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Prevalence, Management, and Treatment of Pediatric Acute Asthma in the Emergency Department: A Descriptive Cross-sectional Study in Zahedan, Iran (2023)

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Abstract

Background: Asthma is a chronic inflammatory airway disease, and its prevalence has increased due to urbanization, technological advancements, and environmental pollution.

Objectives: This study examined the prevalence, clinical presentations, asthma severity, triggering factors, and treatment responses of acute asthma in children admitted to an Emergency Department (ED) in Zahedan University of Medical Sciences.

Methods: This descriptive cross-sectional study involved children aged 1 - 18 years who presented to the ED of Zahedan University of Medical Sciences, in 2023. After applying the exclusion criteria, 155 individuals were eligible for inclusion. The data were analyzed using SPSS version 23, with results presented as frequencies and percentages.

Results: The study found that 67.1% of patients were male, with the highest proportion (42.67%) aged 1 - 5 years. About 72.3% had allergies, while respiratory infections (50.32%) and cold/dry weather (36.12%) were the most common triggers. Shortness of breath (98.7%) and cough (87.1%) were the predominant symptoms. Cases were equally divided between mild and moderate severity (43.2% each). The majority (76.2%) received beta-agonists with corticosteroids, and 56.8% required hospitalization.

Conclusions: Asthma is prevalent in young boys, with infections and weather as key triggers. Standard treatment was effective, but hospitalizations indicate a significant healthcare burden. Future research should assess long-term outcomes, compare treatments, and investigate environmental/genetic influences for better asthma control.

Keywords: Pediatric Acute Asthma, Emergency Department, Asthma Exacerbation, Asthma Triggers

1. Background

In recent years, societal growth, technological advancements, increased environmental pollution, and the shift from rural to urban lifestyles have contributed to a notable rise in the prevalence of both re-emerging and emerging diseases. Among these, asthma and allergic diseases have seen a remarkable increase globally (1, 2). Asthma, a chronic inflammatory disorder of the airways, is characterized by heightened bronchial responsiveness to various stimuli. As one of the most common chronic diseases in children, it involves immune-mediated airway alterations that lead to symptoms such as coughing, wheezing, and breathlessness (3-5). Asthma poses a significant public health burden, affecting approximately 2 - 37% of

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populations worldwide, with an estimated 400 million cases and a steadily rising incidence (6). In Iran, a meta-analysis estimated the pediatric asthma prevalence at 1.5% (7), though regional variations likely exist due to environmental and socioeconomic factors. The disease arises from a complex interplay of genetic predisposition (e.g., atopy, airway hyperreactivity) and environmental triggers (e.g., allergens, air pollution, respiratory infections) (8). While genetic susceptibility plays a central role, the rapid surge in asthma cases over recent decades underscores the dominant influence of environmental and lifestyle changes (9). Acute asthma exacerbations are among the leading causes of pediatric Emergency Department (ED) visits and hospitalizations. In the U.S., 60% of children with asthma experience at least one exacerbation, with 5 - 10% suffering severe, refractory cases requiring specialized care (10, 11). Each exacerbation increases the risk of future episodes and may progress to life-threatening respiratory failure, emphasizing the need for timely intervention (12, 13). Clinically, exacerbations manifest as worsening dyspnea, cough, wheezing, or chest tightness (14). Although spirometry aids in diagnosis, it fails to fully capture symptom severity or heterogeneity, necessitating consideration of differential diagnoses (e.g., COPD, heart failure) to avoid delays in life-saving treatment (15).

Despite global efforts to monitor asthma, region-specific data on pediatric emergency presentations, triggers, and management remain scarce, particularly in underserved areas like Zahedan. Recent meta-analyses (7) and regional studies (16, 17) have advanced general understanding, but no pediatric ED-focused asthma research has been conducted in Zahedan, a region with a unique climate (e.g., dust storms, extreme temperature shifts) and elevated environmental risks (e.g., pollution, limited healthcare access). These gaps hinder tailored public health strategies. This study examines the prevalence, treatment patterns, and outcomes of acute pediatric asthma in an ED, with a focus on identifying local risk factors such as dust exposure and viral infections.

