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Clinical Profile and Risk Factors Associated with Asthma Exacerbation in Children Aged 5 to 15 Years Admitted to Tertiary Health Care Centre

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Abstract: ***Background**: Asthma is a prevalent chronic condition in children. It causes intermittent restriction of airflow. The goal of asthma management is to reduce airway inflammation. **Objectives**: The overarching goals or objectives of the research to study children asthma exacerbation clinical profiles and to research the risk factors for exacerbations of asthma. **Methods**: This study was designed as a Prospective descriptive Study. This study was conducted on children in the age group of 5-14 years with diagnosis of asthma exacerbation admitted to Emergency Department of Pediatrics, BMCRC, Ballari, conducted for a period of 1st Aug 2023 to 31st July 2024. Inclusion criteria include Children aged between 5-14 years with pre-existing asthma presenting with cough, wheeze, breathlessness, chest tightness. **Result**: The present study was conducted on 65 children with acute severe asthma. The present study on childhood asthma concluded that 5–10year children, male gender and malnourished are more prone for developing asthma. Presence of atopy, most commonly allergic rhinitis in the early period of life, can predict the development of asthma later on, and majority of the patients have onset of symptoms having pallor and breathlessness, thus these children should be followed up for early diagnosis. Seasonal allergy, pollen allergy, dust mite allergy, smoke exposure, and previous history of hospitalization are important risk factors for exacerbation in children. Use of talcum powder and smoke and exacerbation after exercise were found to be strongly related with uncontrolled asthma. Thus, it is to be recommended that use of talcum powder by patients with asthma and their family members should be avoided and efforts should be made by parents to decrease the exposure of child to dust mite allergy. **Conclusion**: - In present study majority of patients were males. Maximum cases of asthma exacerbation were reported during seasonal allergy and pollen allergy. Interventions aimed at preventing the triggering factors are likely to reduce the mortality and morbidity due to asthma exacerbation.*

Keywords: Asthma, exacerbation, atopy, allergy, wheeze

1. Introduction

Asthma is one of the most prevalent chronic respiratory diseases globally, especially affecting children. It is characterized by intermittent airway inflammation, bronchial hyperresponsiveness, and reversible airflow obstruction, leading to symptoms such as wheezing, breathlessness, chest tightness, and coughing. According to the World Health Organization (WHO), asthma affects an estimated 262 million people and causes over 461,000 deaths annually, with a significant portion of these cases occurring in children (1). Asthma can severely impact the quality of life, particularly in children, as it interferes with daily activities, physical exertion, and sleep. More importantly, asthma exacerbations, or sudden worsening of symptoms, pose a significant risk of morbidity and mortality in pediatric populations. Understanding the factors contributing to these exacerbations is crucial for improving asthma management and reducing associated health risks.

The underlying pathophysiology of asthma is rooted in chronic inflammation of the airways, which leads to increased sensitivity to various stimuli, such as allergens, respiratory infections, physical exercise, and environmental pollutants (2). Children are particularly vulnerable due to their developing immune systems and smaller airway diameters, which make airway obstruction more pronounced during asthma attacks. The interaction between genetic predisposition and environmental factors plays a central role in the development and progression of asthma (3). Children with a family history of asthma or atopic conditions, such as allergic rhinitis, eczema, or food allergies, are at a higher risk of developing asthma (4). Additionally, environmental factors such as exposure to allergens, pollutants, and tobacco smoke are known to exacerbate symptoms and increase the frequency of asthma attacks.

Globally, asthma exacerbations are a leading cause of emergency department visits and hospitalizations among children. These exacerbations can be triggered by a variety of factors, including viral respiratory infections, allergen exposure, changes in weather, physical activity, and poor adherence to asthma medications (5). In children, common triggers include pollen, dust mites, animal dander, mold, and cigarette smoke. The role of viral infections, particularly those caused by rhinoviruses, in precipitating asthma exacerbations has been well-documented (6). Viral infections can exacerbate the inflammatory response in the airways, leading to more severe symptoms and prolonged recovery times in asthmatic children. Similarly, exposure to environmental tobacco smoke, both prenatal and postnatal, has been associated with an increased risk of asthma exacerbations, as smoke irritates the airways and induces inflammation (7).

Socioeconomic factors also play a significant role in asthma management and outcomes. Children from low-income families are more likely to experience poor asthma control

and more frequent exacerbations due to several factors, including limited access to healthcare, inadequate housing conditions (which increase exposure to indoor allergens), and financial barriers to obtaining asthma medications (8). Additionally, malnutrition, which is more common in underprivileged communities, has been linked to an increased risk of asthma and poorer outcomes in children (9). Malnutrition impairs immune function, making children more susceptible to respiratory infections, which can trigger or worsen asthma symptoms.

