PAVANA · POLICY BRIEF

Centre for Air Pollution & Environmental Health · Pahle India Foundation

Realizing NCAP's Health Promise:

MoHFW Must Do in National Clean Air Programme Reform

MoHFW has established the framework. What is needed is the data linkage to make it consequential.

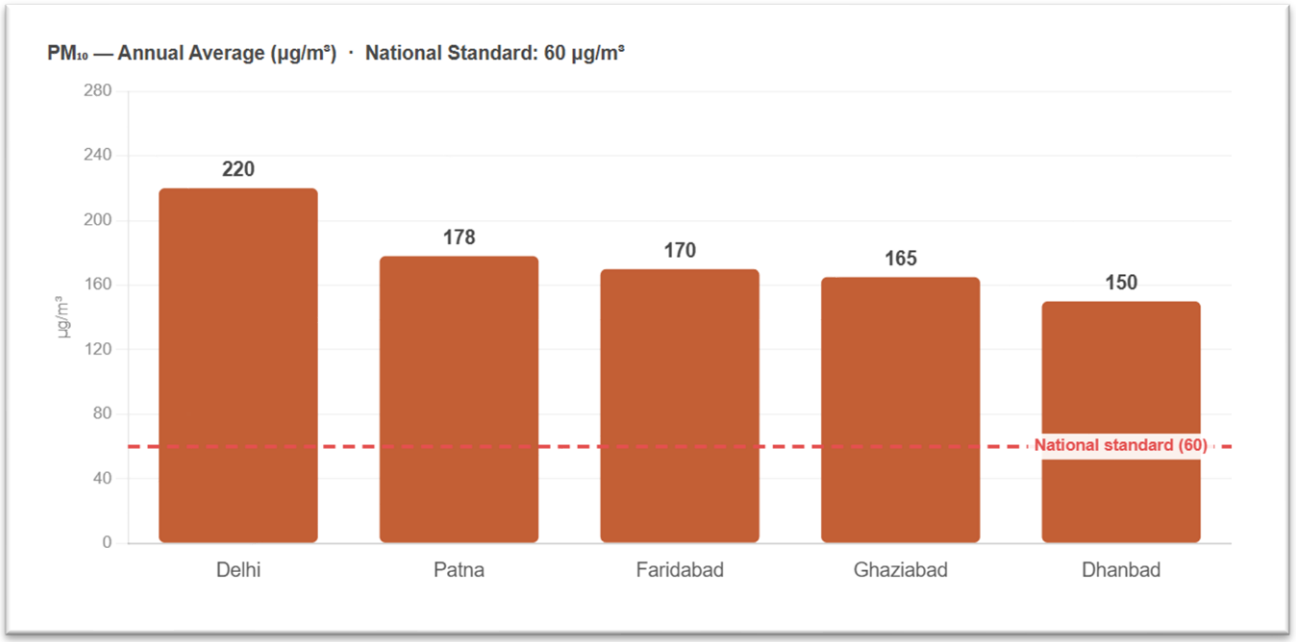
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, 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 that air pollution is not an environment problem alone - it is a health burden requiring a health system response.

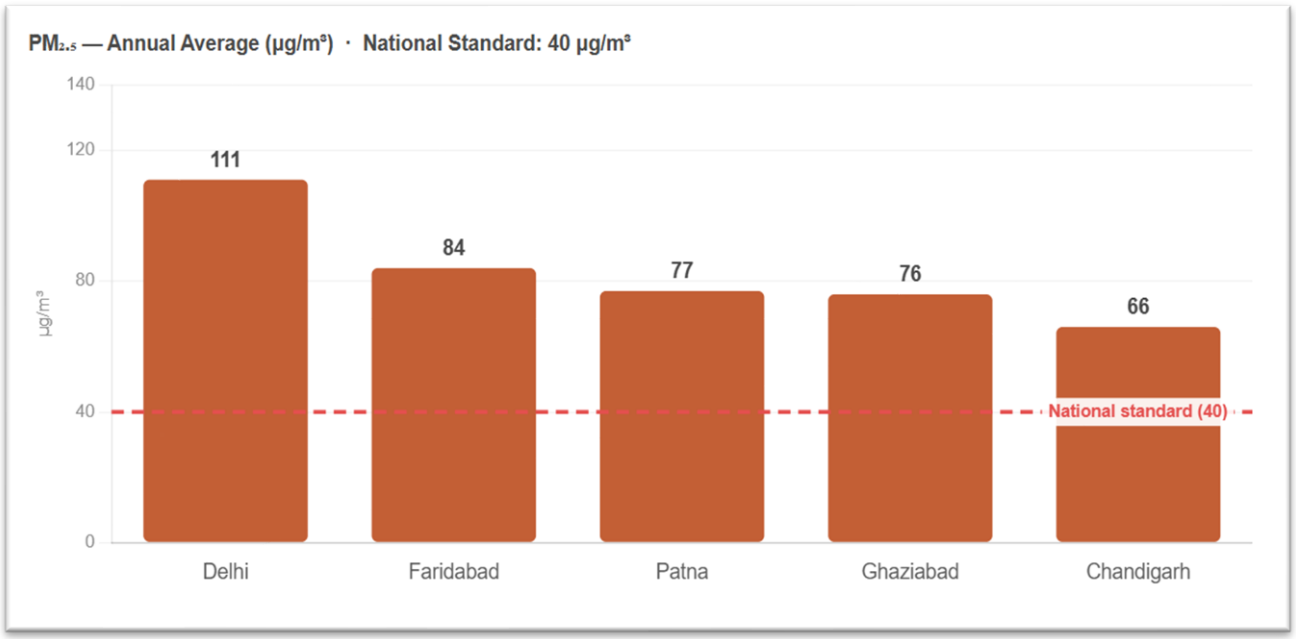
1 India's Clean Air Progress - and the Health Opportunity Ahead

