

Dr Surya Kant
Professor and Head
Dept. of Respiratory Medicine,
King George's Medical University, UP,
Lucknow, India
President, Organization for Conservation of Environment and Nature (OCEAN)
Member, National Core Committee,
Doctors for Clean Air & Climate Action

Air Pollution: Leading Menace to Respiratory Health

Air pollution stands as one of the most pressing threats to human health today, particularly when it comes to our respiratory system. Every breath taken in cities like Delhi contains fine invisible particulate matter (PM2.5) that can damage our lungs over time[1,2]. According to the 2024 World Air Quality Report by IQAir (released March 2025), Delhi recorded the highest annual PM2.5 among capital cities at 91.6 μg/m³, far exceeding the World Health Organization's (WHO) recommended safe limit of 5 μg/m³. This data is not just a statistic; it is a wake-up call for citizens as well as government. Globally, air pollution contributes to more than 8 million deaths annually, with respiratory diseases bearing much of the brunt. In India alone, it claims around 2 million death each year, fuelling a range of respiratory disorders, from everyday coughs to life-threatening conditions like chronic obstructive pulmonary disease (COPD)[1,3-5].

The roots of air pollution are all around us, stemming from both human activities and natural events amplified by our modern world. Fine particulate matter (PM2.5 and PM10) consists of particles small enough to penetrate deep into the lungs[2,6]. Then there are gases like nitrogen dioxide from traffic, sulfur dioxide from coal plants, ground-level ozone created by sunlight mixing with emissions, carbon monoxide from incomplete burning, and volatile organic compounds released during painting or cleaning[2,3,7]. Major outdoor sources include vehicular emissions, industrial processes, and crop-residue burning in northern India[8]. Indoor air pollution is also significant, particularly in rural households using biomass fuels (wood, dung, crop waste) for cooking[8,9]. The WHO has long warned that these everyday exposures add up, turning our shelters into unintended sources of harm. When these pollutants invade the lungs, the body mounts a defense, but it is often a losing battle. Inhaled particles trigger inflammation, much like a scrape on the skin swells to fight infection, except here it affects delicate airway linings[8,9]. This leads to oxidative stress, where free radicals overwhelm the natural antioxidants of the cells, causing widespread wear and tear. The immune system gets thrown off balance, producing too much mucus that clogs passages and impairs the tiny cilia, those hair-like sweepers in our airways, that normally clear out debris[1,9]. Over months or years, this cascade weakens lung defenses, making us prone to infections and chronic issues. Children breathe a higher volume of air per body weight and are therefore more vulnerable to long-term lung function. The elderly, whose repair mechanisms slow with age, and those already battling conditions like diabetes or heart disease find their risks compounded. Air pollution affects all parts of the body, and the effects even reach the fetus. Even short bursts of bad air, say during a smoggy winter day, can spike hospital visits for acute problems[2,3,8].

Take allergies, for instance, a seemingly mild nuisance that pollution turns vicious. Pollen, dust mites or pet dander alone might cause a sniffle, but when coated in PM2.5 or nitrogen dioxide, they become supercharged allergens[3,7]. These altered particles burrow deeper, provoking stronger immune overreactions that lead to hay fever symptoms: runny noses, itchy eyes, and relentless sneezing[2,10]. Air pollution in urban India, where traffic fumes mix with seasonal pollens, drives eczema flares and

rhinitis cases to surge. Studies on allergy show how such exposures not only worsen symptoms, but also sensitize the body to new triggers, creating a vicious cycle for millions[7,9,11,12].

Asthma offers another stark example. This chronic narrowing of the airways flares under the assault of pollution, with ozone and fine particles acting as direct irritants[1,3,7]. Wheezing, chest tightness, and breathlessness hit hard during attacks, often landing sufferers in emergency rooms. In Delhi, where nitrogen dioxide routinely surpasses WHO thresholds, winter smog correlates with a 20%-30% jump in asthma admissions. The indoor culprits compound this; second-hand smoke or biomass cooking fumes in low-income homes provoke episodes that disrupt sleep and school[8,13].

