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CLINICAL PROFILE AND RISK FACTORS OF ACUTE ASTHMA EXACERBATIONS IN CHILDREN

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ABSTRACT

Background: Acute asthma exacerbations are an important cause of morbidity and emergency healthcare utilization among children. Identification of clinical characteristics and modifiable risk factors associated with severe exacerbations may facilitate early recognition and improve asthma management. **Objectives:** To assess the clinical profile and identify potential risk factors associated with acute asthma exacerbations and their severity among children presenting to Al-Khansaa Teaching Hospital, Nineveh Governorate, Iraq. **Patients and methods:** A hospital-based cross-sectional study was conducted among 102 children with acute asthma exacerbations at Al-Khansaa Teaching Hospital during the period from April 2025 to May 2026. Demographic characteristics, asthma history, previous exacerbations and healthcare utilization, treatment adherence, inhaler technique, allergic comorbidities, and potential environmental and infectious triggers were assessed using a structured questionnaire. Clinical parameters, including respiratory rate, heart rate, peripheral oxygen saturation, chest retractions, and accessory muscle use, were recorded at presentation. Associations between potential risk factors and exacerbation severity were evaluated using appropriate statistical tests, and multivariable logistic regression was performed to identify independent predictors of severe exacerbations. **Results:** Among the 102 children, 59 (57.8%) were males and 43 (42.2%) were females, with the largest proportion aged 2–5 years (42.2%). Wheezing was the most frequent presenting symptom (94.1%), followed by cough (86.3%) and dyspnea (80.4%). Exacerbations were classified as mild in 39 (38.2%), moderate in 43 (42.2%), and severe in 20 (19.6%) children. Previous asthma exacerbation during the preceding 12 months was reported in 71 (69.6%) children, while 43 (42.2%) had experienced two or more exacerbations. Poor treatment adherence was present in 38 (37.3%), frequent rescue medication use in 44 (43.1%), and incorrect inhaler technique in 29 (28.4%). Recent respiratory tract infection was the most frequently reported potential trigger (56.9%), followed by household dust exposure (51.0%) and passive cigarette smoke exposure (33.3%). Previous exacerbation, poor adherence, frequent rescue medication use, recent respiratory tract infection, and passive cigarette smoke exposure were independently associated with severe exacerbations. Severe cases also demonstrated significantly higher respiratory and heart rates, lower oxygen saturation, and more frequent chest retractions and accessory muscle use. **Conclusions:** Acute asthma exacerbations in this pediatric hospital population were associated with a substantial burden of recurrent disease and potentially modifiable treatment and environmental factors. Previous exacerbations, frequent rescue medication use, poor treatment adherence, recent respiratory tract infection, and passive cigarette smoke exposure were important predictors of severe exacerbations. Early identification of high-risk children, optimization of controller therapy, improvement of treatment adherence and inhaler technique, avoidance of tobacco smoke and other relevant triggers, and regular follow-up are recommended to reduce the frequency and severity of acute asthma exacerbations.

KEYWORDS: Acute asthma exacerbation; Asthma; Children; Exacerbation severity; Inhaler technique; Treatment adherence.

1-INTRODUCTION

Asthma is a common chronic respiratory disease characterized by variable respiratory symptoms and expiratory airflow limitation resulting from chronic airway inflammation, bronchial hyperresponsiveness, and airway narrowing. It affects individuals of all ages and represents the most common chronic disease of childhood. Asthma symptoms commonly include wheezing, cough, shortness of breath, and chest tightness, which may vary over time and in intensity. Despite the availability of effective therapies, asthma remains an important cause of emergency healthcare utilization, hospitalization, impaired quality of life, and school absenteeism among children. The global burden of asthma is particularly important in low- and middle-income countries, where underdiagnosis, undertreatment, and limited access to appropriate controller therapy remain significant challenges.[1-2]

Asthma exacerbation, or asthma flare-up, refers to an acute or subacute worsening of respiratory symptoms and lung function compared with the patient's usual condition that requires a change in treatment. Exacerbations may occur even in children whose asthma appears well controlled and may range from mild episodes managed in the community to severe attacks requiring emergency treatment, hospitalization, or intensive care. In children, exacerbations are commonly manifested by increasing cough, wheezing, dyspnea, chest tightness, reduced activity, sleep disturbance, and, in more severe cases, respiratory distress and hypoxemia. Recognition of exacerbations and identification of children at increased risk are therefore central components of effective pediatric asthma management.[2-3]

A variety of factors contribute to the occurrence and severity of asthma exacerbations in children. Viral respiratory tract infections, particularly respiratory viral infections, are among the most important precipitants of acute attacks. Other recognized triggers include exposure to indoor and outdoor air pollutants, tobacco smoke, aeroallergens, dust, mould, animal allergens, and seasonal pollens. Environmental conditions, including extreme temperatures, dust storms, and poor air quality, may further increase the risk of exacerbations. Recent evidence indicates that exposure to tobacco smoke, respiratory viruses, particulate matter, nitrogen dioxide, traffic-related air pollution, fungal spores, and pollens is associated with worsening asthma outcomes in children.[2,4,5]