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 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 MoEFCC, Lok Sabha, December 2025[4]	**51%** of released NCAP funds utilized by 82 MoEFCC-funded cities (₹831 cr of ₹1,616 cr released) - a utilization challenge alongside the health challenge 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 MoHFW is not whether air pollution harms health. India's own institutions have answered that. **The question is whether India's policy framework is designed to measure, track, and reduce that harm or to measure the pollution burden itself?**

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 and 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)[23]

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; categorized 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 MoHFW's Own Architecture — Built but not yet connected

MoHFW is not new to air pollution and health. In 2015, MoHFW constituted an expert Steering Committee that produced a landmark report - the first time in India and among the first in any low- and middle-income country that a health ministry directly addressed air pollution as a national health concern[21]. In 2021, MoHFW's National Programme on Climate Change and Human Health (NPCCHH), operating through the National Centre for Disease Control (NCDC), released a Comprehensive Health Adaptation Plan for Diseases due to Air Pollution - a document that established ARI sentinel surveillance, AQI-graded health response protocols, and Centres of Excellence at PGIMER, AIIMS, and VP Chest Institute[22].

That architecture is real. It is operational. And it is the right foundation for India's response to the health burden of air pollution. **But it has a critical structural gap: none of its surveillance, response, or evidence-generation mechanisms are formally linked to the ambient $PM_{2.5}$ data that CPCB continuously collects across NCAP cities.** The ARI surveillance system tracks respiratory emergencies against AQI yet no public report/dashboards exist. PM-JAY HMIS tracks cardiorespiratory admissions with ICD-10 codes. CPCB tracks $PM_{2.5}$ across 130 NCAP cities. These systems operate in parallel, with no formal data linkage between them.

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.

MoHFW has already built the right foundation. The NPCCHH programme's ARI sentinel surveillance - established under the Comprehensive Health Adaptation Plan[22] represents exactly the kind of health outcome tracking that the next phase of NCAP needs. What is missing is the connection: sentinel surveillance data has not been formally linked to CPCB's district-level $PM_{2.5}$ records, and no public data reports have been released from the surveillance system. the next phase of NCAP is the moment to activate what already exists. **MoHFW does not need to build new systems - it needs to connect the ones it has.**

5 Specific Asks for MoHFW

01 Develop a MoHFW–MoEFCC Data Linkage Protocol

India's Ayushman Bharat PM-JAY HMIS captures hospital admissions with ICD-10 disease codes across the country. CPCB's CAAQMS network captures real-time ambient $PM_{2.5}$ across all 130 NCAP cities. These two datasets have never been formally linked. MoHFW to co-develop an inter-ministerial data linkage protocol connecting CPCB district-level ambient $PM_{2.5}$ data with ICD-10 coded cardiorespiratory admissions in PM-JAY HMIS, generating India's first routine pollution–hospitalization evidence pipeline at scale. Both data streams are operational. What is missing is the formal linkage.

