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Estimation of Worldwide Burden of Smoking-Related Asthma

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Smoking · Cigarette · Asthma · Epidemiology · Tobacco

Abstract
Background: Although there is solid evidence that active cigarette-smoking interplays with asthma, no recent information has been published on the worldwide burden of smoking-related asthma. ***Methods:*** An electronic search was carried out in the Global Health Data Exchange (GHDx) registry, using the keywords "asthma" and "smoking." Asthma-related population burden was expressed as disability-adjusted life years (DALYs). ***Results:*** Although smoking-related DALYs for asthma has consistently declined by approximately 20% over the last 3 decades, the burden remains high, accounting for 9.3% of the cumulative 22.8 million DALYs caused by asthma around the world. Across all ages, the burden of smoking-related DALYs for asthma is greater in men than in women and reaches a peak in both sexes at the age of 55–70 years. Europe is the continent with the greatest burden of smoking-related DALYs for asthma, followed by western Pacific nations and Southeast Asia, whilst the least burden is seen in Africa. ***Conclusions:*** The specific asthmatic populations identified with our search shall be specifically targeted with health care policies aimed at decreasing the impact of cigarette-smoking on their asthma condition and thereby contributing to lower the clinical, societal, and economic burden of smoking-related asthma.

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Introduction

There is now solid evidence that active cigarette-smoking strongly interplays with asthma, particularly in environments with limited air exchange, since it can trigger more severe symptoms, a greater vulnerability towards the impairment of lung function, and an inefficient therapeutic response to anti-asthma medications (especially corticosteroids), all of which ultimately translates into an increased demand for and use of health care [1]. Although the direct effect of active exposure to tobacco smoke on the pathogenesis of asthma is complex and multifaceted, active smoking may indeed potentiate asthma-related inflammation and sensitization to antigens and contribute to worse outcomes in terms of lung function and asthma-related mortality [2, 3]. Some population-based reports

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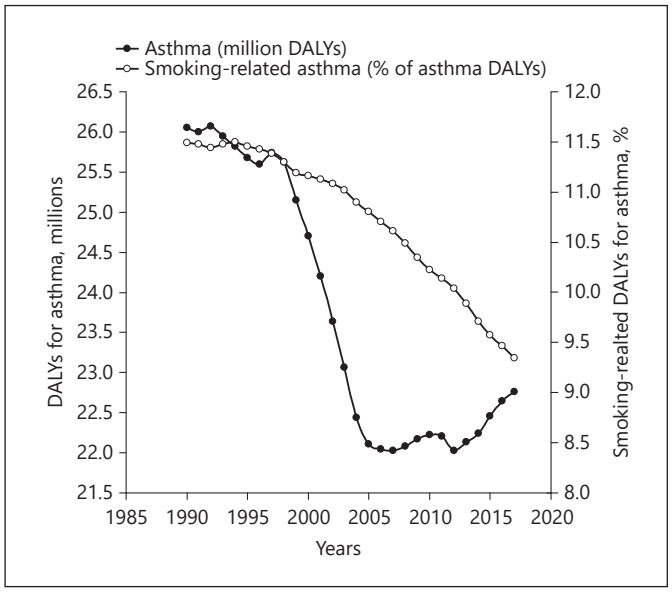

Fig. 1. Worldwide trend of smoking-related disability-adjusted life years (DALYs) caused by asthma.

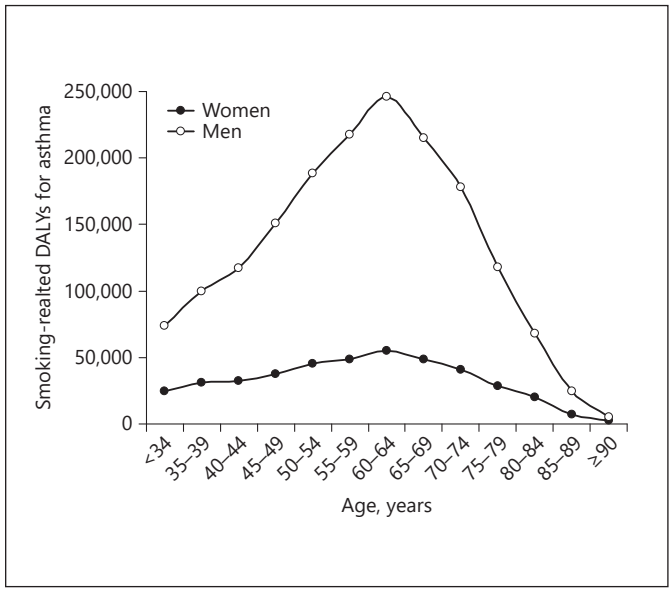

Fig. 2. Age and sex distribution of smoking-related disability-adjusted life years (DALYs) caused by asthma.

have been published on the impact of cigarette-smoking on asthma [4–6], but most articles are not up to date or are only based on local statistics. Therefore, the aim of this concise report is to provide an updated overview of the global burden of active smoking on asthma.

