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Asthma Prevalence in Adolescent Students from a Portuguese Primary and Secondary School

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Abstract: Asthma is one of the most prevalent chronic diseases worldwide, with a considerable increase, especially in children. It is considered the main cause of childhood morbidity, school absenteeism, and limitations in sports practice. The causes are multifactorial, and their prevalence varies from region to region, thus verifying a great disparity in the estimates of the prevalence of asthma. In this sense, the objective of this study is to investigate the prevalence of asthma, its control, as well as the frequency of associated symptoms, in adolescents who attended the 3rd cycle of basic education and secondary education in schools in the municipalities of Paços de Ferreira, Paredes, and Penafiel. The sample consisted of 1222 (587 males and 635 females) (p = 0.17) aged between 12 and 17 years. The instruments used to diagnose asthma-associated symptoms were the standard questionnaire of the "International Study of Asthma and Allergies in Childhood—ISAAC" and to check whether asthma was controlled, the "Test for Asthma Control" questionnaire was used. The results reveal a high prevalence of adolescents with asthma (8.9%) with a significant percentage that did not have the disease under control (38%). There was also a considerable percentage of adolescents who, despite not having asthma, have many symptoms associated with the disease. These results may be associated with environmental factors.

Keywords: adolescents; asthma; prevalence; school

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1. Introduction

"Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms, such as wheeze, shortness of breath chest tightness and cough, that vary over the time and intensity, together with variable expiratory airflow limitation" [1]. It may be also an inflammatory problem of the airways that causes recurrent episodes of dyspnea [2,3]. These symptoms are usually associated with severe but variable airflow limitation that is, at least in part, reversible spontaneously or with treatment [4,5]. The main treatment of asthma is based on drugs, such as inhaled corticosteroids and fast-acting beta-agonists associated with systemic corticosteroids for crisis relief in both children and adults [6].

Although asthma develops at any age, the first symptoms usually occur in childhood; it is considered the main cause of childhood morbidity [7], and an important cause of school absenteeism and limitations in the practice of sports, in addition to limiting other daily activities [8].

Asthma is currently one of the most prevalent chronic diseases, affecting about 300 million people worldwide [9,10], with a considerable increase, especially in children [11,12].

However, this disease reveals a highly variable prevalence worldwide [11], with multifactorial etiology that has been associated with genetic, environmental, gestational, and socioeconomic factors [13,14]. Asthma is considered a serious public health problem with a considerable impact on health economics [9,15]. In adolescents, the prevalence of asthma varies between 7% and 10% in many Western countries [16,17].

In Portugal, there are estimates that asthma has a prevalence of 6.8%, which corresponds to approximately 700,000 people with active asthma [18,19]. In the pediatric age group, the estimated prevalence is 8.4% (approximately 175,000 children), considered one of the most prevalent chronic diseases in children and adolescents [20]. However, there has been a large disparity in the estimates of the prevalence of asthma, which vary between 3.13% and 39.5% [19,20]. The main reasons provided are the different years of studies, the regions studied, and the age of the individuals.

In this sense, the objective of this study is to investigate the prevalence of asthma, its control, as well as the symptoms associated with asthma, in adolescents who attended the 3rd cycle of primary and secondary education in schools in the municipalities of Paços de Ferreira, Paredes, and Penafiel.

2. Materials and Methods

2.1. Sample

The sample consisted of 1222 students from the 3rd cycle of basic and secondary education in schools in the Municipalities of Paços de Ferreira, Paredes, and Penafiel. Table 1 presents the sample characteristics. The distribution of the number of students by age was as follows: 12 years (n = 163); 13 years (n = 263); 14 years (n = 214); 15 years (n = 218); 16 years (n = 188); and 17 years (n = 176).

Table 1. Sample characteristics, number (N), and age mean and standard deviation (SD).