Immediate · MoHFW + MoEFCC + CPCB

02 Expand NPCCHH Surveillance to Cardiorespiratory ICD Codes

MoHFW's NPCCHH programme has established ARI sentinel surveillance across select sites — a protocol that already links acute respiratory illness cases to ambient AQI levels at sentinel hospitals. MoHFW to take two sequential actions: (i) release existing ARI sentinel surveillance data in the public domain; (ii) expand the sentinel surveillance protocol beyond ARI to include ICD-10 cardiorespiratory codes formally linked to CPCB district-level $PM_{2.5}$ data — creating India's first integrated cardiorespiratory pollution surveillance system within NPCCHH's existing mandate.

Immediate · MoHFW + NCDC + CPCB

03 Commission ICMR to Lead a City-Level Health Burden Study

ICMR — in partnership with SRIHER and AIIMS — to produce India's first city-level, primary-data-based estimate of $PM_{2.5}$-associated disease burden. Prioritize cities in the Indo-Gangetic Plain where pollution burden is highest but primary evidence is thinnest — Patna, Kanpur, Lucknow, and Varanasi. ICMR sits under the Department of Health Research, MoHFW, making this directly within MoHFW's institutional mandate to commission.

Short term · ICMR / SRIHER / AIIMS

04 Embed $PM_{2.5}$ Exposure in NFHS and Extend Rural Health Tracking

MoHFW to embed $PM_{2.5}$ exposure at cluster level in the next NFHS round and extend health outcome tracking beyond designated NCAP cities to high-burden rural areas, beginning with the Indo-Gangetic Plain. ISRO satellite-derived $PM_{2.5}$ estimates can be assigned at NFHS cluster coordinates without new monitoring infrastructure. MoHFW's NPCCHH programme is the institutional home for the rural health surveillance that NCAP currently lacks.

Short term · MoHFW + MoEFCC

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 MoHFW is not whether to act. It is whether the next phase of NCAP will be designed to measure, track, and reduce harm or launch without the health outcome infrastructure to know whether it is succeeding.

PAVANA offers four specific forms of technical support to MoHFW:

(1) Co-develop a MoHFW-MoEFCC data linkage protocol connecting $PM_{2.5}$ data to PM-JAY HMIS- as a pilot in 2-3 NCAP cities.
(2) Support MoHFW in publishing NPCCHH ARI Sentinel Site- $PM_{2.5}$ linked data, enabling the evidence base for India's Clean Air Policy and to draft the expanded NPCCHH sentinel surveillance protocol that adds cardiorespiratory disease along with CPCB data integration.
(3) Facilitating the inter-ministerial working group and providing technical support for first 12 months of the data linkage mechanism.
(4) Drafting the terms of reference for an ICMR led city level burden of disease study.

All four are executable within the NCAP architecture, consistent with MoHFW's existing institutional mandate and grounded in work MoHFW has already done.

7 References

1. MoEFCC Annual Report (2024-25) and subsequent NCAP updates. CPCB's National Ambient Air Quality Status Reports.
2. Central Pollution Control Board. National Ambient Air Quality Status and Trends in India, 2021-2022. New Delhi: CPCB, Ministry of Environment, Forest and Climate Change, Government of India; 2024. Available from: cpcb.nic.in
3. Central Pollution Control Board. Annual Report 2024-25. 2025.
4. Ministry of Environment, Forest and Climate Change. Lok Sabha Unstarred Question No. 49, answered 1 December 2025. 18th Lok Sabha, Winter Session 2025.
5. Roy Chowdhary A, Kumari J. National Clean Air Programme- An Agenda for Reform. New Delhi; 2024.
6. World Health Organization. Sustainable Development Goal Indicator 3.9.1: Mortality Attributed to Air Pollution. WHO, 2024. World Health Organization. Environmental risk factors and NCDs. Geneva: WHO; 2024. Available from: https://www.who.int/teams/noncommunicable-diseases/integrated-support/environmental-risk-factors-and-ncds
7. Prabhakaran D, Mandal S, Krishna B, Magsumbol M, Singh K, Tandon N, et al. Exposure to Particulate Matter Is Associated With Elevated Blood Pressure and Incident Hypertension in Urban India. Hypertension. 2020 Oct 1;76(4):1289–98. doi:10.1161/HYPERTENSIONAHA.120.15373 PubMed PMID: 32816598.
8. Mandal S, Jaganathan S, Kondal D, Schwartz JD, Tandon N, Mohan V, et al. PM 2.5 exposure, glycemic markers and incidence of type 2 diabetes in two large Indian cities. BMJ Open Diabetes Res Care. 2023 Oct 5;11(5). doi:10.1136/bmjdrc-2023-003333 PubMed PMID: 37797962.
9. Kumar R, Nagar JK, Kumar H, Kushwah AS, Meena M, Kumar P, et al. Association of indoor and outdoor air pollutant level with respiratory problems among children in an industrial area of Delhi, India. Arch Environ Occup Health. 2007;62(2):75–80. doi:10.3200/AEOH.62.2.75-80 PubMed PMID: 18316264.
10. Kumar R, Nagar JK, Kumar H, Kushwah AS, Meena M, Kumar P, et al. Indoor air pollution and respiratory

