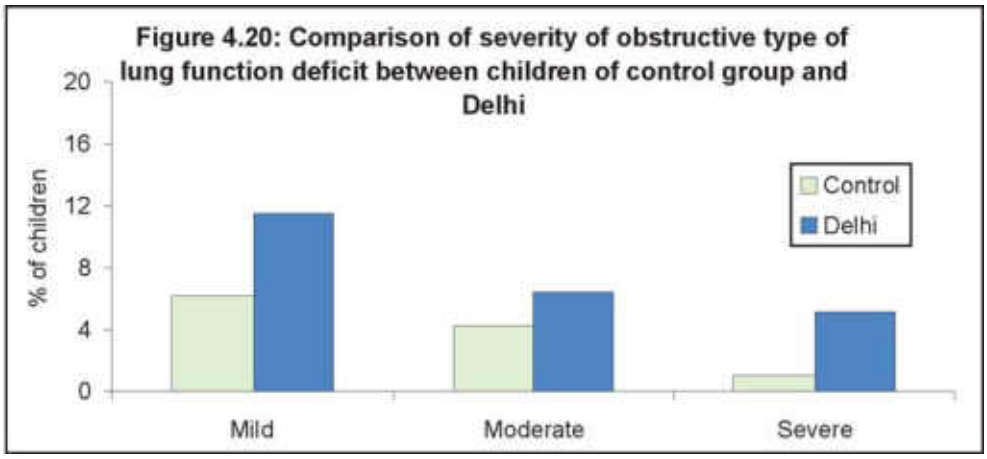
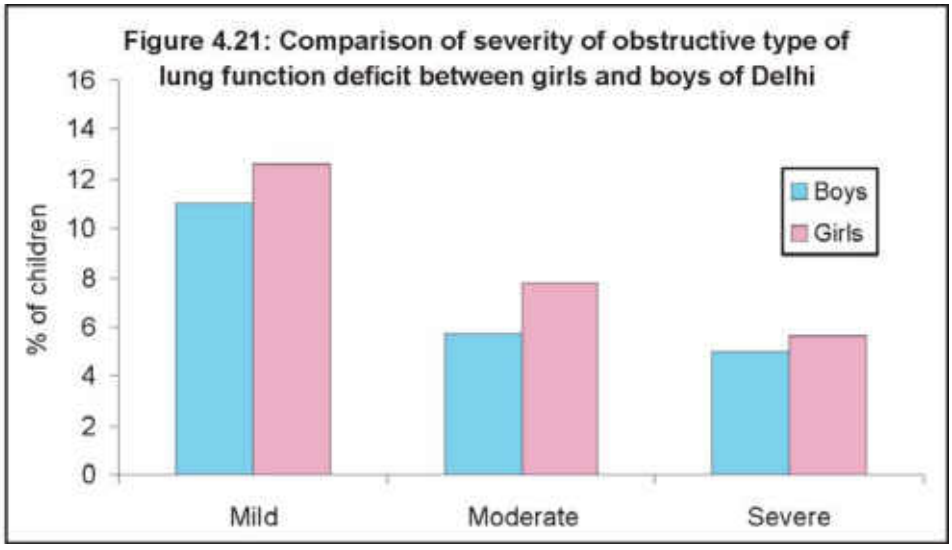


Table 4.12: Severity of obstructive type of lung function deficit in children

FEV_1/FVC (%)	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
50-69 (Mild)	6.0	11.0*	6.6	12.6*	6.2	11.5*
30-49 (Moderate)	3.8	5.7	5.1	7.8*	4.3	6.4*
<30 (Severe)	0.6	5.0*	1.8	5.6*	1.0	5.2*

Results are expressed as percentage of children, p<0.001 compared with control in Chi-square test*



The prevalence of obstructive type of lung function deficiency in Delhi was highest (26.3%) in the age group of 15-17 years, followed by children aged 9-11 years (23.6%), while 12-14 year-old children had the lowest (20.8%) prevalence (Table 4.13). In control group also, children belonging

to 12-14 year age group had the lowest prevalence of obstructive lung (10.4%), but greatest prevalence was found in younger age group (13.3% in 9-11 year-old children).

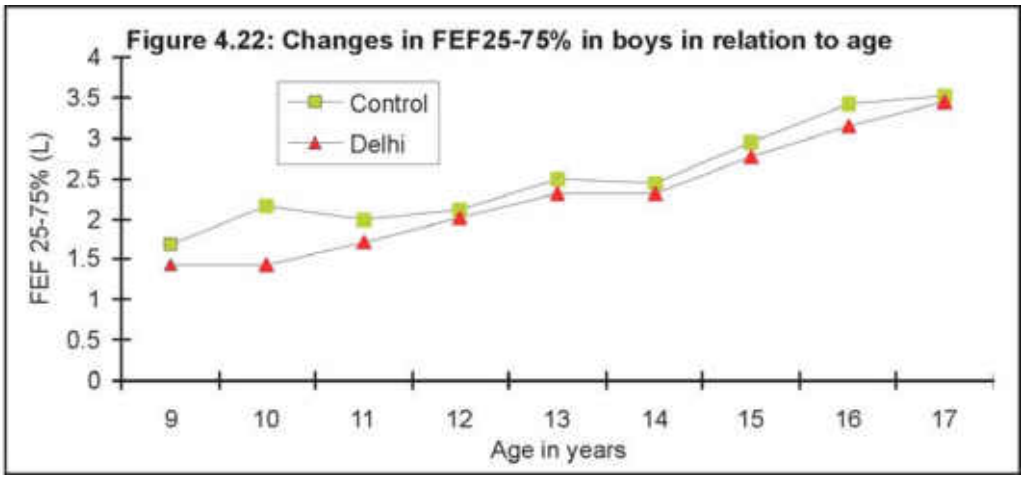
Table 4.13: Prevalence of obstructive type of lung function deficits in children in relation to age

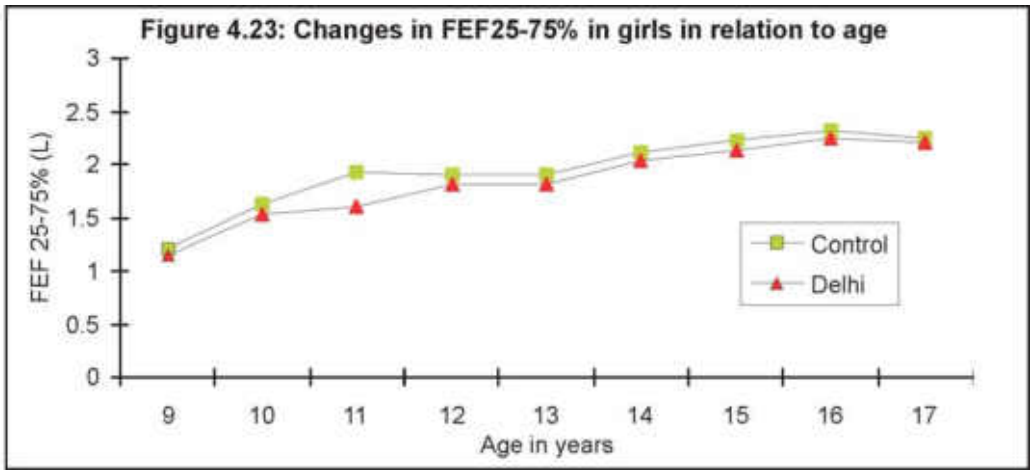
Age of the children	% of children with obstructive lung	
	Control	Delhi
9-11 year	13.3	23.6*
12-14 year	10.4	20.8*
15-17 year	11.9	26.3*

**, p<0.05 compared with control in Chi-square test*

4.3.4 Reduction in $FEF_{25-75\%}$ in Delhi

The mean $FEF_{25-75\%}$ value in boys aged 9 years was 1.44 liters in Delhi and 1.68 liters in control group. Girls of similar age in Delhi and control had $FEF_{25-75\%}$ values of 1.15 and 1.20 liters respectively. $FEF_{25-75\%}$ values increased progressively with age reaching a plateau at the age of 16 years in girls, but the increase continued beyond that age in boys Fig. 4.22 & 4.23).



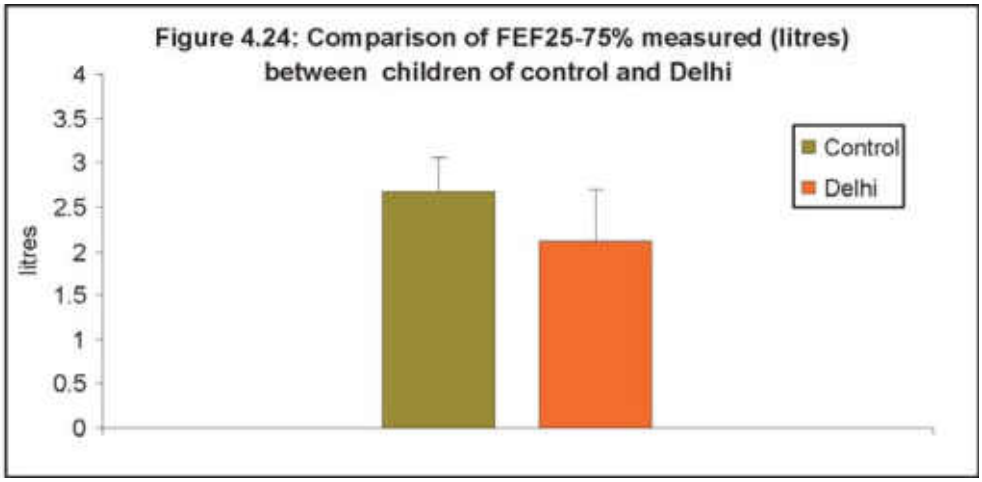


Comparison of $FEF_{25-75\%}$ in relation to age between control and Delhi boys and girls revealed a lower value in Delhi in all the age groups Overall, school children of Delhi demonstrated 21% reduction in $FEF_{25-75\%}$ ($p<0.001$) than the controls, suggesting greater prevalence of underlying small airway obstruction. Compared with respective controls, the reduction of $FEF_{25-75\%}$ was 24.4% in boys, and 21.6% in girls of Delhi. It was observed that the measured value of $FEF_{25-75\%}$ was much lower in both boys and girls of Delhi than the control group (Table 4.14, Fig. 4.24).

Table 4.14: Mean $FEF_{25-75\%}$ in control and Delhi's children

$FEF_{25-75\%}$	Control	Delhi
Boys	2.99 ± 0.65	2.26 ± 0.79*
Girls	2.45± 0.54	1.92± 0.80*
Total	2.66± 0.39	2.10± 0.59*

**, p<0.05 compared with control*



A total of 70.3% children of Delhi had small airway obstruction as evidenced by reduction of $FEF_{25-75\%}$ below 80% of predicted value. In contrast, 32.6% control children had $FEF_{25-75\%}$ < 80% predicted ($p<0.001$). In 17.8% of children of Delhi the reduction in $FEF_{25-75\%}$ was <40% of predicted value, implying severe obstruction of the small airways (Table 4.15). Severe small airway obstruction was found in 9.2% control children, suggesting a 2-fold rise in the prevalence of this problem among the children of Delhi.

Table 4.15: Percentage of children with reduced $FEF_{25-75\%}$

$FEF_{25-75\%}$ (% predicted)	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
60-79	11.5	25.4*	15.0	25.5*	12.7	25.5*
40-59	9.9	27.8*	12.1	25.6*	10.7	27.0*
<40	9.2	17.9*	9.2	17.7*	9.2	17.8*

**, p<0.05 compared with respective control*

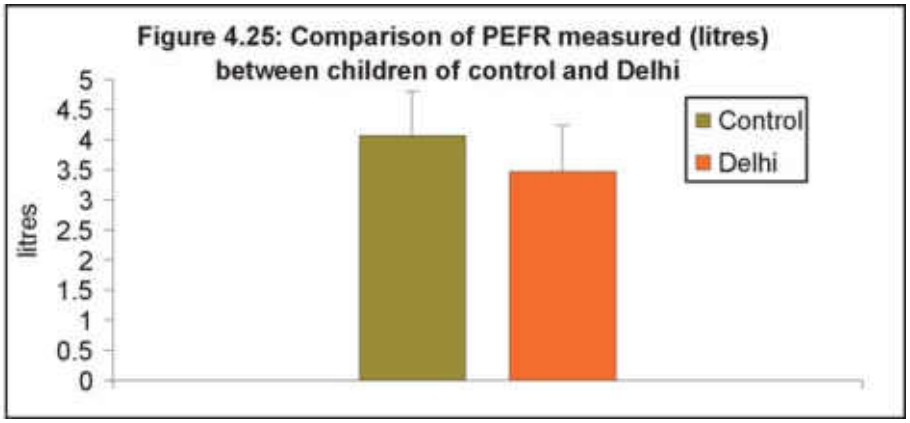
4.3.5. Reduction in PEFR

PEFR was decreased by 15% in Delhi's children when compared with that of control (Table 4.16; Fig. 4.25). The former group had a mean PEFR of 3.46 l/s compared with 4.07 l/s in control (Fig. 4.16). The decline was 17% in boys, and 11% in girls ($p<0.05$ in both cases).

Table 4.16: Comparison of PEFR between control and Delhi's children

PEFR (liter/second)	Control	Delhi
Boys	4.39 ± 0.62	3.63 ± 0.79*
Girls	3.51± 0.78	3.14± 0.81*
Total	4.07± 0.74	3.46± 0.77*

**, p<0.05 compared with control*



A total of 48.4% children of Delhi and 29.4% control children had PEFR value reduced to less than 80% of predicted values based on age, gender and BMI. In 14.2% children of Delhi the reduction in PEFR was <40% of predicted value, against 7.1% in controls ($p<0.001$, Table 4.17). PEFR reduction was more prevalent in girls (54%) than in boys (45.5%) of Delhi.

Table 4.17: Percentage of children with reduced PEFR

PEFR % predicted	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
60-79	7.9	16.0*	13.0	17.8*	9.7	16.6*
40-59	11.7	16.3*	14.2	20.0*	12.6	17.6*
<40	6.5	13.2*	8.3	16.2*	7.1	14.2*

**, p<0.05 compared with control in Chi-square test*

4.3.6 Overall prevalence of lung function deficits in school children: 43.5% in Delhi against 25.7% in control

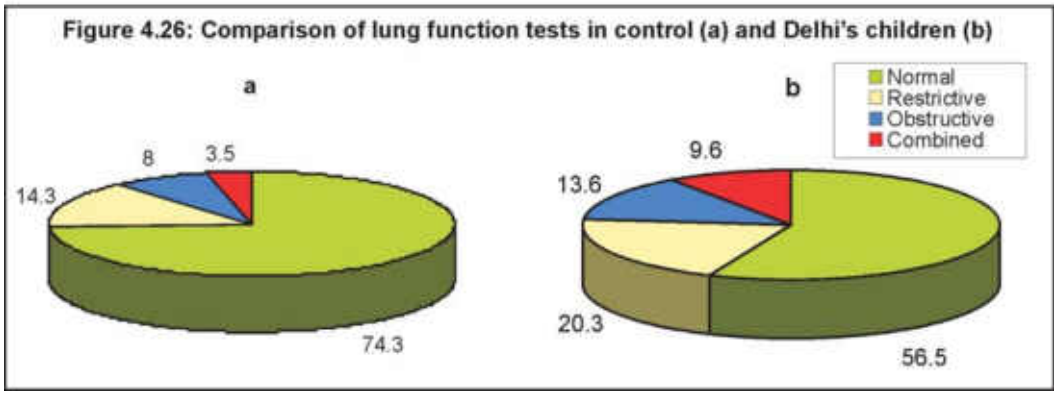
Out of 258 control children who had obstructive type of lung function, 79 children (3.5% of total) had combined type of lung function reduction. Thus, 179 control children (8.0%) had only obstructive type of lung function deficits. Similarly in Delhi, 772 children (13.6%) had obstructive type of lung

function deficits only. Likewise, only restrictive type of deficit was present in 14.5% control and 20.1% Delhi's children. Overall, lung function was reduced in 2468 (43.5%) schoolchildren of Delhi compared with 578 (25.7%) children of control group (Table 4.18). Therefore, the prevalence of reduced lung function in school-going children was 1.7-times more in Delhi. Delhi's schoolchildren had significantly increased prevalence ($p<0.05$) of restrictive (20.3% v. 14.3%), obstructive (13.6% vs. 8%), as well as combined type of lung functions deficits (9.6% vs. 3.5%; Fig. 4.26).

Table 4.18: Prevalence of lung function deficits in schoolchildren

Type of deficit	Number of children with percentages in parentheses	
	Control (n=2245)	Delhi (n=5671)
Restrictive	320 (14.3)	1152 (20.3)*
Obstructive	179 (8.0)	772 (13.6)*
Combined	79 (3.5)	544 (9.6)*
Overall	578 (25.7)	2468 (43.5)*

**, p<0.05 compared with control in Chi-square test*

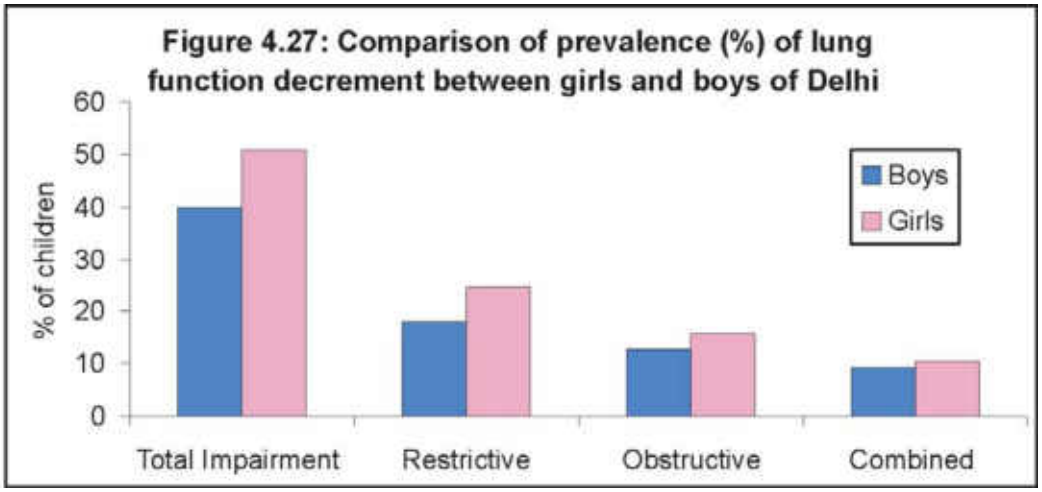


Lung function reduction was more prevalent in girls than the boys both in rural and urban settings. For example, 993 girls of Delhi (51.0%) had reduced lung function compared with 1475 boys (39.8%), and the difference was statistically significant ($p<0.05$). Similarly, 227 girls in controls group (28.1%) had reduced lung function compared with 351 control boys (24.2%). Moreover, the girls had increased prevalence of all three types of lung function deficits (Table 4.19; Fig. 4.27).

Table 4.19: Gender difference in the prevalence of lung function deficits in school children

Type of deficit	Number of children with percentages in parentheses			
	Control		Delhi	
	Boys	Girls	Boys	Girls
Restrictive	202 (14.0)	118 (14.6)	669 (18.0)	483 (24.6)*
Obstructive	104 (7.2)	75(9.3)	462 (12.5)*	310(15.8)*
Combined	45 (3.1)	34(4.2)	344(9.3)*	200(10.2)*
Overall	351 (24.4)	227(28.1)	1475(39.8)*	993(51.0)*

**, p<0.05 compared with control in Chi-square test*

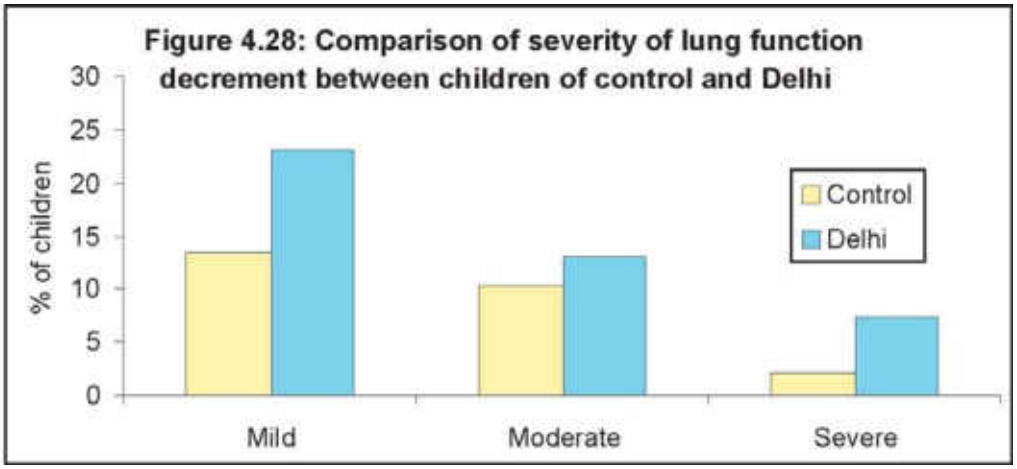


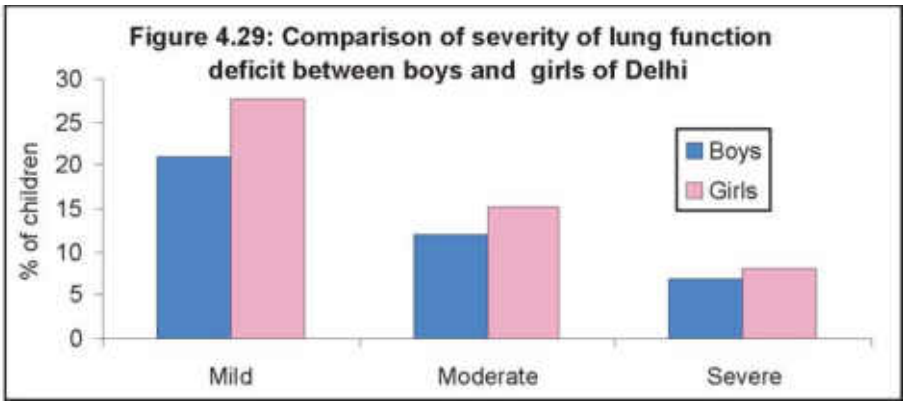
Besides higher prevalence of lung function deficits, the magnitude of the problem was greater in Delhi. For example, 7.3% schoolchildren of Delhi had severe lung function deficits compared with 2.2% children in control group with severe lung function decrement ($p<0.05$, Table 4.20; Fig. 4.28). Moderate lung function deficit was present in 13.1% children of Delhi compared with 10.2% of control, while mild deficit in lung function was present in 23.1% and 13.4% children of Delhi and control group respectively. Compared with boys, severe reduction in lung function was more prevalent among the girls both in Delhi and in control group (Table 4.20, Fig. 4.29).

Table 4.20: Magnitude of lung function reduction in schoolchildren of Delhi compared with rural control

Magnitude of deficits in PFT	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
Mild	11.5	20.9*	17.0	27.7*	13.4	23.1*
Moderate	11.3	12.0	8.1	15.2*	10.2	13.1
Severe	1.7	6.9*	3.1	8.0*	2.2	7.3*

*Results are expressed as percentage of total children; *, $p<0.05$, compared with respective control in Chi-square test*





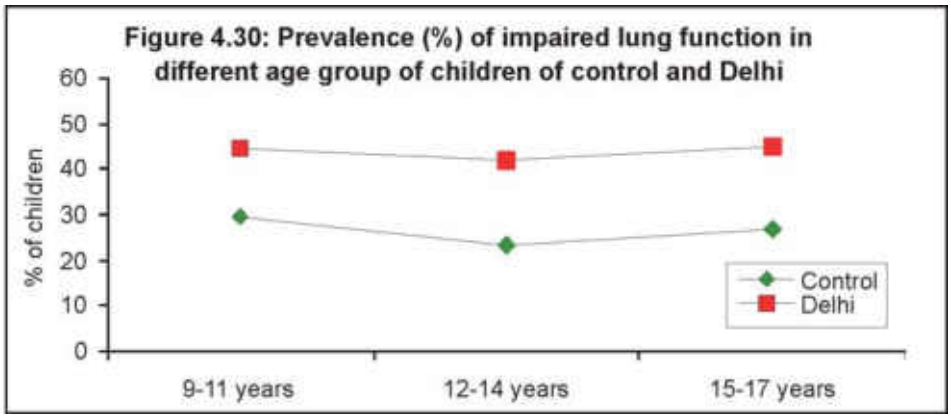
(a) Lung function reduction in different age groups

In Delhi, the prevalence of lung function reduction was highest (44.9%) among schoolchildren in the age group of 15 – 17 years, followed by 44.5% prevalence in 9-11 year-old children and 41.7% in 12-14 year-old children (Table 4.21; Fig. 4.30). On the other hand, highest prevalence of lung function reduction in control group (29.6%) was found in 12-14 year age group, followed by 26.8% in 15-17 year-old, and 23.2% in 12-14 year-old children.

Table 4.21: Prevalence of obstructive type of lung function deficits in school children in relation to age

Age	% Children with lung function deficits	
	Control	Delhi
9-11 year	29.6	44.5*
12-14 year	23.2	41.7*
15-17 year	26.8	44.9*

**, p<0.001 compared with control in Chi-square test*



(b) Seasonal variation in lung function

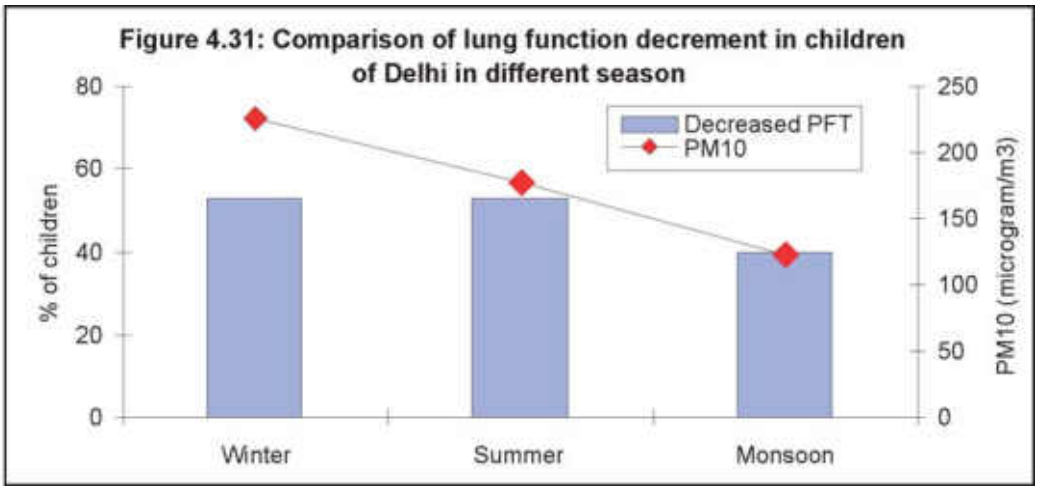
Lung function reduction was found to be associated with seasonal variations. In control group, prevalence of lung function reduction was highest during winter (32.9%) when the particulate pollution level in ambient air was highest. Conversely, lowest prevalence of lung function deficits in

schoolchildren was recorded in monsoon (19.9%) when the breathing air is cleanest. In Delhi, however, high prevalence of lung function deficits was observed both in winter and summer (52.7% in both seasons, Table. 4.22, Fig. 4.31), while a much lower prevalence (39.9%) was observed in monsoon. The difference in the prevalence of lung function deficits between winter/summer and monsoon in Delhi was significant in Chi–square test ($p<0.05$).

Table 4.22: Seasonal variation in the prevalence (%) of lung function decrement

Season	Control	Delhi
Summer	25.5	52.7*
Monsoon	19.9	39.9*
Winter	32.9	52.7*

**, p<0.001 compared with control in Chi-square test*



(c) Inverse relationship between SES and lung function deficits

An inverse relationship was found between SES and the prevalence of lung function deficits: lower the SES greater the percentage of children with reduced lung function. Keeping the prevalence of lung function deficit in high SES constant (OR=1), conditional logistic regression analysis showed that the prevalence of reduced lung function increased significantly in children from families belonging to medium and low SES both in rural and urban settings (Table 4.23).

Table 4.23: Conditional logistic regression analysis for association between lung function deficits and socio economic status (SES)

SES	Lung function deficits	
	Control	Delhi
High	1	1
Medium	1.34 (1.12-1.89)*	1.47 (1.29 – 1.74)*
Low	1.98 (1.25-2.67)*	1.80* (1.56 – 2.54)*

*The results are expressed as odds ratio with 95% CI in parentheses. *, p<0.05 compared with high SES*

(d) Parental smoking and children's lung function

About 28% of control and 27% of Delhi's children were exposed to environmental tobacco smoke (ETS) at home due to smoking habit of their fathers or some other male member of the family. These children had lower lung function than those unexposed to ETS. For example, 50.6% of Delhi's children exposed to ETS (768/1517) had lung function deficits, compared with 40.9% non-exposed children (1700/4154). Similarly in control group, 27% children exposed to ETS and 21.3% non-exposed children had lung function deficits.

(e) Relationship between PM_{10} and the prevalence of lung function deficits

After controlling potential confounders like season, socioeconomic conditions and ETS, PM_{10} level in ambient air was found to be associated with restrictive (OR= 1.35, 95%CI 1.07-1.58), obstructive (OR=1.45, 95% CI 1.16-1.82), and combined type of lung function deficits (OR= 1.74, 95%CI 1.37-2.71) in children.

Spearman's rank correlation test reaffirmed the association. It was found that the decrease in all the lung function measurements was correlated with PM_{10} level in ambient air (Fig. 4.32). The correlation was strongest for FEV_1/FVC ratio (rho value –0.986, $p<0.0005$), followed by $FEF_{25-75\%}$ (rho value –0.944, $p<0.0005$), FVC (rho = -0.912, $p<0.0005$), PEFR (rho = -0.542, $p<0.001$), and FEV_1 (-0.472, $p<0.001$).

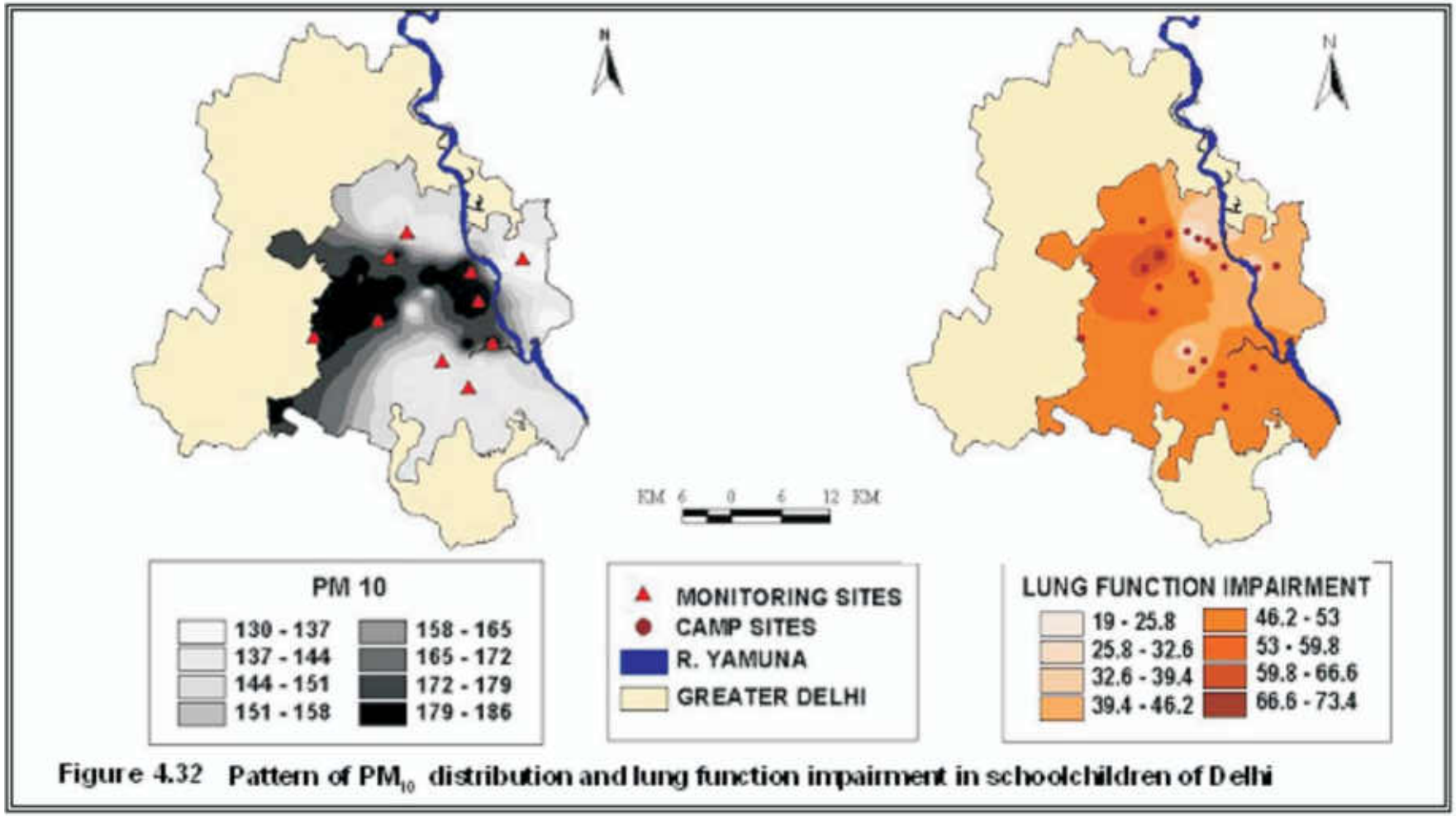


Figure 4.32 Pattern of PM_{10} distribution and lung function impairment in schoolchildren of Delhi

Similarly, the existence of a direct relationship between PM_{10} level in ambient air and lung function deficits was observed in conditional logistic regression analysis. Increasing levels of PM_{10} were found to be associated with increased lung function deficits of obstructive and restrictive type. In nearly all the cases it was found that as PM_{10} increased lung function deficit also increased (Table 4.24).

Table 4.24: Conditional logistic regression analysis of the relationship between PM_{10} level in ambient air and children's lung function.

PM_{10} (µg/m^3)	Reduced lung function	Restrictive type (FVC<80%)	Obstructive type (FEV_1/FVC<70%)
50-75	1	1	1
76-100	1.34* (1.06 – 1.68)	1.48* (1.15 – 1.91)	0.96 (0.70 – 1.23)
101-125	1.62* (1.40 – 1.87)	1.53* (1.30 – 1.81)	1.42* (1.12 – 1.80)
>125	3.75* (3.50 – 4.60)	4.82* (3.90 – 5.97)	1.59* (1.28 – 1.20)

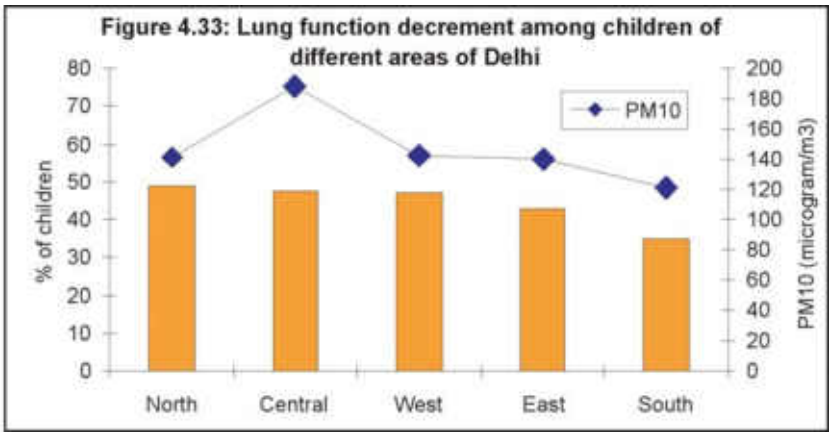
*The results are expressed as odds ratio with 95% CI in parentheses; *, p<0.05*

(f) Lung function in schoolchildren of different areas of Delhi

The prevalence of lung function decrement among school-age children varied greatly in different areas of the city. It was 48.5% in north Delhi, highest in the city, and 34.3% in south Delhi, the lowest in Delhi (Table 4.25; Fig. 4.33). Children from central (47.2%) and west Delhi (46.8%) also had higher prevalence of lung function reductions.

Table 4.25: Lung function in children of different areas of Delhi

Area	No. of children examined	Children with reduced PFT	Prevalence (%)	% Change from city's overall prevalence
East	602	259	43.0	-1
West	511	241	47.2	+9
North	872	426	48.9	+12
South	1687	589	35.0	-20
Central	1999	953	47.7	+10
Overall	5671	2468	43.5	-



Conditional logistic regression analysis revealed that compare with school children from the south, school children from west, north and central had significantly greater prevalence ($p<0.05$) of reduced lung function (Table 4.26).

Table 4.26: Conditional logistic regression analysis of the relationship between lung function of the children and residential area

Residential Area	Reduced lung function	Restrictive type	Obstructive type
South	1	1	1
West	1.47(1.20 – 1.80)*	1.48 (1.21 – 1.83)*	1.47(1.16 – 1.85)*
North	1.72 (1.46 – 2.03)*	1.93 (1.63 – 2.29)*	1.29 (1.05 – 1.57)*
Central	1.51 (1.25 – 1.82)*	1.22 (0.99 – 1.49)	1.62 (1.30 – 2.01)*
East	1.04 (0.92 - 1.20)	0.78 (0.68 – 0.91)	1.23 (1.08 – 1.44)*

*The results are expressed as odds ratio with 95% CI in parentheses; * p<0.05 compared with South*

The magnitude of decrement in lung function also varied in different areas. Severe reduction in lung function was found among 10% (87/872) and 9.2% (183/1999) schoolchildren of North and Central Delhi respectively, whereas only 4.3% schoolchildren of South Delhi (72/1687) had severe reduction in lung function. In essence, greatest impairment of lung function was found in children of North, Central and West Delhi while best lung activity was found in children of South Delhi (Table 4.27).

Table 4.27: Comparison of the magnitude of lung function decrement in school children of different areas of Delhi

Magnitude of lung function decrement	East (n=602)	West (n=511)	North (n=872)	South (n=1687)	Central (n=1999)
Mild	23.4	23.9	23.0	21.8	24.0
Moderate	14.0*	15.8*	16.0*	8.8	14.6*
Severe	5.6	7.4*	10.0*	4.3	9.2*

*The results are expressed as percentage of school children with reduced lung function of variable severity; * p<0.05 in Chi square test compared with South*

4.3.7. Body mass index (BMI) and lung function

(a) Prevalence of overweight in school children

It is evident from Table 4.26 and figure 48 that 5.4% school children of Delhi enrolled in this study were overweight on the basis of their BMI data. In contrast, 2.4% children of the control group were overweight (Table 4.28), and the difference between these two groups in this regard was highly significant ($p<0.001$).

Moreover, 9% of Delhi's school children were at risk of being overweight compared with 4.4% children of control group ($p<0.001$). On the other hand, the prevalence of

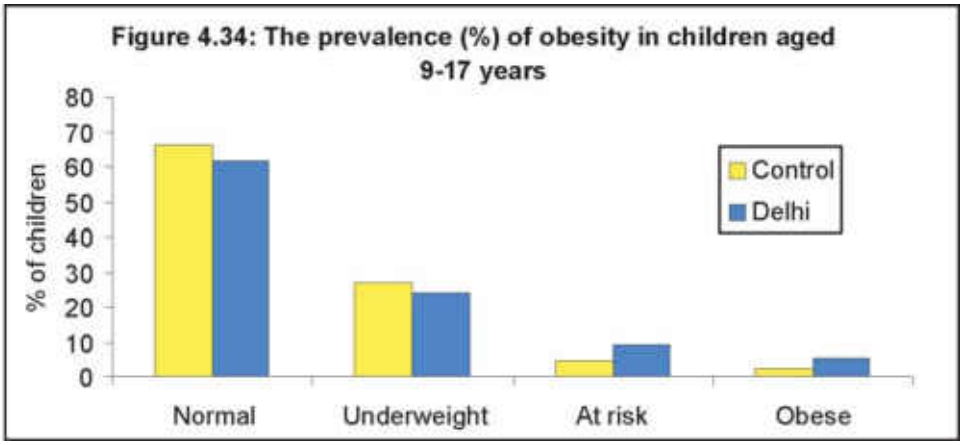
underweight children was greater in control group (26.8 vs. 23.9% in Delhi Tables 4.28 & 4.29, Fig. 4.34).

Table 4.28: Body mass index of boys and girls of Delhi

	Underweight (%)	Normal (%)	At risk (%)	Overweight (%)
Total (n=5671)	23.8	61.8	9.0	5.4
Boy (n=3708)	27.5	58.6	8.6	5.3
Girl (n=1963)	17.1	67.9	9.6	5.5

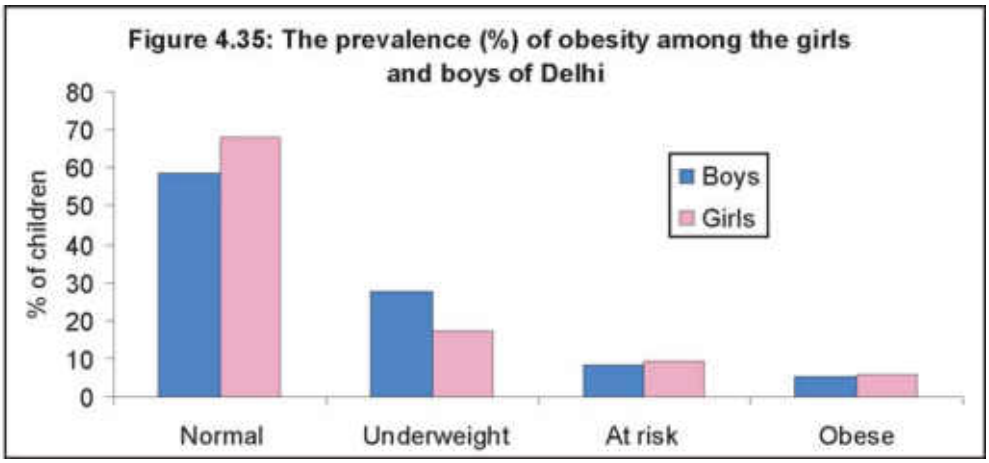
Table 4.29: Body mass index of boys and girls of controls

	Underweight (%)	Normal (%)	At risk (%)	Overweight (%)
Total (n=2245)	26.8	66.4	4.4	2.4
Boy (n=1438)	30.0	63.5	4.0	2.4
Girl (n=807)	20.9	71.6	5.0	2.3



(b) Difference between boys and girls

Girls had a slightly higher prevalence of overweight or at risk of being overweight than the boys both in Delhi and the control group (Tables 4.28 & 4.29, Fig. 4.35).



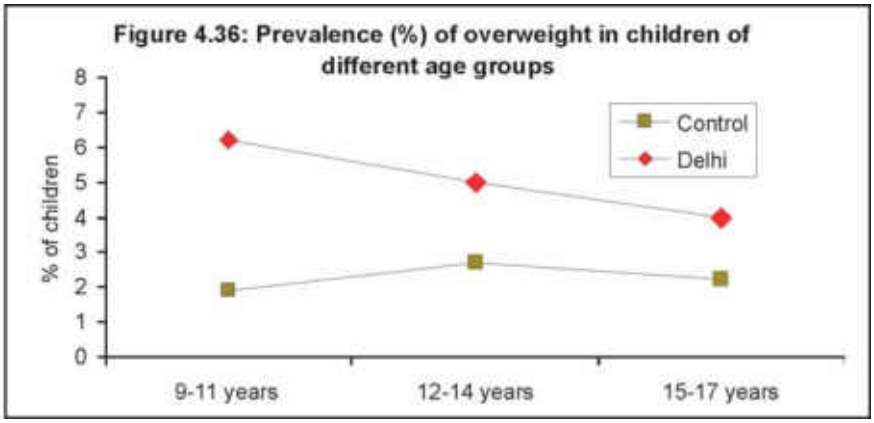
(c) Prevalence of overweight in relation to age

The problem of overweight was most prevalent (6.2%) in Delhi's school children aged between 9 and 11 years. Thereafter the prevalence progressively declined with age. In control group, overweight children were most prevalent (2.7%) in 12-14 year age group, and a modest decline in the prevalence of overweight was recorded thereafter (Table 4.30, Fig. 4.36).

Table 4.30: Prevalence of overweight among school children in relation to age

Age	At risk of overweight (%)Overweight (%)			
	Control	Delhi	Control	Delhi
9-11 years	3.4	9.1*	1.9	6.2*
12-14 years	4.6	9.1*	2.7	5.9*
15-17 years	4.8	8.8*	2.2	4.0*

**p<0.05 in Chi square test compared with control*



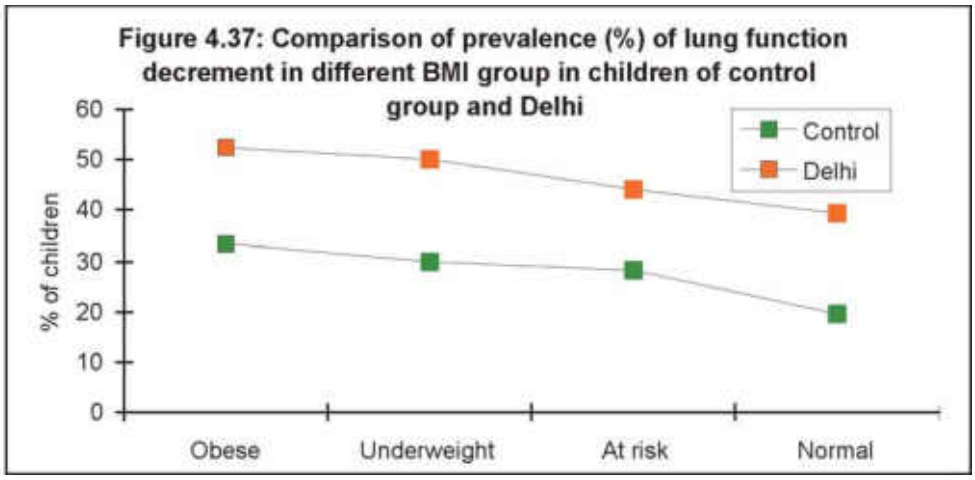
(d) BMI and lung function

BMI of the children had profound influence on their lung function. It was observed that overweight and underweight children had poor lung function than children with normal weight. For instance, 170 out of 306 overweight children (55.6%) of Delhi had decreased lung function compared with 39.3% children (1377/3505) with normal body weight (Table 4.31; Fig. 4.37). Children at risk of being overweight had 48% prevalence of lung function deficits in Delhi. Underweight children also had high incidence of lung function deficits in Delhi (50.1%) as well as in control group (30.0%). Thus, children with excess or subnormal body weight appeared to be more prone to lung function deficits.

Table 4.31. Lung function deficits in children with abnormal body weight

BMI status	% children with reduced lung function	
	Control	Delhi
Underweight	30.0	50.1*
Normal	19.4	39.3*
At risk	28.3	48.0*
Overweight	33.3	55.6*

**p<0.05 in Chi square test compared with control*



4.4 FINDINGS

1. Lung function test was conducted in schoolchildren aged 9-17 years by portable spirometer following the protocol of American Thoracic Society. A total number of 2245 control and 5671 Delhi's children successfully completed the test.

2. The results showed reduction of lung function in 43.5% schoolchildren of Delhi compared with 25.7% in control group. Delhi's children had increased prevalence of restrictive (20.3% vs 14.3%8 in control), obstructive (13.6% vs. 8%), as well as combined (both restrictive and obstructive) type of lung functions deficits (9.6% vs. 3.5%).

3. Lung function reduction was more prevalent in girls than the boys both in rural and urban settings. In Delhi, 51% of the girls had reduced lung function compared with 39.8% of age-matched boys. In control group, 28.1% of the girls had lung function deficits compared with 24.4% of the boys.

4. The prevalence of lung function reduction in Delhi was highest (44.9%) among schoolchildren in the age group of 15 – 17 years. Children belonging to 9-11 year and 12-14 year age group had 44.5% and 41.7% prevalence of lung function deficits respectively. On the other hand, highest prevalence of lung function reduction in control group (29.6%) was found in 12-14 year age group, followed by 26.8% in 15-17 year-old, and 23.2% in 12-14 year-old children.

5. Besides higher prevalence, the magnitude of lung function impairment was much more in Delhi. For example, 7.3% schoolchildren of Delhi had severe lung function deficits compared with 2.2% children in control group.

6. Prevalence of lung function reduction in schoolchildren varied considerably with season. In control group, prevalence of lung function reduction was highest during winter (32.9%) when the particulate pollution level in ambient air was highest. Conversely, lowest prevalence of lung function deficits in schoolchildren was recorded in monsoon (19.9%) when the breathing air is cleanest. In Delhi, however, high prevalence of lung function deficits was observed both in winter and summer (52.7% in both seasons), while a much lower prevalence (39.9%) was observed in monsoon. The difference in the prevalence of lung function deficits between winter/summer and monsoon in Delhi was significant ($p<0.05$).

7. An inverse relationship exists between socio-economic status (SES) and the prevalence of lung function deficits: lower the SES, greater the percentage of children with reduced lung function. Conditional logistic regression analysis showed that the correlation was significant.

8. Exposure to environmental tobacco smoke (ETS) at home due to smoking habit of any member of the family increases the possibility of lung function deficits in children. For example, 50.6% of Delhi's children exposed to ETS had lung function deficits compared with 40.9% non-exposed children. Similarly in control group, 27% children exposed to ETS and 21.3% non-exposed children had lung function deficits.

9. After controlling potential confounders like season, socioeconomic conditions and ETS, PM_{10} level in ambient air was found to be positively associated with restrictive (OR= 1.35, 95%CI 1.07-1.58), obstructive (OR=1.45, 95% CI 1.16-1.82), and combined type of lung function deficits (OR= 1.74, 95%CI 1.37-2.71) in children. Spearman's rank correlation test reaffirmed the association. It was found that the decrease in all the lung function measurements was correlated with PM_{10} level in ambient air. The correlation was strongest for FEV_1/FVC ratio (rho value –0.986, $p<0.0005$), followed by FEF 25-75% (rho value –0.944, $p<0.0005$), FVC (rho = -0.912, $p<0.0005$), PEFR (rho = -0.542, $p<0.001$), and FEV_1 (-0.472, $p<0.001$). Similarly, the existence of a direct relationship between PM_{10} level in ambient air and lung function deficits was observed in conditional logistic regression analysis. Increasing levels of PM_{10} were found to be associated with increased prevalence of lung function deficits.

10. Based on BMI data, 5.4% children of Delhi enrolled in this study were overweight against 2.4% children in control ($p<0.001$). Besides, 9% of Delhi's children were at risk of being overweight compared with 4.4% children in controls ($p<0.001$). On the other hand, the prevalence of underweight children was greater in the control group. The problem of overweight was most prevalent in children aged between 9 and 11 years in Delhi and 12-14 years in control.

11. BMI was shown to have profound influence on lung function. Overweight and underweight children had poor lung function than children with normal weight. For instance, 55.6% of overweight children of Delhi had decreased lung function compared with 39.3% children with normal body weight. Delhi's children who were at risk of being overweight demonstrated 48% prevalence of lung function deficits. Underweight children also had higher rate of reduced lung function in Delhi as well as in control group. Thus, children with excess or subnormal body weight appeared to be more prone to lung function deficits.

CHAPTER-5.0

ASSESSMENT OF CELLULAR LUNG REACTION TO DELHI'S AIR POLLUTION

5.1 INTRODUCTION

Adverse effect of Delhi's air pollution on lung function of the children has been shown in the previous Chapter. It may be emphasized that functional impairment is the ultimate manifestations of a complex pattern of cellular changes that took place for a long time inside the lung. Therefore chronic exposures to city's air pollution are probably impairing the lung at the cellular level, and it was of interest to explore this possibility.

The lung defense against inhaled particles and gaseous pollutants include innate mechanism such as aerodynamic filtration, muco-ciliary clearance, particle transport and detoxification by alveolar macrophages, as well as local and systemic innate and acquired anti viral immunity. In particular, alveolar macrophages provide an innate defense mechanism against bacteria and viruses. Virus particles are ingested by phagocytosis and macrophages, like epithelial and other virus infected cells, produce interferons that potentially inhibit viral replication. AM also contribute to the neutralization of viral infection by removing the debris of the destroyed virus-containing cells and by presenting viral antigen to T lymphocytes. In addition cell mediated immunity such as the development of cytotoxic T lymphocytes which are capable of destroying cells infected with virus, play an important role in the control of many viral infections of the respiratory tract. Many of these functions can be modulated by exposure to PM_{10}, NO_2 and other air pollutants (Chauhan and Johnston, 2003; Chauhan et.al., 2005)

Objective

The objective of this study was to examine whether sustained exposures to ambient air pollution of the city are causing i) inflammatory and allergic changes in the lung, ii) impairment of lung defense with special reference to the activity of alveolar macrophages, the first line of cellular defense in the lung, iii) damage to the alveolar wall, and iv) microscopic hemorrhages inside the lung that may impair lung activity.

5.2 MATERIALS AND METHODS

(a) Subjects and sputum collection

A total number of 250 school children, 100 (boys 65, girls 35) from control group and 150 from Delhi (boys 98, girls 52) participated in sputum analysis study. The children were aged between 13-15 years. They were instructed to cough vigorously and the produced expectorate was collected in a sterile plastic container as sputum. Sputum samples, collected during 8-30 to 11-00 A.M. at the school premises, were smeared on clean glass slides. Three smears were made from the non-transparent part of each sample. The slides were fixed immediately at the site of collection, and brought to the laboratory at Kolkata for staining and evaluation.

(b) Fixation and staining

The slides were semi-dried in air, and fixed for i) 30 minute in ethyl alcohol for Papanicolaou staining, ii) 20 min in buffered formalin (40% formaldehyde in 0.1M phosphate buffer, pH 7.4, 3:1, v/

v) for non-specific esterase staining and iii) 10 min in 10% formalin for Perl's Prussian blue reaction.

(c) Papanicolaou (Pap) staining for cytology

One slide was stained for cytology by Papanicolaou method (Hughes and Dodds, 1966). The staining mixture contained: i) Harris' hematoxylin (Sigma Chem, USA); ii) Orange G (Gurr, Germany); iii) EA 50 containing 0.5% solution of Light green (Gurr, Germany) in 95% alcohol, 0.5% alcoholic solution of Bismarck brown (Gurr, Germany), 0.5% alcoholic solution of Eosin yellow (Sigma Chem, USA), 200 mg of phosphotungstic acid (Sigma, USA) and 0.05 ml of saturated aqueous solution of lithium carbonate. Following staining the slides were dehydrated in graded ethanol, cleared in xylene and mounted in DPX mountant, and observed under light microscope (Leitz, Germany).

Observation and evaluation

The slides were examined thoroughly under light microscope (Leitz, Germany) at 400 and 1000x magnification for cytology (Grubb, 1994). All the cell types present in the sputum except squamous epithelial cells were taken into account. The sputum samples were considered as representative of the lower airways if either cylindrical epithelial cells or AM or both are observed. Children who had delivered non-representative samples were excluded from the study for further investigation.

(d) Staining for non-specific esterase (NSE)

NSE, a marker enzyme for macrophages, was localized by Fast Blue B method (Oliver et al., 1991). The reaction mixture contained 10 mg of alpha naphthyl acetate (Sigma Chem, USA), 100 mg of Fast Blue B (BDH, UK), 0.25 ml acetone, 20 ml phosphate buffer, pH 7.4. NSE-positive cells appeared golden brown in color.

(e) Perl' Prusian blue reaction for ferric iron

Perl's Prusian blue reaction was done in sputum of 205 control and 411 children of Delhi by the method of Pearse (1985). Iron (hemosiderin)-laden AM, known as siderophage, is suggestive of pulmonary hemorrhage. Staining was done using 2% potassium ferrocyanide (SD Fine Chem, India) and 2% hydrochloric acid (Merck, India) in iron-free distilled water. Iron-containing cells appeared blue under microscope

(f) Statistical analysis

All data are expressed as mean± standard deviation. The collected data were processed and analyzed in EPI info 6.0 and SPSS (Statistical Package for Social Sciences) software. Logistic regression analysis using generalized estimating equations (GEEs) was used to examine the relationship between cellular lung reaction and possible confounders such as RSPM levels. Spearman's rank test for continuous variables and Chi-square test for categorical variables were done. $P<0.05$ was considered as significant.

5.3 RESULTS

(a) Rate of acceptance of sputum samples

Altogether, 46 spontaneously expectorated sputum samples of control children (46% of total) and 35 from Delhi's children (25% of total) were discarded as they were not representative of the airways because of the absence of cylindrical epithelial cells and/or AM. Thus, more children in Delhi (75%) expectorated sputum samples than age- and gender-matched controls (54%, $p<0.05$). The findings of the remaining 166 samples (112 from Delhi and 54 from control) are presented in Table 5.1.

Table 5.1: Sputum cytology of the children

Cell type	**Control**(n=54)	**Delhi**(n=112)
Total cells/hpf	37.2± 9.9	58.8± 17.2*
Neutrophil		
%	82.4± 7.6	71.8±8.6*
per hpf	30.6± 2.8	42.2±4.6*
Eosinophil (%)		
%	1.7±0.8	3.2±1.2
per hpf	0.6± 0.3	1.9±0.7*
Lymphocyte (%)		
%	6.5±2.5	8.9±2.5*
per hpf	2.4±0.8	5.2±1.5*
AM (%)		
%	4.6±3.5	8.9±3.5*
per hpf	1.7±1.0	5.2±1.4*
Epithelial cells (%)		
%	4.8±1.6	7.2±3.6*
per hpf	1.8± 1.3	4.2±1.6*

**, p<0.05 compared with control*

(b) Total and differential counts of sputum cells

The total number of cells present in sputum per high power field (hpf) of microscope (10x eye piece x 40x objective) was 58.8 in Delhi against 37.2 in controls, establishing a significant rise of 58% in the former ($p<0.05$, Table 5.1). Thus, the sputum of Delhi's children was more cellular than that of controls.

Neutrophils were the major cell type in sputum of both control and Delhi's children, representing 82.4% and 71.8% of the total cells in these two groups respectively. Due to higher total cell count, however, the number of neutrophil per hpf was more in Delhi than in controls (42.2 vs. 30.6/hpf, $p<0.05$, Table 5.1; Fig. 5.1, 5.2).

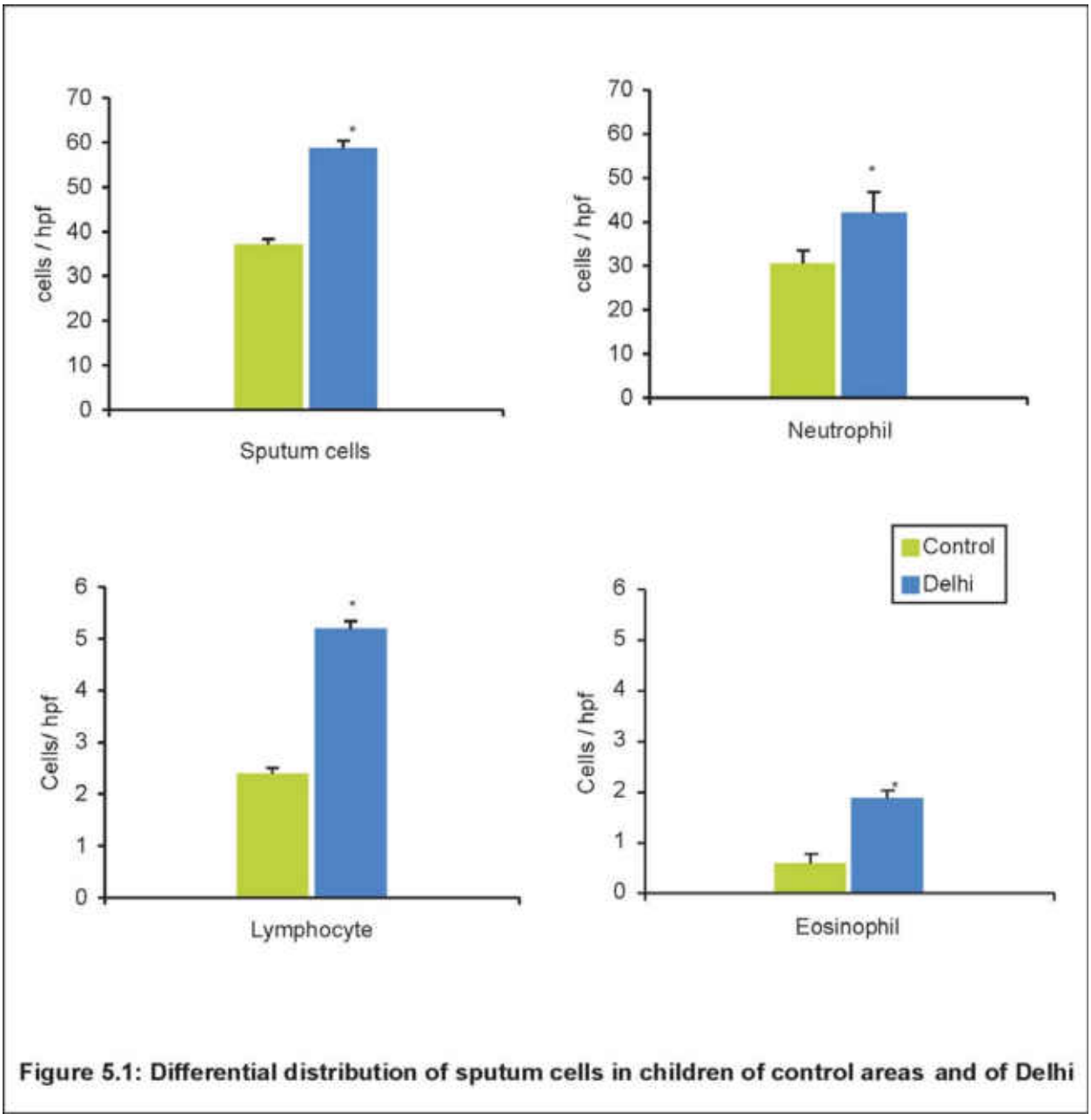


Figure 5.1: Differential distribution of sputum cells in children of control areas and of Delhi

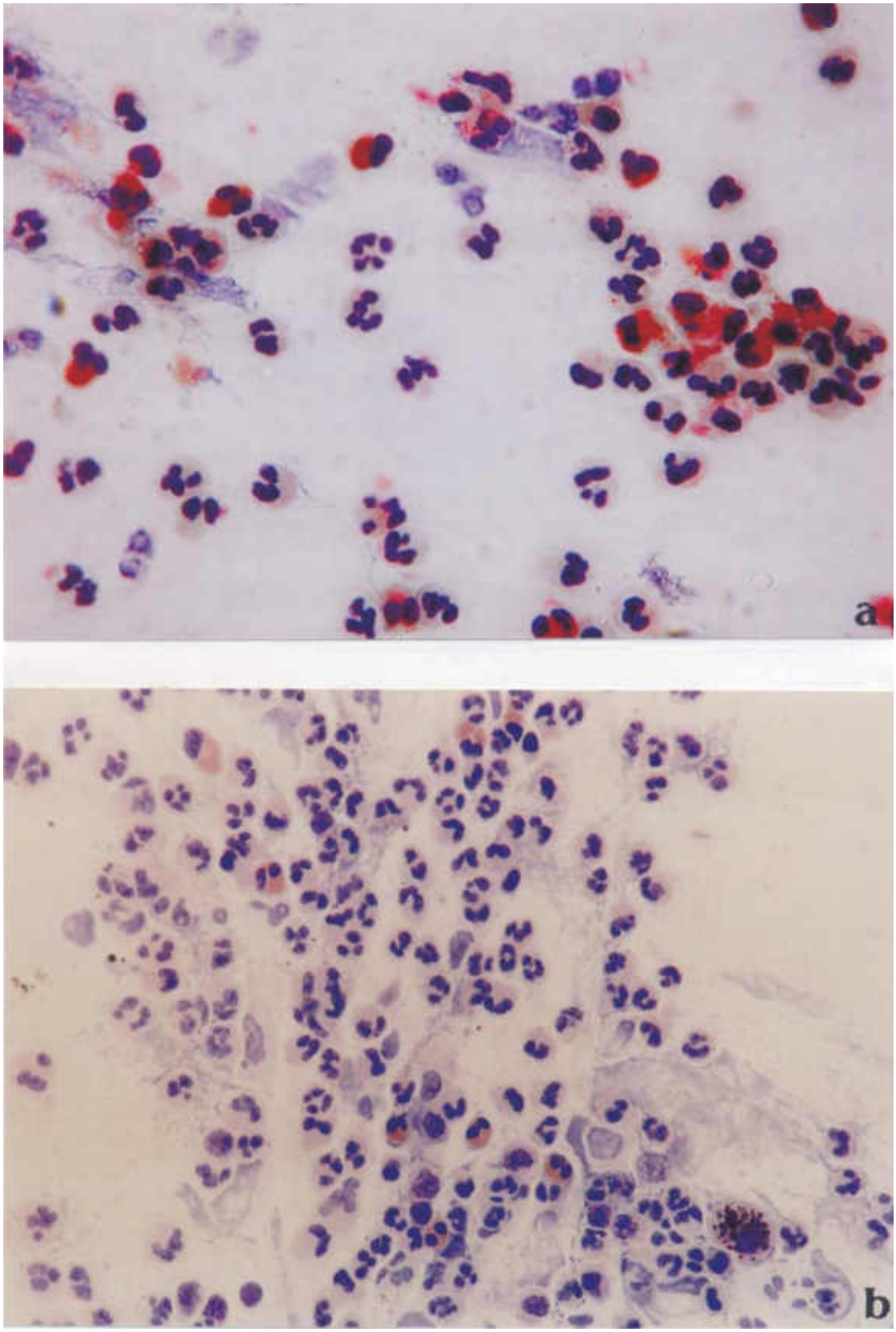


Figure 5.2: Sputum of children chronically exposed to Delhi's air pollution showing increase in the number of eosinophils (a) and neutrophils (b) indicating allergic and inflammatory reactions in the airways. Papanicolaou-stained, x400

Sputum samples of Delhi's school children also contained significantly greater percentage and absolute number ($p<0.05$) of eosinophils, lymphocytes, alveolar macrophages and airway cells such as basal and parabasal cells and ciliated columnar epithelial cells (Table 5.1, Fig. 5.3). Rise in the inflammatory cells like neutrophils and lymphocytes in sputum of Delhi's school children may suggest greater prevalence of pulmonary infection and inflammation in the city. The rise in eosinophil number in sputum of urban children may indicate underlying allergy and hypersensitivity response (Fig. 5.2). Marked rise in AM number with high particle load in these children signifies greater exposure to particulate pollution, because AMs represent the first line of cellular defense against inhaled particles and pathogens (Fig. 5.4, 5.5, 5.6, 5.7). Presence of basal and parabasal epithelial cells in clusters or sheets, that has been found in a number of sputa of children of Delhi, may indicate cellular damage to the airway walls.

