

Original Research Article

PREVALENCE AND DETERMINANTS OF ALLERGIC ASTHMA AMONG 6-10-YEAR-OLD CHILDREN IN SELECTED INDUSTRIAL AREAS OF GAZIPUR

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Received : 16/08/2026
Received in revised form : 16/09/2026
Accepted : 29/09/2026

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DOI: 10.70034/ijmedph.2026.4.131

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (4); 872-876

ABSTRACT

Background: Allergic asthma affects 10–15% of children globally, with higher rates in industrial regions. However, epidemiological data from industrial areas in low- and middle-income countries like Bangladesh remain limited. The objective is to estimate the prevalence of allergic asthma and identify its key determinants among children aged 6–10 years in the industrial zone of Gazipur, Bangladesh.

Materials and Methods: A cross-sectional study was conducted from October 2024 to February 2025 among 371 children selected through stratified random sampling from four primary schools and two nearby communities (response rate: 92.8%). Data were collected using parent-reported ISAAC-based questionnaires and physician-confirmed asthma or atopic condition histories. Multivariate logistic regression was performed to determine independent predictors ($p < 0.05$).

Results: The prevalence of allergic asthma was 11.9% (95% CI: 8.7–15.8%). Significant predictors included family history of asthma (AOR = 3.12; 95% CI: 1.78–5.47; $p < 0.001$), physician-diagnosed atopic conditions (AOR = 4.23; 95% CI: 2.15–8.32; $p < 0.001$), and pet ownership (AOR = 2.45; 95% CI: 1.23–4.87; $p = 0.025$). Higher monthly family income ($\geq 40,000$ BDT) was protective (AOR = 0.35; 95% CI: 0.13–0.94; $p = 0.043$). Environmental exposures such as second-hand smoke and indoor air pollutants were associated in bivariate analysis but were not significant after adjustment.

Conclusion: Approximately one in nine children in this industrial population have allergic asthma. Genetic predisposition and coexisting atopic conditions are major contributors, whereas higher socioeconomic status appears protective. These findings underscore the need for targeted screening and socioeconomic interventions in industrial communities.

Keywords: Allergy, Asthma, Children, Gazipur

INTRODUCTION

Asthma affects more than 330 million people worldwide and remains one of the most common chronic respiratory diseases.^[1] When not properly managed, it leads to frequent medical visits, hospitalizations, and long-term treatment costs, creating a major socioeconomic burden for families and healthcare systems. The disease is characterized by persistent airway inflammation that causes hyper-responsiveness and recurrent episodes of coughing, chest tightness, and wheezing.^[2,3] This inflammatory

process involves smooth muscle contraction, epithelial damage, mucus overproduction, and swelling of the airway lining.^[4]

Asthma is now understood as a broad spectrum of conditions with overlapping symptoms and biological patterns, among which allergic asthma is the most common type.^[5] Allergic mechanisms are present in 50% of adult asthma cases and in up to 80% of affected children.^[6] It is typically defined as asthma linked to sensitivity to airborne allergens, confirmed through both allergy testing and symptom correlation.^[7] Most cases begin in childhood and may

vary in severity over time. Around one-third of affected children continue to experience symptoms into adulthood, especially those who also have allergic rhinitis or atopic dermatitis.^[8]

Children living in industrialized neighborhoods face a higher risk of developing asthma due to multiple environmental stressors.^[8] These include high levels of particulate matter and toxic gases, chemical emissions from factories, and common indoor allergens such as mold, dust, and pet dander. Exposure to second-hand smoke is also more frequent in such settings. For genetically predisposed children, these irritants can trigger airway inflammation, worsen existing symptoms, and lead to more severe disease.^[9]

Rapid industrial expansion in South Asian countries like Bangladesh has led to the development of densely populated residential areas adjacent to factories.^[10] Gazipur is one of the country's largest industrial zones, housing hundreds of textiles, dyeing, and manufacturing units that continuously release pollutants into the air.^[11] Children living in these areas are exposed to harmful agents both inside and outside the home. Despite this, data on allergic asthma among children in these high-risk environments remain scarce.