function of children in Ashok Vihar, Delhi: an exposure-response study. Asia-Pacific journal of public health
11. Kulshreshtha P, Khare M, Seetharaman P. Indoor air quality assessment in and around urban slums of Delhi city, India. Indoor Air. 2008;18(6):488–98. doi:10.1111/j.1600-0668.2008.00550.x
12. Patel S, Leavey A, Sheshadri A, Kumar P, Kandikuppa S, Tarsi J, et al. Associations between household air pollution and reduced lung function in women and children in rural Southern India. Journal of Applied Toxicology. 2018 Nov 1;38(11):1405–15. doi:10.1002/jat.3659 PubMed PMID: 30047157.
13. Nath A, Sathishkumar K, Das P, Sudarshan KL, Mathur P. A clinic-epidemiological profile of lung cancers in India — Results from the National Cancer Registry Programme. Indian Journal of Medical Research. 2022 Feb 1;155(2):264–72. doi:10.4103/ijmr.ijmr_1364_21. PubMed PMID: 35946203.
14. Agarwal KS, Mughal MZ, Upadhyay P, Berry JL, Mawer EB, Puliyel JM. The impact of atmospheric pollution on vitamin D status of infants and toddlers in Delhi, India. Arch Dis Child. 2002;87(2):111–3. doi:10.1136/adc.87.2.111. PMID: 12138058.
15. Ahuja A, Kumar A, Rulia R, Bhardwaj R, Arya G, Surapaneni V, et al. Effect of portable air filtration systems among female residents of old age home in northern India with hazardous air quality. Physiol Rep. 2025 Aug 1;13(15). doi:10.14814/phy2.70475
16. Dhaka SK, Chetna, Kumar V, Panwar V, Dimri AP, Singh N, et al. PM2.5 diminution and haze events over Delhi during the COVID-19 lockdown period: an interplay between the baseline pollution and meteorology. Sci Rep. 2020 Dec 1;10(1). doi:10.1038/s41598-020-70179-8 PubMed PMID: 32778673.
17. Mandal J, Samanta S, Chanda A, Halder S. Effects of COVID-19 pandemic on the air quality of three megacities in India. Atmos Res. 2021 Sep 1;259. doi:10.1016/j.atmosres.2021.105659
18. Salve HR, Dey S, Arora Y, Kapoor S, Ghosh S, Kumar R, et al. Air Pollution Impact on Pregnancy and Early Childhood Development (APiPED) in India: Protocol for a Cohort Study. JMIR Res Protoc. 2025 Nov 11;14:e72683. doi:10.2196/72683
19. Agrawal T, Phuleria HC, Mohan A, D'Souza G, Thimmulappa R, Jayaraj BS, et al. Rationale and methodology of a multicentric prospective cohort study on ' Longitudinal Effects of Air Pollution Exposure on Adolescent Lungs (APEAL)' in urban India: APEAL protocol. BMJ Open. 2025 Aug 12;15(8). doi:10.1136/bmjopen-2025-106329 PubMed PMID: 40803718.
20. Brown PE, Izawa Y, Balakrishnan K, Fu SH, Chakma J, Menon G, et al. Mortality Associated with Ambient PM2.5 Exposure in India: Results from the Million Death Study. Environ Health Perspect. 2022 Sep 1;130(9):097004-1-097004–14. doi:10.1289/EHP9538 PubMed PMID: 36102642.
21. Sagar, A., Balakrishnan, K., Guttikunda, S., Roychowdhury, A., & Smith, K. R. (2016). India leads the way: A health-centered strategy for air pollution. *Environmental Health Perspectives, 124*(7)
22. National Centre for Disease Control, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India. (2021). *Health adaptation plan for diseases due to air pollution: National Programme on Climate Change and Human Health.* NCDC, MoHFW.
23. Krishna B, Mandal S, Madhipatla K, Reddy KS, Prabhakaran D, Schwartz JD. Daily nonaccidental mortality associated with short-term PM2.5 exposures in Delhi, India. Environ Epidemiol. 2021 Aug 6;5(4):e167. doi:10.1097/EE9.0000000000000167. eCollection 2021 Aug. PubMed PMID: 34414349.