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Centre for Air Pollution & Environmental Health · Pahle India Foundation

Realizing NCAP's Health Promise:

Evidence and Recommendations for National Clean Air Programme Reform

Commission of Air Quality Management (CAQM) has the authority. What is missing is the health outcome mandate to go with it.

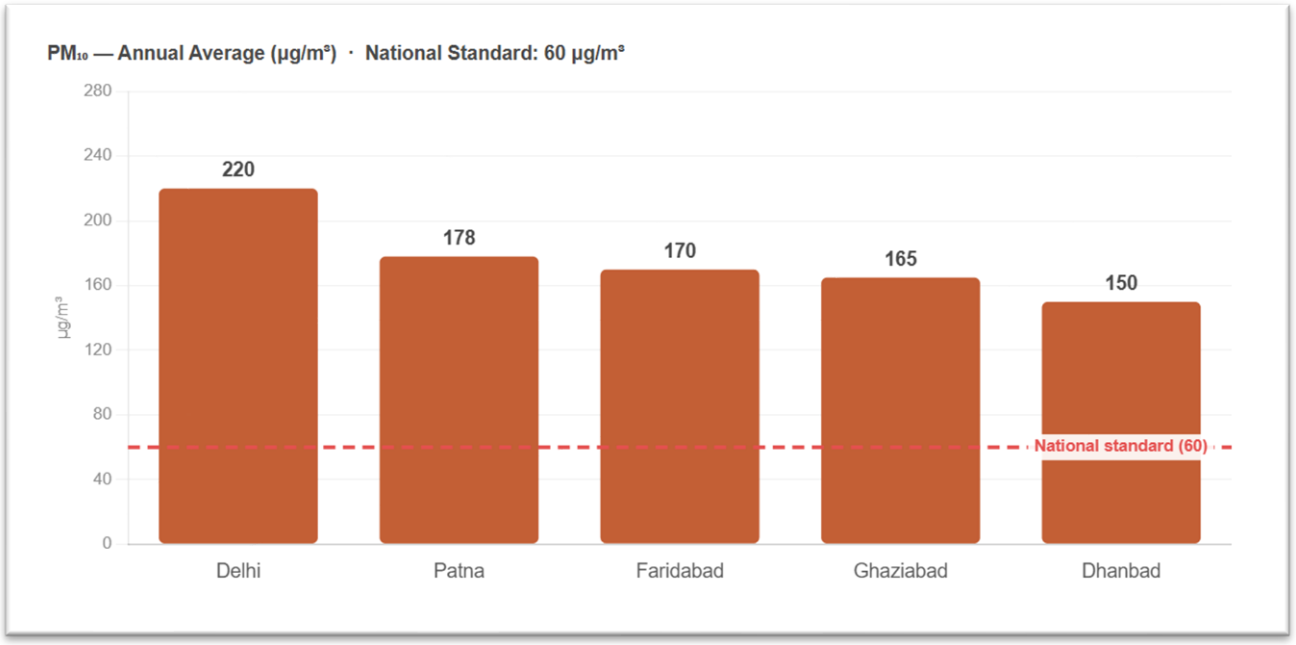
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, 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 mandate requiring $PM_{2.5}$ reduction to be tracked against health outcomes.

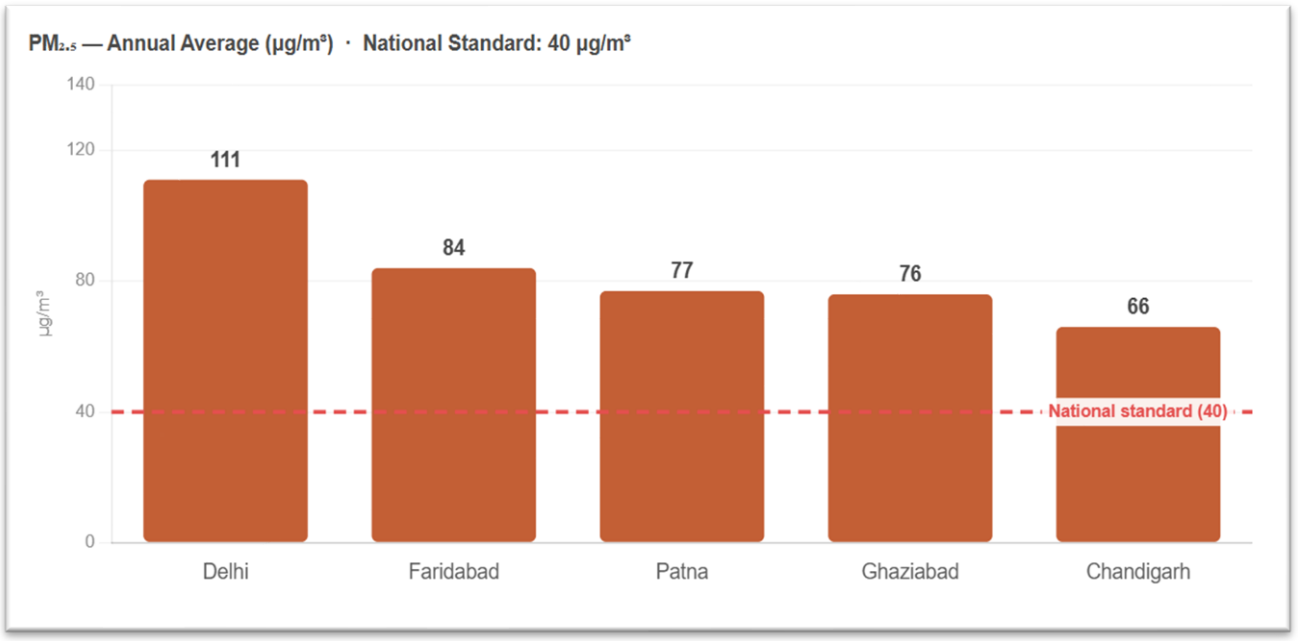
1 India's Clean Air Progress - and the Health Opportunity Ahead

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 CAQM is not whether air pollution harms health. India's own institutions have answered that. The question is whether CAQM will use its statutory authority to require that $PM_{2.5}$ reduction in India's most polluted airshed be tracked against health outcomes - not just against pollution concentrations.