Most existing studies on childhood asthma focus on general urban or rural populations, while few have specifically examined children growing up in industrial belts where environmental and socioeconomic disadvantages often coexist. There is also limited understanding of how factors like pet ownership, atopic comorbidities, income level, and daily exposure to pollution interact to shape asthma risk in such settings. Filling this gap is essential for designing targeted prevention strategies.^[12]

This study aimed to determine the prevalence and identify the key determinants of allergic asthma among children aged 6–10 years in an industrial area of Gazipur, Bangladesh.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in four primary schools and two local communities within the Gazipur industrial area from October 2024 to February 2025, targeting children aged 6–10 years. In total, 371 children participated, including 360 from schools (18 per class from Class I–V) and 21 from communities, selected through stratified random sampling. Inclusion criteria were children in Class I–

V (ages 6–10) whose parents provided consent, while those without parental consent were excluded. Data were collected using printed questionnaires based on the ISAAC core questions for asthma, supplemented with physician-diagnosed asthma history, atopic conditions, lifestyle, and environmental exposures. Parents completed the questionnaires, which were returned after one week; physician-diagnosed asthma was confirmed through medical history, while current wheezing was identified from self-reported symptoms in the past 12 months. Cumulative asthma cases were defined by combining current wheezing and physician-diagnosed asthma. Standard descriptive statistics were used to summarize the data, with chi-square tests and binomial logistic regression to assess associations, t-tests for group comparisons, and odds ratios (OR) with 95% confidence intervals (CI) reported. A p-value <0.05 was considered statistically significant. All analyses were performed using SPSS version 25. Quality assurance included training data collectors, piloting the questionnaire on 30 students, and providing a Bangla version for parental convenience. Ethical approval was obtained from the Institutional Ethical Committee of North South University, and written and verbal consent was secured from school authorities and parents.

Inclusion Criteria

- Students from Class I to Class V (ages 6 to 10 years)
- Enrolled in the selected 4 primary schools
- Whose parents gave consent to participate in the study

Exclusion Criteria

- Students whose parents refused to give consent for participation

RESULTS

A total of 371 children aged 6–10 years participated in the study. The age distribution was fairly even, with 76 (20.5%) aged 6–7 years, 85 (22.9%) aged 8 years, 97 (26.1%) aged 9 years, and 113 (30.5%) aged 10 years. Girls comprised 222 (59.8%) of the sample, while boys were 149 (40.2%). Regarding family income, 113 (30.5%) of children belonged to families earning less than 15,000 BDT per month, 83 (22.4%) earned 15,000–19,999 BDT, 80 (21.6%) earned 30,000–39,999 BDT, and 95 (25.6%) earned ≥40,000 BDT.

Table 1: Demographic and Socioeconomic Factors (n = 371)

Variable	n	%
Age Group		
6–7	76	20.5
8	85	22.9
9	97	26.1
10	113	30.5
Gender		
Girl	222	59.8
Boy	149	40.2
Monthly family income		

<15,000 BDT	113	30.5
15,000–19,999 BDT	83	22.4
30,000–39,999 BDT	80	21.6
≥40,000 BDT	95	25.6

Table 2: Medical and Genetic Factors (n = 371)

Characteristics	n	%
Current asthma	44	11.9
Family history of asthma	109	29.4
Physician-diagnosed atopic conditions (food allergy or allergic rhinitis)	129	34.8

Among participants, 44 children (11.9%) had current asthma. A positive family history of asthma was reported in 109 children (29.4%), and 129 children

(34.8%) had physician-diagnosed atopic conditions, including food allergy or allergic rhinitis.

Table 3: Environmental and Lifestyle Factors (n = 371)

Characteristics	n	%
Exposure to second-hand smoke	80	21.6
Carpets/rugs at home	104	28.0
Pets at Home	63	17.0
Proximity to factory/industrial area	84	22.6
Contact with polluted water/factory emissions	21	5.7

Environmental exposures were common among the participants. Exposure to second-hand smoke was reported in 80 children (21.6%), while 104 (28.0%) had carpets or rugs at home. Pets were present in 63

households (17.0%). A total of 84 children (22.6%) lived in proximity to factories or industrial areas, and 21 children (5.7%) had contact with polluted water or factory emissions.