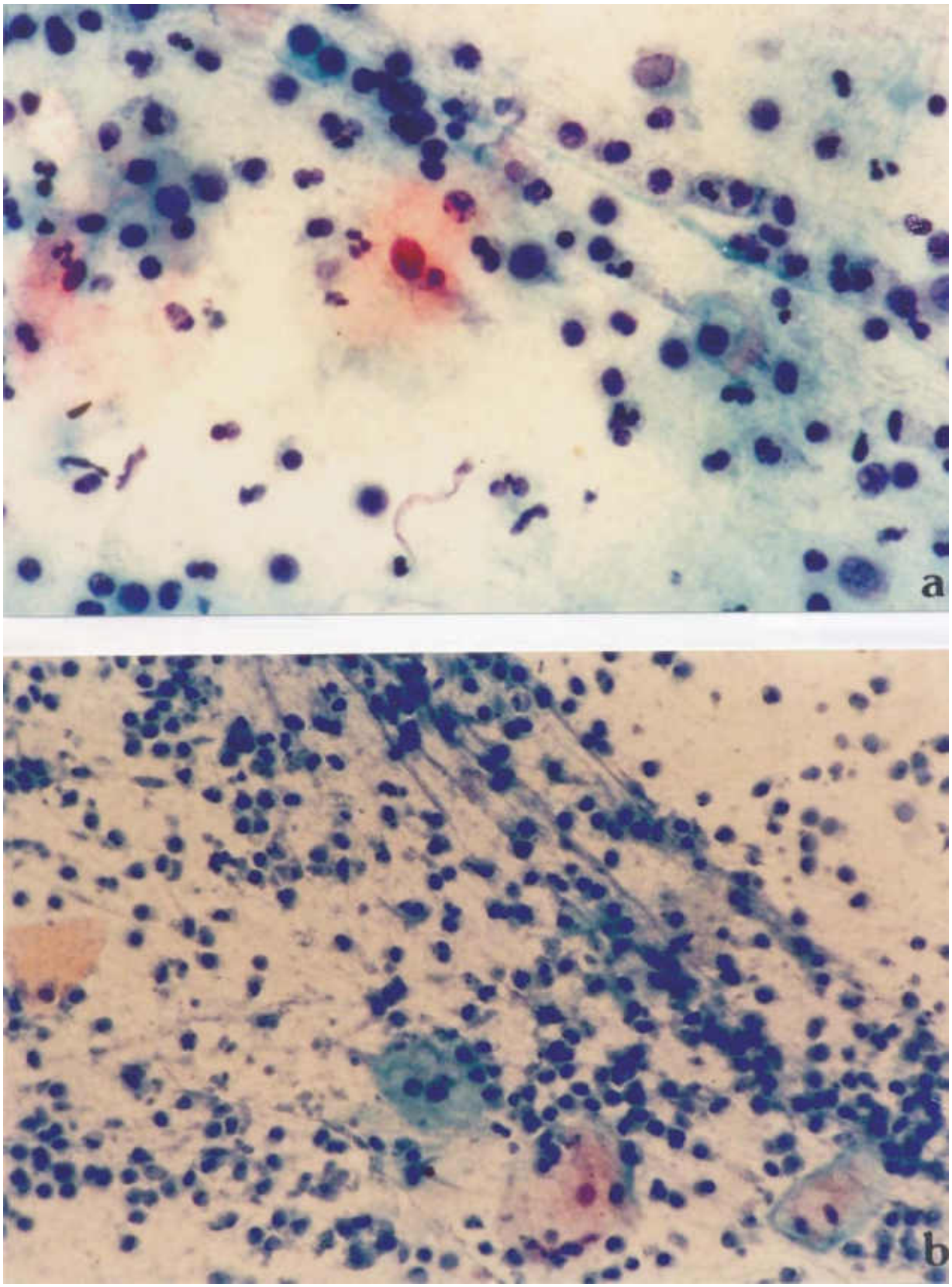
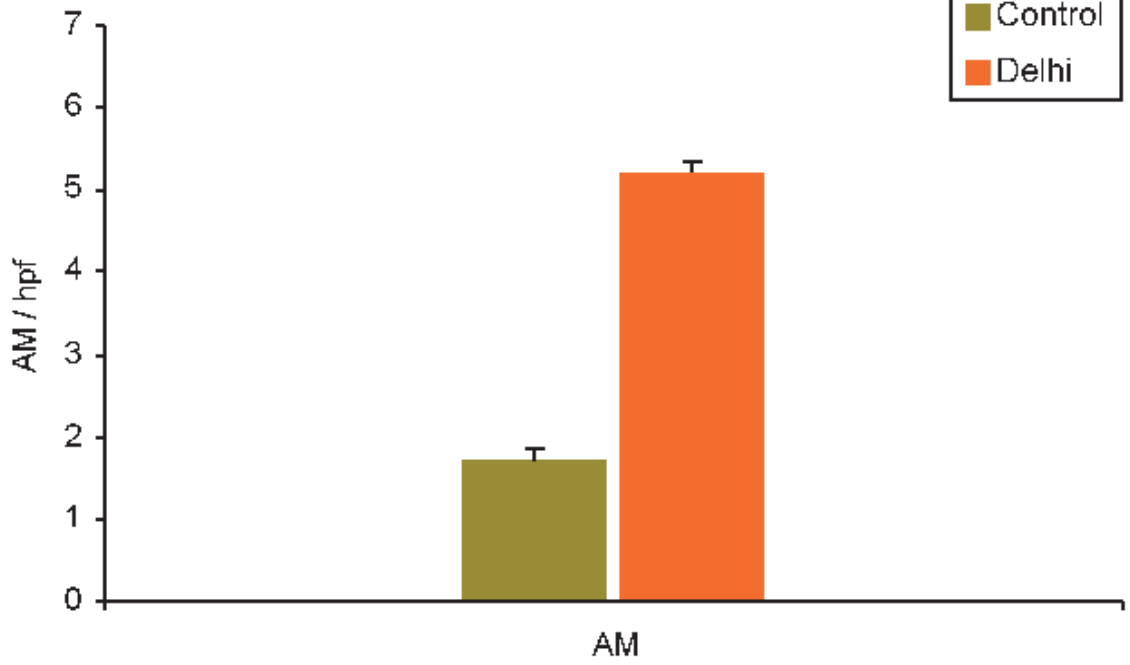


Figure 5.3: Photomicrographs of sputum of school children of Delhi (a, b) showing increase in the number of lymphocytes suggestive of respiratory viral infection. Papanicolaou-stained, x 400

Figure 5.4: Comparison of alveolar macrophage (AM/hpf) in children of control areas and of Delhi



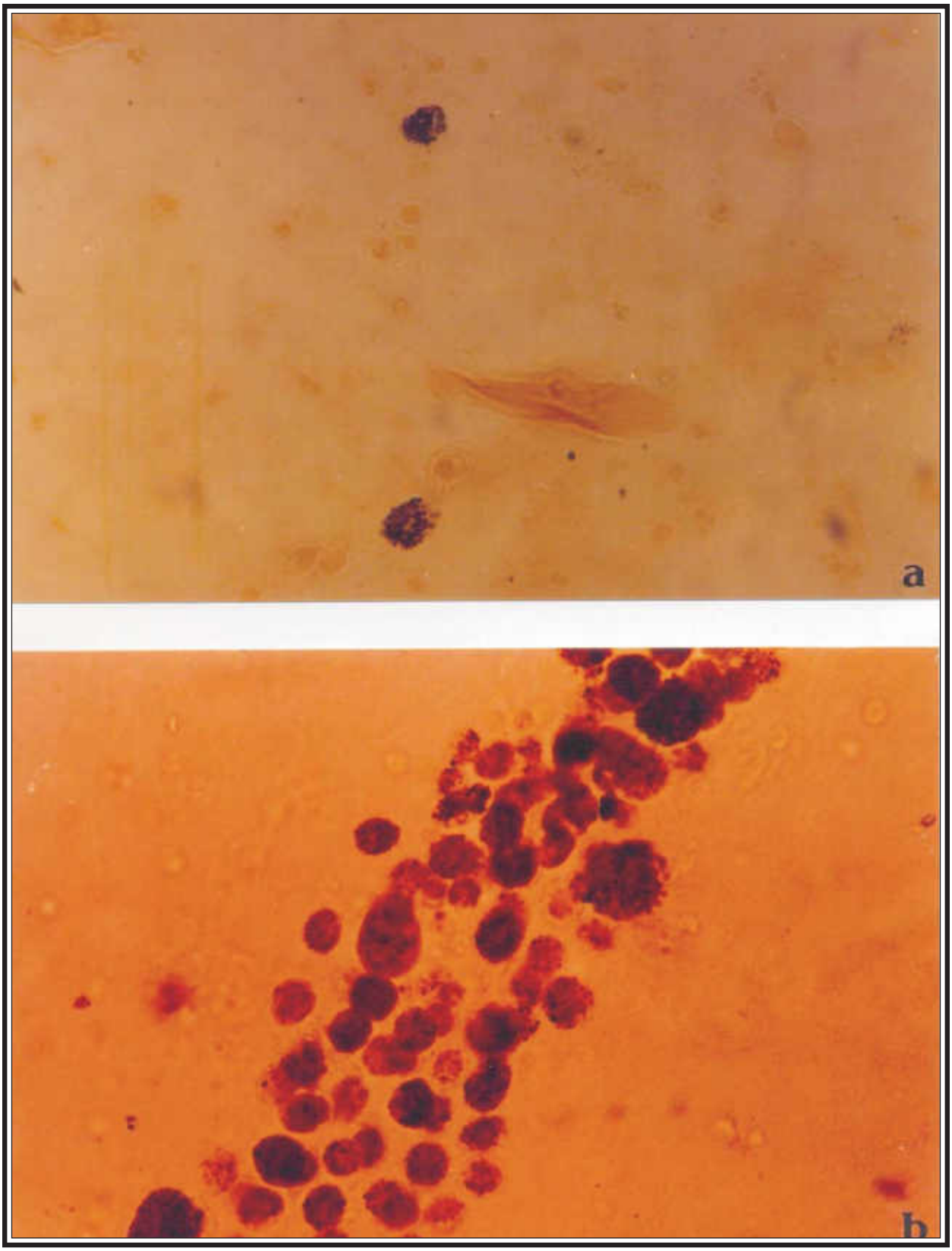


Figure 5.5: Photomicrographs showing particle-laden alveolar macrophages in sputum samples of control (a) and Delhi's school children (b). Note the remarkable increase in number and size of cells in sputum of the urban child. Non-specific esterase-stained, x 400

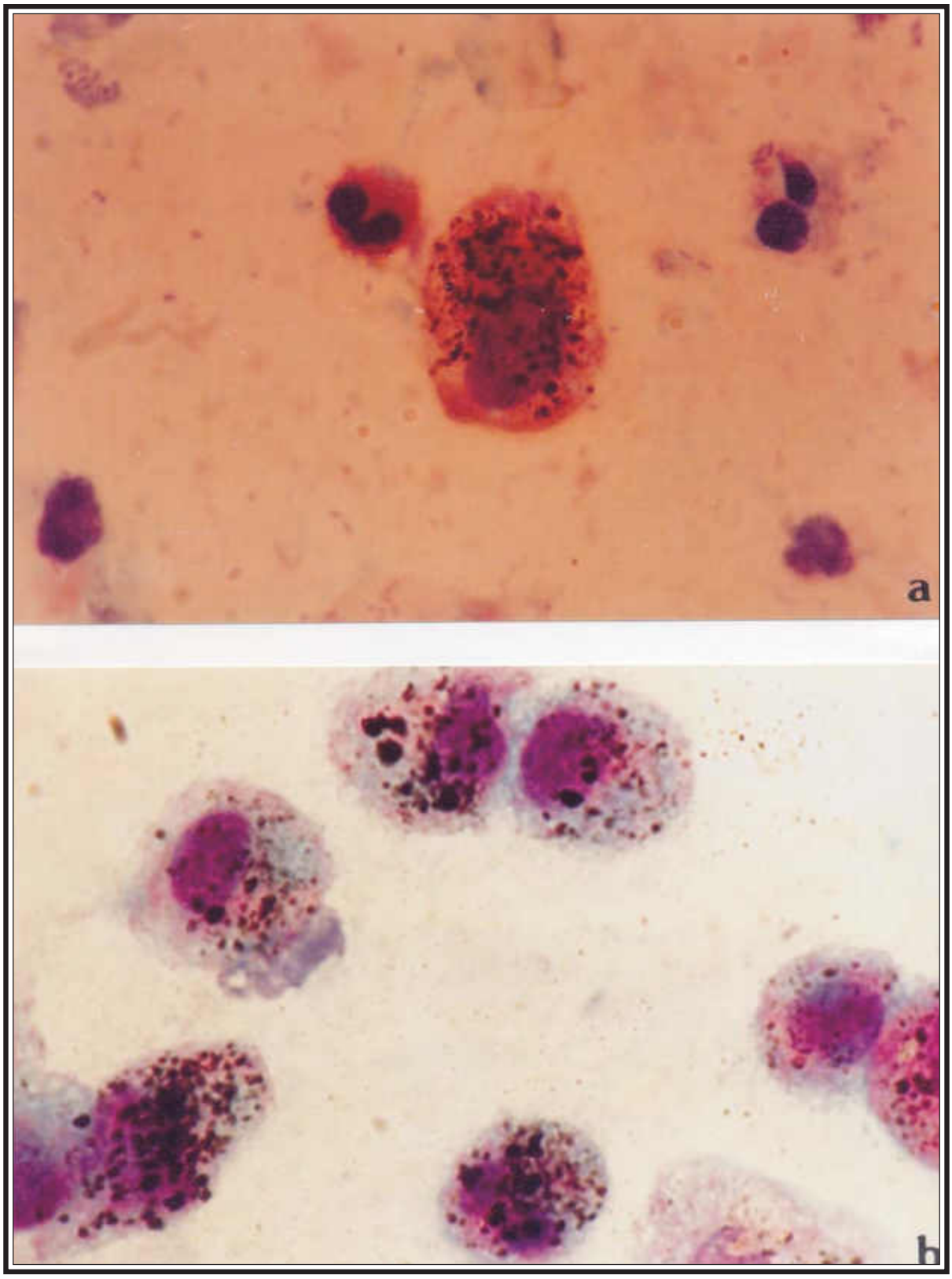


Figure 5.6: Sputum cytology of a 14-year old girl of Delhi (b) and age-, sex-matched control (a) showing abundance of particle-laden alveolar macrophages in former. Papanicolaou- stained, x 1000

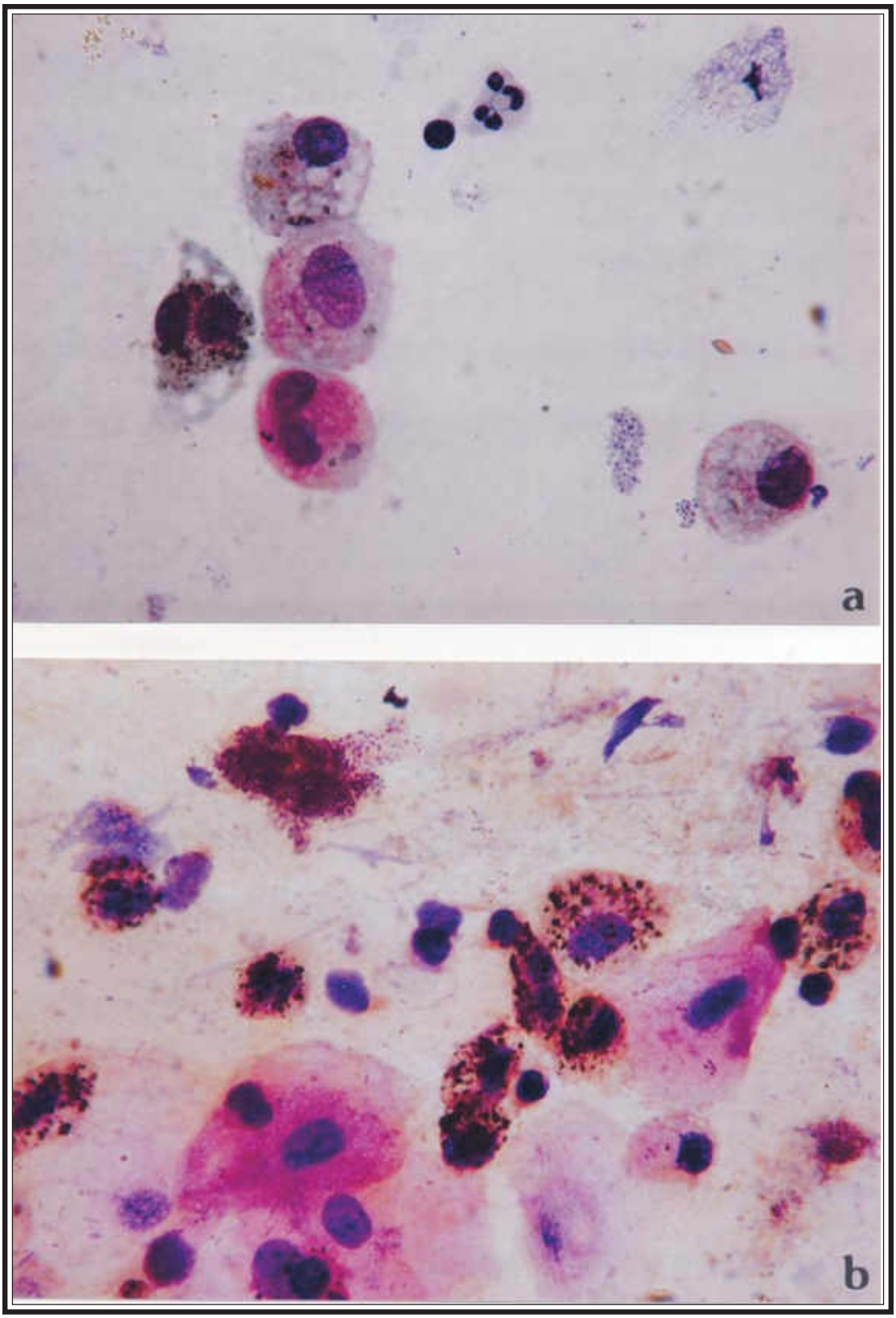


Figure 5.7: Comparison of sputum cytology between children of Delhi (b) and their matched rural control (a). Alveolar macrophages in the former are heavily loaded with particles suggesting greater exposure to particulate air pollution. Papanicolaou- stained, x 1000

(c) Association between particulate air pollution and cellular changes in sputum

The inflammatory changes in sputum of Delhi's children could be due to exposure to higher level of air pollution, because the changes were positively correlated with ambient PM_{10} level in Spearman' rank correlation test ($p<0.001$, Table 5.2).

Table 5.2: Spearman's rank correlation between PM_{10} level and sputum cell count

			Rho (r) value	p value
PM_{10}	with	Cells/hpf	0.643	<0.001
,,	with	Neutrophil/hpf	0.461	<0.001
,,	with	Eosinophil/hpf	0.644	<0.001
,,	with	Lymphocyte/hpf	0.462	<0.001
,,	with	Epithelial cells/hpf	0.448	<0.001
,,	with	AM/hpf	0.581	<0.001

On the other hand, a significant ($p<0.05$) negative correlation was found between total cells in sputum and FVC, FEF_{25-75} and PEFR values (Table 5.3). Likewise, AM number in sputum was negatively correlated with FVC and PEFR ($p<0.05$). It implies that the increase in inflammatory cell population in the airways following exposure to urban air pollution results predominantly in restrictive type of lung function deficits.

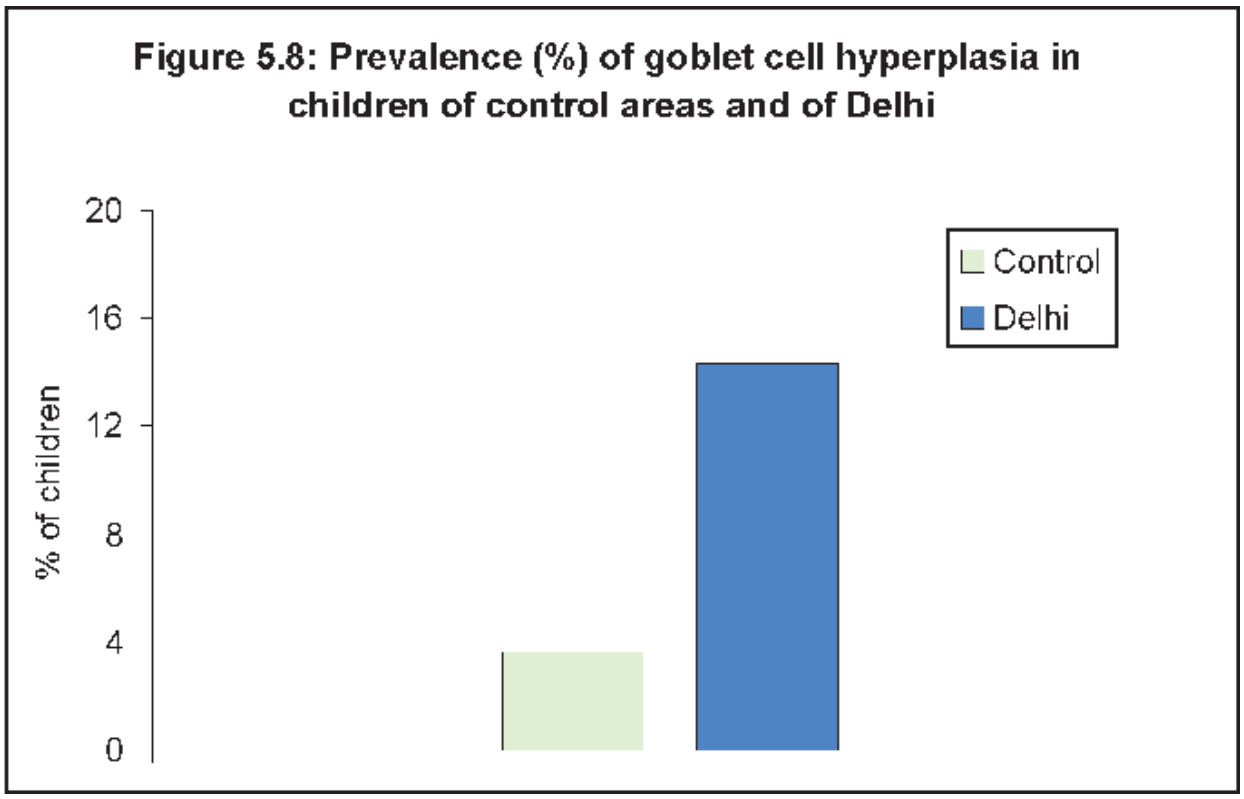
Table 5.3: Spearman's rank correlation test between sputum cell count and lung function

			Rho (r) value	p value
Total cells in sputum /hpf	with	FVC	-0.317	<0.05
‘’	with	FEV_1	-0.182	NS
‘’	with	$FEF_{25-75\%}$	-0.324	<0.05
‘’	with	PEFR	-0.241	<0.05
AM/hpf	with	FVC	-0.264	<0.05
‘’	with	FEV_1	-0.203	NS
‘’	with	$FEF_{25-75\%}$	-0.209	NS
‘’	with	PEFR	-0.364	<0.01

NS, not significant in statistical test

(d) Changes in the air way epithelial cells

Sputum samples of Delhi's children often displayed several qualitative and quantitative changes in airway epithelial cells. For example, goblet cell hyperplasia was found in 14.3% children against 3.7% of controls, and the difference was highly significant ($p<0.001$, Fig. 5.8). The change indicates hypersecrertion of mucous that could be a protective measure to contain inhaled pollutants (Fig. 5.9). Ciliocytophthoria, an indication of influenza virus infection in the airways was found in 4 (3.6%) samples against none in controls (Fig.5.10). Multinucleated columnar epithelial cells, suggestive of disregulation of cell division was found in 6.2% samples of Delhi's children compared with none in controls (Fig. 5.9). Metaplasia of airway epithelial cells was present in 16.1% in Delhi's children compared with 3.7% of controls (Fig. 5.11). Similarly, dysplasia of airway epithelial cells was present in 2 samples (1.8%) of Delhi against none in controls. (Fig. 5.12)


Figure 5.8: Prevalence (%) of goblet cell hyperplasia in children of control areas and of Delhi
20
16
12
8
4
0
% of children
Control
Delhi

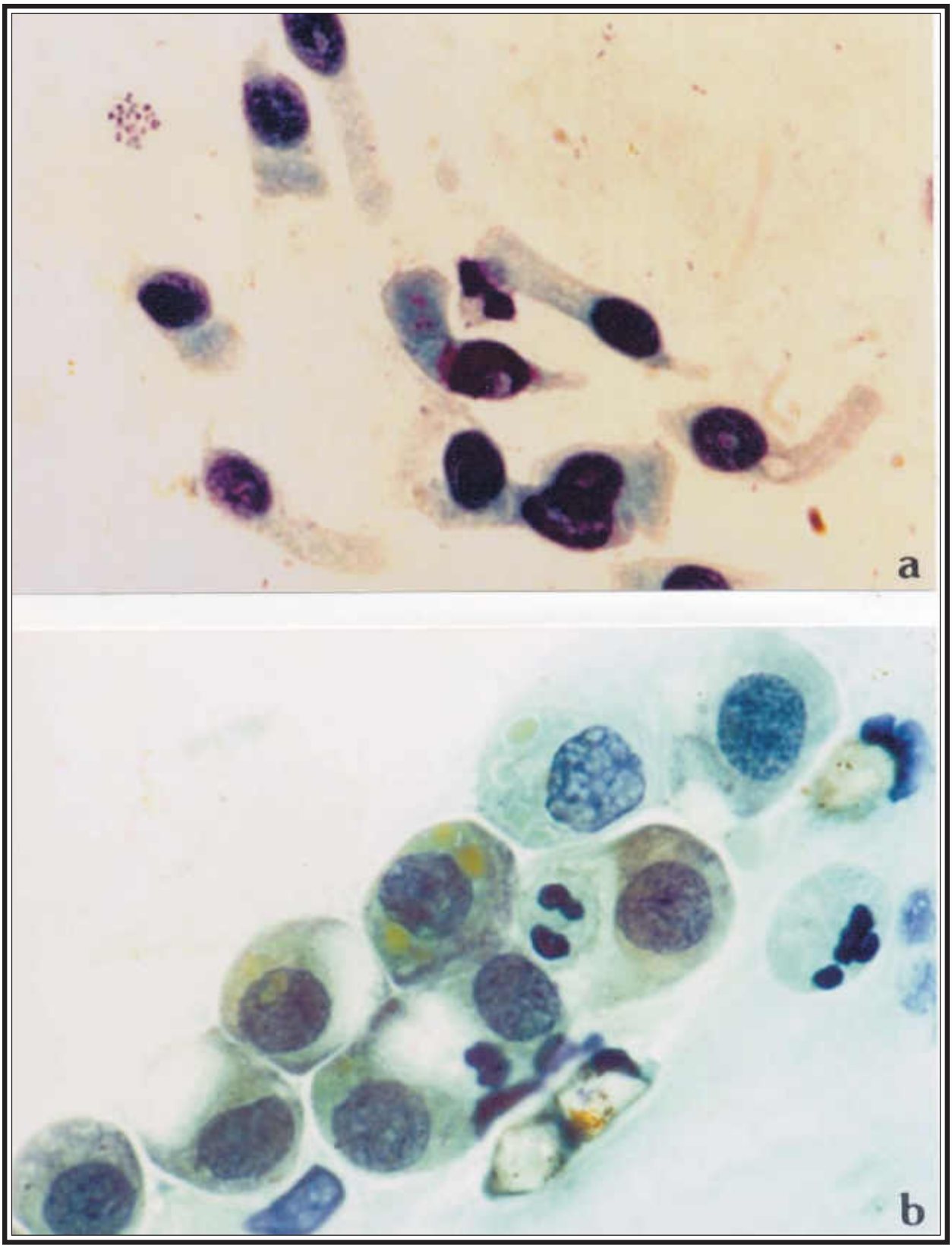


Figure 5.9: Photomicrograph of sputum of children of Delhi illustrating aggregates of columnar epithelial cells (a) suggesting airway injury and cluster of mucus producing goblet cells (b) indicating hyper production of mucus presumably to contain inhaled pollutants. Papanicolaou-stained, x 1000

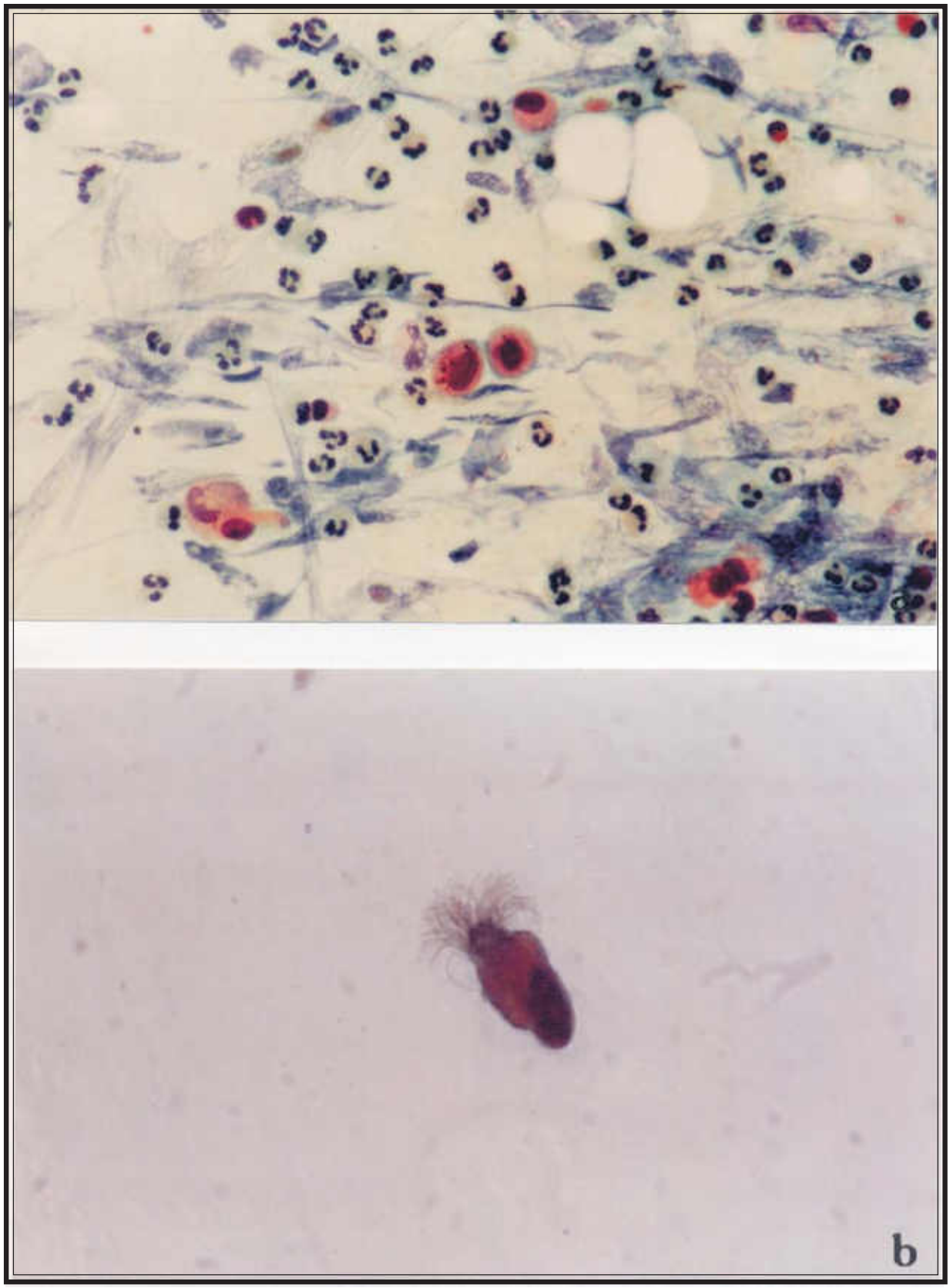
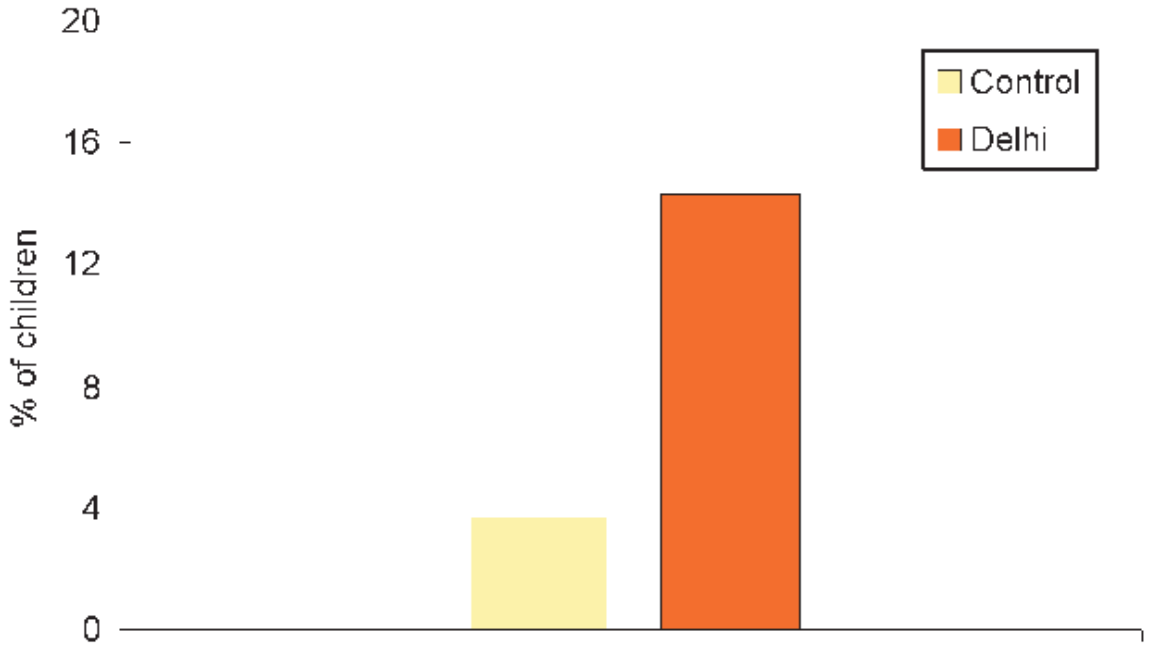


Figure. 5.10: Sputum cytology of school children chronically exposed to Delhi's pollution showing abnormal cells such as highly keratinized alveolar macrophages (a) and ciliocytopthoria (b) which is commonly associated with infection of influenza virus. Papanicolaou-stained, x 1000

Figure 5.11: Prevalence (%) of squamous metaplasia in children of control areas and of Delhi



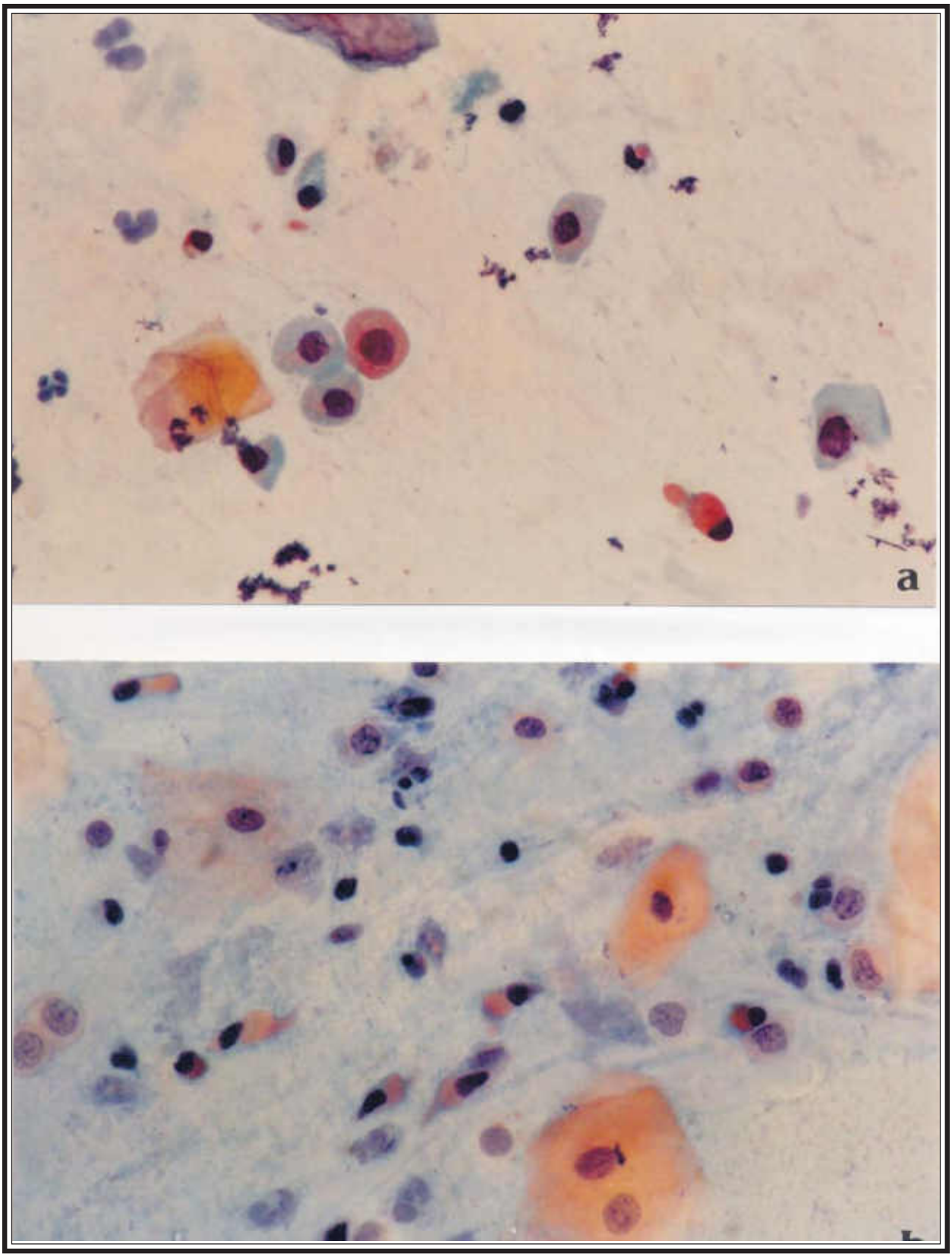
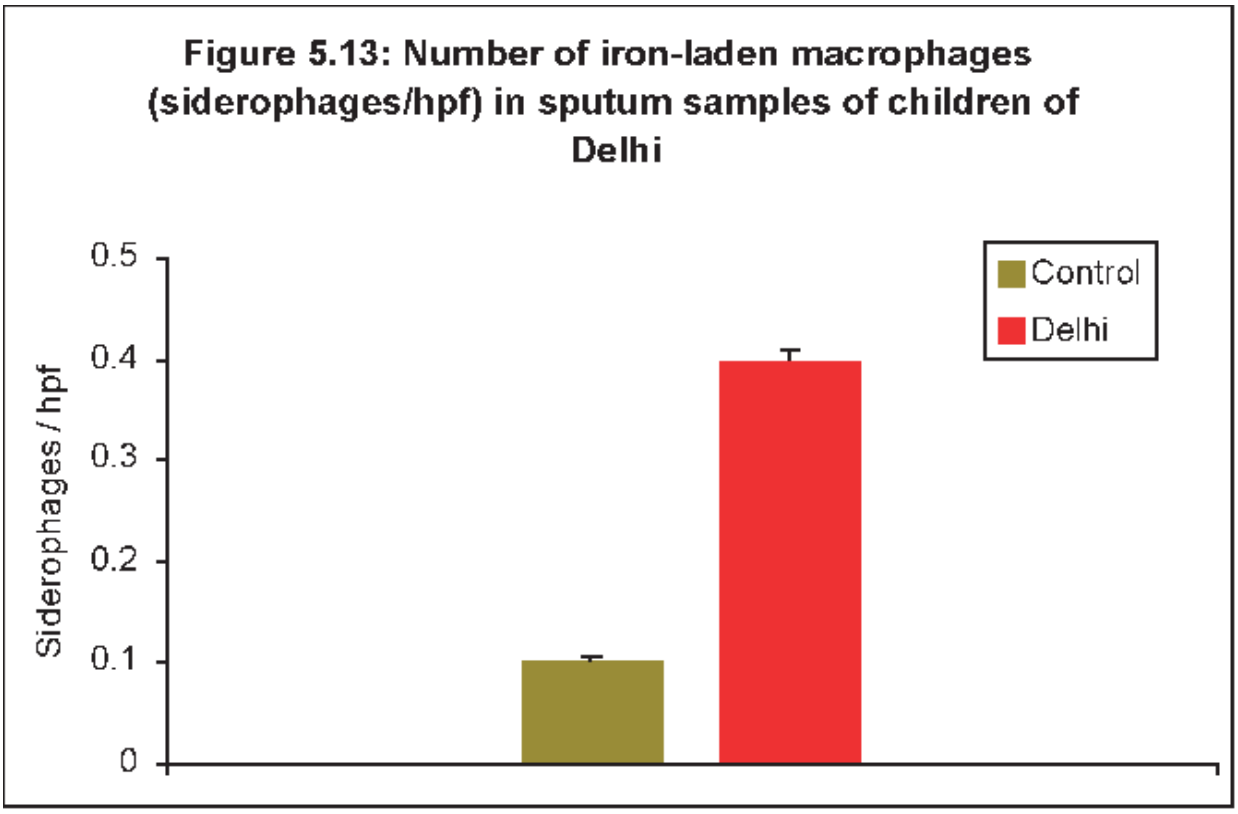


Figure 5.12: Sputum cytology of Delhi's children showing metaplastic changes in squamous epithelial cells of the airway tract (a) and exfoliation of ciliated columnar epithelial cells in clusters (b) suggesting damage to the airway walls. Papanicolaou-stained, x 1000

(e) Iron deposition in AM

Iron-laden AM (siderophages) were rare in control children, as less than 5% (average 3.7%) of AM present in sputum contained Prussian blue-positive hemosiderin iron. Moreover, the intensity of staining, as evaluated by subjective grading, was low (1+). In contrast, 8% of the AM present in sputum of the children of Delhi contained hemosiderin iron, and the intensity of Prussian blue staining was moderate (2+). On an average, 0.4 ± 0.1 (SD) siderophages were recorded per high power field of microscope (400 x magnification) in sputum of Delhi's children against 0.1 ± 0.05 per high power field in control children, indicating a 4-fold rise in the number of siderophages in the former group ($p<0.001$; Fig. 5.13, 5.14).

Figure 5.13: Number of iron-laden macrophages (siderophages/hpf) in sputum samples of children of Delhi



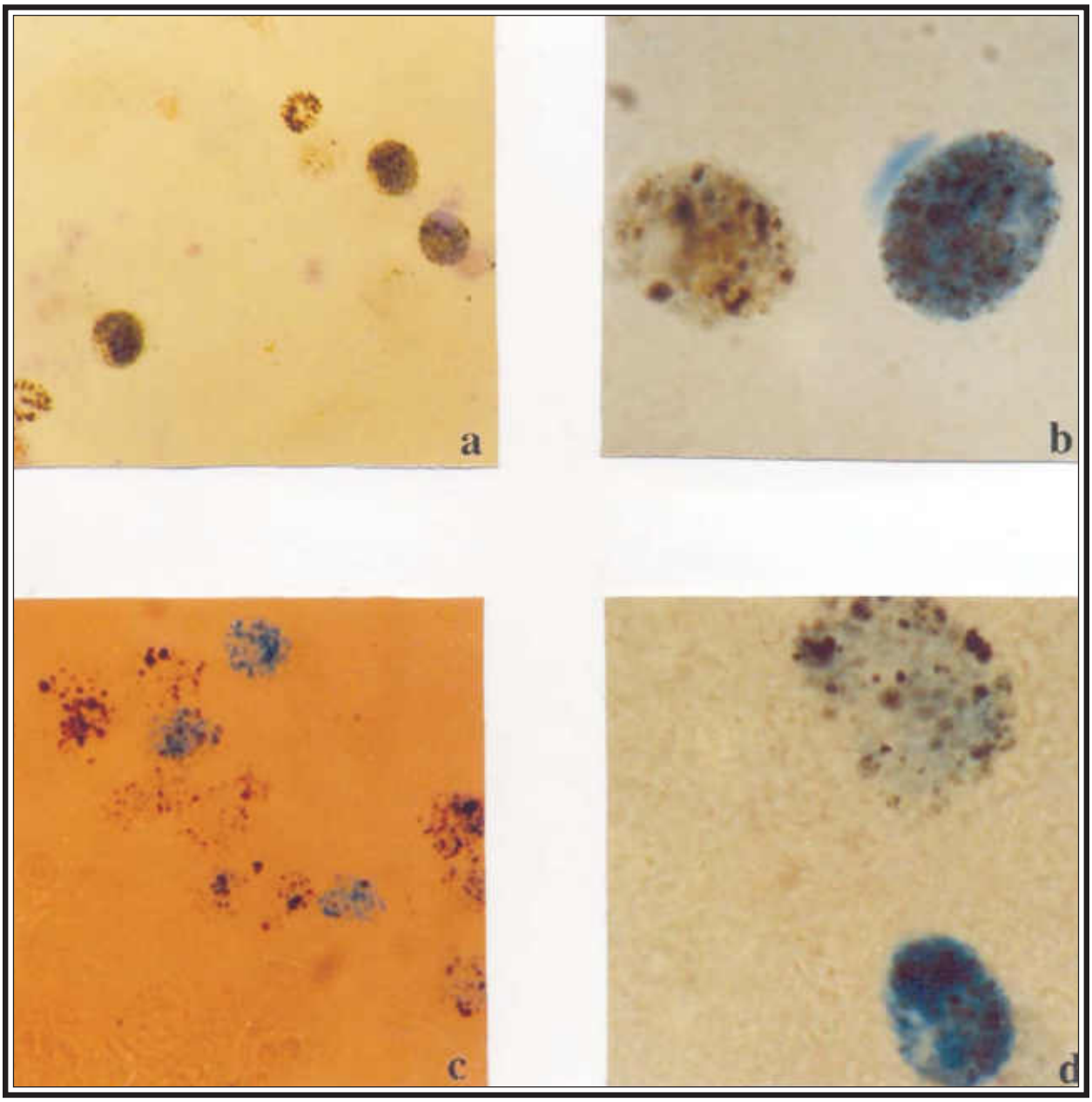


Figure 5.14: Photomicrographs showing iron-laden alveolar macrophages (siderophages) in sputum. Iron deposition in AM is negligible in control children (a) but fairly abundant in student of a school in Central Delhi (b, c, d). Perl's Prussian blue reaction, x 400 (a,c), x 1000 (b,d)

5.4 FINDINGS

1. Sputum samples from 250 school children aged between 13-15 years, 100 (boys 65, girls 35) from control group and 150 from Delhi (boys 98, girls 52) were analyzed. Altogether, 46 sputum samples of control children (46% of total) and 35 from Delhi's children (25% of total) were discarded because they were not representative samples of the airways and alveoli. Finally, 54 samples from control and 125 from Delhi's school children were cytologically and cytochemically analyzed and the results were compared.

2. Microscopical analysis revealed that the sputum samples of Delhi children were more cellular than that of controls: 58.8 cells/hpf were found in the sputum samples of Delhi's children in contrast to 37.2 in the control group. Compared with control children, therefore, Delhi's children had 58% more cells in their sputum ($p<0.05$).

3. The major cell type in sputum of both control and Delhi children were neutrophils, the number being higher in Delhi. The number of neutrophils per hpf was 42.2 in Delhi and 30.6 in the control group ($p<0.05$), which may suggest greater prevalence of pulmonary infection and inflammation in the city.

4. The percentage of eosinophils was also higher in the sputum samples of Delhi's children (3.2% vs. 1.7%) than in control. The rise in eosinophil number is an indication of underlying allergy and hypersensitivity response. Therefore, a greater prevalence of airway allergy may be envisioned among the school children of Delhi.

5. The mean number of alveolar macrophages (AM) per high power field in Delhi's children was 5.2 in contrast to 1.7 AM per hpf in control. Hence, school children of Delhi had 3.1 times more AM in their sputum. Marked increase in AM number signifies greater exposure to particulate pollution as AM represents the first line of cellular defence against inhaled pollutants.

6. Sputum of Delhi's children contained 4-times more iron-laden macrophages (siderophages) than controls (0.4 vs. 0.1 siderophage per high power field, $p<0.001$). Abundance of siderophages in lungs may indicate covert pulmonary hemorrhage among a section of school-going children of Delhi.

7. Changes in the sputum cytology among the school children of Delhi positively correlated with ambient PM_{10} level in Spearman's Rank Correlation, suggesting a close relationship between chronic exposure to Delhi's particulate pollution and cellular changes in the lung ($p<0.001$).

8. Negative correlation ($p<0.05$) was found between total cells in sputum and spirometric lung measurements like FVC, FEF_{25-75} and PEFR values, thereby indicating that the increase in inflammatory cell population in the airways plays a key role in the development of restrictive type of lung function deficits, and small airway obstruction.

9. In essence children chronically exposed to high level of ambient air pollution in Delhi are at a higher risk of inflammation and covert hemorrhage in the lungs that may be lead to lung function deficits.

CHAPTER-6.0

HEMATOLOGICAL AND VASCULAR CHANGES ASSOCIATED WITH AIR POLLUTION EXPOSURE

Chronic exposures to high particulate air pollution, particularly in the ultrafine range, are known to provoke alveolar inflammation that release mediators capable of exacerbating lung disease and increased blood coagulability in susceptible individuals (Seaton, 1995). The heart can be affected by air pollution exposure, because animal studies by Godleski and coworkers have shown that inflamed lung, as evidenced by neutrophil accumulation in bronchoalveolar lavage fluid, release mediator that alter the autonomic nervous system control of cardiac rhythm. Subsequent studies in human subjects have indicated a rise in pulse rate in association with exposures to PM_{10} (Pope et al., 1999a). Air pollution is associated with lower heart rate variability, implying poor autonomic control (Liao et al., 1999; Pope et al., 1999b). Impairment of autonomic control of the blood has also been reported in association with air pollution exposure (Gold et al., 2000), and PM2.5 has been implicated for these changes (Liao et al., 1999).

Cropper et al., (1997) conducted a pioneering, time-series study on the impact of particulate air pollution of Delhi on daily mortality in early 1990's.They found a significant relationship between particulate air pollution and daily deaths from respiratory and cardiovascular problems.

Pande and his co-workers (2002) conducted a 2-year (January 1997-December 1998) time-series analysis in Delhi. Emergency room visits for acute asthma, acute exacerbation of chronic obstructive airway disease, and acute coronary events at All India Institute of Medical Sciences (AIIMS) increased by 21.3%, 24.9% and 24.3% respectively on account of higher than acceptable level of air pollutants (CO, NOx, SO_2). It was concluded that there is a considerable burden of cardiopulmonary diseases in Delhi due to high level of ambient air pollution (Pande et al., 2002).

Studies on laboratory animals and in human volunteers documented abnormal red cell, neutrophil and platelet levels (Salvi et al., 1999), increase in blood viscosity (Schwartz, 2001), and changes in the number of T-lymphocytes, B-lymphocytes, and NK cells (Salvi et al., 1999) in response to air pollution exposure. In addition, neurotoxicity (Anderson et al., 1983; Kilburn, 2000), change in antioxidant defense of the body (Georgieva et al., 2002), and genotoxicity at the level of chromosomes (Zhang et al., 2005) and DNA (Eastman and Barry, 1992; Moller and Wallin, 1998; Don Porto et al., 2001) have been reported.

6.2 METHODOLOGY

(a) Clinical examination and blood pressure measurement

A physician clinically examined the children for general health problems at the school premises. Arterial blood pressure (BP) was measured in 1808 school children (1082 in Delhi and 726 in control) by a sphygmomanometer (Fig. 6.1). An inflatable cuff with a meter attached was placed around the child's arm over the artery, while the child was seated. Systolic (the force that blood exerts on the artery walls as the heart contracts to pump out the blood) and diastolic (force as the

heart relaxes to allow the blood to flow into the heart) blood pressures were expressed in millimeters of mercury (mm Hg). In general, two BP measurements were done at a minimum of two minutes' interval. BP reading tends to decrease with repeated measurement because of an accommodation of the child to the measurement procedure or relaxation (Sinaiko, 1996).



Figure 6.1: Measurement of blood pressure of the children at Mahaveer Senior Secondary School, G.T. Karnal Road, New Delhi

(b) Diagnosis of hypertension

A child's blood pressure is normally lower than an adult's. Children are at risk for hypertension if they exceed the 95th percentile of the age-specific height percentile according to the guideline of National Heart, Lung and Blood Institute's Task Force on Blood Pressure Control in Children (Task Force on High Blood Pressure in Children and Adolescent, updated in 1996, Table 6.1, 6.2).

Table 6.1: Blood pressure of children in relation to height

	Age(yr)	Height Percentile for Boys*				Height Percentile for Girls			
		5 th	25 th	75 th	95 th	5 th	25 th	75 th	95 th
Systolic	3	104	107	111	113	104	105	108	110
	6	109	112	115	117	108	110	112	114
	10	114	117	121	123	116	117	120	122
	13	121	124	128	130	121	123	126	128
	16	129	132	136	138	125	127	130	132
Diastolic	3	63	64	66	67	65	65	67	68
	6	72	73	75	76	71	72	73	75
	10	77	79	80	83	77	77	79	80
	13	79	81	83	84	80	81	82	84
	16	83	84	86	87	83	83	85	86

** The height percentile was determined with standard growth curves*
Ref. Task Force on High Blood Pressure in Children and Adolescent, updated in 1996

Table 6.2: Diagnosis of hypertension in children according to Task Force on High Blood Pressure in Children and Adolescent, 1996

Diagnosis	Systolic /diastolic blood pressure
Normal	Below 90th percentile
High normal	90-95th percentile
Hypertension	>95th percentile

(c) Blood cell counts

Blood samples (100 µl) were collected from 117 schoolchildren (control 46, Delhi 71) aged 13-15 years after informed consent of the parent/class teacher by finger prick by sterile, 21-gauge needle. Blood smears were prepared on glass slides, and routine hematology (hemoglobin measurement, red blood cell, white blood cells and platelets counts) was done following the procedures of Dacie and Lewis (1975). Differential counts of WBC and examination of blood cell morphology were done from Leishman-stained smears under light microscope (Leitz, Germany) following standard procedure (Dacie and Lewis, 1975).

(d) Statistical analysis

The results, expressed as mean ± standard deviation (SD), were statistically analyzed by Student's 't' test and $p<0.05$ was considered as significant.

6.3 RESULTS

(a) Prevalence of hypertension

Arterial blood pressure was measured in 1082 school children of Delhi (boys 604, girls 478) and 726 of rural control (boys 422, girls 304). Overall, hypertension was found in 6.2% participants of

Delhi (67/1082), while only 2.1% of control children (15/726) had hypertension (Table 6.1, Fig. 6.2). The difference in the proportion of hypertensive children in rural and urban areas was highly significant (p<0.001). Hypertension was more prevalent among girls than the boys both in Delhi and in control group. For instance, 7.9% of Delhi's girls (38/478) had hypertension compared with 4.8% (29/604) of the boys (Table 6.3). Similarly, 2.3% of control girls (7/304) had hypertension compared with 1.9% (8/422) of the boys. The difference in hypertension prevalence between girls and boys was statistically significant (p<0.05) in Delhi, but not in control group. Quite contrary to hypertension, prehypertension was found to be more in boys than in girls of Delhi (31.8% vs. 26.4%; Table 6.3, Fig. 6.3).

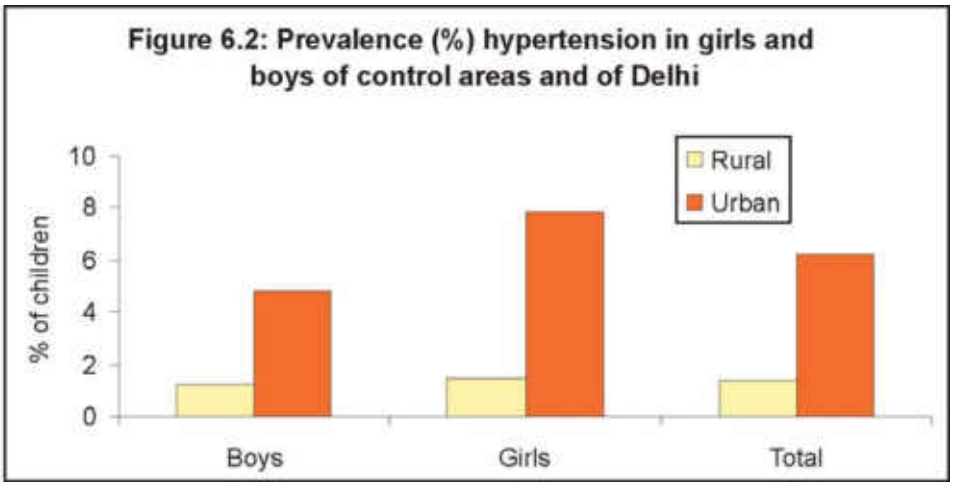
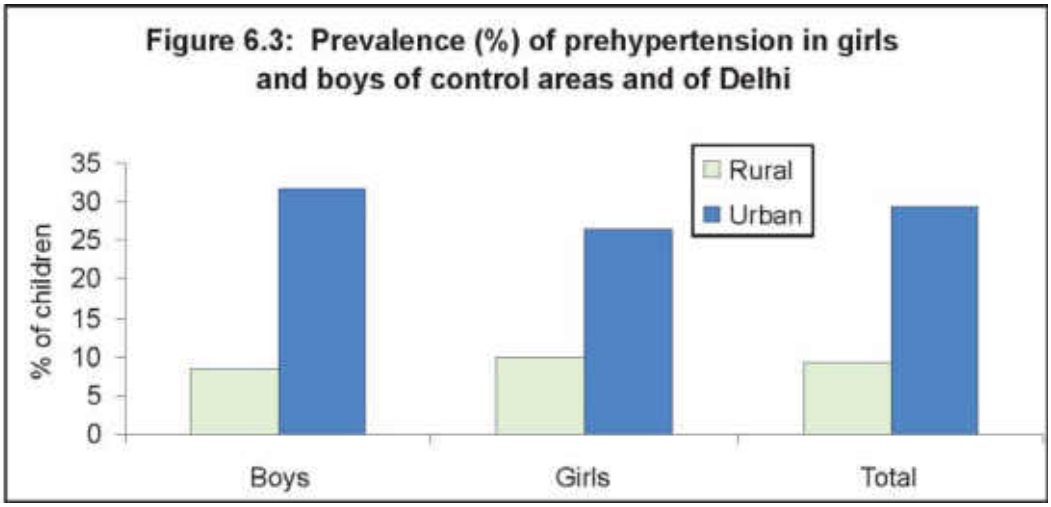


Table 6.3: Prevalence (%) of pre-hypertension and hypertension in school children aged 9-17 years

	Boys		Girls		Total	
	Control (n=422)	Delhi (n=604)	Control (n=304)	Delhi (n=478)	Control (n=726)	Delhi (n=1082)
Pre-hypertension	8.6	31.8*	9.8	26.4*	9.3	29.4*
Hypertension	1.9	4.8*	2.3	7.9*	2.1	6.2*

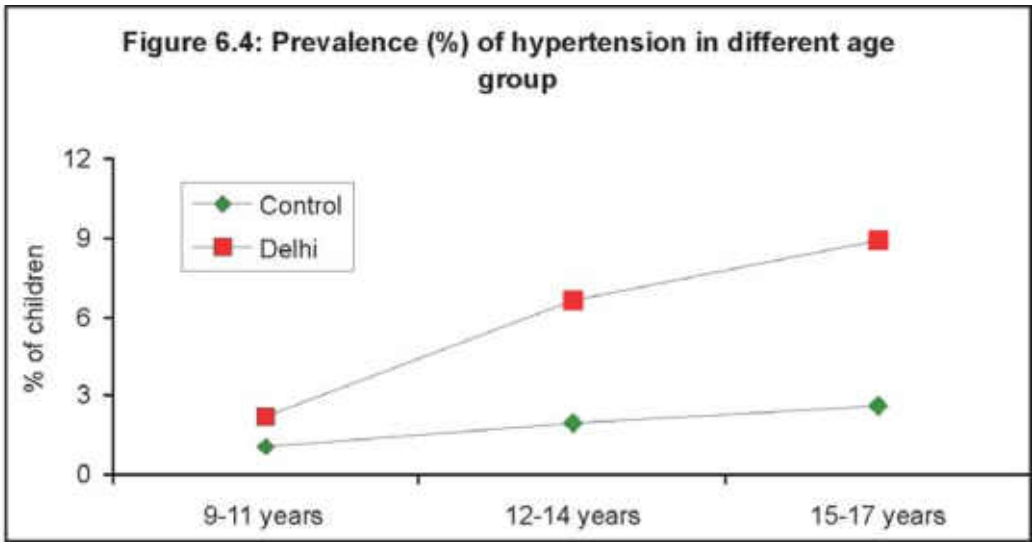


The prevalence of hypertension increased progressively with age. Highest prevalence was recorded in children aged 15-17 years both in rural (2.6%; 8/304) and urban settings (8.9%; Table 6.4, Fig. 6.4).

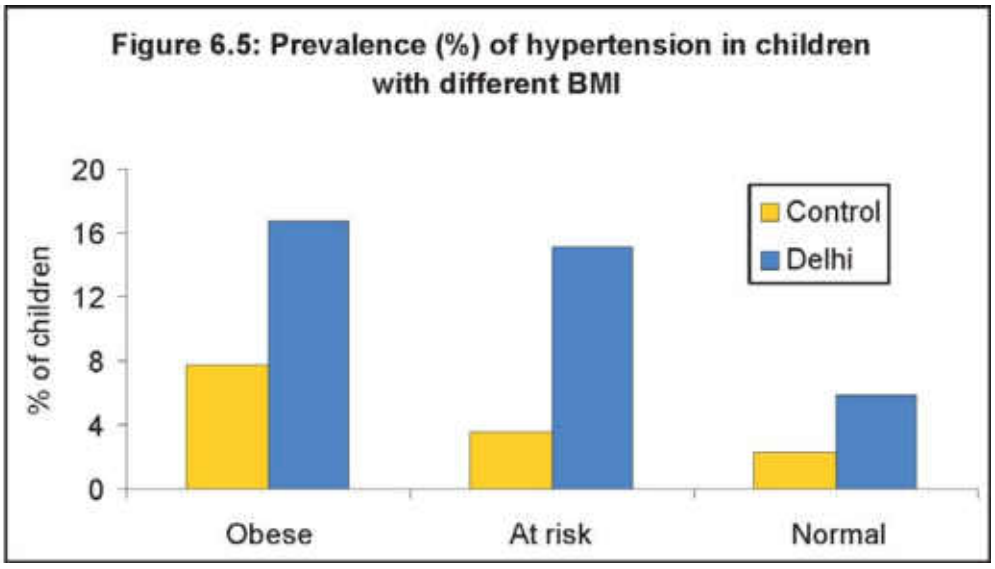
Table 6.4: Prevalence (%) of hypertension in school children

	Control(n= 726)	Delhi(n=1082)
Gender		
Boys Girls	1.9 2.3	4.8* 7.9*
Age (yr)		
9-11 12-14 15-17	1.1 2.0 2.6	2.2* 6.6* 8.9*
BMI		
Underweight Normal At risk Obese	0 2.3 3.6 7.7	1.8* 5.9* 15.1* 16.7*
Socio-economic status (SES)		
Low Medium High	1.3 1.8 3.7	5.8* 5.1* 7.0*

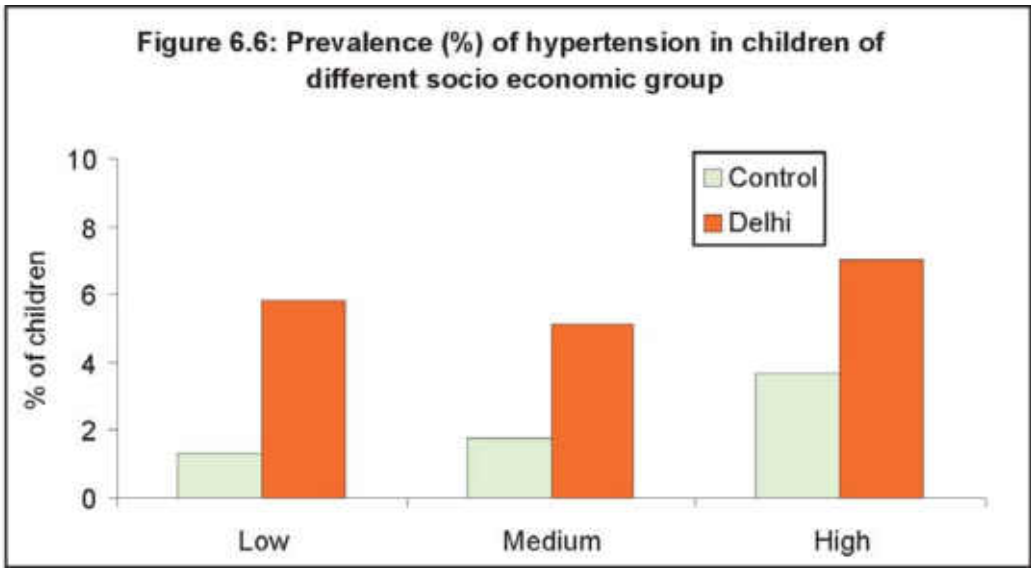
**, p<0.05 compared with control*



BMI was positively associated with the prevalence of hypertension. The prevalence was least (1.8%) in underweight children and highest (16.7%) in obese group (Table 6.4; Fig. 6.5).



Children from high SES had highest prevalence of hypertension (Table 6.4; Fig. 6.6). However in Delhi children from medium SES showed lower prevalence of hypertension (5.1%) than that of children from low SES (5.8%).



(b) Hematological changes

Hemoglobin and total count of RBC, WBC, and platelets

Hematological studies were conducted in 46 control and 71 children of Delhi. The results shown in Table 6.5. Increase in hemoglobin concentration and platelet count correlated significantly with PM_{10} level (rho values –0.295 and 0.354 respectively, $p<0.001$), while correlation between PM_{10} level and other hematological changes were not significant in Spearman's rank correlation test ($p>0.05$).

Table 6.5: Hematological values of the school children

Parameter	Control (n=46)	Delhi(n=71)
Hemoglobin (g/l),	12.2 ± 0.6	13.2±0.7
RBC (x106/ µl)	4.1±0.4	4.5±0.6
WBC (x103/ µl)	5776± 521	6682± 973
Platelet x106/ µl	1.9±0.8	2.2± 0.6

Results are expressed as mean ± S.D ; none of the hematological changes in Delhi's children was statistically significant (p>0.05)

Differential count of WBC showed significantly increased number of monocytes and basophils in peripheral blood of the children of Delhi when compared with that of controls (p<0.05; Table 6.6).

