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Risk Factors of Severe Asthma Exacerbation among Egyptian Children: A Case- Control Study

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ABSTRACT
Background: Asthma is a prevalent major non-communicable disease that significantly affects the quality of life for many individuals. As measured by disability-adjusted life years, asthma is the 16th most common cause of years lived with disability and the 28th most common cause of burden of disease on a global scale.
Objective: This study aimed to determine the risk factors for asthma exacerbations among asthmatic children attending Mansura University Children Hospital and to assess the outcome of exacerbation.
Methods: The study included 110 participants, who were divided into two groups: Cases of asthma exacerbation and age- and sex-matched control group.
Results: This study showed no significant difference among patients and controls in terms of age, sex, residence and parent education. A significantly higher socioeconomic status was detected among control group than in cases. A significant higher mean body mass index, frequency of preterm, positive family history of atopy, asthma, allergic rhinitis, cough, wheezes, bad housing, smoking- related symptoms, viral-related symptoms, cold air-related symptoms, dust-related symptoms among cases than in control group. There was a significant association among severe asthma exacerbation and presence of strong emotions as aggravating factors. There was no significant association between exacerbation severity and past and family history of the studied cases. Younger age at diagnosis, low socioeconomic status were significant predictors of severe asthma. They predicted severity by 74.2%. Decreasing age at diagnosis by one year increased risk of severe asthma by 0.960(0.935 -0.987). Low socioeconomic status increased risk of severe asthma by 11.25 more times than cases with high socioeconomic status.
Conclusion: Obesity, prematurity, low socioeconomic status, younger age of diagnosis, family history of atopy, asthma or allergic rhinitis, bad housing, smoking, dust, viral infections, cold air and strong emotions are the most detected predictors and risk factors for asthma exacerbations among asthmatic children. Severe exacerbations were more associated with low socioeconomic status and presence of strong emotions as aggravating factors. It is imperative to possess an understanding of the specific risk factors in order to develop effective treatment and control protocols. Reduced exposure to these risk factors enhanced management of asthma.
Keywords: Asthma exacerbation, Egyptian children, Risk factors.

INTRODUCTION

An asthma exacerbation, also referred to as an asthma "attack" or "episode," is a common occurrence in pediatric practice. The definition of asthma exacerbation remains controversial, despite the fact that a comprehensive assessment of severity and treatment for exacerbation was initially proposed in guidelines many years ago. An asthma exacerbation was defined as an acute or subacute episode characterized by a progressive increase in asthma symptoms, which was associated with airflow obstruction [1]. Modest asthma exacerbations are defined as the occurrence of at least one of the following events for a minimum of two days (without the need for systemic corticosteroids): An increase in rescue bronchodilator use, a decline in lung function, and/or a decline in symptoms, according to the ATS/ERS consensus statement. In accordance with this definition, asthma-related emergency room visits that do not necessitate systemic corticosteroids should be classified as moderate disease exacerbations [2].

Dyspnea, anxiety, coughing, and wheezing are among the symptoms of severe asthma exacerbation. Patients are unable to converse in sentences or phrases, while lying supine and are diaphoretic at rest. In critical cases, cardiopulmonary dysfunction, obtundation, and apparent cyanosis are all present. Drowsiness and confusion are indicators of imminent respiratory arrest. Central cyanosis, audible wheezing, and the utilization of accessory respiratory muscles are frequently observed in children with severe asthma exacerbation [3].

Severe asthma exacerbations may be the consequence of inadequate asthma management. In order to effectively manage persistent asthma, controller medications, such as inhaled corticosteroids (ICS), are essential. The likelihood of severe disease exacerbations has been consistently demonstrated to be reduced by these medications. Even with the use of controller medications, children who have persistent asthma and have experienced at least one severe exacerbation in the previous year are at a twofold increased risk of experiencing subsequent severe exacerbations. This suggests that there may be inter-individual susceptibility, such as genetics [4]. In order to: (1) mitigate the severity of an exacerbation and (2) prevent future exacerbations subsequent to the current attack, the preventive management of exacerbation can be approached from two primary perspectives [5].