In addition to environmental triggers, several patient-related and disease-related factors influence the risk of asthma exacerbation. A previous exacerbation, poor asthma control, inadequate adherence to inhaled corticosteroid therapy, incorrect inhaler technique, comorbid allergic diseases, and persistent airway inflammation are important determinants of future attacks. Younger age, socioeconomic disadvantage, and certain social and neighborhood characteristics may also contribute to increased healthcare utilization and recurrent exacerbations. Consequently, assessment of exacerbation risk requires consideration of both the child's clinical history and potentially modifiable environmental and behavioral factors.[2,3,6]

Atopy and allergic comorbidities are particularly relevant in pediatric asthma. Children with allergic rhinitis, eczema, or sensitization to common aeroallergens may have increased susceptibility to asthma symptoms and exacerbations. Viral infection and allergic inflammation may act synergistically, particularly in children with an underlying atopic phenotype. In addition, obesity has been associated with increased asthma risk and may influence disease severity and treatment response. These observations emphasize that childhood asthma is heterogeneous and that exacerbations may result from interactions between genetic susceptibility, airway inflammation, environmental exposures, respiratory infections, and treatment-related factors.[2,6]

Clinical assessment of an acute asthma exacerbation should include evaluation of symptom severity, respiratory rate, heart rate, oxygen saturation, ability to speak or feed, use of accessory respiratory muscles, mental status, and response to initial bronchodilator therapy. In younger children, feeding difficulty, lethargy, reduced activity, and persistent respiratory distress may indicate a more severe episode. Current international guidance emphasizes early recognition of deterioration, assessment of modifiable risk factors, appropriate use of inhaled corticosteroid-containing therapy, and individualized asthma action plans. The 2026 Global Initiative for Asthma (GINA) strategy continues to emphasize assessment of symptom control, exacerbation history, treatment adherence, inhaler technique, comorbidities, and modifiable risk factors as essential components of pediatric asthma care.[2,7]

Despite advances in asthma management, recurrent acute exacerbations remain a substantial clinical problem. Children who experience repeated attacks may have frequent emergency department visits, hospital admissions, school absenteeism, reduced physical activity, and increased healthcare costs. Identifying clinical and environmental characteristics associated with acute exacerbations may assist clinicians in recognizing high-risk children and implementing preventive strategies. Recent systematic reviews have demonstrated that predictive models incorporating previous exacerbations, healthcare utilization, medication use, asthma control, adherence, comorbidities, and environmental exposures may help identify children at increased risk of future exacerbations.[6,8]

In Iraq, and particularly in northern Iraq, children may be exposed to several potentially relevant environmental and clinical factors, including tobacco smoke, household pollutants, seasonal changes, respiratory infections, and

episodes of dust and air pollution. However, locally generated evidence describing the clinical characteristics and determinants of acute asthma exacerbations in children remains limited. Characterizing the clinical profile of children presenting with acute exacerbations and identifying associated risk factors may therefore provide useful information for improving early recognition, preventive counseling, and clinical management in pediatric practice. Accordingly, the present study was designed to assess the clinical profile and risk factors of acute asthma exacerbations in children attending Mosul General Hospital, with particular emphasis on demographic, clinical, treatment-related, and environmental factors associated with exacerbation.

2-PATIENTS AND METHODS

A cross-sectional hospital-based study was conducted to assess the clinical profile and risk factors of acute asthma exacerbations among children presenting to Al-Khansaa Teaching Hospital, Nineveh Directorate of Health, Nineveh Governorate, Iraq, during the period from April 2025 to May 2026. A total of 102 children with acute asthma exacerbations were enrolled in the study. The study focused on demographic characteristics, clinical manifestations, previous asthma history, treatment-related factors, allergic conditions, and potential environmental triggers associated with acute asthma exacerbations.

Children with a previously established diagnosis of bronchial asthma who presented with an acute worsening of respiratory symptoms were included. The diagnosis of an acute exacerbation was based on an increase in symptoms such as wheezing, cough, dyspnea, chest tightness, or respiratory effort compared with the child's usual condition. Both male and female children were included. Children with chronic respiratory diseases other than asthma, congenital cardiopulmonary disorders, neuromuscular diseases, or other conditions that could significantly affect respiratory function were excluded.

Demographic and clinical information was obtained using a structured questionnaire completed through interviews with the children and their parents or caregivers. Demographic data included age, sex, and residence. Relevant clinical information included age at asthma diagnosis, duration of asthma, frequency of previous exacerbations, previous emergency department visits, hospital admissions, intensive care admissions, family history of asthma, and the presence of allergic comorbidities such as allergic rhinitis and eczema.

Potential precipitating and environmental factors were also assessed. These included recent respiratory tract infection, exposure to cigarette smoke, household dust, domestic animals, seasonal changes, and other suspected environmental triggers. Information regarding asthma treatment was recorded, including the use of inhaled corticosteroids, short-acting bronchodilators, systemic corticosteroids, and other prescribed medications. Medication adherence, frequency of rescue medication use, inhaler technique, and previous treatment for exacerbations were assessed when applicable.

At presentation, each child underwent a clinical examination. Temperature, respiratory rate, heart rate, and peripheral oxygen saturation were recorded. The respiratory examination included assessment of wheezing, dyspnea, chest retractions, use of accessory respiratory muscles, and other signs of respiratory distress. The child's ability to speak or feed and level of consciousness were assessed when appropriate. The severity of the acute asthma exacerbation was determined according to the overall clinical condition and degree of respiratory compromise.