Table 6.6: Absolute numbers of leukocytes in peripheral blood

Cell type	Control (n=46)	Delhi(n=71)
Neutrophil / µl	3228± 322	3616±432
Lymphocyte / µl	2254± 208	2687±218
Monocyte / µl	112± 34	146± 37*
Eosinophil / µl	132± 32	153± 64
Basophil /µl	24± 12	70± 34*

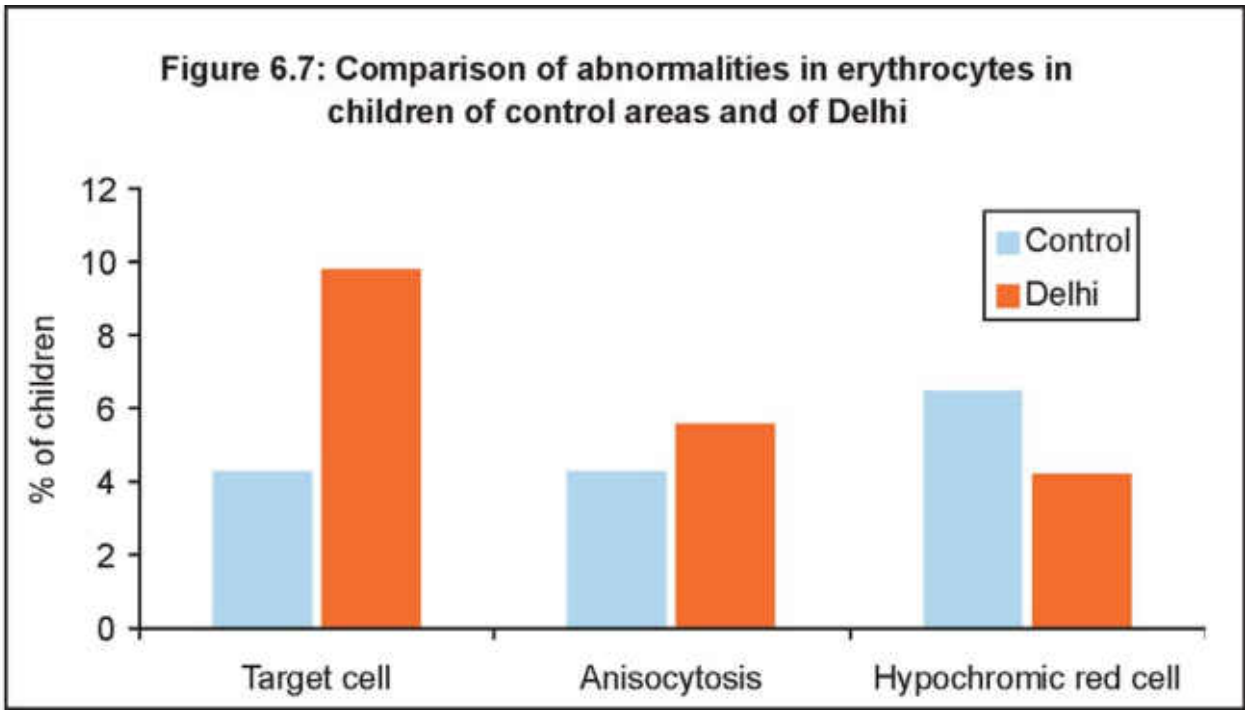
*Results are expressed as mean ± SD; *, p<0.05 compared with respective control value in Student's 't' test*

The children of Delhi had greater prevalence of several morphological abnormalities in blood cells. For example, 9.8% had abundance of 'target' cells in their peripheral blood compared with 4.3% of controls (p<0.001; Table 6.7; Fig. 6.7). Target cells are erythrocytes with higher surface-to-volume ratio. Their presence in circulation in excess signifies liver problem. It implies that a number of the Delhi's children might have liver problem (Fig. 6.8). Children of Delhi and the control group had similar frequencies of aniso-poikilocytosis (changes in red cell shape and size), but the urban subjects had lesser prevalence of hypochromic (RBC with lowered hemoglobin content) cells. The schoolchildren of Delhi had greater prevalence of giant platelets in circulation (5.9% vs. 1.5%, p<0.05) indicating platelet activation (Fig. 6.9). Higher prevalence of circulating immature neutrophil (11.3 vs. 6.5%, p<0.05) and toxic granulation in neutrophil (21.0% vs. 8.7%, p<0.05; Table 6.7; Fig. 6.10) were found in Delhi's school children, suggesting greater risk of infection and inflammation.

Table 6.7: Prevalence (%) of abnormal cell types in peripheral blood

Cell type	Control (n=46)	Delhi(n=71)
Changes in RBC		
'Target' cell	4.3	9.8*
Anisocytosis	4.3	5.6
Poikilocytosis	6.5	5.6
Hypochromic RBC	6.5	4.2*
Changes in WBC		
Toxic granulation in neutrophil	8.7	21.0*
Metamyelocyte/band cell >20%	6.5	11.3*
Change in Platelet		
Giant platelets	1.5	5.9*

**, p<0.05 compared with respective control value in Chi-square test*



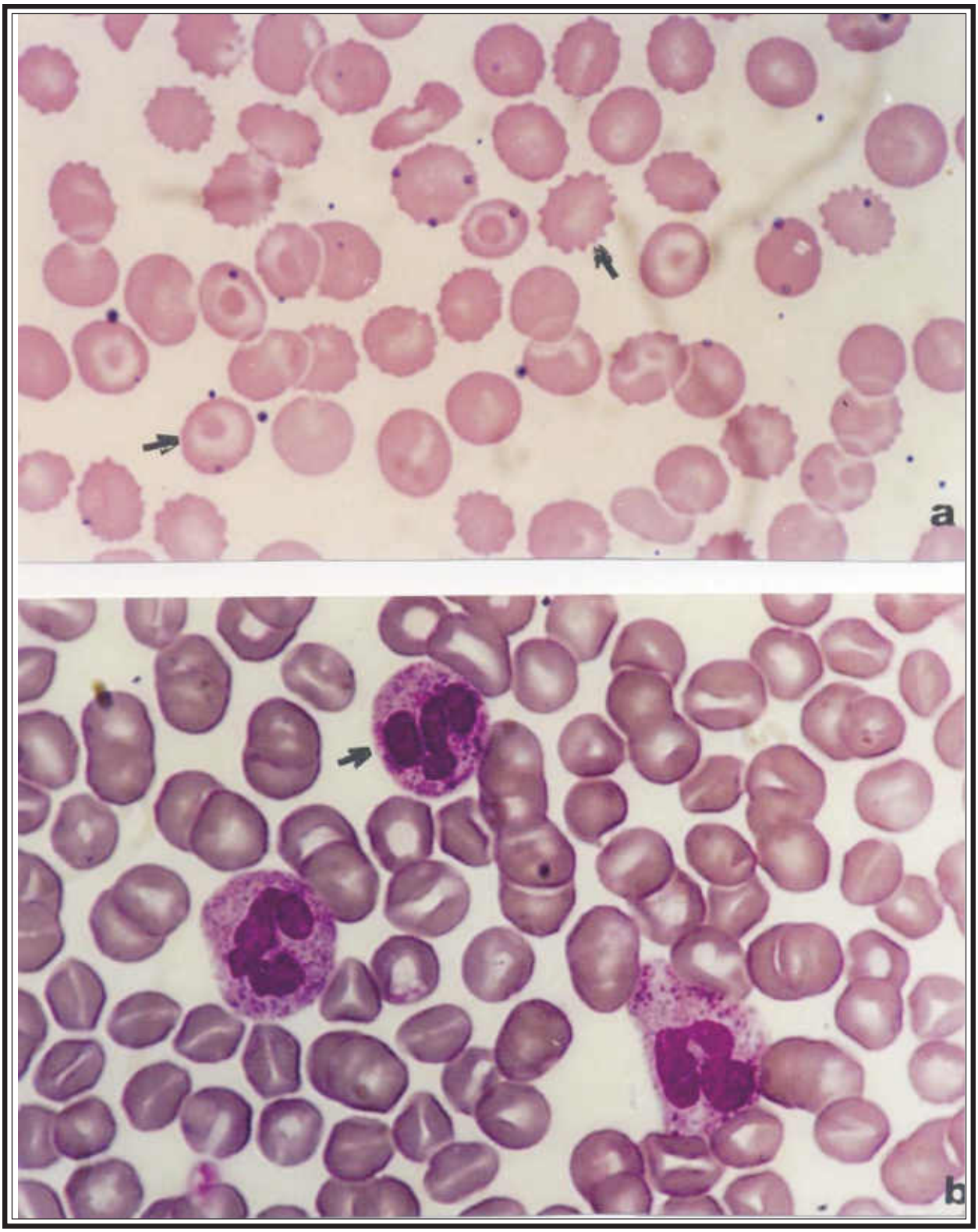
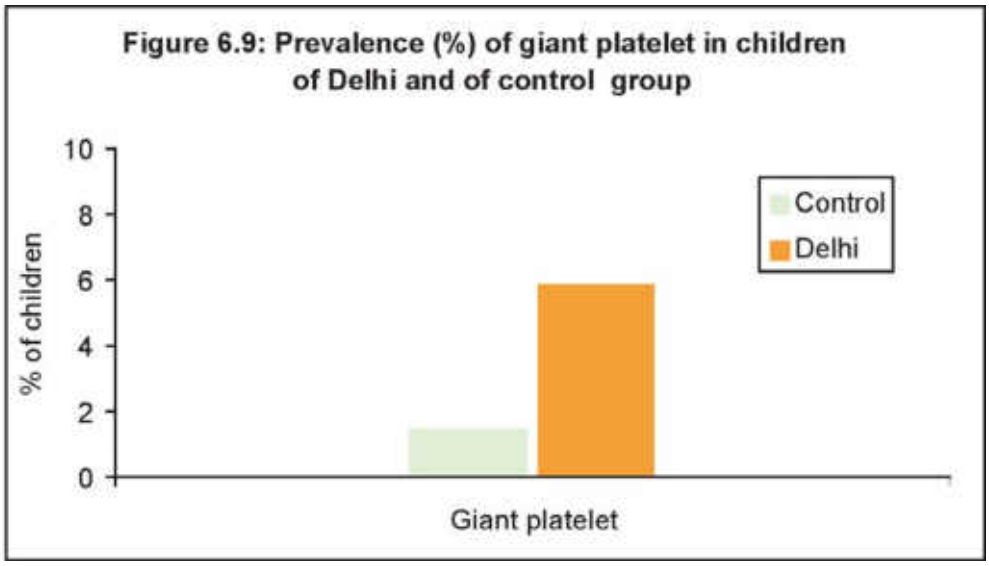
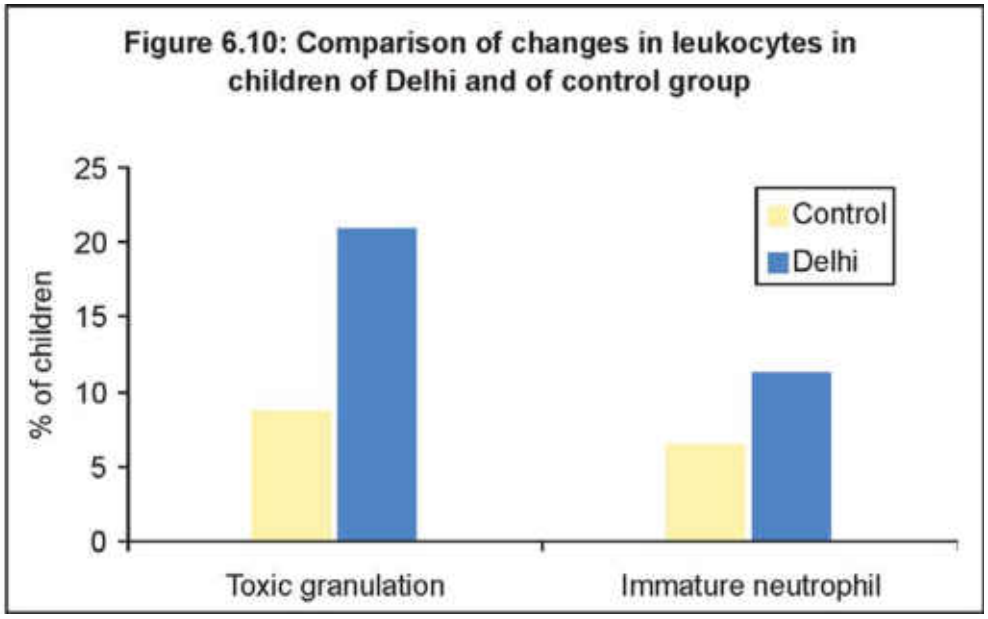


Figure 6.8: Photomicrographs of peripheral blood smear of Delhi's school children showing poikilocytosis and abundance of 'target' cells (a) along with toxic granulation in neutrophils (b). Leishman's stained x 1000





6.4 FINDINGS

1. Arterial blood pressure was measured in 1082 school children of Delhi and 726 of controls. The prevalence of hypertension in children was 6.2% in Delhi compared with 2.1% in control. Thus, Delhi's school children have 3-times more incidence of high blood pressure.

2. Hypertension was more prevalent among girls than the boys: 7.9% of Delhi's girls had hypertension against 4.8% of boys. The prevalence of hypertension increased progressively with age, highest being in the age group of 15 – 17 years.

3. BMI was positively associated with hypertension: the prevalence of hypertension was lowest (1.8%) in underweight children and highest (16.7%) in obese group.

4. The absolute numbers of monocytes and basophils were significantly ($p<0.05$) increased in peripheral blood of Delhi's children as compared to that of control.

5. Rise in hemoglobin concentration and platelet number in Delhi's children were positively correlated with PM_{10} levels.

6. Examination of peripheral blood smears revealed abundance of 'target' cells in 9.8% of Delhi's children against 4.3% of controls, implying a greater risk of liver problem in the former.

7. Higher prevalence of toxic granulation in neutrophils (21.0% vs. 8.7%) and circulating immature neutrophils (11.3% vs. 6.5%) was found among the children of Delhi, which suggests greater risk of infection and inflammation.

8. In essence school children of Delhi had three times more prevalence of hypertension along with several quantitative and qualitative in peripheral blood that indicates greater possibility of infection and inflammation.

CHAPTER-7.0

BEHAVIOR AND ACTIVITIES OF THE CHILDREN

7.1 INTRODUCTION

Studies in laboratory animals have shown that that air pollution may cause brain damage (Calderon-Garciduenas et al., 2002). Investigations in humans have illustrated brain lesions and impairment of olfactory function among residents of highly polluted Mexico City (Hudson et al., 2006).

These reports indicate that chronic exposure to high level of urban air pollution may cause changes in the brain activity that may manifest themselves in behavioral alterations. In children a frequently diagnosed psychiatric problem is Attention-Deficit Hyperactivity Disorder (ADHD), previously known as attention deficit disorder and characterized by inattentiveness, over activity and impulsiveness. Children with ADHD are impulsive, forgetful, restless, prone to fail, unable to follow tasks, unpredictable and moody. Against this background it was decided to find whether the chronic exposure to Delhi's high level of particulate pollution can cause behavioral problems in children. To accomplish this objective the prevalence of ADHD and other behavioral activities was examined in this study in a cross sectional population of schoolchildren of Delhi and compared the results with that of controls.

Objective

The goal of this study was to explore whether sustained exposure to high level of urban air pollution has any impact on the behavior and activities of the in children.

7.2 SUBJECTS AND METHODOLOGIES

(a) Participants

A total number of 4275 children in the age group of 9-14 years were enrolled for ADHD screening. The control group was represented by 1645 children, boys 1220 and girls 425. In Delhi, a total number of 2630 children were enrolled, of which 1750 were boys and 880 were girls. The enrolled children did not have history of neurological problems such as epilepsy, autism, mental retardation, or sensory deficits.

(b) Diagnosis of ADHD

Attention-Deficit Hyperactivity Disorder (ADHD) was screened following the criteria prescribed in the Diagnostic and Statistical Manual of conduct disorders (DSM-IV) of American Pediatric Association (APA, 2000). In evaluating ADHD symptomatology, it is important to obtain independent reports about the child's behavior at school from the teacher and about the child's behavior at home from the parents (de Nijs et al., 2004). Accordingly, reports from the parent as well as the class teacher of the school had been obtained

DSM-IV manual emphasizes that presence of 6 or more symptoms of either category # 1 or 6 or more symptoms of category #2 confirms the diagnosis of ADHD.

#1. Six or more of the following symptom of *Inattention* have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Inattention

a. often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
b. often has difficulty sustaining attention in task or play activities
c. often does not seem to listen when spoken to directly
d. often does not follow through on instruction and fail to finish schoolwork, chores or duties in the workplace not due to oppositional behavior or failure to understand instructions
e. often has difficulty organizing tasks or activities
f. often avoids, dislikes, or is reluctant to engage in tasks or activities such as school work or home work
g. often loses things necessary for tasks or activities (e.g. pencil, pen, books)
h. is often easily distracted by extraneous stimuli
i. is often forgetful in daily activities

2. Six or more of the following symptoms of *Hyperactivity-Impulsivity* have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Hyperactivity

a. often fidgets with hands or feet or squirms in seat
b. often leaves seat in classroom or in other situations in which remaining seated is expected
c. often runs about or climbs excessively in situations in which it is inappropriate
d. often has difficulty in playing or engaging in leisure activities quietly
e. is often 'on the go' or often acts as if 'driven by a motor'
f. often talks excessively

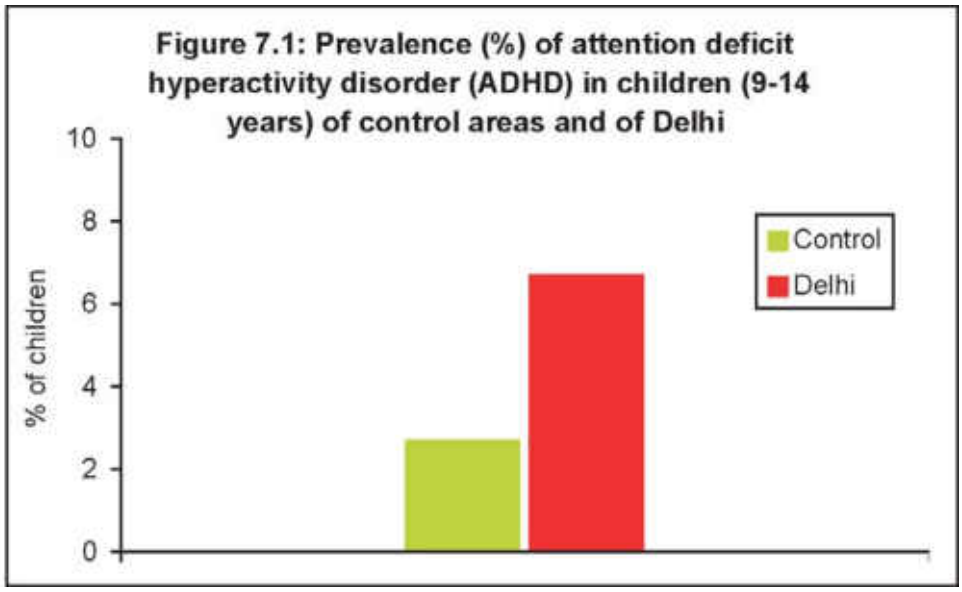
Impulsivity

g. often blurts out answer before question have been completed
h. often has difficulty awaiting turn
i. often interrupts or intrudes on others

7.3 RESULTS

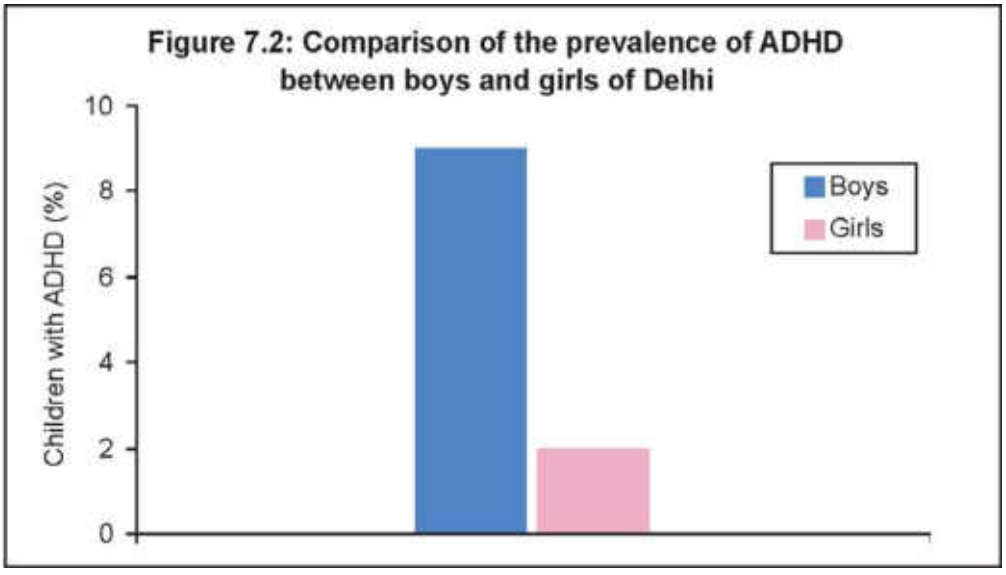
(a) Prevalence of ADHD

Out of 2630 children enrolled in Delhi for this study during 2003-2005, 176 children (6.7%) had ADHD. In contrast, 44 of 1645 control children (2.7%) examined during this period had ADHD (Fig. 7.1). Thus, Delhi's children had 2.5-times more ADHD prevalence than the controls.



(i) Difference between boys and girls

Of the 176 children with ADHD in Delhi, 158 were boys and 18 were girls. Thus, 9% of the boys enrolled in Delhi had ADHD against 2% of the girls, giving a male: female ratio of 4.5:1 in ADHD prevalence in the city (Fig. 7.2). In controls, 41 boys (3.4%) and 3 girls (0.7%) had this problem, giving a male: female ratio of 5:1. Thus, the boys were about 5-times more prone to ADHD than the girls of similar age both in control group and in Delhi. But, Delhi's boys and girls had 2.6- and 2.9-times greater prevalence of ADHD than control boys and girls respectively.



(ii) Type of ADHD

Inattentive type was predominant in Delhi as well as in control group. Among the ADHD children of Delhi, 3.6% had inattentive type, 2.4% had hyperactive-impulsive type, and 0.7% had combined

type of ADHD. In the control group, the relative proportions of these three categories were 2.1%, 0.4%, and 0.2% respectively (Table 7.1).

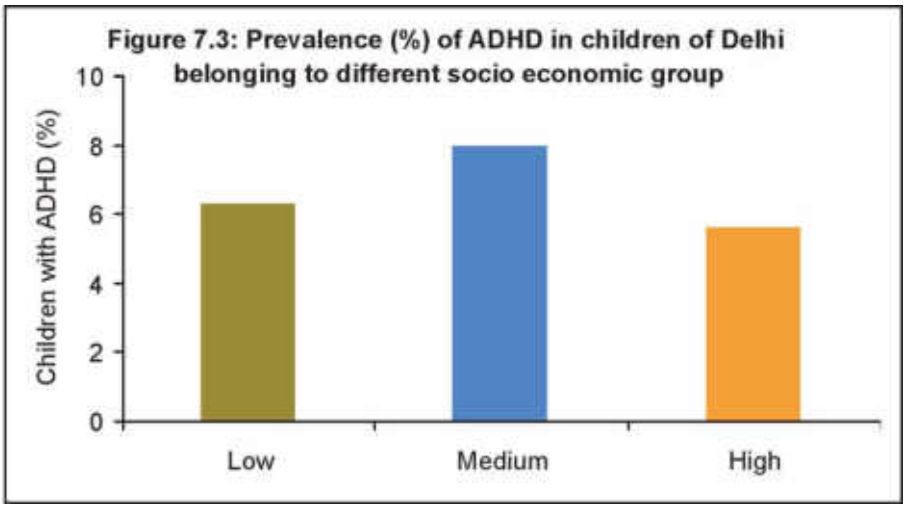
Table 7.1: Prevalence of ADHD and its subtypes

ADHD category	Control (n=1645)		Delhi (n=2630)	
	Number	% of total	Number	% of total
Inattentive	35	2.1	96	3.6*
Hyperactive-impulsive	6	0.4	62	2.4*
Combined	3	0.2	18	0.7*
ADHD, total	44	2.7	176	6.7*

*, p<0.05 compared with control in Chi-square test

(iii) ADHD and socio-economic status

The prevalence of ADHD in Delhi was more in children from medium (8%) and low (6.3%) SES compared with high SES (5.6%, Fig. 7.3).



(iv) Air pollution and ADHD

After controlling potential confounders like age, gender, socioeconomic status and parental smoking, PM_{10} was found to be positively associated with ADHD prevalence in children (OR=1.32, 95% CI 1.08-1.56).

(b) Comparison of physical and creative activities between urban and rural children

(i) Participation in sports

Active participation in sports was more prevalent in control group than in Delhi. About 80 % of control children participated in sports compared with 58% children of Delhi (p<0.05). Boys preferred outdoor games to indoor games, while girls showed an inclination towards indoor games.

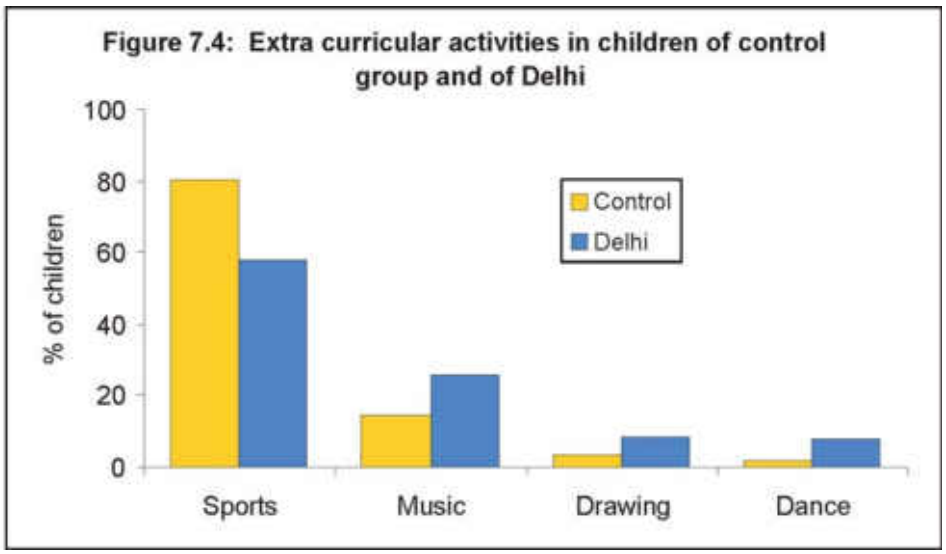
(ii) Interest in music, painting and dance

Delhi' children showed more interest in creative activities such as participation in vocal and instrumental music, drawing or painting and dance than children of the control group, and the difference were statistically significant (Table 7.2, Fig. 7.4).

Table 7.2: Percentage of children with different areas of interest

	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
Sports (%)	88.3	61.4*	66.4	51.1*	80.4	58.0*
Indoor (%)	11.4	22.3*	40.6	20.0*	21.9	21.5
Outdoor (%)	76.9	39.1*	25.8	31.2*	58.5	36.5*
Music (%)	8.7	25.0*	24.5	28.1	14.4	26.0*
Instrumental (%)	4.2	13.3*	3.3	13.4*	3.9	13.3*
Vocal (%)	4.5	11.7*	21.2	14.6*	10.5	12.6
Drawing/painting (%)	2.5	7.2*	5.6	9.9*	3.6	8.2*
Dance (%)	0.5	6.4*	3.5	10.9*	1.6	7.9*

**, p<0.05 compared with controls in Chi-square test*



(iii) Pastimes: watching television

In general, the most preferred pastime of children while at home was watching television, especially in Delhi. About 54% of Delhi's schoolchildren watch television 1-3 hours per day regularly including school days compared with 45% of control (Table 7.3). The boys watched television more than the girls (60.0 vs. 43.1%, p<0.05) in Delhi. In contrast, girls of the control group were more addicted to television than the boys (48.0% vs. 43%). Another 12% of Delhi's children spent 1-2 hours per day with the computers and video games. The percentage of computer/video games users was negligible (0.7%) in the control group.

Table 7.3: Pastime of the children

Pastime	Boys		Girls		Total	
	Control	Delhi	Control	Delhi	Control	Delhi
Reading books and periodicals etc.	39.5	21.4*	37.8	28.4*	38.9	23.8*
Watching television	42.8	60.0*	47.6	43.1*	44.5	54.4*
Listening to music	17.6	8.2*	14.6	12.7	16.6	9.8*

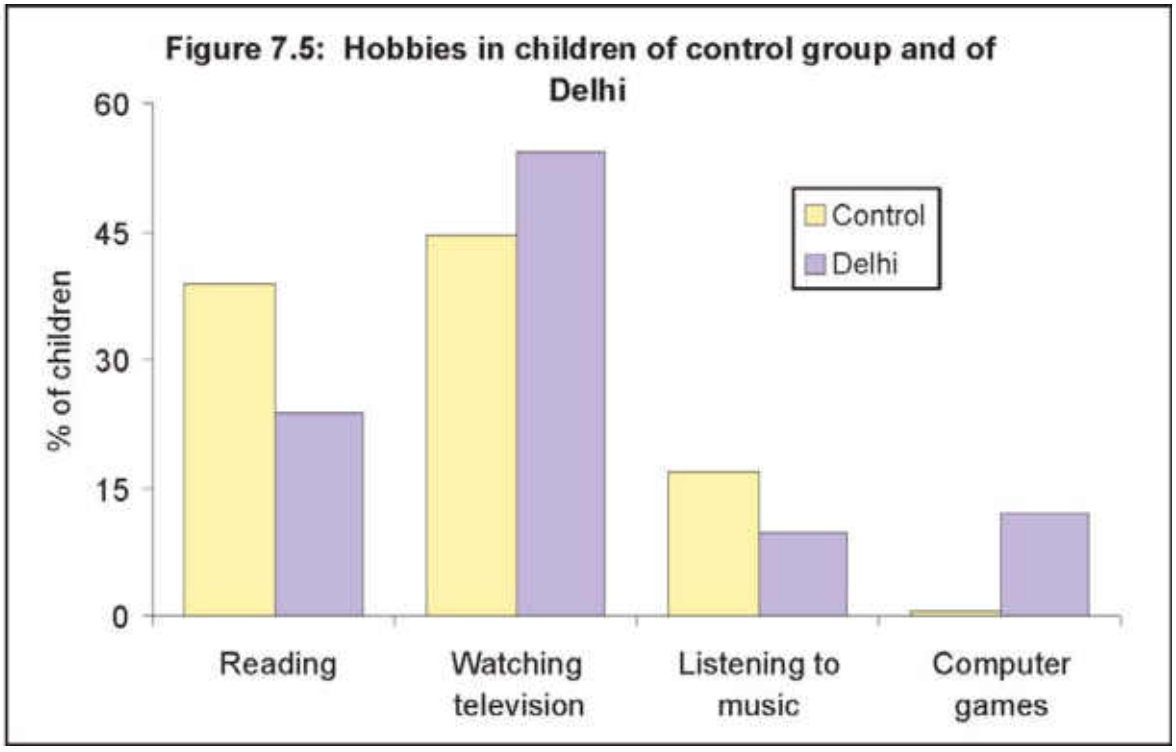
*Results are expressed as percentages of children; *, p<0.05 compared with control in Chi-square test*

(iv) Reading books and periodicals

Reading of books other than schoolbooks, and periodicals was the next preferred pastime for the children. Reading habit was much more prevalent in control group where 40% children had the habit against 24% of city's schoolchildren (p<0.001). Girls were more avid readers than the boys in Delhi (28.4 vs. 21.4%, p<0.05), but not in controls (Table 7.3).

(v) Listening to music

About 10% of Delhi's children and 17% of control had pastime other than watching television and reading books, of which listening to music was most important (Fig. 7.5).



7.4 FINDINGS

1. Delhi's schoolchildren had 2.5-times more ADHD prevalence than age-and sex-matched controls (6.7% vs.2.7%, $p<0.05$). Boys had a remarkably higher prevalence of ADHD than the girls both in Delhi and in control. Boys: girls ratio of ADHD prevalence was 4.5:1 in Delhi (9% vs. 2%) and 5:1 in control (3.4% vs. 0.7%), and children from medium socio-economic status had the greatest prevalence (8.0%) of ADHD. Among the ADHD children of Delhi, 3.6% had inattentive type, 2.4% had hyperactive-impulsive type, and 0.7% had combined type of ADHD. In the control group, the relative proportions of these three categories were 2.1%, 0.4%, and 0.2% respectively.

2. Active participation in sports was more prevalent among control children than in Delhi as 80 % of control children regularly participated in sports compared with 58% schoolchildren of Delhi ($p<0.05$). Boys preferred outdoor games to indoor games, while girls showed an inclination towards indoor games.

3. Delhi' children showed more interest in creative activities such as participation in music (26% vs. 14.4%), drawing or painting (8.2% vs. 3.6%) and dance (7.9% vs. 1.6%) than children of the control group, and the differences were statistically significant ($p<0.05$).

4. The most preferred pastime of children while at home was watching television. About 54% of Delhi's schoolchildren watched television 1-3 hours per day regularly including school days compared with 45% of control (Table 90). The boys watched television more than the girls (60.0% vs. 43.1%, $p<0.05$) in Delhi. In contrast, girls of the control group were more addicted to television than the boys (48.0% vs. 43%). Another 12% of Delhi's children spent 1-2 hours per day with the computers and video games. The percentage of computer/ video games users was negligible (0.7%) in the control group.

5. Reading of books other than schoolbooks, and periodicals was the next preferred pastime for the children. Reading habit was much more prevalent in control group where 40% children had the habit against 24% of city's schoolchildren ($p<0.001$). Girls were more avid readers than the boys in Delhi (28.4% vs. 21.4%, $p<0.05$), but the reverse was true in controls. About 10% of Delhi's children and 17% of control had pastime other than watching television and reading books, of which listening to music was most important (9.8% in Delhi and 16.6% in control).

CHAPTER-8.0

DISCUSSION

Compared with age-and sex-matched rural controls, remarkably higher prevalence of upper and lower respiratory symptoms and lung function deficits were found in Delhi's school-age children. The findings could be linked to city's high level of ambient air pollution, because a large number of studies have shown positive associations between air pollution and respiratory symptoms and lung function impairment (Samet, 2002). Upper and lower respiratory symptoms, which were found in excess in children of Delhi, could be a fall-out of greater interaction of the airways with allergens and pathogens and/or impairment in lung defense. A review of the literature on possible association between air pollution and respiratory symptoms in children show that outdoor and indoor air pollution are positively associated with upper and lower respiratory tract infections in children (Chauhan et al., 2005). Available evidence conclusively suggest that outdoor air pollution, including PM_{10}, $PM_{2.5}$, NO_2, SO_2 and ozone, is associated with increased upper and lower respiratory symptoms in children. Many of these symptoms are related to infections. Viral and bacterial infections can cause severe pathological abnormalities in both the upper and lower respiratory tract, the extent of epithelial damage varied with the pathogen type. The lower airway epithelium between the bronchial and alveolar regions is particularly susceptible compared with nasal, laryngeal and tracheal regions. It is possible that the penetration of pathogens into the epithelium could be facilitated both by epithelial shedding and by reduced ciliary clearance, resulting in easier access of pathogen to antigen presenting cells leading to increased inflammation. Acute respiratory infections (ARIs) are divided into two main groups; upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs). The risk of severe ARIs is greatest in very young children and in the elderly. WHO has defined URTIs as a combination of symptoms including one or more of the following; cough with or without fever, blocked or running nose, sore throat and ear discharge (WHO, 1997). URTIs are usually viral in origin and include the common cold viruses such as rhinoviruses and corona viruses. In contrast, LRTIs involve lung infection with symptoms like cough and dyspnea, bronchitis and pneumonia, which are usually presented in serious forms. URTIs and LRTIs are not mutually exclusive; they frequently coexist during the same episode of respiratory infections. Bacteria and viruses cause infection in both the upper and lower respiratory tracts, and upper respiratory infections is often followed or accompanied by lower respiratory infections (Chauhan et al., 2005).

There has been a series of studies investigating the link between URTIs and air pollution. Traffic related air pollution and the risk of respiratory diseases in a cohort of 4000 children were investigated in Netherlands, and a positive association was observed between air pollution and URTIs. A study in the United Kingdom investigated general practitioner consultation for upper respiratory tract diseases excluding allergic rhinitis with outdoor air pollution. In children aged 0-14 years, a 3.5-fold increase in such consultation was observed for an increase of SO_2 levels between 13-31 $\mu g/m^3$ (Hajat et al., 2002). Another study in Taiwan, China observed 0.3-1.3% increase in consultations with physicians for a 10% increase in levels of NO_2, SO_2 and PM_{10} (Hwang and Chan, 2002). In a cross sectional study in 10 different areas of Switzerland in 6-15 years old children, the risk of bronchitis between the most and least polluted areas was found significant with an odds ratio of 2.17 for PM_{10} (Braun-Fahrlander et al., 1997). A recent study from the UK investigated the association between lower respiratory conditions and primary care consultations in London (Hajat et al., 1991). For a 10-90th percentile increase in pollutant level in winter increase in consultations for respiratory illness in children were observed for NO_2 (7.2%), CO (6.2%) and SO_2 (5.8%), whereas in adults the only consistent association was with PM_{10}. It is possible that air pollution may modify symptoms in children who are already infected. Exposure to NO_2 at hourly peak levels of the order of less than 160 $\mu g/m^3$ compared with background level of 40$\mu g/m^3$ was associated with a significant increase

in sore throat, colds and school absenteeism although no infection was confirmed (Pilotto et al., 1997).

Allergy and asthma

Allergic rhinitis (running or stuffy nose), wheeze, cough and dyspnea were present in a substantial number of children of Delhi. Allergic rhinitis is one of the most common chronic diseases in children (Meltzer, 2006). It can significantly impact a child's health, as it impairs quality of life, and can predispose to the development of co-morbidities such as asthma (Meltzer, 2006). In addition, exposure to fungal spores, such as spores of *Alternaria* could elicit these symptoms (Delfino, 2002). Exposure to airborne bioaerosols including fungus (*Aspergillus* and *Alternaria;* Ponikau et al., 2005), bacteria (*Streptococcus pneumoniae*; Peltola et al., 2006), and viruses (*rhinoviruses*; Osur, 2002) are leading causes of sinusitis. The nose collects bioaerosols that may lead to several human diseases. For instance, living in a moldy house usually increases the risk of respiratory symptoms (Kostamo et al., 2005) and diseases like asthma, allergic rhinitis, sinusitis, and hypersensitivity pneumonitis (Bush et al., 2006). Incidentally, fungal spores are abundant and the prevalence of fungal sinusitis is high in north India (Chakrabarti and Sharma, 2000). Besides bioaerosols, other air pollutants can promote airway sensitization by acting as adjuvant. The prevalence of allergic rhinitis was positively correlated with traffic-related air pollutants after controlling potential confounding and climatic factors (Lee et al., 2003). However, a European study has shown that ambient particles (PM_{10}) from combustion sources act as carrier of allergens (such as pollen) that could elicit allergic reactions in the airways following inhalation (Namork et al., 2006).

Asthma is a chronic respiratory disease characterized by the inflammation of the airways and variable airflow obstruction (Holgate, 1999). The underlying mechanism of asthma is not fully understood. Clinical symptoms include wheeze, shortness of breath, cough, chest tightness and reduction in FEV_1, PEFR and FEF_{50}. It has been proposed that asthma probably encompasses several disparate groups of disorders that produce similar clinical effects (Pearce et al., 1999). In the present study, current asthma and medically diagnosed asthma was in recorded in 4.6% and 1.7% of Delhi's children respectively. Although asthma prevalence was significantly higher in Delhi than in rural areas, prevalence of asthma in Delhi was low compared with urban children of several other countries. For example, doctor-diagnosed asthma was found in 2.6% children aged 15-17 years in Lebanon (Salameh et al., 2003). Contrary to the common belief (Kjellman and Gustafson, 2000), the prevalence of asthma did not decline with advancing age among the children of Delhi. Similar finding has been rmported from some Asian cou~tries including Iran (Golshan et al., 2002) and Thailand (Trakultivakorn, 1999).

Information on the prevalence, magnitude of the problem and risk factors of childhood aóthma in India is scanty. A questionnaire-based survey was carried out in 18,955 children aged 5-17 years from 9 randomly selected schools of Delhi by Chhabra et al., (1999). The prevalence of current asthma was 11.9% while past asthma was reported by 3.4% of children. Boys had a significantly higher prevalence of current asthma as compared to girls (12.8 vs 10.7%). Multiple logistic regression showed that the risk factors were male sex, family history of atopic disorders, and presence of smokers in family, but not the economic class, air pollution, and fuel use at home (Chhabra et al., 1999). In agreement with this study, no causative role of particulate air pollution with asthma was found. However, a lower prevalence of asthma among the schoolchildren of

Delhi compared with earlier report was recorded. Whether this is due to difference in sample size and procedure between these two studies or a genuine decline in asthma prevalence in the intervening years after the introduction of CNG, is yet to be ascertained. In another study in Delhi, univariate analysis showed that the risk factors for asthma in children are family history of asthma, lack of exclusive breast-feeding, and associated allergic rhinitis and atopic dermatitis (Ratageri et al., 2000). Early onset of symptoms, asthma in grandparents and more than10 cigarettes smoked per day by any member of the family were found to be positively associated with severe asthma in 5-15 year old children. Like the previous study of Chhabra et al., (1999) and the current one, Ratageri et al., (2000) found no significant effect of air pollution on asthma development or its severity. On the other hand, the authors reported exclusive breast-feeding for more than 4 months as the most protective factor for development of asthma. The ISAAC questionnaire study in Chandigarh, on the other hand, has established a 12.5% prevalence of wheeze in 13-14 year-old children (Mistry et al., 2004).

There was no association between air pollutants and prevalence of asthma (Ware et al., 1986). A subsequent follow up study confirmed lack of association between particulate matter and the prevalence of asthma symptoms and diagnoses, although a positive association was found between exposures to particulate air pollution and the prevalence of bronchitis and cough (Dockery et al., 1989). Weiland and Forastiere, (2005) have recently reviewed the available data on impact of air pollution on asthma and allergies in children. They found little evidence in favor of a causal association between the prevalence/incidence of asthma and air pollution in general, although there are some suggestive evidence for a causal association between the prevalence/incidence of asthma symptoms and living in close proximity to traffic. Similarly the evidence for an association between the prevalence/incidence of hay fever and exposure to traffic-related air pollution is only suggestive. Among children with asthma, air pollutants cause increase in the frequency of respiratory symptoms, increase in medication use and transient deficit in lung function. The evidence for an association between air pollution exposure and the frequency of hospital admissions or emergency department visits for asthma was sufficient to infer causality. Overall the authors have concluded that air pollution contributes to asthma aggravation, leading to an increase in symptoms, greater use of relief medication and transient decline in lung function (Weiland and Forastiere, 2005). After adjusting potential confounders like ETS and atopy exposure to vehicular pollution before the age of three was found to be significantly associated with asthma while life long exposure was not (Zmirou et al., 2004).

The risk of developing asthma has a genetic basis, as many patients with asthma are atopic, i.e. they have a genetically determined immune reactivity that favors IgE response to multiple environmental antigens (Harris et al., 1997). Still, air pollution could increase the prevalence of asthma symptoms and their severity. A few reports have recorded an association between traffic-related air pollution and symptoms of asthma. For example, vehicular pollution from combustion of diesel has been shown to increase the prevalence of wheeze (Hoppin et al., 2004). After adjustment for age, history of atopy, and parental education, asthma prevalence in 13-15 years old children of Taiwan, China was reported to be associated with traffic-related air pollution, especially CO and NOx (Guo et al., 1999). Long-term exposure to traffic related air pollutants increase the risk of asthma in children (Hwang et al., 2005). In general, 3% increase in asthma symptoms (wheeze and dyspnea) has been observed for every 10 $\mu g/m^3$ rise in PM_{10} (Donaldson, 2000). Besides PM_{10}, a positive and consistent association between asthma outcome and ozone has been reported

(Delfino, 2002). Ozone (O_3), a product of volatile hydrocarbon degradation to nitrogen oxides, is a non-radical oxidant and a major component of photochemical smog. Exposure to O_3 concentration that exceeds current US EPA NAAQS (120 ppb) is a daily occurrence for millions of people throughout the world (e.g. Mexico City ozone >0.12 ppm). School children are especially highly exposed group because they engage in play and competitive outdoor physical activities in the afternoon, when ozone levels are at their peak (Calderon-Garciduenas et al., 1997). Delfino et al., (1998) found that asthma symptoms were associated with both PM_{10} and ozone with a greater relative effect from PM_{10}. Ostro and his group (2001) reported positive association between PM_{10} and $PM_{2.5}$ levels, particularly the former, and the prevalence of cough, shortness of breath, wheeze, and asthma episodes. But the authors could not find any association between these symptoms and ozone.

Some investigators have examined the relationship between socio-economic conditions and asthma. Low SES, expressed in terms of low parental education, was found to be associated with wheeze and nocturnal dry cough, but not with doctor-diagnosed asthma and bronchitis in children aged 6-12 years over 13 countries in Europe and America (Gehring et al., 2006). The authors suggested that crowding and mold and moisture in home could be the connection between low SES and higher prevalence of wheeze in children. It may be emphasized that living in a moldy house or working in a similar environment increases the risk of respiratory symptoms and infections (Kostamo et al., 2005). Increased or subnormal body weight can be important risk factors for asthma and other respiratory complications. For instance, emphysema is significantly associated with underweight (BMI <18.5 kg/m^2) while asthma and chronic bronchitis are more prevalent in overweight (BMI e”28 kg/m^2) persons (Guerra et al., 2002).

Vehicular pollution and respiratory symptoms

The combustion of automotive fuels produces a variety of outdoor pollutants such as NO_2, SO_2 and PM_{10}. There is increasing evidence to suggest that exposure to these pollutants is positively associated with the genesis of several respiratory diseases in children as well as in adults. In many epidemiological studies of outdoor NO_2 and PM_{10} exposure, an association has been found between exposure to these pollutants and adverse health effects often at levels well below the current WHO guidelines. Many of these functions can be modulated by exposure to PM_{10}, NO_2 and other air pollutants (Chauhan and Johnston, 2003; Chauhan et al., 2005). Acute exposure to oxidant pollutants results in ciliostatis in both upper and lower airways, which may prevent the nasal and bronchial mucosal from filtering inhaled particles such as aeroallergens, bacteria and viruses (Devalia et al., 1993). NO_2 reduces ciliary beat frequency of human bronchial epithelial cells and causes ciliary dyskinasis (Helleday et al., 1995). Repeated exposures to NO_2 impair bronchial immunity by reducing total lymphocytes in peripheral blood and CD4+ and CD8+ cell ratio in bronchoalveolar lavage fluid (Sandstrom et al., 1992). Particulate air pollutants are able to penetrate the lower airways in children (Bunn et al., 2001). The percentage of particle-containing AM was found increased (median 10% vs. 3%) in children who lived on a main road compared with those living on a quiet residential road (Bunn et al., 2001).

Several studies have described a close association between traffic-related air pollution and respiratory symptoms (Wjst et al., 1993) and decreased lung function (Brunekreef et al., 1997) in children. Unlike the concentration of RSPM (PM_{10}), the levels of SOx and NOx in Delhi’s air were within the standards. Therefore it seems possible that particulate matter, rather than SOx or NOx,

was primarily responsible for the adverse respiratory changes recorded in city's children. In agreement with this, epidemiological studies have shown that particulate matter, but not SO_2, is associated with increased prevalence of URS and LRS in urban children (Aekplakorn et al., 2003), adolescents (Pierce et al., 2006), and adults (Kamat et al., 1992). However, high level of NO_2 in some Korean cities has been shown to increase URS and LRS in children (Lee et al., 2005). The American 'six cities study' examined the effects of air pollution on the respiratory health of pre-adolescent children living in communities with different levels of air pollution between 1974 and 1977. Questionnaire survey revealed that the frequency of cough and bronchitis was significantly associated with average 24-hr mean concentrations of TSP, TSO_4 and SO_2 during the year preceding the health examination. In another study, no association was found between the prevalence of respiratory symptom in 8-11 year-old children and last year' mean PM_{10} level, suggesting that current air quality is important in relation to respiratory symptoms (Horak et al., 2000).

Exposure of human AM to NO_2 for short durations resulted in a functional impairment of the AM (Kienast et al., 1996). Exposure of AM to PM_{10} significantly reduced respiratory syncitial virus (RSV)-induced production of IL-6 and IL-8. This suggests that AM-related inflammatory responses to viral infection are altered by exposure to PM (Baker and Soukup, 1999). Prior exposure of laboratory animals to diesel particulates has been shown to increase viral replication, lung inflammation and impairment in host defense mechanism (Harrod et al., 2003). Diesel exhaust particles synergistically enhance neutrophilic lung injury related to endotoxin from gram-negative bacteria. In the presence of endotoxin DEP further activated the p65 subunit of NF-kB in the lung and the expression of ICAM-1, MCP-1 and MIP-1 (Takano et al., 2002). Therefore it is likely that alterations in AM function by airborne pollutants are important risk factors for potentially fatal infections in the airways and the alveoli.

Influence of SES

More respiratory symptoms were found in children from low socio-economic status. In agreement with this, poor sanitation, low birth weight, vitamin A and zinc deficiency, and poverty which are usually the hallmark of low socio-economic conditions, have been shown to be significantly associated with 4 million deaths globally due to respiratory infections between 1997 and 1999 (WHO, 2000). Acute respiratory infections were responsible for 25% of all deaths in children under five in Europe in 2001. Besides social and economic conditions, indoor and outdoor air pollution, which itself is intimately related to social and economic fabric of the society, is emerging as a major contributor to this problem. Low birth weight, under nutrition, vitamin A and zinc deficiency, lack of breastfeeding, overcrowding and air pollution increase the risk of pneumonia in children that cause 2 million death each year, 70% of which in Africa ad South-East Asia (Singh, 2005). A study conducted in Delhi has demonstrated lack of breast-feeding, URS in mother or sibling and severe malnutrition as important risk factors for acute lower respiratory symptoms in children below five years of age (Broor et al., 2001). Low socio-economic conditions in childhood may be a risk factor for respiratory illness in adulthood. A study in human volunteers in USA demonstrated a close association between low socio-economic status in childhood and decreased resistance to upper respiratory infections from rhinoviruses in adulthood (Cohen et al., 2004).

Air pollution and lung function deficits in children

Compared with rural controls, reduced lung function growth rate as well as lung function deficits was found at a given age both in boys and girls of Delhi. Lung development and lung function are

influenced by several factors. Most important among these are birth weight, infections, nutrition and environmental factors such as air pollution. It is important to mention in this context that air pollution hampers teenagers' lung development (Khan, 2004). Lung is affected by chronic exposures to high level of NO_2, SO_2 and PM, of which the effect is strongest for PM (Ackerman-Liebrich et al., 1997). Recent study has identified $PM_{2.5}$ as the most dangerous particulate fraction in this regard (Bernstein and Abelson, 2005). Fine particulates ($PM_{2.5}$) are ubiquitous because they are largely derived from common combustion processes such as engines of motor vehicles, power generation, burning of biomass, and manufacturing, and they are transported over long distances and readily penetrate indoors (Pope, 2004b). Exposure to fine particulate matter may be an important public health concern (Pope, 2004b). Such matters that can be breathed deeply into the lungs include sulfates, nitrates, acids, metals, and carbon particles with various chemicals adsorbed onto their surfaces (Pope, 2004b). Chemical composition and radical-generating capacity of the PM depends on the source of emission. Therefore, chemico-toxicological characteristics of PM vary at locations with high traffic emissions from that of PM at low traffic locations, regardless of the mass concentration of PM (Hogervorst et al., 2006). It should be emphasized in this context, that NAAQS is not the safe level. For example, NO_2 below the current European limit value significantly impairs lung function. It has been shown that for every increase of 10 µg/m^3 of PM_{10} and NO_2 lung function parameters are reduced in general, by 1% in school children aged 7-10 years (Moshammer et al., 2006).

The association between air pollution and children's lung function deficits was unveiled by the epidemiologic studies conducted in Europe and the United States. The Second National Health and Nutrition Examination Survey (NHANES II) in the United States demonstrated significant negative correlations between annual concentrations of TSP, NO_2 and ozone and FVC and FEV_1 in children, adolescents and young adults aged 6-24 years (Schwartz, 1989). Studies in young adults have shown that lung function decrement is associated with long- term elevated levels of particulates, and lung function decrement can be further worsened by concomitant exposure of PM_{10} with ozone (Abbey et al., 1998). Indeed, the 24-cities study in North America has shown a strong association of annual mean PM_{10}, ozone and acid aerosols with lung function of elementary school children (Raizenne et al., 1996). The authors reported 2.4% decrement in FVC and 2.1% decrement in FEV_1 for a rise of 17.3 µg/m^3 in annual mean PM_{10} level. Similarly, a 3.4% decrease in FVC has been recorded for every rise of 10 µg/m^3 in PM_{10}, (Ackerman-Liebrich et al., 1997). In general agreement with these studies, significant reduction in FVC (7.6% in medium and 9.9% in high pollution zones), but not in FEV_1, has been reported in school children of Moscow in response to varying ambient air pollution levels (Eroshina et al., 2004). Even in countries with cleaner air such as in lower Austria where annual PM_{10} level varies between 15.8-26.9 µg/m^3 in 1996, a 10 µg increase in last two week's mean PM_{10} was associated with appreciable decrease in FVC, FEV_1, and especially $FEF_{25-75\%}$ (MMEF) in children aged between 8 and 11 years (Horak et al., 2000). Most sensitive indicator for acute effects of combustion-related pollutant was a change in MMEF in small airways (Moshammer et al., 2006).

Measurement of children's lung function over several weeks or months (called Panel studies) before, during and after air pollution episodes in Ohio, USA (Dockery et al., 1982) and Netherlands (Dassen et al., 1986) have shown that lung function decreased after episodes of very high particulates and SO_2, but returned to pre-episode level within a few weeks Similarly, ozone (Kinney et al., 1996; Lippmann and Spektor, 1998) and PM_{10} concentrations (Pope et al., 1991) have been linked with fall in PEFR. Repeated measurements of lung function over many years (called

Prospective Cohort Study) in Poland in preadolescent children demonstrated significantly lower mean lung function growth rate adjusted to height in children living in more polluted areas of Krakow (Jedrychowski et al., 1999). Similar study in Austria for 3 years has found adverse effect of ozone on lung function growth in children (Fischer et al. 1999). In a large prospective cohort study conducted in Los Angeles, California with 3000 children showed a strong association between exposures to PM_{10}, $PM_{2.5}$, NO_2 and inorganic acid vapor with deficits in growth of lung function, as measured by changes in FVC, FEV_1 and MMEF (Gauderman et al., 2000). Compared with children living in the least polluted community, those living in most polluted community of the above study had a cumulative reduction of 3.4% in FEV_1 and 5% in MMEF over the four-year study period, and the deficits were more in children spending longer time outdoors (Gauderman et al., 2000). The latest report from the Children's Health Study in the US with 1759 children aged 10 to 18 years for a long 8-year follow up period has illustrated deficits in FEV_1, FVC, and MMEF in association with exposure to a variety of air pollutants including NO_2, acid vapor, $PM_{2.5}$ and elemental carbon (Gauderman et al., 2004). Impairment of lung function was found in apparently healthy student at levels below current European standards for NO_2- FEV_1 by 1%, MMEF 25% by 1.96% (Moshammer et al., 2006). Peripheral resistance increased by 1.03% per 10 µg/m^3 of $PM_{2.5}$ (Moshammer et al., 2006). Hence NO2 emissions should be strictly controlled. Collectively, these studies suggest that long-term exposure to elevated levels of air pollution during childhood can produce deficits in lung function growth. Therefore, poor air quality of the city can account for deficits in lung function growth in Delhi's schoolchildren. The level of lung function reflects cumulative effects of air pollution over a lifetime. Children with the highest level of lung function at any given age must have been growing faster. This is the 'horse racing effect' described by Fletcher and Peto (1977). This assumes that all children start at the same point in their lung function development. Yet, factors including air pollution may have affected lung function prenatally, and thus influence lung function development from birth onwards. Therefore, the decrement of FVC, FEV_1, MMEF and PEFR in Delhi's children in comparison with that of rural controls may suggest inhibition of expansion of the bronchioles and alveoli in the face of sustained exposure to high particulate pollution of the city.

Greater prevalence of restrictive type of lung function deficit in Delhi

Significant reductions of FVC in Delhi's children relative to age- and sex-matched children from rural areas provide clear signs of pulmonary function deficits in the city. Fall in FVC is associated with fall in total lung capacity and development of restrictive type of lung function decrement that has been seen more often than not in Delhi's children. Lung function and its growth during fetal and neonatal development, infancy, childhood and adolescence are influenced by many factors. These include genes, nutrition and a large number of environmental factors including air quality (Dockery et al., 2005). A recent study has shown that from childhood to adulthood a constant number (300-480 million) of respiratory units or alveoli is maintained in the lungs while both the smallest bronchioles and alveoli expand in size (mean linear diameter of alveoli increases from 184 to 231 µm) to produce the increased lung volume with increasing age and height. Males generally have more alveoli than females at all ages over 1 year, independent of weight (Thurlbeck, 1975). Lung development is essentially complete in girls by the age of 18 years, whereas in boys it continues till early twenties (Schwartz et al., 1988). It is therefore unlikely that the deficits in lung function at the age of 17 years that has been found in a large number of schoolchildren of Delhi will be reversed as they complete the transition into adulthood.

In addition to restrictive lung, Delhi's children had greater prevalence of obstructive type of lung function deficits. They had significantly reduced levels of FEV_1, FEV_1/FVC and $FEF_{25-75\%,}$ suggesting airway obstruction. As high as 70% of Delhi's children had $FEF_{25-75\%}$ value less than 80% of predicted, and in about 18% children it was reduced below 40% of predicted value. Reduction in $FEF_{25-75\%}$ is associated with peripheral (small) airway obstruction. In fact, it is a more sensitive index of airway obstruction than the FEV_1, especially for the small airways that are dependent on the elastic and resistant properties of the distal airways (Seaton and Crompton, 2000). Thus, a 2-fold rise in the prevalence of reduced $FEF_{25-75\%}$ in Delhi relative to control suggests a remarkable increase of small airway obstruction in Delhi that could be attributed to sustained exposure of these children to city's air pollution. COPD is not a well-defined entity in children (Kabra et al., 2001). A child presenting with chronic cough and wheeze should be investigated for asthma, recurrent aspiration airway compressions, chronic infection, cystic fibrosis and immune deficiency. In absence of these causes, environmental factors such as ETS and air pollution could be implicated (Kabra et al., 2001).

Road traffic and breathing problems

Delhi possesses 4.2 million motor vehicles, which is more than the combined number of automobiles possessed by country's other three metros-Mumbai, Kolkata and Chennai. A large number of investigations carried out in Europe and elsewhere support this hypothesis. For instance, a positive correlation between exposures to car traffic and the prevalence of cough, recurrent wheeze, recurrent dyspnea, and reduced lung function particularly PEFR and $FEF_{25-75\%}$ has been reported in Germany (Wjst, 1993). Road traffic also increases the risk of recurrent bronchitis, broncholitis and pneumonia among children in Italy (Ciccone et al., 1998). In the metropolitan areas of Turin, Milan and Rome in Italy the authors reported a positive association between exposures to road traffic and current respiratory symptoms, such as speech-limiting wheeze, persistent cough and persistent phlegm (Ciccone et al., 1998). The prevalence of respiratory symptoms in children aged 0-15 years living in streets with a high traffic density in the Dutch city of Harlem was much more than children living in quiet streets (Oosterlee et al., 1996). A group of Dutch investigators examined the prevalence of respiratory and allergic disorders among children aged 7-12 years who went to schools located less than 1 km from a major highway. Respiratory symptoms including cough, wheeze, and stuffy or runny nose were more prevalent among children attending schools located close (within 100 m) to a highway with high density of truck traffic, and the symptoms were more prevalent in girls (van Vliet, 1997). Lung function measurements of children attending schools located close to the highways were inversely related to truck traffic and concentrations of black smoke (Brunekreef et al., 1997).

Long-term periodic exposure to air pollution (SO_2, NO_2.CO, RSPM) of Jaipur was associated with increased PEF variability even in healthy subjects (Singh et al., 2003). Even brief exposures to particulate air pollutants have been associated with acute decrease in lung function. In an early meta-analysis, Dockery and Pope (1994) reported a 1.5% decrease in FEV_1 and a 0.8% decrease in PEFR for each 100µg/m^3 increase in PM_{10}. Similarly, Zmirou et al., (1997) reported 2.2% decline in FEV_1 and 0.7% decline in PEFR for each 100µg/m^3 rise in PM_{10}. In a meta-analysis, Ward and Ayres (1994) reported a 3.3 liter/min decrease in PEFR in association with 100µg/m^3 increase in PM_{10}. PM_{10} and $PM_{2.5}$ levels have been associated with decreased lung function in children in Utah (Pope, 1996) and southern California (Gauderman et al., 2000, 2002). The effect of particulates may be partially due to particle acidity. Particle strong acidity, categorized by SO_2- derived acidic sulphate particles has been associated with lung function decrement (Raizenne et al., 1996). In a

separate study in college students, it was observed that living for four or more years in regions of the country with high levels of ozone and related co-pollutants was associated with lower lung function, but the effects were more strongly associated with PM_{10} levels than with ozone (Galizia & Kinney, 1999; Kinney & Chae, 2005). Cross sectional analysis of the Children Health Studies also found a negative impact of ozone on PEFR ($r = - 0.75$, $p< 0.005$), and that of $PM_{2.5}$ on MMEF ($r = - 0.80$, $p< 0.005$) [Gauderman et al., 2000]. In the First Children Health Studies Cohort, ozone was not significantly associated with growth of FVC, FEV_1 or MMEF amongst school-aged children (Gauderman, 2000). In the second cohort of fourth grade student, however, ozone was associated with reduced growth of PEFR in children who spent more time outdoors (Gauderman et al., 2002). Overall, the result suggests age-dependent effects of ozone on the growth of small airway function that is most acute during pre-school ages.

In a prospective study of Dutch children followed over a two-year period with serial lung function measurement NO_2 was found negatively associated with MMEF, but the association was not consistent (Dijkstra et al., 1990). Other studies of the effect of NO_2, mainly from indoor sources, on lung function in children have been inconsistent (CEOHA, ATS, 1996). Taken together, the available report suggests that NO_2 at ambient levels may not have an independent effect on lung function level or growth. It is possible, however, that ambient NO_2 level may be associated with lung function growth in combination with other pollutants present in air.

Deficits in lung function have been observed in 1991 Dutch children living within 300 meter of busy roads, and the deficits were larger for traffic counts of diesel powered trucks than for petrol powered cars (Brunekreef et al., 1997). It was found in this study that the girls are affected more severely than the boys. In another study on 4320 fourth grade children in Munich traffic density was associated with diminished lung function (Wjst et al., 1993). Similar study in Leipzig in pre school children exposure to heavy traffic was associated with lower FVC and FEV_1 (Fritz and Herbarth, 2001). Although the effects of living near high-traffic roads may be related to NO_2 exposure, a number of other pollutants that are emitted in exhaust are of interest including diesel exhaust particles and ultra fine particles. Diesel exhaust contains high levels of NO_2 fine and ultra fine particles and organic compounds. Diesel exhausts appear to have acute and chronic effects on lung function (Sydbom et al., 2001). Elemental carbon, a marker of diesel exhaust, has been shown to be associated with reduced lung function in children (Gauderman et al., 2002).

Urban particles exist in three sizes: ultra fine particles < 0.1μm in diameter, accumulation mode particles between 0.1 μm and 2.5 μm in diameter, and coarse particles between 2.5 μm and 10μm in diameter. The fine particle mass $PM_{2.5}$ includes both the ultra fine and accumulation mode particles. UFP contribute very little to the overall mass of fine particles but are very high in number, especially within 100 m of road. These particles are of special interest because they have high deposition in the distal lungs, have larger surface areas coated with organic compound and transitional metals and have the ability to induce oxidative stress and inflammation (Oberdorster, 2001). However, no investigation of the chronic effect of UFP on lung function growth have been reported till date.

The impact of urban air pollution on the respiratory health of the children was studied cross-sectionally in Dresden, Germany (Hirsch, 1999). After adjustment for potential confounders, positive and statistically significant association between air pollutants and respiratory symptoms and reduced lung function was observed. Benzene was found to be associated with asthma and reduce FEF_{25-}

$_{75\%}$. A consistent association between particulate matter and respiratory symptoms has been reported by several panel studies. A majority of the 21 studies, 10 in Europe and 11 elsewhere, on PM_{10} have found an association between particulate pollution and respiratory symptoms. With a notable exception of the large PEACE study which did not find a clear effect of particulates. Six studies have been conducted with $PM_{2.5}$ and all showed a statistically significant effect. There are only a few studies available for $PM_{10-2.5}$ and for UFP so that no conclusion can be drawn for these particle ranges.

Fuel adulteration and children's health

In most cases adulteration involves i. blending of diesel or kerosene with petrol, ii. mixing of up to 30% of industrial solvents such as toluene, xylene and hexane with petrol, iii. mixing of used lubricants with diesel and petrol, and iv. blending as much as 20-30% of kerosene with diesel. Because kerosene is more difficult to burn than petrol, its addition results in higher levels of tailpipe emissions of hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM) and known carcinogen like benzene and polyaromatic hydrocarbons (ESMAP, 2002). Moreover, kerosene has high sulfur level that can deactivate the catalyst of the vehicle leading to lower conversion of engine-out pollutants. If too much kerosene is added, octane quality will fall below the minimum requirement of the engines, causing engine knocking, mechanical damage of the engine besides abnormally higher emissions of PM, HC and NOx.

Impact of specific air pollutants

There are many studies on the effect of mixtures of ambient air pollutants on lung function development, but the specific pollutant responsible for reduced lung function is not clearly understood. Among the large number of chemical species present in ambient air ozone, NO_2, acid vapours, respirable particulates (PM_{10} and $PM_{2.5}$), SO_2 and acid aerosols have been identified as candidate pollutants for adverse effects on lung function (CEOHA, ATS, 1996). Living in regions with high levels of ambient ozone is associated with chronic deficits in lung function caused by reduced growth and faster decline in lung function (Lippmann, 1989). Short-term exposures to ozone are associated with reduced lung function, particularly fall in FEV_1 and PEFR (Kinney et al., 1996). In a meta-analysis of 29 panel studies on children, each 100µg/ m^3 increase in ozone was found to be associated with a 2.2% decrease in FEV_1 and a 3.4% decrease in PEFR (Zmirou et al., 1997). Community ozone level was associated with decrease in both FVC and FEV_1 (Schwartz, 1989). In contrast, no association of ozone with FVC or FEV_1 was found in college students although MMEF was reduced, suggesting that chronic exposure to ozone adversely affect the small airways (Kuenzli et al., 1997). In agreement with this, high lifetime ozone exposure was found to be associated with deficits in small airway function, and the effect was more acute if the exposure occurred earlier in life (Dockery et al., 2005).

Susceptibility

A number of host and genetic factors may contribute to variable response of children's lung to air pollutants. Asthma and other respiratory conditions, time-activity patterns and sex are important determinants of lung function growth. Dietary factors may also affect both lung growth and responses to air pollutants (Schunemann et al., 2002; Romieu et al., 2002; Romieu and Trenga, 2001). A growing number of susceptibility genes have been identified as participants in the

pathogenesis of persistent lung damage (Sanford et al., 2002; He et al., 2002). Genotypes that result in a higher-intensity oxidative stress, inflammatory responses or altered tissue response to damage appear to be associated with increase susceptibility to respiratory effects from acute and chronic exposure to air pollutants (Dockery et al., 2005). Overall lung function studies in children have suggested that air pollution adversely affects lung function growth. These effects of air pollution are generally modest. Nevertheless the effects can be cumulative over a 20- year growing period, and there is uncertainty over whether the chronic effects are reversible. Furthermore, even a small shift in average lung function can yield a substantial increase in the fraction of children with 'abnormally' low lung function. That is small changes in the population mean can reflect large changes in the susceptible subgroup of the population.

