

Programme: BSc Health and Social Care

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Asthma is a chronic inflammatory condition affecting the airways and is characterised by bronchial hyperresponsiveness, airway inflammation and variable airflow obstruction. It is one of the most common long-term respiratory conditions affecting children and adolescents, causing symptoms including wheezing, coughing, chest tightness and shortness of breath (Global Initiative for Asthma, 2024). Although asthma cannot currently be cured, effective management through medication, monitoring and lifestyle changes can improve symptom control and reduce exacerbations.

The development and severity of asthma are influenced by both non-modifiable and modifiable risk factors. Genetic predisposition, family history and allergic conditions represent important non-modifiable factors, whereas exposure to tobacco smoke, vaping, air pollution, respiratory infections, obesity and allergens such as pollen and dust mites can influence asthma control (Papi et al., 2018). Adolescence represents a particularly important stage for asthma management because increased independence may introduce behaviours and environments that negatively affect respiratory health. For example, smoking, vaping and frequent exposure to crowded environments may increase contact with respiratory irritants and infections, potentially worsening airway inflammation.

For adolescents attending a GP asthma clinic, understanding respiratory anatomy, physiology and asthma-related changes is essential. Improved knowledge enables individuals to recognise symptoms, identify triggers and participate more effectively in personalised asthma management plans. This report will examine the structure and function of the respiratory system, explain mechanical respiration and gas exchange, discuss how irritants contribute to airway inflammation, and evaluate how respiratory monitoring and lifestyle modifications can support effective asthma management.

The respiratory system is responsible for supplying oxygen required for cellular respiration and removing carbon dioxide produced through metabolism. It consists of specialised structures that work together to conduct air into the lungs and facilitate gas exchange, maintaining normal physiological function and homeostasis (Tortora and Derrickson, 2021).

The respiratory system is divided into the upper and lower respiratory tracts. The upper respiratory tract consists of the nose, nasal cavity, pharynx and larynx. The nose and nasal cavity filter, warm and humidify inhaled air, while mucus and cilia trap and remove foreign particles and microorganisms before they reach deeper areas of the respiratory system (Marieb

and Hoehn, 2023). The lower respiratory tract includes the trachea, bronchi, bronchioles and alveoli. The trachea is supported by cartilage rings and divides into bronchi, which branch into smaller bronchioles to distribute air throughout the lungs. At the end of the bronchioles are millions of alveoli, which are specialised structures responsible for gas exchange. Their large surface area, thin walls and extensive capillary network allow diffusion of oxygen into the bloodstream and removal of carbon dioxide (Tortora and Derrickson, 2021).

Air movement through the respiratory system occurs through mechanical respiration, also known as pulmonary ventilation. This process depends on changes in pressure within the thoracic cavity created by respiratory muscle activity. During inspiration, the diaphragm contracts and flattens while the external intercostal muscles raise the ribs upwards and outwards. These movements increase thoracic cavity volume, reducing pressure within the lungs below atmospheric pressure and allowing air to enter (Marieb and Hoehn, 2023). Whilst during expiration, the diaphragm and intercostal muscles relax, reducing thoracic cavity volume and increasing pressure within the lungs. This forces air containing carbon dioxide out of the respiratory system. In healthy individuals, this process allows efficient ventilation; however, asthma disrupts normal respiration because airway inflammation and bronchoconstriction increase resistance to airflow. As a result, individuals with asthma may experience difficulty moving air through narrowed airways, particularly during expiration. For this reason, understanding normal respiratory structure and ventilation is essential when examining asthma because symptoms develop as a result of disruption to these physiological processes.

The primary purpose of ventilation is to allow gas exchange between the alveoli and bloodstream. Gas exchange occurs through diffusion across the alveolar-capillary membrane, where oxygen and carbon dioxide move from areas of higher concentration to areas of lower concentration (Tortora and Derrickson, 2021).