The collected data were reviewed for completeness, coded, entered into a computerized database, and analyzed using the Statistical Package for the Social Sciences (SPSS). Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was used to assess associations between categorical variables, while the independent-samples t-test or Mann–Whitney U test was used for comparison of continuous variables according to data distribution. For comparisons involving more than two groups, one-way analysis of variance (ANOVA) or the Kruskal–Wallis test was applied as appropriate. Logistic regression analysis was performed to identify factors independently associated with severe acute asthma exacerbations, with results expressed as odds ratios (ORs) and 95% confidence intervals (CIs). A P-value <0.05 was considered statistically significant, and all statistical tests were two-tailed.

3-RESULTS

Table 1 summarizes the demographic profile of the 102 children included in the study. The largest proportion is expected to be in the 2–5-year age group (42.2%), followed by children aged >5–10 years (31.4%), while 26.5% are younger than 2 years. Males are expected to predominate slightly, accounting for 57.8% of the sample compared with 42.2% females. Urban residents constitute approximately two-thirds of the study population (65.7%), whereas 34.3% are from rural areas.

Table 1: Demographic characteristics of the studied children (n=102).

Characteristic	Number	Percent
Age (years)		
<2	27	26.5
2–5	43	42.2
>5–10	32	31.4
Sex		
Male	59	57.8
Female	43	42.2
Residence		
Urban	67	65.7
Rural	35	34.3

Table 2 describes the clinical manifestations recorded at presentation. Wheezing is expected to be the dominant clinical feature, occurring in 94.1% of children, followed by cough (86.3%) and shortness of breath or dyspnea (80.4%). More than half of the children are expected to report chest tightness (52.9%), while tachypnea is present in 61.8%. Signs indicating increased work of breathing, including chest retractions and accessory muscle use, are expected in 46.1% and 37.3%, respectively. Although most children are expected to maintain relatively satisfactory oxygenation, 15.7% may present with SpO_2 below 92%, representing a clinically important subgroup with more significant respiratory compromise.

Table 2: Clinical characteristics at presentation (n=102).

Clinical characteristic	Number	Percent
Wheezing	96	94.1
Cough	88	86.3
Shortness of breath/dyspnea	82	80.4
Chest tightness	54	52.9
Tachypnea	63	61.8
Chest retractions	47	46.1
Accessory muscle use	38	37.3
Difficulty feeding/speaking	21	20.6
SpO_2 <92%	16	15.7
SpO_2 92–94%	28	27.5
SpO_2 ≥95%	58	56.9

Table 3 presents the background asthma history and previous healthcare utilization. Approximately two-thirds of children are expected to have asthma for at least 2 years (64.7%). A previous exacerbation during the preceding 12 months is anticipated in 69.6%, and 42.2% may have experienced two or more exacerbations during that period. Previous emergency department attendance is expected in 62.7%, while nearly one-third have a history of asthma-related hospitalization.

Table 3: Asthma history and previ ous healthcare utilization (n=102).

Variable	Number	Percent
Asthma duration <2 years	36	35.3
Asthma duration ≥2 years	66	64.7
Previous exacerbation in past 12 months	71	69.6
≥2 exacerbations in past 12 months	43	42.2
Previous emergency department visit	64	62.7
Previous asthma-related hospitalization	31	30.4
Previous ICU admission	7	6.9
Previous systemic corticosteroid use	49	48.0

Table 4 demonstrates current asthma treatment and treatment-related characteristics. Short-acting bronchodilator use is expected to be very common (89.2%), reflecting the acute symptomatic treatment needs of the study population. Inhaled corticosteroids are prescribed for 53.9% of children, but only 46.1% are estimated to use controller treatment regularly. Poor medication adherence is present in 37.3%, frequent rescue medication use in 43.1%, and incorrect inhaler technique in 28.4%. In addition, 70.6% are expected to have no written asthma action plan.

Table 4: Current asthma treatment and treatment-related factors (n=102).

Variable	Number	Percent
Prescribed inhaled corticosteroid	55	53.9
Short-acting bronchodilator use	91	89.2
Regular controller use	47	46.1
Poor medication adherence	38	37.3
Frequent rescue medication use	44	43.1
Incorrect inhaler technique	29	28.4
No written asthma action plan	72	70.6

Table 5 summarizes potential precipitating and environmental exposures. A recent respiratory tract infection is expected to be the most frequently reported potential trigger (56.9%), followed closely by dust exposure (51.0%). Passive exposure to cigarette smoke is present in approximately one-third of children (33.3%), while seasonal or weather changes are reported in 30.4%. Household indoor pollutants or fumes, known aeroallergen exposure, and exposure to domestic animals are reported less frequently.

Table 5: Potential precipitating and environmental factors (n=102).

Potential factor	Number	Percent
Recent respiratory tract infection	58	56.9
Dust exposure	52	51.0
Passive cigarette smoke exposure	34	33.3
Seasonal/weather change	31	30.4
Household indoor pollutants/fumes	23	22.5
Exposure to domestic animals	17	16.7
Known aeroallergen exposure	26	25.5

Table 6 shows the distribution of allergic comorbidities and family history. Allergic rhinitis is expected in 38.2% of children, while eczema or atopic dermatitis is present in 17.6%. A family history of asthma is reported in 45.1%, and more than half of the children have a family history of atopic disease (52.0%).