Other risk factors: malnutrition and low socioeconomic status

Underweight children from low SES of this study had greater prevalence of lung function deficits than that of children with normal weight, suggesting a role of nutrition on lung function. A recent study has documented that social class and poor air quality are independently associated with decreased lung function after controlling potential confounding factors (Wheeler and Ben-Shlomo, 2005). In agreement with the present finding, significant deficits in FVC, FEV_1 and PEFR were found in 5 to18-year-old semi-nomadic Fulani children and adolescents of Nigeria who were underweight due to poor nutrition (Glew et al., 2004). Diminished lung function in those underweight, malnourished children was thought to be due to respiratory muscle weakness and overall energy deficiency (Glew et al., 2004). In an earlier study with 50 boys aged 12-15 years, decreased lung function was found in boys from slums of East Delhi, compared with control boys studying in public school in east Delhi, indicating that environmental pollution and poor nutritional status contribute in unison to lung function deficits in children (Gupta, 1997).

Abnormal BMI

A significantly increased prevalence of overweight was observed among the schoolchildren of Delhi as compared with their control counterparts.This could be an important contributor to poor lung function, because lung function is adversely affected in young people by obesity (Perez-Padilla et al., 2006). A recent study has documented a strong negative correlation between BMI and FVC, FEV_1 and PEFR values (Ulger et al., 2006).

Fuel use at home, location of residence and population density

A study in north India on 200 schoolchildren examined the effect of fuel use at home for cooking on lung function of the children. It was found that lung function was mostly affected in children from biomass fuel and kerosene-using homes compared with LPG using households (Behera et al., 1998). A study in Ecuador supported these findings (Rinne et al., 2005). Duration of cooking hours also influences respiratory symptoms. For example, respiratory illness is more in children from households cooking with LPG two meals a day than one meal a day (Wong et al., 2004). A recent study has shown that children living near busy roads are 35% more exposed to 'soot' than children living in low traffic areas, although they attended the same school that was located far away from busy road (Van Roosbroeck et al., 2006). A major difference between the rural and urban areas covered in this study is the difference in population density, which was several times higher in Delhi. This could have influenced the prevalence of respiratory symptoms and lung function deficits

in city's children, as population density is associated with elevated prevalence of respiratory diseases (Holland and Reid, 1965).

Parental smoking and respiratory illness

Presence of smoker in family increases the risk of respiratory symptom and lung function deficits in children. In agreement with this, a study in Ecuador has shown that children living in homes where the parent or a family member is smoker had lower FVC and FEV_1 (Rinne et al., 2005). On the other hand, parental history of respiratory disease is a risk factor for the development of impaired lung function and airborne diseases in children, especially the boys (Lebowitz, 1989). It has been shown that increase of PM_{10} level over 100 $\mu g/m^3$ for 54 days per year is associated with a 7.2% decrease in FEV_1 as percent predicted in males whose parents had asthma, COPD or hay fever (Abbey et al., 1998).

Diet and respiratory health

Apart from difference in air pollution levels, urban and rural children of the current study have difference in food habit in relation to consumption of fish. While fish intake is high in children of West Bengal, which constitute bulk of the control group, the intake is low in Delhi. This could have influenced the prevalence of respiratory symptoms, because low fish intake is an important predictor of poor respiratory health (Antova et al., 2003).

Alteration of lung defense: changes in sputum cytology

The elevated number of alveolar macrophages in sputum of children in Delhi compared to their control counterparts is consistent with the relatively high level of air pollution in the city. The findings corroborate the observation of Mylius and Gullvag (1986) that the numbers of AM correlate with the level of particulate air pollution. Another significant finding of the study is the prevalence of iron-laden macrophages in the sputum of children of Delhi. Since Prussian blue positive ferric ion in AM generally comes from the disintegration of circulating erythrocytes, greater deposition of iron in AM may suggest chronic pulmonary irritation leading to microscopic hemorrhage (Grubb, 1994). Since the pulmonary tract of growing children is more susceptible to insults by air pollution (WHO, 1986), hemorrhage in lung capillaries of the children chronically inhaling polluted air in Delhi is not unlikely. Indeed, similar changes have been observed in schoolchildren of Kolkata who were chronically exposed to high level of particulate air pollution (Lahiri et al., 2000). In fact, abundance of iron-laden macrophages has been recognized as an adverse lung reaction to air pollution (Roy et al., 2001).

Greater presence of neutrophils, eosinophils and lymphocytes in sputum is indicative of underlying inflammatory and allergic reactions (Nobutomo, 1978). Therefore, the increased number of these inflammatory cells in sputum of Delhi's children underscores inflammatory response of the lungs to air pollution. Sputum neutrophilia in a large number of children in Delhi is suggestive of allergic reactions to air borne pollutants. A negative correlation was also found between sputum neutrophil number and spirometric lung function measurements of the children.

Goblet cell hyperplasia in sputum samples of Delhi's children underscores hypersecretion of mucous in response to chronic air pollution exposures. This could be a defense mechanism to restrict the airborne particle and pathogens and their speedy disposal through sputum expectoration. But it seems the defense is not adequate to contain the high load of particulates because abnormal

cellular characteristic such as multinucleation, metaplasia and dysplasia have already set in. Moreover, the chances of viral infection have apparently increased as recorded by the presence of ciliocytophthoria. The observation suggest that although the lungs have tried its best to resist the incoming pathogens and pollutants by secreting more mucous it has only fulfilled the objective partially and the cells are facing the burnt of toxic effects of air pollutants. In agreement with the present observation, squamous metaplasia was found in nasal epithelial cells of more than 30% children aged 9-12 years from highly polluted urban areas of Mexico City (Calderon-Garciguenas et al., 1997). They all had URS and damaged DNA in nasal cells. In essence, sputum cytology of the children of Delhi has illustrated adverse lung reaction at the cellular level. The inflammatory changes in the lung could be harmful because they exert oxidative stress, which is injurious for the airway lining cells leading to opportunistic infections.

Consequence of respiratory illness and lung function impairment

Childhood history of respiratory symptoms increases the risk of reduced lung function in adulthood, particularly in case of females (Lebowitz, 1989; Abbey et al., 1998). Respiratory symptoms in childhood are considered as significant predictors of all-cause mortality above the age of 30 years in urban subjects (Frostad et al., 2006). Deficits in lung function in childhood, on the other hand, is a strong risk factor for lung function impairment in adulthood (Dockery et al., 1985, Redline and Weiss, 1989), and all-cause mortality in adult life (Schroeder et al., 2003; Schnemann et al., 2000; Knuiman et al., 1999; Ryan et al., 1999; Neas and Schwartz, 1998; Hole et al., 1996; Rodriguez et al., 1994; Bang et al., 1993; Dockery et al. 1993; Krzyzanowski and Wysocki, 1986; Beaty et al., 1985; Kannell et al., 1983; Friedman et al., 1976; Asley et al., 1975). Of all the lung function measurements, depletion of FEV_1 percent predicted is a significant risk factor for mortality in both sexes, while reduced FEV_1/FVC ratio is associated with all-cause mortality only in males (Bang et al., 1993).

Is lung function deficit irreversible?

An important question is whether deficits in lung function growth related to air pollution are permanent or reversible. Cross-sectional prospective studies have shown that lung function may recover if an individual breathes cleaner air, either because improvement of air quality or because the person moves to an area with cleaner air (Dockery et al., 2005). Repeated measurement of children's lung function before, during and after air pollution episodes in Ohio, USA (Dockery et al., 1982) and Netherlands (Dassen et al., 1986) have shown that lung function decreased after episodes of very high particulates and SO_2, but returned to pre-episode level within a few weeks. In an earlier study Arossa and co-workers (1987) have shown decreased FEV_1 and MMEF values in Italian schoolchildren who lived in urban areas compared to their suburban controls. Following improvement in air quality of the city, the lung function of the urban children was so improved that it was hardly different from that of controls. Beneficial effects of reducing air pollution have been described from Dublin, Hong Kong, Atlanta, Schefaild (Chauhan et al., 2005). Lung function of children from more polluted areas who had moved to less polluted areas showed improvement in lung function growth rates (FEV_1, MMEF PEFR) [Avol et al., 2001].

Overall, the available reports suggest that reduction in air pollution in a short period improves lung function of the children. Thus, data from current available studies on responses to improving air quality or migration from areas of high concentrations of air pollutants to ones with lower concentrations suggest that recovery of lung function growth is possible.

Protective effects of antioxidants

Several lung diseases are associated with oxidative stress evoked by environmental pollutants. Dietary factors and nutrients including fruits and vegetables, antioxidant vitamins such as vitamin C, vitamin E, beta carotene and other carotenoids, vitamin A, fatty acids and some minerals such as sodium, magnesium and selenium confer protection against oxidative process and inflammatory response responsible for the genesis of these diseases (Romeiu, 2005). Vitamin E was found to be positively associated with FEV_1 while carotenoids increase FVC (Schunemann et al., 2002). Supplementation of Vitamin E (15 mg /day) and Vitamin C (250 mg/day) in asthmatic children improved MMEF and PEFR (Romieu et al., 2002).

Greater prevalence of hypertension in Delhi

Hypertension is emerging as a major health problem in India, and the magnitude of the problem is much more in urban than in rural subjects (Gupta, 1997). Our study has shown that even the children are not spared from this problem. About 6% children of the city and 1.4% of controls were suffering from hypertension, and the girls were particularly vulnerable to this problem as 7.9% of city's girls had hypertension compared with 4.8% of the boys. Arterial hypertension is influenced by some non-modifiable and modifiable factors. Non-modifiable factors such as age, female gender, and family history of hypertension increase the risk of increased systolic and diastolic blood pressure. Among the modifiable factors, lower physical activity, body weight gain, excess sodium chloride intake (> 5-7 g/day), and alcohol consumption increase BP. Higher prevalence of hypertension has been noted in upper socio-economic groups in countries at a transitional stage of economics.

In the past few years there has been a perceptible change in the lifestyle of the urban children in India. They are depending more and more on fast food and aerated beverages, and their participation in sports and physical activities is declining. It is conceivable that all these factors are leading to greater prevalence of obesity and to hypertension in urban children especially in those coming from affluent section of the society. Besides lifestyle changes, high level of air pollution in Indian cities could be partially responsible for increased prevalence of hypertension in urban children. Study in Brazil has shown that increase in air pollution from vehicular traffic, especially of CO and SO_2, increases systolic, diastolic and mean ambulatory blood pressure and reduces heart rate variability (de Paula Santos et al., 2005). Similarly, exposure to fine particulate pollution ($PM_{2.5}$) has been shown to increase cardiovascular morbidity and mortality (Samet et al., 2000; Pope et al., 2002). The mechanism of air pollution-mediated hypertension is not clearly understood, but exposure to airborne pollutants has been shown to cause arterial vasoconstriction and changes in autonomic balance (Gold et al., 2000; Devlin et al., 2003). In essence, greater prevalence of high blood pressure among the children of Delhi could be attributed to changes in lifestyle along with high level of ambient air pollution.

One of the important fall- out of exposure during pregnancy to high air pollution level is reduced birth weight of the baby. Interestingly, SBP correlates inversely with birth weight, beginning in the first decade of life, and the relation becomes stronger with increasing age in adulthood (Law et al., 1993).

Prevalence of childhood obesity

Obesity during childhood is a matter of growing concern. The global prevalence of overweight in school children is 3.3%. Some countries and regions had considerably higher rates. Highest

prevalence of overweight in the developing world is found mainly in the Middle East, North Africa and Latin America. However, Africa and Asia had 2.5 – 3.5 times more underweight (wasting) children than overweight (deOnis and Blossner, 2000). The problem of overweight amongst preschool children in Asia was 2.9% in 1995. In the cities, however, the prevalence varied from 5% to 9% (Tee, 2000).

Obesity in school-going children is a problem of the more affluent, Western countries. For example, 20.7 % of the boys and 17.2% of the girls in third grade at Baltimore City, USA were obese (Jehn et al., 2006). In contrast, only 2.2% of adolescents aged 10-15 years of Sri Lanka were obese (Jayatissa and Ranbanda, 2006). In fact, underweight children are a major problem of the developing countries, particularly in the villages. Every second child under 3 years of age is underweight in West Bengal, India (Mustaphi and Dobe, 2005). The main cause is malnutrition and poor hygiene. Similarly, the prevalence of underweight among adolescents of Sri Lanka aged 10-15 years was 47.2% (Jayatissa and Ranbanda, 2006).

Perez-Padilla and co-workers (2006) have reported 9.7% of children and adolescents aged 8-20 years of Mexico City as overweight, as they had BMI >95th percentile of CDC growth charts. Obesity was related to male gender, asthma and passive smoking. Lacar et al., (2000) reported that 22.1% of Mexican-Americans, aged between 12-17 years were overweight (>95th percentile). These reports provide example of the influence of better life conditions on body weight: compared with only 9.7% of overweight children in Mexico city, 22.1% of Mexican children in the United States were overweight.

Health consequences of obesity in children

Children who are overweight may begin to experience health consequences during their youth as well as put themselves at risk for weight-related health problems later in life. Lung function is affected adversely by obesity especially in young people (Perez-Padilla et al., 2006). Overweight children have been found to have risk factors for cardiovascular disease, including high cholesterol, elevated insulin levels, and elevated blood pressure during childhood. One study showed that approximately 60% of overweight children had at least one cardiovascular risk factor, such as high cholesterol or high blood pressure; in comparison, only 10% of children with healthy weight had at least one risk factor. Additionally, 25% of overweight children had two or more risk factors (Freedman, 1999).

Other health consequences include Type 2 diabetes, sleep apnea (not breathing for at least 10 seconds during sleep), social consequences including poor self-esteem and social discrimination (Must and Anderson, 2003).

In addition to the health problems that they may experience during their youth, overweight children are at increased risk for various chronic diseases as adults (including hypertension, type 2 diabetes, and coronary heart disease). Overweight adolescents are at greater risk of becoming overweight or obese as adults (Whitaker, 1997). It has been seen that about one third of all severely obese adults were overweight children (Ferraro, 2003).

Maintaining a healthy weight during childhood and adolescence may reduce the risk of becoming overweight or obese as an adult. Therefore, children should be encouraged to keep up healthy eating habits, participate in physical activity on most (preferably all) days of the week.

TV watching and obesity

Hours of TV watching were found to be positively correlated with BMI, and the risk of overweight (Eisenmann et al., 2002). Logistic regression analysis has shown lower precedence of overweight among adolescents who watched TV for lesser period per week combined with frequent moderate to vigorous physical activity compared to those more addicted to television and less inclined to physical activity (Gordon- Larsen et al., 2002). The association between TV viewing and overweight was stronger in girls (OR = 2.45, 95% C.I. 1.51 – 3.97) than in boys (OR = 1.52 95% C.I. 1.08 – 2.14) (Gordon-Larsen et al., 2002). It is important to mention in this context that about 27.5% of adolescents aged 10-15 years of Sri Lanka watched television for more than 2 hours per day (Jayatissa and Ranbanda, 2006). One fourth of US teenagers (14 – 18 years old) watch television e" 4-hrs/school day.

Air pollution and child development

Exposure of pregnant women to elevated levels of PAHs including benz(a)pyrene is thought to be associated with reduced fetal growth (Perera et al., 2005). A comparative study of vitamin D status in 9-24 month old children of more polluted Mori Gate area of Delhi and less polluted Gurgaon was carried out by Agarwal et al., (2002). They found 54% reduction in vitamin D level in blood of the children residing at more-polluted Mori Gate, as compared with less-polluted Gurgaon. Absorption of ultraviolet –B (UVB) photons of sunlight by skin is required for vitamin D synthesis by converting 7-dehydrocholesterol to cholecalciferol (vitamin D_3).

Air pollution and the nervous system

About half of the world's children reside in the South and Southeast Asia. These regions are rapidly undergoing industrialization. It is generally believed that threats to children's health, both physical and mental, are increasing in the process (Suk et al., 2003). Human and animal studies have confirmed that brain is a target organ for several environmental pollutants. Developing brain is particularly vulnerable to toxic chemical insults, and such insults may have long-lasting or even irreversible developmental consequences (Winneke, 2005). Prominent among these neurotoxic chemicals are some heavy metals like lead and mercury, and polyhalogenated aromatic hydrocarbons (PHAHs) such as polychlorinated biphenyls (PCBs) and dioxins (Kilburn, 2000).

Air pollution is also known to cause brain damage (Calderon-Garciduenas et al., 2004). Central nervous system (CNS) develops in orderly, synchronized fashion in four steps viz. proliferation and migration of neurons and glial cells, neuronal differentiation, and myelinization. By the end of 12th week of gestation, brain development of the child goes in full swing. Brain damage during these early stages of CNS development gives rise to gross structural anomalies. The regulation of brain development is partly under hormonal control, and hypothalamic-pituitary-thyroid axis plays an important role in this regard (Porterfield, 1994). Hypothyroid conditions during pregnancy or in the neonatal stage, if left untreated, often results in cretinism associated with mental retardation. This is one of the mechanism by which chemicals interacting with the endocrine system may interfere with brain development and associated neurobehavioral dysfunction in the child.

Lead is an important neurotoxic substance found in abundance in urban air. In Europe, air lead level varies between 0.15 to 0.5 $\mu g/m^3$. It has been estimated that for each 1 $\mu g/m^3$ of lead in air

blood lead level becomes 19 µg/liter (WHO, 2000). Lead is present in urban house dust (5.9-127.9 µg/g in Germany), and surface soil and road/pavement dust (100-600 µg/g) [Brunekreef et al., 1981]. In addition to inhalation, diet is the single most important route exposure in children. Lead in drinking water from lead pipes in old houses may add substantially to the dietary lead exposure.

Children are more sensitive to lead because, on a body weight basis, their dietary intake, absorption, and total retention are markedly higher (Winneke, 2005). In addition, the pollutants can reach the brain easily from circulation, because the blood-brain barrier is not yet fully developed in children. Cross-sectional studies in 6-16-year-old children from six countries-China (Wang et al., 2002), Croatia (Prip-Majic et al., 2000), Mexico (Calderon et al., 2001), Pakistan (Rahaman et al., 2002), Saudi Arabia (Al Saleh et al., 2001), and the United States (Lanphear et al., 2000), however, have elicited conflicting results: four found significant and borderline negative associations between blood lead level and IQ and two found no effect. In contrast, significant negative association between blood lead and children's IQ has been obtained in more recent prospective studies (Wasserman et al., 2000; Schnass et al., 2006). A study in Rochester, New York is important in this context because it has demonstrated lead-related IQ deficits below the presumed critical level of 100µg per liter of blood (Canfield et al., 2003). The study found an average of 0.46-point deficit in IQ evaluated by Stanford-Binet intelligence test for each 10µg/liter of blood lead.

Besides IQ, an association between bone lead level and antisocial behavior and delinquency has been reported (Needleman et al., 1979). Like lead, mercury has been linked to neurobehavioral disorders in children, but the strength of evidence in favor the association is weak than that for lead (Winneke, 2005). Lead emissions from gasoline combustion have been a real threat for children in Southeast Asian countries. However, decline in blood lead level in children has been achieved in Thailand, Philippines, India and Pakistan after the introduction of unleaded gasoline in a few years back (Suk et al., 2003).

Prevalence of attention-deficit hyperactivity disorder

In the present study ADHD was diagnosed in 6.7% of schoolchildren of Delhi against 2.7% in controls, suggesting 2.5-times higher prevalence in Delhi. However, factors like stress which I smore prevalent inurban areas also needs to be considered. To our knowledge this is the first cross-sectional as well as comparative study on the instance of ADHD in school-going children of rural and urban India. In two previous reports in Delhi in the 1990's, 5% (Sidana et al., 1998) and 11.2% (Bhatia et al., 1991) children attending pediatric outpatients' clinics had been diagnosed with ADHD. Similar study in Kolkata found 15.5% ADHD cases in referred children attending pediatric hospital (Mukhopadhyay et al., 2003). The authors found 4-times more ADHD prevalence in boys than the girls, and the 'inattentive' subtype was predominant. These observations are consistent with the present findings. Compared to these studies on referred cases, however, our study was cross-sectional, and still we got ADHD prevalence as high as 6.7%. It implies that the problem has probably increased in the intervening years. Present findings are also compatible with the reports from USA, where ADHD prevalence in school-aged varies between 2% to 18% in a community (CDC, 2005). A recent study in Texas has reported 5.44% ADHD in elementary schoolchildren (Schneider and Eisenberg, 2006). CDC (2005) has estimated that 4.4 million U.S. children aged 4-17 years had a diagnosis of ADHD in 2003; of these 2.5 million were under medication for the disorder. In Taiwan, 9.9% primary schoolchildren had this problem and 3.3-times higher prevalence was found in boys than in girls (Wang et al., 1993). Besides air pollution, the stress of urban living

could have played a role in eliciting greater prevalence of ADHD among the schoolchildren of Delhi.

Health impact of ADHD

ADHD has a significant impact on multiple domains of health-related quality of life (HRQL) in children and adolescents. They have impaired learning ability, decreased self-esteem, social problems, family difficulty and potential long-term effects. In addition, the problems of children with ADHD have a significant impact on parents' emotional health and parents' time to meet their own needs, and they interfered with family activities and family cohesion (Klassen et al., 2004). Recent study has shown that adolescent with ADHD are more prone to all kind of accidents (Brook and Boaz, 2006).

Etiology and possible association with air pollution

It has been hypothesized that ADHD is due to noncortical dysfunction that manifests early in ontogeny (Halperin and Schulz, 2006), but the precise etiology of ADHD is currently unknown. Stress could be a risk factor, because increased pressure for school performance is an important contributing factor for ADHD (Schneider and Eisenberg, 2006). Maternal smoking is another independent risk factor for ADHD in offspring (Linnet et al., 2003; Laucht and Schmidt, 2004; Button et al., 2005). Children of these mothers also exhibit antisocial behavior (Button et al., 2005). By analogy, chronic inhalation of highly polluted air of Delhi by the would-be mothers appears to be a risk factor for ADHD in their offspring.

Importance and significance of the study

Since most of the airway diseases take a long latent period to develop, prevalence of respiratory symptoms, lung function tests, and identification of cellular changes in the airways through sputum cytology are immensely helpful to identify the children at risk so that the disease can be diagnosed at an early stage and medical intervention can be initiated for better control of the disease. The tests that have been used in this study are simple, non-invasive, cost-effective and highly sensitive. Therefore, they are ideally suited for biomonitoring of health effects of air pollution in the developing countries like India.

One of the limitations of this study is that the pollution exposed and control population had a major difference of being urban and rural background respectively. Besides air pollution, there could be several other factors related to lifestyle that could have influenced the observed changes in outcome variables such as obesity, hypertension, blood profile and behavior of the children. These possibilities need to be taken into consideration while exploring the health impact of air pollution. Therefore the findings of the present study and the conclusions made thereof require further confirmation by follow up studies with appropriate study design.

CHAPTER-9.0

SUMMARY AND RECOMMENDATIONS

9.1 SUMMARY

Health hazards associated with chronic exposures to urban air pollution are now well recognized. Although air pollution affects the population in general, children are particularly vulnerable to toxic effects of air pollution because of more outdoor exposures, greater intake of air in relation to body weight, lower breathing zone where particulate concentration is higher and, most importantly, a child's underdeveloped immunity. Air pollution-related health effects ranged from low birth weight, reduced lung development and lung function to behavioral alterations. Compared with the developed nations, however, very little is known about the health effects of urban air pollution on children's health in developing countries including India. One of the main objectives of Air Act is to protect human health from air pollution. Keeping this in mind Central Pollution Control Board initiated a detailed study on health impact of air pollution on children with Chittaranjan National Cancer Institute. The study was carried out through questionnaire survey and study of detailed physiological parameters. The major findings of the study are summarized as below:

9.1.1 Measurement of ambient air quality of Delhi

(a) Mean concentration of total suspended particular matter (SPM) in Delhi's air during 2002-2005 was 370 µg/m3 in residential areas, 396 µg/m3 in industrial areas, and 514 µg/m3 in traffic intersection point at ITO.

(b) Mean concentrations of the respirable suspended particulate matter (RSPM, particulate matter with less than 10 µm diameter, PM10) during this period were 142, 165, and 250 µg/m3 in residential, industrial, and traffic intersection point respectively.

(c) Mean concentrations of sulfur dioxide (SO2) and nitrogen dioxide (NO2) in Delhi's air during 2002-2005 were 10 and 47 µg/m3 respectively. In the control areas the concentrations of SO2 and NO2 were 5.6 and 30.3 µg/m3 respectively. The levels of these two pollutants were within the Standard in Delhi as well as in control areas.

(d) A small decline in the concentrations of SPM and RSPM in ambient air has been recorded in residential areas of Delhi during 2002-05.

(e) The average concentration of benzo(a)pyrene in ambient air of Delhi was 3.70 ng/m3 during December 2004 and January 2005. The concentration was highest at ITO (7.31 ng/m3).

(f) Benzene levels were 7.8 µg/m3 in residential areas of Delhi in 2004. Highest concentration was found in traffic intersection point at ITO.

9.1.2 Prevalence of respiratory and associated symptoms

(a) The prevalence of respiratory and associated symptoms was investigated in 11,628 children from 36 schools in Delhi and 4536 control children from two schools in Uttaranchal and 15 from rural West Bengal. The children were aged between 4 and 17 years, and 55% of them were 12-14 year old. Two-third of the children was boys, and one-third was girls. Respiratory symptom data were collected through specially designed structured questionnaire based on three validated questionnaires of BMRC, ATS-DLD-78-C and IUATALD.

(b) Upper respiratory symptoms (URS) like sinusitis, running or stuffy nose, sneezing, sore throat and common cold with fever were 1.8-times more (23.1% vs. 14.6%) prevalent in Delhi than in controls, and the girls suffered more than the boys.

(c) Children in Delhi had 2-times more (17 % vs. 8%) lower respiratory symptoms (LRS) such as frequent dry cough, sputum-producing cough, wheezing breath, breathlessness on exertion, chest pain or tightness and disturbed sleep due to breathing problems. Thus, compared with control, Delhi's children had 1.8- times more URS and 2-times more LRS suggesting higher prevalence of underlying respiratory diseases.

(d) Prevalence of current asthma was present in 4.6% children of Delhi against 2.5% of controls. Similarly, the instance of physician-diagnosed asthma was 2 times more in Delhi (1.7 vs. 0.9%).

(e) About 15% of Delhi's children had frequent eye irritation compared with only 4% in controls. Similarly, Delhi's children had significantly higher prevalence of frequent headache (27.4 vs. 11.8%), nausea (11.2 vs. 5.6%), and palpitation (7.2 vs. 3.3%) and fatigue (12.9 v. 6.7%).

(f) Respiratory and associated symptoms were most prevalent in children from low socio-economic status, and least in children from families with high socio-economic background.

(g) The symptoms were more prevalent in children during winter when PM_{10} level in air is highest in a year, and lowest during monsoon when particulate air pollution level is lowest, suggesting a positive association with particulate air pollution.

9.1.3 Effect of Delhi's air pollution on children's lung function

(a) Lung function test was conducted in schoolchildren aged 9-17 years by portable spirometer following the protocol of American Thoracic Society. A total number of 2245 control and 5671 Delhi's children successfully completed the test.

(b) The results showed reduction of lung function in 43.5% schoolchildren of Delhi compared with 25.7% in control group. Delhi's children had increased prevalence of restrictive (20.3% vs 14.3% in control), obstructive (13.6% vs. 8%), as well as combined (both restrictive and obstructive) type of lung functions deficits (9.6% vs. 3.5%).

(c) Lung function reduction was more prevalent in girls than the boys both in rural and urban settings. In Delhi, 51% of the girls had reduced lung function compared with 39.8% of age-matched boys. In control group, 28.1% of the girls had lung function deficits compared with 24.4% of the boys.

(d) The prevalence of lung function reduction in Delhi was highest (44.9%) among schoolchildren in the age group of 15 – 17 years. Children belonging to 9-11 year and 12-14 year age group had 44.5% and 41.7% prevalence of lung function deficits respectively. On the other hand, highest prevalence of lung function reduction in control group (29.6%) was found in 12-14 year age group, followed by 26.8% in 15-17 year-old, and 23.2% in 12-14 year-old children.

(e) Besides higher prevalence, the magnitude of lung function impairment was much more in Delhi. For example, 7.3% schoolchildren of Delhi had severe lung function deficits compared with 2.2% children in control group.

(f) Prevalence of lung function reduction in schoolchildren varied considerably with season. In control group, prevalence of lung function reduction was highest during winter (32.9%)

when the particulate pollution level in ambient air was highest. Conversely, lowest prevalence of lung function deficits in schoolchildren was recorded in monsoon (19.9%) when the breathing air is cleanest. In Delhi, however, high prevalence of lung function deficits was observed both in winter and summer (52.7% in both seasons), while a much lower prevalence (39.9%) was observed in monsoon. The difference in the prevalence of lung function deficits between winter/summer and monsoon in Delhi was significant ($p<0.05$).

(g) Lower SES had greater percentage of children with reduced lung function.

(h) Exposure to environmental tobacco smoke (ETS) at home due to smoking habit of any member of the family increases the possibility of lung function deficits in children. For example, 50.6% of Delhi's children exposed to ETS had lung function deficits compared with 40.9% non-exposed children. Similarly in control group, 27% children exposed to ETS and 21.3% non-exposed children had lung function deficits.

(i) After controlling potential confounders like season, socioeconomic conditions and ETS, PM_{10} level in ambient air was found to be positively associated with restrictive (OR= 1.35, 95%CI 1.07-1.58), obstructive (OR=1.45, 95% CI 1.16-1.82), and combined type of lung function deficits (OR= 1.74, 95%CI 1.37-2.71) in children.

(j) Based on BMI data, 5.4% children of Delhi enrolled in this study were overweight against 2.4% children in control ($p<0.001$). Besides, 9% of Delhi's children were at risk of being overweight compared with 4.4% children in controls ($p<0.001$). On the other hand, the prevalence of underweight children was greater in the control group. The problem of overweight was most prevalent in children aged between 9 and 11 years in Delhi and 12-14 years in control.

(k) BMI was shown to have profound influence on lung function. Overweight and underweight children had poor lung function than children with normal weight. For instance, 55.6% of overweight children of Delhi had decreased lung function compared with 39.3% children with normal body weight. Delhi's children who were at risk of being overweight demonstrated 48% prevalence of lung function deficits. Underweight children also had higher rate of reduced lung function in Delhi as well as in control group. Thus, children with excess or subnormal body weight appeared to be more prone to lung function deficits.

9.1.4 Assessment of cellular lung reaction to Delhi's air pollution

(a) Sputum samples from 250 school children aged between 13-15 years, 100 (boys 65, girls 35) from control group and 150 from Delhi (boys 98, girls 52) were analyzed. Altogether, 46 sputum sasmples of control children (46% of total) and 35 from Delhi's children (25% of total) were discarded because they were not representative samples of the airways and alveoli. Finally, 54 samples from control and 125 from Delhi's school children were cytologically and cytochemically analyzed and the results were compared.

(b) Microscopical analysis revealed that the sputum samples of Delhi children were more cellular than that of controls: 58.8 cells/hpf were found in the sputum samples of Delhi's children in contrast to 37.2 in the control group. Compared with control children, therefore, Delhi's children had 58% more cells in their sputum ($p<0.05$).

(c) The major cell type in sputum of both control and Delhi children were neutrophils, the

number being higher in Delhi. The number of neutrophils per hpf was 42.2 in Delhi and 30.6 in the control group ($p<0.05$), which may suggest greater prevalence of pulmonary infection and inflammation in the city.

(d) The percentage of eosinophils was also higher in the sputum samples of Delhi's children (3.2% vs. 1.7%) than in control. The rise in eosinophil number is an indication of underlying allergy and hypersensitivity response. Therefore, a greater prevalence of airway allergy may be envisioned among the school children of Delhi.

(e) The mean number of alveolar macrophages (AM) per high power field in Delhi's children was 5.2 in contrast to 1.7 AM per hpf in control. Hence, school children of Delhi had 3.1 times more AM in their sputum. Marked increase in AM number signifies greater exposure to particulate pollution as AM represents the first line of cellular defence against inhaled pollutants.

(f) Sputum of Delhi's children contained 4-times more iron-laden macrophages (siderophages) than controls (0.4 vs. 0.1 siderophage per high power field, $p<0.001$). Abundance of siderophages in lungs may indicate covert pulmonary hemorrhage among a section of school-going children of Delhi.

(g) Changes in the sputum cytology among the school children of Delhi positively correlated with ambient PM_{10} level in Spearman's Rank Correlation, suggesting a close relationship between chronic exposure to Delhi's particulate pollution and cellular changes in the lung ($p<0.001$).

(h) Negative correlation ($p<0.05$) was found between total cells in sputum and spirometric lung measurements like FVC, FEF_{25-75} and PEFR values, thereby indicating that the increase in inflammatory cell population in the airways plays a key role in the development of restrictive type of lung function deficits, and small airway obstruction.

(i) In essence children chronically exposed to high level of ambient air pollution in Delhi are at a higher risk of inflammation and covert hemorrhage in the lungs that may be lead to lung function deficits.

9.1.5 Hematological and vascular changes associated with air pollution exposure

(a) Arterial blood pressure was measured in 1082 school children of Delhi and 726 of controls. The prevalence of hypertension in children was 6.2% in Delhi compared with 2.1% in control. Thus, Delhi's school children have 3-times more incidence of high blood pressure.

(b) Hypertension was more prevalent among girls than the boys: 7.9% of Delhi's girls had hypertension against 4.8% of boys. The prevalence of hypertension increased progressively with age, highest being in the age group of 15 – 17 years.

(c) BMI was positively associated with hypertension: the prevalence of hypertension was lowest (1.8%) in underweight children and highest (16.7%) in obese group.

(d) The absolute numbers of monocytes and basophils were significantly ($p<0.05$) increased in peripheral blood of Delhi's children as compared to that of control.

(e) Rise in hemoglobin concentration and platelet number in Delhi's children were positively

correlated with PM_{10} levels.

(f) Examination of peripheral blood smears revealed abundance of 'target' cells in 9.8% of Delhi's children against 4.3% of controls, implying a greater risk of liver problem in the former.

(g) Higher prevalence of toxic granulation in neutrophils (21.0% vs. 8.7%) and circulating immature neutrophils (11.3% vs. 6.5%) was found among the children of Delhi, which suggests greater risk of infection and inflammation.

(h) In essence school children of Delhi had three times more prevalence of hypertension along with several quantitative and qualitative in peripheral blood that indicates greater possibility of infection and inflammation.

9.1.6 Behavior and activities of the children

(a) Delhi's schoolchildren had 2.5-times more Attention-Deficit Hyperactivity Disorder (ADHD) prevalence than age-and sex-matched controls (6.7% vs.2.7%, $p<0.05$). Boys had a remarkably higher prevalence of ADHD than the girls both in Delhi and in control. Boys: girls ratio of ADHD prevalence was 4.5:1 in Delhi (9% vs. 2%) and 5:1 in control (3.4% vs. 0.7%), and children from medium socio-economic status had the greatest prevalence (8.0%) of ADHD. Among the ADHD children of Delhi, 3.6% had inattentive type, 2.4% had hyperactive-impulsive type, and 0.7% had combined type of ADHD. In the control group, the relative proportions of these three categories were 2.1%, 0.4%, and 0.2% respectively.

(b) Active participation in sports was more prevalent among control children than in Delhi as 80 % of control children regularly participated in sports compared with 58% schoolchildren of Delhi ($p<0.05$). Boys preferred outdoor games to indoor games, while girls showed an inclination towards indoor games.

(c) Delhi' children showed more interest in creative activities such as participation in music (26% vs. 14.4%), drawing or painting (8.2% vs. 3.6%) and dance (7.9% vs. 1.6%) than children of the control group, and the differences were statistically significant ($p<0.05$).

(d) The most preferred pastime of children while at home was watching television. About 54% of Delhi's schoolchildren watched television 1-3 hours per day regularly including school days compared with 45% of control. The boys watched television more than the girls (60.0% vs. 43.1%, $p<0.05$) in Delhi. In contrast, girls of the control group were more addicted to television than the boys (48.0% vs. 43%). Another 12% of Delhi's children spent 1-2 hours per day with the computers and video games. The percentage of computer/ video games users was negligible (0.7%) in the control group.

(e) Reading of books other than schoolbooks, and periodicals was the next preferred pastime for the children. Reading habit was much more prevalent in control group where 40% children had the habit against 24% of city's schoolchildren ($p<0.001$). Girls were more avid readers than the boys in Delhi (28.4% vs. 21.4%, $p<0.05$), but the reverse was true in controls. About 10% of Delhi's children and 17% of control had pastime other than watching television and reading books, of which listening to music was most important (9.8% in Delhi and 16.6% in control).

9.2 RECOMMENDATIONS

1. Children's health is most acutely affected by air pollution exposures. Therefore, potential adverse effects of air pollution on fetus, infant and child should be the main consideration while setting up standard for an air pollutant as well as during revision of existing standards, and there should be a sufficient margin of safety.

2. Epidemiological studies have identified particulates, especially $PM_{2.5}$, as the most harmful air pollutant in South Asia. It is recommended that regular monitoring of this pollutant may be carried out in the country because of its harmful effect on human health.

3. Children generally spend two-third of their time indoor either at home or at school. Therefore, indoor air quality seems to have significant influence on children's health.

4. Ozone is one of the most harmful air pollutants. Children are particularly susceptible to adverse health effects of ozone. Considering its toxicity, regular monitoring of ozone in Delhi and elsewhere in the country is recommended.

5. Ozone is a secondary pollutant. It is not directly emitted from the sources, but formed via complex chemical reactions between oxides of nitrogen, hydrocarbons and sunlight. As a result, ozone levels tend to be highest in the afternoon. Teachers and parents/guardians should be enlightened in the matter.

6. Considering the high prevalence of lung function deficits among schoolchildren of the city, all children aged 9 years and above in Delhi should undergo lung function test at least once in a year, and those having lung function deficits should be monitored at regular intervals. The medical facilities at the schools should include a separate unit for respiratory health, and every unit should be equipped with a spirometer and trained technicians. Where the schools' own medical facilities are absent, the appropriate authority should make alternative arrangements.

7. In view of the high percentages of children with hypertension in Delhi, blood pressure of the children should be checked regularly at the schools' medical facilities or elsewhere at least once in a year. More frequent follow up should be undertaken for those children with hypertension and/or obesity. Since hypertension affects some organ functions, medical conditions such as enlarged heart and abnormalities in kidney and eye functions should also be checked.

8. Since parental smoking has been found to be associated with respiratory problems in their children, the school authority should impress upon the parents/guardians to quit smoking for the sake of the child during parent-teacher meetings.

9. Diesel exhausts contain fine and ultrafine particles that are very harmful particularly for the children. Therefore a child's exposure to diesel fumes should be avoided as far as practicable. In view of this, school buses and other vehicles used for transportation of the school children everywhere in the country should be changed from diesel to cleaner fuel like CNG or LPG.

10. The Government should recognize childhood obesity as a significant problem in Indian cities. It requires intervention by family-based and school-based multi component programs

that include promotion of physical activity, parents' awareness, behavioral counseling, and nutrition education in the line of recommendations of different dietic associations.

11. Fast food and aerated beverages add excess calorie to the body. Delhi already has a large number of overweight and obese children. Obesity is a risk factor for several diseases including problems of the heart and lung.

12. High intake of fresh fruit and vegetables has beneficial effect on overall health as well as functioning of the lungs.

13. In general, city and land use pattern should encourage designing and redevelopment of communities to promote mass transit, carpooling, pedestrian walkways, and bicycle use.

14. While allotting sites for new schools and child care facilities, due considerations should be given on their distance from roads with heavy traffic and other sources of air pollution. In essence, they should be away from hot spots of localized pollution.

15. Information about air pollution in the country- its potential sources, health consequences and possible ways of abatement should be disseminated among the children. They are quick learners and their youthful exuberance can be utilized for spreading the message of environmental safety among the masses to garner public support that holds the key to success for every pollution mitigation projects.

CHAPTER-10.0

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CHAPTER-11.0

GLOSSARY

Abatement	A process to reduce, remove, or discontinue a nuisance disease vector, or pollutant
Acute	Short and severe
Acute illness	A brief but serious episode of illness
ADHD	It is a neurological disorder, usually diagnosed in childhood which manifests itself with symptoms such as hyperactivity, impulsivity or inattention
Adverse reaction	Undesirable or unwanted side effect as a consequence of a preventive, diagnostic, or therapeutic procedure
Aeroallergens	Airborne antigens like pollen, house dust, mite etc. that cause allergic response in sensitive individuals
Aerosol	Atomized particles suspended in the air that are small having diameters ranging from 1/100 μm to 1μm
Air	The gaseous mixture which makes up the atmosphere surrounding the earth. It consists of approximately 78% nitrogen, 20% oxygen, 0.04% carbon dioxide and traces of ozone, neon, helium etc., and a variable amount of water vapour
Air pollution	Detoriation of the quality of air for the presence of impurities
Air quality standards	Maximum allowable concentration of air pollutants. Concentrations that exceed these limits are considered harmful Primary standards are those needed to protect public health. Secondary standards protect against other effects such as damage to materials
Allergen	Substance or agent that causes allergy
Alveoius	The terminal sac like structures of the lung, which provide vast surface area for gaseous exchange. A large number of blood vessels surround them
Allergy	An altered or exaggerated susceptibility to various foreign substances which are harmless to great majority of individuals. Asthma is an allergic condition
Alveolar macrophages	A type of defense cell present inside the lungs. The cells readily engulf inhaled particles and microorganisms
Ambient	Surrounding conditions of the environment, usually referring to air quality and pollutant levels
Ambient level	The level of pollutant in the general ground level atmosphere, i.e. to which people may be exposed

Antibody	Specific proteins produced in the blood as a reaction to foreign substance. Antibodies bind to a specific antigen that elicits its production causing its destruction. Thus antibodies provide protection against infectious disease
Antigen	It is a substance that stimulates an immune response, especially the production of antibody.
Aplastic anemia	A type of anemia caused by the failure of the bone marrow to generate new blood cells of all types.
Asthma	Intermittent narrowing of the airways causing shortness of breath and wheezing. Usually the muscle of the bronchi walls contract and excess mucus collects restricting flow of air
Bacteria	A group of micro-organisms some of which are pathogenic to man
Benign	Innocent. A term used to denote opposite of malignant
B-lymphocyte	A subpopulation of lymphocytes, which produces antibodies
Bilirubin	A pigment derived from the breakdown of hemoglobin from red blood cells
Biomarker	Observable endpoints indicating the process leading to the genesis of a disease.
Biomarker of exposure	Measure of a parent compound or the unique response attributable to that compound in biological samples following exposure
Biomarker of effect	Quantifiable response of an organism that can directly be linked to the exposure
Biomarker of susceptibility of an environmental toxicant	The measure of the capability of an individual to respond to exposure
Bronchiotasis	Abnormal widening of the larger airways in the lung (bronchi) causing persistent cough with large amount of sputum
Bronchi	The two tubes into which trachea divides at its lower end
Bronchitis	Inflammation of the bronchus; may be acute or chronic
Cilia	Fine hair like strands. Cilia line the airways and trap foreign particles as the air pass through them
Carcinogen	A cancer causing substance
Carcinogenesis	The production of cancer or malignant cells

Cancer	Abnormal, unorganized and unregulated growth of cells in an organism
Cardiovascular disease	One or all of the diseases of the heart and blood vessels
Cardiac	Pertaining to the heart
Case-Control Study	A study of persons with a particular disease in comparison to a reference or control group, which is otherwise similar to the study group
Cell	The building blocks of all living organism.
Cellular immune response	Type of immune response characterized by generation of cytotoxic T- cells.
Cholesterol	A fatty material found in tissues and blood
Chromosome	Thread-like bodies found in cell nucleus which carry hereditary factors,the genes. The number being constant in each species e.g. in man 46 in each cell except in mature ovum and sperm where the number is 23
Chronic	Lingering, lasting, opposed to acute
Chronic Disease	An adverse health condition lasting for 3 months or more
Confidence Interval (CI)	The calculated range of numbers in a data set which, with a specified degree of probability (e.g., 95%), includes the true values of variables such as the mean, proportion, or rate of that set of numbers. The upper and the lower boundaries of the confidence interval are called confidence limits.
Confounding Variable (Confounder)	A factor or variable that can potentially cause or prevent the outcome or disease being studied (the dependent variable), and must be taken into account or it will prevent reaching a conclusion regarding the impact of *independent variable*, or hypothesized cause of the outcome disease being investigated
Chronic obstructive pulmonary disease	Progressive damage of the lungs usually leading to shortness of breath and wheezing. (often mean chronic bronchitis and emphysema)
Cost-Benefit Analysis	A system of analysis that attempts to weigh the cost of some policy such as pollution control, directly against the economic gain.
Cost-Effectiveness Analysis	A form of economic evaluation where all costs are expressed in monetary terms, but the consequences are expressed in non-monetary terms, such as life years gained, cases detected, or cases prevented.
Cough	A reflex in response to irritation or infection in the respiratory tract, which helps to clear irritant or blockages from the airways.

Cross-sectional study	A study of the relationship between diseases with other variables of interest in a defined population at a particular point of time. This establishes the disease prevalence and the presence of the characteristic being studied (e.g., smoking or toxic exposure) in the diseased compared to the non diseased person in the group.
Cytology	Microscopic study of the cells
Dependent Variable	An outcome or manifestation we seek to account for by the influence of an independent variable(s) or intermediate factor(s) in a hypothesized relationship being studied
Developed and Developing Countries	Countries are defined as to their level of development by per capita GNP by the World Bank. Those with per capita GNP of $765 or less in the year 1998 are defined as *low income economies* or least developed countries. Those between $765 – 3,035 and $ 3,035 – 9,386 are considered lower and upper income developing countries respectively. Countries with per capita GNP of $ 9,386 or more are defined as developed (*high income economies*)
Disease	Disease is physiological and psychological dysfunction
DNA	Deoxyribonucleic acid. It is present in cell nucleus. Mitochondria also contains some DNA. It carries genetic information from parents to their progeny and therefore accounts for the continuity of species
Dyspnea	Difficult or labored breathing
Elastase	A connective tissue degrading enzyme
Emission standards	Legal limits of the quantities of air pollutants permitted to be emitted from the exhaust of a source
Emphysema	Alveolar distension often accompanying chronic bronchitis. A common problem encountered in smokers
Environment	All factors external to the individual that may affect its health behavior or well-being. Includes physical, biological, social economic and other factors
Enzyme	Protein molecule which acts as a catalyst in the chemical reactions within the body
Eosinophil	A type of white blood cell containing granules staining in acid dyes such as eosin. They form 2-5% of white blood cells in man, but increased manifold in allergy and parasitic infections
Epidemiology	The study of the distribution and determination of health and its disorders
Epithelium	The surface layer of cells below which lies the basement membrane

Erythrocyte	Hemoglobin-containing red cells present in blood
Etiology	The origin or causes of a disease, health condition or risk factors
Exfoliation	The scaling off of tissues in layers
Expiration	The act of breathing out air from the lungs
Exposure	Quantity and duration of contact between a person and a harmful agent. Exposure may be continuous, periodic or episodic
Extrapolation	The prediction of points on a graph outside the range of observation
FEV_1	Forced expiratory volume in one second. The volume of air that can be expired in one second
Fibrosis	The formation of excessive fibrous tissue in a structure
Fungus	Plants including microscopic organisms capable of producing disease in man.
FVC	Forced vital capacity. The volume of air expired forcefully expiration following maximum inspiration
Gene	The basic unit of heredity composed of molecules of deoxyribonucleic acid (DNA) and located on the chromosomes of each cell. Genes govern every single structural and functional characteristic of an individual
Giand	An organ or structure capable of making internal or external secretions
Goblet cells	Secretory cells, shaped like a goblet, found in the mucous membrane
Granulocyte	Any cell containing granules, e.g. neutrophils, eosinophils and basophils
Green house effect	The effect produced by certain gases such as carbon dioxide or water vapor that causes warming of the earth's atmosphere by absorption of infrared radiation.
Health	WHO states "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"
Hemoglobin	The respiratory pigment in red blood cells. It is composed of iron containing substance "heme" combined with protein globin.
Hemorrhage	Escape of blood from a vessel.
Hemosiderin	A form of storage iron in tissue.
Hygiene	The science dealing with the maintenance of health.
Hyperactivity	Excessive activity

Hyperplasia	Excessive formation of cells
Hypersensitivity	Type of immune response, which has an adverse impact. Also known as allergy
Immune response	Reaction of the body's defense system to insults by foreign substances Lymphocytes, macrophages, neutrophils, eosinophils and basophils play important role in mediating immune response
Immune system	A network of organs and cells responsible for generating immune response
Immunity	Individual's resistance to infection. Resistance to a disease by the host may be natural, passive or acquired
Infection	Invasion of the body by disease-causing organism, with or without manifestation of the disease.
Inhalation	The breathing in of air or other vapor
Inhalable particles	Particles which may be breathe in. "Inhalability" is defined technically as the orientation – averaged aspiration efficiency for the human head (also termed inspirable)
Inspiration	Drawing of air into the lungs
Inflammation	The reaction of living tissue to injury, infection or irritation, characterized by pain, swelling, redness and heat
Intracellular	Within the cell, opposite to extracellular
Leucocytes	White blood cells engaged in body's defense against infection
Leukemia	Cancer in bone marrow cells
Lipid	Fat
Lungs	The two main organs of respiration which occupy the greater portion of the thoracic cavity
Lung function test	A test used to detect airflow problems in the lungs
Lymphocytes	A kind of white blood cells that protect the body against diseases by direct killing or by producing antibodies
Macrophages	Phagocytic cells widely distributed in the body. Plays important role in body's defense, disposal of debris, and repair of the injured tissues
Metaplasia	A reversible cellular change in which one cell type is replaced by another adult cell type

Mucus	A clear, sticky lubricant secreted by glands in the mucus membranes that line the body cavity
Mutagen	An agent that produces mutation, ie. genetic change
Mutation	A change or alteration in the genes of a living cell. As a result the characters of the cell change
Mortality	The death rate; the ratio of the total number of deaths to the total population
Mucosa	A mucous membrane
Natural killer cells (NK)	Type of leukocytes that preferentially inactivate virus-infected or cancerous cells
Neutrophils	Granular white blood cells with the properties of chemotaxis, adherence to immune complexes and phagocytosis: also produce antimicrobial substances including oxidants and proteases
Particulate matter	Particles of solid or liquid matter in the air, including nontoxic materials (soot, dust, dirt), heavy metals (e.g., lead), and toxic materials (as asbestos, suspended sulfates, nitrates)
Pathogen	An organism, toxin, or other agent capable of causing human, animal, or plant disease
Photochemical smog	Smog caused by the formation of particles due to a chemical reaction driven by sunlight
PM_{10}	Particulate matter less than 10 μ m aerodynamic diameter
Pollutant	Any substance that renders the atmosphere or water foul or noxious or a health hazard.
Pollution	The impairment of the quality of some portion of the environment by the addition of harmful impurities
ppb	Parts per billion, 1 part by volume in 109
ppm	Parts per million, 1 part by volume in 106
Prevalence (Rate)	The total number of all individuals who have a disease including new and previous cases in a given population at a designated time (point prevalence) or time period (period prevalence), expressed usually as a rate per 1000 persons during a year
Relative Risk	The relation of risk of disease or death among the exposed, as compared to that of an otherwise comparable nonexposed population group
Respirable particles	Particles which can penetrate to the unciliated regions of the lung

Risk factors	Those characteristics or behavioral pattern known to increase the risk of disease.
Sampling	A sample is a subset of population selected to be as representative as possible of the total population. A sample may be random or non-random, representative or non-representative. The major categories include: *cluster sample*, a group of persons not individually selected, i.e., all person in city block; *grab sample*, A simple survey among people who happen by or show up at a service offered, such as a street fair, from which no general conclusions can be drawn; *probability (random) sample*, where all individuals have an equal or known chance of being selected, or if stratified, subgroups may be assigned greater weight in the design; *simple random sample*, All person in the group are assigned a number, and the selection of the sample is according to a random numbers table, until the needed sample size is achieved; *stratified random sample*, where the population is divide into subgroups, and each of these is sampled randomly; and *systematic sample*, where the sample is selected on the basis of a predetermined method, such as alphabetic order or birth dates
Secondary particle or aerosol	Particles may be formed when two volatile and non-condensable vapor species react to give rise to a product with a very low vapor pressure. Such a product is described as a secondary particle to distinguish it from those arising from the reaction of liquids or solids
Sinusitis	Inflammation of any of the sinuses leading to headache and tenderness in the face
Spirometer	An instrument used to measure the volume (in litres) that one can inhale or exhale over a period of time .The results can indicate whether the airways are narrowed due to lung disease
Smog	A term often used to describe a mixture of smoke and fog. Also used to describe photochemical air pollution,or smoky fog the word is used loosely to describe visible air pollution
Smog precursor	An air pollutant that can undergo chemical reaction in the presence of sunlight
Smoke	Particulate matter, <15μm diameter, derived from the incomplete combustion fuels. Or an aerosol that is usually produced by combustion or decomposition process
Stress	Response to challenge (“fright- fight- flight”) of changes in the status quo of a individual causing overt or hidden psychological pressure that may manifest themselves in overt psychological symptomatology or in physical illness.
Suppressor T-cells	A subpopulation of T- lymphocytes that suppresses immune response

Susceptible	A person with insufficient resistance or with associated risk factors to a particular pathogenic agent or process, so that there is real danger to this person contracting the specific disease if or when exposed to the agent
Symptom	An organic or physiologic manifestation of a disease of which the patient is usually aware and complains of it
Synergism	A condition in which a whole effect is greater than the sum of its parts
Target cells	Abnormally flat red cells with a central mass of hemoglobin surrounded by a ring of pallor and an outer ring of hemoglobin. They are commonly associated with liver disease, impaired or absent splenic function (hyposplenism) and hemoglobinopathies
T-Lymphocytes	A subpopulation of lymphocytes that matures under the influence of thymus.
Threshold level	The minimal dose of a toxic substance that causes harmful effects.
Total suspended particulate matter volume	A term describing the gravimetrically determined mass loading of air borne particles, most commonly associated with use of the US high air sampler in which particles are collected to filter for weighing.
Toxic substance	Any substance whose physiological action is harmful to health.
Tuberculosis	A bacterial infection *(Mycobacterium tuberculosis*) that most often affects the lungs. Usually transmitted by airborne droplets
Urbanization	A demographic process characterized by movement of people from rural to urban settlements
Ultra fine particles	Particles of less than 100nm diameter
Virus	Essentially a capsule of protein that contains either DNA or RNA as genetic material. There is debate as to if it is a living organism or a chemical entity. However, it has powers of reproducing when it invades a living cell.

ABBREVIATIONS USED

ADHD	Attention-Deficit Hyperactivity Disorder
ALL	Acute lymphoblastic leukemia
AM	Alveolar macrophage
AML	Acute myeloblastic leukemia
ARIs	Acute respiratory infections
ATS	American Thoracic Society
BAL	Broncho-alveolar lavage
B(a)P	Benzo(a)pyrene
BMI	Body mass index
BMRC	British Medical Research Council
CNG	Compressed Natural Gas
COPD	Chronic obstructive pulmonary disease
CO	Carbon monoxide
COx	Oxides of carbon
COPD	Chronic obstructive pulmonary disease
CDC	Centre for Disease Control
CD	Cluster determinant
CPCB	Central Pollution Control Board
95%CI	95% confidence interval
CNCI	Chittaranjan National Cancer Institute
CNS	Central nervous system
CRP	C-reactive protein
CSE	Centre for Science and Environment
CVD	Cardiovascular disease
DSM	Diagnostic and Statistical Manual of conduct disorders
DBP	Diastolic blood pressure
DEP	Diesel Exhaust Particles
ESMAP	Energy Sector Management Assistance Program
et al.	And others
ETS	Environmental tobacco smoke
FEV_1	Forced expiratory volume in one second
$FEF_{25-75\%}$	Forced expiratory flow between 25 and 75 percent of the vital capacity
Fig.	Figure
FVC	Forced vital capacity
GEEs	Generalized estimating equations
GIS	Geographical Information System
IARC	International Agency for Research on Cancer
IAQ	Indoor air quality
IL-8	Interleukin-8
IL-6	Interleukin-6
IUATLD	International Union against Tuberculosis and Lung Disease
LPG	Liquid petroleum gas

LRS	Lower respiratory symptoms
LRTIs	Lower respiratory tract infections
MMEF	Mid maximal expiratory flow
NAAQS	National ambient air quality standards
NEERI	National Environmental Engineering Institute
NHANES	National Health and Nutrition Examination Survey
NHLI	National Heart and Lung institute
NK	Natural killer cells
NOx	Oxides of nitrogen
NSE	Non - specific esterase
O_3	Ozone
OR	Odds ratio
PAH	Polycyclic aromatic hydrocarbon
PCBs	Polychlorinated biphenyls
PEFR	Peak expiratory flow rate
PFT	Pulmonary function test
PM	Particulate matter
PM_{10}	Particulate matter with less than 10 µm diameter
$PM_{2.5}$	Particulate matter with less than 2.5 µm diameter
PM_1	Particulate matter with less than 1 µm diameter
Pap	Papanicolaou
RBC	Red blood corpuscles
ROS	Reactive oxygen species
RSC	Respiratory symptom complex
RSPM	Respiratory suspended particulate matter
RSV	Respiratory syncitial virus
SBP	Systolic blood pressure
SD	Standard deviation of mean
SES	Socio-economic status
SM	Squamous metaplasia
SOx	Oxides of sulfur
SPM	Suspended particulate matter
SPSS	Statistical Package for Social Sciences
TERI	Tata Energy Research Institute
TNF- á	Tumor necrosis factor- alpha
UFP	Ultra fine particle with diameter of less than 0.1µm
UNEP	United Nations Environment Program
URS	Upper respiratory symptom
URTIs	Upper respiratory tract infections
US EPA	United States environment protection agency
VOC	Volatile organic compound
WBC	White blood corpuscles
WBPCB	West Bengal Pollution Control Board
WHO	World health organization

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17. 'Parivesh' Newsletters

Annexure -19

TO WHOMSOEVER IT MAY CONCERN

16 November 2025

The severe health consequences of conducting competitive outdoor sports for children in 'Very Poor' to 'Severe' Air Quality (AQI 300-600).

I, Dr. Arvind Kumar, in my capacity of Founder Trustee of the **Lung Care Foundation**, Founder & Lead of **Doctors for Clean Air & Climate Action**; and a senior practicing Chest Surgeon in New Delhi, hereby issue this expert medical opinion in support of the ongoing Public Interest Litigation regarding the conduct of competitive outdoor sports for children during periods of hazardous air quality.

“Doctors for Clean Air” (DFCA) is a national network of thousands of medical professionals across India who routinely witness the harmful effects of air pollution on their patients and advocate for Clean Air for a Healthy India. The network is convened and hosted by the Lung Care Foundation; a registered not-for-profit organisation working towards the care and cure of India’s 2.8 billion lungs and is supported by more than 20 leading medical associations across the country.

Each year, the National Capital Territory of Delhi experiences a recurring and predictable air-pollution emergency during the winter months (October – February). During this period, air quality routinely falls within the “Very Poor” (AQI 301–400) to “Severe” (AQI >400) categories, often persisting for several consecutive days or weeks. These fine particulate pollutants (especially PM2.5) are among the most dangerous air toxins known. International bodies such as the WHO, and national agencies including the Government of India, have repeatedly confirmed that there is no safe threshold for PM2.5 exposure, particularly for vulnerable groups such as children.

Clinically, this period is associated with a dramatic increase in respiratory illnesses including asthma attacks, bronchitis, pneumonia, allergic exacerbations, cardiovascular stress and emergency admissions.

Children Are a Special, High-Risk Group. They are far more biologically vulnerable to toxic air due to factors such as:

1. **Developing lungs, brain and immune system**, which are more susceptible to long-term injury
2. **Higher breathing rate** and greater air intake per kilogram of body weight
3. **Smaller airways**, which inflame and obstruct more easily
4. **Greater time spent in physical activity**, increasing total pollutant dose

Long-term cohort studies have repeatedly shown that exposure to high PM2.5 in childhood leads to **permanent reduction in lung growth and capacity**, which persists into adulthood and predisposes to chronic respiratory disease. Given these established vulnerabilities, **children must be treated as a priority risk group** in any decision involving outdoor exposure.

It is our firm and unequivocal medical opinion that exposing children and adolescents to an ambient Air Quality Index (AQI) of above 300 for PM 2.5 (which is classified as 'Very Poor' to 'Severe'/ ‘Hazardous’) is a direct and foreseeable cause of immediate, short-term as well as long-term harm.

Competitive Outdoor Sports in High Pollution Are Dangerous

While sports play an important role in children's development, the **specific combination of strenuous competitive activity and toxic air** creates an extremely hazardous medical situation for the following reason:

1. Children are a High-Risk Vulnerable Group: Children are not "adults". Their lungs, brains, and immune systems are in a critical phase of development. Their airways are narrower, making them more susceptible to inflammation and obstruction. Exposure to high levels of PM 2.5 during these formative years is directly linked to stunted or diminished lung growth**,** leading to a permanent reduction in pulmonary capacity that will affect them for their entire lives.

2. The Multiplied Risk of "Competitive Sports: The danger is multiplied exponentially by the nature of "competitive sports" as opposed to passive exposure.

    - **Massively Increased Ventilation:** A child at rest breathes 20-25 times per minute, but during strenuous, competitive exertion (e.g., in football, athletics, or handball), this respiratory rate goes up by twice or more, thereby pushing in double, triple, or even more amount of air into their lungs. With air being toxic, it means more toxins are going into the lungs, with health consequences thereof.

    - **Bypassed Nasal Filtration**: During high-intensity exercise, children switch from nasal breathing to mouth breathing, which bypasses the body's primary air-filtration system (the nasal passages).

    When these two factors are combined, the child athlete inhales a massively increased dosage of toxic pollutants directly and deeply into the lower respiratory tract, where they can pass into the bloodstream.

3. Acute and Chronic Medical Consequences: Exposure to such a high toxic dosage on a child's developing body is known to cause:

    - Immediate (Acute) Effects**:** Acute bronchoconstriction (asthma attacks), chest pain, chest constriction, giddiness, headaches, and severe irritation of the eyes and respiratory tract, as noted in the advisories of the Ministry of Health & Family Welfare (MOHFW). This poses an immediate safety risk to the child on the playing field.

    - Long-Term (Irreversible) Effects: The creation of chronic respiratory conditions (asthma, bronchitis), cardiovascular strain, and potential long-term cognitive and neurodevelopmental impairment due to the inflammatory and oxidative stress caused by the pollutants.

To be clear: *scheduling* of official competitive sporting events at these times *creates conditions* that are highly harmful to children, particularly those below the age of 18. This places young athletes and their hapless parents in a difficult state of choosing between their health and their athletic careers, as they are being exposed to a known, severe health hazard in an officially sanctioned event.

The Government of India's own MOHFW advisory explicitly states that when AQI is “Poor” or above, "Physical activities like running, jogging, playing may be avoided or postponed."

Therefore, from a medical and public health standpoint, there is no safe level of strenuous outdoor activity for children in an AQI above 300. Any policy, schedule, or directive that promotes such activity is highly unfortunate and would also be in direct contravention of all established medical science, placing the immediate and long-term health of children at severe, irreversible risk. Purely on medical grounds, we recommend that all such outdoor sports events be postponed or rescheduled to a time when the ambient air quality is verifiably within safe limits.

A compilation of peer-reviewed scientific literature relevant to the health impacts described herein is appended as **Annexure I**, forming an integral part of this expert opinion



Sincerely,
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Annexure 1

"Are the adverse health effects of air pollution modified among children and adolescents who are physically active? A systematic review"

Journal: Preventive Medicine, 2022

This systematic review evaluated evidence from numerous studies on the interaction between physical activity and air pollution exposure in children and adolescents. Multiple included studies found that active children tended to have worse respiratory health outcomes (such as lower lung function) when performing physical activity in areas with higher pollution, despite the general benefits of exercise. The authors explicitly caution that the increased ventilation from physical activity can elevate pollutant intake, heightening negative health effects under polluted conditions.

DeFlorio-Barker, S., Zelasky, S., Park, K., Lobdell, D. T., Stone, S. L., & Rappazzo, K. M. (2022). Are the adverse health effects of air pollution modified among active children and adolescents? A review of the literature. Preventive medicine, 164, 107306. https://doi.org/10.1016/j.ypmed.2022.107306

Annexure 1

"Running in polluted air is a two-edged sword: physical exercise in low air pollution areas is cardioprotective but detrimental for the heart in high air pollution areas"

Journal: European Heart Journal, 2021
Authors: Thomas Münzel, Omar Hahad, Andreas Daiber

Summary:
This editorial reviews recent evidence on the interaction between physical activity and air pollution, highlighting a major cohort study of 1.5 million young adults. The article concludes that while physical exercise is generally protective for cardiovascular health, this benefit is lost—and even reversed—when exercise is performed in environments with high levels of air pollution (notably high PM2.5 and PM10 concentrations). The study referenced shows that for individuals exposed to high particulate pollution, increased physical activity above moderate levels can raise cardiovascular disease risk. Mechanistically, air pollution triggers oxidative stress, inflammation, autonomic and vascular dysfunction, which can neutralize or overtake the cardioprotective effects of exercise. The authors call for new technologies and behavioural strategies to help people avoid outdoor exercise in conditions of poor air quality, to prevent exercise-associated harm from pollution.

Reference:
Münzel, T., Hahad, O., & Daiber, A. (2021). Running in polluted air is a two-edged sword: physical exercise in low air pollution areas is cardioprotective but detrimental for the heart in high air pollution areas. *European Heart Journal*, 42, 2498–2500. https://doi.org/10.1093/eurheartj/ehab227

Annexure 2

Operative pictures of Lungs of patients from Polluted Cities.



Air Quality, Respiratory Health and Performance.

A Report from the IOC Consensus Sub-Group on Acute Respiratory Illness in Athletes

January 2025

Overview

This report presents the findings and recommendations of the International Olympic Committee (IOC) Consensus Sub-Group on acute respiratory illness in athletes. The expert panel, comprising specialists in respiratory or sport medicine, exercise science, and sports health, provides an evidence-based assessment of the risks, prevention strategies, and management approaches for acute respiratory conditions affecting athletes at all levels.