Atopy, or the genetic tendency to develop allergic conditions, is a well-recognized risk factor for asthma. Allergic rhinitis, which often coexists with asthma, is particularly common in children with asthma and is associated with increased severity of asthma symptoms (10). The presence of allergic rhinitis in early childhood has been shown to be predictive of the development of asthma later in life (11). Children with atopic conditions are more sensitive to environmental allergens, such as pollen, dust mites, and pet dander, which can trigger asthma exacerbations. This relationship between atopy and asthma highlights the need for early diagnosis and intervention to prevent or reduce the severity of asthma in at-risk children (12).

Seasonal variation is another important factor influencing asthma exacerbations in children. Studies have shown that asthma exacerbations tend to peak during specific seasons, particularly in the spring and fall, when pollen levels are highest, and during the winter months, when cold air can exacerbate airway inflammation (13). Pollen, one of the most common allergens, can cause significant respiratory distress in children with asthma, particularly during the spring and fall seasons when trees, grasses, and weeds release large amounts of pollen into the air (14). In contrast, the cold air of winter can trigger bronchoconstriction, leading to increased asthma symptoms and exacerbations. This seasonal variation necessitates the need for targeted asthma management strategies during high-risk periods.

Physical activity, while essential for the overall health and well-being of children, can also trigger asthma symptoms in some individuals. Exercise-induced bronchoconstriction (EIB) occurs when physical exertion leads to narrowing of the airways, causing shortness of breath, wheezing, and chest tightness (15). EIB is particularly common in children with poorly controlled asthma or those who engage in vigorous activities without appropriate pre-exercise medication use. Recognizing and managing EIB is crucial to ensuring that children with asthma can remain active and participate in physical activities without the fear of exacerbations.

The use of talcum powder in households with asthmatic children has emerged as a concerning factor in asthma management. Talcum powder, commonly used in personal care products, can become airborne when applied and inhaled by children, potentially triggering asthma symptoms or exacerbations (16). This risk is particularly high in homes with poor ventilation, where airborne particles are more likely to accumulate. Avoiding the use of talcum powder and other airborne irritants in homes with asthmatic children is an important preventive measure to reduce the risk of asthma exacerbations.

In terms of asthma management, a key focus is on preventing exacerbations by reducing exposure to known triggers and maintaining optimal control of the condition through medication adherence. Inhaled corticosteroids (ICS) are the cornerstone of asthma treatment, as they reduce airway inflammation and help prevent exacerbations (17). However, poor adherence to asthma medications remains a significant challenge, particularly in children, who may struggle with the long-term nature of asthma treatment and the need for daily medication use (18). In addition to medication adherence, environmental control measures, such as reducing exposure to allergens and smoke, are essential components of asthma management. Parents and caregivers play a crucial role in ensuring that children with asthma are protected from environmental triggers and receive appropriate medical care.

The importance of early diagnosis and intervention in asthma cannot be overstated. Children who experience frequent asthma exacerbations, particularly those who are hospitalized, are at risk of long-term complications, including reduced lung function and increased susceptibility to respiratory infections (19). Early intervention with appropriate medications, along with strategies to minimize allergen exposure, can help prevent these complications and improve the quality of life for children with asthma (20).

2. Methodology

1) Study Design

This study was designed as a prospective descriptive study. It aimed to observe and describe the clinical profiles and risk factors associated with asthma exacerbation in children. A structured approach was adopted to collect and analyze data from a defined population, focusing on key variables such as age, gender, nutritional status, environmental factors, and clinical presentation of asthma exacerbations.

2) Study Setting

The study was conducted in the Emergency Department of Pediatrics at BMCRC, Ballari, a tertiary care center that provides specialized pediatric care. The facility caters to a large number of pediatric patients, making it an ideal setting for observing cases of asthma exacerbation. The environment facilitated continuous monitoring of the participants and access to relevant clinical data.

3) Study Duration

The study was carried out over a period of 12 months, from August 1, 2023, to July 31, 2024. This duration ensured the inclusion of seasonal variations, which were important in analyzing asthma exacerbation patterns, particularly those triggered by environmental allergens.

4) Participants: Inclusion and Exclusion Criteria

The study included children aged between 5 and 14 years who had a pre-existing diagnosis of asthma and were admitted to the Emergency Department with symptoms of asthma exacerbation. The inclusion criteria involved children presenting with cough, wheeze, breathlessness, and chest tightness. Children with other chronic respiratory conditions or those who did not meet the age requirement were excluded from the study to maintain homogeneity in the sample and ensure accurate analysis specific to asthma exacerbations.

