PAVANA · POLICY BRIEF

Centre for Air Pollution & Environmental Health · Pahle India Foundation

Realizing NCAP's Health Promise: Indian Evidence and Recommendations for National Clean Air Programme Reform

MoWCD reaches India's most pollution-exposed children. What is needed is the formal connection between that exposure and their developmental outcomes.

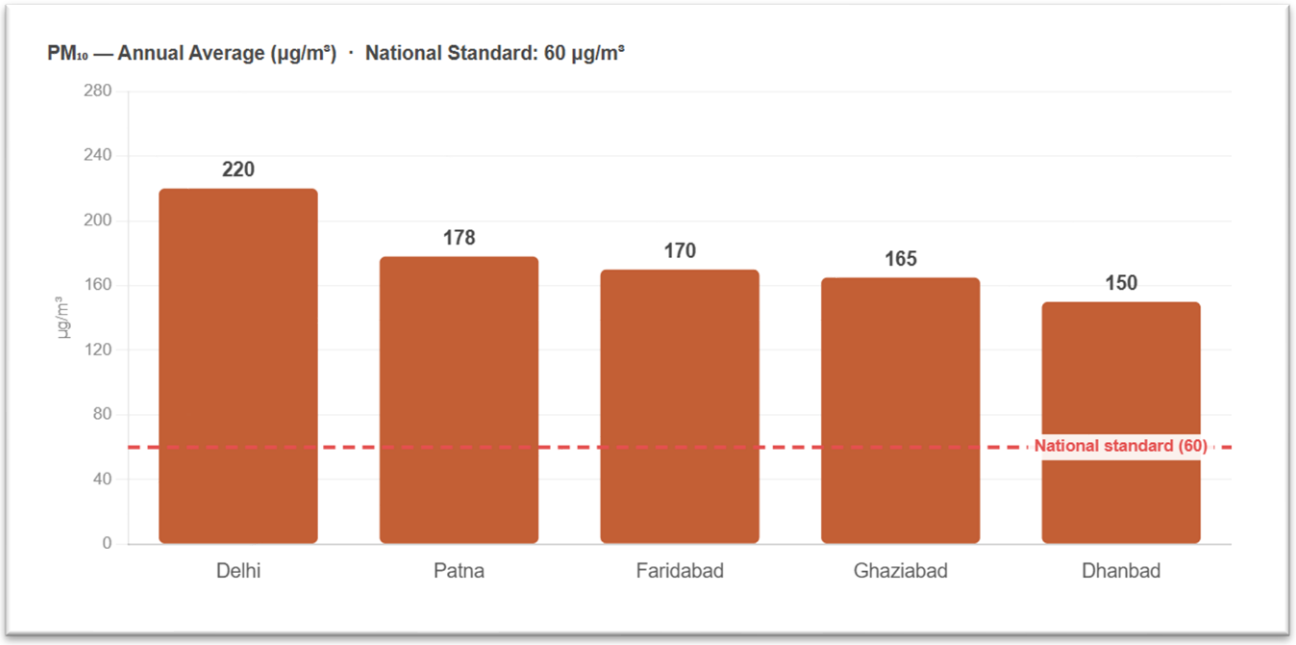
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, Indian registries, Indian surveillance systems, and Indian research institutions. India has produced substantial primary evidence on air pollution and health; what has been missing is a formal recognition within MoWCD that air pollution is a critical and untracked determinant of child development and maternal health outcomes in India.