Inhaled β2-agonists, corticosteroids, and anticholinergic agents are the primary medications for severe asthma exacerbation, while magnesium is effective for critically

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ill patients. Aminophylline is not recommended except in an intensive care unit. In the event that intubation and mechanical ventilation are required, permissive hypercapnia, controlled hypoventilation with respiratory rates that are lower than conventional, and low tidal volume may be implemented. Heliox, sedatives, neuromuscular blockers, and non-invasive ventilation should be implemented with caution [6]. This study aimed to define risk factors for asthma exacerbations among asthmatic children attending Mansura University Children Hospital and to assess the outcome of exacerbation.

PATIENTS AND METHODS

The study was designed as a case-control study and was conducted through the period from November 2022 to November 2023. This study included a total of 110 participants, who were divided into two groups: Cases of asthma exacerbation (Study group) and age- and sex-matched control as controlled asthmatic children. Bronchial asthma was diagnosed in accordance with the guidelines established by the Global Initiative for Asthma [7, 8]. The clinical diagnosis of atopy is contingent upon the presence of current or past symptoms of atopic dermatitis, allergic rhinoconjunctivitis (seasonal or perennial) or food allergy, which are verified by serum IgE [9].

Assessment of asthma severity level: The severity of the patient's asthma was assessed in accordance with the medication they were taking, as directed by GINA [7].
Current definitions of mild asthma include asthma that is effectively managed with as-needed ICS-formoterol or low-dose ICS in conjunction with as-needed SABA.
- Asthma that is effectively managed by step 3 or step 4 treatment, such as low or medium dose ICS-LABA in either treatment track, is currently defined as moderate asthma.
- The term "severe asthma" refers to asthma that requires high-dose ICS-LABA to prevent it from becoming uncontrolled or that remains uncontrolled despite optimized treatment with high-dose ICS-LABA. Severe asthma and asthma that is challenging to manage due to persistent adherence issues, inadequate or inappropriate treatment, or comorbidities such as chronic rhinosinusitis or obesity must be distinguished. The treatment implications are significantly different when asthma is relatively refractory to high-dose ICS-LABA or even OCS [10].

Assessment of asthma exacerbation: The Pediatric Asthma Severity Score (PASS) was used to assess the severity of an asthma attack. It has three parameters: The quantity of wheeze, the amount of work required to breathe as measured by auxiliary muscle use, and the presence of delayed expiration. It's a simple and straightforward technique that was created for use in asthma severity research [11]**.** The score was calculated as a linear sum of individual values for each parameter considered, with limitations ranging from 0 to 6. The PASS was utilized to determine the severity of asthma, with higher scores indicating more severe asthma. (Mild < 2, Moderate = 2 - 3, Severe = 4 - 6).

Early symptoms of an exacerbation may include any of the following: An acute or sub-acute increase in wheezing and shortness of breath, an increase in coughing, particularly while the child is asleep, lethargy or reduced exercise tolerance, impairment of daily activities, including feeding, and an inadequate response to reliever medication are all indicators of the onset of respiratory tract infection symptoms. The trail variables included sex, age, BMI, residence level of parent education, economic factors, exercise, viral infections, household pets, smoking and dust exposure, strong emotions, bad housing, and cold weather.

Ethical Consideration: Informed consents were obtained from all parents of the patients. The study was approved by The Institutional Review Board (IRB), Faculty of Medicine, Mansoura University (Approval code: Ms 11/9-2022). The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis of data:
The IBM-SPSS software (IBM SPSS Statistics for Windows, version 16) was employed to enter and analyze the data. Version 20 of the MedCalc® statistical software. Numbers and percentages were employed to describe qualitative data. The Chi square test was employed to investigate the relationship among categorical variables. The mean and standard deviation were used to describe quantitative normally distributed data, while the median and range were used to describe non-normally distributed data. The Mann Whitney test was employed to compare non-parametric data, while the independent t test was employed to compare parametric data among two groups. The independent variables of asthma were predicted using binary stepwise logistic regression analysis. The forward Wald method was employed to incorporate the significant predictors from the bivariate analysis into the regression model. The odds ratios and their 95% confidence interval were computed. The results were deemed significant when the p-value was less than or equal to 0.05.

