

EDITORIAL

Air Pollution: A Challenge to Public Health and Healthcare Systems

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Air pollution in Pakistan, and the region at large, has become one of the greatest environmental risks to health. Three major cities of Pakistan, Lahore, Karachi, and Peshawar, have been declared the worst in the world for their Air Quality Index and PM_{2.5} air pollution. The population residing in these cities is facing adverse health effects. Children, with developing lungs and geriatric patients with chronic diseases are the worst affected. The impact of short-term and long-term exposure to air pollution includes premature mortality, exacerbated chronic heart and lung disease, lung cancer, decreased lung function in children as well as school absenteeism and restricted activity days.¹ Hospitals and healthcare facilities are facing the increasing burden of a growing number of hospitalizations and emergency department visits. Alarming, a recent global analysis from 116 countries has described an association between PM_{2.5} and clinical antibiotic resistance.² The profound impact of air pollution has been seen recently in Lahore, where school and business closures have hindered the normal functioning of society's education system and economic activities.

Air pollution ranks among Africa and Asia's top ten risk factors for disability-adjusted life-years (DALYs). The combined effect of exposure to fine particles in ambient (outdoor) and household air pollution is associated with 7 million premature deaths annually.¹ Globally, air pollution is the leading cause of death, killing 600,000 children under the age of 15 every year. Ambient air pollution is estimated to have caused 4.2 million premature deaths worldwide; 89% of those deaths occurred in low- and middle-income countries, notably in Asia and Western Pacific Regions.² In Pakistan, it has been estimated that the average lifespan is reduced by 3.9 years due to air pollution, whereas in Lahore, life expectancy is reduced by seven years.

The main sources of air pollution are industrial emissions, traffic-related pollutants, coal power plants, smoke from brick kilns, crop burning, dust from construction sites, household biomass combustion, and indoor pollutants from chemicals and tobacco. The toxic contaminants in the air include particulate matter (PM), ozone (O₃), nitrogen dioxide (NO₂), carbon monoxide (CO), and carbon dioxide (CO₂). PM includes inhalable particles measuring 10 microns or less in size. PM₁₀ & PM_{2.5} are proxy indicators for air pollution with the level of risk and adverse health effects varying with the size of the particles. Fine particulate matter of 2.5 microns or less, including diesel-derived PM, is among the most dangerous airborne pollutants because of its small size and ability to stay airborne longer. Burning fossil fuels, such as gasoline and coal, significantly contributes to air pollution, releasing pollutants like nitrogen oxides and volatile organic compounds into the atmosphere. The interaction of sunlight with nitrogen oxides and volatile organic compounds in the atmosphere creates ground-level ozone, a greenhouse gas and a principal constituent of smog.

Exposure to PM, lead, and the gaseous pollutants CO and SO₂ have reported pro-arrhythmic effects resulting in heart failure, ischemia, and atrial and ventricular arrhythmias.³ It is now widely recognized that PM_{2.5} is associated with enhanced atherosclerosis development, premature aging of blood vessels, build-up of calcium in the coronary artery, and blood coagulability.³ At ground level, ozone causes breathing difficulties, coughing, throat irritation, asthma, and COPD. Ultra-fine PM can penetrate the bronchial epithelial barrier and enter the bloodstream, causing systemic inflammatory changes and oxidative stress, leading to metabolic disorders, dysbiosis, neurodegeneration, and dementia. Research has found links between air pollution exposure and genetic and epigenetic changes that can be inherited across generations. Poor air quality is linked to immune dysregulation, allergic rhinitis, allergic conjunctivitis, and other stronger allergic reactions.

Socially and economically marginalized vulnerable populations, outdoor workers, and professionals like construction workers, athletes, and traffic wardens are more likely to be adversely affected by toxic air. Increased air pollution during outdoor activities has brought into question the public health perspective

advocating outdoor exercise as a preventative measure for various health issues, from heart problems to mental well-being.

The focus of COP28 held in December 2023 revolved around critical objectives such as reducing greenhouse gas emissions. "Beginning of the end" of the fossil fuel era, the United Nations Climate Change Conference (COP 28) signalled the need to move away from fossil fuels for the first time. However, a significant challenge arises for a country like Pakistan, where the swift implementation of green technology is hindered by the substantial costs associated with its adoption. The urgency of addressing climate change is apparent; however, the economic constraints faced by Pakistan make the immediate achievement of fossil fuel reduction targets a complex and formidable task.

Healthcare providers, public health workers, and academia should promote planetary health and advocate for embracing individual responsibility in mitigating the impact of greenhouse gas emissions. A pressing need exists for prioritizing public policies to safeguard individuals from air pollutant exposure, enforce stringent regulations and penalties for polluters, promote sustainable practices, and invest in low-cost carbon sinks like the urban green and blue spaces. Concerted efforts to address this crisis are paramount for our children's future survival.

Editor-in-Chief

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