2. Objectives

By assessing the real-world effectiveness of current treatment approaches, the research aims to inform clinical guidelines, optimize resource allocation, and support targeted interventions such as parental education and trigger avoidance strategies. The findings offer practical insights for clinicians and policymakers, emphasizing the critical need for context-specific asthma management in high-risk and underserved populations, while laying the groundwork for future research in similar settings.

3. Methods

This descriptive cross-sectional study was conducted in 2023 at the ED of Zahedan University of Medical Sciences. The study focused on all children aged 1 - 18 years presenting with acute asthma symptoms after considering exclusion criteria. Given the limited annual population of pediatric asthma cases in this setting, a census-based approach was adopted rather than a sample size calculation. Over the study period, 155 children met the inclusion criteria and were enrolled after applying exclusions. The study was approved by the Ethics Committee of Zahedan University of Medical Sciences and the Faculty of Medicine Research Council.

3.1. Criteria

Inclusion criteria for the study were as follows: Children diagnosed with asthma by a pediatric allergy specialist in accordance with the GINA 2023 guidelines. Eligible participants presented with clinical symptoms such as shortness of breath, wheezing, acute cough, increased respiratory effort, or oxygen saturation below 95%. Additionally, a peak expiratory flow (PEF) of less than 80% of the patient's best recorded value, measured upon arrival at the ED and compared to historical data when available, was required. A positive clinical response to beta-2 agonists was also a necessary criterion for inclusion. Exclusion criteria included children who had been hospitalized for asthma within the past month or those with comorbid chronic cardiopulmonary diseases such as pneumonia or foreign body aspiration. Patients with metabolic disorders or other conditions that could mimic asthma symptoms, such as pneumothorax or pleural effusion, were also excluded. Furthermore, cases in which symptoms were attributed to trauma, renal failure, or gastroesophageal reflux were not considered for inclusion in the study.

3.2. Data Collection

Data were collected using a structured form that captured key variables, including demographics (age,

Table 1. GINA 2023-Based Classification of Acute Asthma Severity in Pediatric Emergency Department Settings [a]

Severity Level	Symptoms	Physical Signs	Functional Measures
Mild	Dyspnea only during activity	Normal mental status; speaks in full sentences; mild end-expiratory wheezing; normal respiratory rate	PEF ≥ 70% predicted/personal best; SpO_2 ≥ 95% (room air)
Moderate	Dyspnea limits activity	Alert, may be agitated; speaks in phrases; moderate wheezing (full expiration); visible accessory muscle use; increased respiratory rate	PEF 40 - 69% predicted; SpO_2 90 - 94% (room air)
Severe	Dyspnea at rest	Agitated/drowsy; speaks in single words; loud biphasic wheezing; prominent accessory muscle use; tachypnea (RR > 30 adults); tachycardia	PEF < 40% predicted; SpO_2 < 90% (room air)
Life-threatening	Impending respiratory arrest	Confusion/lethargy; silent chest; paradoxical breathing; bradycardia; cyanosis	PEF unmeasurable; SpO_2 < 90% on oxygen; normal/elevated $PaCO_2$

Abbreviations: PEF, peak expiratory flow; SpO_2, oxygen saturation; RR, respiratory rate; $PaCO_2$, partial pressure of carbon dioxide (arterial).

[a] Management: Treatment type (e.g., bronchodilators, steroids), response, and hospitalization frequency.

categorized into 1 - 5, 5 - 10, 10 - 15, and 15 - 18 years, and sex), clinical features (such as dyspnea, wheezing, and cough), season of presentation, history of prior asthma diagnosis, and any treatment received before the exacerbation. The severity of acute asthma episodes was classified according to the GINA 2023 criteria, using a standardized table that outlined clinical parameters for assessment in the ED (Table 1).