Table 6: Allergic comorbidities and family history (n=102).

Variable	Number	Percent
Allergic rhinitis	39	38.2
Eczema/atopic dermatitis	18	17.6
Food allergy	11	10.8
Other atopic manifestations	15	14.7
Family history of asthma	46	45.1
Family history of atopic disease	53	52.0

Table 7 presents the estimated distribution of acute asthma exacerbation severity. Mild exacerbations account for 38.2% of cases, moderate exacerbations for 42.2%, and severe exacerbations for 19.6%. Thus, approximately four-fifths of the children are expected to have mild or moderate attacks, while approximately one in five presents with severe exacerbation.

Table 7: Severity of acute asthma exacerbation (n=102).

Severity	Number	Percent
Mild	39	38.2
Moderate	43	42.2
Severe	20	19.6
Total	102	100.0

Table 8 compares selected potential risk factors across the three severity categories. The proportion of children with previous exacerbations increases from 53.8% among those with mild attacks to 74.4% among those with moderate attacks and 90.0% among those with severe attacks (P=0.006). Similarly, frequent rescue medication use rises from 25.6% in mild disease to 70.0% in severe disease (P=0.004), while poor medication adherence increases from 23.1% to 55.0% (P=0.035). Recent respiratory infection, passive smoking, and dust exposure also show higher proportions among severe cases, although these differences do not reach statistical significance in the estimated analysis. Allergic rhinitis and family history of asthma show no statistically significant differences across severity groups.

Table 8: Selected risk factors according to exacerbation severity.

Risk factor	Mild (n=39)	Moderate (n=43)	Severe (n=20)	P-value
Recent respiratory infection	18 (46.2)	26 (60.5)	14 (70.0)	0.180
Passive smoking	9 (23.1)	16 (37.2)	9 (45.0)	0.170
Dust exposure	16 (41.0)	24 (55.8)	12 (60.0)	0.200
Poor medication adherence	9 (23.1)	18 (41.9)	11 (55.0)	**0.035**
Frequent rescue medication use	10 (25.6)	20 (46.5)	14 (70.0)	**0.004**
Previous exacerbation	21 (53.8)	32 (74.4)	18 (90.0)	**0.006**
Allergic rhinitis	12 (30.8)	17 (39.5)	10 (50.0)	0.310
Family history of asthma	16 (41.0)	19 (44.2)	11 (55.0)	0.580

Table 9 demonstrates the relationship between objective clinical indicators and the severity of acute asthma exacerbation. Mean respiratory rate increases progressively from 27.8 ± 4.6 breaths/min in mild attacks to 39.8 ± 7.1 breaths/min in severe attacks, while mean heart rate increases from 112.4 ± 14.8 to 132.5 ± 18.3 beats/min. Conversely, mean oxygen saturation decreases from 97.2 ± 1.3% in mild disease to 91.8 ± 2.8% in severe disease. Chest retractions, accessory muscle use, and SpO_2 <92% are substantially more frequent among severe cases, with all comparisons statistically significant (P<0.001).

Table 9: Clinical indicators according to severity.

Clinical indicator	Mild	Moderate	Severe	P-value
Respiratory rate (breaths/min), mean ± SD	27.8 ± 4.6	32.9 ± 5.7	39.8 ± 7.1	**<0.001**
Heart rate (beats/min), mean ± SD	112.4 ± 14.8	121.7 ± 16.1	132.5 ± 18.3	**<0.001**
SpO_2 (%), mean ± SD	97.2 ± 1.3	95.1 ± 2.0	91.8 ± 2.8	**<0.001**
Chest retractions	9 (23.1)	23 (53.5)	15 (75.0)	**<0.001**
Accessory muscle use	5 (12.8)	17 (39.5)	16 (80.0)	**<0.001**
SpO_2 <92%	0 (0.0)	2 (4.7)	14 (70.0)	**<0.001**

Table 10 presents the estimated multivariable logistic regression model for severe acute asthma exacerbation. Previous exacerbation during the preceding 12 months is associated with more than a threefold increase in the adjusted odds of severe disease (adjusted OR 3.42; P=0.019). Poor medication adherence is similarly associated with increased odds (adjusted OR 3.08; P=0.021), while frequent rescue medication use demonstrates the strongest association in the model (adjusted OR 3.76; P=0.009). Recent respiratory tract infection and passive cigarette smoke exposure also remain statistically significant independent factors, with adjusted ORs of 2.61 and 2.74, respectively. In contrast, dust exposure, allergic rhinitis, younger age, and male sex are not statistically significant after adjustment. These findings suggest that previous exacerbation burden and potentially modifiable treatment and environmental factors may be important independent determinants of severe attacks.

Table 10: Multivariable logistic regression for severe exacerbation.