	N	**Age (Mean ± SD)**
N	1222	14.44 ± 1.63
Male	587	14.38 ± 1.67
Female	635	14.49 ± 1.59
Group comparison significance	p = 0.17	p = 0.19

2.2. Instruments

To diagnose symptoms associated with asthma, the standard questionnaire from the "International Study of Asthma and Allergies in Childhood—ISAAC" was used [11]. To verify that the asthma was controlled, the questionnaire "Test for Control of Asthma" was used [21]. The questionnaire is a rapid and simple quantitative self-assessment tool for asthma control. This instrument consists of five questions, scored from 1 to 5. The overall score that can vary between 5 and 25. The scoring allows to define three classifications of asthma control in the previous 4 weeks, as follows: <20: Uncontrolled asthma; 20–24: Partially controlled asthma; 25: Completely controlled asthma.

2.3. Data Collection and Procedures

Data were collected by Physical Education Teachers during their classes. Therefore, to verify if the students were asthmatic, the teacher asked them directly if they had "asthma diagnosed by a doctor". To diagnose asthma-associated symptoms, non-asthmatic students were asked to fill out the ISAAC questionnaire [11]. To check if asthma was under control, the teacher distributed the questionnaire "Asthma Control Test" to asthmatic students [21].

2.4. Statistical Analysis

Descriptive statistics are presented as the mean ± one standard deviation (SD) with a 95% confidence interval (CI). Categorical variables were expressed using counts (n) and proportions (%). As a measure of central tendency, the mean was used and the standard deviation for dispersion. To analyze the prevalence, frequencies were used. Since the

main variables obtained a non-normal distribution using the Kolmogorov–Smirnov test ($p < 0.001$), the chi-squared test (X^2) was used to compare two nominal variables. The significance level was set to $p < 0.05$ [22,23]. All statistical analyses were conducted using SPSS for Windows Version 26.0 (SPSS Inc., Chicago, IL, USA).

3. Results

Regarding the prevalence of asthma, there was a prevalence of 8.9% ($n = 109$) students), which was higher in female students, although the difference was not significant, which indicates a similar prevalence among genders (male = 8.7%; female = 9.1%; $p = 0.50$) (Table 2).

Table 2. Distribution by gender of the frequency of students who have asthma diagnosed by a doctor.

Asthma Diagnosed by a Doctor	Sex			
	Male		Female	
	N	%	*N*	%
No	536	91.3	577	90.9
Yes	51	8.7	58	9.1
p	0.50			

Of the 109 asthmatic students, although the majority had controlled asthma ($n = 71$; 65%), it is noted that a significant number of asthma patients do not have their asthma controlled ($n = 38$; 35%) (Figure 1).

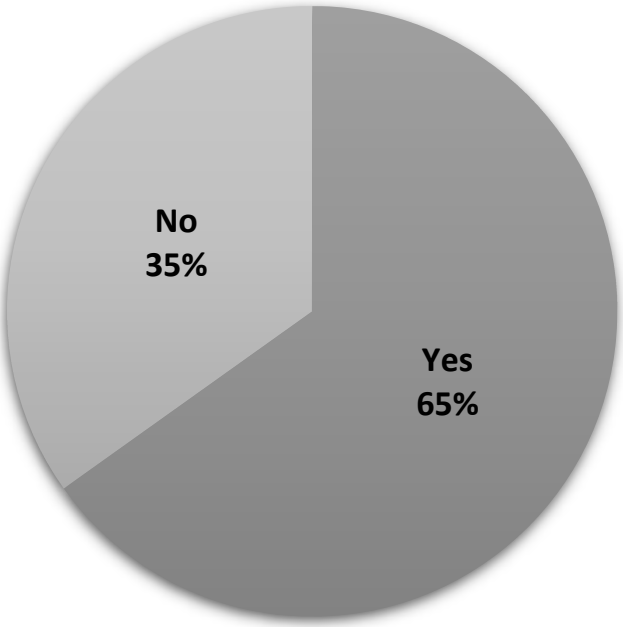

Figure 1. Frequency of students with controlled asthma.

Regarding asthma-associated symptoms, in non-asthmatic students, the vast majority, 69.5% ($n = 774$), did not present any symptoms associated with the disease. However, it is noted that 6.5% of pupils ($n = 73$) had three or more associated symptoms. Even more worrying was the fact that five students had five symptoms associated with asthma, and two students had, each, six and seven symptoms. Regarding asthmatic students, it should be noted that only 8 students (7.3%) did not present any associated symptoms and 70 students (64.1%) had three or more associated symptoms. Table 3 presents participants with and without asthma symptoms.