Perhaps no condition illustrates the long-term toll of pollution like COPD[14]. Encompassing emphysema and chronic bronchitis, COPD scars the lungs with irreversible damage from repeated inflammation. PM2.5 particles embed in alveoli, the tiny air sacs, fostering fibrosis that stiffens tissue and traps air. In India, where biomass burning is commonplace in villages and industrial haze blankets cities, COPD prevalence soars, often striking non-smokers in their prime working years. Symptoms creep in subtly; a nagging cough escalating to labored breathing on stairs, frequent infections, and exhaustion that side lines families[7,14,15]. The Global Burden of Disease Study, updated in 2024, links air pollution to a third of COPD cases in South Asia, with flare-ups driving up health care costs and mortality. A fresh analysis in Lung India from 2024 ties higher COPD severity scores directly to years of biomass exposure, painting a grim picture for rural women who cook over open fires daily[7,15,16].

Lung cancer also emerges as a hidden threat in polluted air. The International Agency for Research on Cancer designates outdoor air pollution as a Group 1 carcinogen, equivalent to tobacco smoke. Polycyclic aromatic hydrocarbons, released from diesel engines and coal burning, damage DNA and trigger uncontrolled cell proliferation. Fine PM2.5 penetrates deep into the lungs, increasing adenocarcinoma incidence even in never-smokers. In India, air pollution contributes to roughly 10% of lung cancer cases, with the greatest impact on city residents and workers in high-exposure occupations such as driving[1,3,7,17].

Beyond these, interstitial lung diseases scarring disorders like idiopathic pulmonary fibrosis thrive in dusty, polluted environments. Coal miners or construction workers inhale silica-laden air, igniting fibrosis that thickens lung walls and starves the body of oxygen. Acute respiratory distress syndrome, a sudden lung failure, can erupt from toxic spikes, as seen in wildfire seasons or industrial accidents. These rarer but devastating outcomes remind us that the reach of pollution extends from bronchi to bloodstream[3,7,9].

The burden is not evenly spread; it carves deep lines of inequality. Poorer neighborhoods hug highways or factories, inhaling concentrated doses that wealthier suburbs escape[3,7,12]. Climate change pours fuel on the fire: warmer temperatures brew more ozone, droughts stir dust, and erratic monsoons trap pollutants low. Yet, glimmers of progress shine wealthier countries like those in Europe have slashed emissions through electric vehicles and scrubbers, dropping respiratory admissions by 20%-30% over decades[1,3,4].

India's story is one of urgency laced with hope. Delhi's perennial smog, born of parali burning in Punjab and Haryana plus vehicular sprawl, chokes visibility and spikes accidents[18]. The 2025 IQAir data shows not just Delhi, but Mumbai and Kolkata also in the global top 10, underscoring a national crisis. To tackle air pollution, governments must enforce tighter emission limits, shift to renewable energy sources, and expand urban tree planting, as trees naturally capture CO_2 and particulate matter[18,19]. Real-time air quality apps, like those used in Delhi, help people avoid outdoor activities during high-pollution periods. At home, simple measures include using kitchen exhaust fans, placing air purifiers in bedrooms, and selecting low-emission paints. For vulnerable groups - children, the elderly, and those with asthma schools should seal windows on high-pollution days, and clinics must stock preventive medications[3,8,10,19].

Additionally, initiatives like the National Clean Air Programme aim to cut PM levels by 40% by 2026, while the LiFE (Lifestyle for the Environment) movement launched by Prime Minister Narendra Modi in 2022 nudges citizens toward eco-friendly habits: swapping bouquets for saplings at weddings, hopping buses over cars, and ditching smokes. Schemes such as the Ujjwala Yojana are helping families switch to cleaner cooking fuels, cutting down indoor smoke. Community drives, from NGO tree-planting to school anti-pollution pledges, build momentum[1-4,19].

In the end, clean air is not a luxury; it is the very foundation of breath itself and a fundamental right of all human beings. Every child deserves skies free from poison, every elder the strength to walk without fear. By choosing renewal over ruin today, we gift tomorrow a world where lungs fill with hope, not harm.

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