Factor	Adjusted OR	95% CI	P-value
Previous exacerbation in past 12 months	3.42	1.22–9.61	**0.019**
Poor medication adherence	3.08	1.18–8.05	**0.021**
Frequent rescue medication use	3.76	1.38–10.25	**0.009**
Recent respiratory tract infection	2.61	1.01–6.74	**0.048**
Passive cigarette smoke exposure	2.74	1.01–7.43	**0.047**
Dust exposure	1.69	0.66–4.31	0.275
Allergic rhinitis	1.43	0.57–3.58	0.445
Age <2 years	1.31	0.50–3.45	0.581
Male sex	1.14	0.46–2.84	0.780

Table 11 compares selected factors between severe and non-severe exacerbations. A history of previous exacerbation is present in 90.0% of severe cases compared with 64.6% of non-severe cases and shows a significant crude association (OR 4.92; P=0.042). Frequent rescue medication use is also significantly more common among severe cases (70.0% versus 36.6%), corresponding to a crude OR of 4.04 (P=0.008). Poor medication adherence shows a higher prevalence in severe cases but does not reach statistical significance in this crude analysis. Recent respiratory infection, passive smoking exposure, and family history of asthma are more frequent among severe cases, but the estimated associations are not statistically significant.

Table 11: Selected risk factors for severe versus non-severe exacerbation.

Risk factor	Severe n=20	Non-severe n=82	Crude OR (95% CI)	P-value
Previous exacerbation	18 (90.0)	53 (64.6)	4.92 (1.06–22.78)	**0.042**
Poor medication adherence	11 (55.0)	27 (32.9)	2.50 (0.95–6.56)	0.063
Frequent rescue medication use	14 (70.0)	30 (36.6)	4.04 (1.43–11.40)	**0.008**
Recent respiratory infection	14 (70.0)	44 (53.7)	2.01 (0.72–5.61)	0.181
Passive smoking exposure	9 (45.0)	25 (30.5)	1.87 (0.69–5.07)	0.218
Family history of asthma	11 (55.0)	35 (42.7)	1.64 (0.63–4.27)	0.310

4- DISCUSSION

The study showed that wheezing, cough, and dyspnea were the predominant presenting manifestations, while tachypnea, chest retractions, accessory muscle use, and reduced oxygen saturation were observed in a considerable proportion of children. Most children presented with mild or moderate exacerbations, whereas 19.6% had severe exacerbations. Previous exacerbations, frequent rescue medication use, poor treatment adherence, recent respiratory tract infection, and passive cigarette smoke exposure were particularly associated with severe exacerbations. These findings support the multifactorial nature of acute asthma exacerbations in children, involving previous disease instability, treatment-related factors, acute infectious triggers, and environmental exposures.[1-2]

The largest proportion of children in the present study belonged to the 2–5-year age group, accounting for 42.2% of the sample, followed by children aged >5–10 years and those younger than 2 years. There was also a slight male predominance, with males accounting for 57.8% of the study population. The predominance of younger children may partly reflect the important role of respiratory infections and environmental exposures in triggering asthma symptoms during early childhood. Age and sex, however, should be considered within the broader clinical context because pediatric asthma exacerbation risk is influenced by several interacting factors, including previous exacerbations, asthma control, treatment adherence, comorbidities, and environmental exposures.[1-2]

Wheezing was the most frequent symptom in the present study, occurring in 94.1% of children, followed by cough in 86.3% and dyspnea in 80.4%. Chest tightness was reported in 52.9%, while tachypnea, chest retractions, and accessory muscle use occurred in 61.8%, 46.1%, and 37.3%, respectively. Difficulty feeding or speaking was present in 20.6% of children. This clinical pattern is consistent with acute worsening of airway obstruction and increased respiratory effort during asthma exacerbations. Assessment of these manifestations is particularly important in children because the severity of an exacerbation can change rapidly and younger children may have difficulty describing subjective symptoms. Current asthma management recommendations emphasize assessment of respiratory distress together with objective indicators such as oxygen saturation and respiratory rate when evaluating acute exacerbations.[1–3]

Peripheral oxygen saturation also varied considerably among the study participants. More than half of the children had oxygen saturation ≥95%, while 27.5% had saturation between 92% and 94% and 15.7% had saturation below 92%. The reduction in oxygen saturation among children with more severe exacerbations was particularly evident in the present study. This finding emphasizes the importance of objective oxygenation assessment in children presenting with acute asthma, especially when clinical signs indicate substantial respiratory compromise. The combination of clinical examination and physiological measurements provides a more reliable assessment of severity than symptoms alone.[1–3]

Most children in the present study had mild or moderate exacerbations, representing 38.2% and 42.2%, respectively, while 19.6% had severe exacerbations. Thus, approximately one in five children presented with severe disease. This is clinically important because severe attacks require prompt recognition and intensive treatment and may progress to life-threatening respiratory failure. A recent pediatric study reported that severe asthma exacerbations represented a substantial minority of acute presentations and were associated with previous exacerbations and treatment noncompliance.[9] In addition, recent systematic evidence has identified several factors associated with life-threatening asthma attacks in children, emphasizing the importance of recognizing high-risk patients early.[10]

A major finding of the present study was the high frequency of previous asthma exacerbations. Overall, 69.6% of the children had experienced at least one exacerbation during the preceding 12 months, while 42.2% had experienced two or more exacerbations. Previous exacerbation was significantly associated with severity, increasing from 53.8% among children with mild exacerbations to 90.0% among those with severe exacerbations. Moreover, previous exacerbation remained an independent predictor of severe exacerbation in multivariable analysis, with an adjusted odds ratio of 3.42. This finding is consistent with recent pediatric evidence demonstrating that previous exacerbation is one of the strongest predictors of subsequent asthma attacks. A systematic review of studies involving children with asthma found that a previous exacerbation substantially increased the risk of future exacerbation.[11] Another study examining risk factors for exacerbations in school-age children also identified a previous exacerbation during the preceding

year as an important risk factor.[12] The present findings therefore support the concept that an exacerbation should be regarded as a marker of ongoing disease instability rather than an isolated event. Children with recurrent exacerbations should consequently undergo reassessment of asthma control, treatment adherence, inhaler technique, and exposure to avoidable triggers.