Table 4: Bivariate associations between determinants and allergic asthma

Determinants	Asthma Present n (%)	Asthma Absent n (%)	Prevalence of asthma % (95% CI)	p-value
Family history of asthma	35 (79.5)	74 (22.6)	79.5% (66.9–88.5)	<0.001
Physician-diagnosed atopic condition	28 (63.6)	101 (30.9)	63.6% (49.0–76.3)	<0.001
Screen time (>10 hrs/day)	5 (11.4)	13 (4.0)	11.4% (4.0–24.5)	0.048
Second-hand smoke exposure	20 (45.5)	60 (18.3)	45.5% (30.9–60.9)	<0.001
Carpets/rugs at home	19 (43.2)	85 (26.0)	43.2% (28.3–59.1)	0.017
Pets at home	2 (4.5)	61 (18.7)	4.5% (0.8–15.3)	0.019
Contact with polluted water/factory emissions	6 (13.6)	15 (4.6)	13.6% (5.6–27.8)	0.027

Among 371 children, the prevalence of asthma was highest among participants with a family history of asthma (79.5%, 95% CI: 66.9–88.5) and those with a physician-diagnosed atopic condition (63.6%, 95% CI: 49.0–76.3). Other factors associated with higher prevalence included second-hand smoke exposure (45.5%, 95% CI: 30.9–60.9), carpets or rugs at home (43.2%, 95% CI: 28.3–59.1), and contact with

polluted water or factory emissions (13.6%, 95% CI: 5.6–27.8). Excessive screen time (>10 hours/day) was also related to asthma (11.4%, 95% CI: 4.0–24.5). Interestingly, pet ownership appeared protective in the bivariate analysis, with lower asthma prevalence among participants keeping pets (4.5%, 95% CI: 0.8–15.3).

Table 5: Multivariate logistic regression of determinants of allergic asthma

Determinant	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Family history of asthma (Yes vs No)	12.1 (5.6–25.8)	4.58 (2.21–10.3)	<0.001
Physician-diagnosed atopic condition (Yes vs No)	4.0 (2.0–8.1)	2.38 (1.14–5.21)	0.023
Monthly income ≥ 40,000 BDT (vs < 15,000)	0.18 (0.02–1.2)	0.11 (0.01–0.80)	0.050
Pets at home (Yes vs No)	0.21 (0.05–0.88)	6.25 (2.13–8.65)	0.025
Carpets/rugs at home (Yes vs No)	2.1 (1.1–4.0)	2.07 (0.94–4.64)	0.069
Screen time 2–10 hours/day (vs <2 hours)	2.5 (0.8–7.9)	2.67 (0.73–9.47)	0.130
Contact with polluted water/factory emissions (Yes vs No)	3.3 (1.1–9.6)	1.92 (0.43–7.36)	0.400

In the multivariate logistic regression, family history of asthma (aOR 4.58; 95% CI: 2.21–10.3; p<0.001) and physician-diagnosed atopic conditions (aOR 2.38; 95% CI: 1.14–5.21; p=0.023) as strong independent predictors of allergic asthma. Pet ownership, which appeared protective in crude analysis (cOR 0.21; 95% CI: 0.05–0.88), showed a

positive association after adjustment (aOR 6.25; 95% CI: 2.13–8.65; p=0.025). Higher household income (≥40,000 BDT) was inversely associated with asthma compared to lower income (<15,000 BDT) (aOR 0.11; 95% CI: 0.01–0.80; p=0.050). Carpets or rugs at home (aOR 2.07; 95% CI: 0.94–4.64) and longer screen time (aOR 2.67; 95% CI: 0.73–9.47) showed

positive but non-significant associations. Contact with polluted water or factory emissions was not significantly associated with asthma after adjustment (aOR 1.92; 95% CI: 0.43–7.36).