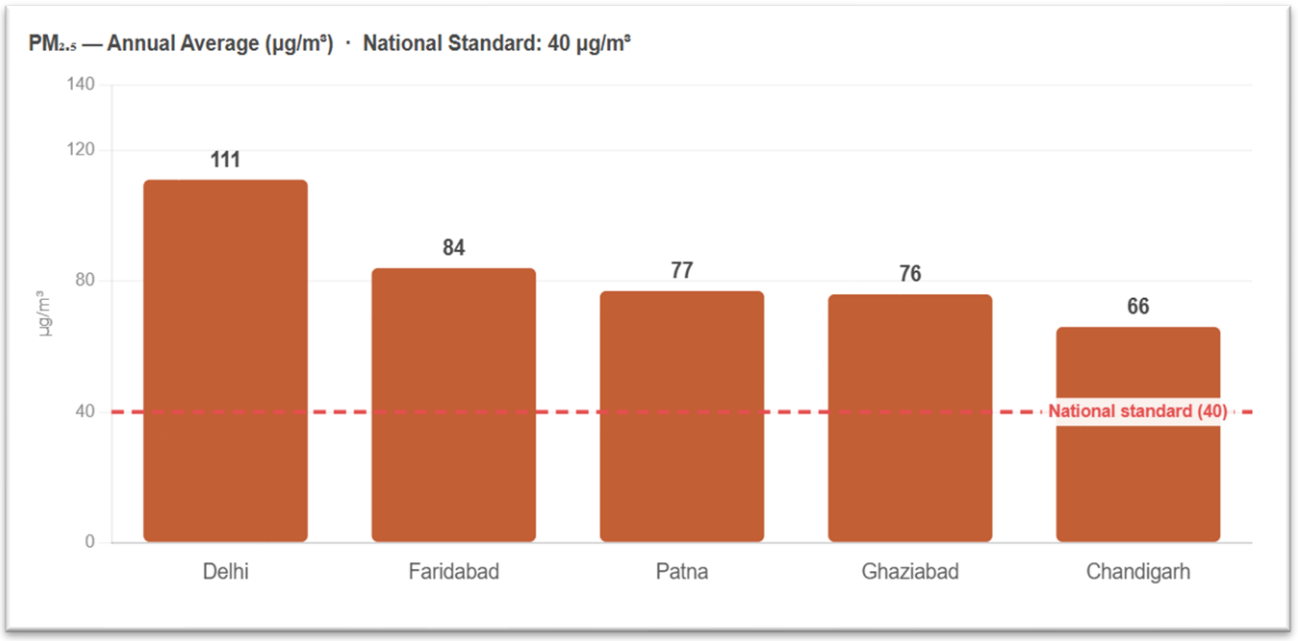
1 India's Clean Air Progress - and the Health Opportunity Ahead

India is home to some of the most polluted cities on earth. Many cities in the Indo-Gangetic Plain including Delhi, Siwan, Greater Noida, Patna, and Lucknow rank among the world's most polluted[1]. Yet the air pollution challenge is not confined to large cities alone. Annual $PM_{2.5}$ concentrations across Indian cities consistently exceed India's own Central Pollution Control Board (CPCB) standard (40 µg/m³)[2]. In 2024, annual average concentrations of PM_{10} and $PM_{2.5}$ exceeded national ambient air quality standards (NAAQS), among cities with continuous CPCB monitoring stations, in 43 and 23 cities respectively[3]. A programme designed to protect Indian lives should also include places where most of those lives, and most of that burden, is actually located. It is against this backdrop that India's own research institutions have spent two decades documenting what this pollution does to Indian bodies and that evidence now demands a policy response.

108 of 130	**51%**
NCAP cities fall short of India's NAAQS PM_{10} standard in FY 2024-25 after six years and ₹13,000+ crore of the programme	of released NCAP funds utilized by 82 MoEFCC-funded cities (₹831 cr of ₹1,616 cr released) - a utilization challenge alongside the health challenge
MoEFCC, Lok Sabha, December 2025[4]	CSE, An Agenda for Reform, July 2024[5]

Top 5 polluted cities in India by PM_{10} & $PM_{2.5}$ concentration (2024)





Source: Central Pollution Control Board (CPCB), Annual Report 2024-25, MoEFCC, Government of India[3]

