



Asthma prevalence and severity in low-resource communities

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Purpose of review

The prevalence of asthma was thought to be low in most low-income countries, but several reports have indicated this is not always true. This is a narrative review of recent publications on the burden of asthma in low and middle-income countries (LMIC) and underprivileged communities from developed countries.

Recent findings

Several studies have reported a low prevalence of asthma in LMIC, but indicate it is increasing. In the last few years, however, many surveys demonstrated this may not always be true. An analysis of the International Study for Asthma and Allergy in Childhood phase III database indicated although the prevalence of asthma among children and adolescents is higher in the developed countries, symptoms of asthma are often more severe in less affluent nations. The rate of uncontrolled asthma is also higher among underprivileged communities of developed countries. Secondary analysis of data generated by the WHO's world health survey performed among adults of 70 countries indicate symptoms of asthma are less frequent in middle-income countries and more frequent in the extremes, low income and high income. This sort of U shaped distribution suggests the disease (or syndrome) comprise more than one major phenotype related to diverse underlying mechanisms. In fact, recent reports show symptoms of asthma among the poor are associated with unhygienic living conditions, which may reduce the risk of atopy but increase the risk of nonatopic wheezing. Urbanization and exposure to air pollution also seem to contribute to an increasing prevalence severity of asthma in LMIC. Access to proper diagnosis and treatment with controller medications for asthma, specially with inhaled corticosteroids is feasible and cost-effective, reduce symptoms, health resource utilization, improves quality of life, and reduce mortality in low-resource settings.

Summary

Prevalence of asthma was thought to be low in low-income countries, but several reports have indicated this is not always true. Under diagnosis, under treatment, exposure to air pollution, and unhygienic living conditions may contribute to a higher frequency and severity of symptoms of asthma among the poor. Proper diagnosis and treatment with controller medications for asthma is feasible and cost-effective in low-resource settings.

Keywords

asthma, environment, epidemiology, poverty

INTRODUCTION

Asthma is a disease usually characterized by airway inflammation and bronchial hyperresponsiveness when the study participants present symptoms. There are, however, various phenotypes of asthma and many prefer to say it is a syndrome. Complex genetic predisposition and varied environment exposures are the determinants of asthma. The diversity of genetic and environmental exposures between populations probably explains the heterogeneity in the prevalence, phenotypes, and severity of asthma around the world. The most notorious study exploring the epidemiology of asthma in a global standardized fashion was the International

Study for Asthma and Allergy in Childhood (ISAAC). The results from the ISAAC study phase III demonstrated a worldwide variation in the prevalence of

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KEY POINTS

- The prevalence and severity of symptoms of asthma may be high in low-resource settings.
- Underdiagnosis, undertreatment, exposure to air pollution, and to unhygienic living conditions, which are common among the poor are related to a higher risk of wheezing.
- Increasing access to proper treatment for the underserved is feasible and cost-effective, by reducing symptoms, health resource utilization, and mortality because of asthma.

asthma, with lower prevalence in low-income countries, but also indicated that it is increasing, and in spite of the lower prevalence, the severity of asthma was greater in lower income countries [1]. Many other studies evaluated the epidemiology of asthma in low and middle-income countries (LMIC) and several have reported a high prevalence of asthma in some of these settings. Our aim is to present a narrative review on recent publications on asthma prevalence and severity in underprivileged communities of LMIC and developed countries as well, and to discuss possible explanations to elevated frequency and severity of symptoms of asthma in low resource settings.

ASTHMA PREVALENCE IN LOW AND MIDDLE-INCOME COUNTRIES

Recent cross-sectional studies estimated the prevalence of asthma in samples of children living in LMIC countries using the questionnaire of the ISAAC study. The prevalence of physician-diagnosed asthma in these studies were 2% in Georgia [2], 2.5% in Mongolia [3], 3% in Senegal [4], 4.8% in China [5], 6% in India [6], and 7.5% in Iran [7]. In Eastern Europe countries, Belarus, Ukraine, and Poland, the prevalence of childhood asthma varied from 1.5 to 4.1% in urban areas and from 1.4 to 3.5% in rural areas [8]. In a countrywide study of 109 104 school adolescents in Brazil, representative of all regions, we have found 12.4% to report a previous medical diagnosis of asthma [9].

