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Centre for Air Pollution & Environmental Health · Pahle India Foundation

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

MoHFW India has generated the evidence. Two decades of Indian research documents what $PM_{2.5}$ does to Indian bodies. What is missing is the institutional architecture to translate that evidence into the policy response it demands.

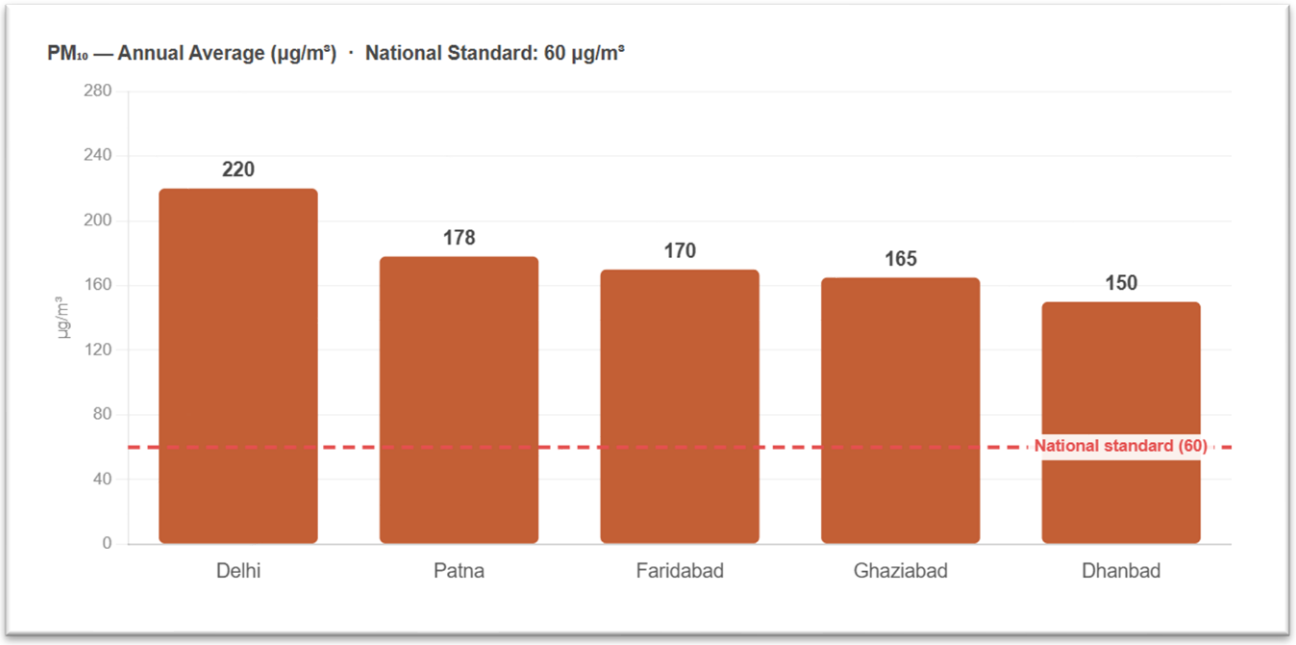
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, 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 translation mechanism - the institutional architecture that moves India's own evidence from its research institutions into the policy frameworks that govern India's air.