Within this broader challenge, NCAP's own performance data tells a partial but important story. In FY 2024-25, 103 of 130 NCAP cities showed improvement in PM_{10} concentrations compared to the 2017-18 baseline, yet only 22 cities actually conform to India's own NAAQS[4]. While the trend is improving, 108 cities still do not meet India's own standard. More critically, NCAP targets remain pegged to PM_{10}, not $PM_{2.5}$, the finer particulate that penetrates deeper into lung tissue and carries stronger dose-response links to cardiovascular mortality. $PM_{2.5}$ penetrates the blood-brain barrier, and has documented impacts on neurological health as well. **A programme benchmarked against the less health-relevant pollutant, and scoped only to cities, is misaligned with the burden it was actually designed to address. The health consequences of this pollution are not confined to the lungs. Evidence generated through Government of India surveillance and research systems consistently demonstrates that air pollution affects multiple organ systems and disease categories across the life course.**

The question before MoWCD is not whether air pollution affects India's children. India's own institutions have documented it does - through neurological impacts, Vitamin D deficiency, respiratory burden, and birth outcomes. The question is whether MoWCD will use its programme infrastructure to track and respond to that burden - or continue measuring child development outcomes without accounting for the air those children breathe.

2 The Evidence: What Indian Research Has Established

A substantial and growing body of primary research, generated by the very institutions that underpin India's tobacco control policy, non-communicable disease (NCD) burden estimates, and maternal health guidelines, documents the health consequences of air pollution across multiple outcomes and populations. The stakes extend beyond domestic health policy. Meeting Sustainable Development Goals (SDG) is not achievable in India without substantially reducing the health burden of air pollution[6]. Air pollution is not a parallel agenda to NCDs; it is one of its primary drivers.

The Government of India routinely relies on evidence in public health generated by institutions such as All India Institute of Medical Sciences, Indian Council of Medical Research, Public Health Foundation of India, the Indian Institutes of Technology, and Sri Ramachandra Institute of Higher Education and Research. These same institutions generate evidence on air pollution and health; hence its integration into clean air policy would be consistent with established evidence-based governance processes.

Evidence by Health Outcome and Intervention Response

Health Outcome	Key Indian Findings and Institution	Study / Source
Cardiovascular - Hypertension	$PM_{2.5}$ exposure associated with elevated systolic blood pressure and significantly higher incidence of hypertension in urban Delhi adults. Prospective cohort design; 5,342 participants. *PHFI / AIIMS-CARRS Cohort, Delhi*	Prabhakaran D et al. (2020)[7]
Metabolic - Type 2 Diabetes	22% higher incidence of type 2 diabetes per 10 µg/m³ increase in annual average $PM_{2.5}$ (HR 1.22; 95% CI 1.09-1.36) among 12,064 participants in Delhi and Chennai. Among the first prospective cohort evidence on $PM_{2.5}$ and diabetes from Indian urban populations. *PHFI - CARRS Cohort, Delhi & Chennai*	Mandal S et al. (2023)[8]
Respiratory - Children	Indoor $PM_{2.5}$ and NO_2 significantly elevated in homes of children with respiratory illness in an industrial area of Delhi. Lung function impairment documented in Ashok Vihar children; exposure- response relationship demonstrated. *Delhi-based research group*	Kumar R et al. (2007, 2008)[9,10]