RESULTS

Table (1) showed that there was non-significant difference among patients and controls in terms of age, sex, residence and parent education. A statistically significant higher mean body mass index was detected among cases than in control group (22.71 ± 11.11 and 17.07 ± 3.41 respectively). A statistically significant higher socioeconomic status was detected among control groups than cases. A statistically significant higher frequency of preterm, positive family history of atopy, asthma, allergic rhinitis among cases than in control group [($p<0.05$), 18.2% versus 5.5% for preterm, 49.1% versus 25.5% for family history of atopia, 85.5% versus 49.1% for family history of asthma and 47.3% versus 29.1% for allergic rhinitis].

Table (1): comparison of socio-demographic characteristics, past history and family history of the studied groups

	Cases group N=55	**Control group N=55**	**Test of significance**
Age / years			Z=0.133
Mean ± SD	6.93 ± 2.89	6.89 ± 2.94	P=0.894
median (min-max)	6 (2-17)	6 (2-17)	
Sex	N (%)	N (%)	
Male	33 (60.0)	39 (70.9)	χ^2=1.45
Female	22 (40.0)	16 (29.1)	P=0.229
BMI (Kg/m2)			t=3.59
Mean ± SD	22.71 ± 11.11	17.07 ± 3.41	p-0.001*
Residence			
Urban	41 (74.5)	47 (85.5)	χ^2=2.05
Rural	14 (25.5)	8 (14.5)	P=0.153
Socioeconomic status			
Low	28 (50.9)	14 (25.5)	
Middle	16 (29.1)	25 (45.5)	χ^2=7.59
High	11 (20.0)	16 (29.1)	P=0.02*
Parent education			
Illiterate	2 (3.6)	1 (1.8)	χ^2=0.424
Middle	12 (21.8)	11 (20.0)	P=0.809
Higher education	41 (74.5)	43 (78.2)	
Preterm			
-ve	45 (81.8)	52 (94.5)	χ^2=4.27
+ve	10 (18.2)	3 (5.5)	P=0.03*
Neonatal asphyxia			
-ve	43 (78.2)	47 (85.5)	χ^2=0.978
+ve	12 (21.8)	8 (14.5)	P=0.459
Twins			
No	42 (76.4)	45 (81.8)	χ^2=0.495
Yes	13 (23.6)	10 (18.2)	P=0.482
Family history of atopy			
-ve	28 (50.9)	41 (74.5)	χ^2=6.57
+ve	27 (49.1)	14 (25.5)	P=0.01*
Family history of asthma			
-ve	8 (14.5)	28 (50.9)	χ^2=16.52
+ve	47 (85.5)	27 (49.1)	P=0.001*
Other comorbidities			
-ve	47 (85.5)	51 (92.7)	χ^2=1.49
+ve	8 (14.5)	4 (7.3)	P=0.221
Allergic rhinitis			
-ve	29 (52.7)	39 (70.9)	χ^2=3.85
+ve	26 (47.3)	16 (29.1)	P=0.05*

Data are presented as mean ± SD, median (IQR) or number (%). SDZ: Mann Whitney U test, $\chi2$= Chi-Square test, *statistically significant $\chi2$=Chi-Square test, *statistically significant (P value≤ 0.05).

Table (2) showed a statistically significant higher frequency of the following symptoms and aggravating factors among cases than in control group: Cough, wheezes, bad housing, smoking- related symptoms, viral-related symptoms, cold air-related symptoms and dust-related symptoms.

Table (2): symptoms, aggravating factors of asthma and adherence to treatment among the studied cases

	Cases group N=55	%	Control group N=55	%	Test of significance
Cough	35	63.6	21	38.2	χ^2=7.13 P=0.008*
Wheezes	33	60.0	19	34.5	χ^2=7.15 P=0.008*
Night related symptoms	29	52.7	20	36.4	χ^2=2.98 P=0.084
Exercise related symptoms	17	30.9	20	36.4	χ^2=0.367 P=0.545
Food related symptoms	14	25.5	12	21.8	χ^2=0.201 P=0.654
Household pets	13	23.6	13	23.6	χ^2=0.0 P=1.0
Bad housing	25	45.5	15	27.3	χ^2=3.93 P=0.047*
Smoking related symptoms	32	58.2	13	23.6	χ^2=13.58 P<0.001*
Viral related symptoms	37	67.3	15	27.3	χ^2=17.65 P<0.001*
Strong emotions related symptoms	7	12.7	12	21.8	χ^2=1.59 P=0.207
Cold air related symptoms	36	65.5	14	25.5	χ^2=17.75 P=0.001*
Dust related symptoms	34	61.8	18	32.7	χ^2=9.34 P=0.002*
Adherence to treatment	32	58.2	28	50.9	χ^2=0.587 P=0.566

Data are presented as number (%). χ^2=Chi-Square test, *statistically significant (P value≤ 0.05)

Table (3) showed that median duration since last exacerbation was 14 days ranging from 2 to 180 days. Median asthma exacerbation was 23 ranging from 2 to 50.