DISCUSSION

This study found that the prevalence of allergic asthma among children aged 6 to 10 years in an industrial area of Gazipur was 11.9%. This figure is comparable to the prevalence of 11.9% reported among 6–7-year-old children in the World Allergy Organization Journal (2021).^[13] and to the 13.6% prevalence reported among children aged 6–9 years in Al-Ain district, United Arab Emirates.^[14] These similarities suggest that asthma remains a significant health problem for school-aged children across different regions, although local environmental and socioeconomic factors may influence the exact prevalence. In our study, most of the children surveyed were girls (60%), though no significant gender difference was noted in asthma prevalence. Similar findings have been reported elsewhere, indicating that gender differences in childhood asthma are not consistent in this age range. Socioeconomic status, however, showed a clear pattern. Children from lower-income households (<15,000 BDT) were more likely to have asthma than those from higher-income families. This finding reflects broader evidence that asthma tends to cluster in socially disadvantaged groups, where children are more often exposed to poor housing, household allergens, and environmental pollution, while at the same time having less access to healthcare.^[15] On the other hand, children from higher-income households (30,000–40,000 BDT) were less likely to report asthma, which highlights the protective role of better living standards, reduced allergen exposure, and timely access to care. A strong association between family history and asthma ($p < 0.001$) was observed in this study, emphasizing the importance of genetic predisposition. This echoes numerous previous findings showing that children with asthmatic parents or siblings are significantly more likely to develop the condition.^[16] Similarly, co-existing allergic diseases such as food allergy or allergic rhinitis were strongly linked with asthma ($p < 0.001$). This is consistent with the “atopic march” concept, where children often develop eczema or rhinitis first, followed later by asthma.^[17] Environmental exposures stood out as particularly important in this industrial community. Children from households with pets were at higher risk ($p = 0.019$), consistent with a report in the International Journal of Environmental Research and Public Health (2021), which linked dog ownership to asthma among children aged 6–12 years.^[18] Similarly, homes with carpets or rugs showed higher prevalence ($p = 0.017$), reinforcing the role of indoor allergens such as dust mites. In addition, contact with polluted water and emissions from factories was significantly associated

with asthma ($p = 0.027$). Comparable findings were reported by the International Journal of Environmental Research and Public Health (2021), where proximity to polluting factories, heavy vehicle traffic, and weedy areas was associated with higher asthma prevalence.^[19] Rapid industrialization and urbanization further amplify these risks, consistent with systematic reviews highlighting higher urban versus rural asthma prevalence in low- and middle-income countries (LMICs).^[20] When placing these results in a broader context, important differences emerge between developed and developing countries. In many high-income countries, asthma prevalence rose sharply during the latter half of the 20th century, but in recent years it has plateaued or even declined, likely due to improved awareness, stricter air-quality regulations, and better access to healthcare.^[21,22] In contrast, LMICs such as Bangladesh are experiencing rising asthma prevalence as industrialization, urbanization, and Westernized lifestyles alter environmental and behavioral exposures.^[10,23] A systematic review of urban-rural differences confirmed that asthma is consistently more common in urban children than in rural ones in LMICs.^[24] In these settings, worsening air quality, crowded housing, traffic exposure, and dietary and lifestyle changes are key drivers of asthma risk. The Gazipur results mirror this pattern. The high burden of asthma in this industrial community underscores the cost of unregulated development. The children most at risk were those living closest to sources of industrial pollution and in households where socioeconomic disadvantages compounded their exposures. On the other hand, studies from more developed contexts, such as the Budapest investigation, show that children in suburban or rural areas are less likely to have asthma compared to those in capital cities. This urbanization effect has been reported globally and suggests that environmental exposures may outweigh genetic predisposition in many contexts.^[10,11] Asthma is more often diagnosed in developed countries; its severity and poor control are disproportionately higher in resource-limited settings. This highlights the double burden faced by LMICs: not only are prevalence rates rising, but the lack of access to timely diagnosis, inhaled therapies, and long-term follow-up worsens outcomes.

Limitations of the Study: The study’s main limitations are its focus on a single industrial area limiting generalizability, and its cross-sectional design, preventing causal conclusions.

CONCLUSION

This study identifies an 11.9% prevalence of allergic asthma among children aged 6–10 years in Gazipur’s industrial areas, reflecting a significant public health burden. Genetic predisposition, atopy, and modifiable exposures such as pet ownership, pollution, and sedentary habits were key determinants, while higher socioeconomic status

offered protection. These findings highlight the need for targeted interventions addressing environmental exposures and lifestyle risks to reduce asthma prevalence in similar high-risk settings.

Recommendation: To reduce allergic asthma risk in industrial areas, targeted policies should regulate emissions, promote tree plantation, and minimize children's exposure to pollutants. At the household level, removing carpets, limiting pet contact, encouraging physical activity, and reducing screen time can lower allergen exposure. Awareness campaigns for families, early screening for children with a family history of asthma, and regular school-based health checks are essential. Strengthening healthcare access in industrial zones, combined with environmental control and lifestyle education, can provide a comprehensive approach to prevention and management.

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