Health Outcome	Key Indian Findings and Institution	Study / Source
Respiratory - Urban Slums	Indoor PM and Respirable Suspended Particulate Matter (RSPM) levels in Nizamuddin slum households in Delhi significantly elevated above reference levels; associated respiratory health effects documented among residents in poorly ventilated housing. *IIT Delhi / Delhi University*	Kulshreshtha P et al. (2008)[11]
Respiratory - Rural Women	Both obstructive and restrictive lung defects documented in women and children exposed to biomass cookstove emissions in rural Tamil Nadu. $PM_{2.5}$ identified as the primary driver. *Multi-institutional, rural Tamil Nadu*	Patel et al. (2018)[12]
Cancer - Lung	ICMR-NCDIR documents higher lung cancer incidence in India's most polluted metro cities. Lung cancer incidence has shown a significant upward trend in Indian metro cities. *National Cancer Registry Programme, Bengaluru*	Nath et al. (2022)[13]
Systemic- Vitamin D	Children aged 9-24 months in high-pollution locality in Delhi had mean serum vitamin D of 12.4 ng/ml less than half of the requirement from low-pollution area. ($p<0.001$). This demonstrates pollution's reach beyond respiratory and cardiovascular systems. *St. Stephen's Hospital, Delhi*	Agarwal KS et al. (2002)[14]
Intervention - BP & Oxidative Stress	Portable HEPA air filtration in an all-female old-age home in Rohtak, Haryana (29 participants) showed statistically significant improvement in systolic blood pressure ($p<0.001$) during active vs. sham filtration, with CRP and oxidative DNA damage as secondary outcomes. *PGIMS, Rohtak, Haryana*	Ahuja A et al. (2025)[15]
Intervention evidence Natural Experiment - Lockdown	COVID-19 lockdown (2020) caused approximately 50% $PM_{2.5}$ reductions across Delhi, Mumbai, and Kolkata documented by CPCB monitoring data and peer-reviewed analysis. This demonstrated that targeted emission controls can achieve rapid, measurable air quality improvements, providing India-specific empirical evidence that policy-driven source reduction works. *Multiple Indian universities*	Dhaka SK et al. (2020) and Mandal J et al. (2021)[16,17]
Mortality	Every 25 $\mu g/m^3$ increase in $PM_{2.5}$ associated with 0.8% increase in daily non-accidental mortality in Delhi; 1.5% increase among adults aged 60 and above. Short-term exposure time-series analysis; 700,512 deaths recorded June 2010–December 2016. *PHFI / Centre for Policy Research, Delhi*	Krishna B et al. (2021)[21]

The studies presented are drawn from a broader peer-reviewed evidence base. Health Effects Institute's global burden of disease evidence portal lists 647 Indian studies, and approximately 200 peer-reviewed studies document direct human health outcome evidence from air pollution exposure in India, spanning respiratory, cardiovascular, metabolic, maternal, and child health outcomes. Please note that studies mentioned above vary in design; table is indicative of the breadth of Indian literature and is not an exhaustive list.

India's Emerging Primary Evidence Infrastructure

Two ongoing prospective cohort studies led by researchers across AIIMS Delhi, IIT Delhi, IIT Bombay, and St John Research Institute will fill the gap with gold-standard primary evidence:

APiPED - Air Pollution Impact on Pregnancy & Early Childhood Development[18]	**APEAL - Longitudinal Effects of Air Pollution on Adolescent Lungs**[19]
Enrolling 2,500 pregnant women from urban and rural Delhi NCR; following children to age 2. Directly measures $PM_{2.5}$ and PM_{10} using personal portable monitors for a sub-sample. Will generate India's first primary clinical evidence linking measured ambient $PM_{2.5}$ to maternal outcomes and early child development - birthweight, inflammation biomarkers, and neurodevelopment.	4,000 adolescents across Delhi, Mumbai, Bengaluru, and Mysuru; categorised by $PM_{2.5}$ exposure level. Uses spirometry and forced oscillation technique alongside blood biomarkers. Will produce India's first age- appropriate lung function reference values in polluted urban settings and establish trajectory of lung development under chronic $PM_{2.5}$ exposure.

Both studies are at the protocol-stage - results are several years away, but this indicates that India's research institutions are now generating the gold-standard prospective cohort evidence that current policy gaps demand. ***the next phase of NCAP should be designed to receive and act on these findings as they emerge.***

Where the Evidence Is Strongest - and Where It Thins

Well-Studied: Regions	**Under-Studied: Regions**
Delhi NCR mainly dominates the primary evidence based followed by Tamil Nadu reflecting the concentration of research infrastructure - AIIMS, PHFI, IIT Delhi, SRIHER in cities where institutional capacity is strongest. Moreover, evidence is also emerging from cities such as Mumbai, Bengaluru and Mysuru.	The Indo-Gangetic Plain cities with the worst pollution burden i.e., Patna, Kanpur, Lucknow, Ghaziabad have the least primary research coverage. This is the most critical geographic gap for policy purposes. Additionally, North-Eastern states have no or little evidence on the growing pollution level.

