

Qualitative review of SMOG crisis and public health in Pakistan

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Abstract

Objective: To evaluate the health impact of the 2024 Lahore SMOG crisis on children, with particular focus on respiratory illnesses and long-term health risks, using qualitative insights to capture lived experiences.

Design: An observational qualitative study utilizing semi-structured interviews with caregivers, healthcare professionals, and community members directly affected by the SMOG crisis.

Setting: The study was conducted in Lahore, Pakistan, one of the most polluted cities in the world in 2024, during and after the severe SMOG period between October 17 and November 16.

Participants: A purposive sample of caregivers of children under 15 years, along with physicians and public health officials, participated in the interviews. These individuals were selected to provide a range of perspectives on health outcomes and system-level responses.

Exposures: Participants were exposed to hazardous air pollution, with the Air Quality Index (AQI) ranging from 180 (unhealthy) to 1,110 (hazardous). The SMOG prompted the closure of schools, suspension of outdoor activities, restrictions on construction, and the shutdown of public spaces.

Main outcomes and measures: Key outcomes included reported incidence and exacerbation of respiratory illnesses such as asthma, bronchitis, pneumonia, and Chronic Obstructive Pulmonary Disease (COPD). Interviews also explored psychosocial impacts, disruptions to education, and perceived long-term risks to children's health.

Results: Findings revealed increased respiratory symptoms and hospital visits among children during the SMOG crisis. Caregivers noted more frequent wheezing, coughing, and breathing difficulties, while physicians reported spikes in pediatric admissions for asthma and bronchitis. Families also expressed concerns about school closures, reduced activity, and potential long-term lung damage. Children's biological vulnerability and limited access to protective measures further amplified health risks.

Conclusions: 2024 Lahore SMOG crisis disproportionately affected children, intensifying both acute and chronic respiratory illnesses while disrupting daily life. These findings highlight the urgent need for policy interventions, enhanced air quality monitoring, and targeted public health strategies to protect vulnerable populations. Addressing the health effects of extreme air pollution is critical not only for immediate relief but also for preventing long-term disease burden in children.

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Received: Dec 08, 2025

Accepted: Feb 06, 2026

Published: Feb 13, 2026

Epidemiology & Public Health - www.jpublichealth.org

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Citation: Khuld H. Qualitative review of SMOG crisis and public health in Pakistan. *Epidemiol Public Health*. 2026; 4(1): 1087.

Keywords: Air pollution; Climate change; smog; Air Quality Index (AQI); Public health emergency; Health impact; Epidemiology; Children's health.

Introduction

Air pollution is a mounting public health crisis in Pakistan, particularly in urban areas like Lahore, which consistently ranks among the world's most polluted cities. In 2024, Pakistan was ranked the third most polluted country globally, following Bangladesh and Chad, according to IQAir's World Air Quality Report [1]. Lahore, the capital of Punjab province and home to over 13 million people, experienced an alarming Air Quality Index (AQI) that reached hazardous levels, peaking at an unprecedented 1110 in November 2024 [2]. These figures are not just statistics - they reflect a tangible and devastating impact on human health, particularly among the most vulnerable populations: children [3]. This paper explores the air pollution in Pakistan caused by the environmental catastrophe and the immediate and long-term health impacts it has had - especially on children - and the serious future public health challenges it portends.

Pakistan's air pollution stems from multiple sources: vehicle emissions from poor-quality fuel, industrial activities, brick kilns, crop residue burning, and the effects of rapid urbanization [4]. Seasonal weather patterns worsen the problem, particularly during fall and winter, when cooler temperatures and lack of rainfall trap pollutants near the ground. In 2024, Lahore's air quality was among the worst recorded globally. During a critical period from October 17 to November 16, the AQI ranged between 180 (unhealthy) and 1110 (hazardous) [2,5]. By mid-November, Lahore's AQI peaked at 2061 near the Center for Economic Research in Pakistan, indicating life-threatening conditions. SMOG created by trapped particulate matter (PM_{2.5}) led authorities to declare a health emergency, close schools, shut public spaces, and ban outdoor activities and construction work.