Table 3: Exacerbation frequency and duration among studied cases

Exacerbation history	N=55	%
Exacerbation since (days), Median (min-max)	14(2-180)	
Exacerbation number, Median (min-max)	23(2-50)	

Data are presented as median (range).

Table (4) showed that 47.3% moderate, 40% severe and 12.7% mild exacerbation. 3.6% of the studied cases needed oxygenation and 1.8% needed mechanical ventilation.

Table (4): Distribution of the studied cases according to severity of asthma exacerbation, need for oxygenation and need for mechanical ventilation

		N=55	%
Severity of exacerbation	**Mild Moderate severe**	7 26 22	12.7 47.3 40.0
Need Oxygenation		2	3.6
Need mechanical ventilation		1	1.8

Data are presented as number (%)

Table (5) showed a statistically significant younger age at diagnosis among cases with severe exacerbation than in mild and in moderate exacerbation (median age 6 months versus 36 months). Severe exacerbations were more associated with low socioeconomic status with statistically significant relation. There was no statistically significant association among exacerbation severity and past, family history of the studied cases.

Table (5): relation between sociodemographic characteristics, past and family history, and severity of exacerbation among studied cases

	Mild -moderate exacerbation N=33	Severe Exacerbation N=22	Test of significance
Age / years **median (min-max)**	6 (2-17)	6 (3-12)	Z=0.374 P=0.709
Age at diagnosis (months) **median (min-max)**	36 (1-108)	6 (1-60)	Z=2.88 P=0.004*
Sex N (%) **Male** **Female**	 19 (57.6) 14 (42.4)	 14 (63.6) 8 (36.4)	χ^2=202 P=0.653
BMI (Kg/m^2) **Mean ± SD**	24.42 ± 12.69	20.15 ± 7.78	Z=1.41 P=0.165
Residence N (%) **Urban** **Rural**	 24 (72.7) 9 (27.3)	 17 (77.3) 5 (22.7)	χ^2=0.144 P=0.705
Socioeconomic status N (%) **Low** **Middle** **High**	 8 (24.2) 16 (48.5) 9 (27.3)	 20 (90.9) 0 2 (9.1)	χ^2=24.37 P=0.001*
Parent education N (%) **Illiterate** **Middle** **Higher education**	 1 (3.0) 8 (24.2) 24 (72.7)	 1 (4.5) 4 (18.2) 17 (77.3)	χ^2=0.342 P=0.843
Preterm **-ve** **+ve**	 29 (87.9) 4 (12.1)	 16 (72.7) 6 (27.3)	χ^2=2.04 P=0.154
Neonatal asphyxia **-ve** **+ve**	 23 (69.7) 10 (30.3)	 20 (90.9) 2 (9.1)	χ^2=3.48 P=0.062
Twins **No** **Yes**	 23 (69.7) 10 (30.3)	 19 (86.4) 3 (13.6)	χ^2=2.3 P=0.154
Family history of atopy **-ve** **+ve**	 16 (48.5) 17 (51.5)	 12 (54.5) 10 (45.5)	χ^2=0.194 P=0.660
Family history of asthma **-ve** **+ve**	 3 (9.1) 30 (90.9)	 5 (22.7) 17 (77.3)	χ^2=1.98 P=0.160
Other comorbidities **-ve** **+ve**	 27 (81.8) 6 (18.2)	 20 (90.9) 2 (9.1)	χ^2=0.878 P=0.349
Allergic rhinitis **-ve** **+ve**	 18 (54.5) 15 (45.5)	 11 (50.0) 11 (50.0)	χ^2=0.109 P=0.788

Table (6) showed a statistically significant association among severe asthma exacerbation and presence of strong emotions as aggravating factor.