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 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. 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] 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.	**APEAL - Longitudinal Effects of Air Pollution on Adolescent Lungs[19]** 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 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.	**Under-Studied: Regions** 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 CAQM's Statutory Mandate - The Legal Authority India's Most Polluted Airshed Needs

CAQM is constituted under an Act of Parliament - the Commission for Air Quality Management in National Capital Region and Adjoining Areas Act, 2021 - with statutory authority to issue binding directions to state governments, central departments, and local bodies within the National Capital Region (including Delhi) and the adjoining areas in the states of Haryana, Uttar Pradesh, Rajasthan, and Punjab. No other body in India has this combination of statutory authority and geographic jurisdiction over India's most polluted airshed.

The cities that consistently top India's pollution charts - Delhi, Gurugram, Faridabad, Greater Noida, Noida, Ghaziabad - are all within CAQM's jurisdiction. The Graded Response Action Plan (GRAP), which CAQM implements, already uses AQI-based thresholds - which incorporate $PM_{2.5}$ concentrations - to trigger emergency restrictions. But GRAP responds to pollution levels, not to the health harm those levels generate. CAQM has both the mandate and the legal authority to change this: to require that $PM_{2.5}$ reduction in NCR cities be tracked against health outcomes, not just pollution concentrations.

The next phase of NCAP presents a structural opportunity. CAQM can mandate within its jurisdiction exactly what the next phase of NCAP is proposing nationally - making NCR the proof of concept for health-linked air quality governance that the rest of India can then replicate.

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 CAAQMS network across NCR and CAQM-jurisdiction cities- Data collected, published, and available for health linkage	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.

CAQM has already established the regulatory framework. GRAP's $PM_{2.5}$-based emergency response protocol means CAQM already uses ambient air quality data to trigger health-relevant actions. What is missing is the formal health outcome linkage: CAQM responds to $PM_{2.5}$ levels, not to the hospitalisations those levels drive. the next phase of NCAP presents a convergent opportunity. CAQM does not need new authority - it needs to direct its existing statutory authority at health outcomes, not just at pollution concentrations.

5 Specific Asks for CAQM

01 Mandate $PM_{2.5}$ and PWE-$PM_{2.5}$ in All CAQM-Directed City Action Plans

CAQM to issue binding directions requiring all NCR and adjoining-state cities to use annual mean $PM_{2.5}$ — not PM_{10} — as the primary performance metric in city action plans submitted to CAQM. Further, direct CPCB to compute Population-Weighted Exposure to $PM_{2.5}$ (PWE-$PM_{2.5}$) for all NCR cities and require its annual reporting as a mandatory element of city action plan performance assessment. This is within CAQM's existing statutory authority — no new infrastructure required.

Immediate · CAQM

02 Issue Binding Directions to Expand CAAQMS Density in Residential Zones

CAQM to issue binding directions to Delhi and NCR state governments requiring all cities within its jurisdiction to achieve a minimum CAAQMS density of ≥1 station per 50 km² in residential zones within 3 years. NCR cities already have India's highest concentration of monitoring infrastructure. Closing the residential coverage gap creates the ward-level data needed to compute PWE-$PM_{2.5}$ with precision and to detect gaming of monitoring station placement when disbursement is linked to performance.

Short term · CAQM

03 Pilot the MoEFCC–MoHFW $PM_{2.5}$-to-Health Data Linkage Within NCR

NCR has India's highest density of both CAAQMS monitoring stations and PM-JAY-enrolled hospitals. CAQM to direct Delhi and NCR state governments to enable linkage of CPCB district-level $PM_{2.5}$ data with cardiorespiratory admissions in PM-JAY HMIS for NCR districts — creating the NCR pilot for the national MoEFCC–MoHFW protocol. A working NCR proof of concept would accelerate national rollout and demonstrate that the linkage is technically feasible within existing Indian government systems.

Short term · CAQM + MoEFCC + MoHFW

04 Commission Source Apportionment with Health Impact Weighting and Link GRAP to Health Data

CAQM already funds source apportionment for NCR. Direct that future studies include a health burden overlay — identifying which emission sources contribute most to cardiorespiratory hospital admissions, not just to pollution concentrations. This transforms how CAQM prioritises interventions: from source-by-concentration to source-by-health-harm. As NCR $PM_{2.5}$-to-health data becomes available, calibrate GRAP triggers to health response thresholds, connecting GRAP directly to documented health outcomes.

Short-Medium term · CAQM

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 institutional mandates, require no new legislation, and carry no foreign technical dependence.

The question before CAQM is not whether it has the legal authority. It does. The question is whether CAQM will use that authority to require that $PM_{2.5}$ reduction in NCR be tracked against health outcomes - making NCR the proof of concept for health-accountable clean air governance that India needs at national scale.

PAVANA offers three specific forms of technical support to CAQM: (1) Computing PWE-$PM_{2.5}$ baselines and designing the monitoring framework for NCR cities; (2) Designing the NCR pilot for the $PM_{2.5}$-to-health data linkage with MoEFCC and MoHFW; (3) Developing the methodology for NCR source apportionment studies with health impact weighting. All three are executable within CAQM's existing statutory mandate.

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