Table 3. Number of symptoms associated with asthma in asthmatic and non-asthmatic students.

Total Symptoms Associated with Asthma	Non-Asthmatic		Asthmatic	
	N	%	*N*	%
0	774	69.5	8	7.3
1	176	15.8	14	12.8
2	90	8.1	17	15.6
3	48	4.3	24	22.0
4	18	1.6	18	16.5
5	5	0.4	20	18.3
6	1	0.1	6	5.5
7	1	0.1	2	1.8
Total	1113	100	109	100

Legend: *N*—number; %—percentage.

Regarding the typology of symptoms associated with asthma, among non-asthmatic students, of the 1113 students with this condition, 339 (30.5%) had symptoms associated with the disease. The symptoms that stood out in these students were "getting tired easily" (141 students = 41.6%) followed by "dry cough after exercise" (122 students = 36%). Regarding asthmatic students, of the 109 students, 101 (92.6%) had symptoms associated with the disease, the most prevalent being "going to the doctor because of shortness of breath" (74 students = 73.3%) and "wheezing" (69 students = 68.3%). Table 4 shows the prevalence of symptoms in the subjects evaluated.

Table 4. Prevalence of symptoms associated with asthma in asthmatic and non-asthmatic students.

Typology of Symptoms Associated with Asthma	N/%	Non-Asthmatic		Asthmatic	
		No	Yes	No	Yes
Wheezing	N	253	86	32	69
	%	74.6	25.4	31.7	68.3
Going to the doctor for shortness of breath	N	252	87	27	74
	%	74.3	25.7	26.7	73.3
Get tired easily	N	198	141	62	39
	%	58.4	41.6	61.4	38.6
Wheezing after exercise	N	257	82	54	47
	%	75.8	24.2	53.5	46.5
Dry cough after exercise	N	217	122	55	46
	%	64	36	54.5	45.5
Dry cough at night	N	285	54	73	28
	%	84.1	15.9	72.3	27.7
Sleeps poorly due to shortness of breath	N	301	38	62	39
	%	88.8	11.2	61.4	38.6

4. Discussion

One of the objectives of this study was to identify the prevalence of asthma in adolescents between the ages of 12 and 17 who attended the 3rd cycle of primary and secondary education. The results indicate a prevalence of 8.9%, being higher in females (male = 8.7%; female = 9.1%; $p = 0.50$). When comparing the prevalence of asthma in our study with that recorded at the national level, in this study, it was higher by 0.5% since it is estimated that in the pediatric age group (up to 18 years of age) the national prevalence will be 8, 4% (about 175,000 children), therefore making it one of the main chronic diseases in children [18,19]. The prevalence of asthma in this study was not only higher than the national one but also higher than in a study carried out in the neighboring municipality of Amarante, where the prevalence was only 5% [24]. We sought to investigate which factors could contribute to the fact that the municipalities in our study had a higher prevalence of asthma (+3.9%) than that

recorded in the municipality of Amarante. Although there are not many reports of studies that show the association between asthma attacks and specific climatic conditions [25,26], studies have shown that asthma attacks are associated with a dramatic decrease in temperature, humidity, and pressure [27,28]. Climatic conditions, such as decreasing wind speeds and abrupt increases in relative humidity, may be important factors in increasing the incidence of asthma attacks [18,29]. Additionally, higher temperature and a rapid decrease in temperature within 3 days were positively associated with an increase in emergency visits [30]. In this sense, it was considered that the climate could be a factor responsible for this difference in the prevalence of asthma between the municipalities of our study and that of Amarante. The data available in the "Climate Data for World Cities" indicate there was a similar climate in all the municipalities studied and compared, both in average temperature and rainfall [27,31].

Another factor that greatly contributes to the increase in the prevalence of asthma is environmental pollution [32]. Air pollution has been associated with several adverse human health outcomes, namely respiratory symptoms and chronic diseases such as asthma [33–35]. In this sense, it was deduced that the air quality in the municipalities of our study could be more favorable for the increase in the prevalence of asthma compared to that observed in the municipality of Amarante. However, the Portuguese Environment Agency was consulted and it was found that the air quality was good in all municipalities [36].

