


Research Article

Asthma attacks in children -challenges and opportunities

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DOI: <https://doi.org/10.5281/zenodo.18956433>

Abstract

Asthma ranks among the most widespread chronic respiratory disorders affecting children globally. It is defined by inflammation of the airways, bronchial hyperreactivity, and reversible obstruction of airflow. Asthma episodes in children represent significant clinical and public health concerns due to their rising prevalence and adverse effects on quality of life. Factors such as environmental pollution, allergens, and genetic predispositions play a vital role in triggering asthma flare-ups. Even with advancements in treatment, numerous children still suffer from inadequately controlled symptoms. This review examines the key challenges linked to asthma episodes in children and emphasises new opportunities for enhanced management and prevention methods.

Manuscript Information

- **ISSN No:** 2583-7397
- **Received:** 14-11-2025
- **Accepted:** 25-11-2025
- **Published:** 30-12-2025
- **IJCRM:**4(6); 2025: 683-689
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- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Yadav M. Asthma attacks in children -challenges and opportunities. Int J Contemp Res Multidiscip. 2025;4(6): 683-689.

Access this Article Online


www.multiarticlesjournal.com

KEYWORDS: Asthma, children, airway inflammation, respiratory disease, environmental pollution.

1. INTRODUCTION

Asthma is a major public health concern and one of the most prevalent chronic respiratory conditions affecting children globally. It is typified by reversible airflow restriction, bronchial hyperresponsiveness, and chronic airway inflammation, which causes repeated episodes of coughing, wheezing, chest tightness, and dyspnea. Asthma attacks or exacerbations can exacerbate these symptoms, which frequently vary in frequency and intensity (1). Childhood asthma has

shown a rising prevalence over the past few decades, particularly in urban areas where environmental pollution and lifestyle changes are more prominent. According to the World Health Organisation, asthma affects hundreds of millions of people globally and is considered one of the leading chronic diseases among children. The disease significantly contributes to healthcare burden, emergency hospital visits, and school absenteeism (2). Over the past few decades, childhood asthma has become more common, especially in metropolitan regions

where lifestyle changes and environmental pollution are more prevalent. Asthma is one of the most common chronic illnesses in children and affects hundreds of millions of people worldwide, according to the World Health Organisation.

Asthma attacks happen when exposure to a variety of triggers, including allergens, respiratory infections, air pollutants, and environmental irritants, causes the inflammation of the airways to become severe. These triggers set off immunological reactions in the airways, resulting in bronchoconstriction, increased mucus production, and airway narrowing, all of which eventually make breathing difficult (3). Effective care of childhood asthma is still difficult, despite notable improvements in diagnostic methods and therapeutic approaches. Inadequate asthma control can result from several factors, including delayed diagnosis, incorrect inhaler technique, poor medication adherence, and ongoing exposure to environmental triggers. Furthermore, parents' and caregivers' lack of knowledge about managing asthma may make the problem worse. Therefore, effective prevention and management techniques require a thorough understanding of the factors that contribute to childhood asthma attacks. The main issues surrounding childhood asthma episodes will be covered in this review article, along with possible ways to enhance long-term disease management, diagnosis, and treatment.

Definition of Asthma Attacks

A sudden worsening of asthma symptoms brought on by increased airway inflammation and airway narrowing is referred to as an asthma attack, also known as an asthma exacerbation. Breathing becomes difficult during an asthma attack because the muscles that surround the airways constrict, the lining of the airways swells, and too much mucus is generated.

The term "asthma attack," or occasionally "lung attack," is a better way to describe the situation than "asthma exacerbation," since it emphasises the gravity of the occurrence rather than a transient worsening of symptoms. These episodes may indicate potentially serious problems that, if left untreated, could result in gradual lung damage (4).

To highlight the fact that asthma is a chronic illness that persists even when a patient is not exhibiting symptoms, some researchers also employ the phrase "flare-up" (5). Clinically, an asthma attack is defined by a sudden reduction in lung function together with respiratory symptoms such as coughing, wheezing, tightness in the chest, and shortness of breath. Measures like peak expiratory flow rate (PEFR) and forced expiratory volume in one second (FEV_1) can be used to quantify this decline in lung function. Although precise measurement may be challenging in very young children or in those who are really sick, PEFR assessment is frequently used in children to determine the severity of an asthma attack and to provide suitable treatment methods (6).

Causes and Triggers of Asthma Attacks in Children

Asthma attacks in children can be triggered by several environmental and biological factors that lead to airway inflammation and narrowing of the airways.