The situation in Lahore is not isolated. It mirrors a broader crisis affecting other Pakistani cities like Karachi, Faisalabad, Multan, Peshawar, and Sialkot, all among the most polluted cities in South Asia. Furthermore, air pollution is a transboundary issue, with pollutants crossing national borders and affecting neighboring countries like India and Bangladesh. This underscores the need for regional collaboration, as air quality management cannot be effectively addressed through domestic policy alone—it demands both local interventions and global cooperation.

Beyond environmental degradation, air pollution in Pakistan represents a public health and developmental emergency. Exposure to toxic air contributes to an estimated 128,000 premature deaths annually, according to the World Bank, disproportionately affecting children under five and adults over sixty [8]. For children, the consequences are particularly devastating. Continuous exposure to fine particulate matter during critical stages of growth impairs lung development, reduces cognitive function, and increases vulnerability to chronic diseases later in life [9]. These early-life exposures not only threaten individual well-being but also hinder Pakistan's broader human capital and economic growth, perpetuating cycles of poverty and poor health outcomes.

This paper explores the causes, scope, and health impacts of air pollution in Pakistan, focusing particularly on how environmental degradation has affected children's immediate and long-term health outcomes. It further examines the policy gaps and public health challenges that Pakistan faces in mitigating this crisis, highlighting the urgent need for sustainable interventions, regional cooperation, and community-based adaptation

strategies to safeguard the nation's future generations.

Health impacts of air pollution

The health impacts of Pakistan's air pollution are severe and widespread. Short-term exposure to high levels of Particulate Matter (PM_{2.5}) results in immediate respiratory problems, including aggravated asthma, bronchitis, pneumonia, and Chronic Obstructive Pulmonary Disease (COPD) [6]. Long-term exposure is even more concerning, leading to heart disease, lung cancer, stroke, diabetes, and reduced life expectancy [7]. It is estimated that air pollution cuts the average life expectancy in Lahore by up to seven years.

In October 2024, across the city of Lahore, there was a sharp spike in hospital admissions due to respiratory illnesses, particularly among children and the elderly. According to Dr. Waheed Imran, the Medical Superintendent of Jinnah Hospital Lahore, noted that "children are more likely to be affected by SMOG, experiencing higher rates of related illnesses and hospitalizations compared to adults" [8,9]. Emergency rooms have been overwhelmed with cases of breathing difficulties, persistent coughing, throat infections, and eye irritations. Hospitals have reported a surge in respiratory illnesses, particularly among children and the elderly [8].

Particularly striking is the toll on the pediatric population. Over 11 million children under the age of five were estimated to be living in the worst-affected areas during the 2024 SMOG crisis [3]. According to the U.N. children's agency, in 2019 approximately 154,000 children aged below five died globally due to outdoor air pollution. In Pakistan, it is one of the top five causes of death among the entire population and young children are the most vulnerable along with the elderly [9]. Children are at greater risk because their lungs are still developing, they breathe more rapidly than adults, and they lack fully developed immune defenses [10]. Future more, children breathe twice as fast compared to adults and take in more air, often through the mouth, leading to more pollutant intake, leading to life-threatening respiratory diseases [10]. As a result, pollutants are more likely to penetrate deeply into their lungs, causing permanent lung damage and setting the stage for chronic illnesses later in life.

To get a better understanding of everyday struggles residents faced, an interview with the Malik family provided some color on impact on families with young children. The Malik's have two small children, ages 9 and 6. Like many families, the children are not going to school because of the poor air quality and low visibility. They shared that ever seeing the poor air quality, they have noticed their children having breathing problems, especially their youngest who would go into violent coughing fits, unable to breath and feeling drowsy. The violent coughing attacks terrified the family and they had to take their youngest to the hospital. At the hospital, the child was admitted and diagnosed with asthma and received an inhaler—finally getting some relief.

This sight is not isolated, as many parents face many sleepless nights, and endless worries as they take their children to the hospital waiting for hours in the crowded corridors waiting their turns while holding their weak children in their arms. As doctors rushed through the crowds tending to the children and providing much needed support to families. For many parents, it's their biggest fear where they are helpless, unable to provide relief to their children.