Following inspiration, oxygen concentration within the alveoli is higher than in the deoxygenated blood arriving through the pulmonary arteries. Oxygen therefore diffuses across the thin alveolar and capillary walls into the bloodstream, where it binds to haemoglobin in red blood cells to form oxyhaemoglobin. This oxygen-rich blood is transported throughout the body to support aerobic cellular respiration and energy production (Marieb and Hoehn, 2023). Carbon dioxide produced through cellular metabolism is then transported through the blood back towards the lungs. As carbon dioxide concentration is higher in pulmonary capillaries than in the alveoli, it diffuses into the alveolar air space and is removed during expiration.

Gas exchange efficiency depends on alveolar adaptations, including a large surface area, thin walls and dense capillary network that support rapid diffusion. These features demonstrate the relationship between respiratory anatomy and physiology, as lung structure enables oxygen delivery and removal of metabolic waste products.

In asthma, gas exchange is affected primarily because airway narrowing reduces ventilation. During an exacerbation, inflammation, bronchoconstriction and mucus production restrict airflow to the alveoli. Although the alveoli are not usually damaged directly, reduced airflow limits oxygen availability and contributes to symptoms including breathlessness and chest tightness.

Asthma is characterised by chronic inflammation of the airways, causing increased sensitivity to environmental triggers and episodes of reversible airflow obstruction. In healthy individuals, the bronchi and bronchioles remain open to allow efficient movement of air towards the alveoli. However, in asthma, exposure to triggers activates an exaggerated immune response, resulting in airway swelling, increased mucus production and bronchoconstriction (Global Initiative for Asthma, 2024). During an inflammatory response, immune cells including mast cells, eosinophils and T-lymphocytes release inflammatory mediators that cause airway swelling, mucus secretion and smooth muscle contraction. These changes reduce airway diameter and increase resistance to airflow, making ventilation more difficult. Consequently, individuals may experience common asthma symptoms including wheezing, coughing, chest tightness and shortness of breath.

Respiratory irritants can intensify this inflammatory process and increase the likelihood of asthma exacerbations. Cigarette smoke is one of the most established environmental factors associated with poor asthma control. Tobacco smoke contains harmful chemicals that damage the respiratory epithelium and impair ciliary function, reducing the removal of mucus, allergens and microorganisms from the airways. This allows irritants to remain within the respiratory tract for longer, contributing to persistent inflammation and increased airway sensitivity (Polosa and Thomson, 2013). Smoking may also reduce the effectiveness of asthma treatment. Evidence suggests that individuals with asthma who smoke can experience poorer symptom control and increased exacerbation frequency due to ongoing airway irritation and reduced responsiveness to corticosteroid medication (Polosa and Thomson, 2013). Therefore, smoking prevention and cessation support are particularly important for adolescents, as early exposure to tobacco products may negatively affect long-term respiratory health.

Vaping is also an increasing concern among adolescents with asthma. Although electronic cigarettes generally expose users to fewer toxic substances than conventional cigarettes, vaping is not risk-free. Inhaled substances within vaping aerosols may irritate airway tissues and contribute to inflammatory responses. While research into the long-term respiratory effects of vaping continues to develop, emerging evidence indicates associations between vaping and increased respiratory symptoms, supporting a precautionary approach when educating young people with asthma (National Institute for Health and Care Excellence, 2024).

Respiratory infections are another important trigger of asthma exacerbations. Viral infections can activate immune responses that increase airway inflammation, mucus production and bronchial hyperresponsiveness. These changes further restrict airflow and can rapidly worsen symptoms. This highlights the importance of infection prevention strategies and appropriate vaccination. Repeated exposure to inflammatory triggers may contribute to airway remodelling, involving structural changes such as thickening of airway walls, increased smooth muscle development and fibrosis. These long-term changes can contribute to persistent airflow limitation and reduced asthma control (Maddox and Schwartz, 2002). Therefore, educating adolescents about how lifestyle choices and environmental exposures influence airway inflammation is essential for preventing future exacerbations.

Effective asthma management requires individuals to recognise changes in their respiratory health and respond appropriately before symptoms become severe. Monitoring respiratory function provides objective information about asthma control and supports early identification of deterioration. Peak Expiratory Flow (PEF) is a measurement of the maximum speed at which an individual can forcefully exhale air following a full inspiration. As asthma causes variable airflow obstruction due to airway inflammation and bronchoconstriction, changes in peak flow readings can provide an indication of changes in airway function (National Institute for Health and Care Excellence, 2024). Recording peak flow measurements over time allows individuals to establish their personal best reading and identify patterns that may indicate worsening asthma control. This is particularly useful because symptoms alone may not always provide an early indication of deterioration. A reduction in peak flow readings alongside increased coughing, wheezing or increased use of reliever medication may indicate worsening asthma control and the need for medical advice.