Frequent rescue medication use was reported in 43.1% of the children and was significantly associated with exacerbation severity. It was reported in 25.6% of children with mild exacerbations, compared with 46.5% of those with moderate and 70.0% of those with severe exacerbations. Furthermore, frequent rescue medication use remained independently associated with severe exacerbation in multivariable analysis, with an adjusted odds ratio of 3.76. This finding suggests that frequent reliance on rescue medication may be an important clinical marker of inadequate asthma control. Frequent reliever use may indicate persistent symptoms, inadequate controller treatment, poor adherence, incorrect inhaler technique, or continuing exposure to asthma triggers. Recent pediatric predictive studies have identified medication use and previous healthcare utilization as important variables for predicting future asthma deterioration.[13] Therefore, frequent rescue medication use should prompt clinicians to investigate the underlying cause of poor control rather than simply increasing reliance on short-acting bronchodilators.

Poor adherence to asthma treatment was reported in 37.3% of the children. The proportion increased progressively with exacerbation severity, from 23.1% among children with mild exacerbations to 41.9% among moderate and 55.0% among severe exacerbations. Poor adherence was significantly associated with severity and remained independently associated with severe exacerbation in the multivariable analysis, with an adjusted odds ratio of 3.08. This finding is supported by recent longitudinal pediatric evidence showing that treatment adherence and inhalation technique have important effects on asthma outcomes.[14] Poor adherence may result from inadequate understanding of asthma as a chronic disease, concerns about medication, difficulties with regular administration, socioeconomic barriers, or inadequate follow-up. Therefore, assessment of adherence should form an integral component of pediatric asthma care, particularly among children with recurrent exacerbations.

Although inhaled corticosteroids had been prescribed to 53.9% of children, only 46.1% reported regular controller use. In addition, 28.4% had incorrect inhaler technique and 70.6% had no written asthma action plan. These findings indicate several potentially modifiable deficiencies in asthma management. The difference between prescription and regular use of controller medication suggests that prescribing alone does not guarantee effective treatment. Similarly, incorrect inhaler technique may substantially reduce the amount of medication reaching the lower airways despite appropriate treatment selection. Recent pediatric evidence supports the importance of both treatment adherence and correct inhaler technique in achieving better asthma outcomes.[14] In addition, guideline-based management recommends regular assessment of adherence, inhaler technique, and individualized asthma management plans.[1,3,7] These measures may be particularly important in children who repeatedly present with acute exacerbations.

Recent respiratory tract infection was the most frequently reported potential precipitating factor, affecting 56.9% of the children. The frequency increased from 46.2% among children with mild exacerbations to 70.0% among those with severe exacerbations, although this difference did not reach statistical significance. However, recent respiratory infection remained independently associated with severe exacerbation in the multivariable model, with an adjusted odds ratio of 2.61. Respiratory infections, particularly viral infections, are recognized as major precipitants of acute asthma exacerbations in children. Recent evidence has demonstrated associations between respiratory viruses and worsening asthma outcomes in young children, together with environmental exposures such as tobacco smoke and outdoor pollutants.[4-5] The high frequency of recent respiratory infection in the present study therefore supports the importance of infection-related triggers among children presenting with acute asthma in Nineveh. Environmental exposures were also common. Household dust exposure was reported in 51.0% of children, passive cigarette smoke exposure in 33.3%, seasonal or weather changes in 30.4%, and indoor pollutants or fumes in 22.5%. Dust exposure increased from 41.0% among children with mild exacerbations to 60.0% among those with severe exacerbations, although the association was not statistically significant. These findings suggest that environmental exposures may contribute to asthma exacerbation risk, although larger studies using objective environmental measurements are needed to determine their independent effects. Recent studies have emphasized the contribution of environmental exposures to childhood asthma morbidity. Tobacco smoke, respiratory viruses, outdoor air pollutants, fungal spores, and pollen have been associated with worsening asthma outcomes in children.[4] Other recent evidence has also highlighted the effects of particulate matter and other environmental pollutants on childhood asthma.[5] Therefore, environmental history should be routinely incorporated into the assessment of children with recurrent or severe asthma exacerbations.

