

Ambient Air Pollution and Public Health: A Call to Action

Key Messages

- The World Health Organization notes that India has a high environmental disease burden, with the Global Burden of Disease (GBD) for 2010 ranking ambient air pollution (AAP) as the fifth largest killer in India.
- Sustained exposure to AAP has led to increased rates of respiratory ailments, acting as a catalyst for rising healthcare costs, and impacting the most vulnerable among us.
- This paper suggests that AAP needs to be addressed through a multi-sectoral approach that cuts across broader themes of development and public health.

Despite a growing awareness of the impact of our interaction with the ecosystem on our health and well-being, the world continues on its perilous course to extract and utilize the resources of the ecosystem in ways that are unsustainable and unsafe. Scientific evidence of the impact of this unsustainable relationship with the ecosystem is now undeniable, with three of nine planetary boundaries having already been breached, and others imminent. India's remarkable growth story, unfortunately, illustrates this reality. The sustained economic expansion of the last two decades has come at a huge price – a dwindling and degraded ecosystem, a growing

cloud of pollution, and a high environmental disease burden.

The World Health Organization (WHO) notes that India has quite a high environmental disease burden, with a significant number of deaths annually associated with environmental risk factors^[1]. The Global Burden of Disease (GBD) for 2010 ranks ambient air pollution as the fifth largest killer in India, three places behind household air pollution. Taken cumulatively, household and ambient air pollution (AAP) constitute the single greatest risk factor for adverse health outcomes in India ^[2]^[3].

Sources of AAP include transport, industrial and heating emissions, biomass burning, and tobacco smoke. They produce pollutants such as sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), ozone, and Particulate Matter (PM₁₀ and PM_{2.5}). A range of other toxic and carcinogenic by-products from biomass burning include formaldehyde, benzene, and poly-aromatic hydrocarbons.

Sustained exposure to AAP leads to increased rates of respiratory disease, chronic obstructive pulmonary disorder, and lung cancer. Thus air pollution acts as a catalyst for rising healthcare costs, placing an ever increasing stress on an already under-funded and ill-equipped health system. In addition, there are the economic losses resulting from the lower productivity of the afflicted labour force.

India's Unbreathable Air

According to a recent Environmental Performance Index study, India officially has the “worst air pollution in the world, beating China, Pakistan, Nepal and Bangladesh”, and ranks last on ambient air quality of all 170+ countries surveyed^[4]. Even by the relatively more lenient national standards set by the Central Pollution Control Board (CPCB), ambient air quality in India is at a hazardous level.

The CPCB – under the National Air quality Monitoring Programme (NAMP) – monitors the air quality at 456 sites, covering 190 cities in 26 states and 5 union territories, monitoring the levels of PM₁₀, SO₂ and NO₂. In over 80 percent of the cities, at least one pollutant exceeded CPCB standards, as noted in the 2010 National Ambient Air Quality Standards (NAAQS) report^[5] ^[6]. While SO₂ levels have declined in recent years, NO_x and PM₁₀ continue to rise. PM₁₀ levels routinely exceed the CPCB standard of 60 µg/m³ (annual mean concentration), with over half the cities registering critical levels (1.5 times the standard).

Figure 1 indicates that at 295 monitoring stations, annual mean concentrations of PM₁₀ exceeded the NAAQS of 60 µg/m³. Maximum values peaked to 1699 µg/m³, as in the case of Delhi.

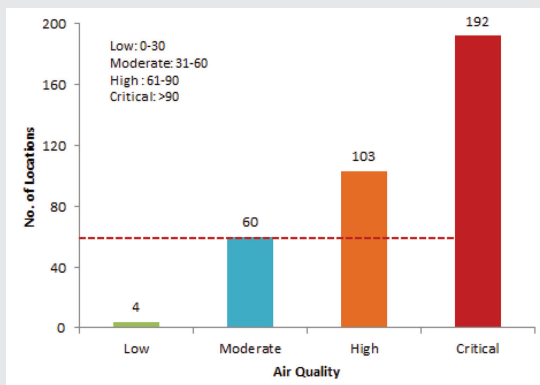


Fig 1: Number of monitoring locations where annual average PM₁₀ levels exceeded National Ambient Air Quality Standards (NAAQS) (residential/ industrial/rural)^[5].