3.3. Statistical Analysis

Data were analyzed using SPSS v.23. Continuous variables were reported as means ± standard deviations, while categorical variables were summarized as frequencies or percentages. No inferential statistics or confidence intervals were calculated, as this study aimed to describe patterns rather than test hypotheses.

4. Results

The study analyzed 155 pediatric patients (aged 1 - 18 years) presenting with acute asthma to the ED of Zahedan University of Medical Sciences. Key findings are listed below.

4.1. Demographic Characteristics

The age distribution of patients was skewed toward younger children, with 53.0% aged 1 - 5 years, 27.7% aged 5 - 10 years, 15.5% aged 10 - 15 years, and only 3.9% in the 15 - 18 age group. There was a marked male predominance, with 67.1% of patients being male compared to 32.9% female. A family history of asthma was reported in 25.2% of cases, and first-degree consanguinity was present in 17.4% of patients. Seasonal variation was notable, with the highest number of cases occurring in winter (37.4%), followed by spring (23.9%) (Table 2).

4.2. Clinical Presentation

The most common presenting symptoms among patients were shortness of breath (98.7%), cough (87.1%), and wheezing (74.2%). The primary triggers identified were infections, accounting for 50.3% of cases, followed by exposure to cold or dry weather (36.1%). Notably, 33.5% of the patients were newly diagnosed with asthma at the time of their ED visit (Table 3).

4.3. Severity and Treatment Patterns

The severity of asthma exacerbations was evenly distributed between mild and moderate cases, each comprising 43.2% of patients, while severe cases accounted for 13.5%. Standard treatment, including beta-agonists combined with corticosteroids, was administered to 76.2% of patients, whereas 23.8% required more advanced therapies. Additionally, 36.1% of the children had not received any treatment prior to their presentation at the ED. Hospitalization was required in 56.8% of cases, while 33.5% of patients were discharged from the ED after improvement, and 9.7% required admission to the ICU. The most common comorbidities were allergic rhinitis, present in 89.3% of patients, and food allergies, reported in 33.9% (Table 4).

5. Discussion

This study confirms that asthma remains the most prevalent chronic condition in early childhood, with incidence gradually declining as children enter adolescence. Consistent with previous research, boys were more frequently affected than girls. While a family history of asthma was present in some cases, environmental exposures and allergic sensitivities

Table 2. Demographic and Clinical Characteristics of Study Participants [a]

Variables	Values
Age groups (y)	
1 to 5	80 (52.99)
5 to 10	51 (37.98)
10 to 15	18 (5.16)
Over 15 up to 18	6 (3.87)
Gender	
Male	104 (67.1)
Female	51 (32.9)
Parental asthma history	
Yes	39 (25.2)
No	116 (74.8)
Parental consanguinity	
Yes	27 (17.4)
No	128 (82.6)
Allergic history	
Yes	112 (72.3)
No	43 (27.7)
Season	
Spring	37 (23.9)
Summer	35 (22.6)
Fall	25 (16.1)
Winter	58 (37.4)
Asthma control education	
Yes	97 (62.6)
No	58 (37.4)

[a] Values are expressed as No. (%).

appeared to play a more significant role in disease manifestation. Parental consanguinity was observed in a smaller subset of cases but still warrants attention as a potential risk factor. A notable finding was the high recurrence of asthma episodes among patients, suggesting possible gaps in long-term asthma management or challenges in adherence to treatment plans at home. The strong association between asthma and comorbid allergic conditions aligns with existing literature. Respiratory infections and environmental factors, particularly cold, dry weather, emerged as the most common triggers for acute exacerbations. Fortunately, only a minority of cases progressed to severe asthma requiring intensive care.

