

Comprehensive Overview of Pediatric Asthma: Diagnosis, Management, and Prevention

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Abstract

Asthma is the most common chronic respiratory condition affecting children worldwide. Factors, such as worsening asthma severity, poor disease management, and the effects of poverty may contribute to the rising number of hospital admissions for asthma. Childhood asthma is prevalent and influenced by both environmental and genetic factors. If a child experiences wheezing before the age of 6, their symptoms are likely to improve over time. Asthma symptoms, including wheezing, shortness of breath, and coughing, are typically triggered by specific environmental factors. Both overdiagnosis and underdiagnosis of pediatric asthma continue to be issues due to several diagnostic obstacles. Spirometry, the foundation of diagnostic examination, helps detect weakness in the respiratory muscles, flaws in the chest wall, and respiratory muscle defects. This method also evaluates airway restrictions and rules out other possible illnesses. A comprehensive strategy that addresses education, pharmacological and non-pharmacological management, and both is necessary for effective asthma control. It is crucial to provide education on effective treatment, trigger avoidance, modifiable risk factors, and what to do during acute attacks through individualized asthma action plans.

Keywords: Inflammatory disease, hyper-responsiveness, bronchodilators, asthma, illnesses

INTRODUCTION

Childhood asthma is characterized by a combination of coughing, wheezing, and shortness of breath. It is a chronic inflammatory condition of the airways marked by persistent inflammation, excessive mucus production, and increased airway sensitivity. The degree of airflow obstruction reversal with bronchodilators can vary among individuals [1].

People with asthma often experience respiratory symptoms, such as wheezing, difficulty breathing, coughing, and a feeling of tightness in the chest. Although the frequency and intensity of symptoms vary greatly, untreated asthma and severe flare-ups can result in respiratory failure and even death.

About 9.1% of children globally suffer from asthma, making it the most prevalent chronic illness among children. About 50% of kids with asthma start having symptoms before they turn three. A child's quality of life can be greatly impacted by pediatric asthma, which can result in emotional anguish, hospitalizations, and lost school days. However, non-asthmatic coughing and wheezing are very prevalent in children and sometimes provide diagnostic difficulty for the healthcare provider [2].

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EPIDEMIOLOGY

Worldwide, childhood asthma is a major public health issue. The World Health Organization estimates that approximately 300 million people

globally are affected by asthma. Asthma causes around 250,000 premature deaths annually, the majority of which are avoidable. Asthma-related deaths in children vary from 0 to 0.7 per 100,000 worldwide. The Global Initiative for Asthma (GINA) was founded in 1989 with the goals of improving asthma management, lowering the burden of asthma globally, and increasing awareness of the disease's rising prevalence. Even among industrialized nations, GINA has failed to meet its objective despite international efforts. Reducing the worldwide burden of asthma is hampered by several factors, such as poor access to treatment and/or medicines and a failure to prioritize it as a public health priority [3].

Causes

Asthma in children is a complicated illness impacted by several variables. While the exact cause of asthma remains unclear, it is believed to result from a combination of environmental and genetic factors. Common triggers for asthma attacks include [4]:

Genetic Factors

- *Family history:* The risk is increased if a parent or sibling has asthma.
- *Genetic predisposition:* Certain genetic variations may impact inflammation and airway responsiveness.

Environmental Factors

- Allergen exposure includes mold, dust mites, pollen, and pet dander.
- *Air pollution:* Being exposed to contaminants, such as nitrogen dioxide, ozone, and particle matter.
- *Tobacco smoke:* Exposure to second-hand smoke.
- Respiratory infections include bacterial or viral illnesses, including the flu or the common cold.

Lifestyle Factors

- *Obesity:* Having a high body mass index makes asthma more likely to occur.
- *Physical inactivity:* The development of asthma may be exacerbated by a lack of regular physical activity.

Diet

A diet deficient in fruits, vegetables, and whole grains and heavy in processed foods may raise the risk.

Other Factors

- A higher risk of asthma is associated with preterm delivery.
- *Low birth weight:* Infants that are underweight are more likely to have asthma.
- *Maternal stress:* Pregnancy-related stress may raise the chance of developing asthma.
- *Caesarean section delivery:* Babies delivered by C-section may be at increased risk of developing asthma.

Triggers

- *Exercise:* Physical activity can trigger asthma symptoms.
- *Emotional stress:* Stress can exacerbate asthma symptoms.
- *Weather changes:* Changes in temperature or humidity can trigger asthma symptoms.
- *Irritants:* Exposure to irritants like strong odors, chemicals, or cleaning products can trigger asthma symptoms.