Table (6): relation between symptoms, aggravating factors, adherence to treatment and severity of exacerbation among studied cases

	Mild -moderate exacerbation N=33	**Severe Exacerbation N=22**	**Test of significance**
Cough	19(57.6)	16(72.7)	χ^2=1.31 P=0.252
Wheezes	19(57.6)	14(63.6)	χ^2=0.202 P=0.653
Night related symptoms	19(57.6)	10(45.5)	χ^2=0.778 P=0.378
Exercise related symptoms	10(30.3)	7(31.8)	χ^2=0.014 P=0.905
Food related symptoms	7(21.2)	7(31.8)	χ^2=783 P=0.376
Household pets	7(21.2)	6(27.3)	χ^2=0.269 P=0.604
Bad housing	12(36.4)	13(59.1)	χ^2=2.75 P=0.097
Smoking related symptoms	18(54.5)	14(63.6)	χ^2=0.448 P=0.503
Viral related symptoms	22(66.7)	15(68.2)	χ^2=0.014 P=0.907
Strong emotions related symptoms	1(3.0)	6(27.3)	χ^2=6.98 P=0.008*
Cold air related symptoms	21(63.6)	15(68.2)	χ^2=0.121 P=0.728
Dust related symptoms	19(57.6)	15(68.2)	χ^2=0.629 P=0.573
Adherence to treatment	18(54.5)	14(63.6)	χ^2=0.448 P=0.583

Z: Mann Whitney U test, $\chi2$:Chi-Square test, *statistically significant (P value≤ 0.05)

Table (7) demonstrated that younger age at diagnosis, low socioeconomic status were statistically significant predictors of severe asthma, they predicted severity by 74.2%. Decreased age at diagnosis by one year increases risk of severe asthma by 0.960 (0.935 -0.987). Low socioeconomic status increase risk of severe asthma by 11.25 more times than cases with high socioeconomic status.

Table (7): Binary logistic regression for predictors of severe asthma

	β	P value	OR (95%CI)
Age / years	-0.043	0.735	0.958 (0.749-1.23)
Age at diagnosis / years	-0.04	0.004*	0.960 (0.935-0.987)
Sex **Male** **Female (r)**	0.254	0.653	1.29 (0.425-3.91) 1
BMI (Kg/m^2)	-0.061	0.07	0.941 (0.881-1.0)
Residence **Urban** **Rural (r)**	0.243	0.705	1.27 (0.363-4.48)
Socioeconomic status **Low** **Middle** **High (r)**	2.42 -19.69	0.006* 0.998	11.25 (1.98-63.96) Undefined 1
Parent education **Illiterate** **Middle** **Higher education (r)**	0.345 -0.348	0.812 0.613 0.844	1.41 (0.082-24.18) 0.706 (0.183-2.73) 1
Preterm	0.761	.339	2.14 (0.450-10.18)
Neonatal asphyxia	-1.42	.102	.240 (0.043-1.33)
Twins	-0.706	.378	.494 (0.103-2.37)
Family history of atopy	-0.152	.812	.859 (.247-2.99)
Family history of ashtma	-0.716	.420	.489 (0.086-2.78)
Allergic rhinitis	0.82	0.741	1.20 (0.407-3.54)
Cough	0.675	0.256	1.97 (0.613-6.29)
Wheezes	0.245	0.653	1.29 (0.425-3.91)
Night related symptoms	-2.570	.042	.077 (0.006-0.909)
Exercise related symptoms	-.483	.660	.617 (0.071-5.32)
Food related symptoms	1.187	.263	3.276 (0.411-26.13)
Household pets	-1.725	.186	.178 (0.014-2.30)
Bad housing	1.276	.205	3.58 (0.497-25.85)
Smoking related symptoms	17.285	.999	3.212 (undefined)
Viral related symptoms	-19.014	1.000	.000 (undefined)
Strong emotions related symptoms	36.041	.998	4.49 (undefined)
Cold air related symptoms	-33.548	.999	.000 (undefined)
Dust related symptoms	36.129	.999	4.90 (undefined)
Adherence to treatment	-.194	.816	.824 (0.161-4.21)
Overall % predicted =74.2%			

r: reference group OR: odds ratio, CI: coefficient interval. *: significant P value < 0.05

DISCUSSION

Asthma is a non-communicable disease that is prevalent and has significant effects on the quality of life of a large number of individuals. Globally, asthma is the 28th most prevalent cause of disease and the 16th most prevalent cause of years lived with disability, as measured by disability-adjusted life years [12]. The purpose of this trail was to define risk factors for asthma exacerbations among asthmatic children attending Mansura University Children Hospital and to assess the outcome of exacerbation.

