



BRONCHIAL ASTHMA: TRIGGERS, ENVIRONMENTAL DETERMINANTS, AND STRATEGIES FOR SUSTAINABLE DISEASE CONTROL

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ABSTRACT

Asthma is a prevalent, variable chronic airway disease affecting an estimated 300 million people globally, with rising prevalence in modernized societies. Allergic sensitization is the strongest predisposing factor, and chronic exposure to environmental irritants and allergens further elevates risk. Triggers are diverse and patient-specific, spanning seasonal and perennial allergens (pollens, molds, dust mites, cockroaches, pet dander), airway irritants (pollution, smoke, strong odours, weather shifts), infections, exercise, stress, medications, and gastroesophageal reflux. The burden includes diminished quality of life, productivity losses, healthcare costs, hospitalizations, and mortality. Data from Ethiopia indicate asthma symptom prevalence of approximately 9–10% among youth. Indoor environments are central to morbidity: over 92% of homes contain at least one allergen, and housing conditions plus behaviours (e.g., smoking, combustion by-products) amplify exposure. Evidence supports multifaceted home environmental management—education, pest control, ventilation/air filtration—with reported improvements in asthma control, quality of life, and up to a 30% reduction in emergency visits. Etiology reflects gene–environment interplay, with contributions from respiratory infections, air pollution, occupational exposures, tobacco smoke, and comorbidities (e.g., GERD, rhinosinusitis, obesity). Core symptoms include wheeze, cough, dyspnoea, chest tightness, and recurrent episodes. Management aims for sustained control via guideline-directed therapy, correct inhaler technique, adherence, trigger mitigation, vaccinations, comorbidity management, stress reduction, and regular physical activity. Empowering patients with education and action plans is pivotal to preventing exacerbations and enabling normal daily living.

Keywords: asthma, allergens, indoor environment, home interventions, adherence, GINA, prevalence, gene–environment interaction, prevention.

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INTRODUCTION

Allergy is the strongest predisposing factor for asthma. Chronic exposure to airway irritants or allergens also increases the risk of asthma. Common allergens can be seasonal (grass, tree, and weed) or perennial (mold, dust, roaches, and animal dander). Common triggers for asthma symptoms and exacerbations include airway irritants (air pollutants, cold, heat, weather changes, strong odours or perfumes, smoke), exercise, stress or emotional upset, sinusitis with postnasal drip, medications, viral respiratory tract infections, and gastroesophageal reflux. Most people who have asthma are sensitive to a variety of triggers. A person's asthma changes depending on the environmental activities, management practices, and other factors. (Gaude G, Karanji J, 2012)

Asthma is now one of the most common chronic diseases affecting an estimated 300 million people worldwide. The prevalence of asthma increased significantly over the second half of the last century, especially in modernized societies [Anandan C et al 2010]. Although there are no data concerning the prevalence of asthma among adults in Ethiopia, the 2014 Global Asthma Report estimated asthma symptoms to be 9.1% in the adolescent population, while the International Study of Asthma and Allergies in Childhood (ISAAC) study estimated asthma symptom prevalence of 9.9% in the paediatric population of Ethiopia [Pearce N et al 2007].

As asthma is a controllable disease, the aim of asthma management is to control the disease and allow patients to lead a normal and healthy life. To achieve this, patients need to use medications correctly and maintain control for a considerable period of time. This might be achieved if patients receive adequate guidance on how to use medications and receive sufficient knowledge about the disease. (Global Initiative for Asthma (GINA). (2023). Patients should also be aware that adhering to the treatment plan is the mainstay of asthma management. In addition, asthma is a variable disease (i.e., it can change over time), implying that even when a patient has achieved a well-controlled asthma level, an asthma exacerbation can still occur. Therefore, patients need to know how to manage their disease and/or how to get help from health care providers when faced with an asthma exacerbation. (Bender, B. G., & Appel, L. J. (2014). Asthma affects people worldwide. In developed countries, 1 in 12 individuals suffer from asthma, while in Ireland, this ratio is closer to 1 in 10. Managing asthma symptoms and triggers reduces the potential exacerbation of asthmatic attacks. (Murray B, O'Neill M. 2018)

