Abstract

The objective of our study was to evaluate the association between the previously described asthma risk factors and the prevalence of asthma in a population of Brazilian adults. A population-based cross-sectional study was conducted using data collected from 7891 patients. All patients in the database > 18 years of age were included. The following variables were collected from the health plan database: age, body mass index, smoking status, alcohol consumption, sedentary lifestyle, heart disease, hypertension, diabetes, and asthma diagnosis. The frequency of the collected variables was compared between patients with or without an asthma diagnosis, and logistic regression was performed. Of our total sample (7891 patients), 150 (1.9%) had asthma. The mean age of patients with asthma was 39.4 years. 1.4% of normal weight patients had the diagnosis of asthma, while 2.4% of overweight and 2.2% of obese patients had the diagnosis. Multivariate analysis demonstrated that a sedentary lifestyle and overweight and obesity were independently associated with asthma prevalence Odds Ratio (OR) [95% confidence interval]: (1.61 [1.16-2.22] and 1.25 [1.03-1.52] respectively). Our data provide evidence that some clinical characteristics, such as sedentarism, overweight, and obesity, may be related to the prevalence of asthma in an adult population in southeastern Brazil. Such factors could be modified and better understood through multidisciplinary research and health programs that evaluate the risk factors for asthma in large populations.

Keywords: Risk factors, asthma, chronic disease, sedentarism, overweight, obesity.

Impact Statement

The presence of some clinical characteristics, such as sedentarism, overweight, and obesity, may be associated with the prevalence of asthma in an adult population in southeastern Brazil

Introduction

Asthma is a common clinical syndrome that affects all age groups. It is considered a heterogeneous chronic disease of the lower airways characterized by chronic inflammation and hyper-reactivity of the airways leading to various respiratory symptoms (1). The prevalence of asthma has increased in recent years throughout the world, and its severity and mortality of asthma vary globally (2). In Brazil, it is estimated that asthma affects more than 10% of the population (3, 4). Many risk factors have been associated with asthma, and the differences in distributions of these risk factors may explain the variations in its prevalence.

Approximately 38% of current adult asthmatics in the United States are also obese, a known risk factor for asthma (5). Sedentary time, is the time spent in any seated or reclining posture during wake time, which is associated with harmful health consequences, such as obesity (6). Although previous data have confirmed the association between sedentary time and obesity, studies exploring sedentarism and asthma development are scarce. Moreover, in the U.S., about 17% of asthmatics adults smoke, a prevalence comparable to that found in healthy subjects, even though cigarette smoke is known to be a trigger for asthma attacks (7) and a risk factor for childhood asthma onset (8).

The diagnosis of asthma is based on anamnesis, clinical examination, and pulmonary function tests. It should be founded on the presence of one or more characteristic symptoms, such as dyspnea, wheezing, chest tightness, and cough, particularly at night and in the morning on awakening. Asthma results from an interaction between genetics, environmental exposure, and other specific factors that lead to symptoms' development and maintenance. Genetic, immunological, and environmental factors can affect the risk of developing asthma (1, 9, 10). Epidemiological studies have shown that environmental factors such as smoking and exposure to air pollution can increase the risk of developing asthma. In addition, atopy, stress, obesity, lifestyle, and dietary patterns are associated with asthma in genetically susceptible people (11, 12).

As previously mentioned, the prevalence of asthma differs according to the geographic region of the individuals studied, and a better understanding of the risk factors associated with asthma is needed. And this knowledge can be used to develop primary prevention strategies that effectively reduce asthma's prevalence. Therefore, the objective

of our study was to evaluate the association between the previously described asthma risk factors and the prevalence of asthma in a population of Brazilian adults.

Materials and Methods

A population-based cross-sectional study was conducted using data collected from 7891 patients. All patients in the database > 18 years of age who are part of the Life Health plan and are followed up in a private referral hospital in São Paulo, Brazil, were included. Variables were collected from the Life Health plan's physical and electronic medical record database. We used the entire population from the hospital database and did not perform a sample size calculation because of this.

The following variables were collected from the Life Health plan database: age, body mass index, smoking (smoker/ex-smokers or non-smoker), alcohol consumption, sedentary lifestyle, heart disease, hypertension, diabetes, and asthma diagnosis. The frequency of the variables collected was compared between patients with or without the medical diagnosis of asthma. This study was submitted and approved by the research ethics committee of Moriah Hospital under protocol 5.269.059.

Clinical variables were defined according to the medical-diagnostic data in the medical records. Patients were classified as hypertensive if their blood pressure was above the recommended optimal levels of 140/85 in non-diabetic patients or 140/80 in diabetic patients on two or more subsequent outpatient measurements, requiring medications to control blood pressure. According to the database, patients were classified as smokers/ex-smokers, those who smoke currently or for at least five years, and nonsmokers, those who never smoked. To evaluate obesity, the patients were classified as having normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9) and obese (BMI > 30), according to BMI classes. A sedentary lifestyle was considered as performing physical activity < 2 times per week.