The worst performers with respect to PM₁₀ were the northern states: Delhi (highest PM₁₀ concentration), Jharkhand (also maximum SO₂), West Bengal (also highest NO₂), Punjab, and Uttar Pradesh. State capitals and industrial cities that registered critical levels of PM₁₀ (>90 µg/m³ annual mean concentration), as per the NAAQS, include Delhi, Ahmedabad, Mumbai, Kolkata, Lucknow, Bhilai, Jamshedpur, Moradabad, and Ludhiana.

Health Risks Posed by Ambient Air Pollution

The International Agency for Research on Cancer (IARC) has recently classified outdoor air pollution as a Class-I carcinogen, linking it to over 220,000 lung cancer deaths per annum globally^[7]. While SO₂ and NO_x are generally not considered to be as damaging to human health as fine particulates, they do have temporary impacts, such as inflammation of the broncho-respiratory system and increased incidences of asthma attacks.

The Impact of Particulate Matter on Health

Exposure to fine particulates on a sustained basis can cause a range of upper and lower respiratory ailments, including chronic bronchitis, chronic obstructive pulmonary disorder, and acute lower respiratory infections.

In India, exposure to PM is estimated to contribute to over 100,000 premature deaths annually. Additionally, high levels of AAP result in over 48,000 new cases of bronchitis every year and approximately 370,000 hospital admissions^[8].

Exposure to PM is responsible for about “3 percent of adult cardiopulmonary disease mortality; about 5 percent of trachea, bronchus, and lung cancer mortality; and about 1 percent of mortality in children from acute respiratory infection in urban areas worldwide”^[9], amounting to 800,000 premature deaths and over 6 million lost life years. Cohen et al.^[9] also noted that since only the mortality aspects of exposure to PM were considered, the overall impact could actually be underestimated. Studies have also shown that increasing atmospheric concentrations of PM have a direct effect on mortality and morbidity.



Studies have also been able to cement the legitimacy of the exposure-response relationship by examining the association between exposure to PM and the likelihood of developing lung cancer and cardiovascular diseases^{[10][11]}. Figure 2 demonstrates that while the exposure-response relationship between increasing atmospheric PM concentration and lung cancer is linear, the impact of PM on cardiovascular diseases is high even at low exposure levels. This implies that “there is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur”.^[8]

The Iniquitous Impact of AAP

Groups with pre-existing conditions (such as lung or heart disease), children, and the elderly are the most susceptible to the health effects of AAP. Children are especially vulnerable as exposure to PM affects lung development, integrating irreversible deficits in lung function and affecting lung growth rates. According to the WHO, the number of healthy life years lost to environmental risk factors globally is five-fold higher in children under the age of five, with a greater difference (seven to ten-fold) for diseases such as upper and lower respiratory infections^[12].

Children in developing countries are subjected to far greater risks, losing eight times as many healthy life years as their counterparts in developed countries. The chasm is even wider for key diseases such as lower respiratory infections (800 times). WHO also notes that acute respiratory diseases account for 13 percent of in-patient deaths in paediatric wards, thereby becoming one of the most common causes for death in children under-five^[12].

Socio-Economic Position (SEP) often plays a big role in the epidemiology of disease associated with ambient air pollution^[13]. This is demonstrated through the iniquitous relationship between low SEP (be it educational or income related) and susceptibility to environmental health risk factors. Especially troubling is the evidence that childhood SEP plays a major role in determining health as an adult, irrespective of future economic attainment.

Based on a review of studies linking SEP to health, O’Neill et al. hypothesized the relationship between SEP and air pollution as follows^[13]: Air pollution exposure is differentially distributed by SEP; Low SEP may directly increase susceptibility to air pollution-related health consequences; and Some health conditions and traits that cause vulnerability to air pollution are linked to SEP (the authors stress the need for further exploration into this nexus).