We have found reports of studies that estimated the prevalence of asthma among adults in LMIC countries using the questionnaire from the European Community Respiratory Health Survey. The prevalence of asthma in these studies were 2.7% in Cameroon [10], 7.1% in Peru [11]. In Chinese cities, the prevalence of adult asthma varied from 1.2 to 3.6% [12].

The prevalence of asthma has increased in some LMIC. In Brazil, the frequency of physician-

diagnosed asthma in adolescent in a sample of seven Brazilian cities with ISAAC methodology increased from 14.3% in 2003 to 17.6% in 2012 [13]. In Turkey, the prevalence of asthma symptoms in children increased from 5.0% in 2002 to 6.2% in 2008 [14]. The prevalence of asthma also increased in many cities of China. In Shanghai, the prevalence of asthma was 0.41% in 1997 and 1.8% in 2010 [15]. In Fuzhou, the prevalence of asthma was 1.57% in 1990, 3.28% in 2000, and 4.1% in 2010 [16]. Environmental changes related to urbanization and possibly lifestyle transformation are likely the main factors that may explain the increasing prevalence of asthma in these countries, such as happened in the high-income countries in the past.

We performed a secondary analysis of data collected by the WHO's world health survey sample of 178 215 individuals from 70 countries aged 18–45-year old, to avoid confusion with Chronic Obstructive Pulmonary Diseases, and reported the global prevalence rate of doctor's diagnosed asthma in adults is 4.3% [17], but the proportion of study participants with symptoms of asthma is 8.6%, suggesting considerable underdiagnosis. Surprisingly, an analysis of the possible relationship between gross national income in purchasing power parity, the prevalence of symptoms and doctor diagnosis of asthma of the same database has found a U shape bimodal distribution of asthma symptoms, higher in high-income and low-income countries, and lower in middle-income countries [18]. How do these unexpected observations in low-income countries can be explained? Several factors may be associated with a higher prevalence of symptoms of asthma among underprivileged communities, such as uncontrolled asthma because of limited access to proper diagnosis and treatment and respiratory problems in regions with high levels of air pollution. Further investigating this matter in a community-based cohort of children in Salvador, Brazil, we have reported unhygienic conditions and poverty are associated with wheezing, although they reduce the risk of atopy [19]. Therefore, it seems plausible atopic asthma is more frequent in high-income settings and nonatopic wheezing is more prevalent in low-resource settings.

ASTHMA SEVERITY IN LOW-INCOME COUNTRIES

Although some LMIC have a low prevalence of asthma, it is more severe in many of these countries. An ecological analysis of the ISAAC study phase III demonstrated that the prevalence of severe symptoms of asthma is higher in children from low-income countries as compared with children from high-income countries [1]. More recently, a survey

demonstrated 62% of children with asthma have severe symptoms in Senegal [4]. In a community-based survey, we performed in Brazil using the Global Initiative for Asthma 2002 classification of severity [20] to children with symptoms of asthma, the majority of them had persistent symptoms and 10% to had severe asthma [21]. The limited access to controller medications for asthma in LMIC possibly contributes to this scenario. In Cameroon, the frequency of current asthma medication use among study participants reporting asthma symptoms was only 0.8% [10]. In Senegal, only 3% of study participants with asthma have ever received a bronchodilator [4]. In China, most children with asthma never used inhaled corticosteroids [5]. Income restriction is the main allegation for under treatment in low-income countries, as few families report that the cost of asthma is affordable [5] and governments frequently report lack of financial resources to provide controller medications free of charge for all individuals with asthma.

