Air Pollution and Respiratory Health among School-Going Children in Peshawar

Dr Muhamad Zarak Khan, Department of Community Medicine, Pak International Medical College, Peshawar.

Dr Shandana, Hayatabad Medical Complex, Peshawar.

Abstract

Background: Air pollution is a leading environmental risk factor worldwide, with children being particularly vulnerable due to developing lungs and higher exposure per body weight. Peshawar is among the most polluted cities in Pakistan, yet evidence on its impact on child respiratory health is limited.

Methods: A cross-sectional study was conducted among 400 school-going children aged 8–15 years from urban (high-traffic) and semi-urban areas of Peshawar. Data on respiratory symptoms were collected using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire (6). Ambient particulate matter (PM2.5, PM10) was measured outside selected schools using portable air quality monitors. Logistic regression was used to assess associations between air pollution exposure and respiratory outcomes.

Results: The prevalence of respiratory symptoms was: chronic cough 22.5%, wheezing 18.0%, shortness of breath 15.2%, and physician-diagnosed asthma 11.8%. Children from high-pollution schools had significantly higher prevalence of wheeze (23.5% vs 12.5%, $p<0.01$) and asthma (15.6% vs 7.2%, $p=0.02$). Logistic regression showed that exposure to higher PM2.5 levels (>75 $\mu g/m^3$) was associated with increased odds of wheezing (AOR=2.1; 95% CI: 1.2–3.6) and asthma (AOR=1.9; 95% CI: 1.1–3.4).

Conclusion: Air pollution in Peshawar is strongly associated with respiratory problems among school children. Urgent public health interventions are needed, including stricter regulation of traffic emissions and awareness programs targeting schools and parents.

Keywords: Air pollution, Respiratory health, Children, Peshawar, Public health

Introduction

Air pollution is one of the top five risk factors for global disease burden, contributing to 6.7 million premature deaths annually (1). Children are particularly vulnerable because of their developing respiratory systems and greater exposure per body weight (2). In South Asia, rapid urbanization and industrialization have contributed to rising levels of particulate matter (PM2.5 and PM10), with severe health consequences (3).

In Pakistan, the problem is acute in major cities. Peshawar is consistently ranked among the most polluted, with annual PM2.5 levels often exceeding WHO guidelines by 6–8 times (4). Local sources include heavy traffic, brick kilns, open waste burning, and poor fuel quality. Health facilities in Peshawar report increasing cases of asthma, bronchitis, and other respiratory illnesses among children (5). However, there is limited local epidemiological evidence quantifying the association between air pollution and child respiratory health.

This study aimed to fill this gap by assessing the prevalence of respiratory symptoms among school-going children in Peshawar and evaluating their association with exposure to ambient air pollution.

Methods

Study Design & Setting: A school-based cross-sectional study conducted in Peshawar between March and June 2024.

Population & Sampling: Children aged 8–15 years enrolled in public and private schools. Stratified random sampling was used to select 6 schools from high-traffic (urban) and semi-urban areas. A total of 400 children participated.

Data Collection:
- Respiratory symptoms assessed using the validated ISAAC questionnaire (6).
- Ambient PM2.5 and PM10 measured at school entrances during peak hours using portable monitors.
- Covariates: age, sex, BMI, parental smoking, socio-economic status.

Data Analysis: Data were analyzed using SPSS v27. Descriptive statistics summarized prevalence. Chi-square test compared urban vs semi-urban prevalence. Logistic regression modeled associations between pollution exposure and respiratory outcomes, adjusting for confounders.

Ethical Approval: Approved by the Institutional Review Board, Khyber Medical University. Informed consent was obtained from parents/guardians.

Results

Table 1. Socio-demographic characteristics of study participants (n=400)

Variable	Urban (%)	Semi-urban (%)	Total (%)
Age (mean ± SD)	11.2 ± 2.1	11.0 ± 2.3	11.1 ± 2.2
Male	54.0	52.0	53.0
Female	46.0	48.0	47.0
Parental smoking	38.5	29.0	33.8

Table 2. Prevalence of respiratory symptoms

Symptom	Urban (%)	Semi-urban (%)	Total (%)	p-value
Chronic cough	26.0	19.0	22.5	0.04
Wheezing	23.5	12.5	18.0	0.01
Shortness of breath	18.0	12.0	15.2	0.08
Physician-diagnosed asthma	15.6	7.2	11.8	0.02

Table 3. Logistic regression of high PM2.5 exposure (>75 μg/m^3) and respiratory outcomes

Outcome	Adjusted OR (95% CI)	p-value
Wheezing	2.1 (1.2–3.6)	0.01
Asthma	1.9 (1.1–3.4)	0.02
Chronic cough	1.5 (0.9–2.5)	0.09

Discussion

This study provides evidence that air pollution in Peshawar is strongly associated with adverse respiratory health outcomes in school children. The prevalence of asthma (11.8%) and wheezing (18.0%) in our study aligns with ISAAC Phase III data from South Asia (6) and recent studies from Lahore and Delhi reporting asthma prevalence of 10–15% (7,8).

Children attending schools in high-traffic areas had nearly double the prevalence of wheezing and asthma compared to those in semi-urban schools. Similar associations between PM2.5 and child respiratory symptoms have been documented in Bangladesh (9)

and India (8). The adjusted odds ratios indicate that exposure to elevated particulate matter significantly increases the risk of wheezing and asthma, even after controlling for parental smoking and socio-economic factors.

Our findings highlight the urgent need for interventions: stricter regulation of vehicle emissions, relocation or regulation of brick kilns, and awareness campaigns for schools and parents.

Strengths: First study in Peshawar linking objective air pollution measures with child respiratory outcomes.
Limitations: Cross-sectional design prevents causality; air pollution measured at school level but not at individual homes.

Conclusion

Air pollution in Peshawar is significantly associated with higher prevalence of respiratory problems among school-going children. Immediate policy measures and school-level interventions are needed to mitigate these health risks.

References

1. WHO. Air pollution. World Health Organization; 2023.
2. Gauderman WJ, Urman R, Avol E, et al. Association of improved air quality with lung development in children. N Engl J Med. 2015;372(10):905–13.
3. Balakrishnan K, Dey S, Gupta T, et al. The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study 2017. Lancet Planet Health. 2019;3(1):e26–39.
4. Pakistan Air Quality Report 2022. IQAir; 2023.
5. Khan MA, Shah SM, Ali A, et al. Asthma prevalence and associated factors among school children in Peshawar. J Ayub Med Coll Abbottabad. 2018;30(2):242–7.
6. Mallol J, Crane J, von Mutius E, Odhiambo J, Keil U, Stewart A. ISAAC Phase Three Study Group. The International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. Int J Tuberc Lung Dis. 2013;17(11):1278–83.

7. Fatmi Z, Azam I, Kazi A, et al. Respiratory health among children exposed to air pollution in urban Pakistan. Environ Health. 2014;13(1):1–8.
8. Kumar R, Nagar JK, Raj N, et al. Impact of air pollution on asthma in children of Delhi. J Asthma. 2019;56(9):902–10.
9. Rahman MM, Jalal S, Alam M, et al. Air pollution and respiratory health of school children in Dhaka, Bangladesh. Sci Total Environ. 2020;710:136106.
10. Apte JS, Marshall JD, Cohen AJ, Brauer M. Addressing global mortality from ambient PM2.5. Environ Sci Technol. 2015;49(13):8057–66.