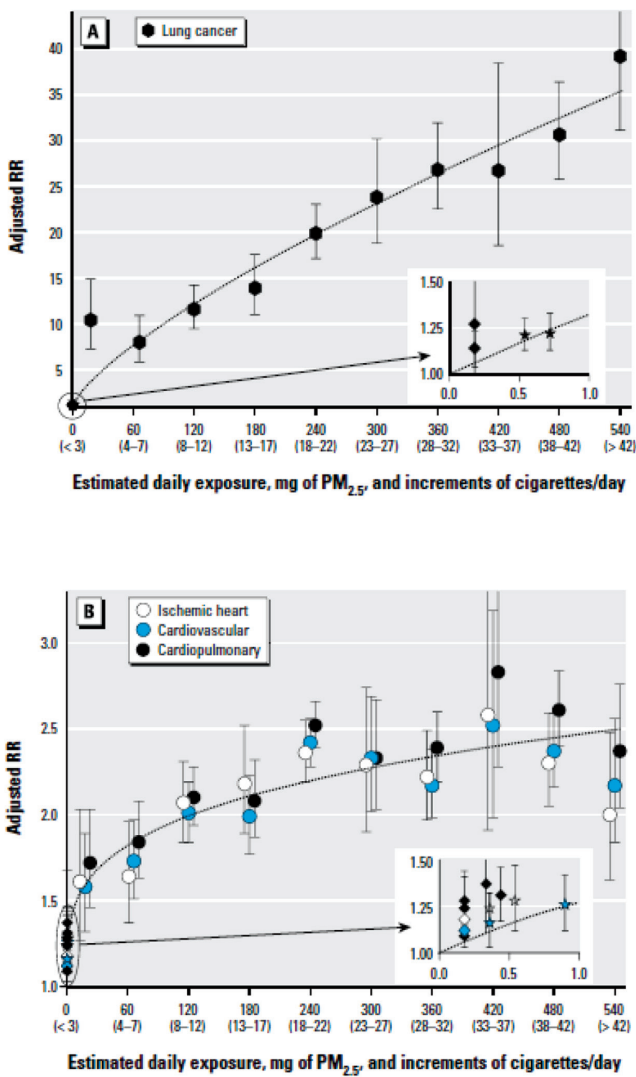


Fig 2: From Pope et al. (2011)^[11], examining the exposure-response relationship between PM_{2.5} and (a) lung cancer, (b) cardiovascular disease.

The Cost of Not Addressing Environmental Risk Factors

The impact of ambient air pollution in epidemiological terms is not restricted to the health perspective. High levels of AAP have a significant impact on both opportunity and economic costs. As Table 1 shows, the number of disability adjusted life years (DALYs) lost to AAP is substantial, the primary contributor being mortality (accounting for 60 percent). Taking a human capital approach, the authors of a study by the World Bank^[8] estimated the annual cost of AAP and PM to be Rs. 1,103 billion or 1.7 percent of GDP in 2009: 90 percent of the cost was associated with mortality and the rest with morbidity.

Health end-points	Total Cases	Total DALYs
Premature mortality adults	109,340	820,049
Under 5 mortality rate	7,513	255,431
Chronic bronchitis	48,483	106,663
Hospital admissions	372,331	5,957
Emergency room visits /Outpatient hospital visits	7,303,897	32,868
Restricted activity days	1,231,020,030	369,306
Lower respiratory illness in children	16,225,360	105,660
Respiratory symptoms	3,917,855,052	2,93,839
	Total	1,989,773

Table 1: Estimated health impact in DALYs of ambient air pollution^[8]

Current Policies to Curb AAP in India

- The Environment (Protection) Act of 1986 mandated the regulation of emissions from industrial sources. Furthermore, re-zoning of cities ensures that highly polluting industries are no longer in direct conflict with areas of housing and are located a safe distance away.
- The Air Act of 1981 (amended in 1987) is the primary air pollution control mechanism in the country, establishing monitoring and enforcement powers with the Central and State Pollution Control Boards (SPCB). Through the NAMP, the SPCBs collect data on NO_x, SO₂, and PM.
- In 2001, the Supreme Court passed a directive to the CPCB and SPCBs to develop directed action plans for cities which do not meet ambient air quality standards, specifically focusing on PM.
- Regulations to curb vehicular emissions were introduced in 1988 in the Motor Vehicle Act and further strengthened by the Supreme Court in 1995. In addition, fuel quality standards are set and regularly updated through the Euro equivalent emission norms.