PATHOPHYSIOLOGY

Asthma is a complex and multifactorial disease characterized by chronic inflammation, airway hyperresponsiveness, and reversible airflow obstruction. Here's a comprehensive overview of the pathophysiology of asthma [5]:

Chronic Inflammation

1. *Inflammatory cells:* Eosinophils, neutrophils, mast cells, and T lymphocytes infiltrate the airways.
2. *Cytokines and chemokines:* Pro-inflammatory mediators, such as IL-4, IL-5, and TNF- α , promote inflammation.
3. *Airway remodeling:* Chronic inflammation leads to structural changes, including thickening of the airway wall, smooth muscle hypertrophy, and increased mucus production.

Airway Hyperresponsiveness

1. *Smooth muscle contraction:* Hyperresponsive airway smooth muscle contracts in response to stimuli, causing bronchoconstriction.
2. *Neurotransmitters:* Acetylcholine, substance P, and other neurotransmitters contribute to airway smooth muscle contraction.
3. *Sensory nerve activation:* Activation of sensory nerves, such as those expressing TRPV1, contributes to airway hyperresponsiveness.

Reversible Airflow Obstruction

1. *Bronchoconstriction:* Contraction of airway smooth muscle reduces airway diameter, increasing airway resistance.
2. *Mucus plugging:* Excess mucus production and impaired mucociliary clearance led to airway obstruction.
3. *Inflammation and edema:* Chronic inflammation and edema contribute to airway narrowing.

Trigger Factors

1. *Allergens:* Pollen, dust mites, pet dander, and mold trigger allergic reactions.
2. *Respiratory infections:* Viral and bacterial infections, such as the common cold or flu, exacerbate asthma.
3. *Air pollutants:* Exposure to pollutants, such as particulate matter, ozone, and nitrogen dioxide, worsens asthma.
4. *Exercise and stress:* Physical activity and emotional stress can trigger bronchoconstriction.

Pathological Changes

1. *Airway wall thickening:* Increased thickness of the airway wall due to chronic inflammation and remodeling.
2. *Smooth muscle hypertrophy:* Increased size and number of smooth muscle cells contribute to airway hyperresponsiveness.
3. *Mucus gland hyperplasia:* Increased size and number of mucus-producing glands lead to excess mucus production.
4. *Subepithelial fibrosis:* Deposition of collagen and other extracellular matrix proteins beneath the airway epithelium contributes to airway remodeling.

Symptoms

Pediatric asthma is a chronic respiratory condition marked by frequent episodes of wheezing, coughing, chest tightness, and shortness of breath. The typical clinical signs of pediatric asthma include [6]:

1. *Wheezing:* A high-pitched whistling sound during exhalation.
2. *Coughing:* A persistent dry or productive cough.
3. *Chest tightness:* A sensation of constriction or tightness in the chest.
4. *Shortness of breath:* Difficulty breathing or feeling out of breath.
5. *Cyanosis:* A bluish tint to the lips, fingers, or toes, which occurs in severe cases.

Classification

Table 1 outlines the different levels of asthma severity based on the frequency of symptoms during the day and at night. The severity is categorized as mild intermittent, mild persistent, moderate

persistent, or severe persistent, with criteria specifying the frequency of daytime and nighttime symptoms [7].

Table 1. Classification of asthma severity based on symptom frequency.

S.N.	Assessment	Symptoms
1.	Mild intermittent	Symptoms occur ≤ 2 times/week, and night-time symptoms occur ≤ 2 times/month.
2.	Mild persistent	Symptoms occur > 2 times/week but ≤ 1 time/day, and night-time symptoms occur > 2 times/month.
3.	Moderate persistent	Symptoms occur daily, and night-time symptoms occur > 1 time/week.
4.	Severe persistent	Symptoms occur throughout the day, and night-time symptoms occur frequently.

ASSESSMENT

Classic Symptoms

The hallmark symptoms of asthma include coughing, wheezing, chest tightness, and shortness of breath. These symptoms often occur in episodes and can be triggered by various factors, such as upper respiratory infections, physical activity, exposure to allergens, and irritants like tobacco smoke. Symptoms may also worsen at night [8].

Physical Examination

The physical examination should focus on three key areas to aid in developing a differential diagnosis and identifying any comorbid conditions. These include the overall nutritional status and body structure, signs of allergic conditions, and evidence of airway dysfunction. In some cases, the physical exam may appear entirely normal. However, signs, such as digital clubbing, a barrel-shaped chest, localized wheezing, or eczema may indicate other underlying conditions or comorbidities [9].

Physical Examination Findings:

1. *Wheezes*: Audible wheezes during auscultation.
2. *Crackles*: Fine crackles or rales during auscultation.
3. *Tachypnea*: Rapid breathing rate.
4. *Tachycardia*: Rapid heart rate.
5. *Prolonged expiration*: Delayed expiration phase.