Materials and Methods

An electronic search was carried out in the Global Health Data Exchange (GHDx) registry, a large database of health-related data maintained by the Institute for Health Metrics and Evaluation [7], using the keywords "asthma" (ICD-10 codes J45-J46.0 and Z82.5) and "smoking." The asthma-related population burden has been estimated with DisMod-MR 2.1 as the main model from as many as 1,389 site-years from all 21 Global Burden of Disease (GBD) regions worldwide [8], and finally expressed as disability-adjusted life years (DALYs), calculated as the sum of years of potential life lost due to premature mortality and years of productive life lost due to disability, whereby 1 DALY approximates 1 lost year of "healthy" life. Notably, the number of disability cases is multiplied by the average duration of a disease and by a weight factor reflecting disease severity on a scale of 0 (perfect health) to 1 (death). The smoking-related burden of respiratory diseases was estimated in the GDHx database by using the ST-GPR model, and current smokers were defined as individuals currently using any smoked tobacco product on a daily or occasional basis (additional details can be found elsewhere) [9]. Finally, the effect sizes according to the number of cigarettes per smoker per day was synthesized to produce dose-response curves using a Bayesian metaregression model, ultimately generating sex- or age-specific risk curves.

The GHDx database search was combined with some epidemiologic variables such as "year," "sex," "age," and "location." The last searchable year in the GHDx registry is 2017, which was used for providing updated information on the relationship between smoking and asthma disability. The output of the electronic search was downloaded in comma-separated values (CSV) imported into an Excel file (Microsoft, Redmond, WA, USA) and analyzed with Analyse-it (Analyse-it Software Ltd, Leeds, UK) and MedCalc (MedCalc Software, Ostend, Belgium). Simple (Pearson's correlation) regression analyses were used for assessing potential associations (and their relative 95% confidence intervals [CIs]) among different epidemiologic measures, with risk being expressed as odds ratio (OR) and relative 95% CI.

Results

The temporal trends of DALYs for asthma and the relative percentage of smoking-related DALYs for asthma are shown in Figure 1. Notably, although the overall burden of asthma expressed as DALYs consistently declined in the period 1998–2012, an increasing trend during the last 5 years was observed, attesting to asthma-related DALYs of approximately 22.8 million in 2017. The temporal trend of smoking-related DALYs for asthma is, on the other hand, more linearly decreasing (Fig. 1), with the impact of smoking on worldwide asthma burden having progressively declined from 11.5% in 1990 to 9.3% in 2017 ($r = 0.967$; $p < 0.001$).

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The sex- and age-dependent smoking-related DALYs for asthma are shown in Figure 2. Notably, across all year ranges, this burden was considerably higher in men than in women (OR 4.31; 95% CI 4.16–4.45; $p < 0.001$) and reached the peak in both sexes at an age of 55–70 years.

Regarding geographic location, Europe (14.7% of all DALYs for asthma) was the continent with the highest burden of smoking-related DALYs for asthma, followed by western Pacific nations (12.0%), Southeast Asia (10.1%), the eastern Mediterranean (7.9%), and the Americas (7.1%), whilst the lowest burden was, predictably, in Africa (3.6%). Interestingly, worldwide, the countries with the greatest burden of smoking-related DALYs for asthma were Montenegro, Serbia, Bulgaria, Bosnia and Herzegovina, Greece, Macedonia, and Hungary (all >20% of all DALYs for asthma), and those with the lowest burden were Nigeria and Sudan (both approx. 1% of all DALYs for asthma).

Discussion

Asthma is one of the most common noncommunicable diseases, affecting >330 million people worldwide, and causing a high global burden of death and acute or chronic disability [10]. Asthma also has a dramatic impact on health care budgets, as asthmatic patients frequently present to emergency services, have recurrent hospital admissions, need specific and often highly expensive medications, are often subjected to complementary investigations or treatments (e.g., diagnostic imaging, blood testing, lung function analysis, and rehabilitation), and need domestic or professional preventive measures, assistance in home-care, transportation to medical visits, and so forth [11]. Asthma also incurs a variety of indirect costs, such as those attributable to the loss of work due to temporary disability and early mortality [11]. Reliable health care policies aimed at limiting individual exposure to causal or triggering factors, including controlling tobacco smoking, have now become virtually unavoidable for asthma control. They should be implemented in targeted and/or more vulnerable asthmatic populations, who will benefit more from tobacco control.

What clearly emerges from our analysis in the GHDx repository is that the burden of poorer health due to smoking-related asthma has gradually decreased over time, declining by approximately 20% between 1998 and 2017 (i.e., from 11.5 to 9.3%). This is obviously the combined result of implementation of legislative smoking bans and efficient policies of smoking dissuasion around the world [12]. Nevertheless, smoking-related asthma currently remains a major worldwide public health care issue, causing as many as 2.12 million DALYs (i.e., 9.3% of all DALYs for asthma). According to our findings, males are the most affected, along with subjects aged 55–70 years and people leaving in Europe, the western Pacific, and Southeast Asia.

Conclusion

We believe that the asthmatic populations identified by our research should be more specifically targeted by means of health care policies, both informative and restrictive, aimed at decreasing the impact of cigarette-smoking on their asthma condition. This will contribute to a reduction of the clinical, societal, and economic burdens of smoking-related asthma.

Statement of Ethics

The study was performed in accordance with the Declaration of Helsinki and under the terms of relevant local legislation. Ethics board approval is unnecessary at the local institution (University Hospital of Verona) for articles based on free scientific database searches.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

G.L. designed the study, obtained and analyzed the data, and drafted the manuscript; C.M. reviewed the files, was involved in manuscript preparation, and reviewed the final version.

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