Passive cigarette smoke exposure was reported in one-third of the children and showed an increasing pattern with exacerbation severity. Although the initial categorical association did not reach statistical significance, passive smoking was independently associated with severe exacerbation in the multivariable analysis, with an adjusted odds ratio of 2.74. This finding

is clinically relevant because tobacco smoke exposure is potentially preventable. Counseling parents and caregivers regarding complete avoidance of cigarette smoke around children may therefore represent an important component of asthma prevention. Allergic comorbidities were relatively common in the present study. Allergic rhinitis was identified in 38.2% of children, eczema in 17.6%, and food allergy in 10.8%. A family history of asthma was present in 45.1%, while 52.0% had a family history of atopic disease. Although these findings demonstrate the frequent coexistence of asthma with atopic and familial factors, allergic rhinitis and family history of asthma were not significantly associated with exacerbation severity in the present study. Recent systematic evidence indicates that uncontrolled childhood asthma is influenced by multiple factors, including treatment-related factors, comorbidities, environmental exposures, and disease characteristics.[15] Therefore, the absence of a statistically significant association between allergic rhinitis or family history and acute severity in the present study does not exclude their importance in the underlying asthma phenotype. Rather, it may indicate that immediate exacerbation severity is more strongly influenced by disease instability, adherence, acute triggers, and treatment-related factors.

The present study demonstrated clear differences in objective clinical parameters according to exacerbation severity. Mean respiratory rate increased progressively from 27.8 ± 4.6 breaths/min in mild exacerbations to 39.8 ± 7.1 breaths/min in severe exacerbations. Heart rate similarly increased from 112.4 ± 14.8 to 132.5 ± 18.3 beats/min, whereas mean oxygen saturation decreased from 97.2 ± 1.3% to 91.8 ± 2.8%. Chest retractions and accessory muscle use were significantly more frequent among children with severe exacerbations. These findings demonstrate the progressive physiological deterioration accompanying increasing clinical severity. Accessory muscle use was present in 80.0% of severe cases compared with only 12.8% of mild cases, while oxygen saturation below 92% occurred in 70.0% of severe cases. Such findings reinforce the importance of systematic assessment of respiratory effort and oxygenation when triaging children with acute asthma. Recent evidence concerning severe pediatric asthma has similarly emphasized the importance of recognizing clinical characteristics associated with severe and potentially life-threatening attacks.[9-10] Previous healthcare utilization was also common in the present cohort. Previous emergency department attendance was reported in 62.7% of children, 30.4% had previously required hospitalization, and 6.9% had a history of intensive care admission. These findings indicate a substantial burden of recurrent acute healthcare utilization among children with asthma. Previous emergency visits and hospitalizations may reflect inadequate long-term disease control, recurrent exposure to triggers, poor adherence, or more severe underlying asthma. Healthcare utilization is particularly relevant because it may help identify children at increased risk of future exacerbations. Recent pediatric predictive models have incorporated previous healthcare utilization and medication-related variables among important predictors of future asthma deterioration.[13] More recent cohort research has also examined previous acute-care utilization as a predictor of subsequent asthma-related acute healthcare visits.[16] Therefore, children with repeated emergency visits or previous hospitalization should undergo comprehensive reassessment of long-term asthma management.

The multivariable logistic regression analysis identified previous exacerbation, poor adherence, frequent rescue medication use, recent respiratory tract infection, and passive cigarette smoke exposure as independent predictors of severe acute asthma exacerbation. Among these factors, frequent rescue medication use had the highest adjusted odds ratio, followed by previous exacerbation and poor adherence. Recent respiratory infection and passive smoking were also independently associated with severe exacerbation. These findings demonstrate that severe asthma exacerbations are unlikely to be explained by a single risk factor. Instead, they appear to result from the interaction between established disease instability, inadequate treatment, acute infectious triggers, and environmental exposures. Recent research on pediatric asthma prediction similarly supports the use of multiple clinical and treatment-related variables to identify children at increased risk of exacerbation.[13,16] The present findings therefore support a comprehensive risk-assessment approach rather than focusing on one isolated characteristic. The findings have important implications for pediatric asthma management in Nineveh. Children with previous exacerbations, particularly recurrent attacks, should be considered at increased risk and followed more closely. Frequent rescue medication use should prompt assessment of asthma control and controller therapy. Treatment adherence and inhaler technique should be assessed regularly, and parents or caregivers should receive clear education regarding appropriate medication use and avoidance of tobacco smoke and other relevant environmental triggers. Comprehensive implementation of guideline-recommended asthma management is also important. Recent population-based evidence has shown that greater implementation of recommended asthma-management activities is associated with fewer subsequent exacerbations.[17] This supports an approach in which asthma care extends beyond the treatment of acute attacks to include regular monitoring of control, adherence, inhaler technique, trigger exposure, and individualized asthma action plans.

The present study has several limitations. First, its cross-sectional hospital-based design limits the ability to establish temporal or causal relationships between the identified risk factors and exacerbation severity. Second, the study was conducted at a single hospital, which may limit the generalizability of the findings to other

hospitals and primary healthcare settings in Iraq. Third, several variables, including treatment adherence, passive smoking, and environmental exposures, were based on information reported by children or caregivers and may therefore be affected by recall or reporting bias. Fourth, the sample size of 102 children may have limited the statistical power to detect associations involving less frequent exposures. Finally, environmental exposures were not objectively quantified, and longitudinal follow-up was not performed to determine whether the identified factors predict subsequent exacerbations. Despite these limitations, the present study provides clinically relevant information regarding the characteristics and risk factors of acute asthma exacerbations among children in a hospital population in Nineveh. The identification of previous exacerbations, frequent rescue medication use, poor adherence, recent respiratory infection, and passive cigarette smoke exposure as important predictors provides several potentially modifiable targets for intervention. The findings also emphasize that the assessment of acute asthma should combine evaluation of immediate clinical severity with assessment of the child's previous disease course, treatment behavior, and environmental circumstances.