THE FINANCIAL COST OF ASTHMA IN LOW-INCOME SETTINGS

Asthma results in direct and indirect costs to patients, their families, and for the health system. The financial costs of asthma are because of expenses with visits to physicians, medications, emergency room visits, hospital admissions, days out of school, days out of work, and other. In Thailand, the average annual cost of asthma in year 2011 was 598 United States of America Dollars per patient, but the cost varied according to the severity of asthma and the kind of health insurance [22]. A prospective evaluation of a sample of 180 study participants with severe asthma enrolled in Program for Control of Asthma in Bahia (ProAR), an intervention to provide free treatment and multidisciplinary care for severe asthma in Salvador, Brazil, demonstrated the families spent 29% of their income with one case of asthma, a proportion that has been considered a catastrophic expenditure. One year after the enrolment, income of the families increased by US\$ 711 per year, as their members went back to work. The total cost of asthma to the families was reduced by a median US\$ 789 per family per year. Consequently, an annual surplus of US\$ 1500 per family became available [23]. An assessment of the costs of treatment and absenteeism to work of an outpatient clinic cohort of study participants with asthma in Rio, Brazil, demonstrated lack of control of asthma is associated with higher costs [24].

The most cost-effective intervention for asthma control in LMIC as well as in affluent countries is secondary prevention of symptoms and exacerbations through controller medications, such as

low dose of inhaled corticosteroids for mild asthma and low dose of inhaled corticosteroids associated with long-acting β_2 agonists for moderate asthma [25]. A recent experience in Brazil reinforces that this is likely the best public health policy for LMIC. Since 2003, many Brazilian municipalities started to supply controller medications for asthma free of charge. In year 2010, around 1870 (34% of the total) municipalities were distributing free controller medications for asthma and this number is still growing. Recently, in a longitudinal ecological study of all Brazilian municipalities we demonstrated that those offering free medication for asthma had 45% higher odds to decrease hospital admission rates from asthma [26²²]. Most remarkably, this study also indicated municipalities that distributed free controller medications for asthma tripled their chances of reducing death rates due to asthma [26²²].

ENVIRONMENT AND ASTHMA IN LOW-INCOME POPULATIONS

The prevalence of asthma is increasing in LMIC. It is likely environmental changes related to urbanization observed in these countries in recent decades may be the determinants of the trends of increased prevalence of asthma. A study performed in rural Ecuador indicates a 'dose response' gradient effect of increasing urbanization in the frequency of symptoms of asthma in children [27]. It probably contributed not only to the prevalence but also to the severity of asthma in these countries. Recent cross-sectional studies demonstrated that the urban population of Macedonia and Peru have higher prevalence of asthma compared with the rural population [11²⁸]. In Brazil, a population-based study estimated that the frequency of physician-diagnosed asthma was 4.6% in adults from some urban centers and 3.1% in the rural area nearby [29]. Our longitudinal ecological study of all municipalities of Brazil has indicated municipalities increasing the proportion of their urban population were less likely to reduce hospital admissions and death rates for asthma, as compared with municipalities that did not increase the proportion of urban population, after correcting for possible confounding factors [26²²]. Once urbanization is an irreversible fact, it is important to understand the biological mechanisms leading to asthma morbidity in urban areas. Lack of natural regulation of the immune system may be one of these biological mechanisms. Allergic sensitization to inhalant allergens is higher in study participants raised in an urban area, as compared with study participants raised in rural area [30³¹]. It suggests certain environment exposures in urban