The current study showed non-statistically significant difference among studied groups as regards sex, age, residence and parent education. A statistically significant higher mean body mass index was detected among cases than in control group (22.71 ± 11.11 and 17.07 ± 3.41, respectively). A statistically significant higher socioeconomic status was detected among control groups than cases. This outcome is consistent with the findings of **Elnady *et al.*** [13] who identified that a total of 128 pairs of asthmatic children aged 7–16 years old, with a mean age of 10.14 years, and their caregivers were taken into account.

Of the patients examined, 58 (45.3%) were males and 70 (54.7%) were females. There were no significant correlations found among environmental tobacco smoke exposure, household size, BMI, age, or sex of the child ($P > 0.05$). This finding is at odds with the findings of **Redline *et al.*** [14] and **Kalyoncu *et al.*** [15] who asserted that male gender was a significant risk factor for asthma.

The current trail demonstrated statistically significant higher frequency of preterm, positive family history of atopy, asthma, allergic rhinitis among cases than in control group ($p < 0.05$), (18.2% versus 5.5% for preterm), (49.1% versus 25.5% for family history of atopy), (85.5% versus 49.1% for family history of asthma) and (47.3% versus 29.1% for allergic rhinitis). This finding is consistent with **Ibrahim *et al.*** [16] who discovered that of the 124 asthma patients, one (2.6%) had a family history of asthma, 12.9% had a history of tobacco smoking, and 7.0% had a previous history of acute severe asthma admission. Age (x2 = 15.48, p <.001) and tobacco smoking were statistically significantly associated with asthma mortality. In this context, **Xu *et al.*** [17] discovered that previous research indicated that maternal history has a more significant correlation with the risk of asthma in children than paternal history.

The mean body mass index of the cases was statistically significantly higher than that of the control group in the current study (22.71 ± 11.11 versus 17.07 ± 3.41 respectively). This discovery is in agreement with that of **Ng *et al.*** [18] who found that an elevated BMI was linked with an increased number of asthma-related missed school days, lifetime hospital admissions, emergency department visits, and activity limitations. In contrast to **To *et al.*** [19], who found no statistically significant correlation between obesity and asthma in children, this finding is in direct opposition.

The socioeconomic status of the control group was statistically significantly higher than that of the cases in the current study. This finding is consistent with the findings of **Georgy *et al.*** [20] who discovered that the severity of asthma symptoms is both more prevalent and severe in children from lower socio-economic backgrounds in a trail of the prevalence and socioeconomic associations of asthma and allergic rhinitis in Egypt. Asthma and asthma-related adverse events, including hospitalizations were more prevalent among children from lower socioeconomic backgrounds. Additionally, **Hossny *et al.*** [21] discovered that 53.3% of the asthmatic children had an associated allergic disease in a separate study conducted in Egypt.

The present trail demonstrates that the following symptoms and aggravating factors were present in a statistically significant higher frequency among the cases than the control group: Cough (63.6% in cases and 38.2% in control), wheezes (60% in cases and 34.5% in control), bad housing (45.5% in cases and 27.3% in control), smoking-related symptoms (58.2% in cases and 23.6% in control), viral-related symptoms (67.3 % in cases and 27.3% in control), cold air-related symptoms (65.5% in cases and 25.5% in control) and dust-related symptoms (61.8% in cases and 32.7% in control). This outcome is consistent with the assertion made by **Anwar *et al.*** [22] that the student's comprehension of the aggravating factors of bronchial asthma was demonstrated. Smokes and dust were identified as the primary aggravating factors by a significant number of participants (93.9% and 90.1%, respectively). Perfumes and bakhour were ranked second (80.2%), followed by weather changes (76.3%) and the common cold (63.4%). The students mentioned anxiety and stress, exposure to animals, and the intake of certain types of food in smaller percentages (51.1%, 42%, and 32.8% respectively). The most prevalent symptoms of bronchial asthma exacerbation in our trail were coughing and wheezing. In the same vein, **Chang *et al.*** [23] discovered that the most prevalent chest complaints in asthmatic children were cough, dyspnea, wheezy chest, nocturnal symptoms, and chest infection. In that order, our results are in agreement with the findings of other published studies, which indicate that asthma has a strong association with recurrent chest infections and cold/flu. Conversely, a comprehensive epidemiologic study conducted in Germany has unequivocally demonstrated that the risk of the development of atopy and asthma in the future is significantly reduced by the frequent occurrence of upper respiratory infections during the first year of life, even in children with a family history of atopic diseases. The hygiene hypothesis is corroborated by these data, however they seem to contradict the positive correlations between respiratory infections and asthma in our series [24].