➤ Allergens

One of the most frequent causes of asthma attacks in children is allergen exposure. Dust mites, pollen, mould spores, and animal dander are examples of allergens that can trigger immunological reactions in the airways, leading to bronchoconstriction and inflammation. Asthma attacks are more common in children who are susceptible to certain allergens, particularly during seasonal changes or in surroundings with high allergen exposure (3).

➤ Respiratory Infections

Another significant factor contributing to children's asthma flare-ups is respiratory virus infections. Asthma attacks can be triggered by viruses that irritate the airways and exacerbate pre-existing inflammation, such as rhinovirus, influenza virus, and respiratory syncytial virus. Because their immune systems are still maturing, young children are especially vulnerable to these diseases (7).

➤ Air Pollution and Environmental Irritants

Children who are exposed to environmental contaminants such as particulate matter, nitrogen dioxide, tobacco smoke, and industrial emissions are far more likely to experience asthma episodes. These contaminants aggravate asthma symptoms by irritating the lining of the airways and causing inflammatory reactions. As a result, children who reside in cities with high air pollution levels are more likely to have frequent asthma flare-ups (8).

Asthma attacks in children are often initiated by exposure to various environmental and biological triggers such as allergens, respiratory infections, and air pollutants. These triggers activate immune responses in the respiratory tract, leading to inflammation and swelling of the airway lining. As a result, the airways become more sensitive and reactive to external stimuli. The inflammatory process further causes bronchoconstriction, increased mucus production, and narrowing of the air passages. These physiological changes restrict airflow and make breathing difficult, which ultimately results in the typical symptoms of asthma attacks such as wheezing, coughing, chest tightness, and shortness of breath.

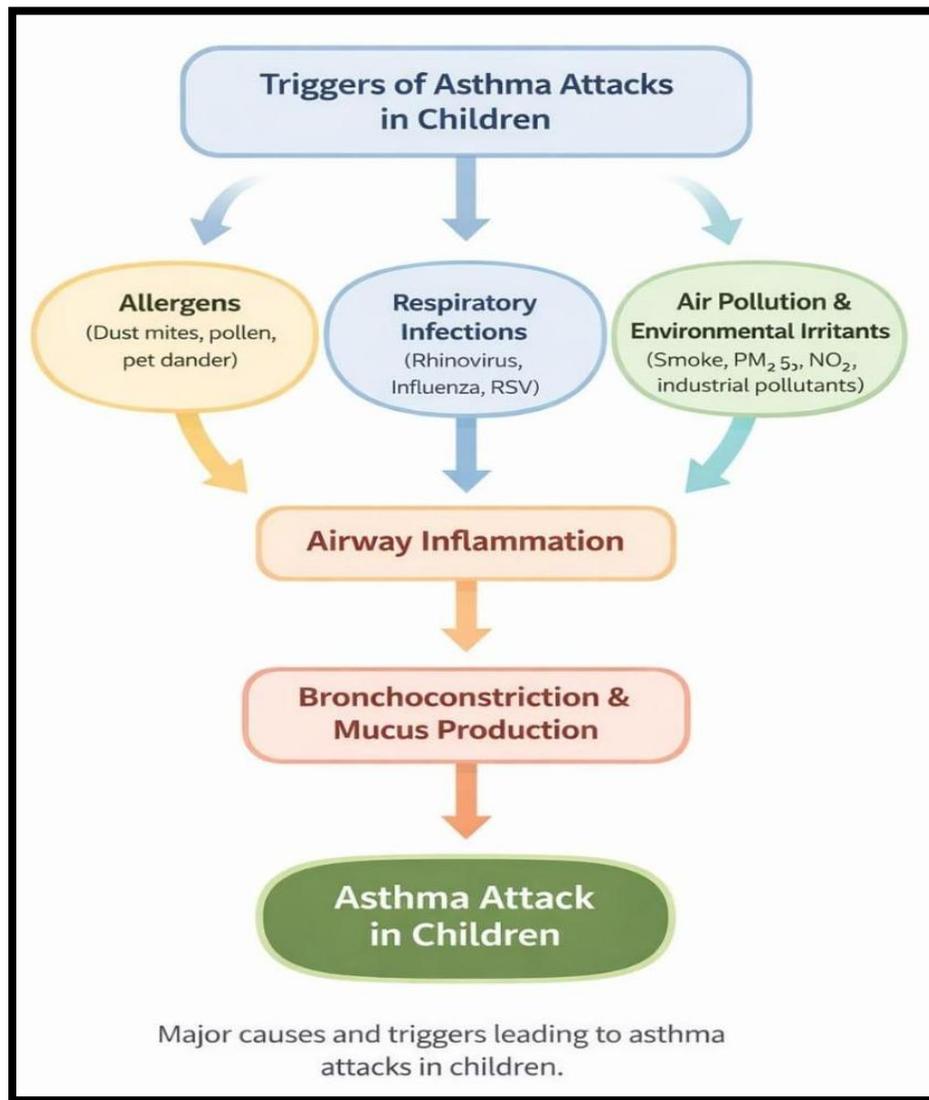


Figure 1. Schematic representation of major causes and triggers responsible for asthma attacks in children.