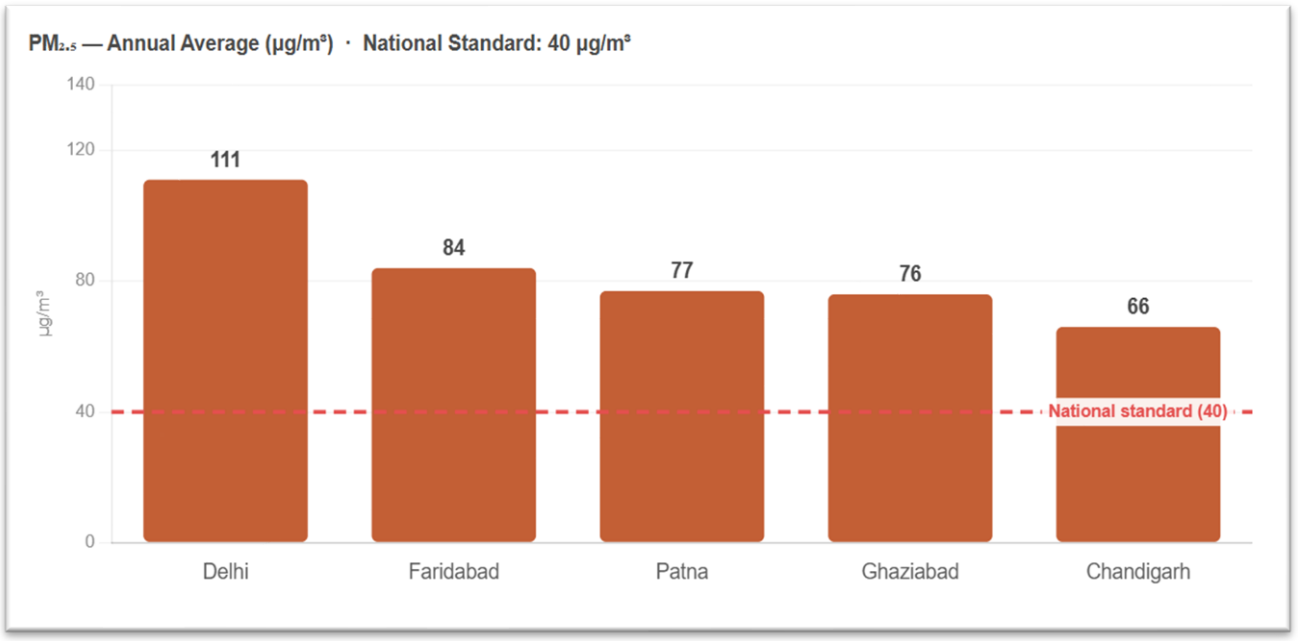
1 India's Clean Air Progress - and the Health Opportunity Ahead

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 for India's research, civil society, and development community is not whether India's evidence is strong enough. Two decades of Indian research has answered that. The question is whether this community will provide the evidence, the advocacy, and the institutional support that transforms what India's researchers have documented into what India's policymakers will act on - before the next phase of NCAP is designed without health outcome metrics.

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. *Technical research institutions / 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 µg/m³ 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. HEI'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 and other leading Indian research institutions 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.*** Under NCAP, Ministry of Environment, Forest and Climate Change (MoEFCC) has established the National Knowledge Network (NKN) on Air Pollution Management coordinated through IITs and other premier institutions as the technical advisory and capacity-building framework for NCAP implementation, with dedicated technical personnel deployed across NCAP cities. The government has built the infrastructure. **What is missing is the translation of India's evidence into India's policy.**

Where the Evidence Is Strongest - and Where It Thins

Well-Studied: Regions	Under-Studied: Regions
Delhi NCR mainly dominates the primary evidence base, with strong coverage from Delhi NCR and Tamil Nadu. 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 India's Evidence-to-Policy Gap- Built but Not Yet Translated

Two decades of Indian research led by AIIMS, PHFI, IIT Delhi, IIT Bombay, ICMR-NCDIR, and many other institutions have documented what $PM_{2.5}$ does to Indian bodies across cardiovascular disease, type 2 diabetes, lung cancer, child respiratory health, neurological development, and Vitamin D deficiency. The studies are Indian, the populations are Indian, and the institutions are India's own.

What India has is a translation problem. CPCB's CAAQMS network generates real-time $PM_{2.5}$ data across NCAP cities. PM-JAY HMIS captures hospital admissions with ICD-10 codes. NPCCHH has established ARI sentinel surveillance. NFHS tracks child health outcomes across all districts. POSHAN Tracker geo-tags 1.3 million Anganwadi Centres. These systems operate in parallel and no formal mechanism connects any of them to India's pollution monitoring data.

The consequence is a policy vacuum. NCAP operates without health outcome metrics. the next phase of NCAP is being designed now - and the window to embed health measurement into the programme architecture is open. Closing that gap requires action from government institutions, and it requires the research, civil society, and development community to build the evidence, the public demand, and the institutional capacity that government cannot generate alone.

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	PM-JAY	NPCCHH ARI Sentinel Surveillance
Real-time $PM_{2.5}$ from CPCB's nationwide CAAQMS network across NCAP cities- Data collected, published, available	Hospital admissions with ICD-10 disease codes across Ayushman Bharat- Data collected, not linked to pollution	Operational since 2017 across selected sites across states but no public data reports released and no formal $PM_{2.5}$ linkage

These three systems operate in parallel. No formal mechanism connects them.