The results of the numerical variables that follow a normal distribution are presented as mean and standard deviation. Non-numerical variables are expressed as proportions/percentages. The chi-square test was used to compare categorical variables, the Mann-Whitney U test was used to compare numerical variables with nonparametric distribution. Logistic regression was used for the identification of significant factors associated with asthma. To build our statistical model, first, bivariate logistic models were

used to estimate the strength of association between individual predictors and the prevalence of asthma, variables with significance level of *P* value (<0.1) were selected for the statistical model. A multivariable logistic regression model was then used to identify the independent risk factors associated with the disease. In logistic regression, backward elimination was used to select variables to be maintained in the final model, using 5% as criterion for statistical significance of associations. The quality of the fit was measured by the Hosmer-Lemeshow test. SPSS version 20.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data, and p values less than 0.05 were considered statistically significant.

Results

Of our total sample (7891 patients), 150 (1.9%) had asthma at the time of inclusion. The mean age of the patients with asthma was 39.4 years (± 13.36) and for the patients without asthma was 38.2 (± 27.00). The difference in age between the two groups was not statistically significant (p=0.627).

Data on smoking, sedentarism, obesity, hypertension, and diabetes are shown in table 1. Hundred ninety-six patients reported being smokers (2.5%), while 7695 were nonsmokers (97.5%). When associated with the diagnosis of asthma, we found that 4.1% of the patients who smoked had the disease, while for the nonsmokers, only 1.8% had asthma (p=0.024).

Regarding sedentarism, 3122 patients reported being sedentary (39.6%), whereas 4769 (60.4%) patients reported physical activity at least two times per week. When analyzing the relation between sedentarism and asthma, we found that 78 (2.5%) sedentary patients had asthma, while 72 (1.5%) non-sedentary patients had the disease (p=0.002).

In our sample, 3546 (44.9%) patients had normal weight, 2097 (26.6%) were overweight, and 2248 (28.5%) were obese. We found that 49 (1.4%) patients with normal weight had a diagnosis of asthma, while 51 (2.4%) overweight and 50 (2.2%) obese patients had the diagnosis (p=0.008).

Hypertension and diabetes were present in 14.2% and 5.3% of the cohort. When we evaluated whether the presence of diabetes and hypertension was associated with asthma, we found no statistically significant differences between groups.

A multivariate analysis was performed, including smoking, sedentarism, and BMI variables, and we found that sedentarism, overweight, and obesity were independently associated with asthma (table 2), Odds Ratio (OR) [95% confidence interval]: 1.61 [1.16-2.22]; p = 0.004 and 1.25 [1.03-1.52]; p = 0.02 respectively). Smoking was not independently associated OR [95% confidence interval]: 2.05 [0.99-4.26]; p = 0.053).

Discussion

The prevalence of asthma varies significantly in different regions of the world. Prevalence trends are best estimated by surveying large samples in the same area using validated methods. The European Community Respiratory Health Survey (ECRHS) and the International Study of Asthma and Allergy in Children (ISAAC) are the two most extensive global asthma assessments (13, 14). According to the results of these surveys, the highest asthma rates were found in higher-income countries. Despite therapeutic advances, the continued increase in the prevalence of asthma suggests that the specific causes of asthma are still poorly understood. As with prevalence data, studying of risk factors in asthma has proved difficult because many factors are related (15).

Modern lifestyle may explain variations in the prevalence of asthma in urban areas in developing countries (16). In Latin America, asthma prevalence has been associated with changes in lifestyle and environment of the population in urban areas in recent decades, which play an essential role in asthma or related phenotypes (17, 18). This cross-sectional study showed a high prevalence of sedentarism and overweight/obesity in patients with asthma in a southeastern Brazilian population. Few previous cross-sectional studies related obesity to asthma (19, 20).

Obesity is associated with increased prevalence and incidence of asthma. However, this association has been inconsistently reported in genders, across different races, and among age groups (21). The study results' heterogeneity highlights this association's complexity, including different asthma definitions and study designs. Despite these limitations, it is a consensus that weight gain and obesity adversely affect respiratory health (21).

In a previous meta-analysis of 7 longitudinal cohort studies by Beuther and Sutherland, there was a dose-response effect between increasing BMI and asthma incidence. Compared to normal weight, a BMI ≥ 25 was associated with an OR of 1.5 for

having asthma (95 % CI; 1.2 – 1.6), whereas the OR for a BMI > 30 was 1.9 (95 % CI; 1.4 – 2.6) (5).