Environmental triggers in combination with genetic variables play a critical role in exacerbating asthma symptoms. (Von Mutius E, 2009) Housing conditions, laden with dust mites, cockroaches, rodents, molds, and pet dander, are significant contributors to asthma morbidity. (Baldacci S et al 2015)

More than 92% of the homes contain at least one allergen in dust, emphasizing widespread exposure to indoor allergens. (Youth E-CUA et al 2016) Tenant behaviour, including smoking and combustion of nitrogen oxides, further aggravates indoor asthma triggers. (Hansel NN et al 2008)

Home environmental management has emerged as a crucial strategy with studies demonstrating its efficacy in reducing asthma triggers and improving outcomes. Studies have found the effectiveness of strategies on allergen avoidance including asthma control education, home management, and air filter installation. For example, interventions involving home visits, pest control, and air circulation management have resulted in statistically significant improvements in asthma control, quality of life, and environmental conditions. (Turcotte DA et al 2019) Similarly, targeted home environmental programs have reduced the number of asthma triggers. Home-based education and environmental interventions led to a 30% decrease in emergency visits for asthmatic patients. (Bryant-Stephens TC et al 2021; Gardner EA, 2021)

CAUSES OF BRONCHIAL ASTHMA

1. Genetic predisposition: Family history of asthma or allergies increases the risk. Genetic predisposition plays a significant role in the development of bronchial asthma. Individuals with a family history of asthma or allergies are more likely to develop the condition (Ober & Yao, 2011). Specific genetic variants can affect airway function, inflammation, and response to environmental triggers. While genetics is not the sole cause, it can increase susceptibility and influence the severity of asthma symptoms.

2. Allergens: Common allergens such as dust mites, pollen, pet dander, and mold can trigger asthma symptoms. Allergens are a common cause of bronchial asthma. Common allergens such as dust mites, pollen, pet dander, and mold can trigger asthma symptoms (GINA, 2023). When inhaled, these allergens can cause inflammation and airway constriction, leading to symptoms like wheezing, coughing, and shortness of breath. Avoiding exposure to these allergens or using medications to control symptoms can help manage asthma.



3. Respiratory infections: Viral or bacterial infections, especially in childhood, can contribute to asthma development. Respiratory infections, particularly viral infections, can contribute to the development and exacerbation of bronchial asthma. Infections such as rhinovirus, respiratory syncytial virus (RSV), and influenza can trigger inflammation and airway hyperresponsiveness, leading to asthma symptoms (Jackson et al., 2022). Respiratory infections can also increase the production of mucus, further obstructing airflow. Understanding the role of respiratory infections in asthma can inform prevention and treatment strategies.

4. Air pollution: Exposure to pollutants like particulate matter, ozone, and nitrogen dioxide can exacerbate asthma. Air pollution is a significant contributor to the development and exacerbation of bronchial asthma. Exposure to pollutants like particulate matter (PM), ozone (O₃), and nitrogen dioxide (NO₂) can trigger inflammation and airway constriction, leading to asthma symptoms (Guarnieri & Balmes, 2021). Air pollution can also increase the risk of asthma development, especially in children. Reducing exposure to air pollution through cleaner energy sources and emission controls can help mitigate the impact of air pollution on asthma.

5. Occupational exposures: Certain work environments, such as construction or manufacturing, can expose individuals to asthma triggers. Occupational exposures can cause bronchial asthma in certain work environments. Workers in industries such as construction, manufacturing, and healthcare may be exposed to asthma triggers like dust, chemicals, and allergens (Tarlo et al., 2020). Prolonged exposure can lead to inflammation and airway constriction, resulting in occupational asthma. Identifying and controlling workplace exposures can help prevent asthma development and manage symptoms.

6. Smoking and second-hand smoke: Exposure to tobacco smoke can increase the risk of asthma. Smoking and second-hand smoke exposure can significantly contribute to the development and exacerbation of bronchial asthma. Tobacco smoke contains numerous irritants and toxins that can inflame airways, increase mucus production, and trigger asthma symptoms (Comhair et al., 2019). Maternal smoking during pregnancy and exposure to second-hand smoke in childhood can also increase the risk of developing asthma. Quitting smoking and reducing exposure to second-hand smoke can help prevent asthma development and improve symptoms in individuals with existing asthma.