India's research and civil society community has already built critical components of the foundation. APiPED and APEAL are generating the prospective cohort evidence that government surveillance alone cannot produce. Community monitoring networks are producing hyperlocal exposure data that CAAQMS cannot capture. India's emissions inventory infrastructure provides the source-apportionment data that health-linked policy needs. Civil society organisations have built the policy advocacy infrastructure. The components exist. What is missing is the coordination that connects them to a single outcome: embedding health metrics into the next phase of NCAP before the design window closes.

5 How India's Research, Civil Society, and Development Community Can Help

01 Research and Academic Partners: Build and Share India's Health-Evidence Pipeline

APiPED and APEAL are generating India's first gold-standard prospective cohort evidence on $PM_{2.5}$ and child and adolescent health. provides India's most granular city-level source-apportionment data. PAVANA proposes: (i) formal data-sharing agreements between APiPED, APEAL, and a PAVANA-maintained health-evidence repository for government submissions; (ii) joint publication of city-level source apportionment–health burden co-analysis using Urban Emissions data alongside ICMR-NCDIR cancer registry data; (iii) development of India-specific $PM_{2.5}$ exposure-response coefficients from Indian cohort data that the next phase of NCAP can formally adopt as national health impact coefficients.

02 Funders and Foundations: Fund the Health-Evidence and Policy Translation Pipeline

No dedicated institutional funding mechanism exists for translating Indian health evidence into government-facing policy submissions, maintaining the health-evidence repository, and sustaining the inter-ministerial engagement that policy translation requires. PAVANA proposes: (i) core funding for PAVANA's evidence-synthesis and policy-submission function through the the next phase of NCAP design and implementation cycle; (ii) catalytic grants to expand APiPED and APEAL to additional NCAP non-attainment cities in the Indo-Gangetic Plain; (iii) seed funding for community monitoring in Delhi's low-income settlements to generate hyperlocal exposure data unavailable from CAAQMS alone.

03 Civil Society and Technology Partners: Build Community Exposure Data and Public Demand

Government monitoring stations capture city-level averages - but $PM_{2.5}$ exposure among India's most vulnerable populations is not captured by CAAQMS alone. PAVANA proposes: (i) waste worker exposure monitoring to generate India's first occupational $PM_{2.5}$ exposure dataset, linked to HMIS health outcomes, for policy submission to the Ministry of Labour and Employment (MoLE) and CPCB; (ii) low-cost sensor deployment in Delhi's low-income settlements, linked to PAVANA's health correlation methodology, generating community-level exposure-outcome

04 International Organizations: Anchor India in Global Health-Linked Air Quality Frameworks

India is the only country of this scale - with two decades of health evidence and a national clean air programme - that still operates without formal health outcome metrics in NCAP. PAVANA proposes: (i) technical support for embedding child health outcome indicators in the next phase of NCAP, drawing on international experience linking child health monitoring to ambient air quality; (ii) support for the development of a South Asia regional framework for health-accountable clean air governance, anchored in India's the next phase of NCAP; (iii) joint PAVANA–international partner

evidence for civil society advocacy; (iii) civil society advocacy for $PM_{2.5}$ targets and health outcome metrics in the next phase of NCAP, building the public and media demand that government-only engagement cannot generate.	advocacy for $PM_{2.5}$-based NCAP targets before the design window closes.

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 actionable within the existing institutional mandates of India's research, civil society, and development community, require no new legislation, and are aligned with India's own SDG commitments.

The question before India's research, civil society, and development community is not whether to act. The evidence is Indian, the burden is Indian, and the moment is now. The question is whether this community will coordinate its institutional capacity - through research partnerships, funder coordination, civil society advocacy, and international accountability to deliver what the next phase of NCAP needs to be designed for health, not just for pollution.

PAVANA serves as the coordination architecture for this coalition: (1) Synthesizing Indian health evidence for government-facing policy submissions, providing research partners with a GoI-credible translation mechanism for their findings; (2) Co-designing community monitoring and data linkage protocols with technology and implementation partners; (3) Building the inter-ministerial policy asks that require civil society–government co-development.

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