Pathophysiology of Asthma Attacks in Children

Chronic airway inflammation is a key factor in the development of asthma attacks and is part of the pathophysiology of asthma. Children with asthma develop extremely sensitive airways to a variety of environmental stimuli, including allergens, respiratory infections, and air pollution. These triggers cause inflammation of the lining of the airways by activating the immune system. The airways become swollen and more sensitive as a result of this inflammatory reaction, increasing the likelihood of obstruction (9).

T-lymphocytes, mast cells, and eosinophils are among the inflammatory cells that build up in the airway tissues during an asthma attack. These cells cause bronchoconstriction and airway oedema by releasing inflammatory mediators such as histamine, cytokines, and leukotrienes. At the same time,

excessive mucus is produced by the airway glands, which further blocks the already narrowed air passages. Mucus

secretion, bronchoconstriction, and airway inflammation all work together to drastically limit lung airflow (10).

Children are more vulnerable to airway obstruction during asthma attacks because their airways are inherently smaller and more reactive than those of adults. The narrowing of the airways makes it harder for air to enter and exit the lungs, which causes symptoms including coughing, wheezing, tightness in the chest, and shortness of breath. Long-term alterations in airway structure and function may result from recurrent inflammation and airway constriction if improperly treated (11).

Risk Factors for Asthma Attacks in Children

Several factors can increase the likelihood of asthma attacks in children by making the airways more sensitive to environmental triggers. Genetic predisposition is one of the biggest risk factors. Asthma and recurrent asthma attacks are more common in children with a family history of asthma, allergic rhinitis, or other allergic conditions. Immune responses and airway sensitivity can be influenced by genetic variables, which increases the risk of airway inflammation. Exposure to environmental contaminants, including tobacco smoke, is another important risk factor. Particularly in young children, passive smoking can irritate the airways and raise the chance of developing and worsening asthma. Regular secondhand smoke exposure in children frequently results in decreased lung function and increased airway inflammation (12).

If not properly treated, comorbid conditions like obesity, obstructive sleep apnea, anxiety, psychiatric problems, gastro-oesophageal reflux, dysfunctional breathing, and rhinitis worsen symptoms. A higher risk of asthma exacerbations has been linked to elevated fractional exhaled nitric oxide (FeNO) (13), low FEV1 (14), high bronchodilator reversibility (15), and higher levels of sputum eosinophilia (16). Exposure to respiratory infections, poor air quality, and household allergens are examples of environmental risk factors (17).

Children from socially disadvantaged families have worse asthma control and are more likely to experience asthma attacks for a variety of reasons, such as increased exposure to allergens like tobacco smoke, indoor and outdoor air pollution in low-socioeconomic housing developments, and lower financial and educational status that affects access to medical facilities and medication (18). Asthma attacks are also made more likely by psychological stress and exposure to unfavourable life events, and it has been shown that psychosocial stresses directly cause lung inflammation (19).

In addition to environmental and genetic factors, certain coexisting allergic conditions are frequently linked with asthma in children. Disorders such as eczema and allergic rhinitis are commonly observed among pediatric asthma patients. These conditions share similar immunological pathways that involve hypersensitive immune responses and chronic inflammation. Because of these shared mechanisms, children who suffer from eczema or allergic rhinitis often develop increased airway sensitivity. The presence of these allergic diseases can worsen respiratory symptoms and may increase the likelihood of asthma attacks. In many cases, the immune system of affected

triggers. These risk factors may influence the development, severity, and frequency of Asthma attacks.

children reacts strongly to common environmental allergens such as dust mites, pollen, or pet dander. This heightened immune response can trigger airway inflammation and narrowing, making breathing more difficult during an asthma episode.

Therefore, children with multiple allergic conditions are considered to be at a higher risk of developing more frequent or severe asthma attacks. Proper identification and management of these associated allergic disorders can play an important role in improving asthma control and reducing the occurrence of asthma exacerbations (20).