Test

- Pulmonary function tests to measure how well the lungs are working.
- Allergy tests to identify allergens that may be triggering asthma attacks.
- Chest X-ray to rule out other conditions.

Medical Management

1. *Inhalers*: Bronchodilators (e.g., albuterol) for quick relief and corticosteroids (e.g., fluticasone) for long-term control.
2. *Medication delivery devices*: Nebulizers, metered-dose inhalers, or dry powder inhalers (DPIs) may be used.
3. *Combination therapy*: Using multiple medications, such as an inhaled corticosteroid and a long-acting bronchodilator.
4. *Leukotriene modifiers*: Montelukast or zafirlukast may be added to inhaled corticosteroids.

Lifestyle Changes

1. *Avoid triggers*: Identify and avoid common asthma triggers, such as allergens, irritants, and respiratory infections.
2. *Maintain a healthy weight*: Encourage a balanced diet and regular physical activity.
3. *Exercise safely*: Develop an exercise plan that includes warm-up and cool-down periods.
4. *Get enough sleep*: Establish a consistent sleep schedule to help regulate asthma [10].

Education and Monitoring

1. *Asthma action plan*: Create a personalized plan outlining medication use, trigger avoidance, and emergency procedures.
2. *Peak flow monitoring*: Use a peak flow meter to track lung function and adjust treatment as needed.
3. *Symptom tracking*: Keep a symptom diary to monitor asthma symptoms and identify patterns.
4. *Regular follow-ups*: Schedule regular appointments with a healthcare provider to review treatment and adjust.

Additional Considerations

1. *Vaccinations*: Ensure the child receives recommended vaccinations, including the flu vaccine.
2. *Allergy testing*: Consider allergy testing to identify specific allergens triggering asthma symptoms.
3. *Mental health support*: Provide emotional support and consider counseling to address anxiety or stress related to asthma.

Complications

1. *Status asthmaticus*: Severe, life-threatening asthma exacerbation.
2. *Respiratory failure*: Inability of the lungs to provide adequate oxygenation.
3. *Pneumonia*: Infection of the lungs.
4. *Atelectasis*: Collapse of lung tissue.

CONCLUSIONS

In conclusion, the management of pediatric asthma requires a comprehensive, individualized approach that includes early diagnosis, appropriate pharmacologic treatment, and effective environmental control to minimize triggers. Regular monitoring of symptoms and adherence to prescribed therapies are essential for preventing exacerbations and ensuring optimal lung function. Additionally, education for both children and caregivers is crucial to empowering them in recognizing and managing symptoms proactively. With a combination of personalized care, lifestyle adjustments, and ongoing medical support, most children with asthma can lead active, healthy lives, while minimizing the impact of the disease on their quality of life.

REFERENCES

1. Chu R, Bajaj P. Asthma medication in children. [Updated 2024 Jan 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. Available at <https://www.ncbi.nlm.nih.gov/books/NBK441823/>
2. Devonshire AL, Kumar R. Pediatric asthma: Principles and treatment. *Allergy Asthma Proc.* 2019;40(6):389–392.
3. Ferrante G, La Grutta S. The burden of pediatric asthma. *Front Pediatr.* 2018;6(186):1–7. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6023992/>
4. Lizzo JM, Cortes S, Doerr C. Pediatric Asthma (Nursing). PubMed. Treasure Island (FL): StatPearls Publishing; 2022. Available at <https://www.ncbi.nlm.nih.gov/books/NBK568735/>
5. Lizzo JM, Cortes S. Pediatric asthma. PubMed. Treasure Island (FL): StatPearls Publishing; 2024. Available at <https://www.ncbi.nlm.nih.gov/books/NBK551631/>
6. Martin J, Townshend J, Brodlie M. Diagnosis and management of asthma in children. *BMJ Paediatrics Open.* 2022;6(1):1–12.
7. Paul vinod K, Bagga A. Ghai Essential Pediatrics. 8th ed. New Delhi: CBS Publishers & Distributors; 2013.
8. Penn Medicine. What is Asthma? – Penn Medicine [Internet]. Pennmedicine.org. 2016. Available at <https://www.pennmedicine.org/for-patients-and-visitors/patient-information/conditions-treated-a-to-z/asthma>
9. Serebrisky D, Wiznia A. Pediatric asthma: A global epidemic. *Ann Glob Health.* 2019;85(1). Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7052318/>
10. World Health Organization. Asthma [Internet]. World Health Organisation. 2024. Available at <https://www.who.int/news-room/fact-sheets/detail/asthma>