📌 *This report is intended to serve as a scientific reference for researchers, sports organisations, healthcare providers and policy makers to help reduce the impact of air pollution on the health and performance of athletes.*

This report has been summarised in a narrative review published in Br J Sports Med 2025, entitled: Air quality, respiratory health and performance in athletes: a summary of the IOC consensus subgroup narrative review on 'Acute Respiratory Illness in Athletes

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Abbreviations

Airparif: Association for Air Quality Monitoring in the Paris Region

AQ: Air Quality

AQHI: Air Quality Health Index

AQI: Air quality index

CO: Carbon Monoxide

CO_2: Carbon Dioxide

COPD - Chronic Obstructive Pulmonary Disease

EIB: Exercise-Induced Bronchoconstriction

FEV_1: Forced Expiratory Volume in One Second

GPS - Global Positioning System

HEPA: High-Efficiency Particulate Air

HIIT: High-Intensity Interval Training

IOC: International Olympic Committee

IPCC: Intergovernmental Panel on Climate Change

LUR: Land-Use Regression

MIIT: Moderate Intensity Interval Training

NO_2: Nitrogen Dioxide

NO_x: Nitrogen Oxides

O_3: Ozone

OPG: Olympic and Paralympic Games

PFAS: Per- and Polyfluoroalkyl Substances

PM: Particulate Matter

PM_{10}: Particles with a diameter ≤10 µm

$PM_{2.5}$: Particles with a diameter ≤2.5 µm

SO_2: Sulfur Dioxide

TRAP: Traffic-Related Air Pollutants

TV: Television

UFP: Ultrafine Particles (PM < 0.1 µm)

US: United States

US EPA: United States Environmental Protection Agency

UTC: Coordinated Universal Time

VOCs: Volatile Organic Compounds

$\dot{V}E$: Minute Ventilation

$\dot{V}O_2$: oxygen uptake

WHO: World Health Organisation

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Introduction

Air quality (AQ) can be defined as the degree to which the ambient air is free of pollutants, assessed by measuring a number of pollutant indicators [1]. Direct emissions, but also air pollutants caused by climate change, affect the health of the population, and the resulting reduced air quality affects mortality [2–4] and the aggravation of various diseases, such as, but not limited to, respiratory diseases [4]. For this reason, air quality indices have been developed and adapted around the world to make physical activity recommendations for healthy individuals and those with chronic diseases [5,6]. Although studies on the effects of physical activity as a function of pollutant concentration on various health parameters are multiplying, the search for the breaking point at which the effects on health become detrimental is still far from being answered. Endurance athletes, who are exposed to pollutants during prolonged high-intensity exercise, are of particular concern. Up to now, we do not know the exact mechanisms of air pollution in the development of respiratory problems during sport, nor do we know what other health risks athletes may face in the future. During air pollution episodes, the measures taken should depend on the type of event, the climatic conditions, and the type of pollutant, furthermore various questions remain: Should a sports event be cancelled when air pollution reaches an alert level? If not, what are the risks? Who is at risk? The world is changing rapidly, and it is necessary to take stock of our current knowledge of the effects of pollutants on the health and performance of regular athletes in a changing climate. Future sporting events are likely to take place in polluted environments.

The aim of this review was to highlight the current knowledge and gaps regarding the effects of air pollution on respiratory health and performance of athletes. The first part of the review is devoted to a presentation of the different air pollutants and the methods used to measure air quality, as well as the AQ index used worldwide. The second part consists of a review of the

effects of different pollutants on respiratory parameters and athletic performance. Finally, management issues are discussed.

Methods

The authorship group was selected based on expertise in air quality, sports medicine, sports sciences, environmental health, and respiratory diseases. In September 2019, on behalf of the IOC Medical and Scientific Commission, a core group for the IOC consensus statement on "Acute respiratory illness in athletes" was convened, chaired by MS. A subgroup (number 3 of 7 subgroups) of this core panel, consisting of 7 members (VB, PEA, NS, KF, CC, MS, WS), focused on non-infectious acute respiratory illness (ARill) caused by environmental factors in athletes. Three experts from the IOC Medical and Scientific Commission (LE, TS and RB), who were the originators of the request for the report on air quality in sport and who were involved in the discussions from the beginning, contributed to the formation of the group. Each part has been reviewed in the context of the authors' collaborations with experts outside the IOC, and/or their research work. We benefitted from the experience of some authors with the air quality during the Olympic and Paralympic Games (KF), or during sport events (PA, NS and VB), and the involvement of some authors with elite athletes, as sport scientist, medical doctor and member of International Federations or IOC. Consensus was obtained through several rounds of author revisions.

This report has been developed with the aim of being inclusive and providing useful information to all. The IOC consensus sub-group 3 included experts from different countries (Australia, Austria, Canada, France, Italia, South Africa, Sweden, Switzerland) and continents (Africa, America, Europe, Oceania). The author group also includes a former Olympian (RB). Two women are involved in the group, including the leader.

The starting point for this narrative review as a previous systematic review we conducted, which highlighted the lack of data on the impact of environmental factors on non-infectious respiratory diseases in the context of physical activity among athletes [7]. This review provided a critical framework, emphasizing the need for more targeted research and informing the structure of our guidelines. Existing position statements and narrative or systematic reviews, available for most of the topics covered—except for the role of education and the sections on air quality in Paris and Los Angeles—were consulted to ensure alignment with current knowledge and best practices. Additionally, more recent articles were identified through searches in PubMed, Scopus, and Web of Science. The guidelines were developed through interdisciplinary collaboration involving experts who synthesized the available evidence and tailored it to the specific focus of our study. Although we did not use a formal framework such as the DELPHI methodology, as the expert group was already assembled, the process was rigorous and scientifically grounded. Given that existing reviews were available for each topic, we instead consolidated the work into an updated review, which allowed us to produce a comprehensive report in the form of a synthesis

Definition of air pollution

Air pollution is defined as the presence of one or more substances in the air at concentrations and duration above the natural limits [8]. Air pollutants are often categorized as primary, for those directly emitted in the atmosphere from a source, and secondary, for those formed within the atmosphere from a chemical reaction involving primary pollutants and natural components of the environment (eg. heat, UV, oxygen, water). Air pollutants are in the form of gas/vapors or particulate matter (PM) of different sizes and composition suspended in the atmosphere. They have various geographical distributions according to their properties and environmental conditions. Locally distributed pollutants have a very short lifetime in the atmosphere and are found at high concentrations only around their source of emission, and not in the atmospheric

background. Urban sources of pollutants have generally few hours lifetime and are found in high concentration in the cities where they are produced, and at lower levels in the atmosphere of adjacent rural areas. Regionally distributed pollutants are generally fine particles, aerosols, and gas, which have a lifetime of days to weeks sand are therefore transported over hundreds, sometimes thousands, of kilometres from their sources. Finally, some pollutants have a lifetime of several months or even years and are spread all over the world.

Type of pollutants most encountered

Carbon monoxide (CO)

Carbon monoxide is a gas formed during the incomplete combustion of carbon-containing fuels. Motor vehicles are an important source of CO, as well as heating appliances using carbonaceous fuel. Oil refineries, pulp, paper and carbon black factories, iron and other metals metallurgy, industries producing methanol, or carbonyl metals are also major producers of CO, as well as incinerators, or industries producing heating gas. Red blood cells have a much higher affinity for CO than for O_2, therefore, it may cause a rapid decrease in SaO_2, resulting in death [9].

Sulfur dioxide (SO_2)

Sulfur dioxide (SO_2) is a gas mainly emanating from volcano and many industrial activities that process materials containing sulfur, such as combustion of coal, petroleum, gasoline, and non-desulfurized natural gas [10]. The main anthropogenic source of SO_2 is the combustion of fossil fuels containing sulphur for domestic heating, electricity generation or motor vehicles. The emissions of SO_2 have decreased considerably over the past few years in developed countries. However, in less developed countries, the use of fuel oils and diesel with high sulfur content cars are responsible for SO_2 production. Shipping is also a major source of SO_2.

Nitrogen oxides (NOx) and dioxide (NO_2)

The primary source of outdoor emissions of nitrogen oxides (NOx) into the atmosphere is the combustion of fuels rich in nitrogen, such as coal. NOx is also secondarily formed through the combination of atmospheric oxygen and nitrogen, and high-temperature combustion, road traffic and electricity generation being its major sources. The emission of primary NO_2 by these sources is low (5%) and most of its concentration in the atmosphere is of secondary origin. NO_2 is also a key precursor of a range of secondary photochemically generated pollutants, such as ozone, and organic nitrate and sulfate particles measured as PM_{10} or $PM_{2.5}$ [10].

Volatile organic compounds (VOCs)

Volatile organic compounds (VOCs) are substances that are characterized by their high volatility, i.e. they emit vapors even at ambient pressure and temperature, and therefore spread easily in gaseous form in the air [11]. The predominant source is typically through leakage from pressurized systems (e.g. natural gas, methane) or evaporation of a liquid fuel such as benzene from the fuel tank of a vehicle. The effects of VOCs vary greatly depending on the nature of the pollutant in question. They range from a certain olfactory discomfort to mutagenic and carcinogenic effects (benzene among others). Finally, as they break down in the atmosphere under the effect of solar radiation and heat, they cause the formation or accumulation of harmful compounds in the environment, such as ozone. Some sources of indoor VOCs are cigarette smoke, vehicle exhaust gases, building materials, gases released from furniture, and household products.

Particulate Matter (PM)

PM comprises of materials in solid or liquid phase suspended in the atmosphere and may be of primary or secondary source. Such particles can cover a wide range of sizes and of chemical composition. The very large particles have a short atmospheric existence, tending to fall out

rapidly through gravity and wind-driven impaction processes. Thus, in practice there are few particles in the atmosphere exceeding 20 μm in diameter (PM_{20}), except in areas very close to sources of emission. PM_{10}, $PM_{2.5}$ and ultrafine particle fractions (PM<0.1μm or UFP), which are typically measured within the atmosphere for the purposes of health effects studies. Synergic interactions between PM, SO_2 and water vapor have been observed [12,13]. When they are combined, their adverse effects are increased.

Ozone (O_3)

Ozone (O_3) is considered a secondary pollutant because it is formed from a photochemical reaction in the atmosphere between nitrogen oxides (NOx), especially nitrogen dioxide (NO_2), CO, sunlight, and hydrocarbons [10]. Ozone is one of the most widespread global air pollutants; it travels with the wind, tending to reach high concentrations in big cities, the downwind distant peripheries, and surrounding hills or mountains, especially during hot and sunny weather [10]. High concentrations of O_3 are a major problem in America and Europe. In hot climate megacities, the level of O_3 may exceed 200 μg/m^3 (0.10 ppm) whatever the continent for several days [14–17], constituting a significant threat to public health. High O_3 concentrations are generally observed during heat waves, but no synergic effect on respiratory symptoms or lung function changes of O_3 and heat have been reported in healthy subjects, nor with other pollutants [18].

Sources of pollutants when exercising

Traffic-related air pollutants (TRAP)

One of the sources of concern are all all-road transport emissions, regardless of use or type of vehicle. The combustion of petrol or diesel fuel results in the production of exhaust gas which contains potentially harmful pollutants. These include carbon monoxide (CO), nitrogen oxides (NOx), VOCs and PM. In the presence of high temperatures, ozone can also be formed in large

quantities. Non-exhaust emissions of PM from road vehicles result from sources such as wear and tear of brake components, tyres and the road surface itself. Vehicles also cause particles to be resuspended from the road surface into the air, either by turbulence in the wake of the vehicle or by shear forces between the tyre and road surface. Exercising near major roads or in heavy traffic exposes the athlete to the inhalation of TRAP. Stadiums built near major roads for easy access with adjacent car parks are potentially polluted sites during match time. Viana et al. [19] observed pollutant concentrations follow different patterns, by studying air quality at 6 athletic stadiums around the world, and they observe that each stadium has its own signature. Pollutants such as NO and NO_2 followed the characteristic traffic pattern, with peaks during the morning and evening rush hours from car exhausts (roughly, 6–9am and 18–22pm), and as expected inverse to the O_3 pattern due to titration (dissolution by interaction). Despite different intensities, all stadiums seemed to be affected by traffic emissions and the pattern was stronger in stadiums located close to major roads. The study of PM concentrations showed markedly different trends, highlighting the hyper-local nature of these pollutants. It should be noted that large sporting events can have a significant impact on local air quality and the health of the local population, by increasing at least PM, NO_2 and O_3, from different sources [20–22]. In 2015, authors measured air pollution at a football stadium in the USA during 3 games using four stationary and mobile monitors [23]. They identified very localised high concentration peaks (18 to 22 peaks during a game) of unhealthy air (mainly $PM_{2.5}$), mainly due to idling cars in traffic or in car parks, charcoal barbecues used by spectators before the game, and old generators. The worst air quality was observed at the end of the game as everybody left the stadium at the same time by car and for several hours after the match.

Wildfires, megafires and biomass combustion

In its 6th Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) predicted that climate change will lead to an increase in the fire frequency of about 30% [24]. Wildfires

are undoubtedly responsible for many health problems and an increased mortality [24,25]. Fires and megafires, release high concentrations of carbon dioxide (CO_2) into the atmosphere, dramatically increasing concentrations of air pollutants. In June 2017, fires broke out in Portugal and Spain, and values as high as 1000 ug/m^3 for PM_{10}, 951 ug/m^3 for O_3, 100 ug/m^3 for CO, 478 ug/m^3 for NO_2 and 116 ug/m^3 for SO_2 were recorded [25–27]. The authors mentioned that the instruments had reached their upper operating limit, suggesting that it may have been higher. Of course, people are evacuated during fires, if necessary, but fire smoke can travel thousands of kilometres downwind and easily spread to surrounding and sometimes distant towns. During the fires in Portugal, daily concentrations exceeding the European/national guidelines for PM ranged from 7 to up to 14 days, depending on the city and its proximity to the fire [27]. In 2023, the impact of major wildfires on air quality in Canada, again raised questions about the dangers of exercising in such conditions [28], as wood smoke and wildfire exposure can severely increase respiratory morbidity [29,30]. In Australia, the "black summer" (2019-2020) burned for 5 months in eastern and southern Australia, leading to recommendations from the Australian Institute of Sport in 2023 on exercising in bushfire smoke for high performance athletes [31]. Major sporting events occurring during wildfire smoke episodes are generally postponed to protect the health of athletes [32]. The model of firefighters exposed to wildfire smoke is extreme, as they are subjected to very high concentrations of air pollutants while being physically active. A decrease in lung function has been observed up to three months after the onset of the first wildfire in these individuals [33,34]. Over the longer term, the risk of lung cancer mortality in wildfire firefighters is increased by 8 to 43%, according to notably the length of exposure [35].

Artificial turf

A recent concern has been raised on the possible effects on health of artificial turfs for athletics or soccer fields. Recreational and artificial turf fields are generally made of recycled tire, comprising polycyclic aromatic hydrocarbons, vulcanisates, additives, plasticisers, antioxidants, and heavy metals [36–38]. People playing on tire crumb are exposed to their constituents by inhalation of dust, skin contact with the material, surface water runoff, or ingestion of the tire crumb. A specific microbiota has also been found in artificial soccer fields [39]. The supposed risks are often regarding mutagenicity of the organic extracts of PM, rather than direct respiratory health. The amount of the compounds found in sport fields is above legislated or recommended safety thresholds for each target matrix and among them some are carcinogens [36,37,40–42]. In addition, many chemicals in or released from crumb rubber have no guidelines for possible hazardous effect [37,43]. Further studies are urgently needed on the potential hazardous effects on health of playing or practicing sport on such artificial fields. Other considerations for grass include arsenic-contaminated irrigation water or the use of pesticides [44–48]. It is important to note that artificial turfs also contain per- and polyfluoroalkylated substances (PFAS) [49] and contributes to the plastic pollution of natural aquatic environments through water run-off [50].

Per- and polyfluoroalkylated substances (PFAS), phthalates and other substances

Many chemicals, such as phthalates or PFAS, are found in the air, although this is generally not the primary route of exposure. Instead, they are more commonly found in the athlete's environment, such as in certain clothing, drinking water, sports cans or bottles, cosmetics, and other items. Per- and polyfluoroalkylated substances (PFAS), especially, are a complex chemical class of several thousand organic fluorine compounds, including pesticides. They are

synthetic products that do not occur naturally in the environment. The thermal and chemical stability of PFAS makes them highly resistant to degradation and persistent in the environment. They also have unique chemical properties, such as solubility in water and fats, that make them very useful in many industrial and commercial applications. PFAS are used for their flame retardant, stain resistant, non-stick, emulsifying, and waterproofing properties. However, there are currently insufficient studies on the relationship between sports activities, PFAS and health. PFAS, in particular, have been detected in public swimming pools [51], and can be released into the environment after ski waxing [52–55]. A systematic review found an increased incidence of cancer and Parkinson's disease among green space workers occupationally exposed to pesticides [56]. Among the studies, a retrospective cohort of 682 golf course superintendents in the USA showed an excess mortality from all cancers, especially prostate cancer, non-Hodgkin's lymphoma, brain or nervous system tumours, and colorectal cancer [56,57]. However, to date, there are no study on the effects of pesticides or phthalates on athletes' health in the short or long-term. In skiing activities, ski or snowboard waxing pose a significant risk of exposure to PFAS and other contaminants [52–55], but research in other sports remain limited. A recent review on professional ski wax technicians showed that waxes can lead to some of the highest airborne PFAS concentrations of any occupation, which may cause lung injuries, decreased lung diffusion capacity, severe dyspnoea, cough and rhinitis [58]. Additionally, PFAS exposure can impact immunity, suppress neutrophilic function, and increase susceptibility to infections [59]. A recent study in an Inuit community also linked elevated blood PFAS levels to an increased risk of asthma and decrease lung function, though without affecting respiratory symptoms [60].

Indoor pollutants

Indoor air pollution can come from both indoor and outdoor sources. The importance of the outdoor source depends on the penetration coefficient, the ventilation rate and the decay rate,

despite some filtering. The smallest particles as well as ozone penetrate easily from outside to inside. Ozone reacts with indoor surfaces and its concentration may thus be less than outdoor. The first studies on indoor air pollutants, when excluding lead in shooting range, were performed in arenas with the measurement of CO and NO_2 produced especially by ice resurfacing process [61,62]. More recent studies, still insufficient, focused on pollution in gym, fitness centre and sports halls [63]. PM, VOCs, CO_2 but also bacteria and fungi may be found in huge quantities, or not, depending on the number of participants, and the type of ventilation [63,64]. High concentrations of VOCs may originate from cleaning products and alcohol-based hand disinfectant [65], fragranced products [66], gym equipment and building materials. The type of activity (ventilation, movement) also influences the concentration of some pollutants in indoor air, *i.e.* yoga being less pollutant than self-defence classes [63,65]. The resuspension of particles is a cause of high PM, and very few studies report CO or NO/NO_2, that have been found to be elevated in some sport halls. No increase in O_3 has been observed, due to indoor components, but there is not enough data to conclude. Open windows during concomitant hot summers and peak of O_3 may allow the spread of the gas into the room but in poorly ventilated rooms, the closed windows may increase CO_2.

Seasonal variations

Exposure to pollutants when exercising outdoors may be due to episodes of pollution, generally characterized by high PM when the climate is temperate and O_3 when it is hot. However, events such as wildfires occurring during the summer can also drastically contribute to increase the PM concentration in the atmosphere during the hot season. With climate change, pollen will be present in the atmosphere at higher concentrations for longer periods of time, and a synergistic effect of pollutants, pollen and meteorological conditions has been observed in people with asthma [67,68]. The effect of such a combination during exercise has not yet been reported. With concern, pollens are now found in normally free-pollen zones (altitude) [69].

Methods to measure of air quality

There are three main types of tools that in various combinations provide information on air quality: (1) Monitoring and measurements; (2) Air quality modelling using both statistical and atmospheric dispersion/chemical transport models, and (3) Assessment of air quality using a combination of measurements and models. The selection of the methodology depends on the purpose of the measurements. For example, the selection of instruments for monitoring is always used for regulatory purposes and the instruments must be in line with the legislative requirements. In the case of compliant monitoring networks, these require the use of reference instrumentation or instruments for which equivalence with the reference methods has been demonstrated. Monitoring devices integrate different sensors based on the type of pollutants they measure.

Gas sensors

Gas sensors are of two main types, metal-oxide, and electrochemical sensors. Metal-oxide sensors are sensitive to pollutant concentrations based on the electric conductivity of their metal surface. In clean air, donor electrons in the metal (e.g., tin dioxide) are attracted towards oxygen on the surface of the sensing material, preventing electric current flow. In the presence of pollutant concentrations (e.g., reducing gases) the surface density of adsorbed oxygen decreases as it reacts with the reducing gases. The main limitations of these sensors are that their response is limited at high concentrations (e.g., ozone sensors) and they have been shown to have interferences with other gases present in the atmosphere [70–73]. Electrochemical sensors are composed of noble metal electrodes in an electrolyte. The electrolyte is normally an aqueous solution of strong inorganic acids. These sensors have been shown to have interferences with relative humidity and temperature, requiring additional measurements to be made to obtain reliable results [74,75]. They have also been shown to have interferences with

other gases present in the atmosphere. For instance, NO_2 sensors have interferences with O_3, however, some newer NO_2 sensors include a filter for O_3 to reduce the interference [76].

Particle sensors

Particle sensors most commonly rely on optical measurements, typically light scattering. Conversely, reference instruments are based on particle gravimetry. The principle of operation of particle sensors is based on a source of light (LED, laser) which is shone onto the particles introduced into the monitor by a small pump or an induced thermal gradient. The light scattered by the particles is monitored using a photo detection device. The particle concentration is proportional to the scattered light intensity. The actual measurement is typically carried out by nephelometry, which measures particle light scattering of the total aerosol, or optical particle counting, which detects particle size and number of individual particles. Neither of these techniques measure particle mass directly and assume a certain particle density to convert particle number into particle mass concentrations (in the case of optical counters) or must be compared to a reference instrument (in the case of nephelometers). The particle sizes detected depend on the specific particle sensor monitors, and it should be highlighted that none of the monitors currently available are able to detect ultrafine particles (<100nm in diameter), their lower limit frequently being >300 nm [77]. Low-cost PM sensors are also affected by relative humidity. Unless they have a system to dry the particles, at high relative humidity (above 80-90%) the sensor system will also measure water droplets, overestimating the particulate mass [78].

Validity of sensor systems

The performance of sensor systems is evaluated by assessing several parameters, including: (1) Sensitivity (their ability to reach high or low concentrations); (2) Selectivity (the lack of interference from other pollutants); (3) Temporal resolution; (4) Reproducibility

(comparability between different units of the same monitor); (5) Stability over time [79]. The way to assess each of these indicators is by comparing the data generated by the sensor system with that of a reference instrument, for the single or group of pollutants selected. This process is typically referred to as calibration, and it results in a set of coefficients or algorithms which enable the correction of the data generated by the sensor system to resemble those from a co-located reference instrument. Different options are available to calibrate sensor systems, with different requirements and resulting in varying levels of data quality. Sensors are initially tested during their manufacturing process, mainly for operation and technical malfunctions. Then they are calibrated in the laboratory (by the manufacturer or a research institution), in chamber experiments with a known gas mix and gas or particle concentrations. Numerous studies showed that sensor performance in chamber experiments cannot be extrapolated to ambient (or even indoor) air due to the interference from the actual aerosol and gas mix or other environmental variables such as relative humidity and temperature [76,80]. Therefore, field calibrations are essential to guarantee the correct assessment of the performance of non-regulatory monitors.

Field sensor systems

In the field, sensor systems are calibrated by collocation. The sensor systems are deployed in close proximity (<10 m) [79] to a reference instrument (preferably close to the air intake of the reference instruments, which is usually on the top of the station), and compared to reference data in order to obtain a field calibration algorithm [81–83]. Because of changing environmental conditions and drifts in sensor performance over time, this kind of comparison should preferably be carried out on a regular basis (at least, the comparison should cover the different seasons) and take between 2-3 weeks [76,82,83].

Machine learning techniques

Machine learning techniques (ranging from sophisticated linear regression models to artificial neural networks) are currently being applied to the calibration of sensor networks [83]. These techniques consider several variables (i.e. temperature, relative humidity, other gases) instead of only considering the targeted gas [79,83]. Machine learning is based on statistical learning across sensor systems, where sensors are calibrated against each other while always including the comparison of several units in the network with reference instrumentation (once again, by collocation). Machine learning techniques are currently being tested, with positive results so far [79].

General population guidelines on air quality

The US Environmental Protection Agency (USA EPA) defines the human health standard as « the attainment and maintenance of which in the judgment of the administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public » [84]. The World Health Organisation (WHO) serves as the global authority overseeing AQ standards (Table 1), with its most recent guidelines updated in 2021. Many countries have their own AQ indices and alert thresholds, such as US EPA [85] (Table 2) or European countries (Table 3) [6], often with less stringent limits for certain pollutants than the WHO guideline. Initially, PM_{10} was the particulate matter that was predominately measured in the atmosphere. However, since 2010, with the widespread availability of real-time AQ data online, $PM_{2.5}$ has become the global standard, and the WHO has adopted it as the preferred index in its guidelines. It is worth noting that, unlike gaseous pollutants, the guidelines for $PM_{2.5}$ and PM_{10} are still primarily based on daily means. While most countries measure real-time and hourly mean concentrations of $PM_{2.5}$, the 24-hour mean concentrations have traditionally been used to provide health guidance. More countries incorporates now hourly values of particulate matter into their AQ indices, such as Australia [86] and South Africa [87]. Measuring $PM_{2.5}$ on an hourly basis, and

using real-time data is expected to become more widespread in the future, notably in the world of sport [88]. However, how these measurements are utilised and what advice should be given to the population based on them remain to be scientifically validated. Current guidelines and health messages are generally designed without sufficient scientific rationale regarding individual's physical activity levels, whether they are residents or visitors, or their training status. Consequently, these guidelines cannot be relied upon to determine when a sports competition might pose health risks to competitors. PM and O_3 are the predominant pollutants that can affect athletes. High levels of PM are typically found in winter in temperate and polar climates, while O_3 is more prevalent during hot summers in these regions, as well as in areas with hot climates, such as California or Mexico. NO_2 is also commonly measured and is linked with both PM and O_3. SO_2 primarily comes from industry and ports, but also from volcanic activities, and may be a concern for some athletes, for example in the case of fire smoke exposure. To communicate with the population, government and/or environmental agencies and many free websites use colour codes and air quality index (AQI). The colours range from green, indicating that the AQ guideline level is respected (AQ good), to red or dark purple when the health risks are very high, and air quality is hazardous for health (AQ extremely poor) (Tables 4 and 5). The indices are calculated based on data from fixed monitoring stations. The index reflects the poorest level of any of six pollutants (CO, NO_2, O_3, $PM_{2.5}$, PM_{10}, SO_2). It is worth noting that in some countries, such as Australia (Table 5) [86] or Japan [89], AQ guidelines incorporate the measurements of larger particles (total suspended particles, PM<100 µm) and sometimes of visibility (Table 5). Given that Australia is prone to wildfires, their experience and the inclusion of new parameters in the AQI highlight the importance of considering local specificities in air quality indices and health messages. For example, depending on these specificities, visibility may have little or no correlation with certain particles or O_3 [90–92]. The AQI index has since been revised, resulting in different indices

that better account for local AQ characteristics, multipollutant exposure and the impact on health on a country-wide scale [93–95]. Beyond the six commonly measured air pollutants (PM_{10}, $PM_{2.5}$, NO_2, O_3, CO, SO_2), additional pollutants are sometimes regulated, and certain air quality indices specific to particular locations incorporate these pollutants into the calculation of the AQI. For example, the French ICAIR+ index can include local industrial sources such as benzene, vinyl chloride monomer, 1,3-butadiene, and 1,2-dichloroethane [96]. Recent studies have also proposed disease-specific [97] or wildfire specific adjustments of these new quality health index (AQHI). In all the guidelines, the short-term health effects are estimated by the effect of the pollutant concentration on the excess risk of hospital admissions, outpatient visits and/or morbidity, and do not consider the public who do not seek hospital or medical attention when they have symptoms, nor the individual's susceptibility to the pollutant or the inhaled dose. Therefore, these guidelines cannot be extrapolated to advise when a sports competition or training might be harmful to participants.

Table 1. WHO air quality guidelines and interim targets *[10]*.

Pollutant	Averaging time	Air quality guideline level	Interim target			
			4	3	2	1
$PM_{2.5}$, $\mu g/m^3$	Annual	5	10	15	25	35
	24-hour	15	25	37.5	50	75
PM_{10}, $\mu g/m^3$	Annual	15	20	30	50	70
	24-hour	45	50	75	100	150
O_3, $\mu g/m^3$	Peak season	60	-	-	70	100
	8-hour	100	-	-	120	160
NO_2, $\mu g/m^3$	Annual	10	-	20	30	40
	24-hour	25	-	-	50	120
	1-hour	200	-	-	-	-
SO_2, $\mu g/m^3$	24-hour	40	-	-	50	125
	10-minutes	500	-	-	-	-
CO, mg/m^3	24-hour	4	-	-	-	7
	8-hour	10	-	-	-	-
	1-hour	35	-	-	-	-
	15-minutes	100	-	-	-	-

Air quality guideline level: It is assumed adverse health effects do not occur or are minimal below this concentration level. The **interim targets** represent air pollution concentrations with a specific increase of health risks.

Table 2. US EPA air quality guidelines *[85]*

Pollutant	Averaging time	Air quality guideline level
$PM_{2.5}$, $\mu g/m^3$	Annual	12-15
	24-hour	35
PM_{10}, $\mu g/m^3$	24-hour	150
O_3, ppm	8-hour	0.070
NO_2, ppb	Annual	53
	1-hour	100
SO_2, ppb	1-hour	75
	3-hours	0.5 ppm
CO, ppm	8-hour	9
	1-hour	35

Table 3. European air quality directives [6]

Pollutant	Averaging time	Target value	Limit value	Indicative limit value	Long-term objectives
$PM_{2.5}$, $\mu g/m^3$	Annual	-	25	20	
PM_{10}, $\mu g/m^3$	24-hour		50	Not to be exceeded on more than 35 days/year	
	Annual		40		

O_3, ppm	8-hour	120 (not to be exceeded more than 25 days/year (averaged over 3 years)			120
NO_2, ppb	Annual		40		
	1-hour		200		
SO_2, ppb	1-hour		350		
	24-hours		125		
CO, ppm	8-hour		10		

Table 4. Examples of the air quality index of US EPA and Queensland government (Australia)

A. Breakpoints for the AQ index, according to US EPA (US EPA Health Classification of Air Quality Index) [99]

Air pollutant		AQ category					
Air pollutant	**Averaging time**	**Good**	**Moderate**	**Unhealthy for sensitive groups**	**Unhealthy**	**Very Unhealthy**	**Hazardous**
AQ index		**0-50**	**51-100**	**101-150**	**151-200**	**201-300**	**300+**
$PM_{2.5}$, µg/m^{-3}	24-hour mean	≤9	9.1-35.4	35.5-55.4	55.5-125.4	125.5-225.5	≥225.5
PM_{10}, µg/m^{-3}	24-hour mean	≤ 54	55-154	155-254	255-354	355-424	≥425
O_3, ppb	1-hour mean	--	-	125-164	164-204	205-404	≥405
	8-hour mean	≤ 54	55-70	71-85	86-105	106-200	≥201
NO_2, ppb	1-hour mean	≤ 53	54-100	101-360	361-649	650-1249	≥1250
SO_2, ppb	1-hour mean	≤ 35	36-75	76-185	186-304	305-604	≥605
CO, ppm	8-hour mean	≤ 4.4	4.5-9.4	9.5-12.4	12.5-15.4	45.5-30.4	≥30.5

B. Breakpoints for the AQ index of the Queensland government (Australia) [86]

Air pollutant			AQ category				
Air pollutant	**Averaging time**	**Guideline**	**Good**	**Fair**	**Poor**	**Very poor**	**Extremely poor**
$PM_{2.5}$, µg.m^{-3}	1-hour mean	50	<25	25-50	50.1-100	100.1-300	≥300.1
	24-hour mean	25	<12.5	12.5-25	25.1-50	50.1-150	≥150.1
PM_{10}, µg.m^{-3}	1-hour mean	100	<50	50-100	100.1-200	200.1-600	≥600.1
	24-hour mean	50	<25	25-50	50.1-100	100.1-300	≥300.1
O_3, ppm	1-hour mean	0.100	<0.067	0.067-0.100	0.101-0.150	0.151-200	≥0.201
	8-hour mean	0.065	<0.043	0.043-0.065	0.066-0.097	0.098-0.130	≥0.131
NO_2, ppm	1-hour mean	0.080	<0.053	0.053-0.080	0.081-0.120	0.121-0.160	≥0.161
SO_2, ppm	1-hour mean	0.100	<0.067	0.067-0.100	0.101-0.150	0.151-200	≥0.201
CO, ppm	8-hour mean	9	<6	6-9	9.1-13.5	13.6-18	≥18.1
	1-hour mean	250	<125	125.1-250	250.1-500	500.1-1500	≥1500.1

TSP*, μg.m^{-3}	24-hour mean	80	<40	40-80	80.1-160	160.1-480	≥480.1
Visibility, Mm^{-1}**	1-hour mean	235	<118	118-235	236-470	471-1410	≥1411

**TSP: Total suspended particles: Airborne particles up to about 100 micrometres in diameter. These particles are generated by combustion and non-combustion processes, including windblown dust, sea salt, earthworks, mining activities, industrial processes, motor vehicle engines and fires. **Visibility-reducing particles: Aerosols and fine particles can reduce visibility. Smoke from fires or haze are common causes of poor visibility.*

Effects of air pollution on athletes' respiratory health and performance

Studying the effects of air pollution on health and performance necessitates to have information on the pollutants present in the air in addition to climatic conditions, their deposition and mode of action into the airways, and the characteristics of exercise, but also of the athlete.

The role of inhaled dose

People who exercise increase their inhaled dose of pollutants, which is characterised by the product of the pollutant concentration (ug/m^3), effort ventilation (litres) and exposure time (min). Whatever the pollutant, the inhaled dose is an important feature when studying the effects of pollution on health and performance. While this equation is useful for quantifying the inhaled dose of each pollutant, certain specifics need to be considered, and the difficulty of accounting for the interdependence and co-occurence of different pollutants raises questions. For example, in a very comprehensive review of O_3 and exercise, Adams [18] reported that the primary predictor of the lung function change during exercise, was the O_3 concentration, accounting for 50 to 75% of the variance, whereas $\dot{V}_E$ accounted for only 10 to 20% of the variance. The correlation coefficients for the polynomial regression of FEV_1 on effective O_3 dose were also higher when O_3 concentration was raised to the power of 1.8 (r=0.92), compared to when the simple product of concentration, $\dot{V}_E$ and exposure time was used (r=0.82). It should be noted that $\dot{V}_E$ is sometimes missing or not measured in studies, making it difficult to compare the effects of different inhaled doses.

The role of deposited dose

As described above, pollutants differ in type and size, which affects where and how much they are deposited in the respiratory tract and their effects on health. Gases, such as O_3, are confined to the respiratory tract after inhalation, but can affect the brain via the lung-brain axis [100]. PM enter the body mainly by inhalation, and the location of deposition in the respiratory tract

depends on their biological, chemical and physical properties [101]. Ultrafine particles (UFP or $PM_{0.1}$) penetrate deep into the respiratory system, and reach the alveolar region, where the blood can carry and circulate PM, causing serious health effects in various organs. The total number of deposited particles increases with exercise due to the combined increase in minute ventilation but also potentially in the deposition fraction [102,103]. The deposited dose of PM or internal dose of inhaled particles is usually calculated by using numerical models [101,103–106], which require knowledge of the aerosol size distribution, to which an individual is exposed, the density, shape, hygroscopicity, and chemical reactions of the PM [103]. Individual anatomical characteristics of the upper and lower airways [107], as well as pre-existing lung pathology, are likely to influence the deposited dose.

Effects of short-term exercise in polluted air on respiratory health

The acute effects of exercising in air pollution have been studied comparing filtered air *vs* polluted air in exposure chambers air (chamber-controlled studies) or comparing polluted area in the city versus rural or less polluted area (field studies) in both healthy participants and those with chronic disease. Pollutants have been studied separately, or in combination, and various exercise protocols and pollutant concentrations have been included. However, there are noteworthy limitations in this literature overall. Firstly, few studies reported the effects of exposure to air pollution exposure during high-intensity exercise (eg, ventilation above 100 l/min, as is common in well-trained endurance sport athletes) on respiratory health. Secondly, for PM, most of the studies used the model of diesel exhaust to represent traffic-related air pollution such that few data are generally available on the other types of particles, for example wildfire-derived PM, and their potential specific effects on health. In spite of those limitations, it is worth noting some of the more recent narrative and systematic reviews that have captured the relevant literature and have summarized the effects of acute air pollution on respiratory health and performance with exercise, though few of these speak specifically to athletes.

Readers are encouraged to turn to these reviews for details, but some key points are worth highlighting now. For example, Hung *et al*. [108] recently synthesised randomised controlled trials in this domain and found that while short-term ozone exposure in moderate-to-vigorous exercise causes transient reductions in lung function and increased symptoms (and thus presumably impaired performance) there is little evidence in the broader air pollution literature to suggest definitive harm on this time scale. However, these authors identified major gaps in the literature, so the message should be a call for further research more rather than simple reassurance. Morici *et al* [109] had earlier reached similar conclusions but were somewhat more concerned with lung function upon exposure to PM, perhaps due to inclusion of studies with non-randomized designs. Madureira and colleagues' [110] review emphasized adverse effects of traffic pollution on inflammation and vascular function but did not translate these into performance deficits. Other reviews noted the active emergence of literature on this topic [111], and lamented the lack of sufficient evidence for clear advice to those considering exercise across various scenarios [112], but none admonished broadly against brief bouts of exercise, even vigorous and even on days of elevated pollution. A commonality amongst these reviews is the lack of a reliable biomarker by which to practically follow pollution-related harm in an exercising population.

While the majority of athletes do not suffer from significant chronic disease, there is reason to be concerned that those who are unfortunately so compromised may be at greatest risk. However, very little understanding of pollution effects in athletes with other chronic conditions exists. Best understood in this regard is asthma. As inflammation and oxidative stress in the bronchial tree is a mechanism common to most forms of respiratory health compromise due to pollution, it is rationale to be concerned with asthmatic people, who by definition already enter exercise with some degree of baseline airway narrowing and/or tendency to narrow with stimulus.

Effects of long-term exercise in polluted air on respiratory health

The effects of long-term exposure to air pollution are well understood in the general population and have been the subject of numerous reviews. What is poorly understood is the degree to which athletes are more at risk due to increased ventilatory rates (during exertion) that will increase pollution intake. While the fraction of a given day associated with increased exertion (due to training and competition) is limited it nonetheless is non-trivial and for some athletes particularly in peak periods can amount to several hours per day. While dose-response relationships are non-linear, the known multi-fold increases in airway exposure to particles and gases upon increased exertion can reasonably be expected to have an adverse cumulative impact over years of athleticism. On the other hand, some authors suggested the chronic exposure to pollutants in recreational athletes could lead to adaptations and, accordingly, some mitigation of airway response and some markers of oxidative stress and inflammation [113]. If this hopeful supposition is validated, performance may therefore be less affected than feared.

Effects of air pollution on sports performance

Potential mechanisms of impact on athletic performance

Air pollution can affect exercise performance in healthy athletes, primarily due to its impacts on the respiratory system [114]. However, its influence may extend to cardiovascular [115] and muscular systems as well [116], though these effects are less well understood and warrant further investigation. Exposure to various pollutants lead to an oxidative stress and inflammation in the airways, leading to an increase in pulmonary resistance, a significant decrease in lung function, and respiratory symptoms. Gas exchange may thus be impaired, reducing oxygen availability to the muscles during physical activity. This can lead athletes to experience fatigue earlier, heightened perception of effort, and a reduction in endurance or at least maximal performance capacities [18,114]. Moreover, exposure to some pollutants during exercise could increase cardiovascular stress, raising heart rate and systemic or pulmonary

blood pressure, which would reduce exercise efficiency [115,117]. In addition to its effects on physical performance, air pollution could also impair cognitive function in healthy athletes, leading to a decrease in technical or strategical skills in sport. Exposure to air pollutants have been shown to negatively affect brain function, leading to difficulties with attention, memory, reaction time, executive function task performance, and decision-making [118,119], all of which can be critical during team or technical sports performance. Finally, Air pollution, through oxidative stress and inflammation, may significantly affect metabolic processes, including glucose metabolism, mitochondrial function, and lipid regulation, while also disrupting insulin signalling [120]. These changes could potentially reduce the efficiency of both aerobic and anaerobic energy systems. Additionally, impacts on iron metabolism and other organs could be hypothesised, though comprehensive studies are lacking. The effects of air pollutants on the adaptation processes to training also remain largely unexplored, highlighting the need for further research in this area.

Individual susceptibility

In addition to the vulnerability attributed to higher pollutant concentration, there is susceptibility imposed by individual characteristics [121], including a genetic susceptibility [122,123], and that has not yet been clearly characterised in this context, as only a few studies have been carried out in elite athletes. Variants in genes of oxidative stress metabolism are common, and these common variants can acutely decrease airflow by nearly 25% when pollution is combined with allergen exposure, at least in laboratory settings [124]. While these simulations do precisely mimic competitive settings, they are proof of principle of oxidative stress as a critical mechanism for impact on relevant physiology; one can easily imagine that even a minor version of such an effect in an elite athlete could have serious implications on performance. Interestingly, the most studied of these variants, GSTM1, did not influence the response to ozone, in particular, in a controlled human exposure study [125]. This suggests that

for ozone, other susceptibility factors may be at play, but a multicentre study was unable to identify them in spite of an attempt to carefully do so [126]. The individual susceptibility will be highlighted in the following paragraphs, where applicable.

Experimental and Epidemiological observations

Randomized control studies examined time trials, physiological parameters, or rate of perceived exertion in exposure chambers with a single or a mixture of air pollutants *versus* filtered air [108]. Under real conditions, mainly using economic models applied to sports, the productivity of athletes has been estimated based on their performance, defined according to the sport studied, in conjunction with available data on air pollutants. The sports studied are mainly athletics, endurance sports (running, marathon, triathlon), and team sports (soccer, football, baseball, basketball) and the performances studied are measured performances and technical skills. The measured performances were assessed by tracking the timed running or cycling performances of athletes over several seasons, or by studying the performances achieved at various international marathons, athletic meetings, triathlons, or during games or training in team sports. These performances were then linked to environmental measurements taken in the cities, which are generally accessible.

Exposure chambers and randomized control trials

Each pollutant has been studied individually during exercising in exposure chambers, at different inhaled doses in healthy subjects. Few reviews have been published on the acute effects of PM, NO_2, peroxyacetyl nitrate, CO, O_3, SO_2 or a mixture of several pollutants, using randomized control trials (RCT) [18,108,114,127]. Despite the literature suggesting impaired general cognitive function in the general population due to air pollutants exposure [119,128], no RCT studies have been led in athletes on the effects of pollutants on cognitive function. Irrespective of the pollutant, no strong evidence in favour of an acute effect on submaximal or maximal aerobic performance was observed at the concentrations studied, despite a significant

decrease in lung function and respiratory symptoms, in some individual cases. However, there is an individual susceptibility to pollutants, the proportion of which depends on the dose inhaled, and the failure to study sensitive subjects separately from others, does not allow us to conclude with certainty that pollutants have no effect on performance on an individual basis. In fact, it is likely that for some athletes, the effects on performance may be significant, leading to the cessation of exercise, as it has been observed in elite cyclists and runners [129,130]. Few RCTs have been conducted in highly trained athletes ($\dot{V}O_2$ max> 60 ml/kg/min for men and $\dot{V}O_2$ max> 55 ml/kg/min for women) during a simulated race, and to the best of our knowledge, all have been conducted with O_3. In 10 healthy young male runners (mean $\dot{V}O_2$max : 65±3 ml/kg/min) performing a 30 min cycle race at 85% $\dot{V}O_2$ max (competition simulation) when exposed to filtered air or O_3 (at concentrations of 0.20 ppm and 0.35 ppm), Adams and Schelegle [129] reported that at the highest concentration (0.35 ppm, inhaled dose≥1680 ppm/l) 4 runners had to abandon exercise, and 9 said they would not have been able to perform at their best in a competition under these conditions and one was unsure. At a concentration of 0.20 ppm, (inhaled dose ≥ 960 ppm/l), already 4/10 felt they couldn't have performed maximally if required to compete under such conditions and one was unsure. In 17 elite competitive road cyclists (15 men, 2 women) cycling 60 min at 70% $\dot{V}O_2$ max and then until maximum (incremental exercise), when exposed to filtered air, 0.12 ppm (inhaled dose = 706±142 ppm/l) or 0.20 ppm (inhaled dose = 1094±209 ppm/l) O_3, no statistical difference in submaximal or maximal performance was observed by the authors, despite all of the cyclists complaining of respiratory symptoms [130]. However, 5 subjects were only able to complete 41 to 55 min of submaximal work during exposure to 0.20 ppm. Finally, of 50 trained competitive cyclists exposed to different concentrations of O_3 during a 60-min exercise at 50% $\dot{V}O_2$ max and a $\dot{V}E$ ~55 l/min, 16 and 3 had to reduce the workload to complete the exercise at concentrations of 0.32 ppm and 0.16 ppm, respectively [131].

Real-life conditions

Numerous articles have estimated the effect of air quality on athlete performance, using mathematical/statistical models applied to performance data from various events and data provided by official air quality monitoring associations on hourly concentration of air pollutants and weather conditions. One of the first studies to look at the link between pollution and performance in real conditions was carried out by Wayne et al. [132] in Los Angeles. All the running times achieved by the local team's athletes during competitions held on their athletics field between 1959 and 1964 were included in the analysis. These were then correlated with the hourly concentrations of pollutants provided by the Los Angeles County station, located 2 miles from the field. The authors concluded that the level of oxidants in the air the hours before the competition strongly correlated to the % decrease in performance (r=0.95). Despite the methodological biases, this study has the merit of being the first, and has subsequently led to other studies, mainly in athletic disciplines. Some studies have shown that an increase in $PM_{2.5}$ and PM_{10} levels leads to longer marathon and 5 km running times, especially for women [133,134], and may affect all the athletes [135]. This effect is likely due to a reduction in $\dot{V}O_2$ max and an increase in perceived exertion. It's worth noting that this correlation exists when pollutant levels do not surpass World Health Organization (WHO) thresholds. However, these performance variations may not be readily noticeable on an individual basis or within short-term studies [136,137]. To illustrate, despite pollutant levels being below WHO thresholds during the day, research has shown that each 10 ug/m^3 increase in PM_{10} results in a 1.4% increase in running time for female marathon runners [133]. When the air is highly polluted, the effects become more pronounced. For instance, during the 2014 Beijing Marathon, which had highly polluted air, the average marathon runner took about 12 minutes longer to complete the race compared to a day with moderately polluted air [138]. In amateur competitive Italian track and field athletes competing outdoors (running, jumping, throwing), Granella [139]

observed each 10 ug/m^3 increase in $PM_{2.5}$ results in a loss of one third of a percentile in nationwide rankings, even at concentrations well below the WHO threshold of 25 ug/m^3. The effects were larger as the average duration of an event increases [139]. The author did not report any differences between women and men, nor discernible impact of ozone on performance, but the effect of $PM_{2.5}$ was greater for athletes who perform in the top decile at least half of the competitions, compared to their peers [139].

Ozone is likely the pollutant with the most significant impact on endurance performance [140]. High concentrations of O_3 can lead to performance declines and up to 50% of participants abandoning their efforts [132,141]. Again, at lower atmospheric concentrations, the individual effects are hardly noticeable. However, one study estimated that athletic performance drops by 0.39% for each increase of around 20 ug/m^3 of O_3 [141]. In London commuter cyclists, the cycling speed was slowed down from 20 ppb of ozone (~35 ug.m^3), and every 10 ppb increase in ozone causes the cycling speed to decrease by 0.4% [142]. Analysing data from five Ironman events held annually in the USA over seven years, it was revealed that O_3 affects swimming performance, while $PM_{2.5}$ impacts cycling and running performance [143]. In the last study, a 20 ug/m^3 increase in O_3 resulted in a 1% increase in the mean final time, and a 1 mg/m^3 increase in $PM_{2.5}$ led to a 0.12% increase in the mean final time. Some authors have reported that professional or highly-trained athletes are less susceptible to the effects of pollutants, potentially because their exposure is shorter compared to other athletes [134,143].

Team sports are not immune to these effects. Reductions in the total distance covered per match, high-intensity effort, 30 m sprint speed, and the change of direction test have been reported in professional and adolescent soccer players [144–147]. Executive functions and soccer technical skills are also negatively affected by air pollution; it has been shown that the number of passes and the pass success rate decrease with poor air quality [148]; accuracy in soccer-specific tasks

measured via serious games is reduced with increases in PM_{10}, NO_2 and O_3 [146]; and cognitive function, i.e. cognitive flexibility, working memory and inhibitory control efficiency, is altered with increases in ambient NO_2 [146]. A poor air quality index has also been found to predict an increased number of mistakes and a decrease in interceptions in professional baseball and American football leagues (MLB and NFL) [149]. High levels of $PM_{2.5}$ in outdoor stadiums where games were played have also been shown to negatively affect the effectiveness of the defence in particular [150]. It has been suggested that the negative effect of acute pollution on the players of the visiting team, i.e. the number of passes and their success rate, may be much greater than on the players of the home team [148], giving the home team an advantage. In electronic sports (e-sports), the League of Legends study found that higher $PM_{2.5}$ levels in the indoor stadium improved the performance of the stronger team in a match and hindered that of the weaker team, regardless of the absolute strength of a team [151]. This affects decision making and tactics, especially in the weaker teams, favouring the better players. The $PM_{2.5}$ measured during the League of legends varied from 1.5 to 258 $\mu g/m^3$, with a mean of 36±28 $\mu g/m^3$ [151]. Finally, professional umpires have also been shown to be affected, and in baseball, an increase of 1 ppm in CO (3-hour average) and 2.6% in $PM_{2.5}$ (12-hour average) led to an 11% increase in umpiring errors [150].

It's important to note that the effects of pollution on performance can sometimes be overshadowed by the more substantial impact of heat [140]. However, these effects do exist and, although they may be relatively small in scale, they can affect outcomes in sporting events where victory is often determined by fractions of a second. In addition, training in polluted air can blunt training adaptations and increase fatigue. For example, young soccer players exposed to smog during a 12-week training period showed no improvement in the Cooper test and increased fatigue perception, despite having a similar training load [152]. Furthermore, air pollution levels negatively affect the physical activity behaviour of the general population

[153,154]. Thus, in addition to previously reported observations of reduced physical, technical, and cognitive performance, air pollution may increase training workload and make sustaining maximal effort more difficult. Finally, not all athletes are equally sensitive to pollutants. Some individuals are more affected than others, highlighting the need for further research to differentiate between sensitive and non-sensitive athletes and to understand the nuances of these effects.

Guidelines: Management of air quality to protect respiratory health and sports performance in athletes

Individual management plans and literature-based advice have been published previously [7,31,108,155]. Working with the host cities, a successful comprehensive management plan is also developed years before the Olympic Games to help improve AQ (and water quality) before the event (see below). Precise minimum levels of pollution or air quality above which a competition should be abandoned or postponed are not possible at present because of the considerable influence of meteorological conditions, physical activity and individual qualities, and the nature and composition of air pollution. Furthermore, it is not only the athletes but also the staff, officials (e.g. referees) and spectators who should be taken into account, meaning that the threshold could be gradual. Below the threshold recommended by the WHO, air pollution is not considered as a factor for adjusting training or limit physical activity. However, in 2019, it is estimated that more than 99% of the world's population was exposed to annual $PM_{2.5}$ concentrations above 5 ug/m^3, and more than 70% of the days per year had mean daily concentrations above 15 ug/m^3, rising to 90% in South and East Asia, including high-income countries such as Qatar and Singapore [156]. In these conditions, it is recommended that exposure to air pollutants during exercise should be avoided or reduced as much as possible. On the other hand, stopping all physical activity in the event of air pollution is not a sustainable

solution. Given the major health benefits of physical activity and the detrimental effects of sedentary lifestyles [157], it is crucial to encourage everyone to take part in physical activity and, where appropriate, to adapt it to environmental conditions. Although we currently lack data on patients' physical activity during pollution peaks, increased ventilation through exercise may increase the effects of pollutants at the organ level and may be partly responsible for the observed increase in emergency visits during pollution episodes. Therefore, physical activity in polluted environments should be adapted for sensitive people. To decrease the inhaled dose of pollutants, two options are available; (1) to reduce the instantaneous inhaled concentration of pollutants (the most effective method supported by real-time and anticipated air pollution measurements); (2) to reduce the ventilation, and/or duration of exercise.

Search for lower-concentrated locations or hours

Individual measures can be taken to reduce exposure to pollution during physical activity. The first is not to add to it. Driving a gasoline-powered car increases the concentration of pollutants in city air, and the inhalation of these pollutants by its occupants. Favouring active modes of transport allows for physical activity and contributes to the collective effort. However, some precautions should be taken to avoid increasing the inhaled dose. Being active in a low traffic area, choose a route between two points that avoids major roads, and staying as far away as possible from motor traffic or other sources of pollution may reduce the inhaled dose. Rundell et al. [158] measured air pollution (PM_1, CO, NO_2, SO_2 and O_3) locally in a university soccer field, with 12 measuring points around the stadium. The field was bordered on one side by a major interstate highway. The authors observed a strong relationship between ambient PM_1 concentration and distance from the highway, which was highly dependent on wind direction in relation to the busy particle source and the measurement sites. The highest particle counts were measured when the wind came from the motorway or on days when there was no measurable wind. The particles count at 80 m from the highway was 3-fold lower than the

number of particles at 30 m, illustrating the possibility of reducing the dose of particles inhaled during exercise, by moving away from the source, depending on the wind. This has since been confirmed by studies on commuting cyclists or walkers [159–162], that may be less exposed to PM, black carbon or NO_2 if they choose less busy roads or parks. Urban green spaces and forests [163], at least through the production of biogenic VOCs (i.e. terpenes), may be selected for their potential beneficial effects on mental and physical health, and probably all natural landscapes in general [164]. Although further studies are needed, a significant protective association between greenness and mortality was observed in highly active individuals [157], but not in less active individuals. The concentrations of pollutants are not continuous during the days and some hours of the day are more favourable than others [19]. Therefore, a strategy to avoid the peak pollutant concentration would be to train regularly during the least polluted hours.

Indoor physical activity can be an alternative to outdoor activity in the presence of air pollution, provided the indoor air is healthy. This is especially true in the case of O_3, where it may be impossible to avoid outdoor exposure. Ideally, if a person goes to a gym, it should be well ventilated, equipped with HEPA filters that facilitate the removal of PM, and have levels of PM or VOCs from indoor and outdoor sources that are then lower than those of polluted outdoor air. There is little O_3 formation indoors, and its concentration is mainly related to the room's ventilation system, including open windows. In the event of ozone, windows should be kept closed to prevent the gas from diffusing into the room, but care should be taken with CO_2 levels, which can build up if ventilation is poor. As seen in the first part, PM and COVs may come from inside the room, and if the physical activity is performed at home, in non-sport rooms, with an inappropriate ventilation system, or with a high concentration of O_3, VOCs and/or PM, the physical activity should be adjusted.

Adjust physical activity levels

To reduce the total ventilation through the decrease in intensity and duration of training/physical activity it may decrease the inhaled dose. In the case of physical activities less dependent on high levels of ventilation (i.e. relaxing practises, stretching, muscle conditioning, etc), less adaptation is probably needed due to the low ventilation. For this reason, despite no available studies on the risks of performing such activities during pollution alerts, it could be advisable for sensitive individuals to replace endurance or high intensity training session with one of these activities. In people less sensitive, a decrease in inhaled dose may be reached through a decrease in intensity (i.e. heart rate, power, speed, rate of perceived exertion, etc), by the replacement of HIIT (high intensity interval training, i.e. work bouts at 90% of maximal aerobic power) by MIIT (moderate intensity interval training, i.e. work bouts art 65% of maximal aerobic power), which are less asthmogenic [165] and require less ventilation, or by a decrease of planned running/walking pace. The duration may be decreased by reducing the number of bouts of exercise (for example, by reducing the length of a match) and increasing the rest periods or the global duration of the physical activity, for example. Continuous exercise may also be replaced by interval training exercise at a same intensity, less asthmogenics [165].

While acclimatisation is likely to occur after a few days, the long-term health effects of exposure are undesirable. Therefore, in the absence of further data, acclimatisation may be a voluntary short-term option for competitive athletes only, with pre-existing exposure at the competition site being preferable to artificial exposure in an exposure chamber [7,166].

The role of regulatory agency and sports organisations policies

Combined public and sports policies play an important role in reducing urban (but also rural) air pollution and ensuring good air quality for physical activity. Effective measures used at various international sporting events hosted by China, including the Summer and Winter Olympic Games, included production shutdowns and restrictions on heavily polluting industrial

activities, restrictions on motor vehicles and traffic control, and strict control of construction dust to reduce transient pollutant emissions [167,168]. If these measures are effective for $PM_{2.5}$, PM_{10}, NO_2, CO and SO_2, ozone is resistant [167]; this is consistent with observations made during the COVID-19 confinement, which showed a decrease in air pollutants except for O_3 which varies little or increases [169–179]. Nevertheless, these measures are the privilege of the major world sporting events, nearly exclusively the Olympic Games, and are seldom applied to other events. International sports organisations have also started to address the issue and are planning ways to improve the quality of air at sporting events. Launched in 2018, World Athletics, the global governing body for athletics and track and field, is leading the way with a commitment to record air quality at sporting events to protect athletes and recreational runners from the harmful effects of air pollution [19]. Their aim is to identify site-specific pollution patterns and their sources by real-time monitoring and data collection over several sporting events, weeks, or months. To this end, Viana et al. [19] deployed 6 identical medium-cost air quality monitors in the main sports stadiums of 6 major cities around the world, over a period of one year. The aim was to evaluate the extent to which these monitors can contribute to the characterisation of air quality and assist stadium operators in providing recommendations to the athlete community to minimise exposure to air pollutants. World Athletics' broader objectives are to campaign and advocate for clean air by providing real-time information on air quality in athletics stadiums or during athletics events; to use these data to influence policy, find solutions to air pollution, create awareness campaigns and propose mitigation initiatives around athletic events; and to work with local and national governments, media and communication partners to share air quality monitoring results [88]. Finally, easy access to green spaces for children and adults to be active in a less polluted area should be equitable for the whole population. The creation of such green spaces in specific areas could be a tool to promote health equity and

provide urban planners, park managers and public health professionals with ways to address health inequalities [180].

The role of information and education

"If you want to reduce your exposure to pollutants, you need to know how much you are exposed to". The information currently available is often inadequate and not localised, particularly for indoor areas. What's more, the public has been shown to be often unaware of their country advice on how to exercise according to their health status, despite being conscious of the fact that air pollution may impact health [181–183]. A first step, as mentioned above, would be not only to have existing air quality monitoring sites and tools at our disposal, but also to measure and clearly display the air quality in each establishment hosting a physical and/or sports activity. To indicate the official recommendation corresponding to the colour of the AQ index would help people to take a decision on their attendance or not to a sport site and eventually adapt their physical activity programme. Exercise specific recommendations based on the AQI have indeed been proposed by some countries (Tables 5 and 6).

Table 5. US EPA exercise-specific recommendations according to the pollutant *[99]*

AQ index	AQ category	Health implication	Cautionary statement on outdoor physical activity*
0-50	**Good**	AQ is considered satisfactory, and air pollution poses little or no risk	It's a great day to be active outside.
51-100	**Moderate**	**Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.**	**Unusually sensitive people**: **O_3 and PM**: Consider making outdoor activities shorter and less intense. Watch for symptoms such as coughing or shortness of breath. These are signs to take it easier. **NO_2**: Consider limiting prolonged exertion especially near busy road. **CO:** It's a great day to be active outside. **SO_2**: It's a great day to be active outside.
101-150	**Unhealthy for sensitive groups**	Members of sensitive groups may experience health effects. The public is not likely to be affected.	**Sensitive groups**: **O_3:** Make outdoor activities shorter and less intense. Take more breaks. Watch for symptoms such as coughing or shortness of breath. Plan outdoor activities in the morning when ozone is lower. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **PM**: Make outdoor activities shorter and less intense. It's OK to be active outdoors but take more breaks. Watch for symptoms such as coughing or shortness of breath. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **People with heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider **NO_2:** Limit prolonged exertion outdoors, especially near busy roads. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **CO:** Limit heavy exertion outdoors and avoid sources of CO, such as heavy traffic **SO_2:** Consider limiting outdoor exertion. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy.
151-200	**Unhealthy**	Everyone may begin to experience health effects; Members of sensitive groups may experience more serious health effects.	**Sensitive groups**: **O_3**: Make outdoor activities shorter and less intense. Take more breaks. Watch for symptoms such as coughing or shortness of breath. Plan outdoor activities in the morning when ozone is lower. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **PM**: Make outdoor activities shorter and less intense. It's OK to be active outdoors but take more breaks. Watch for symptoms such as coughing or shortness of breath. **People**

			with asthma: Follow your asthma action plan and keep quick relief medicine handy. **People with heart disease**: Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **CO**: Limit moderate outdoor exertion and avoid sources of CO, such as heavy traffic. **NO_2**: Avoid prolonged outdoor exertion near roadways. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **SO_2:** Limit outdoor exertion. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy. **Everyone else:** **O_3**: Reduce long or intense outdoor activity. Take more breaks, do less intense activities. Schedule outdoor activities in the morning when O_3 is lower. **PM:** Keep outdoor activities shorter and less intense. Go inside if you have symptoms. **NO_2:** Limit prolonged outdoor exertion especially near busy roads
201-300	**Very Unhealthy**	Health warnings of emergency conditions. The entire population is more likely to be affected.	**Sensitive groups**: **O_3**: Avoid all physical activity outdoors. Move activities indoors** or reschedule to when air quality will be better. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **PM:** Avoid all physical activity outdoors. Reschedule to a time when air quality is better or move activities indoors**. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy. **People with heart disease**: Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **CO**: Avoid outdoor exertion and sources of CO, such as heavy traffic **NO_2**: Avoid all outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **SO_2:** Avoid outdoor exertion. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy. **Everyovne else** **O_3**: Avoid long or intense outdoor exertion. Schedule outdoor activities in the morning when O_3 is lower. Consider moving activities indoors. **PM:** Limit outdoor physical activity. Go indoors if you have symptoms.

			NO_2: Avoid prolonged outdoor exertion especially near busy roads. **SO_2:** Reduce outdoor exertion.
300+	**Hazardous**	Health alert; Everyone may experience more serious health effects.	**Sensitive groups**: **O_3**: **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **PM:** Stay indoors** and keep activity levels light. Follow tips for keeping particle levels low indoors. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy. **People with heart disease**: Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **CO**: Avoid outdoor exertion and sources of CO, such as heavy traffic **NO_2**: Remain indoors Avoid all outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **SO_2:** Remain indoors. **People with asthma**: Follow your asthma action plan and keep quick relief medicine handy. **Everyone:** **O_3**: Avoid all physical activity outdoors. **PM:** Avoid all physical activity outdoors. **CO:** Limit heavy outdoor exertion. **NO_2**: Avoid all outdoor exertion. **SO_2**: Avoid outdoor exertion.

Unusually sensitive groups are people with heightened sensitivity to pollutants: This can include individuals with allergies or those who are sensitive to specific components of air pollution. **Sensitive** groups for **O_3** are people with lung disease, such as asthma; children, including teenagers, people who are active outdoors, and older adults; for **PM**: people with heart or lung disease; older adults; and children, including teenagers. In addition, some minority groups, people with lower incomes, and outdoor workers may experience higher exposure that can worsen underlying health conditions; for **CO**: people with heart disease; **NO_2**: people with lung disease, such as asthma, children, including teenagers,

and older adults; for **SO_2**: people with asthma, children, and older adults [99]. **be careful of indoor heat and CO_2. AQ: Air quality; US EPA: United States Environmental Protection Agency.

Table 6. Australian Institute of Sport exercise-specific recommendations according to $PM_{2.5}$ for high performance athletes *[31]*

$PM_{2.5}$ AQ category	**Hourly $PM_{2.5}$ concentrations (ug/m^3)**	**Exercise-specific recommendations**
Good	<25	• All forms of exercise are encouraged **At risk individuals and unusually sensitive people:** • Consider the previous 5 days air quality exposure • At risk individuals may still get increased symptom and need to seek medical advice
Fair	25-50	**Sensitive individuals:** Think to alter training to reduce potential exposure. Prolonged high intensity endurance exercise (e.g. rowing, cycling, long-distance running) may need to be completed indoors. If exposure is unavoidable (i.e. schedule match), defer the next 3-5 days to allow recovery. **Others**: Most individuals will tolerate exercise as normal, without symptoms.
Poor to very poor	51-150	**Sensitive and at risk individuals:** • Limit exposure as much as practical **Others**: • Complete prolonged high intensity endurance activities (e.g. rowing, cycling, long-distance running) in a facility with better air quality • Intermittent exercise (e.g. tennis, netball, beach volleyball, cricket) and power activities (e.g. sprint training, javelin training, jump training, rugby skills training) represent less risk than prolonged high intensity endurance activities. However, risk remains elevated above baseline and susceptible athletes should have a current asthma management plan and relevant medications accessible during the session. • Non susceptible individuals may unexpectedly develop symptoms at these concentrations and should seek medical review early
Very poor to extremely poor	>150	• All efforts should be made to reduce smoke exposure as much as is practical. • Reschedule events, relocate them indoors, shorten overall time outdoors etc. • Where there is an attention to play organised high-level sport and there are medical staff on site to advise, these levels of pollution should trigger a discussion between medical staff and officials about the advisability or otherwise of proceeding with the event.

For outdoor sports, or in places where there are no available sensors, individual sensors measuring particles and VOCs can be envisaged. However, if such sensors in addition to an education programme led to an increased awareness and positive behaviour changes [184], their acceptability, and the effects of using such sensors on long-term behaviour in adults and children still need to be studied. Indeed, for example, the use of connected objects to monitor step counts has been shown to be very efficient in the short term in adults but this efficiency decreases over time [185]. Social inequality in purchasing these sensors and access to less polluted places to exercise are also still under-researched issues.

The awareness of air quality index of the adult population is far from being optimal. In the US, a study on a large survey led on adults showed a third to 54% of the population being aware of the AQ alerts, and only 19% of adolescents [181–183]. The main channels accounting for 75% of the AQ advisories were the TV, radio, and newspapers [182]. In adolescents, the AQ awareness was similar in asthmatics *vs* non-asthmatics, whereas in adults, the awareness was greater in patients with asthma (but not in COPD nor heart disease). Awareness was lower in places where the AQ index was not available. An increasing number of days with poor air quality was associated with increased awareness of air quality alerts, perception of air quality and changes in behaviour due to poor air quality. The adherence rates to health advices accompanying AQ index is largely suboptimal [186]. The change in behaviour or activities associated with a poor AQ index have been reported in only 10-15% of the US adult population studied [181,182]. Behavioural changes include reducing time spent outdoors (9%), reducing strenuous activities (3%), exercising indoors rather than outdoors (3%), and changing the timing or characteristics of physical activity (2%) [181]. The change in behaviours is, however, more related to the perception of poor air quality, which itself is not related to $PM_{2.5}$ or O_3 measures, than to AQ advisories [182]. Psychosocial facilitators were identified as knowledge on where to find AQ indices, beliefs that one's symptoms were due to air pollution or perception of poor

AQ (not related to $PM_{2.5}$ or O_3 measures), and advice received by health care professionals [182,186]. The severity of air pollution is also a facilitator, such as during wildfires, the adherence and change in behaviours is close to 100% [187]. To the contrary, barriers to adherence included lack of understanding of the AQ indices, and lack of time [186]. Care should be taken regarding the role of education in asthmatic patients, as being registered to an air quality alert system for those has been associated with an 4-fold increase in emergency admissions and 2-fold increase in emergency admissions for respiratory condition compared to a control group of asthmatics not receiving the alerts [188]. In addition, which can make it difficult to assess the effectiveness of these communications, the health advice associated with AQ alerts is rarely specific and exhaustive.