Critical Disease Gaps

India has no prospective cohort study linking ambient $PM_{2.5}$ to COPD incidence. For ischemic heart disease, the Million Death Study - using nationally representative SRS mortality data found a null-to-weak association[20] These gaps are significant and must not become a reason for inaction.

3 MoWCD's Reach to India's Most Vulnerable and Its Missing Pollution Link

MoWCD is not new to the health of India's youngest and most vulnerable. Through the Integrated Child Development Services (ICDS) scheme, MoWCD operates over 1.3 million Anganwadi Centres serving children under six years old and pregnant and lactating women - the population groups most biologically susceptible to the health effects of $PM_{2.5}$ exposure. POSHAN Abhiyaan, India's flagship nutrition programme, tracks child development outcomes through the POSHAN Tracker at granular geographic levels. The Pradhan Mantri Matru Vandana Yojana (PMMVY) provides direct benefit transfers to pregnant women enrolled across India's most polluted districts.

That infrastructure is real. It is operational. And it constitutes exactly the platform India needs to connect air pollution exposure to child developmental outcomes at national scale. But it has a critical structural gap: no MoWCD scheme, survey, or surveillance system formally tracks the $PM_{2.5}$ levels to which ICDS beneficiaries and PMMVY-enrolled mothers are exposed. POSHAN Tracker geo-tags Anganwadi Centres but does not assign pollution exposure. India's evidence on $PM_{2.5}$ and child health including neurological impacts, Vitamin D deficiency, and respiratory burden is documented in Indian research institutions, but has never been formally integrated into MoWCD's programme architecture. MoWCD does not need new beneficiaries. It needs to track what the air its beneficiaries breathe is doing to their health.

4 The Opportunity: Connecting India's Air Quality and Health Data

India does not have an evidence problem. It has an institutional design problem. India generates pollution data and health data in parallel and has no routine system to connect them.

CPCB	POSHAN Tracker	NFHS and HMIS
ISRO satellite derived $PM_{2.5}$ estimated geo-tagged to Anganwadi centers via POSHAN tracking coordinates. No new ground-level monitoring infrastructure required - district-level satellite $PM_{2.5}$ estimates are already available. Sub-district resolution to be validated with ISRO.	Child development outcomes (height, weight, anemia, stunting) under MoWCD - Data collected, not linked to pollution	Nationally representative child health and nutrition data from NFHS and state HMIS-documents the burden but no formal $PM_{2.5}$ linkage

These three systems operate in parallel. No formal mechanism connects them. MoWCD has already built the right foundation. POSHAN Tracker geo-tags over 1.3 million Anganwadi centres across India. ISRO satellite-derived $PM_{2.5}$ estimates can be assigned to these coordinates without any new monitoring infrastructure - creating India's first nationally representative dataset linking child development outcomes with ambient pollution exposure at scale. What is missing is the formal connection: POSHAN Tracker's child development data has never been linked to ambient $PM_{2.5}$ estimates. the next phase of NCAP is the moment to build that connection into MoWCD's existing programme architecture. MoWCD does not need to build new systems - it needs to link the data it already collects to the pollution burden its beneficiaries already carry.

5 Specific Asks for MoWCD

01 Embed $PM_{2.5}$ Exposure in POSHAN Tracker at Anganwadi Level

MoWCD to direct NIC and the POSHAN Tracker team to assign ISRO satellite-derived $PM_{2.5}$ estimates at Anganwadi Centre coordinates — using ISRO INSAT-3D aerosol optical depth data cross-validated against CPCB CAAQMS ground stations. This creates India's first nationally representative, geo-located dataset linking early child development indicators (weight, height, anaemia, vaccination status) with ambient $PM_{2.5}$ exposure, without building new monitoring infrastructure. Data to be shared with ICMR and AIIMS-led cohort teams as a reference exposure dataset.