Impact of Asthma Attacks in Children

Children who experience asthma attacks may suffer serious physical, psychological, and social consequences. Breathing problems, decreased lung function, and higher healthcare utilisation might result from frequent asthma flare-ups. Severe asthma episodes frequently necessitate hospitalisation or emergency medical attention, which can be very taxing on families and healthcare systems (3). A child's everyday activities and general quality of life might also be adversely affected by asthma attacks. Children suffering from recurrent asthma symptoms may experience sleep disturbances, fatigue, and limitations in physical activities such as sports and exercise. Their involvement in social and academic activities may be diminished by these restrictions (21). Children with poorly controlled asthma may experience the compounding effects of poor sleep due to nocturnal symptoms, poor school attendance due to hospital admissions, and decreased participation in recreational sports due to fears of worsening symptoms, because asthma attacks often require hospital admissions. The entire family is also impacted by recurrent asthma episodes, as parents must miss work and forfeit income to care for their children while they are in the hospital (22).

Additionally, children frequently miss school due to asthma problems. Academic achievement and regular school attendance may be disrupted by recurrent symptoms and hospital stays. A child's psychological health and self-confidence may also be impacted by the emotional strain of a chronic disease (23).

Prevention of Asthma Attacks in Children

Prevention of asthma attacks in children involves a combination of pharmacological and non-pharmacological approaches. Medications help in controlling airway

inflammation and relieving symptoms, whereas lifestyle modifications and environmental control measures reduce exposure to triggers and improve overall asthma management.



Figure2: Pharmacological and non-pharmacological strategies for the prevention of asthma attacks in children.

➤ Pharmacological Management

In order to prevent childhood asthma attacks, pharmacological control is crucial. This strategy primarily entails the use of drugs that assist in reducing inflammation in the airways and enhancing breathing. For children with chronic asthma, inhaled corticosteroids are thought to be the best long-term controller drugs because they lessen airway inflammation and the frequency of asthma flare-ups. Additionally, short-acting β_2 -agonists and other bronchodilators are frequently utilised to quickly relieve acute symptoms. In certain instances, leukotriene receptor antagonists and long-acting bronchodilators may also be recommended to enhance asthma management and stop repeated episodes (3).

➤ Non-pharmacological Management

Children's asthma attacks can also be prevented with non-pharmacological methods. The primary goals of these actions are to improve lifestyle choices and lessen exposure to environmental triggers.

Asthma flare-ups can be greatly reduced by avoiding common allergens such as dust mites, pollen, pet dander, and tobacco smoke. Other crucial preventive measures include lowering exposure to air pollution, maintaining clean indoor air, and making sure there is adequate ventilation. Effective asthma therapy also heavily depends on teaching parents and kids how

to use inhalers correctly, identify symptoms early, and follow treatment regimens (24).

The proper use of inhaler devices with spacers, adherence to controller therapy, identifying asthma attacks and instances of poor asthma control, the significance of exercise and diet, and the management of modifiable risk factors in the individual's surroundings are all topics that should be covered in asthma education.

A written asthma action plan on how to detect and address asthma control should be given to every kid with the condition. Research has demonstrated that giving caregivers individualised asthma action plans boosts their self-esteem and lowers the likelihood of asthma symptoms returning 14 days after an ER visit (25).

CONCLUSION

Asthma attacks in children represent a major health concern worldwide due to their increasing prevalence and significant impact on the physical and social well-being of affected children. These attacks are often triggered by a variety of environmental and biological factors, including allergens, respiratory infections, air pollution, and other irritants. Exposure to such triggers leads to inflammation of the airways, which plays a central role in the development and progression of asthma symptoms.

The pathophysiology of asthma involves complex inflammatory processes within the airways that result in bronchoconstriction, airway swelling, and excessive mucus production. These physiological changes narrow the air passages and make breathing difficult, leading to common symptoms such as wheezing, coughing, chest tightness, and shortness of breath. In children, the smaller airway size and increased airway sensitivity make them more vulnerable to severe asthma attacks and respiratory complications.

Several risk factors, including genetic predisposition, environmental exposures, and coexisting allergic conditions such as eczema and allergic rhinitis, may further increase the likelihood of asthma exacerbations in children. Frequent asthma attacks can negatively affect a child's quality of life, academic performance, and daily activities, highlighting the importance of early identification and effective management strategies.

Effective prevention and management of asthma attacks requires a comprehensive approach that combines both pharmacological and non-pharmacological strategies. Appropriate use of medications, along with avoidance of environmental triggers, improved indoor air quality, and proper education of parents and caregivers, can significantly reduce the frequency and severity of asthma exacerbations. Therefore, early diagnosis, regular monitoring, and awareness programs are essential for improving asthma control and promoting better long-term health outcomes in children.

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