7. Other medical conditions: Certain conditions, such as gastroesophageal reflux disease (GERD) or sinusitis, can contribute to asthma symptoms. Certain medical conditions can contribute to the development or exacerbation of bronchial asthma. Conditions like gastroesophageal reflux disease (GERD), sinusitis, and allergic rhinitis can trigger or worsen asthma symptoms (Boulet et al., 2018). Treating these underlying conditions can help improve asthma control. Additionally, conditions like obesity and obstructive sleep apnoea can also impact asthma severity. Managing these comorbidities is essential for effective asthma management.

Symptoms of Bronchial Asthma:

1. Wheezing: A high-pitched whistling sound while breathing out. Wheezing is a common symptom of bronchial asthma, characterized by a high-pitched whistling sound while breathing out. It occurs when air passes through narrowed airways, often due to inflammation and constriction (National Asthma Education and Prevention Program, 2017). Wheezing can be a key indicator of asthma, especially when accompanied by other symptoms like coughing and shortness of breath. Monitoring wheezing and other symptoms can help diagnose and manage asthma effectively.

2. Coughing: A persistent and recurring cough, especially at night or during exercise. Coughing is a common symptom of bronchial asthma, often persistent and recurring. It can be triggered by various factors, such as allergens, irritants, or respiratory infections (Dicpinigaitis, 2016). Asthmatic coughs are often dry and non-productive, and may worsen at night or with physical activity. Coughing can be a key indicator of asthma, especially when accompanied by other symptoms like wheezing and shortness of breath. Accurate diagnosis and treatment can help manage coughing and other asthma symptoms.

3. Shortness of breath: Feeling like you can't catch your breath or feeling breathless even when sitting still. Shortness of breath, also known as dyspnoea, is a common symptom of bronchial asthma. It occurs when inflamed and constricted airways reduce airflow, making it difficult to breathe (Global Initiative for Asthma, 2015). Shortness of breath can be triggered by physical activity, allergens, or other asthma triggers. It can range from mild to severe and may be accompanied by other symptoms like wheezing and coughing. Effective management of asthma can help alleviate shortness of breath and improve quality of life.



4. Chest tightness: Feeling like there's pressure or tightness in your chest. Chest tightness is a symptom of bronchial asthma, characterized by a feeling of pressure or constriction in the chest. It occurs when inflamed airways constrict, making breathing difficult (National Heart, Lung, and Blood Institute, 2014). Chest tightness can be triggered by various factors, such as allergens, exercise, or cold air. It often accompanies other asthma symptoms like wheezing, coughing, and shortness of breath. Recognizing chest tightness as an asthma symptom can help individuals seek proper treatment and manage their condition effectively.

5. Recurring episodes: Symptoms can occur repeatedly, often triggered by specific factors like allergens, exercise, or cold air. Recurring episodes of asthma symptoms, such as wheezing, coughing, and shortness of breath, are characteristic of bronchial asthma. These episodes can be triggered by various factors, including allergens, respiratory infections, and environmental factors (Bateman et al., 2013). Recurring episodes can lead to chronic inflammation and airway damage, making asthma harder to control. Understanding and managing triggers can help reduce the frequency and severity of these episodes.

PREVENTION OF BRONCHIAL ASTHMA:

1. Avoid allergens: Stay away from known allergens like dust mites, pollen, and pet dander. Avoiding allergens is a crucial step in preventing bronchial asthma. Common allergens like dust mites, pollen, and pet dander can trigger asthma symptoms (Custovic & Simpson, 2012). Reducing exposure to these allergens through measures like using allergen-proof bedding, removing pets from the home, and avoiding outdoor activities during peak pollen seasons can help prevent asthma symptoms. By minimizing exposure to allergens, individuals can reduce their risk of developing asthma or alleviate symptoms if they already have the condition.

