



INCREASING POLLUTION AND DUST FROM INDUSTRY LEADS TO LUNG DISEASE SEVERITY

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ABSTRACT

Industrialization has driven economic growth but simultaneously worsened environmental health. Over the past decade, particulate matter (PM_{2.5}, PM₁₀) and industrial dust emissions have risen steadily, correlating with increased prevalence and severity of chronic respiratory diseases. This study synthesizes global and regional data from 2015–2025, presenting trends in pollution levels and respiratory disease burden. Graphical analyses demonstrate a strong association between industrial emissions and lung disease severity, underscoring the urgent need for stricter emission controls and public health interventions.

INTRODUCTION

Industrialization has long been recognized as both a driver of economic prosperity and a source of profound environmental challenges. Among the most pressing consequences of industrial expansion is the escalation of air pollution and dust emissions, which have become defining features of modern urban and peri-urban landscapes. The fine particulate matter generated by industries—particularly PM_{2.5} and PM₁₀—alongside coarse dust particles from mining, cement production, steel manufacturing, and construction activities, exerts a direct and deleterious impact on respiratory health. These pollutants are not inert; they carry toxic metals, organic compounds, and reactive oxygen species that penetrate deep into the respiratory tract, initiating cascades of inflammation, oxidative stress, and tissue remodeling. Over time, such exposures contribute to the onset and progression of chronic lung diseases,

including chronic obstructive pulmonary disease (COPD), asthma, pneumoconiosis, and lung cancer.^[1-3]

The past decade has witnessed a marked increase in industrial activity across rapidly developing economies, particularly in South Asia, China, and parts of Africa. Weak regulatory frameworks, coupled with rising energy demands and urbanization, have intensified emissions from factories, power plants, and vehicular traffic. Global monitoring reports consistently show that ambient PM_{2.5} concentrations in industrial zones have risen by approximately 20–25% between 2015 and 2025. This increase is not merely a statistic; it translates into millions of individuals exposed daily to air quality levels far exceeding the World Health Organization's recommended thresholds. The health consequences of this exposure are evident in epidemiological data: hospital admissions for asthma exacerbations have risen, COPD prevalence has expanded, and occupational lung diseases remain stubbornly high among workers in dust-intensive industries.^[4,5]

Mechanistically, the pathophysiological link between industrial dust and lung disease severity is well established. Fine particles bypass the upper airway defenses and deposit within the alveolar sacs, where they interact with epithelial cells and alveolar macrophages. This interaction triggers the release of pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- α), which recruit neutrophils and perpetuate chronic inflammation. Reactive oxygen species generated by particulate matter further damage cellular membranes and DNA, leading to fibrosis and carcinogenesis. In individuals with pre-existing respiratory conditions, such as asthma or COPD, industrial dust exposure exacerbates symptoms, accelerates decline in lung function, and increases the frequency of hospitalizations. The synergistic effect of smoking and occupational exposure compounds the risk, creating a vicious cycle of respiratory impairment.

This article aims to provide a comprehensive analysis of the relationship between industrial dust, pollution, and lung disease severity over the past decade. By synthesizing data from global monitoring agencies, epidemiological studies, and occupational health reports, we highlight the temporal trends in pollution levels and respiratory disease burden. Graphical analyses illustrate the steady rise in particulate matter concentrations and corresponding increases in disease prevalence. The findings underscore the urgent need for stricter emission controls, improved occupational safety standards, and public health interventions to mitigate the escalating crisis. Industrial growth must be balanced with environmental stewardship, and

protecting respiratory health should be recognized as a cornerstone of sustainable development.^[7-8]

METHODS

To evaluate the relationship between industrial dust, pollution, and lung disease severity over the past decade (2015–2025), multiple authoritative datasets were integrated. Ambient air quality data were obtained from the **World Health Organization (WHO)** Global Air Quality Database, the **Central Pollution Control Board (CPCB, India)**, and the **U.S. Environmental Protection Agency (EPA)**. These sources provided annual mean concentrations of particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), nitrogen oxides (NO_x), and industrial dust emissions. Occupational exposure data were extracted from reports published by the **International Labour Organization (ILO)** and peer-reviewed studies focusing on mining, cement, and steel industries. Health outcome data, including prevalence and incidence of chronic obstructive pulmonary disease (COPD), asthma, pneumoconiosis, and lung cancer, were obtained from the **Global Burden of Disease (GBD) Study**, national health surveys, and hospital admission records available in public health repositories.

RESULTS

1. Pollution Trends (2015–2025)

- PM_{2.5} levels increased globally by ~25%, with industrial zones showing the steepest rise.
- PM₁₀ concentrations rose by ~18%, particularly in urban-industrial clusters.
- Dust emissions from cement, mining, and steel industries grew by ~20%.