The results of the policy efforts have so far been mixed, with air regulations leading to minor improvements in air pollution specifically in the case of NO_x. However, they have had no significant impact on the levels of SO₂ and PM^[14]. But this is also attributable to the changing economic circumstances of the Indian demographic, greater growth and industrialisation, as well as an ever-increasing number of vehicles.

Recommended Actions

Ambient air pollution is no longer an issue that can or should be addressed purely from an environmental perspective, but through a nexus approach that cuts across broader themes of development and public health as well. A more broad-based approach to addressing the issue of AAP would therefore include the following:

- **Expanding real-time monitoring:** Capacity for continuous monitoring of air quality standards is currently heavily skewed towards urban centres, with monitoring centres virtually non-existent in rural areas. Of the urban centres, Delhi currently has the largest capacity for continuous monitoring and reporting of PM and other pollutants^[5]. While the CPCB is expanding this continuous monitoring to 16 cities through NAMP, further expansion – both rural and urban – is required to truly study the impact of ambient air pollution.
- **Transparency and standardization in data reporting:** At the moment, air quality data is generated by multiple agencies including the CPCB. While this provides continuous monitoring data, the data is not standardised and is therefore not useful in tracking trends. Also, sourcing data from stations that are not a part of the continuous monitoring mechanism can sometimes be a challenge. Greater standardization in the collection of data and transparency in the reporting mechanism would aid not only in research but also building awareness.
- **Enforcing existing regulations to curb industrial emissions:** Research by Greenstone et al.^[15] has shown that reform of existing reporting mechanisms through incentivising stakeholders to report accurately, thus reducing systemic corruption can make regulation more effective. Replicating this nationwide is a vital step forward to curbing industrial emissions.
- **Ending unsustainable fuel subsidies:** A major contributor to transport emissions, especially of PM, is diesel exhaust. With 49% of all new cars in India running on diesel (the cost of which is subsidised by the government) this poses a major challenge that needs to be tackled, first by updating outdated emissions regulations, and further through the gradual phasing out of diesel subsidies.
- **Expanding awareness about air quality:** There is a lack of awareness in the general public of the adverse health impacts of AAP. A comprehensive programme to raise awareness through the use of conventional and new media (Facebook and Twitter), can create momentum for political action, and can help change behaviour from poor practices like bursting firecrackers, burning of solid waste and other such polluting activities.
- **Reframing the message:** Research has shown that framing issues that were formerly confined to the environmental domain – such as climate change – in a public health narrative has led to broader acceptance of the need for change, and this could resonate with ambient air pollution as well^[14].
- **Engaging the Public Health community:** Public health professionals and researchers can play a leading role in the promotion of AAP as a critical public health issue by voicing support for policies that address the sources of pollution, such as transport and industrial emissions. The Ministry of Health and Family Welfare (MoHFW) has already taken a step in the right direction through the convening of a steering committee to address the health issues related to air pollution and the hope is that policy recommendations arising out of the committee would be multi-sectoral in nature. The evidence generated by this committee, along with other independent research could also be used by the MoHFW and the broader public health community at large as a starting point to engage with other interested parties.
- **Expanding the knowledge base:** Research focused on modelling the impacts of ambient air pollution on health could be used to predict future needs in terms of the health system's capacity to deal with the fallout.
- **Expanding health coverage:** Given the nature of health care in India, much of the expenditure to treat the health impacts of AAP is borne by the

patient. Since AAP impacts the most vulnerable in society, those who are least equipped to deal with the resultant health and economic burden, it is imperative that health coverage be expanded to provide a much-needed safety net.

- **Greater investment in and promotion of public transport:** The success of the Delhi Metro needs to be replicated in other cities through greater investment, promotion, and exchange of best practices between local, state, and central governments. Implementation of congestion

pricing and paid parking (virtually free in most cities) would also help by lowering traffic and increasing uptake of public transport.

- **Protecting green spaces:** The importance of green spaces not just as a public expanse for congregation and recreation, but also as an important front in the battle against air pollution needs to be recognised. India has some of the lowest levels of per-capita public spaces, with Delhi being one of the few exceptions.

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