Asthma is one of the most frequent chronic diseases in childhood affecting 5–25% of school-aged children in Europe. Data on prevalence in poor countries and the so-called third world are less well established; however, the International Study of Asthma and Allergies in Childhood (the ISAAC study, the only global study on paediatric asthma and allergy) has provided important, precious knowledge not only regarding prevalence but also treatment opportunities for many countries in the world. The World Health Organization (WHO) has estimated that approximately 300 million people worldwide are affected by asthma.

Asthma is characterised by chronic airways inflammation, reversible airways obstruction and bronchial hyper-responsiveness (BHR); however, the precise underlying pathophysiology is still not completely clarified. The chronic inflammation is often characterised by eosinophilic activity and allergic inflammation and therefore anti-inflammatory treatment by the use of inhaled corticosteroids (ICS) is one of the cornerstones of asthma therapy. To date asthma cannot be cured but it can be treated effectively if patients have access to a regular supply of medication and are actually taking that medication. Nevertheless, the burden of asthma has been increasing continuously over the last 30 years, particularly in poorer countries. Many factors influence disease activity and hence asthma outcome, including the age of the child, variability in clinical presentation, co-morbidities, socio-economic and psychosocial factors, and environmental exposures (including air pollution, as illustrated in figure 1). Indeed, by looking at the circumstances of two patients we can illustrate how much the environment can produce unequal chances for children in regard to asthma, as shown below for Samuel and Elisabeth.

Samuel is one of five siblings living in a poor neighbourhood in the city centre of a town in India. His mother uses a stove with an open fire and his older brothers, aged 12 and 15 years, have started smoking cigarettes. Samuel has been exposed to indoor air pollution since he was born and even from before that, as his mother smoked during pregnancy. Samuel has lived in a detrimental environment for all of his life and has been exposed to numerous toxic substances due to breathing contaminated air. He has an increased risk for decreased lung growth and size and his exposure to tobacco and other indoor and outdoor toxins is most likely the cause of his being born prematurely (his mother went into premature labour and gave birth at 34 weeks) and his issues with recurrent respiratory tract infections and impaired immune response to viral infections (including two where he needed a week of hospitalisation with supplemental oxygen and antibiotics), a factor further complicated by his mother (a heavy smoker) deciding not to breastfeed him.
Given these factors, Samuel had an increased risk of early childhood asthma. Indeed, at age 3 years he was first given the diagnosis “preschool wheezer” and, due to the severity and frequency of his respiratory infections and his frequent wheezing, he was treated with continuous inhaled steroids. Continuous environmental tobacco exposure (ETS) prevented the steroids from exerting their full effects and, unsurprisingly, his parents stopped the therapy as they had the impression it was not helping.

His lung function at age 8 years is now already considerably worse when compared to other children his age and size. His asthma frequently exacerbates and he is currently hospitalised for severe exacerbations every 4–6 months. Missing the school day is already becoming an issue and his self-confidence has suffered from a lack of success in school compared to his school mates; furthermore, he has behavioural issues and these are more common in children who have been exposed to cigarette smoke during pregnancy.

Elisabeth is also 8 years old and suffers from asthma, like her siblings and her parents. On the other hand, she is living in the suburbs of Pressbaum, a small town in lower Austria, and the family lives an active life. Asthma medication is part of her daily routine and she even took part in a study using home spirometry for a short period to increase self-awareness of symptoms. Although she was born as a late preterm, at 34 weeks, she is doing fine and has never had severe exacerbations needing hospitalisation. Despite undoubtedly having asthma she is living a normal life.

During pregnancy, preventing exposure to tobacco smoke is probably the most important measure required to prevent childhood asthma. Surveillance on a population level, with routine testing for tobacco exposure in all pregnant women, could conceivably be used as a first-step in increasing awareness of the issue. After birth, prevention of indoor as well as outdoor air pollution is the most important measure required to reduce morbidity from respiratory disease, while, during childhood, the greatest challenges come from factors such as inhalation technique, symptom awareness, adherence to medication advice and psychosocial factors associated with worse disease/health outcomes.

The goal of current asthma therapy and management is to achieve and maintain clinical control, to reduce risks including loss of asthma control (exacerbation), to allow normal development of lung function and, ultimately, to prevent asthma-related death. Asthma is considered well-controlled if daytime symptoms occur two or less times per week, if no night-time symptoms leading to sleep disturbance occur, if there are no limitations to physical activity, if rescue medication is needed two times per week or less, and if lung function is normal.
Whereas asthma control in children is not optimal even in rich countries such as Switzerland, insufficient availability of essential asthma medication is the main reason for very poor asthma control in developing countries. Hence, there is a high level of morbidity and mortality associated with the fact that ICS especially are either not available or not affordable in many low- and middle-income countries. Here we present two cases (Marco and Aghavni) to illustrate how pricing and availability are both key factors that affect not only access to medicines but also their regular use and can lead to inequality in treatment of allergic asthma in children between rich and poor countries.