History of air pollution and the Summer Olympics

Past Olympic Games

This section is based on the experience of Ken Fitch, who was a physician at the 1972 Olympic Games and served as chief physician at every Olympic Games from 1975 to 1984. A detailed review can be found in reference [189]. The 1984 Los Angeles Olympic Games was when air pollution (AP) first became a potential problem for elite athletes. In book published in 1981 and titled '*Air pollution and athletic performance'*, McCafferty explained why AP in Los Angeles posed a threat to these Olympic Games [190]. In the lead up to these Games, some Olympic athletes experienced respiratory side-effects, however major reductions in and modifications to vehicular traffic during the Games, undertaken to facilitate enhanced transport for Games' spectators, appeared to almost completely rectify these issues [189]. In 1984, air quality (AQ) monitoring in USA was both in its infancy and could not be satisfactorily correlated with the traffic changes. Twelve years later, again it was the outcome of traffic modifications in Atlanta 1996 that resulted in benefits for residents due to changes to traffic. Significant reductions in emergency attendances for asthma were reported and no athlete reported any health problems

that could have been due to AP during these Olympic Games [191]. On this occasion, there was some correlation with AQ, with significant reductions in both PM_{10} and O_3 reported during the Games although the data was only from a couple of monitoring sites.

Prior to the 2008 Beijing Olympics, the IOC established an AQ Expert Panel that liaised with the Beijing Organising Committee to monitor AQ during these Games. A huge and costly effort to improve AQ during the Olympic and Paralympic Games (OPG) by the Beijing Municipal Authority and overseen by the Beijing Environmental Protection Bureau included the cessation of all construction in the city of Beijing and major reductions to permitted traffic that significantly reduced Traffic Related Air Pollution (TRAP). This was supplemented by many projects to enhance the 'greening' of the city and surrounds. The primary pollutant monitored was PM_{10} – it would be a few years before the concentration of ambient $PM_{2.5}$ would become part of the AQ Index (AQI). The available AQ data indicated that acceptable concentrations of PM_{10} prevailed during the Games and no athlete is known to have experienced any ill-effects from AP [192]. The improvement in AQ during the Games was verified by data from a NASA satellite [193]. Sadly, Beijing's AP reverted to the Pre-Games high level almost immediately post-Paralympics when construction and traffic were again unrestricted. The IOC's AQ Expert Panel had advised that endurance events that demanded one hour or more of continuous high intensity exercise placed the participating athletes at greatest risk if the AP was poor [189].

It is not only athletes who experience health problems from wildfires. A detailed report to the Australian government estimated that pollution from the Australian wildfires of 2019-2020 caused 2,027 people to be admitted to hospital with respiratory problems, 1,305 people to go to emergency departments with asthma-related conditions, around 1,124 people were admitted to hospital with cardiovascular problems caused by the fires, and the bushfire smoke was responsible for 417 deaths [194]. Psychological health, particularly anxiety, is also a concern during wildfires and can have long-term consequences for some individuals [195,196]. More

recently, megafires in Canada in Spring-Summer 2023 have again raised the question of the dangers of physical activity in the event of major pollution.

Air pollution, the recent and the future Summer Olympic and Paralympic Games Paris 2024

French information and alert thresholds

In France, an inter-ministerial order defines the information and warning procedure in the event of a pollution incident and organizes emergency measures to inform the population and reduce and/or limit the emission of pollutants into the atmosphere in order to limit the impact on health [197]. This procedure is defined in an inter-prefectural order for the Paris area [198]. The process has two distinct levels associated with different thresholds: an information level and an alert level. The information threshold corresponds to a level of pollutant concentration in the atmosphere above which short-term exposure poses a risk to the human health of particularly sensitive sections of the population, requiring immediate and appropriate information to be given to these groups and recommendations to reduce certain emissions. The alert threshold corresponds to a level of pollutant concentration in the atmosphere above which short-term exposure poses a risk to the health of the population as a whole or to the environment, justifying emergency action. In October 2021, the French *Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail* (ANSES) published a review notice on the revision of the thresholds for triggering prefectural procedures in the event of ambient air pollution episodes. It is possible that the information and alert thresholds will be modified for the 2030 Olympic Games, which may be held in France, at the time of writing. The current information and alert thresholds and ANSES recommendations are shown in Table 7. The new information threshold suggested by ANSES corresponds to the transition from moderate to poor air quality and the alert threshold corresponds to the transition from poor to very poor air quality, using the new ATMO France AQ index (2020) (Table 8) [199]. While the air quality index essentially reflects the pollutant with the highest concentration, new indices have been

developed, such as the ICAIR presented in 2023, which is the cumulative air quality index accepted at European level, considering the cumulative effects of different pollutants [96].

Table 7. French information and alert thresholds *[200]* and recommended revisions from ANSES *[201]*

Air pollutant		**Information threshold**		**Alert threshold**		
$PM_{2.5}$	Daily mean	25 µg.m^{-3}		50 µg.m^{-3}		
PM_{10}	Daily mean	50 µg.m^{-3}		80 µg.m^{-3} 100 µg.m^{-3}		
O_3	Hourly mean	180 µg.m^{-3} 130 µg.m^{-3}		**Level 1** 240 µg.m^{-3} at least 3 consecutive hours	**Level 2** 300 µg.m^{-3} for at least 3 consecutive hours	**Level 3** 360 µg.m^{-3}
NO_2	Hourly mean	200 µg.m^{-3} 120 µg.m^{-3}		400 µg.m^{-3} or 200 µg.m^{-3} if the information and recommendations procedure was triggered the day before and on the same day and if the forecasts indicate a risk for the following day 230 µg.m^{-3}		
SO_2	Hourly mean	300 µg.m^{-3} 350µg.m^{-3}		500 µg.m^{-3}		

Legend. In black: French legislation (Accessed 27 March 2024). In grey, suggested ANSES 2021 revised thresholds when needed. The procedure is triggered for a pollutant when the relevant threshold is exceeded or when Airparif, the accredited association responsible for monitoring and providing information on air quality in the Paris region, predicts a risk of exceeding the threshold. During periods of peak of air pollution, the Ministry of Health reminds people of the health recommendations [161]. These recommendations are available in French on the website of the Île-de-France Regional Health Agency [202]. *Once the procedure has been triggered, the information measures, recommendations and measures taken by the authorities to reduce pollution come into force for 24 hours. They are renewed if necessary.*

Table 8. ATMO France AQ index (ATMO AQI)

		ATMO AQI (Decree of 10 July 2020)[203]					
		Good	**Satisfactory**	**Moderate**	**Poor**	**Very poor**	**Extremely poor**
(French)		***Bon***	***Moyen***	***Dégradé***	***Mauvais***	***Très mauvais***	***Extrêmement mauvais***
$PM_{2.5}$	Daily mean	0-10	11-20	21-25	26-50	51-75	>75
PM_{10}	Daily mean	0-20	21-40	41-50	51-100	101-150	>150
NO_2	Max hourly mean	0-40	41-90	91-120	121-230	231-340	>340
O_3	Max hourly mean	0-50	51-100	101-130	131-240	241-380	>380
SO_2	May hourly mean	0-100	101-200	201-350	351-500	501-750	>750

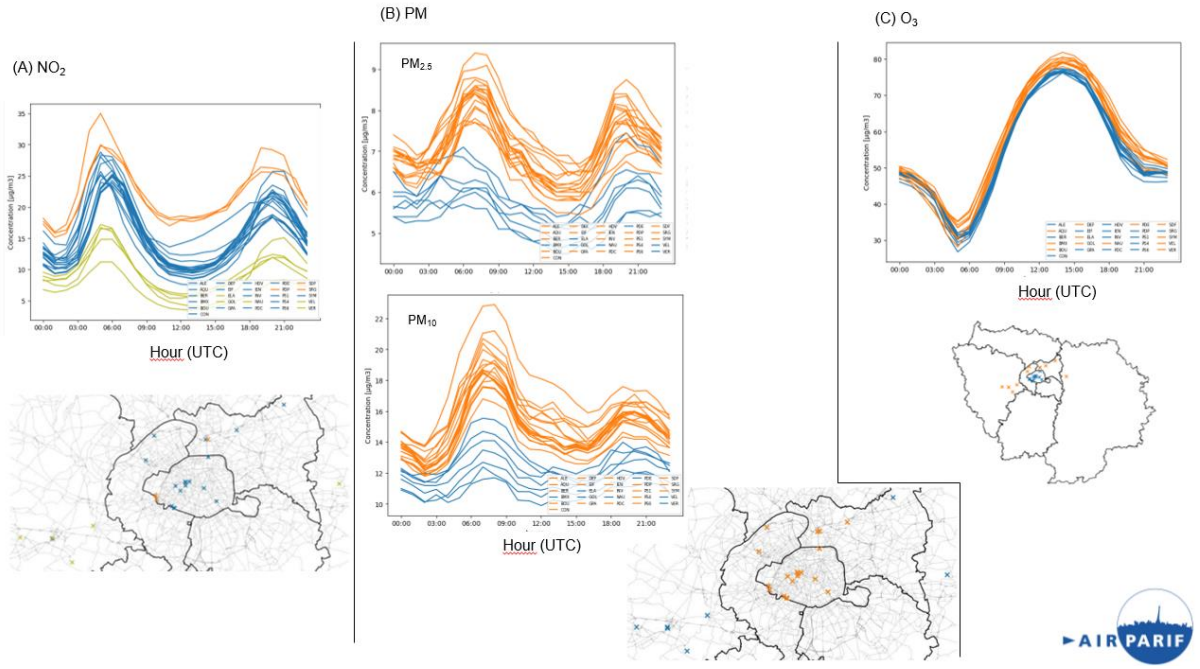
Legend. The AQI is a simplified representation of daily air quality in 'background' conditions, i.e. away from specific sources of pollution such as road traffic, for example. The ATMO AQI characterises the overall state of AQ to be expected during a day. It is calculated for a whole day. The index is calculated from 0 h UTC. The ATMO index is not intended to characterise air quality in the immediate vicinity of fixed or mobile sources of pollution (road junctions, fixed installations emitting pollutants, etc.). This index does not replace the specific information provided to the public, particularly when regulatory pollution regulatory pollution thresholds are exceeded.

Air quality forecast before the OPG

The last summer Olympic Games occurred from the 26th July to 11th August and from 28th August to 8th September 2024 for Paralympic Games at various sites in Paris (https://www.paris2024.org/fr/sites-de-competition/). The air quality data for the summer months in the Paris area, collected from 2020 to 2023, were analysed to inform attendees of the 2024 OPG about typical air quality conditions during this season [204]. In summary, data from 50 permanent autonomous air quality monitoring stations and *Airparif's* modeling chains were utilized to create spatial maps of air quality for each existing Olympic site in the region. This analysis also considered information from the organizers regarding the expected reduction in traffic during the Games. In brief, before the OPG air pollution levels were expected to be within accepted air quality thresholds at the Paris OPG [204]. However, in the case of very hot

and clear conditions, O_3 concentrations were expected to be significantly raised during the afternoon whatever the location (traffic, urban or rural area). It is to note that the maximum O_3 concentration reported to one station during previous summers (2020-2023) was of 221 $\mu g.m^{-3}$, so above the French information hourly threshold (180 $\mu g.m^{-3}$), but below the alert threshold (240 $\mu g.m^{-3}$). Clustering of air quality in Paris area at the Olympic sites before the OPG, according to values from summers 2020 to 2023, is summarised in Figure 1 [204].

Figure 1. Clustering of air quality in Paris region at the Olympic sites for the main pollutants in the summers (July to September) 2020 to 2023 *[204]*



Legend: Each curve represents the modelled daily median for each Olympic site (July-September, 2020-2023). Each identified cluster has a different colour. Two clusters were identified for $PM_{2.5}$ and PM_{10} and three for NO_2. Each Olympic venue is represented by a cross on the map of the Paris region (and by an abbreviation on the hourly median). The colour of each cross corresponds to the colour of the cluster in which that site is identified on the hourly evolution graph. For ozone, no significant difference was found between the sites in terms of median profiles, the colours *represent the venues in the urban area (blue) and the suburban areas (orange). Hours are expressed as coordinated universal time (UTC). To obtain the local hour add 2h (Paris: UTC+2h). The figure was produced by Airparif.*

Air quality during the OPG

During the period of the event, to support and inform athletes, spectators, and residents about air pollution exposure, *Airparif* introduced hourly air quality forecasts to help adapt routes and

behaviors based on air quality, especially during pollution or heatwave episodes. Available on the *Airparif* website and mobile app, users could track hourly air quality predictions for every street in the Paris area. For the OPG, *Airparif* also added a feature to zoom in on specific Olympic sites and access detailed local air quality maps.

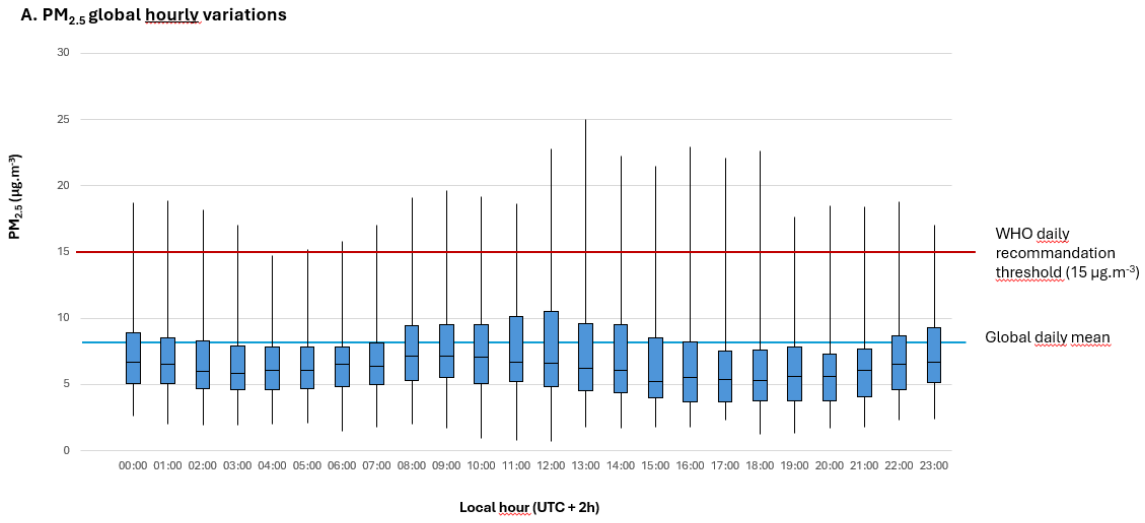
We conducted a brief *a posteriori* analysis of air quality in Paris area from July 26 to September 8, 2024, using Open data from *Airparif* [203]. Data from 24 stations for O_3, 18 stations for $PM_{2.5}$ (7 traffic, 8 urban and 3 rural stations) and 36 stations for NO_2 (9 traffic, 15 urban, and 2 rural stations) were analysed (Figures 2 to 7) and compared with previously published air quality forecasts [204]. The methodology differs slightly between the two periods as we did not exclude extreme values and instead directly used the station-level data available in the open dataset. However, in general, the observed air quality during OPG 2024 was similar to previous summers and aligned with expectations (Figures 2 to 7). Notably, during the summer of 2024, the O_3 information threshold was exceeded on one particularly hot day (30 July 2024, temperature ~34°), with the highest value recorded at one station being 199.8 $\mu g.m^{-3}$. The end of the French holiday period, especially towards the end of August, coincided with increased traffic congestion in the Paris area, and a peak in PM and NO_2 concentrations (Figures 2 and 6).

Figure 2. $PM_{2.5}$ hourly concentrations for the 18 stations (7 traffic stations, 8 urban stations, 3 rural stations) in the Paris area from the 26th July to 8th September 2024.



Legend: Traffic stations are represented in orange, urban stations in green and rural stations in blue. The data used is from open access Aiparif dataset.

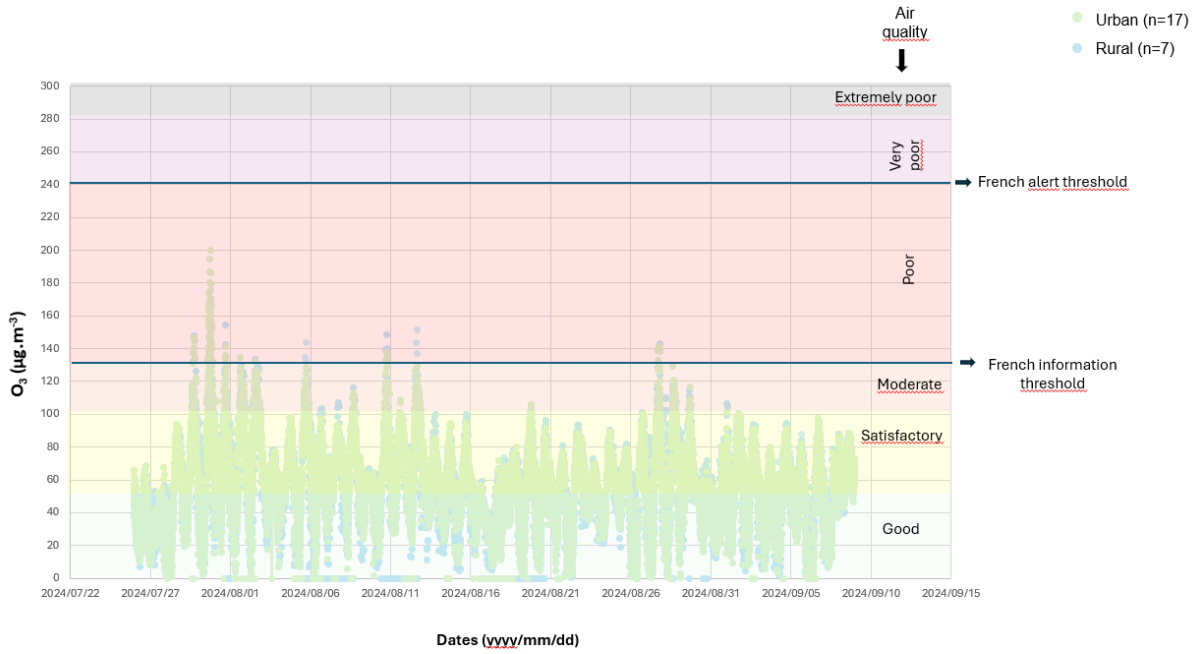
Figure 3. A. Global daily variations of PM2.5 concentrations and **B.** global daily mean values



B. $PM_{2.5}$ global daily mean values

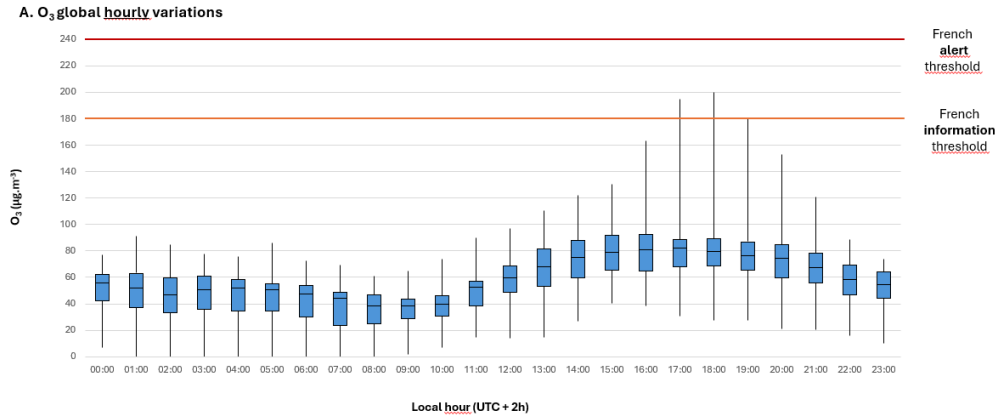
$PM_{2.5}$ (µg.m^{-3}) daily mean	Summer 2020-2023	Summer 2024 (OPG)
Traffic	11±6	9±3
Urban	7±4	7±3
Rural	5±4	4±3

Figure 4. O_3 hourly concentrations for the 24 stations (17 urban stations, 7 rural stations) in the Paris area from the 26th July to 8th September 2024.



Legend. In addition to the concentration levels recorded at each station during the OPG period, the air quality (ATMO AQI) is represented. The official AQI colors have been modified in the figure to enhance readability.

Figure 5. A. Global hourly variations of O_3 concentrations and **B.** Hourly exceedance and maximum O_3 values.



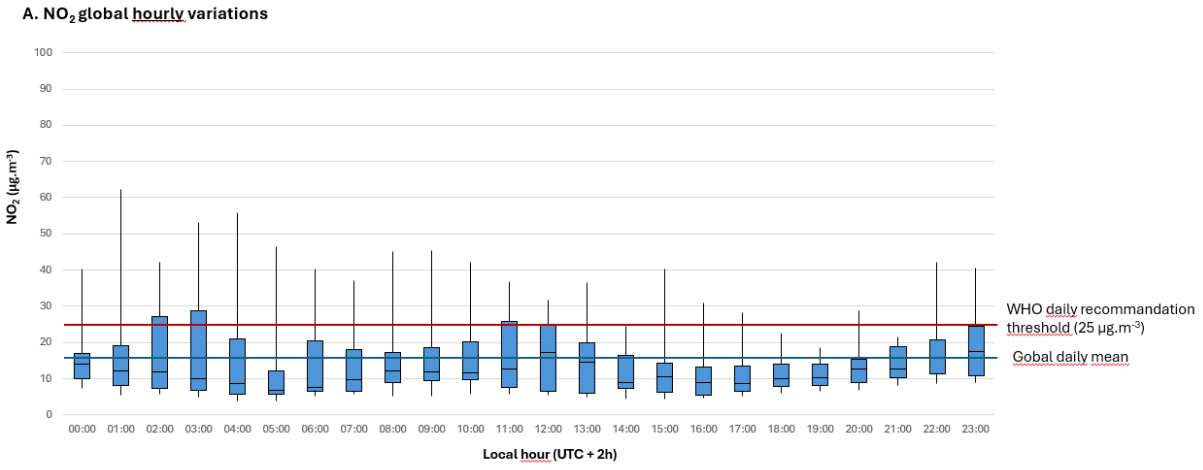
B. O_3 hourly threshold exceedance and maximum value

O_3 (µg.m^{-3}) hourly mean	Summer 2020-2023	Summer 2024 (OPG)
Number of exceedance of the French information hourly threshold (180 µg.m^{-3})	1 to 9 days a month	1 (30 July 2024)
Maximum hourly value recorded (µg.m^{-3})	221	199.8

Figure 6. NO_2 hourly concentrations for the 35 stations (9 traffic stations, 24 urban stations, 2 rural stations) in the Paris area from the 26th July to 8th September 2024.



Figure 7. **A.** NO_2 global hourly variations and **B.** NO_2 global daily mean values



B. NO_2 global daily values

NO_2 (µg.m^{-3}) daily mean	Summer 2020-2023	Summer 2024 (OPG)
Traffic	40±24	28±8
Urban	17±14	14±5
Rural	5±3	4±1

Los Angeles 2028

The 2028 Summer Olympic and Paralympic Games will be held in Los Angeles from 14 to 30 July and 15 to 27 August, respectively. Many studies on the effects of ozone on respiratory

health and performance were conducted before the 1984 Los Angeles Olympic Games, the region being famous for its poor air quality due to ozone in the summer, as shown in the evolution of mean O_3 concentrations during the years (Figures 8 and 9). O_3 has been declining in Los Angeles since 1984, thanks to regulations that lead to a decrement of its precursors such as NOx and VOCs [205,206]. However, it has been recently reaffirmed that the heatwave and lack of ventilation on consecutive days, as observed during recent years, could largely offset the regulation benefits [205,207,208]. Pfannerstill *et al*. recently reported that about 60% of O_3 in summertime Los Angeles is caused by biogenic VOCs emissions (especially terpenoids), and this contribution strongly increases with temperature [208]. The authors mention that at high temperatures, terpenoids became the main drivers for the formation potential of ozone and particles even in the downtown area, where traffic and consumer product emissions would be expected to be largest [208]. In a period of climate change, it is difficult to predict the air quality in Los Angeles in 2028, but with rising temperatures, drought and water scarcity, it is probable that biogenic VOCs will be increased during the summer, increasing O_3 and $PM_{2.5}$ [208]. All the updated concentrations and AQ data for Los Angeles county are freely available on the website of the US EPA [209]. The concentration plots of US EPA for O_3 and $PM_{2.5}$ and PM_{10} and NO_2 from 2019 to 2023 are shown in Figures 10 and 11. They confirm the region is at risk of high O_3 concentrations during July and August, especially in case of heatwave. From 2019 to 2023, the number of O_3 exceedance days (>0.07 ppm e.g. ~ 140 $\mu g/m^{-3}$) is quite stable and varies from 17 to 30 days in July and 19 to 22 days during August.

Figure 8. US EPA concentration plot on daily maximum 8-hour ozone concentrations rom 01/01/2019 to 12/31/2019 (https://www.epa.gov/outdoor-air-quality-data)

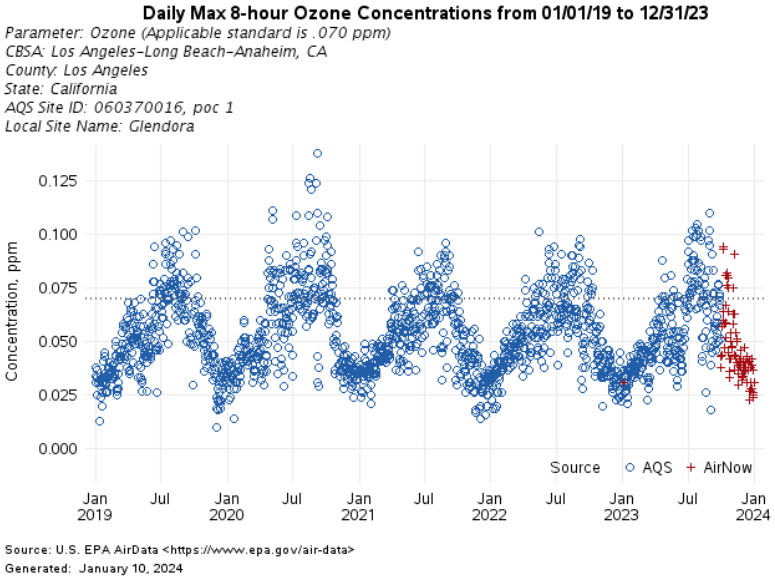


Figure 9. US EPA concentration plot on daily maximum 8-hour ozone concentrations from 01/01/2003 to 12/31/2023 (https://www.epa.gov/outdoor-air-quality-data)

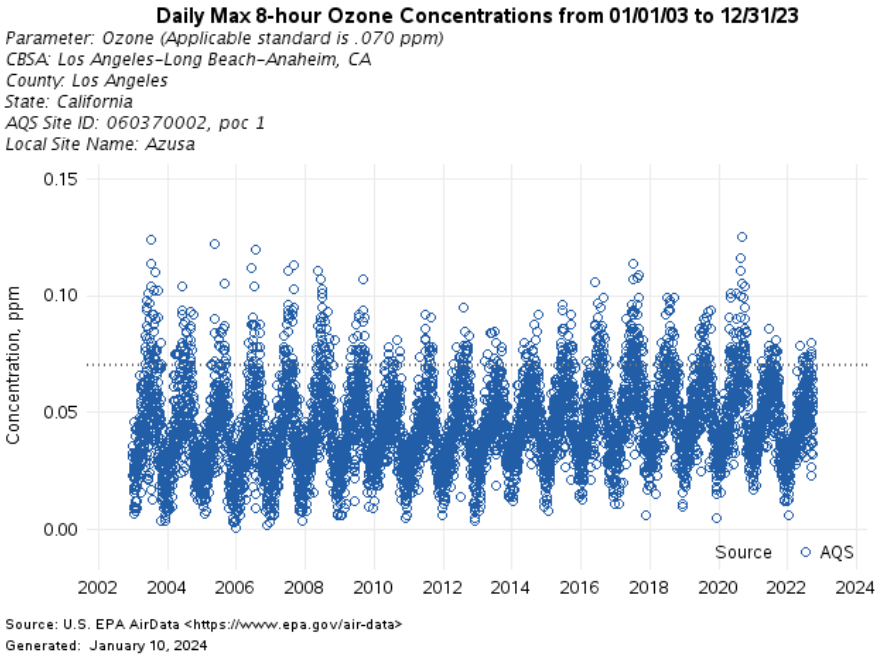


Figure 10. Daily O_3 and $PM_{2.5}$ air quality index (AQI) values from 2019 to 2023 in Los Angeles County, CA, USA.

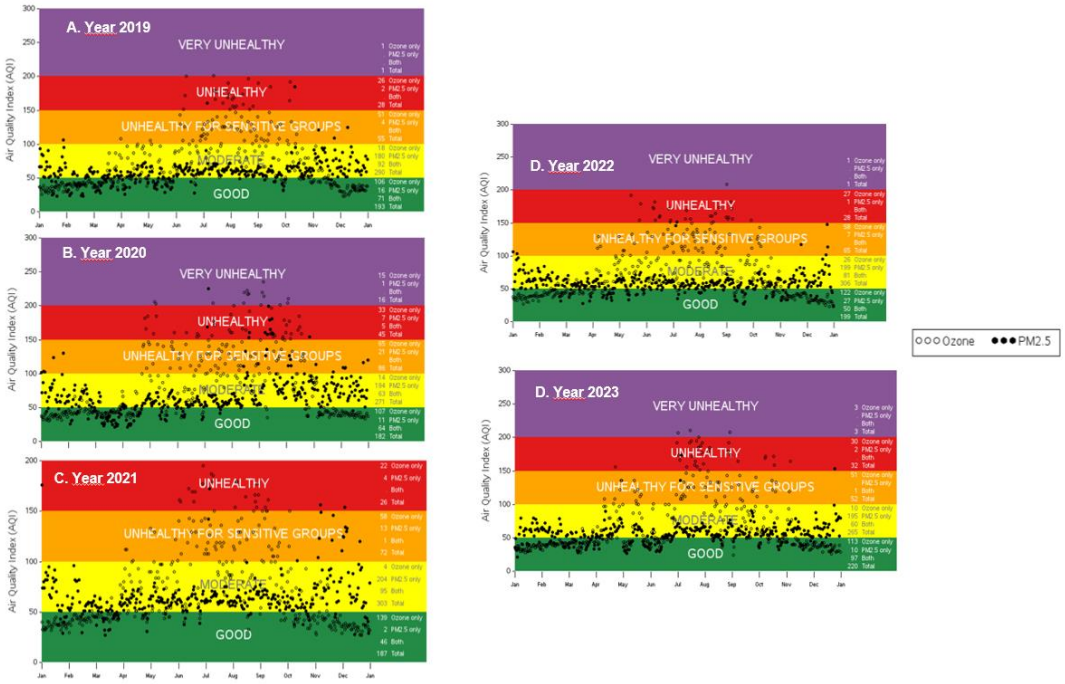
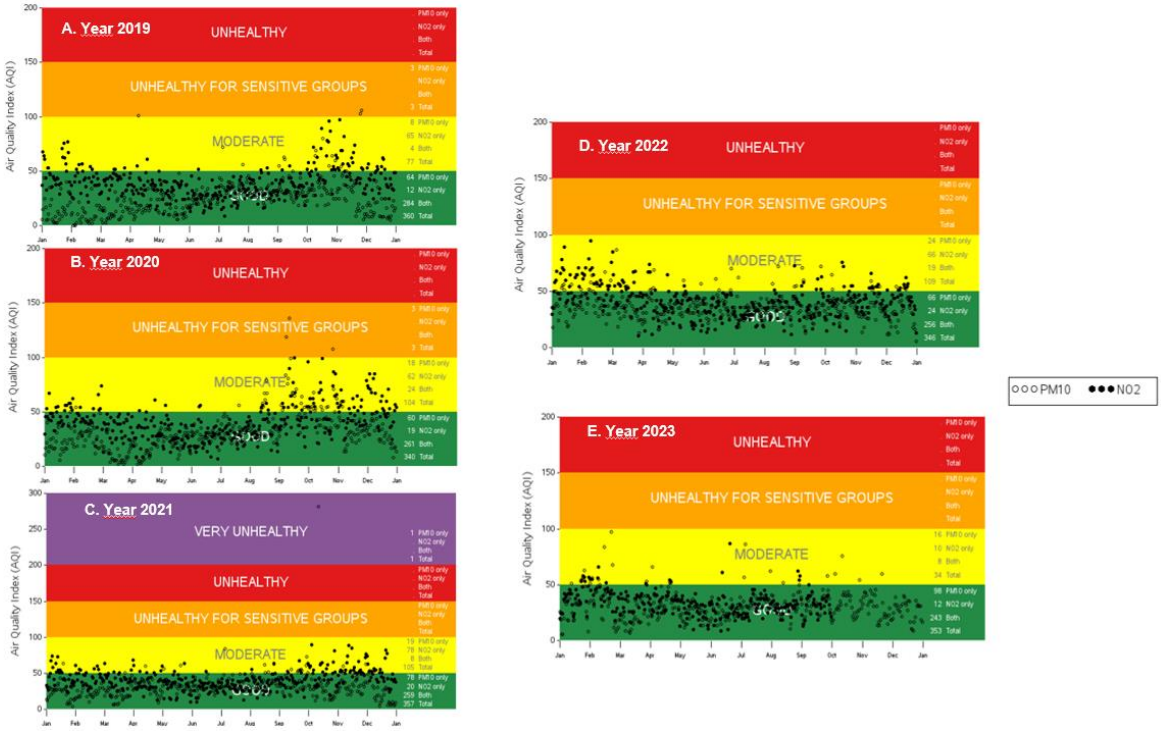


Figure 11. Daily O_3 and PM_{10} and NO_2 air quality index (AQI) values from 2019 to 2023 in Los Angeles County, CA, USA



Sources of both Figures: US Environmental Protection Agency. Air Quality System Data Mart [internet database] available via https://www.epa.gov/outdoor-air-quality-data. Accessed February 02, 2024.

Future research direction

Future research should focus on addressing critical gaps in our understanding of the effects of air pollution on athletic performance and health. First, A key area of focus should be the detailed characterisation of the 'athletic exposome', according to the sport, which includes all the environmental exposures that athletes face during training and competition, such as air pollutants (e.g. PM, O_3 and NO_2), temperature, humidity and allergens. Such data are crucial for understanding the interactions between these exposures and their cumulative effects on exercise performance. Current studies have shown that air pollution, particularly fine particulate matter (PM), and ozone (O_3), can notably impair lung function, provoke respiratory symptoms which can reduce negatively athletic performance in some endurance sport athletes. Further research should also continue to explore the specific mechanisms by which different air pollutants impact the respiratory system, including the increase pollutant-induced risk of acute respiratory infections [210], and how these pollutants might affect other physiological systems, including the cardiovascular, metabolic, and cognitive systems. Longitudinal studies could elucidate the chronic effects of exposure on training adaptations, recovery and long-term performance. Such data are crucial for understanding how chronic exposure to air pollution may alter athletes' ability to adapt to training, recover effectively, and maintain long-term performance and health. Addressing inter-individual variability, such as genetic predisposition and the influence of pre-existing conditions, the role of sex or training status, would provide insights into athletes' susceptibility and resilience. In addition, the development and validation of practical mitigation strategies, ranging from behavioural adaptations (education) to technological interventions, is still necessary to complement existing recommendations. Finally, collaborative efforts involving researchers, policymakers and sports organisations

could facilitate recommendations to reduce exposure during outdoor sports, especially in urban areas with high levels of pollution, while standardising methods for assessing both exposure and performance effects under different environmental conditions.

Conclusion

Athletes are unevenly exposed to a variety of air pollutants during their sporting activities, depending on where they live, train and compete. The means of measuring air quality have developed considerably in recent years but are still in their infancy and are poorly suited to sporting activities, especially those that require constant movement. Similarly, too few studies are currently available on the effects of acute exposure to air pollution during intense exercise, depending on the type and concentration of pollutants, confounding variables such as co-exposure, meteorological conditions, habitual exposure rates of athletes and exercise conditions (intensity, duration, type). It is not yet possible to give a clear answer to the demands of the sporting world as to the threshold at which an event should be cancelled or postponed, except in the case of dramatic concentrations (forest fires...). What criteria should be used? Health risks? The severity and frequency of respiratory symptoms in athletes depends on the individual, some being more sensitive than others, and on the concentration of the pollutant(s) during the sporting activity. Setting a threshold would mean choosing the number of athletes who withdraw from competition because of respiratory (or other) problems related to air pollution. It is likely that air pollution affects various aspects of performance, which increase with concentration and intensity of effort, although there is no conclusive evidence. No data are available on the risk-benefit balance of year-round exposure to air pollutants during sport training (chronic exposure) on health and performance. In the context of climate change, air pollution is likely to increase, with episodes of high pollutant concentrations. To better understand and act in the future, many studies are urgently needed to protect the health of

athletes, who should be models of good health. These studies will require the collaboration of scientists, sport and environmental stakeholders and decision-makers.

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End of the report



Annexure-21

Convention on the Rights of the Child

Adopted and opened for signature, ratification and accession by General Assembly resolution 44/25 of 20 November 1989

entry into force 2 September 1990, in accordance with article 49

Preamble

The States Parties to the present Convention,

Considering that, in accordance with the principles proclaimed in the Charter of the United Nations, recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world,

Bearing in mind that the peoples of the United Nations have, in the Charter, reaffirmed their faith in fundamental human rights and in the dignity and worth of the human person, and have determined to promote social progress and better standards of life in larger freedom,

Recognizing that the United Nations has, in the Universal Declaration of Human Rights and in the International Covenants on Human Rights, proclaimed and agreed that everyone is entitled to all the rights and freedoms set forth therein, without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status,

Recalling that, in the Universal Declaration of Human Rights, the United Nations has proclaimed that childhood is entitled to special care and assistance,

Convinced that the family, as the fundamental group of society and the natural environment for the growth and well-being of all its members and particularly children, should be afforded the necessary protection and assistance so that it can fully assume its responsibilities within the community,

Recognizing that the child, for the full and harmonious development of his or her personality, should grow up in a family environment, in an atmosphere of happiness, love and understanding,

Considering that the child should be fully prepared to live an individual life in society, and brought up in the spirit of the ideals proclaimed in the Charter of the United Nations, and in particular in the spirit of peace, dignity, tolerance, freedom, equality and solidarity,

Bearing in mind that the need to extend particular care to the child has been stated in the Geneva Declaration of the Rights of the Child of 1924 and in the Declaration of the Rights of the Child adopted by the General Assembly on 20 November 1959 and recognized in the Universal Declaration of Human Rights, in the International Covenant on Civil and Political Rights (in particular in articles 23 and 24), in the International Covenant on Economic, Social and Cultural Rights (in particular in article 10) and in the statutes and relevant instruments of specialized agencies and international organizations concerned with the welfare of children,

Bearing in mind that, as indicated in the Declaration of the Rights of the Child, "the child, by reason of his physical and mental immaturity, needs special safeguards and care, including appropriate legal protection, before as well as after birth",

Recalling the provisions of the Declaration on Social and Legal Principles relating to the Protection and Welfare of Children, with Special Reference to Foster Placement and Adoption Nationally and Internationally; the United Nations Standard Minimum Rules for the Administration of Juvenile Justice (The Beijing Rules) ; and the Declaration on the Protection of Women and Children in Emergency and Armed Conflict, Recognizing that, in all countries in the world, there are children living in exceptionally difficult conditions, and that such children need special consideration,

Taking due account of the importance of the traditions and cultural values of each people for the protection and harmonious development of the child, Recognizing the importance of international co-operation for improving the living conditions of children in every country, in particular in the developing countries,

Have agreed as follows:

PART I

Article 1

For the purposes of the present Convention, a child means every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier.

Article 2

1. States Parties shall respect and ensure the rights set forth in the present Convention to each child within their jurisdiction without discrimination of any kind, irrespective of the child's or his or her parent's or legal guardian's race, colour, sex, language, religion, political or other opinion, national, ethnic or social origin, property, disability, birth or other status.

2. States Parties shall take all appropriate measures to ensure that the child is protected against all forms of discrimination or punishment on the basis of the status, activities, expressed opinions, or beliefs of the child's parents, legal guardians, or family members.

Article 3

1. In all actions concerning children, whether undertaken by public or private social welfare institutions, courts of law, administrative authorities or legislative bodies, the best interests of the child shall be a primary consideration.

2. States Parties undertake to ensure the child such protection and care as is necessary for his or her well-being, taking into account the rights and duties of his or her parents, legal guardians, or other individuals legally responsible for him or her, and, to this end, shall take all appropriate legislative and administrative measures.

3. States Parties shall ensure that the institutions, services and facilities responsible for the care or protection of children shall conform with the standards established by competent authorities, particularly in the areas of safety, health, in the number and suitability of their staff, as well as competent supervision.

Article 4

States Parties shall undertake all appropriate legislative, administrative, and other measures for the implementation of the rights recognized in the present Convention. With regard to economic, social and cultural rights, States Parties shall undertake such measures to the maximum extent of their available resources and, where needed, within the framework of international co-operation.

Article 5

States Parties shall respect the responsibilities, rights and duties of parents or, where applicable, the members of the extended family or community as provided for by local custom, legal guardians or other persons legally responsible for the child, to provide, in a manner consistent with the evolving capacities of the child, appropriate direction and guidance in the exercise by the child of the rights recognized in the present Convention.

Article 6

1. States Parties recognize that every child has the inherent right to life. 2. States Parties shall ensure to the maximum extent possible the survival and development of the child.

Article 7

1. The child shall be registered immediately after birth and shall have the right from birth to a name, the right to acquire a nationality and. as far as possible, the right to know and be cared for by his or her parents.

2. States Parties shall ensure the implementation of these rights in accordance with their national law and their obligations under the relevant international instruments in this field, in particular where the child would otherwise be stateless.

Article 8

1. States Parties undertake to respect the right of the child to preserve his or her identity, including nationality, name and family relations as recognized by law without unlawful interference.

2. Where a child is illegally deprived of some or all of the elements of his or her identity, States Parties shall provide appropriate assistance and protection, with a view to re-establishing speedily his or her identity.

Article 9

1. States Parties shall ensure that a child shall not be separated from his or her parents against their will, except when competent authorities subject to judicial review determine, in accordance with applicable law and procedures, that such separation is necessary for the best interests of the child. Such determination may be necessary in a particular case such as one involving abuse or neglect of the child by the parents, or one where the parents are living separately and a decision must be made as to the child's place of residence.

2. In any proceedings pursuant to paragraph 1 of the present article, all interested parties shall be given an opportunity to participate in the proceedings and make their views known.

3. States Parties shall respect the right of the child who is separated from one or both parents to maintain personal relations and direct contact with both parents on a regular basis, except if it is contrary to the child's best interests.

4. Where such separation results from any action initiated by a State Party, such as the detention, imprisonment, exile, deportation or death (including death arising from any cause while the person is in the custody of the State) of one or both parents or of the child, that State Party shall, upon request, provide the parents, the child or, if appropriate, another member of the family with the essential information concerning the whereabouts of the absent member(s) of the family unless the provision of the information would be detrimental to the well-being of the child. States Parties shall further ensure that the submission of such a request shall of itself entail no adverse consequences for the person(s) concerned.

Article 10

1. In accordance with the obligation of States Parties under article 9, paragraph 1, applications by a child or his or her parents to enter or leave a State Party for the purpose of family reunification shall be dealt with by States Parties in a positive, humane and expeditious manner. States Parties shall further ensure that the submission of such a request shall entail no adverse consequences for the applicants and for the members of their family.

2. A child whose parents reside in different States shall have the right to maintain on a regular basis, save in exceptional circumstances personal relations and direct contacts with both parents. Towards that end and in accordance with the obligation of States Parties under article 9, paragraph 1, States Parties shall respect the right of the child and his or her parents to leave any country, including their

own, and to enter their own country. The right to leave any country shall be subject only to such restrictions as are prescribed by law and which are necessary to protect the national security, public order (ordre public), public health or morals or the rights and freedoms of others and are consistent with the other rights recognized in the present Convention.

Article 11

1. States Parties shall take measures to combat the illicit transfer and non-return of children abroad.

2. To this end, States Parties shall promote the conclusion of bilateral or multilateral agreements or accession to existing agreements.

Article 12

1. States Parties shall assure to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child.

2. For this purpose, the child shall in particular be provided the opportunity to be heard in any judicial and administrative proceedings affecting the child, either directly, or through a representative or an appropriate body, in a manner consistent with the procedural rules of national law.

Article 13

1. The child shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of the child's choice.

2. The exercise of this right may be subject to certain restrictions, but these shall only be such as are provided by law and are necessary:

(a) For respect of the rights or reputations of others; or

(b) For the protection of national security or of public order (ordre public), or of public health or morals.

Article 14

1. States Parties shall respect the right of the child to freedom of thought, conscience and religion.

2. States Parties shall respect the rights and duties of the parents and, when applicable, legal guardians, to provide direction to the child in the exercise of his or her right in a manner consistent with the evolving capacities of the child.

3. Freedom to manifest one's religion or beliefs may be subject only to such limitations as are prescribed by law and are necessary to protect public safety, order, health or morals, or the fundamental rights and freedoms of others.

Article 15

1. States Parties recognize the rights of the child to freedom of association and to freedom of peaceful assembly.

2. No restrictions may be placed on the exercise of these rights other than those imposed in conformity with the law and which are necessary in a democratic society in the interests of national security or public safety, public order (ordre public), the protection of public health or morals or the protection of the rights and freedoms of others.

Article 16

1. No child shall be subjected to arbitrary or unlawful interference with his or her privacy, family, home or correspondence, nor to unlawful attacks on his or her honour and reputation.

2. The child has the right to the protection of the law against such interference or attacks.

Article 17

States Parties recognize the important function performed by the mass media and shall ensure that the child has access to information and material from a diversity of national and international sources, especially those aimed at the promotion of his or her social, spiritual and moral well-being and physical and mental health.

To this end, States Parties shall:

(a) Encourage the mass media to disseminate information and material of social and cultural benefit to the child and in accordance with the spirit of article 29;

(b) Encourage international co-operation in the production, exchange and dissemination of such information and material from a diversity of cultural, national and international sources;

(c) Encourage the production and dissemination of children's books;

(d) Encourage the mass media to have particular regard to the linguistic needs of the child who belongs to a minority group or who is indigenous;

(e) Encourage the development of appropriate guidelines for the protection of the child from information and material injurious to his or her well-being, bearing in mind the provisions of articles 13 and 18.

Article 18

1. States Parties shall use their best efforts to ensure recognition of the principle that both parents have common responsibilities for the upbringing and development of the child. Parents or, as the case may be, legal guardians, have the primary responsibility for the upbringing and development of the child. The best interests of the child will be their basic concern.

2. For the purpose of guaranteeing and promoting the rights set forth in the present Convention, States Parties shall render appropriate assistance to parents and legal guardians in the performance of their child-rearing responsibilities and shall ensure the development of institutions, facilities and services for the care of children.

3. States Parties shall take all appropriate measures to ensure that children of working parents have the right to benefit from child-care services and facilities for which they are eligible.

Article 19

1. States Parties shall take all appropriate legislative, administrative, social and educational measures to protect the child from all forms of physical or mental violence, injury or abuse, neglect or negligent treatment, maltreatment or exploitation, including sexual abuse, while in the care of parent(s), legal guardian(s) or any other person who has the care of the child.

2. Such protective measures should, as appropriate, include effective procedures for the establishment of social programmes to provide necessary support for the child and for those who have the care of the child, as well as for other forms of prevention and for identification, reporting, referral, investigation, treatment and follow-up of instances of child maltreatment described heretofore, and, as appropriate, for judicial involvement.

Article 20

1. A child temporarily or permanently deprived of his or her family environment, or in whose own best interests cannot be allowed to remain in that environment, shall be entitled to special protection and assistance provided by the State.

2. States Parties shall in accordance with their national laws ensure alternative care for such a child.

3. Such care could include, inter alia, foster placement, kafalah of Islamic law, adoption or if necessary placement in suitable institutions for the care of children. When considering solutions, due regard shall be paid to the desirability of continuity in a child's upbringing and to the child's ethnic, religious, cultural and linguistic background.

Article 21

States Parties that recognize and/or permit the system of adoption shall ensure that the best interests of the child shall be the paramount consideration and they shall:

(a) Ensure that the adoption of a child is authorized only by competent authorities who determine, in accordance with applicable law and procedures and on the basis of all pertinent and reliable information, that the adoption is permissible in view of the child's status concerning parents, relatives and legal guardians and that, if required, the persons concerned have given their informed consent to the adoption on the basis of such counselling as may be necessary;

(b) Recognize that inter-country adoption may be considered as an alternative means of child's care, if the child cannot be placed in a foster or an adoptive family or cannot in any suitable manner be cared for in the child's country of origin;

(c) Ensure that the child concerned by inter-country adoption enjoys safeguards and standards equivalent to those existing in the case of national adoption;

(d) Take all appropriate measures to ensure that, in inter-country adoption, the placement does not result in improper financial gain for those involved in it;

(e) Promote, where appropriate, the objectives of the present article by concluding bilateral or multilateral arrangements or agreements, and endeavour, within this framework, to ensure that the placement of the child in another country is carried out by competent authorities or organs.

Article 22

1. States Parties shall take appropriate measures to ensure that a child who is seeking refugee status or who is considered a refugee in accordance with applicable international or domestic law and procedures shall, whether unaccompanied or accompanied by his or her parents or by any other person, receive appropriate protection and humanitarian assistance in the enjoyment of applicable rights set forth in the present Convention and in other international human rights or humanitarian instruments to which the said States are Parties.

2. For this purpose, States Parties shall provide, as they consider appropriate, co-operation in any efforts by the United Nations and other competent intergovernmental organizations or non-governmental organizations co-operating with the United Nations to protect and assist such a child and to trace the parents or other members of the family of any refugee child in order to obtain information necessary for reunification with his or her family. In cases where no parents or other members of the family can be found, the child shall be accorded the same protection as any other child permanently or temporarily deprived of his or her family environment for any reason , as set forth in the present Convention.

Article 23

1. States Parties recognize that a mentally or physically disabled child should enjoy a full and decent life, in conditions which ensure dignity, promote self-reliance and facilitate the child's active participation in the community.

2. States Parties recognize the right of the disabled child to special care and shall encourage and ensure the extension, subject to available resources, to the eligible child and those responsible for his or her care, of assistance for which application is made and which is appropriate to the child's condition and to the circumstances of the parents or others caring for the child.

3. Recognizing the special needs of a disabled child, assistance extended in accordance with paragraph 2 of the present article shall be provided free of charge, whenever possible, taking into account the financial resources of the parents or others caring for the child, and shall be designed to ensure that the disabled child has effective access to and receives education, training, health care services, rehabilitation services, preparation for employment and recreation opportunities in a manner conducive to the child's achieving the fullest possible social integration and individual development, including his or her cultural and spiritual development

4. States Parties shall promote, in the spirit of international cooperation, the exchange of appropriate information in the field of preventive health care and of medical, psychological and functional treatment of disabled children, including dissemination of and access to information concerning methods of rehabilitation, education and vocational services, with the aim of enabling States Parties to improve their capabilities and skills and to widen their experience in these areas. In this regard, particular account shall be taken of the needs of developing countries.

Article 24

1. States Parties recognize the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health. States Parties shall strive to ensure that no child is deprived of his or her right of access to such health care services.

2. States Parties shall pursue full implementation of this right and, in particular, shall take appropriate measures:

(a) To diminish infant and child mortality;

(b) To ensure the provision of necessary medical assistance and health care to all children with emphasis on the development of primary health care;

(c) To combat disease and malnutrition, including within the framework of primary health care, through, inter alia, the application of readily available technology and through the provision of adequate nutritious foods and clean drinking-water, taking into consideration the dangers and risks of environmental pollution;

(d) To ensure appropriate pre-natal and post-natal health care for mothers;

(e) To ensure that all segments of society, in particular parents and children, are informed, have access to education and are supported in the use of basic knowledge of child health and nutrition, the advantages of breastfeeding, hygiene and environmental sanitation and the prevention of accidents;

(f) To develop preventive health care, guidance for parents and family planning education and services.

3. States Parties shall take all effective and appropriate measures with a view to abolishing traditional practices prejudicial to the health of children.

4. States Parties undertake to promote and encourage international co-operation with a view to achieving progressively the full realization of the right recognized in the present article. In this regard, particular account shall be taken of the needs of developing countries.

Article 25

States Parties recognize the right of a child who has been placed by the competent authorities for the purposes of care, protection or treatment of his or her physical or mental health, to a periodic review of the treatment provided to the child and all other circumstances relevant to his or her placement.

Article 26

1. States Parties shall recognize for every child the right to benefit from social security, including social insurance, and shall take the necessary measures to achieve the full realization of this right in accordance with their national law.

2. The benefits should, where appropriate, be granted, taking into account the resources and the circumstances of the child and persons having responsibility for the maintenance of the child, as well as any other consideration relevant to an application for benefits made by or on behalf of the child.

Article 27

1. States Parties recognize the right of every child to a standard of living adequate for the child's physical, mental, spiritual, moral and social development.

2. The parent(s) or others responsible for the child have the primary responsibility to secure, within their abilities and financial capacities, the conditions of living necessary for the child's development.

3. States Parties, in accordance with national conditions and within their means, shall take appropriate measures to assist parents and others responsible for the child to implement this right and shall in case of need provide material assistance and support programmes, particularly with regard to nutrition, clothing and housing.

4. States Parties shall take all appropriate measures to secure the recovery of maintenance for the child from the parents or other persons having financial responsibility for the child, both within the State Party and from abroad. In particular, where the person having financial responsibility for the child lives in a State different from that of the child, States Parties shall promote the accession to international agreements or the conclusion of such agreements, as well as the making of other appropriate arrangements.

Article 28

1. States Parties recognize the right of the child to education, and with a view to achieving this right progressively and on the basis of equal opportunity, they shall, in particular:

(a) Make primary education compulsory and available free to all;

(b) Encourage the development of different forms of secondary education, including general and vocational education, make them available and accessible to every child, and take appropriate measures such as the introduction of free education and offering financial assistance in case of need;

(c) Make higher education accessible to all on the basis of capacity by every appropriate means;

(d) Make educational and vocational information and guidance available and accessible to all children;

(e) Take measures to encourage regular attendance at schools and the reduction of drop-out rates.

2. States Parties shall take all appropriate measures to ensure that school discipline is administered in a manner consistent with the child's human dignity and in conformity with the present Convention.

3. States Parties shall promote and encourage international cooperation in matters relating to education, in particular with a view to contributing to the elimination of ignorance and illiteracy

throughout the world and facilitating access to scientific and technical knowledge and modern teaching methods. In this regard, particular account shall be taken of the needs of developing countries.

Article 29

1. States Parties agree that the education of the child shall be directed to:

(a) The development of the child's personality, talents and mental and physical abilities to their fullest potential;

(b) The development of respect for human rights and fundamental freedoms, and for the principles enshrined in the Charter of the United Nations;

(c) The development of respect for the child's parents, his or her own cultural identity, language and values, for the national values of the country in which the child is living, the country from which he or she may originate, and for civilizations different from his or her own;

(d) The preparation of the child for responsible life in a free society, in the spirit of understanding, peace, tolerance, equality of sexes, and friendship among all peoples, ethnic, national and religious groups and persons of indigenous origin;

(e) The development of respect for the natural environment.

2. No part of the present article or article 28 shall be construed so as to interfere with the liberty of individuals and bodies to establish and direct educational institutions, subject always to the observance of the principle set forth in paragraph 1 of the present article and to the requirements that the education given in such institutions shall conform to such minimum standards as may be laid down by the State.

Article 30

In those States in which ethnic, religious or linguistic minorities or persons of indigenous origin exist, a child belonging to such a minority or who is indigenous shall not be denied the right, in community with other members of his or her group, to enjoy his or her own culture, to profess and practise his or her own religion, or to use his or her own language.

Article 31

1. States Parties recognize the right of the child to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts.

2. States Parties shall respect and promote the right of the child to participate fully in cultural and artistic life and shall encourage the provision of appropriate and equal opportunities for cultural, artistic, recreational and leisure activity.

Article 32

1. States Parties recognize the right of the child to be protected from economic exploitation and from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.

2. States Parties shall take legislative, administrative, social and educational measures to ensure the implementation of the present article. To this end, and having regard to the relevant provisions of other international instruments, States Parties shall in particular:

(a) Provide for a minimum age or minimum ages for admission to employment;

(b) Provide for appropriate regulation of the hours and conditions of employment;

(c) Provide for appropriate penalties or other sanctions to ensure the effective enforcement of the present article.

Article 33

States Parties shall take all appropriate measures, including legislative, administrative, social and educational measures, to protect children from the illicit use of narcotic drugs and psychotropic substances as defined in the relevant international treaties, and to prevent the use of children in the illicit production and trafficking of such substances.

Article 34

States Parties undertake to protect the child from all forms of sexual exploitation and sexual abuse. For these purposes, States Parties shall in particular take all appropriate national, bilateral and multilateral measures to prevent:

(a) The inducement or coercion of a child to engage in any unlawful sexual activity;

(b) The exploitative use of children in prostitution or other unlawful sexual practices;

(c) The exploitative use of children in pornographic performances and materials.

Article 35

States Parties shall take all appropriate national, bilateral and multilateral measures to prevent the abduction of, the sale of or traffic in children for any purpose or in any form.

Article 36

States Parties shall protect the child against all other forms of exploitation prejudicial to any aspects of the child's welfare.

Article 37

States Parties shall ensure that:

(a) No child shall be subjected to torture or other cruel, inhuman or degrading treatment or punishment. Neither capital punishment nor life imprisonment without possibility of release shall be imposed for offences committed by persons below eighteen years of age;

(b) No child shall be deprived of his or her liberty unlawfully or arbitrarily. The arrest, detention or imprisonment of a child shall be in conformity with the law and shall be used only as a measure of last resort and for the shortest appropriate period of time;

(c) Every child deprived of liberty shall be treated with humanity and respect for the inherent dignity of the human person, and in a manner which takes into account the needs of persons of his or her age. In particular, every child deprived of liberty shall be separated from adults unless it is considered in the child's best interest not to do so and shall have the right to maintain contact with his or her family through correspondence and visits, save in exceptional circumstances;

(d) Every child deprived of his or her liberty shall have the right to prompt access to legal and other appropriate assistance, as well as the right to challenge the legality of the deprivation of his or her liberty before a court or other competent, independent and impartial authority, and to a prompt decision on any such action.

Article 38

1. States Parties undertake to respect and to ensure respect for rules of international humanitarian law applicable to them in armed conflicts which are relevant to the child.

2. States Parties shall take all feasible measures to ensure that persons who have not attained the age of fifteen years do not take a direct part in hostilities.

3. States Parties shall refrain from recruiting any person who has not attained the age of fifteen years into their armed forces. In recruiting among those persons who have attained the age of fifteen years but who have not attained the age of eighteen years, States Parties shall endeavour to give priority to those who are oldest.

4. In accordance with their obligations under international humanitarian law to protect the civilian population in armed conflicts, States Parties shall take all feasible measures to ensure protection and care of children who are affected by an armed conflict.

Article 39

States Parties shall take all appropriate measures to promote physical and psychological recovery and social reintegration of a child victim of: any form of neglect, exploitation, or abuse; torture or any other form of cruel, inhuman or degrading treatment or punishment; or armed conflicts. Such recovery and reintegration shall take place in an environment which fosters the health, self-respect and dignity of the child.

Article 40

1. States Parties recognize the right of every child alleged as, accused of, or recognized as having infringed the penal law to be treated in a manner consistent with the promotion of the child's sense of dignity and worth, which reinforces the child's respect for the human rights and fundamental freedoms of others and which takes into account the child's age and the desirability of promoting the child's reintegration and the child's assuming a constructive role in society.

2. To this end, and having regard to the relevant provisions of international instruments, States Parties shall, in particular, ensure that:

(a) No child shall be alleged as, be accused of, or recognized as having infringed the penal law by reason of acts or omissions that were not prohibited by national or international law at the time they were committed;

(b) Every child alleged as or accused of having infringed the penal law has at least the following guarantees:

(i) To be presumed innocent until proven guilty according to law;

(ii) To be informed promptly and directly of the charges against him or her, and, if appropriate, through his or her parents or legal guardians, and to have legal or other appropriate assistance in the preparation and presentation of his or her defence;

(iii) To have the matter determined without delay by a competent, independent and impartial authority or judicial body in a fair hearing according to law, in the presence of legal or other appropriate assistance and, unless it is considered not to be in the best interest of the child, in particular, taking into account his or her age or situation, his or her parents or legal guardians;

(iv) Not to be compelled to give testimony or to confess guilt; to examine or have examined adverse witnesses and to obtain the participation and examination of witnesses on his or her behalf under conditions of equality;

(v) If considered to have infringed the penal law, to have this decision and any measures imposed in consequence thereof reviewed by a higher competent, independent and impartial authority or judicial body according to law;

(vi) To have the free assistance of an interpreter if the child cannot understand or speak the language used;

(vii) To have his or her privacy fully respected at all stages of the proceedings.

3. States Parties shall seek to promote the establishment of laws, procedures, authorities and institutions specifically applicable to children alleged as, accused of, or recognized as having infringed the penal law, and, in particular:

(a) The establishment of a minimum age below which children shall be presumed not to have the capacity to infringe the penal law;

(b) Whenever appropriate and desirable, measures for dealing with such children without resorting to judicial proceedings, providing that human rights and legal safeguards are fully respected. 4. A variety of dispositions, such as care, guidance and supervision orders; counselling; probation; foster care; education and vocational training programmes and other alternatives to institutional care shall be available to ensure that children are dealt with in a manner appropriate to their well-being and proportionate both to their circumstances and the offence.

Article 41

Nothing in the present Convention shall affect any provisions which are more conducive to the realization of the rights of the child and which may be contained in:

(a) The law of a State party; or

(b) International law in force for that State.

PART II

Article 42

States Parties undertake to make the principles and provisions of the Convention widely known, by appropriate and active means, to adults and children alike.

Article 43

1. For the purpose of examining the progress made by States Parties in achieving the realization of the obligations undertaken in the present Convention, there shall be established a Committee on the Rights of the Child, which shall carry out the functions hereinafter provided.

2. The Committee shall consist of ten experts of high moral standing and recognized competence in the field covered by this Convention. The members of the Committee shall be elected by States Parties from among their nationals and shall serve in their personal capacity, consideration being given to equitable geographical distribution, as well as to the principal legal systems.

3. The members of the Committee shall be elected by secret ballot from a list of persons nominated by States Parties. Each State Party may nominate one person from among its own nationals.

4. The initial election to the Committee shall be held no later than six months after the date of the entry into force of the present Convention and thereafter every second year. At least four months before the date of each election, the Secretary-General of the United Nations shall address a letter to States Parties inviting them to submit their nominations within two months. The Secretary-General shall subsequently prepare a list in alphabetical order of all persons thus nominated, indicating States Parties which have nominated them, and shall submit it to the States Parties to the present Convention.

5. The elections shall be held at meetings of States Parties convened by the Secretary-General at United Nations Headquarters. At those meetings, for which two thirds of States Parties shall constitute

a quorum, the persons elected to the Committee shall be those who obtain the largest number of votes and an absolute majority of the votes of the representatives of States Parties present and voting.

6. The members of the Committee shall be elected for a term of four years. They shall be eligible for re-election if renominated. The term of five of the members elected at the first election shall expire at the end of two years; immediately after the first election, the names of these five members shall be chosen by lot by the Chairman of the meeting.

7. If a member of the Committee dies or resigns or declares that for any other cause he or she can no longer perform the duties of the Committee, the State Party which nominated the member shall appoint another expert from among its nationals to serve for the remainder of the term, subject to the approval of the Committee.

8. The Committee shall establish its own rules of procedure.

9. The Committee shall elect its officers for a period of two years.

10. The meetings of the Committee shall normally be held at United Nations Headquarters or at any other convenient place as determined by the Committee. The Committee shall normally meet annually. The duration of the meetings of the Committee shall be determined, and reviewed, if necessary, by a meeting of the States Parties to the present Convention, subject to the approval of the General Assembly.

11. The Secretary-General of the United Nations shall provide the necessary staff and facilities for the effective performance of the functions of the Committee under the present Convention.

12. With the approval of the General Assembly, the members of the Committee established under the present Convention shall receive emoluments from United Nations resources on such terms and conditions as the Assembly may decide.

Article 44

1. States Parties undertake to submit to the Committee, through the Secretary-General of the United Nations, reports on the measures they have adopted which give effect to the rights recognized herein and on the progress made on the enjoyment of those rights

(a) Within two years of the entry into force of the Convention for the State Party concerned;

(b) Thereafter every five years.

2. Reports made under the present article shall indicate factors and difficulties, if any, affecting the degree of fulfilment of the obligations under the present Convention. Reports shall also contain sufficient information to provide the Committee with a comprehensive understanding of the implementation of the Convention in the country concerned.

3. A State Party which has submitted a comprehensive initial report to the Committee need not, in its subsequent reports submitted in accordance with paragraph 1 (b) of the present article, repeat basic information previously provided.

4. The Committee may request from States Parties further information relevant to the implementation of the Convention.

5. The Committee shall submit to the General Assembly, through the Economic and Social Council, every two years, reports on its activities.

6. States Parties shall make their reports widely available to the public in their own countries.

Article 45

In order to foster the effective implementation of the Convention and to encourage international co-operation in the field covered by the Convention:

(a) The specialized agencies, the United Nations Children's Fund, and other United Nations organs shall be entitled to be represented at the consideration of the implementation of such provisions of the present Convention as fall within the scope of their mandate. The Committee may invite the specialized agencies, the United Nations Children's Fund and other competent bodies as it may consider appropriate to provide expert advice on the implementation of the Convention in areas falling within the scope of their respective mandates. The Committee may invite the specialized agencies, the United Nations Children's Fund, and other United Nations organs to submit reports on the implementation of the Convention in areas falling within the scope of their activities;

(b) The Committee shall transmit, as it may consider appropriate, to the specialized agencies, the United Nations Children's Fund and other competent bodies, any reports from States Parties that contain a request, or indicate a need, for technical advice or assistance, along with the Committee's observations and suggestions, if any, on these requests or indications;

(c) The Committee may recommend to the General Assembly to request the Secretary-General to undertake on its behalf studies on specific issues relating to the rights of the child;

(d) The Committee may make suggestions and general recommendations based on information received pursuant to articles 44 and 45 of the present Convention. Such suggestions and general recommendations shall be transmitted to any State Party concerned and reported to the General Assembly, together with comments, if any, from States Parties.

PART III

Article 46

The present Convention shall be open for signature by all States.

Article 47

The present Convention is subject to ratification. Instruments of ratification shall be deposited with the Secretary-General of the United Nations.

Article 48

The present Convention shall remain open for accession by any State. The instruments of accession shall be deposited with the Secretary-General of the United Nations.

Article 49

1. The present Convention shall enter into force on the thirtieth day following the date of deposit with the Secretary-General of the United Nations of the twentieth instrument of ratification or accession.

2. For each State ratifying or acceding to the Convention after the deposit of the twentieth instrument of ratification or accession, the Convention shall enter into force on the thirtieth day after the deposit by such State of its instrument of ratification or accession.

Article 50

1. Any State Party may propose an amendment and file it with the Secretary-General of the United Nations. The Secretary-General shall thereupon communicate the proposed amendment to States Parties, with a request that they indicate whether they favour a conference of States Parties for the purpose of considering and voting upon the proposals. In the event that, within four months from the date of such communication, at least one third of the States Parties favour such a conference, the Secretary-General shall convene the conference under the auspices of the United Nations. Any

amendment adopted by a majority of States Parties present and voting at the conference shall be submitted to the General Assembly for approval.

2. An amendment adopted in accordance with paragraph 1 of the present article shall enter into force when it has been approved by the General Assembly of the United Nations and accepted by a two-thirds majority of States Parties.

3. When an amendment enters into force, it shall be binding on those States Parties which have accepted it, other States Parties still being bound by the provisions of the present Convention and any earlier amendments which they have accepted.