area deviates the immune system toward a Th2 phenotype, which is an important immunopathological pathway for asthma, or else, that moving away from the rural environment deprives the population from exposure to microorganisms that provide adequate stimulation to physiological immunomodulatory pathways. Air pollution from motor vehicles, very common in urban areas, is associated with persistent respiratory symptoms and higher prevalence of asthma as well [6,31]. Air pollution seems to induce unspecific airway inflammation, which exacerbate airway symptoms of study participants with asthma. Some environment exposures that may contribute to deterioration of asthma symptoms are not related to urbanization. Exposure to indoor combustion of solid fuels for heating or cooking is more common in low-income populations from rural areas. Cross-sectional and longitudinal studies evaluated the relationship between these exposures and the occurrence of asthma symptoms. Indoor air pollution was found to be associated with increased prevalence and severity of asthma in a sample of 5539 adults in Colombia [32]. Helminths, which are frequent pathogens in rural area from LMIC, may down regulate the immune responses related to atopy [33]. Another longitudinal ecological study of trends of asthma morbimortality in Brazil demonstrated communities reducing helminths-related hospitalizations were less likely to reduce hospital admission and death rates from asthma, in comparison with communities that have never been endemic for helminth infection or communities that maintained the same rate of hospitalizations because of helminths [34]. The improvement of sanitation in LMIC deworms the population and many have unintentionally contributed to the increasing prevalence and severity of asthma in LMIC. Figure 1 diagram summarizes the likely most

relevant factors contributing to the burden of asthma in LMIC.

Studies with migrating populations also demonstrate the environment contributes to a lower prevalence of asthma in low-income settings. Study participants migrating from a low to a high-income country have lower odds of asthma compared with native study participants. A genetic cause for this association is not probable because this protection is more evident in subjects that lived longer in the original country and is lost some years after migration [35].

THE BURDEN OF ASTHMA FOR UNDERPRIVILEGED COMMUNITIES WITHIN AFFLUENT COUNTRIES

The prevalence of asthma in some underprivileged communities living in developed countries is high. In France, almost 20% of homeless children have asthma [36]. Low income is an independent risk factor for asthma in children from the United States [37²²]. Developed countries have financial resources and expertise to provide proper treatment for asthma to their citizens. However, the prevalence of undertreated and uncontrolled asthma is still high in many of these countries in the general population [38²²]. This scenario is worse for the underprivileged communities living within. For instance, 85% of homeless children with asthma from France need to use health services at least once a month because of symptoms of the disease [36] and minority youth from Chicago, United States, self-reported a 90% rate of uncontrolled symptoms of asthma [39]. The low access and poor adherence to controller medications are not the only variables that contribute to this scenario. Environment and ethnicity may also play a role. In the United States, exposure to endotoxins from the environment that may induce asthma symptoms is more frequent in low-income families [40²,41²], which may be a possible mechanism to explain the high risk of symptoms of asthma that has been reported in many low-income settings throughout the world.

CONCLUSION

Several reports have indicated prevalence of asthma is not always low in low-income countries. Poor control of asthma and greater severity are more frequent among the underserved. Underdiagnosis, undertreatment, exposure to air pollution, and unhygienic living conditions may contribute to a higher frequency and severity of symptoms of asthma in these communities. Although it may take long to reduce the inequalities and improving living

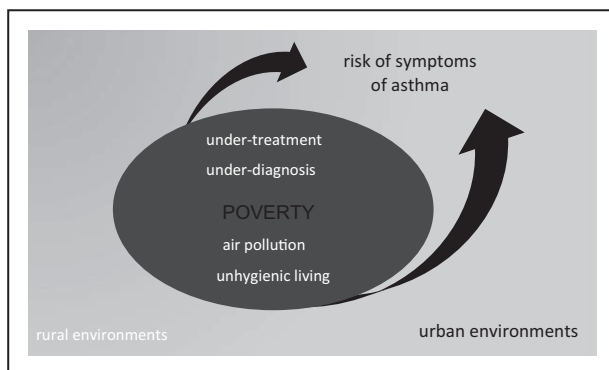


FIGURE 1. Factors related to poverty that may increase the risk of symptoms of asthma regardless of the type of environment, although living in urban environments is a risk factor for asthma.

standards, there is abundant evidence that access to proper diagnosis and adequate treatment reduce symptoms, health resource utilization, improves quality of life, and avoids deaths from asthma.

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

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