Marco, a boy aged 12 years, presented at a clinic in Zurich with allergic asthma that was uncontrolled despite regular high-dose ICS therapy with a formoterol–budesonide combination (budesonide dose: 800 μg·day⁻¹). He was sensitised to *Aspergillus fumigatus* and suffered regular exacerbations (8–10 per year) while exhibiting a reduced value of forced expiratory volume in 1 s (FEV₁) of 75% of predicted. Other diseases, such as cystic fibrosis and allergic bronchopulmonary aspergillosis (ABPA), were excluded and he stabilised on systemic corticosteroids; however, he then stopped growing. A low-dose adrenocorticotropic hormone (ACTH) test showed significant suppression of the hypothalamic–pituitary–adrenal axis. After referral to another centre, he was started on omalizumab (dose determined by weight) and total serum immunoglobulin E (IgE; 300 mg every 2 weeks) while oral corticosteroids were tapered off and finally stopped. The boy remained stable on budesonide (400 μg·day⁻¹) and subcutaneous omalizumab (final interval: 4–6 weeks) while he started to grow again, finally reaching a normal height.

Aghavni, an Armenian girl aged 5 years, living in a town close to Erewan, was hospitalised at a central paediatric hospital with a severe acute asthma exacerbation (the eighth hospitalisation within the previous 3 years). She was allergic to house dust mites and grass pollen and was limited in her ability to exercise by breathlessness even outside of exacerbations. She was not on a regular ICS treatment because, at that time, the only available asthma medication was a fixed dry powder combination of salmeterol–fluticasone and she was not able to inhale effectively with this device. The family could not afford to buy a nebuliser for salbutamol inhalation and, therefore, asthma therapy was generally performed with systemic corticosteroids while she was hospitalised with an exacerbation but not on a regular base outside of this. At a later date, fluticasone treatment with a metered-dose inhaler (pMDI) and spacers was introduced in Armenia. However, as the family was in the low-income range (~$120·month⁻¹) the cost of the regular fluticasone therapy (250 μg·day⁻¹) was still too expensive (5.5 days wages per 120 inhalation puffer). Therefore, despite the correct and effective treatment being available her asthma remained uncontrolled due to insufficient dosing of the ICS therapy.

A relatively recent cross-sectional pricing survey was conducted in 52 low- and middle-income countries to determine the availability, pricing and affordability of salbutamol, budesonide and beclometasone, drugs that are on the World Health Organization’s model list of essential medicines. The study revealed a particularly poor general availability of ICS, which was even worse in main hospitals and procurement centres, and pricing showed considerable variability between countries (figure 2). Affordability, defined as the number of days wages per inhaler, was calculated according to the cost of a 1-year supply and was dependent upon the availability of a generic brand (which was the case in most countries). The affordability of a beclometasone inhaler (100 μg) ranged from 0.5 days in Afghanistan to 10 days in Cambodia or 14 days in Madagascar. In most of the assessed countries affordability ranged from 2 to 4 days. On the other hand, availability of generic budesonide was much lower and this had an important impact on its affordability, which ranged from 2 days in Peru to 18 days in Egypt, 48 days in Burkina Faso, 51 days in Mozambique and up to 107 days in the Republic of Guinea. These very impressive numbers clearly show that in low- and middle-income countries, where people are often required to purchase medicines as an out-of-pock
expense, they are often unaffordable for large parts of the population. This results in insufficient therapy leading to persistently uncontrolled asthma, which in turn leads to increased morbidity, rate of hospitalisation and risk of death. In addition, chronically undertreated asthma may be associated with reduced lung function and hence a significantly increased risk for chronic obstructive pulmonary disease (COPD). However, meeting the price for asthma treatment is often at the expense of food and other basic requirements, a lack of which would have its own effect on health outcomes.

Inequality in childhood asthma is many-fold and is profound between wealthy regions and low- and middle-income countries. Not only do chronic hazardous exposures lead to more severe disease but availability and affordability of WHO-recommended essential asthma medicines also remains an important issue.

CONFLICT OF INTEREST

None declared.

RECOMMENDED READING


Gabriels RL, Wamboldt MZ, McCormick DR, et al. Children's