Article 51

1. The Secretary-General of the United Nations shall receive and circulate to all States the text of reservations made by States at the time of ratification or accession.

2. A reservation incompatible with the object and purpose of the present Convention shall not be permitted.

3. Reservations may be withdrawn at any time by notification to that effect addressed to the Secretary-General of the United Nations, who shall then inform all States. Such notification shall take effect on the date on which it is received by the Secretary-General

Article 52

A State Party may denounce the present Convention by written notification to the Secretary-General of the United Nations. Denunciation becomes effective one year after the date of receipt of the notification by the Secretary-General.

Article 53

The Secretary-General of the United Nations is designated as the depositary of the present Convention.

Article 54

The original of the present Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations. IN WITNESS THEREOF the undersigned plenipotentiaries, being duly authorized thereto by their respective governments, have signed the present Convention.

Children's Rights in Sport Principles

unicef

Forward



Ryoko Akamatsu

Chairperson

Japan Committee for UNICEF

The Convention on the Rights of the Child, adopted on 20 November 1989, says that every child has the "right to play."

Sport has the important power to promote children's sound growth, regardless of their age, gender, place of birth, or whether or not they have any disabilities.

However, globally, there are cases of sport adversely affecting children.

With the hope that the sport would genuinely promote sound growth and prosperous lives of children, Japan Committee for UNICEF, together with UNICEF, has developed *the Children's Rights in Sport Principles*.

I am sincerely grateful to everyone who helped us develop the Principles, and to all of you who have shown your support to the Principles.

Thank you.



Andrés Franco

Deputy Director

UNICEF Private Sector Engagement

Millions of children take part in sporting activities every day across the world. For some, this is purely for recreation and fun. For others, sport may be their chosen future career, as talented athletes, coaches, or officials.

All children have the right to participate in sport in a safe and enjoyable environment. At the most fundamental level, **play is a child's right,** as noted in Article 31 of the Convention on the Rights of the Child.

The UN along with many other development actors have long held that sport not only helps to fulfil this right, but that it also helps achieve broader social and economic development outcomes. We however are also aware of the reality that, in many corners of the world, sport can bring risks such as violence and abuse. Sport therefore has a duty to safeguard all children taking part.

The Children's Rights in Sport Principles are UNICEF's first document of this kind to address this old but still emerging issue, which concerns every one of us.

We thank the Japan Committee for UNICEF for this initiative, and members of the drafting committee for their interest, work, and participation, in particular a number of Japan's Sport Bodies led by Japan Sport Agency. Our sincere gratitude also goes to UNICEF UK's child rights and child safeguarding experts for their valuable contributions. UNICEF plan to use this pioneering work by our colleagues, friends and partners in Japan as the starting point towards the development of a global set of principles, as we further develop our understanding of child rights and child safeguarding in context of sport.

Congratulation

Let me congratulate you on the completion of *the Children's Rights in Sport Principles*.

The right of all people to lead a life of happiness and abundance through sports is made explicit in the Basic Act on Sports. The core of the value of sports is the *fun* and *joy* to be attained through *doing* sports; that continuing to *do* sports makes us know courage, confidence, friendship and other values, while realizing personal growth, improved physical and mental health, and a life full of meaning and purpose.

Children stand at the start line of life. Ensuring they can savor the value of sports for the rest of their long lives is important not only to the children themselves, but for society as a whole.

The Japan Sports Agency completed an international sports strategy on September 6. That strategy also notes the need for a foundation upon which human rights are protected to ensure that all people can enjoy sports. That will require safety in all sports venues as well as fairness and equality in the management of sports.

These things are in common with the *Children's Rights in Sport Principles* you have completed. I have confidence that efforts in line with *the Children's Rights in Sport Principles* will ensure that the value of sports reach all children.

Let me conclude by expressing my great regard for all those involved in the drafting of these principles, including the Japan Committee for UNICEF, while hoping for the spread and popularization of these principles.



Daichi Suzuki
Commissioner
Japan Sports Agency

Children's Rights in Sport Principles

Expectations for Sports Organizations, Educational Institutions, and Coaches

01 **Commit to Respect and Support the Rights of Children**

02 **Consider Balanced Growth of Children through Sports**

03 **Protect Children from the Risks of Sports**

04 **Protect the Health of Children**

05 **Develop Governance System to Protect the Rights of Children**

06 **Ensure Understanding and Engagement by Adults Involved with Children and Sports**

Expectations for Sponsoring Companies

07 **Incorporate Children's Rights in Sponsorship Decisions**

08 **Engage with the Organizations who are Sponsored**

Expectations for Adult Athletes

09 **Approach and Hold Dialogues with Stakeholders**

Expectations for Parents and Guardians of Children

10 **Support the Healthy Growth of Children through Sports**



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Preamble

Sport has the important power to promote children's sound and well-rounded growth and to convey a wide and active message to the world through its vast influence.

Every child has the "right to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts."[i] Similar to education, play and sport can have a great, positive influence on the lives of children[ii]. Children can learn about their society through participation in physical education, physical activity and sport (hereinafter refereed as 'sport') including cooperation with others, self-control, observation of rules, and respect for others. Programs for reconciliation and peace through sports activities have also been implemented around the world and been a force for good.

Sport is universally shared across human culture, based on voluntary participation. Lifelong participation in sport can promote prosperous living and cultural development, and is integral to the pursuit of health and well-being, including for children.

Unfortunately, diverse cases have been observed, of sport adversely affecting children's rights, such as corporal punishment, bullying and allowing children to over train in the course of sports instruction, practice, and matches[iii]. As the scaling-up, commercialization, and early specialization in sport continues, it has been pointed out that the understanding and development of systems related to the protection of the rights of children is inadequate.

Against the backdrop of the UN Convention on the Rights of the Child - which provides for the protection of children from all forms of physical and mental violence, unfair treatment and exploitation - the reality that sport can be a context where such maltreatment takes place has been gradually recognized and addressed in recent years.

When we get it right in sport we can have wider impacts on other aspects of lives of children because of the great influence sport has. In this context, there are some movements that have taken action. For example, the World Players Association, of which more than 100 professional sport associations from more than 60 countries are members, has adopted the Declaration on Safeguarding the Rights of Child Athletes[iv]. While the power of sport is attracting much global

attention due to various mega sports events including Olympics/Paralympics, FIFA, Rugby and other World Cups and world matches, and the spread of sports across borders, it is extremely important for a wide range of stakeholders to work together to ensure that sport truly supports the sound growth of children and does not negatively affect their rights[v].

The Children's Rights in Sports Principles exist so that all stakeholders involved in sports including sports organizations, educational institutions, sponsor companies and organizations, adult athletes and their organizations, coaches, parents and guardians should support these Principles by[vi]:

- Expressing their commitment to take actions towards implementing the Principles;
- Striving to actively disclose and explain the status of that implementation to promote mutual collaboration and dialogue in this area.

Definition

Children:

Every person under the age of eighteen years.

Children in Sport:

Children that participate, in any form, in physical education, physical activity and sport, including those who aspire to become professional athletes or officials, and those who play sports or participate other aspects of sport for leisure, recreational and exercise reasons (e.g. ball-boys and girls). Young persons aged 18 years and older may receive protection in accordance with these Principles if they have similar needs for protection and support.

Sports Organizations:

Sports organizations include all organizations where their main purpose is to conduct or oversee sporting activities.

Expectations for Sports Organizations, Educational Institutions, and Coaches

01 *Commit to Respect and Support the Rights of Children*

Commit to respect and support the rights of children, based on the spirit of the UN Convention on the Rights of the Child. Specifically, endorse the following universal values and share them within and outside of their organization.

a. **Always act in the best interests of the child**

Make the best interests of the child the paramount consideration in all actions concerning children. Noting that the “win at all costs” mentality does not always serve the best interests of the child, or foster children’ s lifelong participation in sport.

b. **Respect the views of the child**

Respect that children can express their views freely in all matters affecting themselves, including their willingness or unwillingness to participate in matches and practice, in accordance with their age and maturity. Respect the views of the child on how they wish to participate in and enjoy sport, including those aiming to become professional athletes and those wishing to enjoy sport as a leisure and recreation activity.

c. **Non discrimination of children**

Ensure no child is discriminated on the basis of their gender, ethnicity, birth, sexual orientation or identity, language, religion, culture, political or other opinion, national or social origin, disability, or economic or other status of the child or his or her parents or guardians.

For children with a disability steps should be taken to provide parasport activities, or to adapt sports so that participation can be enjoyed alongside children without a disability. This may involve making facilities universal in design, ensuring they are appropriately supported by officials, coaches and other support personnel, or adapting the rules of the sport or equipment to be inclusive for disabled athletes.

d. **Protect children from all forms of violence and adverse impact on their rights**

Eliminate all forms of violence and abuse against children and address issues that adversely affect the rights of children.

e. **Commit to supporting the rights of children through sport**

Commit to actively support children’s rights through supporting sound and well-rounded physical and mental development through sport, as well as promoting the fundamental values of sport including fair play, teamwork and respect.



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02 *Consider Balanced Growth of Children through Sports*

Help children achieve holistic and comprehensive personal development by considering how to balance with other non-sporting activities including rest, time spent with family, leisure and recreation and learning. Specifically, the following perspectives should be taken into account, and efforts should be made in accordance with the size, character, and activities of each organization.

a. Promote balanced growth of children

Respect the time children spend with their families and ensure their right to family life.

To help the child develop his or her personality, talents, and mental and physical abilities to their fullest potential, promote balanced growth of children by allowing them sufficient opportunities to engage in learning, play, sport, leisure and recreational activities appropriate to the age of the child, and to participate freely in cultural and art activities.

Promote honesty, fairness and integrity of sport and the virtue of fair play and teamwork among children, and provide them with the information needed to promote balanced growth such as on the importance of education, the need for a healthy and balanced diet and lifestyle, and for protection from all forms of violence against children, including bullying.

Also provide information about the risks and dangers associated with a sporting career, including that the lifetime as elite athletes can be short and that opportunities for sporting success may be interrupted due to accident or injury.

b. Ensure opportunities for education/learning

Afford all children involved in sport, including those who are aspiring to be elite athletes, sufficient time for learning.

Provide children with access to appropriately qualified academic and life advisors outside of sports, and assist with preparing them for the transition to the next phase of their lives, including potential future employment outside sport.

03 *Protect Children from the Risks of Sports*

Protect children from risks such as violence and abuse and ensure an environment in which children can play sports safely. Specifically, the following perspectives should be taken into account, and efforts should be considered in accordance with the size, character, and activities of each organization.

a. Protect children from violence and abuse

Throughout the course of sports instruction, practice and matches, eliminate all forms of physical or mental violence, injury, abuse (including sexual abuse), excessive training, harassment (sexual and power harassment), bullying, hazing, neglect, negligent treatment, maltreatment, exploitation, excessive rules and/or punishment and trafficking.

Do not tolerate any physical or mental abuse or demeaning language or treatment of children, including that conducted by other children or via social media.

Collect data on cases of injury during sports instruction, practice and matches and analyze the underlying causes of the results.

b. Make sure children are taught by qualified personnel with appropriate coaching skills

Make sure that all personnel who are involved in teaching, coaching, medical support and administration of sport have appropriate qualifications, training and access to continuous professional development.

c. Guarantee a safe sporting environment for children

Guarantee a safe and secure environment for children to practice, compete and officiate in sport, including by ensuring the prevention of sport-related accidents, and ensuring a secure sporting environment which is only accessible to persons who have passed background checks.

Provide children with safe and appropriate transportation of a suitable quality, housing, and meals when they travel to play sports.

d.

Ensure the sporting environment for children free from fraudulent conduct

Ensure that children can play sports without engaging in fraudulent conduct (e.g. match fixing, corruption and manipulation) triggered by prestige or economic interests.

Recognizing that children are more likely to become victims of such misconduct compared to adults, as the scaling-up and commercialization of sports progresses, educate and discipline all persons involved in children's sports (also known as "entourage"[vii]) on this matter.

Prevent persons, including coaches, who have the authority to decide whether or not to allow children to participate in games, from receiving economic or other rewards that may influence their decisions, to ensure fairness and transparency.

e.

Protect children from all forms of exploitation

Make sure that children are protected from all forms of exploitation including political, social as well as economic exploitation.



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04 *Protect the Health of Children*

Protect the physical and mental health of children, including protecting them from doping. Specifically, the following perspectives should be taken into account, and efforts should be made in accordance with the size, character, and activities of each organization.

a. Protect the physical and mental health of children

Consider the appropriate type, intensity and method of teaching sport according to the age and development of the child.

Based on scientific and medical knowledge, ensure that sport does not negatively affect the physical and mental health of children, including through burn-out, by excessive training. Recognize that pushing children into those situations may constitute a form of child abuse. Contribute to setting rules on the limit and extent of training and participation in matches, in collaboration with relevant stakeholders outside of the organization as appropriate.

Recognize that adults tend to have unrealistic expectations that can cause children to over-work without due consideration for the risks of serious injuries that could affect their future lives, and encourage children to make calm judgments by means such as appropriately notifying them of the risks associated with sports, and effectively protecting the mental and physical health of children, by creating an environment in which all persons involved respect the judgment of children without imposing excessive pressure on them.

Provide children with ready access to certified athletic trainers and/or medical doctors, as well as other relevant professionals to educate and counsel the children on physical and mental health.

b. Protect children from doping and provide nutritional guidance

Based on scientific and medical knowledge, protect children from all doping and ensure that legal substances, such as nutritional supplements for the purpose of performance enhancement are never provided to children without duly considering the effect on children's short and long-term physical and mental health. Recognize that pushing children into doping may constitute a form of child abuse.

Provide all persons involved, including coaches medical staff and caregivers, with access to education on proper nutrition, the need for a healthy diet, and the appropriate use of medicines and supplements for children, from an appropriately qualified professional.

Provide all relevant persons with the information they need to identify and refer to for support, in cases of eating disorders or disordered eating amongst children taking part in sport, recognizing the particular risks in weight-making sports.

c. Help establish an appropriate and balanced lifestyle

Recognizing that 24 hours is not all for sport, help establish an appropriate and balanced lifestyle for children, setting appropriate time allocation for sports vis-a-vis time for learning and other activities, as well as for rest and sleep.



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05 *Develop Governance System to Protect the Rights of Children*

Develop a governance system to effectively implement Principles 1 to 4. Specifically, the following measures should be implemented in accordance with the size, character, and activity of each organization.

a. **Formulate and publish basic policies**

Formulate a policy for committing to Principles 1 to 4 (including those covering wider aspects including the rights of children) and publicize the policy inside and outside of the organization.

b. **Identify and assess risks and adopt appropriate measures according to the level of risks**

Identify and assess any actual or potential adverse impact on the rights of children in accordance with the nature and activities of each sports organization, and implement measures according to the identified risks.

c. **Establish and implement rules, guidelines, and codes of conducts**

Establish specific rules, guidelines, and codes of conducts to implement the policies for respecting and supporting the rights of children set out in Principles 1 to 4, and ensure that they are followed by all persons involved.

d. **Monitor and continuously improve**

Monitor regularly whether violence, overtraining and other issues that adversely affect the rights of children occur in the course of sport instruction, practice, and matches.

Continue to review and improve the status of efforts to respect and support the rights of children based on the results of monitoring.

e. **Secure reporting mechanisms and remedy channels to address problems**

Ensure that children have access to services to report and consult safely and confidentially on violence, overtraining and other issues that adversely affect their rights. Provide children with information about their rights and about how they can report and discuss their concerns.

Prepare mechanisms that allow third parties or anyone who is worried, to report or make their concerns known on issues that might adversely affect the rights of children.

Ensure access to effective remedies that are appropriate to the needs of children by placing top priority on the best interest of the child when receiving concerns or complaints. Ensure that remedy channels are accessible to children and that children are able to participate in them meaningfully.



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06 *Ensure Understanding and Engagement by Adults Involved with Children and Sports*

Promote understanding and dialogue among all persons involved in order to ensure effective implementation of the Principles. Specifically, the following measures should be implemented in accordance with the size, character, and activity of the organization.

a. **Ensure appropriate recruitment and education of persons supporting children in sport**

Adopt appropriate standards for recruiting persons supporting children in sport, including coaches, official, teachers, trainers and volunteers, to ensure that they do not adversely affect children' s rights, through such measures as incorporating respect for children' s rights in recruitment standards, and checking prior records of abuse.

Hold regular educational and training opportunities to promote the proper understanding and implementation of these Principles, in collaboration with relevant organizations as appropriate.

b. **Promote understanding of all concerned through engagement**

Promote the understanding of the Principles among all those involved through regular dialogues within the organization including with the children, and with external stakeholders including guardians, schools and adult athletes, so that the Principles are properly implemented according to each specific situation. Provide children with a safe and secure space in which to share their issues, concerns and ideas.

Expectations for Sponsoring Companies

07 *Incorporate Children's Rights in Sponsorship Decisions*

In deciding whether or not to sponsor a sport organization or an educational institution, take into account the state of the sport organization's efforts in respecting and supporting the rights of children as set out in Principles 1 to 6. Where appropriate, require the sport organization or the educational institution to make explicit commitments to respect and support the rights of children, in accordance with Principles 1 to 6, as a condition of sponsorship.

08 *Engage with the Organizations who are Sponsored*

Ask sports organizations and educational institutions who are sponsored to explain their efforts to respect and promote the rights of children, as stipulated in Principles 1 to 6, in accordance with their specific risks, and use leverage to encourage them to implement any measures which have not been fully implemented.

Expectations for Adult Athletes

09 *Approach and Hold Dialogues with Stakeholders*

Given that children are often placed in a position that makes it difficult for them to speak out on issues that negatively affect their rights and those of other children due to their vulnerabilities, expectations and pressure from others and the extent of their ability to articulate their concerns, adult athletes who may have similar experience, and represent or support children or share their concerns, should be encouraged to work with other stakeholders to support children in the following ways.

a. **Encourage stakeholders including sports organizations to support and protect children**

Based on their own experiences, hold dialogues with stakeholders including sports organizations and sponsor companies on how to respect and support the rights children, and urge them to implement initiatives in accordance with Principles 1 to 8.

b. **Hold Dialogues with Children**

Share, to the extent possible and appropriate, their experiences with children and their guardians, raising awareness and understanding of the issues children can face in sport to make it easier for children to discuss and seek help on issues such as violence, overtraining, and other issues that adversely affect children's rights.

Expectations for Parents and Guardians of Children

10 *Support the Healthy Growth of Children through Sports*

Parents and guardians of children should support the sound and balanced growth of their children by taking the following measures, taking into account the important role they play in providing children with physical and mental support, and their role in communicating the power and opportunities of sports, and the ways in which they can support the activities of sports organizations and educational institutions.

a. **Support Healthy and Balanced Growth of Children**

Recognizing the importance of their role as the foremost protector of their children, help them reach their potential and enjoy their time in sports, by caring for them with consideration to a balanced lifecycle. Ensure they discuss with their child how he or she wants to participate in and enjoy sports, what kind of support the child feels they need, and do not create any negative impact on children including by excessive expectations or involvement. Recognize that children can sometimes push themselves too hard and adults may need to set appropriate boundaries to protect them from this.

b. **Hold Dialogues with Stakeholders and Take Actions to Protect Rights of Children**

Implement the relevant items in Principles 1 to 4 from the standpoint of parents and guardians, while holding constructive dialogues with other relevant stakeholders including the sport organizations.

c. **Support Addressing Issues that Adversely Affect the Rights of Children**

Continuously monitor whether there are issues that adversely affect the rights of the child. If advised by the child or if they identify themselves violations of child rights, support developing a solution to the problem in a manner that gives top priority to the best interests of the child.

Note

[i] Article 31, paragraph 1, of the Convention on the Rights of the Child, "State parties recognize the right of the child to rest and leisure and the right of the child to engage freely in cultural life and the arts, as well as playing and recreational activities appropriate to his or her age."

[ii] Committee on the Rights of the Child, "General comment No.17 (2013) on the right of the child to rest, leisure, play, recreational activities, cultural life and the arts (art. 31)."

[iii] For example, UNICEF Innocenti Research Centre, "Protecting Children from Violence in Sport: A Review with a Focus on Industrialized Countries", 2010.

[iv] Published on 8 November 2017. Stipulates the best interests of the child as the guiding principle and includes such components as protection of children from violence, abuses and other risks in sport, ensuring right to education, and hearing children's voices.

[v] This document is formulated based on the Children's Rights and Business Principles (CRBP) as its model. The CRBP set out ten principles for companies and organizations to respect and support children's rights, complementing the UN Guiding Principles on Business and Human Rights which require companies and organizations to assess and address adverse human rights impacts as part of their responsibility to respect human rights.

[vi] When there are individual circumstances which makes it inappropriate to implement these principles in their entirety, efforts shall be made to explain the circumstances.

[vii] Guidelines for the Conduct of the Athletes' Entourage approved by the IOC Executive Board in Durban- 4 July 2011 define the Entourage as "all the people associated with the athletes, including, without limitation, managers, agents, coaches, physical trainers, medical staff, scientists, sports organisations, sponsors, lawyers and any person promoting the athlete's sporting career, including family members."

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for every child, play and sport

Children's Rights in Sport Principles
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Government of India

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Introduction

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. The National

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda,Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

Previous Policies

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

Principles of this Policy

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying,** and **fostering the unique capabilities of each student,** by sensitizing teachers as well as parents to promote each student's holistic development in both academic and non-academic spheres;
- **according the** highest priority **to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today's 'coaching culture';
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;

- a **'light but tight' regulatory framework** to ensure **integrity, transparency**, and **resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

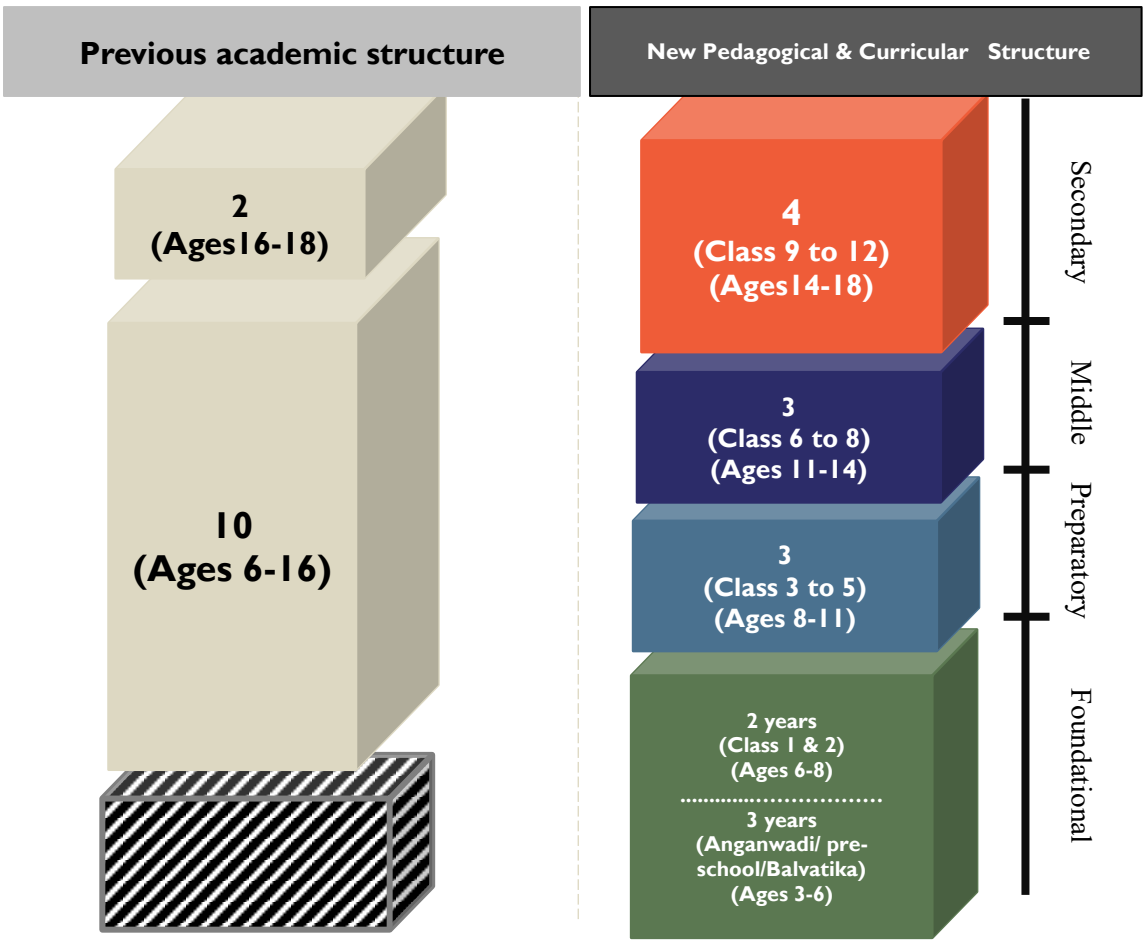
- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.



Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

1. Early Childhood Care and Education: The Foundation of Learning

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education–including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging

Restructuring school curriculum and pedagogy in a new 5+3+3+4 design

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

Holistic development of learners

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

Reduce curriculum content to enhance essential learning and critical thinking

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

Experiential learning

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment "as", "of", and "for" learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

Empower students through flexibility in course choices

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among 'curricular', 'extracurricular', or 'co-curricular', among 'arts', 'humanities', and 'sciences', or between 'vocational' or 'academic' streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

Multilingualism and the power of language

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the *'Ek Bharat Shrestha Bharat'* initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

Curricular Integration of Essential Subjects, Skills, and Capacities

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.

4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. "Knowledge of India" will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of "doing what's right", and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva, ahimsa, swachchhata, satya, nishkam karma, shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

National Curriculum Framework for School Education (NCFSE)

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

National Textbooks with Local Content and Flavour

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

Transforming Assessment for Student Development

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts – one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21st century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

Support for Gifted Students/Students with Special Talents

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

5. Teachers

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

Recruitment and Deployment

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as 'master instructors' in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

Service Environment and Culture

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

Continuous Professional Development (CPD)

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

Career Management and Progression (CMP)

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

Professional Standards for Teachers

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

Special educators

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

Approach to Teacher Education

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.

5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as 'master instructors', for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

6. Equitable and Inclusive Education: Learning for All

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India's children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a 'Gender-Inclusion Fund' to build the nation's capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children's access to and participation in education. Similar 'Inclusion Fund' schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a 'system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities'. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPwD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

7. Efficient Resourcing and Effective Governance through School Complexes/Clusters

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish "Bal Bhavans" where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a "Samajik Chetna Kendra".

8. Standard-setting and Accreditation for School Education

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

(a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.

(b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.

(c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

    Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

(d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.

Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to 'marks' of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic 'health check-up' of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

Part II. HIGHER EDUCATION

9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21st century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

(a) a severely fragmented higher educational ecosystem;
(b) less emphasis on the development of cognitive skills and learning outcomes;
(c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
(d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
(e) limited teacher and institutional autonomy;
(f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
(g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
(h) suboptimal governance and leadership of HEIs;
(i) an ineffective regulatory system; and
(j) large affiliating universities resulting in low standards of undergraduate education.

9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

(a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
(b) moving towards a more multidisciplinary undergraduate education;
(c) moving towards faculty and institutional autonomy;
(d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
(e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
(f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
(g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
(h) "light but tight" regulation by a single regulator for higher education;
(i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

10. Institutional Restructuring and Consolidation

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of 'affiliated colleges' over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall be replaced simply by 'university' on fulfilling the criteria as per norms.

11. Towards a More Holistic and Multidisciplinary Education

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta's Kadambari described a good education as knowledge of the 64 Kalaas or arts; and among these 64 'arts' were not only subjects, such as singing and painting, but also 'scientific 'fields, such as chemistry and mathematics, 'vocational ' fields such as carpentry and clothes-making, 'professional 'fields, such as medicine and engineering, as well as 'soft skills' such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered 'arts', has distinctly Indian origins. This notion of a 'knowledge of many arts' or what in modern times is often called the 'liberal arts' (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

12. Optimal Learning Environments and Support for Students

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

Internationalization

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.

Student Activity and Participation

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

Financial support for students

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

13. Motivated, Energized, and Capable Faculty

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a ‘tenure-track’ i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of 'tenure' i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in it's Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

14. Equity and Inclusion in Higher Education

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

14.4.1. Steps to be taken by Governments

(a) Earmark suitable Government funds for the education of SEDGs
(b) Set clear targets for higher GER for SEDGs
(c) Enhance gender balance in admissions to HEIs
(d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
(e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
(f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
(g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
(h) Develop and support technology tools for better participation and learning outcomes.

14.4.2. Steps to be taken by all HEIs

(a) Mitigate opportunity costs and fees for pursuing higher education
(b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
(c) Conduct outreach on higher education opportunities and scholarships
(d) Make admissions processes more inclusive
(e) Make curriculum more inclusive
(f) Increase employability potential of higher education programmes
(g) Develop more degree courses taught in Indian languages and bilingually
(h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
(i) Develop bridge courses for students that come from disadvantaged educational backgrounds
(j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
(k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
(l) Strictly enforce all no-discrimination and anti-harassment rules
(m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

15. Teacher Education

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor′s degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor's degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

16. Reimagining Vocational Education

16.1. The 12th Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from 'mainstream' or 'academic' education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagination of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India's demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of 'academic' or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor's degree programmes, including the 4-year multidisciplinary Bachelor's programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. 'Lok Vidya', i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across 'general' and vocational education.

17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one's own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world′s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

21st century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

(a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
(b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
(c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
(d) recognise outstanding research and progress

18. Transforming the Regulatory System of Higher Education

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a 'light but tight' and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions' websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a 'meta-accrediting body', called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as 'graduate attributes'. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21st century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act

as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

Curbing Commercialization of Education

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

19. Effective Governance and Leadership for Higher Education Institutions

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

Part III. OTHER KEY AREAS OF FOCUS

20. Professional Education

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

21. Adult Education and Lifelong Learning

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

22. Promotion of Indian Languages, Arts, and Culture

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible !ndia", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to

determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

23. Technology Use and Integration

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
b) build intellectual and institutional capacities in educational technology;
c) envision strategic thrust areas in this domain; and
d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-contents into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields "AI + X" and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India's diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace′s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

24. Online and Digital Education: Ensuring Equitable Use of Technology

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(a) **Pilot studies for online education**: Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.

(b) **Digital infrastructure**: There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.

(c) **Online teaching platform and tools**: Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.

(d) **Content creation, digital repository, and dissemination**: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

(e) **Addressing the digital divide**: Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.

(f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRABHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

(g) **Training and incentives for teachers**: Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

(h) **Online assessment and examinations**: Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21st century skills.

(i) **Blended models of learning**: While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

(j) **Laying down standards**: As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

Part IV. MAKING IT HAPPEN

25. Strengthening the Central Advisory Board of Education

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

26. Financing: Affordable and Quality Education for All

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursal mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

27. Implementation

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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Abbreviations

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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सत्यमेव जयते
Government of India
Ministry of Youth Affairs and Sports

KHELO BHARAT NITI - 2025

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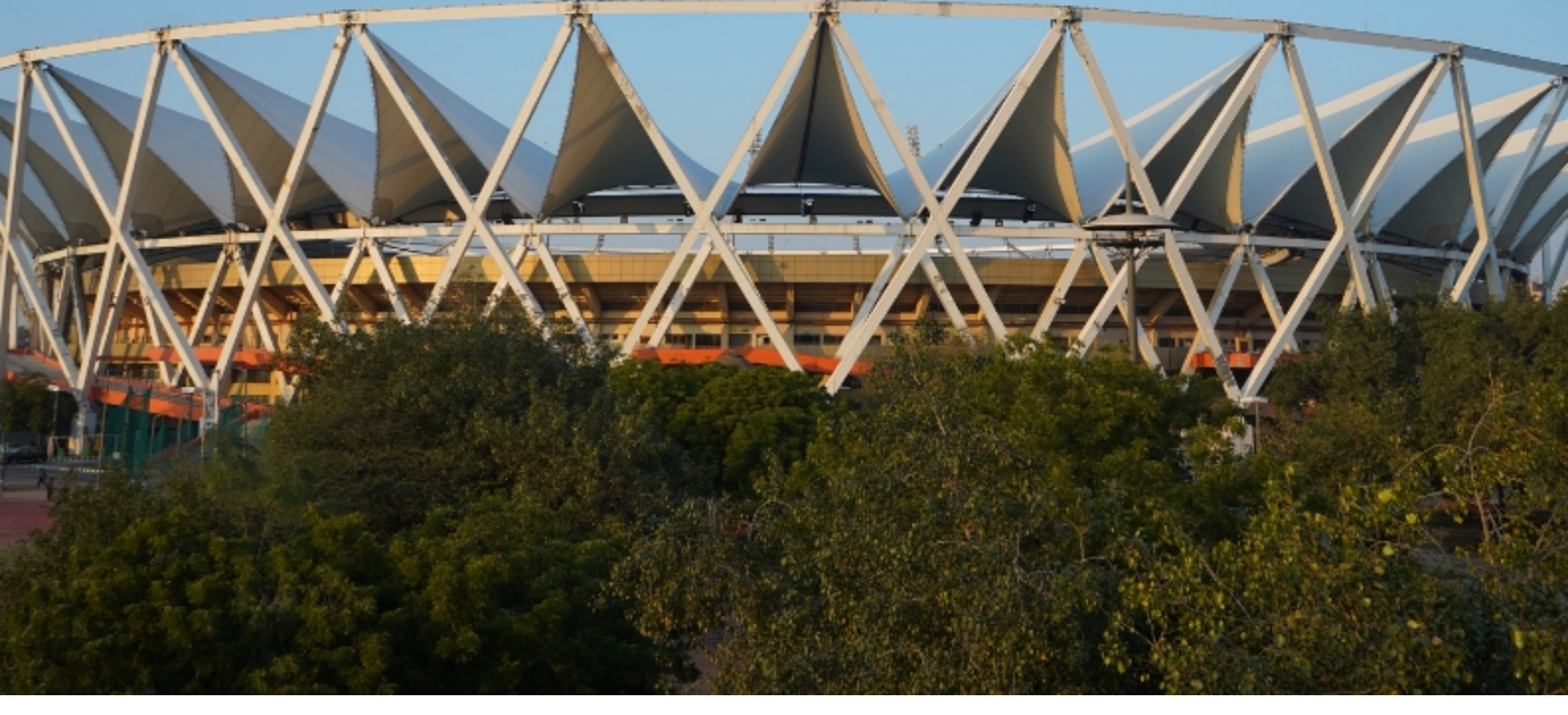


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INTRODUCTION

The Government of India, recognizing the transformative power of sports in nation-building and holistic development, hereby formulates the **Khelo Bharat Niti - 2025** (National Sports Policy - 2025). This policy aims to harness the potential of sports to drive excellence, economic growth and social progress while promoting the overall well-being of the nation's citizens. Building upon the foundations laid by previous initiatives such as the **National Sports Policy-2001**, the Khelo India Scheme and the Target Olympic Podium Scheme (TOPS), this comprehensive policy seeks to create an inclusive and robust sporting ecosystem that nurtures talent from the grassroots to the Olympic podium including **Olympics 2036**.

India, with its favorable demographic dividend and rapidly growing economy, stands at a crucial juncture in its journey towards becoming a global leader. As one of the youngest nations in the world, with a fifth of the global youth population (i.e. between the age group 15-29), India possesses immense potential to leverage sports as a catalyst for national development. The **Khelo Bharat Niti - 2025** is designed to align with the principles outlined in the **"Viksit Bharat"**.

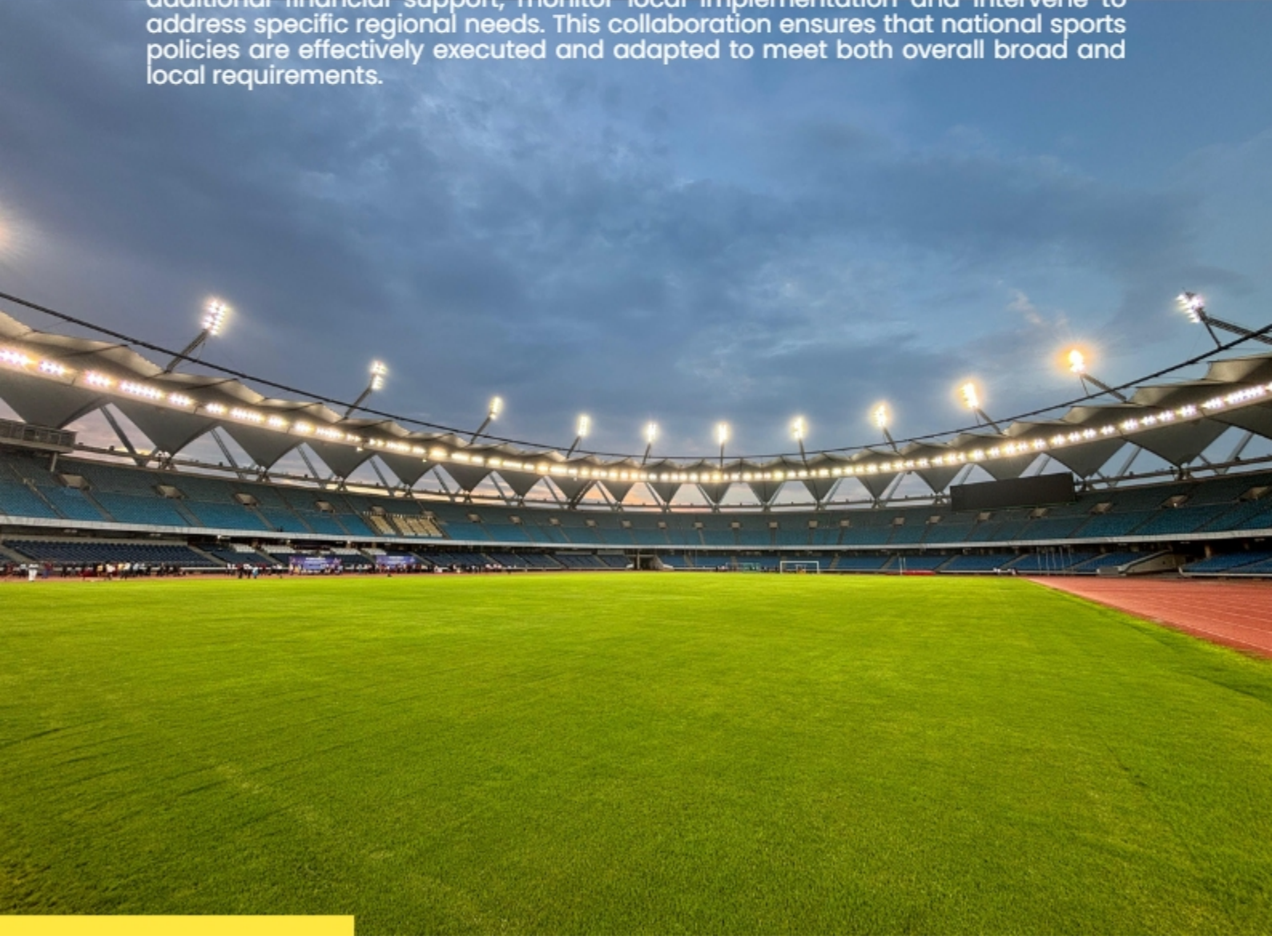
The policy takes into account India's performances in major international competitions, including the **Olympic Games, Paralympic Games, Commonwealth Games and Asian Games**. It recognizes the need to build on these achievements and create a sustainable system for long-term success in sports.



VISION
AND OBJECTIVES

The vision of the Khelo Bharat Niti – 2025 is **"Sports for Nation Building – Harness the Power of Sports for Nation's Holistic Development"**. This policy aims to strengthen the sporting culture and ecosystem from the grassroots to the national level, ultimately achieving excellence in sports on the global stage, leveraging sports for economic development, utilizing sports as a tool for social development and making sports a people's movement for health and well-being.

In sports policy implementation, the Union Government and State governments each play crucial yet complementary roles. The Union government is responsible for creating national policies, providing financial and operational support, establishing regulatory standards and offering advisory guidance. It also facilitates major events and develops frameworks that set the direction for sports development across the country. Whereas, State governments focus on implementing these national policies at the regional level, managing local sports infrastructure and organizing grassroots programs. They provide additional financial support, monitor local implementation and intervene to address specific regional needs. This collaboration ensures that national sports policies are effectively executed and adapted to meet both overall broad and local requirements.



To realize this vision, the policy focuses on several key objectives, which are given below:

- Establish comprehensive sports programs for all participation groups, from grassroots to elite levels.
- Organize sports competitions and leagues at various levels, creating a robust competitive structure.
- Implement physical literacy initiatives to promote a culture of sports and physical activity.
- Develop a robust talent identification and development system to nurture future champions.
- Ensure equitable access to sports infrastructure across the country.
- Provide athlete-centric support systems for the holistic development of sportspersons.
- Promote sports science, medicine and innovation to enhance performance and well-being.
- Strengthen governance and institutional frameworks in the sports sector.
- Revamp funding mechanisms to ensure sustainable development of sports.
- Foster economic growth through sports-related industries and activities.
- Promote social development and inclusion through sports.
- Establish sports as a viable career option for youth.
- Encourage mass participation in sports and fitness activities for a healthier nation.
- Develop a robust mechanism to reward and recognize champion athletes as well as retired athletes.
- Develop a framework and guidelines for educational institutions to act as feeder institutes to impart sporting culture.





CONTOURS OF THE **KHELO BHARAT NITI - 2025**

The Khelo Bharat Niti - 2025 is built upon five key pillars that aim to transform India's sports landscape. First, it focuses on achieving Nation's Excellence on the Global Stage by enhancing infrastructure, talent identification and international competitiveness. Second, Sports for Economic Development emphasizes leveraging sports to boost industries such as tourism, manufacturing and sports technology. Third, Sports for Social Development promotes inclusivity, health and education through sports, fostering societal cohesion. Fourth, Sports – A People's Movement seeks to engage communities in physical activities, making sports a cultural cornerstone. Finally, the Khelo Bharat Niti - 2025 aligns with the National Education Policy (NEP) 2020, integrating sports with education to nurture holistic development and life skills in students, youth, promoting both academic and athletic excellence. Each of the above contours are explained in the subsequent paragraphs.

Nation's Excellence on the Global Stage

Strengthening the sporting culture and ecosystem from the block level to the national level is a key focus of the Khelo Bharat Niti - 2025. This comprehensive approach aims to integrate sports deeply into the fabric of Indian society, ensuring access and opportunities for all, starting from the grassroots levels. At the block level, community engagement is vital to fostering a sporting culture. Block-level sports programs need to be established to promote mass participation, targeting schools, local clubs and community centers. Regular sports festivals, talent scouting camps and competitions will encourage wide spread participation and help identify promising athletes at early stage. Additionally, sports infrastructure will be developed to ensure that even the most rural or remote areas have access to facilities, fostering inclusivity and engagement.



The Khelo Bharat Niti – 2025 outlines a comprehensive strategy for enhancing the sporting culture and ecosystem across various levels in India. The policy includes a range of initiatives aimed at bolstering sports programs, leagues and competitions, while fostering physical literacy, outreach and awareness.





- **Sports Programs:** The Khelo Bharat Niti - 2025 advocates for the implementation of inclusive sports programs across all participation groups, starting from the unit level and extending to educational institutions like schools, colleges, universities, etc. This involves developing structured sports programs that cater to different age groups, abilities and skill levels, ensuring that every individual has access to sporting opportunities. National Sports Federations (NSFs) will facilitate to create robust program frameworks at various levels of the sports development pyramid, promoting a seamless progression from grassroots to elite levels.

- **Sports Leagues & Competitions:** The policy emphasizes the establishment of sports competitions and leagues at the community, educational institution, and district levels. By enabling NSFs to develop a sustainable framework for these competitions, the Khelo Bharat Niti - 2025 aims to foster a competitive spirit and provide regular opportunities for athletes to showcase their skills. This framework will be developed in collaboration with all stakeholders to ensure a cohesive and effective competition structure.

- **Physical Literacy:** An action plan for imparting physical literacy from early childhood is a central component of the policy. In alignment with the National Education Policy 2020, sports and physical literacy will be developed as major subjects in educational institutions, ensuring that students develop a life long appreciation for physical activity and well- being.

- **Outreach & Awareness:** Regular sports outreach programs will be organized to engage the general public and provide opportunities to interact with renowned national/international sports stars. Awareness campaign and knowledge sessions will be conducted to encourage active participation in sports and promote the benefits of a physically active lifestyle amongst masses.

- **Major Sporting Events:** A roadmap for organizing major sporting events, involving various stakeholders such as the Indian Olympic Association (IOA), Paralympic Committee of India (PCI), various NSFs, state governments and the other relevant organizations recognized by Ministry of Youth Affairs and Sports (MoYAS) and private organizations will be prepared. This includes creating a sustainable framework to ensure that these events are executed effectively and generate tangible returns for betterment of society.

- **Strong Sports Promotion Institutions:** Sports promotion institutions in the country, including NSFs, will be strengthened by focusing on operational efficiency, professional management, transparency and financial sustainability. This will call for the enhancement of national-level monitoring agencies to ensure seamless functioning and effective issue redressal mechanisms.

- **Athlete-Centric Sports Development:** A framework will be established to create an accessible and efficient sports support ecosystem for athletes. This includes comprehensive coaching, scientific support and streamlined mechanisms for addressing athlete issues. The policy also proposes a simplified funding framework to support potential and elite athletes, along with mechanisms to aid athletes at different stages of their careers, including post-retirement support.

- **Sports Personnel:** The sports personnel ecosystem shall be strengthened through effective programs for training and development. This will include focusing on continuous skill upgradation of coaches through certification and re-certification through accredited national and international training programs, workshops and online modules. Emphasis will be placed on integrating modern training methodologies, sports science, technology and data analytics into coaching curricula. Partnerships with global sports institutions and federations will be encouraged to facilitate knowledge exchange and exposure to best practices. Similarly efforts will be instituted for skill up gradation of other support personnel including referees/umpires, etc. Skill enhancement in sports support eco-system will be emphasized such as for sports administrators, managers, commentators, editors, etc.





- **Safety, Ethics & Professionalism:** Strengthening institutions focused on sports safety, ethics, gender parity, grievance redressal and professionalism will be prioritized. This will include developing programs for anti-doping, officiating and para-classification, as well as encouraging research in these areas. National agencies will be formed to ensure a safe and ethical sports environment.

- **Sports Science, Medicine and Technology, Research & Innovation:** Sports science, sports psychology, sports medicine and technology will be actively promoted as integral components of India's sports development strategy. Cutting-edge advancements in these areas such as biomechanics, injury prevention and recovery, nutrition, performance analytics and mental conditioning will be encouraged to enhance athlete performance and well-being. Educational institutions will be encouraged to undertake interdisciplinary sports-related research with initiatives such as hackathons and research grants. A Sports Innovation Task Force will be established to oversee targeted innovation efforts. Facilities for sports science and sports medicine will be provisioned in major training centers.



- **Rewards & Recognition for Champion Athletes:** A framework for rewarding and recognizing champion and retired athletes will be established, alongside a recruitment mechanism for hiring athletes in government services.



- **Educational Institutions in Sports Development:** Educational institutions will be guided to act as feeder institutes for sports development, with frameworks to foster a sporting culture and identify talent early. NSFs and other sports promotion agencies will be encouraged to organize sporting activities for students. Knowledge about sports to be disseminated through interactive engagements including structured Sports Quizzes, Trivia etc.

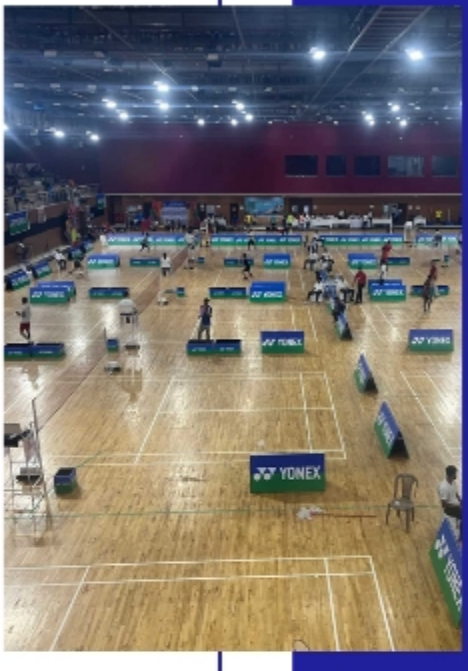
- **Strengthening Funding Mechanism for Sports Development:** The policy proposes a revamped funding mechanism, including innovative initiatives such as "Adopt an Athlete", "Adopt a District", "Adopt a Venue", "One Corporate-One Sport", "One PSU-One State", etc. wherever feasible. An oversight body or mechanism, if required, may be formed to strategize, execute, and supervise funded activities, ensuring a collaborative approach to sports development including CSR.

- **Talent Search & Development:** The Khelo Bharat Niti - 2025 aims to expand sports talent search and development activities involving important stakeholders like NSFs, States, educational institutes, private organizations. A National platform that facilitates talent identification, development and monitoring will also be developed to act as a single window. Integration with educational institutions and a smooth transition mechanism for athletes will be key components.

- **Sports Infrastructure:** The policy emphasizes equitable access to sports facilities, with a focus on infrastructure development from block to state levels irrespective of economic, social and geographic disparities. A targeted approach will be adopted to address high-performance needs based on regional data like demographic, personnel, previous performance etc.

- **Districts & States:** States and districts will be encouraged to strengthen their sporting ecosystems, with initiatives such as Model Sports State and Model District programs designed to enhance local sports capabilities.

- **Excellence in Para-Sports:** Athlete pathways and programs will be formulated and implemented for excellence in Para-Sports. The major focus domain will include physical literacy for the differently-abled, grassroots sports development in para-sports, elite para-sports development, para-sports compliant sports infrastructure, etc.





Sports for Economic Development

Sports play a pivotal role in driving economic development and several strategies can enhance this impact. The initiatives for promoting economic development through sports encompasses various measures including tourism, entrepreneurship, manufacturing, etc. These are enumerated below:

- **Sports Tourism through major Sporting Events:** To position India as a global sports tourism hub, it's essential to capitalize on major sporting events. By attracting international participants and spectators, India can significantly boost its tourism sector, create jobs, and stimulate local economies. To achieve this goal, major International tournaments/games will be hosted in India which can generate substantial revenue and enhance the country's global image.

- **Strong Sports Equipment Manufacturing Ecosystem:** Developing a robust sports equipment manufacturing sector is crucial for economic growth. Integrating this sector with national schemes such as "Make in India" and "Atmanirbhar Bharat" will be emphasized which can drive innovation and create significant job opportunities. Additionally, the manufacturing and distribution of sports equipment shall be encouraged to ensure high standards, which will further enhance product quality and market competitiveness.

- **Strong Sports Startup & Entrepreneurship Environment:** Fostering a thriving environment for sports startups and entrepreneurs is vital for innovation and growth. Government initiatives such as procurement programs, innovation hackathons, sports incubator programs, etc. will provide the necessary support for startups. Sports Startup & Entrepreneurship Accelerator Program shall be established to further promote ventures that contribute to sports development, providing them with mentorship, resources, and networking opportunities.

- **Operational & Financial Sustainability of Hard & Soft Sports Assets:** Ensuring the financial sustainability and operational excellence of sports infrastructure is essential for their long-term success. Both hard (stadiums, arenas) and soft (digital platforms, community programs) sports assets shall be considered to monetized to attract private investment through Public-Private Partnership (PPP) model and increase participation. Effective management and strategic partnerships will enhance revenue streams and maintain high operational standards.

- **Recognition for Innovation:** Innovation in sports will be encouraged in various emerging areas such as digital technology, affordable products, and inclusivity.

- **Global Sports Destination:** Leveraging India's diverse geographic and climatic conditions can transform it into a premier global sports destination. Regions with unique attributes shall be promoted — such as Himalayan States for winter sports, the coastal States for beach sports and hill states for adventure sports. By this, global athletes and tourists will be attracted.





- **Sports Business Advisory Group:** Efforts shall be made to establish Sports Business Advisory Group comprising representatives from relevant Ministries, the private sector, and other stakeholders for fostering the growth of the sports industry. This committee will provide strategic guidance, facilitate collaboration, and support the implementation of policies and initiatives aimed at expanding sports business activities across the country.



Sports for Social Development

By leveraging sports as a unifying force, global peace and mutual understanding can be promoted. Emphasizing inclusivity ensures that all individuals, regardless of background, have equal opportunities to participate and excel. This inclusive approach, combined with efforts to promote sports careers and educational pathways, paves the way for the prosperity of youth, empowering them to achieve their full potential and contribute to positivity of society.

- **Reduced Barriers for Participation of Underrepresented Population Groups:** To foster inclusivity and increase participation in sports among underrepresented groups such as women, economically weaker sections, tribal communities, and those with physical or psychological challenge, dedicated sports facilities will be established along with services tailored to their unique needs. Creating and maintaining such facilities can significantly reduce barriers and promote active participation among them. Additionally, regular sporting leagues will be organized which are specifically designed for these groups to boost engagement and provide ongoing opportunities for their involvement. Developing and enforcing guidelines to be undertaken to ensure a safe and inclusive sports environment is essential to safeguard against discrimination and creating a welcoming atmosphere for all participants.



- **Promotion of Indigenous Sports and Games:** Expanding the recognition and support for indigenous games from various states can enrich India's sports landscape and preserve the cultural heritage. Research will be promoted for documenting the historical roots and development of various games in India. Strengthening the infrastructure, training personnel, and establishing a robust competition framework for these games will be ensured to help elevate their profile and ensure their sustainability. Investing in the promotion and development of indigenous games will not only celebrate cultural diversity but shall also provide new avenues for talent discovery and community engagement.

- **Underrepresented Population Talent Development Initiatives:** A comprehensive talent development mechanism tailored for underrepresented groups shall be established which is vital for nurturing sports talent across the country. Special focus shall be given to tribal talent development initiatives, considering anthropometric, genetic, and other factors that may influence performance in specific sports. Targeted events, such as tribal games and women's games, will be organized that will provide platforms for showcasing talent and identifying potential athletes from these groups. These initiatives will help bridge participation gaps and foster a more inclusive sporting environment.

- **Peace & International Cooperation Activities through Sports:** Sports can serve as a powerful tool for international diplomacy and cooperation. International sports exchange programs will be promoted to allow knowledge sharing, capacity building and collaborative development efforts. Sports can serve as a powerful bridge between the Indian diaspora and India, fostering enduring emotional, cultural and social connections. To strengthen this bond, dedicated sporting events and leagues can be organized specifically for and among the Indian diaspora. Wherever feasible, promising and prominent Indian-origin athletes living abroad may be encouraged to come back and play for India at the international level. Together, these efforts can transform sport into a dynamic tool of cultural diplomacy and nation-building, strengthening the global Indian identity.





- **Promotion of Sports & Allied Services as Mainstream Career:** To enhance the recognition and attractiveness of sports as a career option, it is important to promote sports professional education through structured frameworks and regulations. States and other stakeholders shall be encouraged to establish sports educational institutions which will provide more pathways into the industry. Creating resources to raise awareness about sports careers among youth, along with a national platform for sports certifications, degrees, courses and job vacancies, will help streamline career pathways. Dual-career programs will be promoted that balances academics and sports which will also support students in pursuing their athletic and educational goals simultaneously.

- **Sports Volunteering Programs:** Engaging the youth in sports volunteering can enhance community involvement and support various sporting schemes. Robust sports volunteering mechanisms, such as the Khelo India Sports Activator and FIT India Volunteer programs, will be established in order to encourage active participation. Recognizing and rewarding volunteers will be promoted through incentives like course credits, event passes and opportunities to meet champion athletes which will further motivate young individuals to contribute to the sports sector and foster a culture of volunteerism.





Sports – A People's Movement

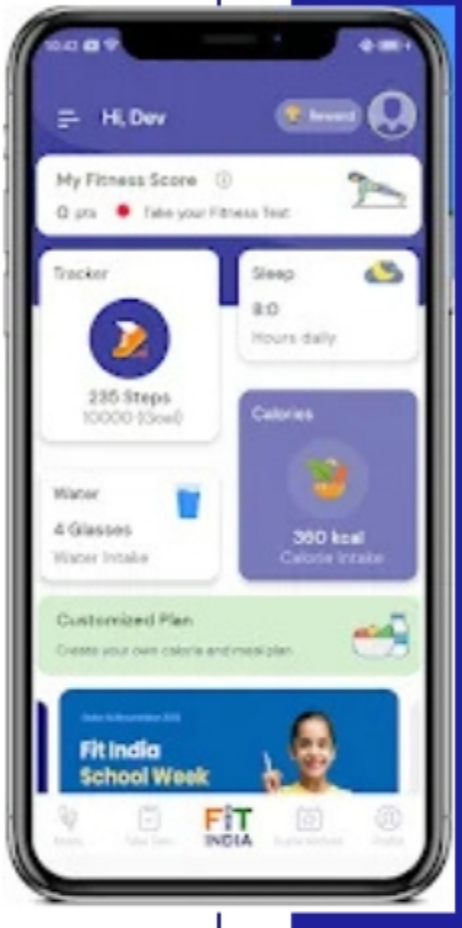
Sports can transform into a powerful people's movement by addressing key aspects of physical and mental well-being while serving as a major leisure and entertainment activity. Prioritizing physical health through sports improves overall fitness, reduces healthcare costs and promotes a healthier lifestyle. Mental health benefits are also significant, as regular physical activity can reduce stress, anxiety and depression, while fostering a sense of community and belonging. Additionally, sports offer a valuable source of leisure and entertainment, enriching lives and enhancing quality of life.

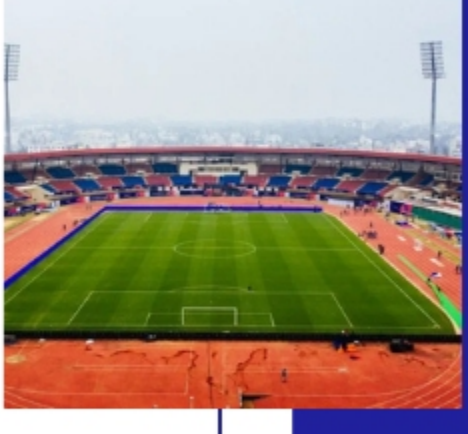
- To support this movement, a **Fitness Ranking & Indexing system** will be implemented to incentivize educational institutions and workplaces to excel in their sports and physical education programs. Mechanisms like the School Fitness Index and Fit Workplace Index will be developed to drive excellence and innovation in fitness initiatives. Furthermore, a robust **Personnel Training & Certification** programs would be established as it is crucial for equipping trainers and educators with the skills necessary to deliver effective sports and Physical Education programs, enhancing health outcomes and talent identification.

- **National Sports Federations (NSFs)** shall be actively engaged with educational institutions to promote their disciplines and formulate frameworks focusing on physical and mental well-being. This will be achieved through initiatives such as School Soccer Programs and Tennis for Tots. Standard Operating Procedures (SOPs) would be created for fitness programs at schools, colleges and workplaces which will ensure structured and consistent delivery of fitness activities, supported by a resource repository like the FIT India Information & Knowledge Hub.

- **Physical Education Framework** will be revamped in collaboration with the Ministry of Education to enhance the effectiveness of physical education programs and improve talent development mechanisms.

- **Access to sporting facilities** will be improved through guidelines and frameworks that will facilitate greater public participation and support the establishment of social sports hubs at block and district levels.





- **Model sports programs and events,** such as Family Sports Weekends and periodic community engagement activities will be encouraged to promote regular participation and foster a culture of active living. Barriers to participation will be reduced and underutilized public facilities will be leveraged to further enhance accessibility. Finally, national-level programs and digital initiatives, like the Yoga Challenge and 10,000 Steps a Day Challenge, will be conducted which will drive large-scale engagement and cement sports as a central element of community life, transforming it into a true people's movement.



Major Focus Areas to Harmonize Khelo Bharat Niti – 2025 with NEP 2020

To achieve alignment between the Khelo Bharat Niti - 2025 and the National Education Policy (NEP) 2020, several key focus areas will be addressed. A framework and delivery of sports modules for the holistic education program will be facilitated to ensure that sports and physical education are integrated seamlessly into the overall curriculum. This approach will promote a balanced development of students, combining academic learning with physical fitness and personal growth.

- A framework for the active engagement of sports groups and circles in educational institutions will be formulated to enhance the presence and impact of sports in schools. This shall involve establishing partnerships with local sports organizations and creating structured programs that encourage participation and talent development within educational settings.



- A sports and physical education skill development program for teachers will be framed and facilitated for the effective delivery of sports education. Providing educators with specialized training and resources will ensure they are well-equipped to teach and inspire students, thereby improving the quality of sports programs across schools.

- Liaising with various stakeholders to develop an action plan and timeline will be encouraged to address the infrastructure and resource needs for effective sports program delivery. This will include ensuring adequate manpower, securing necessary resources such as playgrounds, and implementing school-level programs on a regular basis. Coordinated efforts among government bodies, educational institutions and sports organizations will help achieve these objectives and create a sustainable framework for integrating sports into the educational landscape.

STRATEGIC FRAMEWORK

FOR ACHIEVING THE OBJECTIVES

The strategic framework outlines a comprehensive strategy to advance the sports ecosystem in India through robust governance, education, technological integration and private sector engagement. Key pillars of this framework include:

- **Strong Professional Sports Governance, Implementation & Monitoring:** With a view to prepare India's sports ecosystem for Olympics 2036, the requisite regulatory framework including law, if required, for governance shall be established. In line with the international code on doping, a national law shall be enacted. National- level regulatory bodies and/or processes shall be established to ensure ethical practices, fair play and healthy competition in the sports sector. It will also involve the creation of national agencies and inter-ministerial committees to facilitate swift action and effective issue resolution, promoting transparency and seamless operations across the sports ecosystem.



- **Technological Intervention:** Existing platforms will be revamped to enhance efficiency, transparency and effectiveness in implementing and monitoring various sports schemes and projects. By utilizing technology including artificial intelligence for data-driven analysis, it aims to monitor and analyze performance, enabling timely interventions for ongoing programs to ensure optimal outcomes and continual improvement in the sports sector.

- **National Framework & Regulatory Bodies:** A robust national structure with clear benchmarks, key performance indicators (KPIs), and time-bound targets will be established to guide the development of sports in the country. It will focus on holistic growth by encompassing grassroots development, elite athlete training and infrastructure enhancement. Additionally, it will support the organization of sports leagues at various levels, to ensure comprehensive and inclusive progress in the sporting ecosystem.

- **Private Sector Engagement:** Policies and schemes will be developed to actively encourage extensive participation from the private sector in sports development activities. To incentivize this contribution, the policy will incorporate Return on Investment (ROI) considerations for private entities, making their involvement in sports development both attractive and sustainable. This approach aims to foster a collaborative environment where the private sector plays a crucial role in advancing the country's sports infrastructure and programs.





CONCLUSION

- The Khelo Bharat Niti – 2025 embodies a visionary and comprehensive framework aimed at revolutionizing sports development in India. It is designed to align sports advancement with the broader objectives of economic and social progress, leveraging sports as a powerful tool for nation- building. The policy adopts a multi-faceted strategy that addresses critical areas such as infrastructure development, talent identification, nurturing, governance reforms, and enhancing mass participation. By improving sports facilities, creating robust talent pipelines, implementing governance reforms and encouraging widespread involvement, Khelo Bharat Niti - 2025 aspires to elevate India to the status of a global sporting powerhouse to host major international sports events and also improve its participation as well as its medal tally in international sports competitions.

- The Khelo Bharat Niti – 2025 will serve as a model policy for States who shall be encouraged to modify their existing Sports Policy, if any, or adopt new Sports Policy in line with this policy. Further, following a whole of Government approach, this Policy needs implementation and integration by all Ministries/Departments in their work domain, policies, schemes, etc. to ensure promotion of sports.

- Achieving the ambitious goals outlined by Khelo Bharat Niti - 2025 will require a unified effort from all relevant stakeholders, including State Governments, government agencies, sports federations, private sector entities, and the general public. Each stakeholder will play a crucial role in the successful execution of the policy's initiatives. Government agencies will provide the necessary regulatory framework and funding, sports federations will drive talent development and competition, the private sector will contribute resources and innovation, and the public will engage in and support sports activities.

- Through this collaborative approach, India has the potential to unlock its full sporting potential, setting the stage for a transformative impact on the nation's global standing in sports and contributing significantly to its overall development.





सत्यमेव जयते

Government of India

Ministry of Youth Affairs and Sports

Annexure-25

World Health Organization India

Advisory for Air Pollution

Different areas of National Capital Region (NCR) are recording ambient levels of air pollution that are rated as severe, exceeding the safety limits for key air pollutants that pose health risks to people. Here is an advisory to reduce personal exposure to high levels of air pollution.

The WHO air quality guidelines [i] offer global guidance on thresholds and limits for key air pollutants that pose health risks. The guidelines indicate that reducing air pollution (particularly that of fine particulate matter - PM 2.5), can achieve significant health benefits.

In the prevailing conditions of severe levels, the following measures are encouraged:

- Avoid prolonged or heavy outdoor activities.
- Face masks are generally not regarded as a suitable measure for protection of health but may be indicated in certain special circumstances. For example, during prolonged commuting and outdoor activities in situations of hazardous air quality. Disposable masks known as N95 may help. N95 masks can filter most of the PM2.5 particles. If masks are used, they must be fitted properly with a tight seal around the users' mouth and nose. Paper "comfort" or "dust" masks are designed to trap large particles only, such as sawdust. These masks will not protect the lungs from small particles such as PM2.5. Scarves or bandanas are not helpful.
- Use of air purifiers at the office and at home. Use of air conditioners may also help to reduce the concentration of particulate in the indoor environment.
- Ensure gaps in windows and doors are all sealed.
- Remain indoors as much as possible particularly those more vulnerable, such as children, pregnant women and older people, or those with pre-existing illness, should stay indoors as much as possible and avoid roads with heavy traffic. External doors and windows should remain closed to reduce the penetration of pollution from outside. Keep washing your eyes with running water regularly and do regular gargles with warm water.
- Keep rooms inside homes clean:

    - Wet mopping and dusting is preferable to sweeping or vacuuming, as sweeping and vacuuming can stir up additional dusts and particles. However, vacuums with a High Efficiency Particulate Air (HEPA) filter can be used.
    - Various types of air purifiers exist, including HEPA filters, and electronic air cleaners, such as electrostatic precipitators. All air purifiers need to be used according to manufacturers' guidelines. Avoid using an air purifier that works by generating ozone, as this will increase the pollution levels.
    - Keep windows closed.
    - Prioritize the cleaning of rooms used for sleeping, particularly for vulnerable groups. This could mean more regular cleaning, assigning an air purifier to these rooms, sealing windows to prevent outdoor air coming inside.

- Please visit the nearest hospital/dispensary in case of any breathlessness, giddiness, chest pain, chest constriction, and irritation in eyes. Persons who are taking medications to help manage existing illness should ensure that do not miss their medication.

- Check the advice from Central and Delhi Government to guide your planned activities.