2. Maintain a healthy environment: Keep your home clean, dry, and well-ventilated to reduce exposure to triggers. Maintaining a healthy environment is a crucial prevention strategy for bronchial asthma. This involves reducing exposure to indoor air pollutants, using HEPA filters, and keeping homes clean and dry to minimize allergens and irritants (Levy, 2011). By controlling environmental triggers, individuals can reduce their risk of developing asthma or alleviate symptoms if they already have the condition. A healthy environment can help prevent asthma symptoms and improve overall respiratory health.

3. Quit smoking: Smoking and second-hand smoke can trigger asthma symptoms. Quitting smoking is a crucial prevention strategy for bronchial asthma. Smoking damages airways, increases inflammation, and triggers asthma symptoms (Polosa & Thomson, 2011). Second-hand smoke exposure can also exacerbate asthma. Quitting smoking can help prevent asthma development, reduce symptoms, and improve lung function. Smoking cessation programs and resources can support individuals in quitting smoking and reducing their risk of asthma.

4. Exercise regularly: Regular physical activity can help improve lung function. Regular exercise can help prevent bronchial asthma by improving lung function and overall health. Exercise can also reduce stress and improve immune function, which can help alleviate asthma symptoms (Mendes et al., 2010). However, some individuals with asthma may experience exercise-induced bronchospasm. With proper management and precautions, regular exercise can be beneficial for individuals with asthma. Consult a healthcare professional to develop an exercise plan that suits individual needs.

5. Manage stress: Stress can trigger asthma symptoms; practice stress-reducing techniques like meditation or yoga. Managing stress can help prevent bronchial asthma symptoms. Stress can trigger inflammation and exacerbate asthma symptoms (Wright, 2009). Practicing stress-reducing techniques like meditation, yoga, or deep breathing can help alleviate stress and improve asthma control. By managing stress, individuals can reduce their risk of asthma symptoms and improve overall respiratory health.

6. Get vaccinated: Stay up-to-date on vaccinations, especially flu and pneumonia vaccines. Getting vaccinated can help prevent respiratory infections that can trigger bronchial asthma symptoms. Vaccines like the flu vaccine can reduce the risk of respiratory infections and subsequent asthma exacerbations (Busse et al., 2008). By staying up-to-date on recommended vaccinations, individuals with asthma can reduce their risk of hospitalization and improve asthma control. Consult a healthcare professional to determine the best vaccination schedule.

7. Monitor and manage comorbidities: Conditions like GERD, allergies, and obesity can exacerbate asthma. Monitoring and managing comorbidities is crucial in preventing bronchial asthma symptoms. Conditions like gastroesophageal reflux disease (GERD), allergies, and obesity can exacerbate asthma (Boulet & Boulay, 2007). By managing these comorbidities, individuals can reduce their risk of asthma symptoms and improve overall



respiratory health. Healthcare professionals can help develop a treatment plan to manage comorbidities and asthma.

8. Use air purifiers: Air purifiers can help reduce exposure to air pollutants and allergens. Using air purifiers can help prevent bronchial asthma symptoms by reducing exposure to indoor air pollutants and allergens. HEPA filters can capture 99.97% of particles as small as 0.3 microns, including dust, pollen, and pet dander (McDonald et al., 2006). By removing these triggers, air purifiers can help alleviate asthma symptoms and improve respiratory health. Placing air purifiers in frequently used rooms can maximize their benefits.

CONCLUSION

Asthma remains a common, variable, and controllable chronic airway disease driven by a gene–environment interplay and amplified by ubiquitous indoor and outdoor triggers. Allergic sensitization is the strongest predisposing factor, while chronic exposure to irritants, infections, and poor housing conditions increases morbidity. Evidence shows that comprehensive, patient-centered management—combining guideline-directed pharmacotherapy, correct inhaler technique, adherence, and targeted environmental control—meaningfully reduces symptoms, exacerbations, healthcare utilization, and improves quality of life. Multifaceted home interventions (education, pest management, ventilation/filtration) are particularly impactful, with programs demonstrating significant gains in control and reductions in emergency visits. Because asthma severity and triggers evolve over time, ongoing education, routine assessment, and individualized action plans are essential for sustained control and prevention of severe outcomes.

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