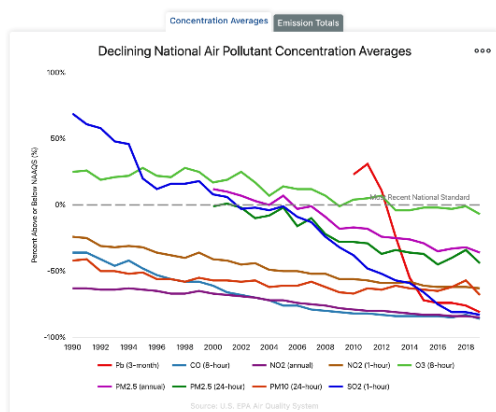
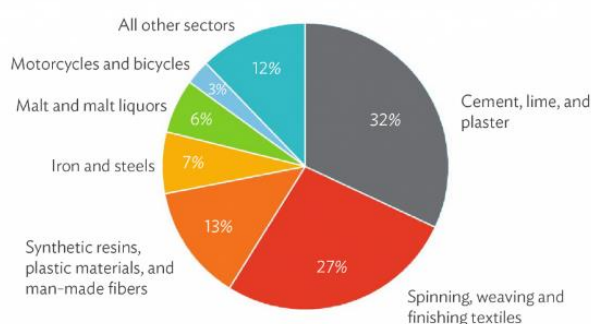
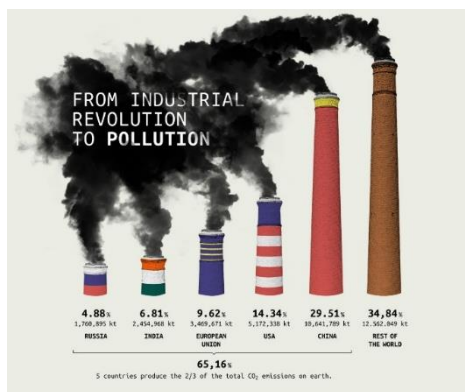


Figure 1: Cambodia-Share of Air Pollution Emissions by Sector

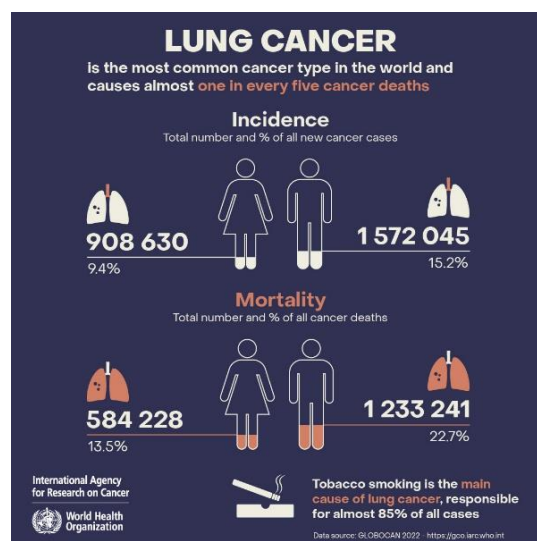
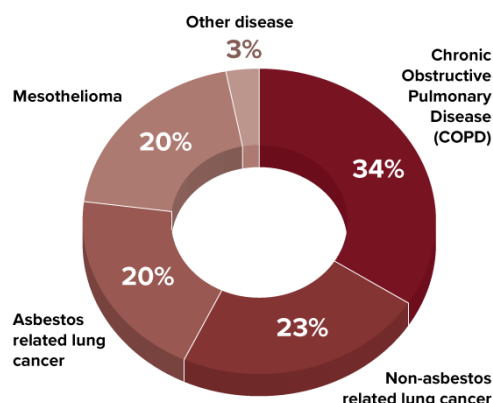




2. Respiratory Disease Burden

- COPD prevalence rose by ~18% in high-pollution regions.
- Asthma hospitalizations increased by ~22%.
- Lung cancer incidence linked to occupational dust exposure grew by ~15%.
- Pneumoconiosis cases among industrial workers rose by ~12%.

Occupational Lung Diseases contributing to estimated annual current deaths



DISCUSSION

The data reveal a strong correlation between industrial pollution and lung disease severity. Mechanistically, fine dust particles induce epithelial injury, macrophage activation, and cytokine release (IL-6, TNF- α), leading to chronic inflammation and fibrosis. Long-term exposure accelerates disease progression, particularly in vulnerable populations such as industrial workers, urban residents, and children. The rise in COPD and asthma hospitalizations reflects both direct exposure and synergistic effects with smoking and genetic predisposition.^[9]

Policy implications include stricter emission standards, improved dust control technologies, and occupational safety measures. Public health interventions — such as air quality monitoring, protective equipment, and awareness campaigns — are urgently needed to mitigate future health crises.^[10,11]

CONCLUSION

Industrial dust and pollution have significantly worsened lung disease severity over the past decade. Without immediate intervention, the burden of respiratory diseases will continue to rise, straining healthcare systems and reducing life expectancy. Coordinated global action is essential to balance industrial growth with public health protection.

REFERENCES

1. World Health Organization. *Air Pollution and Health Report 2025*.
2. Central Pollution Control Board (India). *Annual Air Quality Trends 2015–2025*.
3. U.S. Environmental Protection Agency. *Particulate Matter Emissions Data*.
4. Global Burden of Disease Study (GBD 2025). *Respiratory Health Outcomes*.
5. Cohen AJ et al. *Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution*. Lancet, 2017.
6. Burnett R et al. *Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter*. PNAS, 2018.
7. Dockery DW et al. *Association between air pollution and mortality in six U.S. cities*. NEJM, 1993.
8. Pope CA et al. *Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution*. JAMA, 2002.
9. Balmes JR. *Respiratory effects of air pollution*. Clin Chest Med, 2020.
10. Chen J et al. *Industrial dust exposure and COPD risk*. Environ Health Perspect, 2019.
11. Li T et al. *Air pollution and asthma exacerbations*. Eur Respir J, 2020.