There are many mechanisms by which obesity could potentially worsen asthma, including its effects on pulmonary physiology. Increasing weight can affect lung physiology, including reducing respiratory system compliance, primarily due to fatty tissue deposits around the chest and abdominal wall. This could result in reduced total lung capacity and low expiratory reserve volume. Therefore, airway closure occurs at or above functional residual capacity in the dependent lung zones, which can lead to significant ventilation/perfusion mismatching (22).

Not every obese asthmatic has an increase in asthma severity suggests that other non-mechanical factors are involved. It has been previously proposed that obesity, as a chronic systemic inflammatory disorder, could affect asthma by enhancing airway inflammation (23). In a study by Desai et al., obesity was associated with increased sub-mucosal eosinophils and greater IL-5 levels. This phenomenon in obese asthmatics may be due to altered eosinophil survival or clearance or a functional change in eosinophil response to cytokines or chemokines. Moreover, obesity has increased airway neutrophilia (24). So, we can postulate that obesity-mediated changes in airway inflammation are more consistent with a non-predominant Th-2 phenotype and potentially a more Th-1 polarized immune response (25).

In our study, we also found a high prevalence of sedentarism in patients with asthma. Evidence in the literature supports this finding, but most epidemiological studies analyzed this association in pediatric and adolescent populations (23, 26, 27). A few studies demonstrated that obesity might be a confounding factor to asthma due to the low prevalence of physical activity and high prevalence of sedentarism in the same population, rather than having a cause-effect relation (28, 29). A longitudinal study demonstrated that excessive screen time during childhood predicts low cardiorespiratory fitness levels in adolescence (30).

In our study, we identified that smoking seems to have some relationship with the prevalence of asthma. According to the literature, the prevalence of active smoking in adults with asthma is similar to that in the general population. However, smoking-related asthma is associated with poorer disease control, impaired response to drug therapy, accelerated decline in lung function, and increased rate of health care utilization (31).

Although epidemiological studies indicate that many other factors are likely associated with the development of asthma, the relationships are not considered causal due to inadequate evidence and inconsistent results from recent studies. This may highlight that sufficient data and exact mechanisms of causality still need further studies (11).

The methodological limitations of our study include its cross-sectional design and the use of retrospective data. In addition, we restricted the analysis to a population seen in a private hospital. We cannot conclude its generalizability until the results are replicated in other populations and geographic regions. The clinical characteristics associated with asthma prevalence that we discuss here may change over the years according to the population's lifestyle. This may involve a range of influences determined by cultural, economic, environmental, and other factors (17, 32). We addressed asthma in a population with a shared history, culture, and geography and selected clinical characteristics based on the asthma literature and our database. In addition, although we collected detailed information related to asthma risk factors, other data such as environmental air sampling and seasonal or geographic data were unavailable.

Indeed, this study has the inherited drawbacks of its retrospective nature. However, the prevalence of risk factors for asthma was never analyzed in such a large Brazilian population.

Conclusions

Our data provide evidence that the presence of some clinical characteristics, such as sedentarism, overweight, and obesity, may be associated with the prevalence of asthma in an adult population in southeastern Brazil. Such factors could be modified and better understood through multidisciplinary research and health programs that evaluate the risk factors for asthma in large populations.

Disclosure Statement

Disclosure of Interest: The authors report no conflict of interest
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Declarations

Ethics approval and consent to participate: This study was submitted and approved by the Research Ethics Committee of Moriah Hospital under protocol 5.269.059.
Availability of data and materials: The datasets used and/or analysed during the current study are available the corresponding author on reasonable request.

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Table 1. Comparison between Asthma and Smoking, Sedentarism, Overweight and Obesity, Hypertension, Prediabetes and Diabetes.

	Asthma, N (%)		**P value**
Smoking	No	Yes	
No	7553 (97.6)	142 (94.7)	**0.024***
Yes	188 (2.4)	8 (5.3)	
Sedentarism			
No	4697 (60.7)	72 (48.0)	**0.002***
Yes	3044 (39.3)	78 (52.0)	
Overweight and Obesity			
No	3497 (45.2)	49 (32.7)	
Overweight	2046 (26.4)	51 (34.0)	**0.008***
Obesity	2198 (28.4)	50 (33.3)	
Hypertension			
No	6644 (85.8)	126 (84.0)	0.525
Yes	1097 (14.2)	24 (16.0)	
Prediabetes and Diabetes			
No	7273 (94.0)	146 (97.3)	
Prediabetes	54 (0.7)	0	0.200
Diabetes	414 (5.3)	4 (2.7)	

*Chi-square test.

Table 2. Logistic regression analysis of risk variables Smoking, Sedentarism, Overweght and Obesity for Asthma.

Variables	Odds ratio	CI 95%	P value
Smoking	2.05	0.99 – 4.26	**0.053**
Sedentarism	1.61	1.16 – 2.22	**0.004**
Overweight and Obesity	1.25	1.03 – 1.52	**0.02**