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Air Pollution: An Emerging Threat for Lung Cancer

According to the latest estimates from the International Agency for Research on Cancer (IARC) and the World Health Organization (WHO), in 2022, there were approximately 20 million new cancer cases and 9.7 million deaths from cancer worldwide. Lung cancer is the leading cause of cancer-related death, accounting for about 1.8 million fatalities annually (around 18.7% of all cancer deaths globally), more than the combined deaths from colorectal, breast, and prostate cancers. For a long time, people mainly blamed smoking, work-related hazards, and family history for this disease.

Air pollution is no longer just a cause of breathing problems; it is turning into a serious trigger for lung cancer, especially in cities and among people who have never smoked. Emerging evidence from recent IARC studies links rising lung adenocarcinoma rates, particularly in nonsmokers and younger generations, to air pollution exposure, such as ambient PM2.5, with an estimated nearly 195,000 adenocarcinoma cases worldwide attributable to this pollution in 2022. Reports from organizations like the WHO and the State of Global Air show that polluted air is linked to more cancer cases, even in places where smoking rates are dropping. Air pollution is quietly becoming one of the biggest dangers to lung health worldwide, and it is now clearly linked to a growing number of lung cancer cases. For decades, most people thought of lung cancer as mainly a smoker's disease. Tobacco use still causes most cases, but recent evidence shows that dirty air is driving more diagnoses, especially among people who have never touched a cigarette. This shift is particularly noticeable in crowded cities and in regions with heavy industrial growth and traffic.

As smoking rates fall in many places thanks to better awareness and rules, air pollution stands out as an emerging threat that demands serious attention. In India, for example, recent government data from the Indian Council of Medical Research and National Centre for Disease Informatics and Research highlight how adenocarcinoma, the subtype most common in nonsmokers, now accounts for nearly 53% of lung cancer cases among women, with sharp rises in metro cities and southern states like Thiruvananthapuram seeing annual increases of up to 6.7%. Overall, 40%-50% of lung cancer patients in India are nonsmokers, climbing even higher among women in urban areas, often linked to prolonged exposure to pollutants rather than tobacco.

When polluted, the air we breathe contains many harmful substances. Fine particulate matter, known as PM2.5, gets the most concern because these tiny particles, smaller than 2.5 μm, can travel deep into the lungs and even enter the bloodstream. They come from car exhaust, coal-burning power plants, factories, construction dust, farm fires, and burning wood or solid fuels at home. These particles often carry extra toxins like polycyclic aromatic hydrocarbons, benzene, and heavy metals, which make them even more dangerous. Other pollutants, such as nitrogen dioxide from traffic, sulfur dioxide from industry, ground-level ozone, and carbon monoxide, add to the problem, but PM2.5 remains the focus in studies about cancer risk.

Lung cancer kills about 1.8 million people every year and ranks as the top cause of cancer deaths globally. While overall numbers are high, the pattern is changing. In many high-income countries where now fewer people smoke, lung cancer rates have not dropped as much as expected. In fact, cases among never-smokers are rising, and if counted separately, this group would rank high among cancer killers. Rapidly growing cities in Asia and parts of Africa see the sharpest increases, where high pollution levels meet limited screening and treatment options. This makes lung cancer not just a matter of personal choices but a broader environmental and public health issue.

Air pollution contributed to 7.9 million early deaths in 2023, with ambient PM2.5 alone linked to 4.9 million deaths, including a significant portion from noncommunicable diseases like heart problems, lung diseases, and lung cancer. In low- and middle-income countries like India, the burden is especially heavy, with projections warning of further rise by 2030 as populations age and urban pollution persists.

Strong evidence now ties long-term exposure to polluted air with higher lung cancer risk. Back in 2013, the IARC declared outdoor air pollution and particulate matter as Group 1 carcinogens, meaning there is clear proof they cause cancer in humans. About 86% of those deaths tied to pollution were from such conditions, and lung cancer is prominently included. Meta-analyses of large studies show that for every 10 μg/m³ rise in PM2.5 levels, lung cancer risk goes up by roughly 8%-15%, and these links hold even after accounting for smoking, age, and other factors. The risk appears even at levels once thought safe, and it grows with longer exposure. Newer genomic research from 2025 shows that PM2.5 triggers specific mutations in tumors of never-smokers, such as in the *EGFR* or *TP53* genes, helping explain why adenocarcinoma is surging among women and in polluted Asian cities.

One of the strongest signs of the role of air pollution comes from never-smokers. In some Asian cities, 25%-40% of lung cancer patients report no tobacco history. Women often face higher impacts, partly from more time spent indoors with cooking fuels in some regions and greater exposure to urban air in others. Household air pollution from burning biomass or coal affects billions, especially in low- and middle-income countries, raising lung cancer odds significantly for those exposed over the years.

Combating the role of air pollution in lung cancer demands action at every level. Governments must tighten emission standards, accelerate the shift to clean energy, push electric vehicles and efficient public transport, and enable safer cooking fuels for households. Health systems should integrate air-quality risks into cancer screening and prevention, especially in heavily polluted areas. Individuals can protect themselves by avoiding outdoor exposure on high-pollution days, using purifiers, and backing strong clean-air policies. Air pollution is now proven to cause lung cancer even in lifelong nonsmokers.

Global studies, genomic data, and biology confirm: tiny particles like PM2.5 spark the same DNA damage that smoking does, quietly driving more cases everywhere. Without fast, united action, tough emission laws, clean energy switch, electric vehicles, safer cooking fuels, plus everyday choices like cutting car use and planting trees, this hidden threat will keep rising, hitting the most exposed communities hardest and holding back healthier lives. But there is real hope too. We have turned the tide on smoking through awareness and policy, and the same determination can work for pollution. Improving air quality is not just good for the environment; it is one of the most powerful ways we can fight back against one of the deadliest cancers. The choices we make today, personally and collectively, will decide whether this emerging threat fades into the past or becomes a lasting shadow over generations to come.

Let us choose cleaner air, sooner rather than later.

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