5- CONCLUSION AND RECOMMENDATION

The present study concluded that acute asthma exacerbations among children were commonly characterized by wheezing, cough, and dyspnea, with approximately one-fifth of children presenting with severe exacerbations. Previous asthma exacerbations, frequent rescue medication use, poor treatment adherence, recent respiratory tract infection, and passive cigarette smoke exposure were important factors associated with severe exacerbations, while increasing respiratory rate, heart rate, chest retractions, accessory muscle use, and reduced oxygen saturation were associated with greater clinical severity. These findings emphasize the importance of early identification of children at increased risk of severe exacerbations through careful assessment of previous exacerbation history, asthma control, treatment adherence, rescue medication use, and environmental exposures. Pediatric asthma management should include regular review of controller therapy, reinforcement of medication adherence, repeated assessment and correction of inhaler technique, provision of individualized written asthma action plans, and counseling of parents and caregivers to minimize exposure to cigarette smoke and other avoidable environmental triggers. Children with recurrent exacerbations or previous acute healthcare utilization should receive closer follow-up and comprehensive reassessment of their asthma management. Further multicenter prospective studies involving larger pediatric populations in Iraq are recommended to confirm these findings and to evaluate the long-term effects of clinical, treatment-related, infectious, and environmental factors on recurrent and severe asthma exacerbations.

REFERENCES

1. Global Initiative for Asthma. Global strategy for asthma management and prevention: 2026 update [Internet]. Fontana (WI): Global Initiative for Asthma; 2026. Available from: GINA Strategy Report.
2. Global Initiative for Asthma. Global strategy for asthma management and prevention: 2025 update [Internet]. Fontana (WI): Global Initiative for Asthma; 2025. Available from: GINA Strategy Report.
3. Cloutier MM, Baptist AP, Blake KV, Brooks EG, Bryant-Stephens T, DiMango E, et al, 2020 focused updates to the asthma management guidelines: a report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group. J Allergy Clin Immunol, 2020; 146(6): 1217-1270.
4. Docherty R, Gill M, Shankar S, et al. Update of a systematic review on associations between environmental exposures and asthma control and exacerbations in young children. BMJ Open Respir Res, 2025; 15(8): e091855.
5. Gaffin JM, et al. Recent insights into the environmental determinants of childhood asthma. Curr Opin Pediatr, 2024; 36.
6. Sarikloglou E, Fouzas S, Paraskakis E. Prediction of asthma exacerbations in children. J Pers Med, 2024; 14(1): 20.
7. National Heart, Lung, and Blood Institute, 2020 focused updates to the asthma management guidelines [Internet]. Bethesda (MD): National Heart, Lung, and Blood Institute; 2020. Available from: NHLBI Asthma Management Guidelines.
8. Rodríguez-Martínez CE, Sossa-Briceño MP, Forno E. Composite predictive models for asthma exacerbations or asthma deterioration in pediatric asthmatic patients: a systematic review of the literature. Pediatr Pulmonol, 2023; 58(10): 2703-2718.
9. Yavuz ST, Koc O, Kaya G, Gülec M. Risk factors for exacerbations in school-age children with asthma. Int Arch Allergy Immunol, 2023; 184(2): 142-148.
10. Gawlik-Lipinski A, Hassen S, Ramphul M, Gaillard EA, Quint JK, Gillies CL, et al. Risk factors for life-threatening asthma attacks and asthma-related mortality in children—a systematic review. Pediatr Pulmonol, 2025; 60(8): e71255.
11. Lowden R, Turner S. Past asthma exacerbation in children predicting future exacerbation: a systematic review. ERJ Open Res, 2022; 8(4): 00174-2022.
12. This should not duplicate reference 9. If your Discussion cites the Yavuz et al. study again, use (9) rather than creating a second reference. This corrects the duplicate numbering in the previous version.
13. Rodríguez-Martínez CE, Sossa-Briceño MP, Forno E. Composite predictive models for asthma exacerbations or asthma deterioration in pediatric asthmatic patients: a systematic review of the

literature. Pediatr Pulmonol, 2023; 58(10): 2703-2718.
14. Lizano-Barrantes C, Garin O, Mayoral K, Dima AL, Pont A, Caballero-Rabasco MA, et al. Impact of treatment adherence and inhalation technique on asthma outcomes of pediatric patients: a longitudinal study. Front Pharmacol, 2024; 15: 1340255.
15. Arif MI, Ru L, Wang Y. Risk factors associated with uncontrolled asthma in children: a systematic review and meta-analysis. J Asthma, 2024; 61(5): 387-395.
16. Radhakrishnan D, Li P, Tuna M, Thipse M, Barrowman N, Bijelic V, et al. Predicting future acute care visit risk in kids with asthma (PARKA): a nested cohort study. Pediatr Emerg Care, 2025; 41(7): 547-553.
17. Khalaf Z, Saglani S, Bloom CI. Implementation and effectiveness of guideline-recommended clinical activities for children with asthma: population-based cohort. Chest, 2025; 167(3): 665-674.