An association between exposure to environmental tobacco smoke and pulmonary morbidity in children with asthma was reported by **Chilmonczy and colleagues** [25]. The significance of systemic, persistent endeavors to prevent the exposure of children with asthma to environmental tobacco smoke is underscored by these data and our own. Numerous publications indicated that the likelihood of asthma was elevated in individuals who resided or worked in an environment that contained smoke, fumes, or dust.

In reality, emotional stress functions as an asthma trigger, as demonstrated by**.** Hyperventilation and hypercapnia, which can result in airway narrowing, can be caused by extreme expressions of fear, anger and cry, or laughter. Posited that a variety of health conditions, including frequent exacerbations and severe asthma symptoms, are associated with inadequate ventilation and overcrowding in housing [25].

The present study revealed a significant statistical difference among the two groups that were analyzed in relation to dust as a risk factor for acute asthma exacerbation. Sensitization to dust is a significant risk factor for asthma exacerbations and rehospitalization, as per the Institute of Medicine in Washington and **Etzel *et al.*** [26]**.** Additionally, the research conducted by **Abdel-Baseer *et al.*** [27] demonstrated that the frequency of acute exacerbations of bronchial asthma in asthmatic children increased statistically significantly when they were exposed to noxious fumes inhalation, house dust, viral upper respiratory tract infections, cold air exposure, and parental smoking.

The current study reported that the median duration since the most recent exacerbation was 14 days, with a range of 2 to 180 days. The median number of asthma exacerbations was 23, with a range of 2 to 50. **Asseri** [28] found that the average length of stay for children with asthma exacerbation was between two and four days, which is in direct opposition to this result. **Suruki *et al.*** [29] estimated that the overall mean annual exacerbation rates per patient in the US and UK were 0.16/year and 0.11/year respectively during the 12-month period following the index date. This information is relevant in this context. The mean annual exacerbation frequency increased in correlation with the severity of the disease (GINA step, severe uncontrolled, and uncontrolled eosinophilic asthma status) and the frequency of historical exacerbations. Exacerbations were more common in females and atopic patients, and their frequency increased with the Leidy category. Despite the fact that the US had higher overall mean annual exacerbation rates, the mean annual exacerbation rate trends were generally consistent across covariates in both the US and UK during the 12-months follow-up period.

The present investigation demonstrated that 47.3% of patients experienced moderate, 40% severe, and 12.7% mild exacerbations. **Puranik *et al.*** [30] anticipated that a clinical score based on yes/no questions would yield a final score between 0 and 17 points when used in a questionnaire that could be administered in a general pediatrician's office to predict severe asthma exacerbations. This estimate is relevant in this context. The odds of an exacerbation in the previous year increased by 1.6-fold for each 1-point increase in score in the initial sample of Costa Rican children aged 6 to 14 (95% CI, 1.3 – 2.0; P < 0.001). This was based on an area under the curve (AUC) of 0.75. The AUC for predicting exacerbations up to one year later was 0.69 when applied to North American children who were enrolled in a longitudinal study. Note that the cutoff score for children at low risk had a positive predictive value of 94–99% for "no hospitalizations." This is an important point to consider. Despite its imperfections and the necessity for additional refinement and validation in more diverse and diverse populations, this score is promising. In the end, it may enable clinicians to distinguish between children who are at a low and high risk of experiencing severe asthma exacerbation [31].

In this context, **Malmström *et al.*** [31] discovered that readmissions occurred 38 times in mechanically ventilated patients among 1976 and 1985 and 5 times among 1986 and 1995. The current trail indicates that 3.6% of the studied cases required oxygenation and 1.8% required mechanical ventilation. **Malmström *et al.*** [31] reported that asthma was the cause of death in three of the five patients who received mechanical ventilation.