- A fact sheet on air pollution and measures that can be taken by individuals to mitigate against the risk of health impacts can be found on the **SEAR website**

- Please also refer to the advisories from National Centre for Disease Control, Ministry of Health and Family Welfare, Government of India

- https://ncdc.gov.in/WriteReadData/p92g8/10611197501542002192.gif
- https://ncdc.gov.in/WriteReadData/p92g8/78346924851542002344.gif
- https://ncdc.gov.in/WriteReadData/p92g8/64781509811542002413.gif
- https://ncdc.gov.in/WriteReadData/p92g8/2854177061542002460.gif

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https://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/

सत्यमेव जयते
Government of India
Ministry of Health and Family Welfare

National Programme on Climate Change and Human Health



National Programme on Climate Change &Human Health
National centre for Disease Control
Directorate General of Health Services
MoHFW

September 2024

Purpose P

Purpose of the Document

The present health advisory document on air pollution is updated and meant for the health department in the states including the programme officials to enable them in developing certain appropriate mechanisms to address health issues arising due to exposure to air pollution in their respective areas. This includes a background understanding of the present burden of diseases attributed to air pollution, major sources of pollution, vulnerable groups, its health effects and main symptoms and understanding of air quality information in their respective areas.

The document also provides suggestions to the state health department on ways to obtain the air quality information from pollution control board for making people aware of the potential health issues and informed them of protective and preventive health measures. The addressing mechanisms also mention on ways to focus on strengthening of health care service provisions in the health facilities, its preparedness and response actions during high air pollution level. It further mentions of health sector strengthening measures like health action plan development, considerations of air pollution and few action points for health sector in Delhi NCR. It also suggested IEC messages for widespread public health communication on Do's and Don'ts to protect, prevent and control health issues of the general population and also, for those having medically underlying diseases. Some of the social media messages are also added for reference purposes. There is an addition for messages particularly for households and for school children in the country.

The document has provided important links to access relevant documents on air pollution and health issues like the technical documents, IEC materials, training modules etc. developed under NPCCHH and others for references of the state officials.

Acknowledgement

The present document on Health Advisory on Air Pollution, 2024 under NPCCHH (MoHFW) is updated from the previous public health advisory on air pollution. Under the guidance of Prof. Atul Goel, Director General, DGHS, Ms. L. S. Changsan, Additional Secretary, MoHFW, Ms. Latha Ganapathy Joint Secretary, MoHFW, Dr. Anil Kumar, Principal Advisor, NCDC and Dr Aakash Shrivastava, Head and Addl. Director, NPCCHH (HQ) at NCDC, the contents in the previous document were revised and edited with inclusion of certain new areas and relevant messages on air pollution related health issues by the undersigned.

The updated advisory contents were then shared with the members of the Technical Expert Group (TEG) on air pollution and health including some of the special invitees working in the subject areas for their suggestions/ inputs. Inputs from some expert members were received and during the TEG meeting, the contents of the document were presented. Inputs suggested were considered and the final document got developed, CPCB's inputs in Air quality information, diagrams on Health Effects and Vulnerables attributable to air pollution, recommendations specially for the programme officials, considerations during the time of high AQI levels, CPCB's Delhi NCR Graded Response Plans and its recommendations to programme officials, Social media message templates, important links and references.

The TEG members on Air pollution and Human Health under NPCCHH along with special invitees from relevant stakeholders working on air pollution and health concerns provided inputs for update of the advisory document are as follows-

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19. Mrs. Marion, World Bank India
20. Dr Carmin, Lung Care Foundation
21. Divya Datta, UNEP India
22. Sumit Sharma, UNEP India

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The programme is very grateful to all those who have provided valuable inputs in the document to help address the health issues of the people impacted due to exposure to air pollution in the country.

Dr. Aniket Chowdhury
Assistant Director
NPCCHH (HQ) NCDC

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Glossary of Abbreviations

AIIMS	**All India Institute Of Medical Sciences Delhi**
AP	**Air Pollution**
AQEWS	**Air Quality Early Warning System**
AQI	**Air Quality Index**
CAAQMS	**Continuous Ambient Air Quality Monitoring Stations**
CHCs	**Community Health Centers**
CHO	**Community Health Officer**
CNS	**Cerebrovascular Strokes**
CO	**Carbon Monoxide**
COPD	**Chronic Obstructive Pulmonary Disease**
CPCB	**Central Pollution Control Board**
CVD	**Cardio Vascular Disease**
CVS	**ischaemic heart diseases**
DALY	**Disability-Adjusted Life Year**
DHs	**District Hospitals**
DNO-CC	**District Nodal Officer Climate Change**
ED	**Emergency Department**
GoI	**Government of India**
HAP	**Health Action Plan**
HCFs	**Health Care Facilities**
HIRA	**Hazard Identification and Risk Assessment**
ICMR	**Indian Council of Medical Research**
IEC	**Information Education Communication**
IIT	**Indian Institute of Technology**
IITM	**Indian Institute of Tropical Meteorology**
IMD	**Indian Meteorological Department**
LCF	**Lung Care Foundation**
LED	**Light-Emitting Diode**
LPG	**Liquefied Petroleum Gas**
MO	**Medical Officer**
MoEFCC	**Ministry of Environment Forest and Climate Change**
MoES	**Ministry of Earth Sciences**
MoHFW	**Ministry of Health and Family Welfare**
NCAP	**National Clean Air Programme**
NCD	**Non-Communicable Diseases**
NCDC	**National Centre for Disease Control**
NOx	**Nitrogen Oxide**
NO_2	**Nitrogen Dioxide**
NPCCHH	**National Programme on Climate Change and Human Health**
OPD	**Out-Patient Department**
PGIMER	**Post Graduate Institute of Medical Education & Research, Chandigarh**
PHCs	**Primary Health Centers**
PHFI	**Public Health Foundation of India**
PM	**Particulate Matters**
PPE	**Personal Protective Equipment**
PWD	**Public Works Department**
PUC	**Pollution Under Control**
SBS	**Sick Building Syndrome**
SDHs	**Sub-District/Divisional Hospitals**
SMOG	**Smoke + Fog**
SNO-CC	**State Nodal Officers Climate Change**
SOP	**Standard Operating Procedures**
SO_2	**Sulphur Dioxide**
SRIHER	**Sri Ramachandra Institute for Higher Education & Research**
TEG	**Technical Expert Group**
ToT	**Training of Trainers**
UNEP	**United Nations Environment Programme**
VOCs	**Volatile Organic Compounds**
WB	**World Bank**
WCs	
WCD	**Women and Child Development**
WHA	**World Health Assembly**

Health Advisory on Air Pollution (NPCCHH)

1. What is Air Pollution and its key pollutants?

Air pollution is the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO).

Key health harmful air pollutants include following-

- Particulate Matters ($PM_{2.5}$ and PM_{10}), Carbon Monoxide (CO), ground level Ozone (O_3), Volatile Organic Compounds, metals,[A1] Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2).

2. Major sources of air pollution in the country are –

i. **Ambient (outdoor) air pollution** is from both anthropogenic and natural.

a) Industrial emissions (through fossil fuel burning/ process and fugitive emission)

b) vehicular exhaust

c) re-suspension of road dust, construction and demolition activities,

d) refuge burning (garbage, horticulture wastes, crop residues etc.)

e) use of solid fuels for cooking and burning of firecrackers etc.

ii. **Household (Indoor) air pollution** is caused by burning biomass such as

a) wood, coal, dung, kerosene in chulhas or fireplaces for cooking and heating purposes.

b) Others such as

- by burning mosquito coils, incense sticks, cigarettes, bidis,
- use of sprays, solvents, and fumes from chemicals used in building interiors etc.

iii. **Sick Building Syndrome (SBS)**: Building occupants experience acute health and comfort effects which appear to be linked to time spent in a building, but no specific illness or cause can be identified is called Sick Building Syndrome (SBS).

a) The complaints may be localized in a particular room or zone, or may be widespread throughout the building.

b) The major sources are inadequate ventilation, chemical and biological contaminants (molds and fungi) from indoor sources or outdoor sources, dust, smoke, fumes, fabric fibers, bright or flickering lights and problems with cleaning and layout

3. Understanding air quality/AQI levels and its health significance:

To avoid complexities in understanding the data and for its effective communication and to educate public on status of air pollution and its related health perspectives, Central Pollution Control Board has launched the mechanism of publishing Air Quality Index (AQI) depicted in easily understandablesix (6) colour code categories with their likely health impacts as

i. Good

ii. Satisfactory

iii. Moderately polluted

iv. Poor

v. Very Poor

vi. Severe

AQI Considerations and its significance

- Air pollutants measured by real time analysers at Continuous Ambient Air Quality Monitoring Stations (CAAQMS)
  - First calculate moving averages of last 24 hours for individual pollutant
  - Then, the AQI sub-index for a particular pollutant is calculated and finally, the highest sub-index is declared as AQI of that day of the area or location.
- AQI value never indicates synergistic status of air pollution or impact of air pollution on health; rather it indicates about most problematic air pollutant

Worsening of Air Quality Index (higher AQI value) especially of 'poor to severe' in an area may result in increase in morbidity and mortality among those who are exposed to it particularly vulnerable populations like children, elderly, underlying medical conditions etc.

Therefore, a general health advisory related to AQI is issued by CPCB with AQI bulletin as in table below-

Table: AQI levels, Health effects and Certain Protective Health Measures

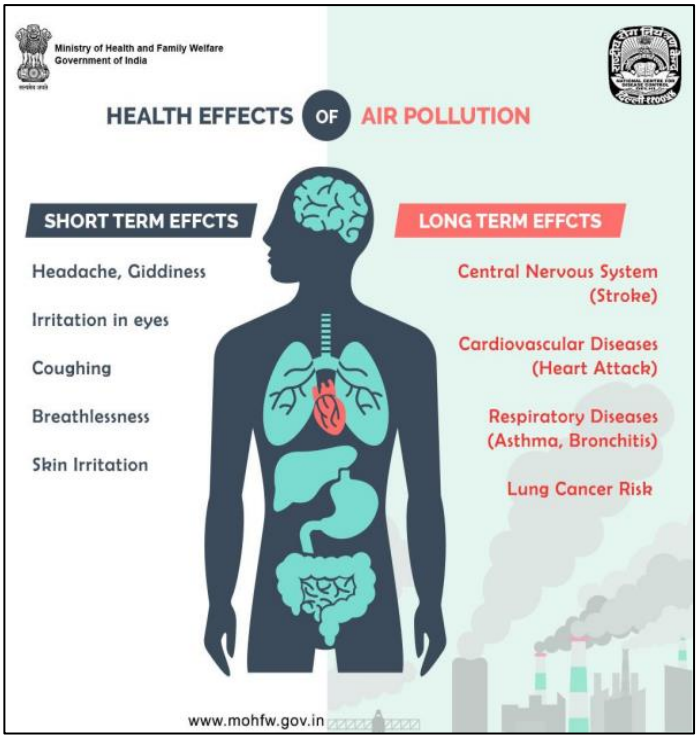
Air Quality Index (AQI)# (Pollution level)	Possible Health Consequences	Advice for	
		General Population	Vulnerable Population*
Good (0-50)	Low risk	No special precautions	No special precautions
Satisfactory (51-100)	Minor breathing discomfort in vulnerable population*	No special precautions	Do less prolonged or strenuous outdoor physical exertion
Moderate (101-200)	Breathing or other health related discomfort in vulnerable population*	Do less prolonged or strenuous outdoor physical exertion	Avoid prolonged or strenuous outdoor physical exertion
Poor (201-300)	Breathing discomfort in healthy people on prolonged exposure Breathing or other health related discomfort in vulnerable population*on short exposure	Avoid outdoor physical exertion	Avoid outdoor physical activities

Very Poor (301-400)	Respiratory illness in healthy people on prolonged exposure Pronounced respiratory or other illnesses in vulnerable population* on short exposure	Avoid outdoor physical activities, especially during morning and late evening hours	Remain indoors and keep activity levels low
Severe (401- 500)	Respiratory illness in healthy people on prolonged exposure Serious respiratory or other illnesses in vulnerable population* on short exposure	Avoid outdoor physical activities	Remain indoors and keep activity levels low

Sameer app from CPCB is a mobile app which can provide the city level hourly update of the National Air Quality Index (AQI) published by Central Pollution Control Board. Health Officials and general public may download it for use to get information of the air quality level in their respective areas.

4. Health consequences of air pollution:

The health impacts of air pollution depend on the level of pollution and exposure duration. The individuals' vulnerability to the health impacts of pollution can also differ based on demographic factors and predisposing health conditions.



i. Short-term high-level exposures can result in acute health reactions with involvement of various human organs and patients may present with certain suggestive symptoms like irritation of eyes, nose, throat and skin, cough, breathing difficulty, wheezing, chest discomfort, chest pain, headache, giddiness, limb weakness, facial deviation etc. Vulnerable groups can experience more severe effects such as lower respiratory tract inflammation and infection, exacerbation of asthma, bronchitis or exacerbation of chronic illnesses such as chronic obstructive pulmonary disease (Respiratory System), ischaemic heart diseases (CVS), and cerebrovascular strokes (CNS) etc. The Figure 1 (in the right) shows various health effects attributed due to air pollution.

ii. Long term exposures to even lower level of air pollution can result in chronic illnesses of respiratory and cardiovascular systems, lung cancer and premature deaths.

5. Vulnerable Population to health effects of air pollution:

i. **Age group:** Children particularly under 5 years and old age groups

ii. **Pregnant women:** Exposure during pregnancy may have consequences for child in womb.

iii. **Predisposed health conditions:** Those with pre-existing illnesses of respiratory cardiovascular and cerebrovascular systems are at higher risk

iv. **Low socio-economic conditions:** Those with poor nutritional status; those living in poor housing, using fossil fuels for cooking, heating/ lighting purposes are at risk.

v. **Outdoor working groups:** Those with possibility of prolonged exposures such as traffic policemen, traffic volunteers, construction workers, road sweepers, rickshaw pullers, auto-rickshaw drivers, roadside vendors, and others working outdoors in air polluted settings, labours working near boilers or furnace smelters, miners etc. are at higher risk.

vi. Besides, women with burning biomass for cooking, and sweeping dust are vulnerable on account of their household work.

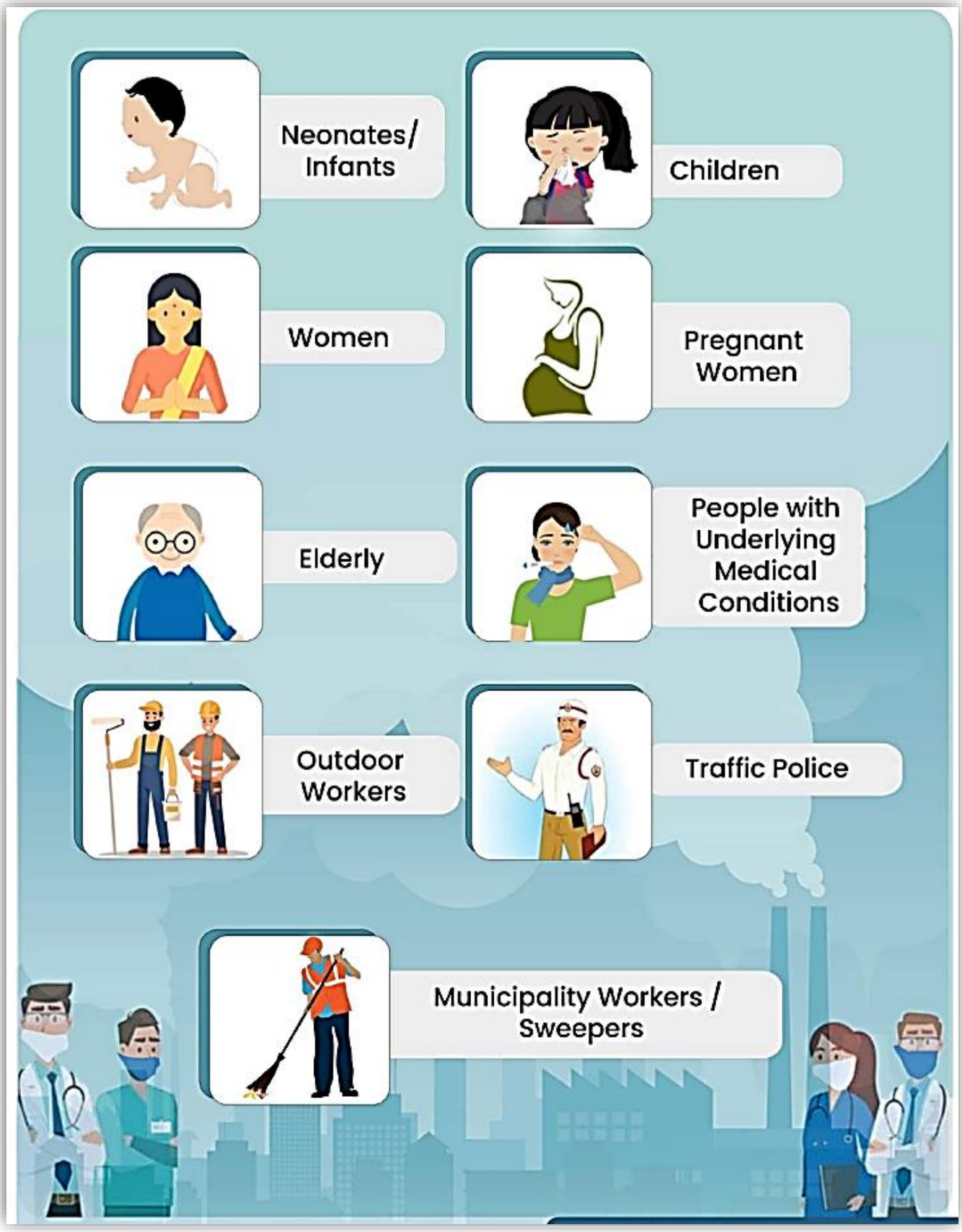


Figure2.Vulnerable populations to air pollution exposure

6. Air Quality Early Warning System (AQEWS) for Delhi and India (Advanced High Resolution)

Under the auspices of Ministry of Earth Sciences, India Meteorological Department (IMD) and Indian Institute of Tropical Meteorology (IITM) have commissioned Air Quality Early Warning System (AQEWS) for India. The advanced high-resolution Air Quality Early Warning System is operational specifically for Delhi-NCR. It is also available for some specific Indian cities (Pune, Mumbai, Bengaluru, Kolkata, Varanasi, Lucknow, Kanpur, Ludhiana, Ahmedabad, Hyderabad, Visakhapatnam, Chennai, Coimbatore, Bhubaneswar, Ranchi, Patna, Raipur etc.). The final forecast is made available in terms of Air Quality Index (AQI) so that appropriate health advisories can be issued depending on severity of the pollution levels.

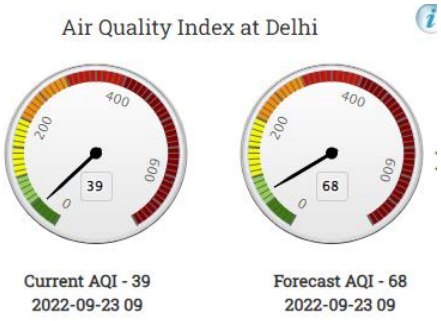
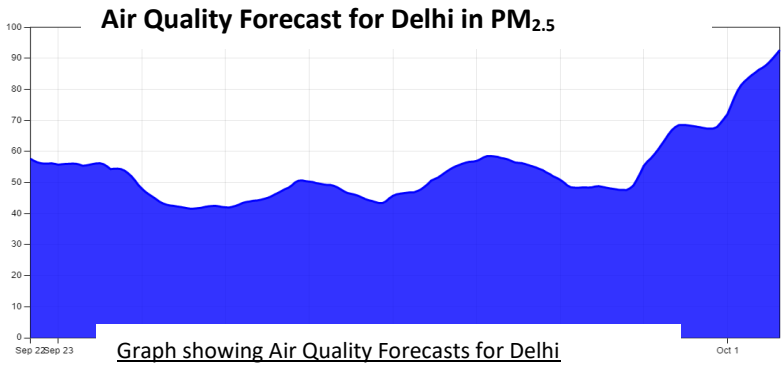
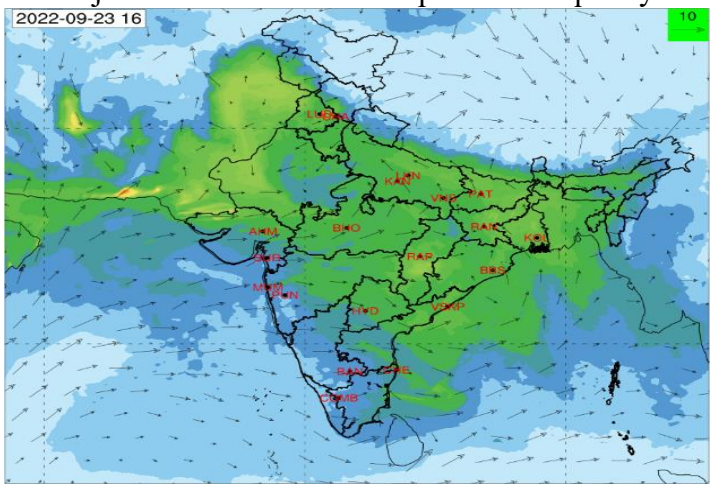


Figure showing AQ forecast and AQ current (IAQI in Delhi



Graph showing Air Quality Forecasts for Delhi

The objective is: "to enable and provide air quality forecasting and information services in aharmonized and standardized way tailored to the needs of society and pollution control authorities". Climate and weather factors like wind, temperature, precipitation and other meteorological factors play a key role in the poor air quality that populations face.



How to access the Air Quality Forecast: The Air Quality forecast spatial plots are available for the Indian region. The air quality forecasts products are available at the following linkshttps://ews.tropmet.res.inand https://mausam.imd.gov.in .

State programme officials are to monitor the AQ forecasts regularly which are available for the respective areas at present. Depending on severity of the pollution levels in their respective areas, the officers are to take up appropriate health related actions including issuance of health advisory to increase the awareness level of the public on the Do's and Don'ts IEC messages in the social media and other media channels. These are the acts required to protect, prevent and control the health issues which may arise when people are exposed to air pollution.

7. Recommendations to the States (4 main action points)–

(NPCCHH programme Nodal Officers at State and District levels to supervise, monitor and coordinate the activities)

i. Getting Air Quality information in Health Sector:

State health authorities to keep a check on the daily air quality data in the cities particularly NCAP cities and these are available at CPCB website or State Pollution Control Board. As mentioned above, Sameer App. can also be used for obtaining the information.

- State may coordinate with pollution control board for developing a system of availing such air quality information in health sector regularly.
- The same air quality data may preferably be made available to health facilities (WCs, PHCs, CHCs, SDHs and DHs and others) for health-related actions
- Based on the air quality data, healthcare facilities may strengthen appropriate healthcare service provisions to address health issues arising in their respective area and also, for the outreach activities at the community level.
- This information is also for use in surveillance on air pollution related illnesses

ii. Strengthening of Healthcare services to address the air pollution related health issues

a) Public Awareness Generation

IEC materials

- Posters, GIFs, Audio-Video Spots, Social media messages (Prototypes at NCDC website)
- Locally translated/created IEC materials
- IEC messages (Annexure 1)
- Social Media Messages (Annexure 2)

IEC dissemination plans

- Timing: For example-
  - Winter months (Sept.-Oct to Feb.-March)
  - Pre and Post Diwali
  - Stubble Burning Days
  - SMOG (Smoke + Fog)- Fog admix with polluted air (Hazardous to health)
  - International Day of Clean Air for blue skies (7th September) every year
  - International Days related to Environment and Health
- Channels for disseminations-
  - Social media - Twitter, Facebook, Instagram, You Tube, Whatsapp
  - Posters, Wall paintings, Street plays/Nukkad Natak
  - Radio Television channels (AIR, Doordarshan, FM channels)
  - Public means of transport vehicles- Bus etc.
  - Competitions (Painting, Quiz, Debates, Symposium)

- Key Public Officials and Senior officials
- Experts and Panel discussion

b) <u>Capacity building of the health sector</u> including healthcare facilities –

- Development of an action plan in health sector (District level, city level etc.)
- Training calendar- Programme officials, Surveillance Nodal officers, Community level workers etc.
- Training modules development and its conduction of the ToTs, Programme officials, MOs, Paramedics, CHOs, Community Health Workers, Surveillance Nodal Officers etc.

c) <u>Surveillance Strengthening</u> and Monitoring in the State: NPCCHH programme officials at the State (SNO-CC) and District (DNO-CC) roles are –

- To establish and expand sentinel surveillance on air pollution related illnesses in the state particularly NCAP cities.
- About (3-4) sentinel hospitals/ city including hospital nodal officers to identify
- Each sentinel hospital to report regarding daily air pollution related illness cases attending the emergency department to DNO-CC regularly/ timely.
- Each DNO to monitor reports from sentinel sites; analyse statistics of illnesses related to air pollution and share to the State and Central level for timely actions.

(Details in the SOP of Surveillance on air pollution related illnesses)

d) <u>Health sector response mechanisms</u> - Healthcare facilities strengthening

Doctors/Staffs orientation on the issues

Strengthening support to manage cases attributed to air pollution

- Patient care service areas
  - OPD services (mainly General OPDs, Medicine, Paediatrics, Respiratory Medicine, Cardiology and Neurology etc.)
  - Emergency services
  - Referral Services
  - Ambulance services
  - Outreach services
- Medications availability- acute respiratory/ cardiovascular/ cerebrovascular etc.
- Diagnostic/Laboratory Services
- Medical equipments like oxygen supply, nebulizers, ventilators
- Hospital beds, Stretchers, Wheelchairs, Ambulances
- Referral mechanisms

iii. Health Sector Response Action Plans during high level of air pollution (particularly post-Diwali, Stubble burning and Winter days/ months (SMOG) in State/ District/ City)

Certain considerations (7 points) for Health Sector Responses –

- Health Department to activate the action plan during higher AQI levels
- Health Department may increase to coordinate with concerned departments for IEC Campaigns (Environment, Pollution Board, Transport, Urban development, Coal, Power, PWD (construction related works), Municipality/ Panchayat, Traffic Department, WCD, Labour department etc.)
- Health Departments including healthcare facilities to strictly monitor daily AQI levels during such high air pollution days/ months as reported from pollution control boards. Health Facilities may provide daily AQI value to inform people and measures to protect, prevent and control themselves from air pollution.
- Strengthening further of public awareness campaigns in health sector (increasing frequency/ channels of dissemination to reach the target populations who are likely to have more health issues due to exposure to air pollution - School children, College students, Elderly, Women, Patients with underlying medical conditions of respiratory, cardiovascular, cerebrovascular diseases, outdoor exposures; vulnerable hot spot areas).
- Strengthening of healthcare services provisions- Patient care services at the Emergency departments; Outdoor departments etc.; Availability of medications/ equipments in the ED/ OPDs to treat the illnesses; Human resources to attend patient care in departments; Logistics; Enhancement of beds if required in (ED). These may be appropriately taken up at different levels of healthcare facilities at WCs, PHCs, CHCs, SDHs, DHs and others tertiary cares
- Strict Monitoring of the sentinel surveillance reports; types of increasing cases reporting in the health care facilities (Respiratory cases, Cardiovascular, cerebrovascular cases). This information to share with concerned departments and Hospitals/ Healthcare Facilities for actions to take.
- Engagements of Civil Societies/ Private facilities to support in addressing the issue.

iv. Health Adaptation Plan on air pollution and health (State/ District level):

- State/ Districts to finalize action plan to address on air pollution related illnesses
- State and District Task Force on Climate Change and Health may coordinate with concerned departments to finalize action plan on air pollution related illnesses
- The Health Action Plan for state/ district/ cities may include actions to achieve programme objectives
- Air pollution issues in the State including non-attainment cities identified
  - Name of the non-attainment cities
  - System to avail daily air quality data in health sector from pollution control board and sharing the same to the healthcare facilities
- Awareness Generation and its dissemination planning (IECs, public health advisories, translated IECs, dissemination channels and areas identified)
- Capacity building activities (Modules and Training of DNO-CCs, Medical Officers, Paramedics, Community level health workers) – HCFs in the State
- Surveillance strengthening on air pollution related illnesses (cities, hospitals, nodal officers, training, surveillance data, its analysis and actions

- Health-sector preparedness and response action plans
- Details of Roles/ Responsibilities of healthcare personnel
- Inter-sectoral coordination mechanisms (Health and Non-Health)

8. Health sector's response in context of CPCB's "Graded Response Action Plan"

In view of the serious concern and urgent action requirements to address the high level of air pollution in Delhi & NCR, a Graded Response Action Plan and appropriate measures based on air pollution levels was notified in 2017 under the MoEF&CC. It has an added new category of "Severe+ or Emergency" in the previous 6 AQI categories. It defined various mitigating and adapting activities as graded response actions to address the higher level of air pollution and identified the respective implementing agencies from concerned Ministries and Departments. Its detail is available at *https://cpcb.nic.in/uploads/final_graded_table.pdf*

Health sector in Delhi NCR region (Delhi, Haryana, Punjab, Rajasthan and Uttar Pradesh) may do -

i. State NPCCHH programme officials may coordinate with implementing agencies as mentioned in the action plan for the purpose of awareness generation of health issues associated with air pollution among the people.

ii. These concerned departments may be considered as members for State/ District level Task Force under NPCCHH programme for taking support/ inter-sectoral coordination in addressing the issues in the State/Districts of these regions.

Annexure I:

IEC messages for Public Awareness on
Air Pollution and Health Concerns under NPCCHH

- **Target Population-**
  - General population and
  - Those having underlying medical conditions
  - Optional interventional choices

I. General Population:

Reduce risk from exposure to air pollutants by taking up the following measures –

Avoid preferably places with high air pollution like roads with slow & heavy traffic, areas near polluting industries, construction-demolition sites.

1. Avoid outdoor morning and late evening walk, run, jog and physical exercise. Do not open external doors and windows during morning and late evening hours, may ventilate if necessary between 12 p.m. to 4 p.m. in afternoon (Days with poor to severe AQI)
2. Avoid burning biomass such as wood, coal, animal dung, kerosene. Use clean smokeless fuels (gas or electricity) for cooking and heating purposes. If using biomass, use clean cook stoves.
3. Avoid burning of wood/ charcoal in 'Anghiti' during winters, in closed and confined condition which may be fatal due to CO and built up CO_2
4. Avoid use of room fresheners, it has ill effects as it consume O_2 in vicinity very fast.
5. Avoid burning firecrackers.
6. Avoid burning in open any form of wood, leaves, crop residues, & waste.
7. Do not smoke cigarettes, bidis and related tobacco products.
8. Avoid burning mosquito coils and incense sticks in closed premises.
9. Reschedule outdoor activities as per AQI, and remain indoors on days with poor to severe AQI.
10. Practice wet mopping instead of sweeping or vacuum cleaning inside homes. If you choose to use vacuum cleaner, use those having High Efficiency Particulate Air (HEPA) filter
11. Keep washing your eyes with running water regularly and do regular gargles with warm water
12. Consult the nearest doctor in case of breathlessness, giddiness, cough, chest discomfort or pain, irritation in eyes (red or watery)
13. As a "no-regret" strategy, healthy diet, with fruit and vegetables rich in antioxidants, and adequate amount of hydration by drinking water is advocated.

II. **Those with underlying medical conditions particularly chronic pulmonary or cardiovascular problems** should have following additional measures

1. Be more careful to avoid exposure to air pollution
2. Avoid any strenuous activity and stay indoor during higher AQI levels
3. Keep a check on exacerbations of suggestive symptoms
4. Properly follow doctor's instructions on healthcare
5. Keep the prescribed medications readily available
6. Seek immediate medical advice if symptoms worsen.

III. Optional choices (**Face Mask, Air Purifiers, Air Conditioners**)

1. If you choose to use face mask, the disposable N95 or N99 is useful provided user instructions are followed. These masks may help provided the period of exposure is short. Masks should have proper fitting on users' mouth and nose. Ensure to replace the masks after usage as instructed. Paper masks, handkerchiefs, scarves and cloth are not effective.
2. If you choose to use air purifier, follow manufacturers' guidelines, however it may be advised to have expert's consultation on suitability, positioning, technology selection and cleaning capacity (area coverage). Ensure to replace and clean filters as instructed. Avoid using an air purifier that works by generating ozone, as it increases pollution inside rooms.
3. When operating air conditioners in buildings or vehicle, use in "re-circulate" mode to avoid contact with outside air.

IV. IEC materials (Posters, GIFs, Audio Spots and Video Spots) are available at NCDC website

1. Link to find them- https://ncdc.gov.in/index1.php?lang=1&level=2&sublinkid=887&lid=430

Annexure II:
Social Media Messages under NPCCHH

1. Check the daily Air Quality Index (AQI) of your area before planning your day out.
2. Avoid places with high air pollution like roads with slow & heavy traffic areas near polluting areas to minimize exposure to air pollution.
3. Avoid construction-demolition sites, coal-based power plants, brick kilns etc. to minimize exposure to air pollution
4. On days of poor to severe plus air pollution (AQI>200)
    a) avoid outdoor morning & late evening walk
    b) avoid jogging, running or other exertional physical activities
    c) avoid opening external doors and windows during morning and late evening hours.
    d) ventilate rooms if necessary between 12 p.m. to 4 p.m. in afternoon
    e) remains indoors, and reschedule outdoor activities as per AQI levels
    f) if person experiences breathlessness, cough, chest discomfort or pain, giddiness, irritation in eyes (red or watery) – consult the nearest doctor immediately.
    g) high risk people like pregnant women, young children and elderly should restrict outdoor movements as far as possible.

5. Avoid burning in the open environment of any form of wood, leaves, crop residues, and waste which can further worsen air pollution
6. Practice wet mopping instead of sweeping or vacuum inside homes to reduce exposure to air pollution.
7. Avoid burning firecrackers
8. To reduce the harmful effects of air pollution, eat seasonal fruits and vegetables rich in antioxidants and drink adequate water to maintain hydration.
9. Patients with chronic pulmonary or cardiovascular problems, pregnant women, young children and elderly people should be more careful and avoid exposure to air pollution.
10. On days of poor to severe plus air pollution avoid any strenuous activity by persons with chronic cardio-pulmonary disease.

11. Patients with chronic pulmonary and cardio vascular disease should keep their prescribed medicines readily available while going outdoors on poor to severe plus air pollution days (AQI>200).
12. Patients with chronic pulmonary and cardio vascular disease should keep a check on exacerbation of symptoms on poor to severe plus air pollution days (AQI>200).
13. Patients with chronic pulmonary and cardio vascular disease could seek immediate medical advice if symptoms worsen during poor to severe plus air pollution days (AQI>200).
14. On days of poor to severe plus air pollution (AQI>200) consider use of close fitted N95 orN99 masks to reduce exposure to air pollution.
15. On days of poor to severe plus air pollution (AQI>200) use of air purifiers may be beneficial to reduce the effects of air pollution.
16. Avoid uses of air purifiers that works by generating ozone and other harmful byproducts as they increase indoor air pollution.
17. Air conditioners in buildings and vehicles may use “re-circulate” mode to avoid contact with outside polluted air on days of poor to severe plus air pollution (AQI>200).
18. Stop smoking cigarettes, bidis and other related tobacco products which aggravate ill effects of air pollution.
19. When the air pollution level is poor to severe plus (AQI>200), drive the vehicle with windows closed to minimize exposure to air pollution.
20. Use public transport whenever possible to reduce air pollution.
21. When the air pollution level is poor to severe plus (AQI>200), if someone experiences cough, wheezing, chest tightness – level of exertional activity should be decreased or stopped and immediately consult to nearest doctor.
22. Follow local air quality forecasts before planning to outdoor activity.
23. Ensure cooking areas are well ventilated with cross ventilation by opening windows, doors to reduce exposure to household air pollution.
24. Avoid burning mosquito coils and incense sticks in closed premises to reduce exposure to indoor air pollution.
25. Avoid spending long periods of time in busy routes in poor to severe plus air pollution days.
26. Avoid exercising near high traffic areas where exposure to air pollution is usually high.
27. Act in time, protect yourself from ill effects of air pollution.

28. Pollution due to fire-cracker burning can seriously impact health of person's suffering from cardiovascular, respiratory diseases.
29. Avoid fire-crackers burning especially by people suffering from asthma or another lung disease.
30. Stay indoor during nights of Diwali to reduce exposure to air pollution.
31. Wear a mask (N95 or N99) to reduce exposure to air pollution by fire-crackers.
32. If a person develops breathing difficulty during Diwali, consult to doctor immediately.
33. When complete escape from air pollution is difficult, taking some measures can provide you a certain level of protection from its harmful effects on your health.
34. Increased air pollution level can have major health consequences. Do check the AQI before planning your outdoor activities for the day. Website to check AQI: CPCB
35. It makes such a difference to live in a green and healthy city! Become aware & Act now
36. Vulnerable population are the highest risk of their health being affected due to Air Pollution. These vulnerable groups should avoid outdoor physical activities when Air Quality is poor to severe.
37. Choose green to breathe clean: Planting more trees can reduce the effect of air pollution on health. Head towards a pollution free tomorrow with every tree you plant.

Note please: Hash tags may be considered to coordinate with relevant Ministries/ departments/ Institutes/ Organizations like Central/ State Pollution Control Board, Environment, NPCCHH Programme etc.

Health Advisory for household air pollution

A. To minimise pollution by mitigating or reducing from sources -

i. Cooking with solid fuels like firewood, cow dungs, coal and kerosene etc.
ii. Heating purposes during colder or winter days from solid fossil fuels
iii. Lighting purposes from kerosene lamps etc.
iv. Smoke from mosquito coils or incense sticks during poor air quality days
v. Smoking of cigarettes, bidis, traditional hookah etc.
vi. Outside pollution sources - nearby construction sites, and materials like paints, and composite wood products; vehicular exhausts in houses nearby the roads
vii. Burning of wastes, crop residues, plastics, bottles and food wrappers etc.

B. Adoption of better practices while cooking in Kitchen or at homes

i. Use of cleaner fuels (LPG, electronic based)
ii. To ventilate air adequately to reduce smoke properly during cooking (opening windows or doors; use of exhausts fan)
iii. Avoid to burn fossil fuels and if to do, use open spaces or small pieces of wood
iv. To minimise cooking hours by prior soaking of foods if possible
v. During poor air quality level, to avoid cooking causing smoke or to shift timing if possible
vi. To take breaks for clean air while cooking if possible
vii. To cover pots and bottom cleansed for faster cooking and efficiency
viii. Women to make elderly, children stay away from polluting sources

C. Considerations in other household areas and vicinity during polluted air levels

i. To use energy efficient measures like LED bulbs or other electronic devices at homes
ii. To ventilate properly by opening doors/ windows wherever possible; restrict if air quality is poor
iii. Avoid burning fossil fuels having smoke inside houses for heating and lighting purposes
iv. Restrict sweeping causing dust particles in air; timings may change to afternoon
v. Use damp sweeping/ clothes for cleaning floors and surfaces
vi. Avoid havan indoor when air quality level is poor
vii. Reduce air fresheners, sprays and mosquito coils and sprays if poor air quality
viii. Do not burn crop residue or wastes causing smoke
ix. Discourage visitors/ family members from smoking tobacco/ hookah indoor or vicinity

1. School health authorities, head, teachers and parents to develop mechanisms to create awareness and motivate in adopting better practices among students to mitigate and adapt on air pollution.
2. Children to be awared by organising activities and events on air pollution at school level -
    a. Areas- Cities and urban areas are more likely for outside pollution levels
    b. Season/ days- Colder winter seasons/ days in cities/ urban; Diwali/ Dust storm
    c. Timings- Morning and evening hours if SMOG is prevailing and sunlight not visible
    d. Sites for precautions - transit from home to school, near school gates, and outdooring
    e. Younger children, respiratory health issues, medically underlying conditions are more vulnerable and to take more precautionary measures from risk exposure/ attacks
3. Adoption of vehicles for school (cars, vans, school buses) to reduce emissions/ air pollution
    a. School buses (to encourage)
    b. Public transport (to encourage)
    c. To adopt cleaner fuels like CNGs
    d. Car-pooling (to encourage)
    e. Electric cars
    f. To adopt use of bicycles by bigger children appropriately
4. To minimise exposure to air pollution among school children -
    a. Shorter school distance to prefer
    b. To stay away from polluted sources like vehicular exhausts during transit to school or dusty environments at school by covering nose with cloth or mask
    c. Ensure proper classroom ventilation by opening windows properly or installing exhaust fans
    d. To close windows if air quality level is poor and above
    e. To adopt wet mopping for floor cleaning in school or before students arrive to school
    f. Marker pens may be used for writing on board instead of chalks.
5. Precautions and avoidance of outdoor activities in school if AQI levels is poor and above
    a. To display, if possible, to students/ teachers of AQI levels and alert
    b. Schools to limit outdoor activities during days of higher pollution levels
    c. During break sessions, stay indoors and minimize outdoor exposure
    d. Physical activities like running, jogging, playing may be avoided or postponed
    e. School activities, functions, celebrations and even birthday celebrations if possible
6. Medical officials/ staffs at school to sensitise on air pollution related health issues and ways to manage such cases for support also from nearby emergency health facilities if required.

Advisory for construction and demolition workers

The construction and demolition activities cause the air pollution in following ways:

- **Dust emission:** The operation of machinery, demolition activities, and the loading and unloading of goods emit suspended particulate matter (PM10, PM2.5, and PM1) that pose health concerns upon inhalation.
- **Emissions from machines:** Construction machinery, such as bulldozers, trucks, and generators, usually run on diesel fuel. These emit pollutants like nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), and fine particulate matter.
- **Transportation of construction material:** The management of construction materials significantly intensifies pollution levels, particularly particle matter that can cause serious health problems. The larger heavier particles settle out of the air quickly and are hazardous to the operators of plant and equipment (on-site) and to those in the immediate vicinity (off-site). The finer small particles (usually invisible) are transported further causing health hazards (off-site).

The impact of air pollution at construction site can be minimized upon following preventive measures:

1. **Suggestive measures/practices for employer to strengthen the workforce[1]**
    a. Sensitization of workers (skilled or unskilled labour) on health, safety and environmental protection.
    b. Training of all workers on the potential health risks associated with air pollution, air quality index (AQI), expected hazards of air pollution due to prolonged exposure.
    c. Training of workers operating a motor vehicle on the job (on or off premises) on vehicle maintenance to ensure operation of vehicle within emission norms and minimize air pollution.
    d. Awareness program for workers on implementation of emergency preparedness plan based on Disaster Management Plan. This will ensure workers are prepared to respond to emergencies effectively.
    e. Training on the correct selection, use, and maintenance of Personal Protective Equipment (PPE) is essential. Workers should be equipped with appropriate PPE, such as face masks

[1]Safety Manual for Construction Workers, Labour Department, Directorate of Industrial Safety and Health

and respirators, to protect themselves from airborne pollutants and other site-specific hazards.

f. Training of workers and staff on the identification of health issues or respiratory problems (such as coughing and dyspnoea). Prompt medical attention should be encouraged for any workers showing signs of respiratory distress.

g. Conduct regular health check-ups at the construction site to monitor lung function using spirometer/peak flow meter. This will help identify any early signs of respiratory or other pollution-related health issues

h. The workers need to be shifted/rotated in different job operations or different tasks to minimize extended exposure to high-dust environments.

i. Provide regular breaks depending upon the assigned task for workers to reduce the harmful impact of air pollution on health.

2. Adoption of better behavioral practices for construction workers[2]

a. Use the dust masks or personal protection provided by the management to safeguard against the inhalation of fine particulate matter (PM2.5), dust, and odours. In the absence of PPE, cloth mask or bandana may be used to cover nose and mouth when working in dusty conditions.

b. Workers shall wear long-sleeved shirts and full-length trousers to minimize skin exposure to dust.

c. All workers are advised to consistently use safety goggles to protect their eyes from irritation caused by dust, debris, and exposure to chemicals.

d. Gloves and coveralls must be worn to prevent direct contact with hazardous materials like asbestos, concrete dust, and chemicals. Proper protective clothing helps protect the skin from irritation and minimizes the risk of exposure to toxic substances.

e. Workers should maintain personal hygiene including regular hand and face wash with clean water, especially before eating, changing outer layer of clothing before going home and bath or shower after work to remove dust from your skin and hair.

f. Workers are advised to ensure adequate water intake to facilitate toxin elimination and support overall health, as dehydration can exacerbate the effects of pollution (at least 2 litres).

g. Food intake should include balanced diet including fruits, local vegetables, cereals, pulses and milk products, which provide all nutrients in adequate proportion[3]. The spices like

2Proceedings of 186 meeting of SEAC held on 26.12.2019

[3]https://www.nin.res.in/downloads/DietaryGuidelinesforNINwebsite.pdf

turmeric, cumin, coriander, and ginger have antioxidant and anti-inflammatory properties that help in counteracting the effects of pollution[4], and jaggery provide iron and other minerals that help in detoxifying the body[5].

h. Workers are advised to pay attention to the symptoms like persistent coughing, wheezing, or difficulty in breathing and seek medical attention if these symptoms persist or worsen.

3. Development of better operational practices for construction workers[6],[7]

a. Regular use of water sprinkling or fine sprays from nozzles should be adopted to suppress dust at the site, preventing its resuspension into the air.

b. Construction & Demolition wastes or construction material whether stored or transported (Lorries / tractors) to be preferably covered.

c. Areas where loading / unloading (fugitive dust) activities should be demarcated and located in areas where dust dispersal can be minimized.

d. Equipment such as conveyor belts, crushers, and other machinery used on site that generates dust should be operated with water sprinklers to minimize emissions.

e. Conduct regular maintenance check of Gensets (DG sets) to ensure low emissions.

f. All vehicles used for transporting materials should be well-maintained and comply with Pollution Under Control (PUC) certifications to ensure minimal emissions.

g. Dry sweeping of work areas to be prohibited.

h. Transport & stored material that are easily carried by the wind need to be covered by a sheet made of either jute, tarpaulin, plastic or any other effective material.

i. The paints, solvents, and other hazardous substances are needed to be securely stored in sealed containers to prevent vapor emission.

j. The intensive activities that cause significant pollution such as demolition and excavation should be avoided during elevated pollution levels (e.g., early mornings or late afternoons in urban areas with significant traffic pollution).

k. The air quality required to be monitored regularly to detect pollutant concentrations and initiate measures when levels surpass safety limits.

l. Provisions should be available for any medical assistance including investigations, and treatment for workers involved in construction activities, handling materials and debris associated with dust emissions.

[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5618098/
[5] https://www.sciencedirect.com/science/article/abs/pii/B9780128169186000160
[6] Guidelines on dust mitigation measures in handing construction material and Construction & demolition waste
[7] Graded Response Action Plan (see - http://cpcb.nic.in/final_graded_table.pdf)

References and links to access information and documents on air pollution and those related to air pollution health issues from NPCCHH programme, CPCB etc.-

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3. NPCCHH programme- https://ncdc.gov.in/index1.php?lang=1&level=1&sublinkid=876&lid=660
4. Detailed forecast analysis/ verification for air pollution in Delhi: https://ews.tropmet.res.in
5. AQI bulletin at CPCB: https://cpcb.nic.in//upload/Downloads/AQI_Bulletin_20220816.pdf
6. 132 Non-attainment/ Million plus cities in India under NCAP : https://cpcb.nic.in/uploads/Non-Attainment_Cities.pdf
7. Sameer app (Mobile app for AQI level): https://play.google.com/store/apps/details?id=com.cpcb&hl=en_IN&gl=US
8. CPCB's **"Graded Response Action Plan"** for Delhi NCR on air pollution as- *https://cpcb.nic.in/uploads/final_graded_table.pdf*
9. file:///C:/Users/HP/Downloads/Katoto%202021.pdf
10. file:///C:/Users/HP/Downloads/Maleki%202021.pdf
11. https://www.who.int/health-topics/air-pollution#tab=tab_1

National Centre for Disease Control
Government of India

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

National Programme on Climate Change and Human Health

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
(EXTRA-ORDINARY ORIGINAL JURISDICTION)
CM No._____ OF 2025
IN
WRIT PETITION (CIVIL) NO. _____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. **PETITIONERS**

VERSUS

GOVERNMENT OF NCT OF DELHI & ANR. **RESPONDENTS**

APPLICATION ON BEHALF OF THE PETITIONER UNDER SECTION 151, CODE OF CIVIL OF CIVIL PROCEDURE, 1908 SEEKING EXEMPTION FROM FILING THE LEGIBLE/TYPED, CLEAN/ COPIES OF DOCUMENTS

1. This Writ Petition under Article 226 of the Constitution of India, filed by the Petitioners who are minor school children and actively participate in state scheduled sports tournaments, camps, trials etc. The Petitioners are constrained to file the present Writ Petition praying *inter alia* that the Respondents be directed to, henceforth, schedule the annual outdoor sports calendar in a manner so as to avoid scheduling of trials, zonal tournaments, inter-zonal tournaments, state tournaments, national tournaments and coaching camps etc. for school children (across multiple outdoor sports and disciplines) in Delhi during the months of November to January, when the air quality in the Delhi is verifiably and foreseeably 'Severe' and 'Hazardous'.

2. The complete facts of the Petitioners' case leading to the filing of the Petition have been stated in detail in the Petition and may kindly be read as part of this instant application. For the sake of brevity and to avoid repetition, the same are not being reproduced.
3. The Petitioners have instituted the present Petition in haste and therefore have not been in a position to file the certified/original and/or clean/typed copies of the documents. The Petitioners are filing true copies of all the documents along with the Petition and undertake to file clean/ typed copies of **Annexure 3,4,5, 8,9, 10,11,12,13,14** thereof within Two Weeks from the date of listing of the present Petitioner.
4. This Application is being made bona fide and in the interest of justice.

PRAYER

In view of the facts and circumstances as explained above the Petitioner most respectfully prays that this Hon'ble Court may graciously be pleased to:

a. May exempt the Petitioners from filing legible/typed/clean copies of documents along with the Petition; and

b. Pass other and further order(s) as this Hon'ble Court may deem fit and proper in favour of the Petitioner.

1. 10. 11.

PETITIONERS

2. 8. 3. 5. 4, 6. 9. 7.

FILED THROUGH

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
E21, Lower Ground Floor,
Lajpat Nagar 3, New Delhi-110024
Mobile: 9818408503/9811195114
Email: dasgupta.manjira@gmail.com/
bhargav@chambersofbhargavthali.com

NEW DELHI
DATE:15.11.2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

IN THE MATTER OF: CM No._____ OF 2025

NYSA BEDI & ORS.
....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Sarah Bedi, D/o Late Vinod Kapoor, aged about 46 years, resident of 412P, Sector 21, Gurugram - 122016, Haryana do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 1, Ms. Nysa Bedi, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

Verified at Gurugram on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

NOTARY
SAJJAN SINGH
GURGAON
Regd. No. 1652
Exp. 24-4-2030
GOVT. OF INDIA

ATTESTED
SAJJAN SINGH
ADVOCATE & NOTARY
GURGAON

15 NOV 2025

This document has been registered
at Sr. No 957 Book No. 3
Page No 287 On Dated 20.
15-11-2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Renuka Raichand Poddar, D/o General Shri Ravi Raichand, aged about 48 years, resident of 6, A.P.J. Abdul Kalam Road, New Delhi – 110011, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 2, Master Reyansh Poddar, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-[illegible]2030
GOVT. OF INDIA

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Self Deponent who has Signed in my Presence.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Rishuka Rajkhand Poddar
S/o, W/o, D/o Late Sh. Ravi Rajkhand
R/o .....
Identified By Sh./Smt. Self
has solemnly affirmed before me at Delhi
on..... & Sh. No. .....
that the contents of the affidavit which
have been read & explained to him are
true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Shweta Punj, D/o Shri Balbir Punj, aged about 46 years, resident of W143, 1st Floor, Greater Kailash I, New Delhi – 110048, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 3, Master Aarav Punj Tripathi, (minor), aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-12-2030
GOVT. OF INDIA

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Deponent who has Signed in my Presence.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Shyam Sunder
S/o, W/o, D/o Baldev Prasad
R/o Rohini Delhi
Identified By Sh./Shri Rohan Poddar Adv.
has solemnly affirmed before me at Delhi
on ..... at Sl. No. 1
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Rachna Prasad, D/o Shri Chandru Motwani, aged about 49 years, resident of H52/2, Lane W10F, Western Avenue, Sainik Farms, New Delhi – 110062, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 4, Master Yuvan Prasad, (minor), aged about 13 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

DEPONENT

VERIFICATION: 15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Deponent who has Signed in my Presence.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. ...Krishna Prasad...
S/o, W/o, D/o ....Dhanraj...Agarwal...
R/o .....
Identified By Sh./Shri ...Rohan Poddar, Adv.
has solemnly affirmed before me at Delhi
on.....at Sl. No.....8.....
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Gaurav Gulati, S/o Shri Yogesh Gulati, aged about 52 years, resident of 10, Paschimi Marg, Ground Floor, Vasant Vihar, New Delhi - 110057, do hereby solemnly affirm and state as under:

1. That I am the father of Applicant/Petitioner No. 5, Master Abhiveer Gulati, (minor), aged about 15 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-08-2030
GOVT. OF INDIA

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Deponent who has Signed in my Presence.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 04-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. Gaurav Gulati
S/o, W/o, D/o Yogesh Gulati
R/o .....
Identified By Sh./Shri ....Rohan Poddar, Adv.
has solemnly affirmed before me at Delhi
on.....at Sl. No.....6.....
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Pankaj Sahni, S/o Late Shri Pavan Prakash Sahni, aged 48 about years, resident of B-6, Greater Kailash I, New Delhi – 110048, presently in Gurugram, do hereby solemnly affirm and state as under:

1. That I am the father of Applicant/Petitioner No. 6, Zoya Sahni, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

DEPONENT

VERIFICATION:

Verified at Gurugram on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

NOTARY GOVT. OF INDIA RACHNA RANI Reg.No.19824 GURUGRAM

ATTESTED

RACHNA RANI
ADVOCATE & NOTARY
DISTT. COURT, GURUGRAM (HR)
15/11/25

This document has been registered at
Book No. 1
Sr. No. 461
Date 15/11/25

DEPONENT

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025
CM No._____ OF 2025
IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Mr. Aakansha Singh Arora, D/o Late Shri Yogendra Singh, aged about 51 years, resident of 212A, Tower 2, DLF Magnolias, Golf Course Road, Sector 42, Gurugram – 122009, presently in New Delhi, do hereby solemnly affirm and state as under:

1. That I am the father of Applicant/Petitioner No. 7, Master Lukshya Arora, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

I Identified the Deponent who has Signed in my Presence.

DEPONENT

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. ...Ankamedha Singh Arora
S/o, W/o, D/o ...Yogendra Singh
R/o .....
Identified By Sh./Shri ...Ratan Poddar, Adv.
has solemnly affirmed before me at Delhi
on.....at Sl. No.....
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025
CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Mehboob Shaw, D/o Md. Hussain, aged about 52 years, resident of W15A, Western Avenue, House J206, Sainik Farms, New Delhi – 110062, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 8, Ms. Shirin Shaw, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
RAM PAL SINGH
DELHI
Regd.No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

Mehboob Shaw

DEPONENT

VERIFICATION:

15 NOV 2025

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

I Identified the Deponent who has Signed in my Presence.

NOTARY
RAM PAL SINGH
DELHI
Regd. No. 16973
Valid upto 02-02-2030
GOVT. OF INDIA

CERTIFIED THAT THE DEPONENT
Shri/Smt./Km. ..Mehboob Shaw
S/o, W/o, D/o ..M. Ali Hussain
R/o .....
Identified By Sh./Shri ...R. Qureshi Podder, Adv.
has solemnly affirmed before me at Delhi
on.....at Sl. No.....12
that the contents of the affidavit which have been read & explained to him are true and Correct to his knowledge

Notary Public, Delhi (INDIA)

15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI& ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Shipra Kukreja Bose, D/o Shri GD Kukreja, aged about 47 years, resident of C-9/9563, Vasant Kunj, New Delhi, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No.9, Ms. Coco Shirali Bose, (minor), aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

Shipra

DEPONENT

NOTARIAL REGISTER
Entry No. 3/2025
Date 15/11/2025

VERIFICATION:

15 NOV 2025

Verified at New Delhion this day 15th November 2025,that thecontents of the above affidavit are true and correct to the best ofmy personal knowledge and belief, and nothing has been concealed therefrom.

Shipra

DEPONENT

NOTARY PUBLIC ★ GOVT. OF INDIA ★
AJAY KUMAR
Advocate
Regn No. 4053/2025
DELHI
Expiry Year 2030

ATTESTED
NOTARY PUBLIC
Govt. of India

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025

CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Dimple Mathur, D/o Shri Deepak Sangwan, aged about 40 years, resident of C-36, Nangal Dewat, Vasant Kunj, New Delhi, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 10, Ms. Nayonika Mathur, (minor), aged about 12 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
OMBIR SANGWAN
AREA-NCT DELHI
REGD. NO. 10665
EXP. DT.-26/06/2029
GOVT. OF INDIA

DEPONENT

VERIFICATION:

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

DEPONENT

NOTARY GOVT. OF INDIA
OMBIR SANGWAN
AREA-NCT DELHI
REGD. NO. 10665
EXP. DT. 26/06/2029
NOTARIAL

Solemnly Affirmed Sworn Before Me
ATTESTED
OMBIR SANGWAN NOTARY PUBLIC DELHI
Regd. No. 10665, Govt. of India
Ch. No.: 5, Patiala House Court, N. Delhi-110001
Book No. 3 SPG No. 48 SL No. 3017/2025
15 NOV 2025

IN THE HON'BLE HIGH COURT OF DELHI AT NEW DELHI
EXTRAORDINARY CIVIL WRIT JURISDICTION
CIVIL WRIT PETITION NO. OF 2025
CM No._____ OF 2025

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

AFFIDAVIT

I, Ms. Ritu, D/o Shri Jai Narayan Kadyan, aged about 43 years, resident of JVD Homes, Nangal Dewat, New Delhi, do hereby solemnly affirm and state as under:

1. That I am the mother of Applicant/Petitioner No. 11, Master Zorawar, (minor), aged about 16 years, in the aforementioned writ petition and I am fully conversant with the facts and circumstances of the present matter and I am competent to verify the present affidavit for an on behalf of the said Petitioner.
2. That the accompanying Application has been drafted under my instructions and I have gone through the contents thereof.
3. I state that the statements made in this affidavit are true and correct to the best of my knowledge and belief.

NOTARY
A.C. TIWARI
Regn. No. 2162
GOVT. OF INDIA

Ritu
DEPONENT

15 NOV 2025

15 NOV 2025

VERIFICATION:

Verified at New Delhi on this day 15th November 2025, that the contents of the above affidavit are true and correct to the best of my personal knowledge and belief, and nothing has been concealed therefrom.

Identify the deponent who has signed in my presence

Ritu

DEPONENT

NOTARY
A. C. TIWARI
DELHI
Regn. No. 2162
GOVT. OF INDIA

ATTESTED

NOTARY PUBLIC
(DELHI INDIA)

15 NOV 2025



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS.
....APPLICANT/PETITIONER
VERSUS
GOVT. OF NCT OF DELHI & ORS.
....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Sarah Bedi, D/o Late Vinod Kapoor, aged about 46 years, resident of 412P, Sector 21, Gurugram – 122016, the mother of Petitioner No. 1, Ms. Nysa Bedi, do hereby appoint solemnly affirm and state as under:

MANJIRA DASGUPTA D3104/2009
BHARGAV RAVINDRAN THALI D5080/2017
MAYANK KHAITAN D10269/2025
(ADVOCATES)
E21, Lower Ground Floor, Lajpat Nagar 3, New Delhi-110024
Mobile: 9818408503/9811195114
E-mail: dasgupta.manjira@gmail.com//bhargav@chambersofbhargavthali.com

herein after called Advocates to be our advocates in the above noted case and authorize them

To act appear and plead in the above noted case in the court or in any court in which the same may be tried or heard and also in the appellate courts including High Court.

To sign, verify and present pleadings application, appeals, cross objections or petitions for execution, review, restoration, withdrawal, compromise or other petitions, replies, objections or affidavits or documents as may be deemed necessary or proper for the prosecution of the said case in all its stages.

To file and take back documents.

To withdraw or compromise the said case or submit to arbitration any difference of disputes that may arise touching or in any manner relating to the said case.

To take out execution proceedings.

To deposit, draw and receive moneys, cheques and grant receipts there and to all other acts and things which may be necessary to be done for the progress and in the course of prosecution of that said case.

To appoint and instruct other legal practitioners authorizing him to exercise the power and authorize hereby confer upon the advocate whenever he may think fit to do so and sign the power of attorney on our behalf.

And I/ We undersigned do hereby agree ratify and confirm acts done by the advocates or his substitute in the matter is my/ our acts as if done by me/us to all intents and purposes.

And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.



Accepted

Sarah Bedi
Client

ATTESTED
SAJJAN SINGH
ADVOCATE & NOTARY
GURGAON
15 NOV 2025

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I Ms. Renuka Raichand Poddar, D/o General Shri Ravi Raichand, aged about 48 years, resident of 6, A.P.J. Abdul Kalam Road, New Delhi – 110011, the mother of Petitioner No. 2, Master Reyansh Poddar, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
E21, Lower Ground Floor, Lajpat Nagar 3, New Delhi-110024
Mobile: 9818408503/9811195114
E-mail: dasgupta.manjira@gmail.com//bhargav@chambersofbhargavthali.com

herein after called Advocates to be our advocates in the above noted case and authorize them

To act appear and plead in the above noted case in the court or in any court in which the same may be tried or heard and also in the appellate courts including High Court.

To sign, verify and present pleadings application, appeals, cross objections or petitions for execution, review, restoration, withdrawal, compromise or other petitions, replies, objections or affidavits or documents as may be deemed necessary or proper for the prosecution of the said case in all its stages.

To file and take back documents.

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And I/ We undersigned do hereby agree ratify and confirm acts done by the advocates or his substitute in the matter is my/ our acts as if done by me/us to all intents and purposes.

And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Renuka Raichand Poddar
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Shweta Punj, D/o Shri Balbir Punj, aged about 46 years, resident of W143, 1st Floor, Greater Kailash I, New Delhi – 110048, the mother of Petitioner No. 3, Master Aarav Punj Tripathi, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Shweta Punj
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Rachna Prasad, D/o Shri Chandru Motwani, aged about 49 years, resident of H52/2, Lane W10F, Western Avenue, Sainik Farms, New Delhi – 110062 the mother of Petitioner No. 4, Master Yuvan Prasad, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Mobile: 9818408503/9811195114
E-mail: dasgupta.manjira@gmail.com//bhargav@chambersofbhargavthali.com

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IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Rachna Prasad
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Mr. Gaurav Gulati, S/o Shri Yogesh Gulati, aged about 52 years, resident of 10, Paschimi Marg, Ground Floor, Vasant Vihar, New Delhi – 110057, the father of Petitioner No. 5, Master Abhiveer Gulati, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Gaurav Gulati
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Mr. Pankaj Sahni, S/o Late Shri Pavan Prakash Sahni, aged about 48 years, resident of B-6, Greater Kailash I, New Delhi – 110048, the father of Petitioner No. 6, Zoya Sahni, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Mobile: 9818408503/9811195114
E-mail: dasgupta.manjira@gmail.com//bhargav@chambersofbhargavthali.com

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And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Pankaj Sahni
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Mr. Aakansha Singh Arora, D/o Late Shri Yogendra Singh, aged about 51 years, resident of 212A, Tower 2, DLF Magnolias, Golf Course Road, Sector 42, Gurugram, the mother of Petitioner No. 7, Master Lukshya Arora, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Mobile: 9818408503/9811195114
E-mail: dasgupta.manjira@gmail.com//bhargav@chambersofbhargavthali.com

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And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Aakansha Singh Arora
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]



VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Mehboob Shaw, D/o Md. Hussain, aged about 52 years, resident of W15A, Western Avenue, House J206, Sainik Farms, New Delhi – 110062, the mother of Petitioner No. 8, Shrin Shaw, do hereby appoint solemnly affirm and state as under

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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And I/ We undersigned do hereby agree that in the event of any part of the fees agreed by me/ us to be paid to the Advocate remaining unpaid, he shall be entitled to withdraw from the prosecution and would be entitled to the same.

IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Mehboob Shaw
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]

ADVOCATES' WELFARE FUND STAMP ₹25 2371497 BAR COUNCIL OF DELHI DELHI TWENTYFIVE RUPEES पच्चीस रुपये

VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Shipra Kukreja Bose, D/o Shri GD Kukreja, aged about 47 years, resident of C-9/9563, Vasant Kunj, New Delhi, the mother of Petitioner No. 9, Ms. Coco Shirali Bose, do hereby appoint solemnly affirm and state as under:

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Mobile: 9818408503/9811195114
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IN THE WITNESS WHEREOF I/ We do hereby upto put my/ our hand to these presents the contents to which have been understood by me / us on the 15th day of November, 2025.

Accepted

Shipra Kukreja Bose
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]

15 NOV 2025

NOTARY PUBLIC
AJAY KUMAR
Advocate
Regn No 4053/2025
DELHI
Expiry Year 2030
GOVT. OF INDIA

NOTARIAL REGISTER
Entry No 4/2025
Date 15/11/2025

ATTESTED
NOTARY PUBLIC
Govt. of India

ADVOCATES' WELFARE FUND STAMP ₹25 2371503 BAR COUNCIL OF DELHI DELHI TWENTYFIVE RUPEES

VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Dimple Mathur, D/o Shri Deepak Sangwan, aged about 40 years, resident of C-36, Nangal Dewat, Vasant Kunj, New Delhi, the mother of Petitioner No. 10, Ms. Nayonika Mathur, do hereby appoint solemnly affirm and state as under:

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Accepted

Dimple Mathur
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]

ADVOCATES' WELFARE FUND STAMP ₹25 2371485 BAR COUNCIL OF DELHI DELHI TWENTYFIVE RUPEES

VAKALATNAMA

IN THE MATTER OF:

NYSA BEDI & ORS. ....APPLICANT/PETITIONER

VERSUS

GOVT. OF NCT OF DELHI & ORS. ....RESPONDENTS

KNOWN ALL to whom these presents shall come that I, Ms. Ritu, D/o Shri Jai Narayan Kadyan, aged about 43 years, resident of JVD Homes, Nangal Dewat, New Delhi, the mother of Petitioner No. 11, Master Zorawar, do hereby appoint solemnly affirm and state as under:

MANJIRA DASGUPTA
D3104/2009

BHARGAV RAVINDRAN THALI
D5080/2017

MAYANK KHAITAN
D10269/2025

(ADVOCATES)
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Accepted

Ritu

Ritu
Client

Signature Identified

MANJIRA DASGUPTA /BHARGAV RAVINDRAN THALI/MAYANK KHAITAN
[D3104/2009/ D5080/2017/D10269/2025]

752

Gmail

Manjira Dasgupta <dasguptamanjira@gmail.com>

Re: Nysa Bedi & Ors. v GNCTD & Anr.; WP (C) No ____/2025

1 message

Manjira Dasgupta <dasguptamanjira@gmail.com> Mon, Nov 17, 2025 at 11:04 AM
To: secyedu@nic.in, info23-27@sgfi.org.in
Cc: Bhargav <bhargav@chambersofbhargavthali.com>, Mayank Khaitan <mayankkhetan2@gmail.com>

Dear All,

Re: Nysa Bedi & Ors. v GNCTD & Anr.; WP (C) No ____/2025

We are concerned for the Petitioners in the captioned subject matter. Please find attached herewith a Writ Petition being filed on behalf of the Petitioners before the Hon'ble Delhi High Court.

The instant email shall be treated as advance service of the Petition.

Regards,

Manjira Dasgupta
Advocate

Strictly Confidential-Attorney-Client privileged communication.
Unintended recipients of this email are prohibited from disseminating, distributing, copying or using its contents. They should immediately destroy the email and notify the sender. Recipients should run their own virus checks. I shall not be liable for any losses.

Nysa Bedi and Ors v GNCTD and Anr.- Writ Petiti…