5) Study Sampling

The sampling method employed was purposive sampling, where participants were selected based on the predefined inclusion criteria. The study population consisted of children presenting with asthma exacerbation at the emergency department during the study period. This sampling method allowed for a focused investigation of the target population and relevant clinical features.

6) Study Sample Size

A total of 65 children were included in the study. The sample size was determined based on the average monthly admission rate of children with asthma exacerbations at the emergency department and the duration of the study. The sample size was considered sufficient to provide meaningful insights into the clinical profiles and risk factors associated with asthma exacerbation.

7) Study Groups (if applicable)

Since the study was descriptive, no distinct intervention or control groups were established. However, within the sample, participants were analyzed based on several subgroups, such as age (5-10 years and 11-14 years), gender, and nutritional status, to identify patterns of asthma exacerbation in different demographic and clinical segments.

8) Study Parameters

The primary study parameters included age, gender, nutritional status, history of atopy (especially allergic rhinitis), seasonal allergies, pollen and dust mite allergies, smoke exposure, and history of previous hospitalizations. These parameters were selected to identify factors that potentially contributed to asthma exacerbation and uncontrolled asthma. Clinical symptoms such as wheeze, breathlessness, and chest tightness were also documented.

9) Study Procedure

Upon admission to the Emergency Department, children presenting with asthma exacerbation were thoroughly evaluated. A detailed history was taken from the child's parents or guardians, focusing on the onset of symptoms, possible triggers, and previous medical history, including any known allergies or past hospitalizations. Clinical examination was conducted to assess the severity of asthma exacerbation. The participants were monitored throughout their hospital stay, with appropriate medical interventions administered based on established clinical guidelines for asthma management.

10) Study Data Collection

Data collection was carried out using a standardized data collection form. The form was used to record demographic details, clinical presentations, environmental exposure (e.g., to dust mites or smoke), and any known atopic conditions. Information regarding the use of talcum powder, exposure to smoke, and exercise-induced exacerbations was also noted. Clinical outcomes and the response to treatment during the hospital stay were carefully documented. Data was collected in real-time by the attending pediatricians and subsequently reviewed for completeness and accuracy.

11) Data Analysis

The collected data was entered into a statistical software program for analysis. Descriptive statistics were used to summarize the clinical characteristics of the participants, while inferential statistics were employed to identify correlations between asthma exacerbation and potential risk factors such as atopy, environmental exposure, and nutritional status. The chi-square test was used to assess the significance of categorical variables, while logistic regression was employed to identify significant predictors of asthma exacerbation.

12) Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of BMCRC, Ballari. Informed consent was obtained from the parents or guardians of all participants prior to their inclusion in the study. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. Participants' privacy and confidentiality were maintained throughout the study, with data anonymized during analysis to protect the identity of the children.

3. Results

A total of 65 children, aged between 5 and 14 years, were included in the study. The majority of the participants were males, and the age group most affected by asthma exacerbations was 5–10 years. The findings indicated that several risk factors, including nutritional status, presence of atopy, seasonal and pollen allergies, and environmental exposures, played significant roles in exacerbating asthma symptoms in these children.

1) Demographic Distribution

Out of the 65 participants, 42 (64.6%) were male, and 23 (35.4%) were female, reflecting a male predominance in asthma exacerbations. The majority of cases (53.8%) occurred in children between the ages of 5 and 10 years, while 30.8% were aged 11–14 years.

Parameter	Number of Patients (n = 65)	Percentage (%)
Gender		
Male	42	64.6
Female	23	35.4
Age Group		
5–10 years	35	53.8
11–14 years	20	30.8

2) Nutritional Status

Malnutrition was prevalent in 38 children (58.5%), and these children were observed to have more frequent and severe asthma exacerbations compared to those with a normal nutritional status.

Nutritional Status	Number of Patients (n = 65)	Percentage (%)
Malnourished	38	58.5
Normal	27	41.5

3) Presence of Atopy

The presence of atopy, specifically allergic rhinitis, was a significant factor in predicting asthma exacerbations. A total

of 44 children (67.7%) were found to have allergic rhinitis, while others had skin allergies or a combination of both.

Atopy	Number of Patients (n = 65)	Percentage (%)
Allergic Rhinitis	44	67.7
Skin Allergies	8	12.3
Combination (Rhinitis + Skin)	13	20

4) Environmental Triggers

Environmental factors such as seasonal and pollen allergies, exposure to dust mites, and smoke exposure were strongly associated with asthma exacerbation. The majority of exacerbations were noted during the pollen allergy season, with 49.2% of cases triggered by pollen. Dust mite exposure and smoke exposure were also significant triggers, found in 32.3% and 20% of cases, respectively.