For adolescents, respiratory monitoring is valuable because increasing independence may introduce triggers such as smoking, vaping and infection exposure. Understanding changes in

their own respiratory patterns allows young people to become more actively involved in managing their condition.

Peak flow monitoring is most effective when incorporated into a personalised asthma action plan. These plans provide individuals with guidance regarding symptom recognition, medication use and when professional support is required. The National Institute for Health and Care Excellence (2024) recommends that asthma care should include education, regular reviews and personalised management strategies to improve outcomes.

Within the GP asthma clinic setting, respiratory monitoring also supports healthcare professionals by providing objective information during consultations. Reviewing peak flow readings alongside symptoms, medication adherence and trigger exposure allows clinicians to assess asthma control accurately and tailor advice according to individual needs. Therefore, monitoring respiratory function should be viewed as part of a wider self-management approach rather than an isolated measurement.

Although medication remains central to asthma management, lifestyle modifications and reducing exposure to triggers are essential components of achieving effective long-term control. For adolescents, education should focus on helping individuals understand how daily behaviours influence airway inflammation and the risk of exacerbations. One of the most important recommendations is avoiding tobacco smoke exposure. Smoking increases airway inflammation, damages respiratory tissues and contributes to poorer asthma control. Healthcare professionals should routinely discuss smoking behaviours with adolescents and provide appropriate support to encourage prevention and cessation (National Institute for Health and Care Excellence, 2024).

Reducing vaping exposure should also be encouraged. While further research is required to fully understand the long-term respiratory consequences of vaping, current evidence suggests that inhaled substances may irritate airway tissues and contribute to respiratory symptoms. Providing adolescents with accurate information allows them to make informed decisions and understand the potential impact of vaping on asthma management.

Regular physical activity should be encouraged when asthma is appropriately controlled. Exercise can improve cardiovascular fitness, psychological wellbeing and quality of life. Although some individuals experience exercise-induced symptoms, asthma should not generally prevent participation in physical activity. Appropriate asthma control strategies, including correct

medication use and understanding personal triggers, can allow individuals to remain active safely (Global Initiative for Asthma, 2024). Medication adherence and correct inhaler technique are also essential. Preventer inhalers reduce underlying airway inflammation, while reliever inhalers provide short-term symptom relief. Incorrect inhaler technique or inconsistent medication use may reduce treatment effectiveness and increase exacerbations. Regular asthma reviews provide opportunities for healthcare professionals to assess technique, address concerns and reinforce treatment adherence.

Finally, adolescents should be supported to identify and manage personal triggers, including allergens, air pollution and respiratory infections. However, trigger avoidance should be balanced with maintaining quality of life. A personalised approach allows individuals to reduce avoidable risks while continuing normal activities. Understanding normal respiratory anatomy and physiology demonstrates how effective ventilation and gas exchange depend upon open airways and healthy alveolar function. However, asthma disrupts these processes by increasing airway resistance and reducing airflow to the lungs.

For adolescents attending GP asthma clinics, education is essential because lifestyle changes may introduce new respiratory risks. Smoking, vaping, respiratory infections and environmental triggers can increase airway inflammation and contribute to exacerbations. Supporting young people to understand these factors allows them to make informed decisions about their respiratory health.

Monitoring respiratory function through symptom tracking and peak flow measurements enables earlier recognition of deterioration and encourages active participation in asthma self-management. Combined with appropriate medication use, regular healthcare reviews and evidence-based lifestyle modifications, these strategies can improve asthma control and reduce the impact of the condition on daily life.

Ultimately, successful asthma management requires partnership between healthcare professionals and patients. By improving adolescents' knowledge, confidence and ability to monitor their condition, healthcare providers can support safer respiratory management and improve long-term health outcomes.

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