Acute asthma exacerbations are a leading cause of pediatric ED visits, underscoring their substantial impact on child health. These episodes not only increase the likelihood of future flare-ups but also carry the risk of progressing to life-threatening respiratory failure. Early diagnosis and prompt treatment are critical for effective disease management (10-12). Rangachari et al. (16) examined children visiting EDs for asthma and reported a male predominance (67%), with higher prevalence among those under 5 years old. These findings align with our study but may suggest an earlier onset of asthma in our population. Similarly, Nabavizadeh et al. (17) investigated socio-demographic and environmental factors in 737 asthmatic children (aged 5 - 15) in southwestern Iran, also noting a higher prevalence in males (mean age: 8.1 years). However, our study included a broader age range (infancy to 18 years), which may account for some differences. Lee et al. (18) conducted a nationwide study exploring the link between childhood asthma and socioeconomic status, reporting a mean age of 4.6 ± 3.4 years, with 52.8% males and 47.2% females. Dondi et al. (13) found that 76% of pediatric emergency asthma cases were under 6 years old, with 65% being male. These results reinforce our findings, highlighting the higher asthma prevalence in

Table 3. Clinical Features, Triggers, and Severity of Asthma Among Study Participants [a]

Variables	Values
Asthma triggers	
Infection	78 (50.32)
Physical activity	18 (11.61)
Medication	8 (5.16)
Food	26 (16.77)
Inhalation agents	48 (30.96)
Smoking	25 (16.13)
Cold/dry weather	56 (36.12)
Psychiatric issues	1 (0.64)
Unknown	3 (1.93)
Symptoms	
Wheezing	115 (74.2)
Shortness of breath	153 (98.7)
Vomiting	9 (5.8)
Coryza	12 (7.7)
Gastrointestinal disturbances (e.g., diarrhea)	13 (8.4)
Cyanosis	2 (1.3)
Prior asthma diagnosis	
Yes	103 (66.45)
No	52 (33.55)
Asthma severity	
Mild	67 (43.2)
Moderate	67 (43.2)
Severe	21 (13.5)

[a] Values are expressed as No. (%).

Table 4. Treatment Approaches, Responses, and Associated Allergic Conditions in Asthma Patients [a]

Variables	Values
Treatment type	
Inhaler only	25 (16.1)
Corticosteroids	1 (0.6)
Inhaler + corticosteroids	118 (76.2)
Inhaler + corticosteroids + magnesium sulfate	3 (1.9)
Inhaler + corticosteroids + epinephrine	2 (1.3)
Inhaler + corticosteroids + magnesium sulfate + epinephrine	6 (3.9)
Treatment response	
Icu admission	15 (9.7)
Hospital admission	88 (56.8)
Improvement in emergency Dept.	52 (33.5)
Associated allergies diseases	
Eczema	29 (23.77)
Allergic rhinitis	100 (89.28)
Food allergy	38 (33.92)

[a] Values are expressed as No. (%).

young boys and emphasizing the importance of early diagnosis and intervention.

In our study, about a quarter of children had a first-degree relative with asthma, while parental consanguinity was noted in 17.4%. In contrast,

Nabavizadeh et al. (17) reported a higher familial asthma prevalence (~50%). Although consanguinity rates in our study were lower than expected, regional factors — such as tribal cultural practices in some Iranian provinces — may contribute to a higher asthma burden. Bijanzadeh et al. (19) identified both consanguinity and family history as significant contributors to childhood asthma. Similarly, Ansari et al. (20) and Xu et al. (21) found that a maternal asthma history increased a child's asthma risk by 3.71-fold. These findings support the role of genetic predisposition in asthma development. Additionally, 72.3% of children in our study had a history of allergies, further reinforcing the asthma-allergy connection. Lee et al. (18) observed that 75.5% of children with acute asthma also had allergic rhinitis, while 34.2% had atopic dermatitis. Gezmu et al. (22) similarly reported high rates of allergic comorbidities (73.7% rhinitis, 68.3% conjunctivitis, 45.5% dermatitis, 47.7% food allergies). These findings align with our data, underscoring the need for close monitoring of children with allergic predispositions to prevent asthma exacerbations. Most acute asthma cases in our study occurred in winter (37.4%), followed by spring (23.9%), summer (22.6%), and fall (16.1%). Dondi et al. (13) reported similar seasonal trends, with exacerbations peaking in fall/winter for preschoolers and spring/fall for school-aged children. Xing et al. (23) linked climate change to increased asthma exacerbations in spring/summer, though their lack of age stratification limits direct comparisons. Collectively, these findings suggest that infections in colder months and allergens in warmer months drive seasonal asthma patterns.