Another interviewee, Sarah who's in her late teens, shared that she was home all day, feeling the air was thick and experiencing shortness of breath. Around the late afternoon, she fainted and her family rushed her to the hospital. There she received IV drips and an inhaler. Sarah shared that she didn't have the strength to get out of bed for a few days—feeling as her lungs were on fire and her body felt heavy. She kept going under dizzy spells. A scenario tragically echoed by countless other families.

Future health impacts on children

The current crisis paints a grim picture for Pakistan's future health landscape. Continuous exposure to hazardous air pollution during critical stages of development can have lifelong consequences for children [10]. Studies suggest that early exposure to high levels of PM_{2.5} can stunt lung growth, leading to lower lung capacity and increased susceptibility to respiratory diseases throughout adulthood [11]. Children's smaller airways and faster breathing rates make them particularly vulnerable, as they inhale more pollutants per body weight compared to adults.

Moreover, air pollution's impact is not limited to the respiratory system. Emerging research links prolonged exposure to polluted air with neurodevelopmental issues, cognitive decline, and increased risk of mental health disorders [12]. Children growing up in high-pollution environments are at higher risk for conditions like Attention Deficit Hyperactivity Disorder (ADHD), depression, and even impaired academic performance [13]. Chronic exposure to pollutants such as Nitrogen Dioxide (NO₂) and Ozone (O₃) can interfere with brain development, affecting emotional regulation and learning capacity during formative years [14].

Prenatal exposure to air pollution compounds these risks even further. Expectant mothers exposed to high pollution levels are more likely to experience preterm births, low birth-weight infants, and developmental delays in early childhood [15]. These early-life disadvantages can have cascading effects on a child's long-term health, educational attainment, and overall socioeconomic potential [16].

From a public health perspective, the burden of disease linked to today's pollution crisis places enormous strain on Pakistan's already overburdened healthcare system. The increase in childhood hospital admissions due to respiratory and neurological conditions not only strains medical infrastructure but also imposes emotional and financial hardship on families [17]. The long-term cost in terms of healthcare expenses, lost productivity, and reduced quality of life will be staggering unless immediate, robust action is taken.

Therefore, air pollution is not only an environmental or health concern but a developmental crisis—one that threatens to undermine Pakistan's progress in human capital formation and sustainable growth. Protecting children from the harmful effects of polluted air is an urgent public health priority that demands coordinated policy interventions, strengthened environmental regulation, and community-level education to mitigate exposure risks [18].

Conclusion

Pakistan's air pollution crisis, particularly the unprecedented levels seen in Lahore in 2024, is a public health emergency with far-reaching consequences. The immediate effects on respiratory health are severe, especially among children whose

developing bodies are most vulnerable to environmental toxins. The future health of an entire generation is at risk, with implications that extend beyond individual well-being to national economic stability and societal progress.

While emergency measures like school closures, construction bans, and mandatory mask-wearing provide temporary relief, they are insufficient. Addressing the crisis requires systemic reforms: reducing industrial emissions, investing in clean energy, promoting sustainable agriculture, enforcing stricter vehicle emissions standards, and enhancing urban planning to include green spaces.

Additionally, international collaboration is vital. Air pollution knows no borders, and the crises in Lahore, Delhi, Dhaka, and Kabul are interconnected. Global partnerships, knowledge sharing, and multinational policies must be leveraged to tackle what is fundamentally a shared challenge.

The health of Pakistan's children - and indeed, its future - depends on swift, coordinated, and sustained action.

Key points

Question: What were the health impacts of the 2024 Lahore SMOG crisis on children?

Findings: The crisis led to sharp increases in pediatric respiratory illnesses, hospital admissions, and psychosocial stress. Caregivers reported severe coughing, breathing difficulties, and disrupted schooling, while physicians noted spikes in asthma and bronchitis cases. Children's biological vulnerability amplified risks.

Meaning: The 2024 SMOG crisis underscores the urgent need for targeted policies, improved air quality monitoring, and child-focused interventions to mitigate both immediate and long-term health consequences.

Declarations

Acknowledgement: I would like to thank the interviewees who shared their experiences and my mother for her endless support.

Conflicts of interest: The author declares no conflicts of interest.

Funding: No funding or support was provided for this paper.

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