Environmental Trigger	Number of Patients (n = 65)	Percentage (%)
Seasonal Allergy	21	32.3
Pollen Allergy	32	49.2
Dust Mite Allergy	21	32.3
Smoke Exposure	13	20

5) Clinical Symptoms

The clinical symptoms most frequently observed in these children were breathlessness and wheezing, with pallor observed in 72.3% of cases. Additionally, 63.1% of children reported chest tightness during exacerbations.

Symptom	Number of Patients (n = 65)	Percentage (%)
Pallor	47	72.3
Breathlessness	50	76.9
Wheezing	42	64.6
Chest Tightness	41	63.1

6) Previous History of Hospitalization

Previous hospitalization for asthma was recorded in 30 children (46.2%), indicating that a significant portion of participants had recurrent severe asthma exacerbations requiring emergency care.

Previous Hospitalization	Number of Patients (n = 65)	Percentage (%)
Yes	30	46.2
No	35	53.8

7) Use of Talcum Powder

The use of talcum powder by either the children or their family members was significantly associated with uncontrolled asthma. In total, 34 children (52.3%) had exposure to talcum powder, and these children had more frequent exacerbations.

Use of Talcum Powder	Number of Patients (n = 65)	Percentage (%)
Yes	34	52.3
No	31	47.7

8) Exercise-Induced Exacerbation

Exercise-induced exacerbations were noted in 24 children (36.9%), demonstrating a significant association between physical activity and uncontrolled asthma.

Exercise-Induced Exacerbation	Number of Patients (n = 65)	Percentage (%)
Yes	24	36.9
No	41	63.1

9) Seasonal Variation in Asthma Exacerbation

Seasonal variation was evident, with the highest number of exacerbation cases reported during the spring season (40%), when pollen counts were highest. The winter months also saw an increase in cases due to cold air exposure.

Season	Number of Patients (n = 65)	Percentage (%)
Spring	26	40
Winter	20	30.8
Summer	12	18.5
Autumn	7	10.7

4. Discussion

The present study aimed to investigate the clinical profiles and risk factors associated with asthma exacerbations in children aged 5 to 14 years, with particular focus on demographic, environmental, and clinical factors. The results provide valuable insights into the complex interplay of various elements that contribute to asthma exacerbation, thereby offering key information that can guide asthma management and prevention strategies in children.

One of the significant findings of the study was the predominance of male children in asthma exacerbations, with 64.6% of the participants being male. This male predominance aligns with other research that has shown asthma to be more common in boys than girls during early childhood, possibly due to physiological differences in lung development and airway size. In contrast, females tend to have higher asthma prevalence during adolescence and adulthood. This finding suggests that gender may influence asthma patterns, which should be considered in managing asthma in pediatric populations. Another critical finding was the age distribution of the children, with 53.8% falling within the 5–10 year age group. Asthma exacerbations were more prevalent in this younger age group, indicating that younger children, particularly those under 10 years of age, may be more susceptible to asthma triggers, possibly due to underdeveloped immune responses or greater vulnerability to environmental allergens.

Nutritional status emerged as a significant factor influencing asthma exacerbation. In this study, 58.5% of the children were malnourished, indicating that undernutrition could be a contributing factor to the severity and frequency of asthma episodes. Previous research has demonstrated that malnutrition can impair immune function, making children more vulnerable to respiratory infections and exacerbations of asthma. This finding highlights the importance of addressing nutritional deficiencies in children with asthma, as improving overall health and nutrition may contribute to better asthma control. Programs aimed at improving child nutrition should be integrated into asthma management plans to minimize the frequency and severity of exacerbations, particularly in low-resource settings where malnutrition is prevalent.

The presence of atopy, particularly allergic rhinitis, was another significant predictor of asthma exacerbation in the studied population. A total of 67.7% of children had allergic rhinitis, with an additional 20% having a combination of allergic rhinitis and skin allergies. Atopy, or a genetic tendency to develop allergic conditions, is a well-established risk factor for asthma. Children with allergic rhinitis often exhibit heightened sensitivity to allergens such as pollen, dust mites, and animal dander, which can trigger asthma attacks. These findings are consistent with previous studies that have shown allergic rhinitis to be a strong predictor of asthma development and exacerbations in children. Early identification and management of atopy, through the use of antihistamines, nasal corticosteroids, or allergen avoidance strategies, may help mitigate the risk of asthma exacerbations.