In contrast to mild and moderate exacerbations, instances of severe exacerbation exhibited a statistically significant younger age at diagnosis (median age 6 months versus 36 months). Low socioeconomic status was statistically significantly associated with severe exacerbations. **Joy *et al.*** [32] discovered that all participants were currently enrolled in schools and that approximately 74.2% of them had self-reported satisfactory academic performance in spite of their asthma diagnosis. Therefore, our finding is in direct opposition to their findings. The mean number of children in each household was 3.59 ± 1.4 and the total number of individuals in the household was 5.98 ± 1.63. Tertiary education was completed by 49 (76.5%) of the mothers. The principal component analysis (PCA)-based SES of the children revealed the association with the socio-demographic variable and the asthma control status of the participants. The participants were categorized as follows: the most impoverished (16) (24.2%), the very impoverished (17) (25.7%), the poor (17) (25.7%), and the least impoverished (16) (24.2%). The age and socioeconomic status of the participants did not affect the asthma control outcome. Furthermore, the asthma control level was not influenced by the educational level, employment status, or number of children in the household of the mothers [33]**.**

The current study did not reveal any statistically significant association between the severity of exacerbations and the past and family histories of the cases under investigation. The findings of our study are in direct opposition to those of **Mahfouz *et al.*** [33] who discovered a significant association among asthma control and allergic rhinitis in the Qassim region. Poor asthma control is significantly associated with symptoms such as nasal obstruction, sneezing, and a runny nose (p = 0.006). It is significantly associated with poorer asthma control to have a known family history of asthma, eczema, or allergic rhinitis (0.004). The research revealed that patients who were younger, female, had shorter disease durations, and did not have comorbidities were more satisfied with their allergy treatment. These results underscore the significance of taking into account patient preferences and characteristics when formulating and administering allergy treatment strategies.

The present study demonstrated a statistically significant association among the presence of strong emotions as an aggravating factor and severe asthma exacerbation. **Sanya *et al.*** [34] estimated that the risk factors of sex, level of education, non-adherence to medication, exercise/sport, household pets, smoking, strong emotions, exposure to in-house wood or charcoal burning, rainy weather, non-steroidal anti-inflammatory drugs, and beta blockers were not statistically significant. Our finding is in contradiction to their findings.

The current study illustrated that severe asthma is statistically significantly predicted by a younger age at diagnosis and a low socioeconomic status, with a prediction of 74.2%. The risk of severe asthma is increased by 0.960 (0.935 - 0.987) when the age at diagnosis is reduced by one year. The risk of severe asthma was 11.25 times higher in cases of low socioeconomic status than in cases of high socioeconomic status. This finding is in agreement with **Ibrahim *et al.*** [16] who estimated that using binary logistic regression model, patients' aged > 60 years (COR, 14.857; 95% CI: 2.489 – 88.696, p < .001), tobacco smoking (COR, 6.741; 95% CI: 1.170 – 38.826, p = .016), more than three co-morbidities (COR, 2.750; 95% CI: 1.147 – 26.454, p = .012), diabetes mellitus (COR, 13.750; 95% CI: 2.380 – 79.433, p < .001), HIV (COR, 117.000; 95% CI: 9.257 – 1479.756, p < .001), ≥ 2 days before presentation (COR, 7.440; 95% CI: 1.288 – 42.980, p = .039), SP02 < 90% (COR, 6.800; 95% CI: 1.432 – 60.029, p < .049), and SABA overuse (COR, 7.041; 95% CI: 1.005 – 62.165, p = .044) were the predictors of asthma mortality in this trail.

CONCLUSIONS

Asthma exacerbations are caused by a variety of risk factors. From the results of the current trail, obesity, prematurity, low socioeconomic status, younger age of diagnosis, family history of atopy, asthma or allergic rhinitis, bad housing, smoking, dust, viral infections, cold air and strong emotions are the most detected predictors and risk factors for asthma exacerbations among asthmatic children attending Mansura University Children Hospital. Severe exacerbations were more associated with low socioeconomic status and presence of strong emotions as aggravating factor. It is imperative to possess an understanding of the specific risk factors in order to develop effective treatment and control protocols. The management of asthma is enhanced, and the frequency and severity of exacerbations are diminished by reducing exposure to these risk factors.

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