Immediate · MoWCD + NIC + ISRO

02 Designate ICDS Sentinel Sites in High-Burden IGP Districts for $PM_{2.5}$–Child Development Linkage

MoWCD to designate a sub-set of ICDS sentinel sites in high-pollution districts of the Indo-Gangetic Plain — Patna, Kanpur, Lucknow, Varanasi — to collect child development data formally linked to district-level $PM_{2.5}$ from CPCB. Using existing ICDS weighing and development assessment protocols with no new data collection burden on workers, this generates India's first primary evidence directly linking ambient $PM_{2.5}$ to child development outcomes from a national government programme — filling the geographic evidence gap that no academic institution currently covers at this scale.

Short term · MoWCD + CPCB + ICMR

03 Formally Recognise APiPED and APEAL as MoWCD Evidence Partnerships

APiPED (enrolling 2,500 pregnant women in Delhi NCR[18]) and APEAL (following 4,000 adolescents across four Indian cities[19]) are generating exactly the evidence MoWCD programmes need. MoWCD to formally partner with these research teams to: (i) share PMMVY and ICDS enrolment data to strengthen cohort design; (ii) receive study findings as they emerge for integration into POSHAN Abhiyaan and ICDS protocol updates; (iii) co-commission with ICMR a rapid review of $PM_{2.5}$–child development evidence from Indian institutions, drawing on the literature documented in this brief.

Immediate · MoWCD + AIIMS Delhi + IIT Delhi + IIT Bombay

04 Embed Air Quality as a Determinant in POSHAN Abhiyaan's Programme Design

POSHAN Abhiyaan's framework tracks nutrition outcomes but does not account for pollution as a driver of stunting, anaemia, and early cognitive deficits — despite Indian evidence linking $PM_{2.5}$ to Vitamin D deficiency (Agarwal et al. 2002[14]), respiratory burden in children (Kumar et al. 2007, 2008[9][10]), and neurological development. MoWCD to: (i) formally recognise air pollution as a risk factor in POSHAN Abhiyaan's national programme design; (ii) co-develop with MoHFW a joint surveillance protocol linking NFHS round-7 child health data with district-level $PM_{2.5}$ estimates; (iii) mandate air quality impact assessment in MoWCD's district performance frameworks for NCAP cities.

Short term · MoWCD + MoHFW + ICMR

6 Conclusion

India's challenge in addressing air pollution is not a shortage of evidence, but rather one of institutional design and policy translation. NFHS data traces its footprint in child respiratory health. ICMR-NCDIR cancer registries show its signature in lung cancer incidence in India's most polluted cities. CPCB's own monitoring network confirms that virtually all 130 NCAP cities exceed the $PM_{2.5}$ NAAQS of 40 µg/m³ and 108 cities still fall short of even the less stringent PM_{10} standard. Primary studies from AIIMS, PHFI, IIT Delhi, and other

institutes independently document what this exposure does to Indian lungs, hearts, and metabolic health. ***The science is Indian. The data is Indian. The conclusion is unambiguous.***

The window to embed health outcome metrics into the next phase of NCAP is open now - and it will not remain open indefinitely. Programme architecture, inter-ministerial data protocols, and surveillance mandates are set at the design stage. A programme that launches without formal $PM_{2.5}$ to health linkage will spend years trying to retrofit what could have been built in from the start. The four asks in this brief are executable within existing MoWCD programme mandates, require no new legislation, and carry no foreign technical dependence.

The question before MoWCD is not whether to act. POSHAN Tracker, ICDS, and PMMVY already reach the most vulnerable population - children under six and pregnant women in India's most polluted districts. The question is whether the next phase of NCAP will be designed to connect that reach to pollution exposure data - or launch without the ministry best positioned to document what India's air is doing to its youngest citizens.

PAVANA offers three specific forms of technical support to MoWCD:
(1) Developing the methodology for assigning ISRO satellite-derived $PM_{2.5}$ estimates to POSHAN Tracker Anganwadi Centre coordinates;
(2) Designing the ICDS sentinel site $PM_{2.5}$ child development data linkage protocol for IGP districts;
(3) Drafting the POSHAN Abhiyaan air quality integration framework. All three are executable within MoWCD's existing programme mandates.

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