Environmental triggers, such as exposure to seasonal and pollen allergies, dust mites, and smoke, were found to be major contributors to asthma exacerbation. In this study, 49.2% of exacerbations were linked to pollen allergies, while 32.3% were associated with dust mites, and 20% with smoke exposure. These findings underscore the significant impact of environmental allergens on asthma control in children. Pollen and dust mites are common triggers of allergic asthma, particularly in children who are sensitized to these allergens. The high proportion of cases triggered by pollen allergies is not surprising, given that the study spanned seasonal changes, including spring and fall, when pollen levels are typically high. Dust mites, often found in household environments, are another significant contributor to asthma exacerbations. These tiny organisms thrive in warm, humid conditions and can be difficult to eliminate from bedding, carpets, and upholstery. The high prevalence of dust mite-related asthma exacerbations suggests that parents and caregivers should take steps to reduce dust mite exposure, such as using hypoallergenic bedding covers and maintaining clean living environments.

Smoke exposure, either from cigarette smoke or biomass fuels, is another important risk factor identified in this study. The 20% of children who had been exposed to smoke were more likely to experience uncontrolled asthma exacerbations. Smoke irritates the airways, leading to inflammation and increased sensitivity to allergens, which in turn exacerbates asthma symptoms. This finding underscores the importance of educating families about the dangers of secondhand smoke exposure and encouraging smoke-free environments for children with asthma. Furthermore, the use of talcum powder was found to be associated with uncontrolled asthma in 52.3% of the children. Talcum powder, often used in personal care products, can become airborne and be inhaled, potentially irritating the airways and worsening asthma symptoms. Avoiding the use of talcum powder in households with asthmatic children may help reduce exacerbation risk.

Clinical symptoms of asthma exacerbation were well-characterized in this study, with the majority of children (76.9%) presenting with breathlessness and 64.6% experiencing wheezing. Pallor, a sign of oxygen deprivation and poor circulation, was observed in 72.3% of cases, while 63.1% of children reported chest tightness. These symptoms are characteristic of acute asthma exacerbation, which involves the narrowing of airways and difficulty in breathing. The high prevalence of pallor and breathlessness as presenting symptoms suggests that healthcare providers should closely monitor these indicators for early intervention in managing asthma exacerbations.

A significant proportion of children (46.2%) had a history of previous hospitalization for asthma exacerbations, highlighting the recurrent nature of asthma in these patients. This finding emphasizes the chronic and often cyclical nature of asthma, where exacerbations may recur despite preventive measures. It also points to the need for improved asthma management strategies that focus on long-term control and minimizing triggers. Additionally, exercise-induced asthma was noted in 36.9% of the children. Physical activity can trigger asthma symptoms in some individuals due to increased breathing rates, which can cause airways to cool and dry, leading to bronchoconstriction. Recognizing exercise-induced asthma is crucial for helping children remain active while managing their asthma with appropriate preventive measures, such as using inhalers before exercise.

The seasonal variation observed in this study provided further insights into asthma exacerbation patterns. The majority of exacerbations occurred during the spring season, when pollen counts are highest, with 40% of cases reported during this time. This was followed by winter, with 30.8% of exacerbations, likely due to cold air exposure, which is known to aggravate asthma symptoms. These findings suggest that asthma exacerbations in children are closely linked to seasonal changes, and healthcare providers should counsel parents and caregivers to implement preventive measures during high-risk periods. This might include staying indoors on days with high pollen counts, wearing scarves over the nose and mouth in cold weather, and using prescribed asthma medications to maintain control during these seasons.

The data collected from this study provides a comprehensive understanding of the risk factors and clinical presentation of asthma exacerbations in children. Male gender, younger age, malnutrition, atopy, and environmental exposures were all identified as significant contributors to asthma exacerbation. The findings underscore the importance of early identification of atopic conditions, improvement in nutritional status, and minimizing exposure to known environmental triggers as essential strategies in preventing asthma exacerbations. Furthermore, the study highlights the need for public health interventions to reduce smoke exposure and discourage the use of talcum powder in households with asthmatic children.

5. Conclusion

In conclusion, the study has identified several modifiable risk factors associated with asthma exacerbations in children. By addressing these factors, healthcare providers and caregivers can reduce the frequency and severity of asthma exacerbations, ultimately improving the quality of life for children with asthma. Future research should focus on exploring additional preventive strategies, particularly in resource-limited settings, where asthma exacerbations may be exacerbated by environmental and socioeconomic factors. The findings from this study provide a foundation for developing targeted interventions aimed at reducing the burden of asthma in pediatric populations.

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