In our study, 63.9% of children were on asthma treatment, and 62.6% had received prior asthma education. Despite this, 66.45% had recurrent attacks, indicating gaps in long-term control. Miller et al. (24) found that children with prior severe exacerbations had a 6.33-fold higher risk of future attacks, even with education. This highlights the need for sustained education and proactive management. Shayo et al. (25) and Al-Muhsen et al. (26) emphasized that poor inhaler adherence and inadequate education contribute to uncontrolled asthma. Their findings mirror ours, stressing the importance of patient education, follow-up, and treatment adherence. Dyspnea (98.7%), cough (87.1%), and wheezing (74.2%) were the most common acute asthma symptoms in our study. Non-respiratory symptoms, such as gastrointestinal disturbances (14.19%), coryza (7.7%), and cyanosis (1.3%), were also observed. Rafaat and Aref (15) reported similar trends, with dyspnea (95%) and wheezing (90%) predominating. Asseri (27) noted that cough and dyspnea were frequent even during the COVID-19 pandemic, reinforcing the need for comprehensive symptom assessment. Among our patients, 43.2% had mild asthma, 43.2% moderate, and 13.5% severe. Nearly all received inhaler therapy, with corticosteroids (83.9%), magnesium sulfate (5.8%), and epinephrine (5.2%) used as needed. Hospitalization was required for 56.8%, while 9.7% needed ICU care. Larsson et al. (28) reported that 95% of cases were mild-to-moderate, with severe asthma being rare (4.2%). The higher severe asthma rate in our study (13.5%) may reflect differences in study settings (tertiary ED vs. primary care). Lee et al. (29) highlighted the efficacy of albuterol, ipratropium, and dexamethasone in acute management, while reserving magnesium sulfate for severe cases.

Given Zahedan's dry, dusty climate, parents should be counseled on minimizing dust exposure and using masks when necessary. Awareness of common food allergens (e.g., fish, wheat, milk, eggs) and avoidance of cigarette smoke and heating emissions are also crucial for asthma prevention.

5.1. Conclusions

The study concluded that pediatric asthma is influenced by a complex interplay of demographic, environmental, and clinical factors. Acute asthma cases were more prevalent among young boys and strongly associated with allergic conditions, with seasonal peaks observed in winter and spring. Although most cases were classified as mild, a significant proportion required hospitalization, highlighting the critical need for early intervention and effective management. Standard treatments such as inhaled beta-agonists and corticosteroids proved effective; however, poor treatment adherence and limited patient education contributed to frequent exacerbations and recurrences. Regional environmental factors, including Zahedan's dusty climate, also played a significant role in triggering asthma attacks. Despite certain limitations, these findings provide valuable insights that can inform improvements in asthma care. Future research should focus on long-term clinical outcomes, the comparative effectiveness of different treatment protocols, the role of environmental interventions, and strategies to

enhance patient education and adherence, particularly in underserved and high-risk populations.

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Footnotes

Authors' Contribution: Z. S. G. and A. M. contributed in to conceptualization, supervision, and project administration. Z. A. contributed in data collection. M. M. did the analysis and A. T. contributed in methodology, formal analysis, investigation, and writing original draft visualization.

Conflict of Interests Statement: The authors declare conflict of interest.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication. The data are not publicly available due to belonging to a huge database.

Ethical Approval: The approval code was obtained from the Faculty of Medicine Research Council, Zahedan University of Medical Sciences (IR.ZAUMS.REC.1401.273).

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