The Directorate-General for Health (DGS) released a "Review of the National Health Plan", in which there are specific measures for each reality. In the municipalities of our study, the combat measures focus, among others, on respiratory diseases [37]. These data suggest that the municipalities involved in this study have a high prevalence of people with respiratory diseases. Recognizing that asthma is closely associated with hereditary factors, if one parent is asthmatic the prevalence approaches 20%, but if both parents are asthmatic, this may approximate 50% [38,39]. In this sense, the high prevalence of asthma in children in the municipalities under study may be associated with hereditary factors. Paços de Ferreira and Paredes have a strong production in the furniture sector, and Penafiel in the granite industry, both employing a lot of people (men and women), and these types of industries produce and use numerous elements that are very harmful to the respiratory system. In the past, there were (and still are) many gaps in safety and hygiene at work, exposing workers to possible respiratory diseases [39]. Knowing that the development of asthma is largely due to environmental exposure, exposing people permanently to highly polluting environments (sawdust, dust, paints, varnishes, etc.) contributes to the increase in the prevalence of asthma in this region, being also hereditary [18,40].

Another objective of this study was to analyze whether asthmatics would have their asthma controlled. The results show that, although the majority had controlled asthma (65%), there was a significant percentage of asthmatics who, despite being medicated, did not have their asthma under control (35%). Added to this is the fact that only 7.3% (8 students) did not have any symptoms associated with the disease and 64.1% (70 students) had three or more associated symptoms. These data may indicate that these asthmatic adolescents are likely to need a medication adjustment to their illness. The study "Cost of Asthma in Children" showed that there are around 175,000 asthmatic children in our country and that half (50%) do not have the disease under control [9,26]. One of the biggest obstacles to achieving control results from the fact that the vast majority of uncontrolled patients (9 out of 10) consider themselves to be doing well [18,20,40]. Uncontrolled asthma is associated with a worse quality of life, an increase in school absences, an increase in medical consultations, visits to emergency services, and hospital admissions [41,42]. It is during the transition period between childhood and adulthood that individuals face greater difficulties in diagnosing and managing asthma [43]. On the other hand, socioeconomic difficulties can also lead to difficulties in attending consultations for asthma control and management [44]. Thus, despite advances and changes in guidelines, there is no known treatment for asthma, and the primary objective will be disease control [11]. Additionally, the metabolic condition should be considered for respiratory diseases [45].

Additionally, as expected in this study, most non-asthmatic students (69.5%) did not present any symptoms associated with the disease; however, 6.5% presented three or more associated symptoms, and, more worrying was the fact that 0.4% (5 students) had five symptoms associated with asthma, and 0.2% (2 students) had six and seven symptoms. Thus, these data indicate that there may be other adolescents with asthma, or other respiratory problems, without a diagnosis. In this sense, it would be recommended that these students should seek a specialized doctor for this purpose. This situation may result from the fact that adolescents have little knowledge about asthma or the symptoms associated with it [46], making it difficult for them to recognize it, and making its treatment difficult [47]. Adolescents usually do not want asthma to be part of their daily lives and want to be considered "normal" among their friends and thus are afraid of showing vulnerability due to asthma symptoms [48]. It is important to highlight that, in the present study, a pre-test was not conducted and so, prior adaptation to the questionnaire was not ensured. However, the instrument is rapid and easier to apply.

5. Conclusions

This study revealed a high prevalence of adolescents with asthma, with a significant percentage of them not having the disease under control. It was found that a high percentage of adolescents, despite not having asthma, have many symptoms associated with the disease. These results may be related to environmental factors.

The recommendations resulting from this study include: Educating adolescents with asthma to avoid environments that may trigger an asthma attack; Advise the adolescents with asthma that, even though they are medicated, if they reveal many symptoms associated with the disease, they should visit the doctor for possible medication adjustment; It is suggested that non-asthmatic adolescents, who presented many symptoms associated with asthma, should visit the doctor to be screened for the disease. In addition, it is essential to educate students with asthma on the importance of the correct use of inhalation therapy to control the disease.

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Informed Consent Statement: Informed Consent Statement was obtained from all parents and/or legal guardians of the subjects involved in the current investigation.

Data Availability Statement: Data are available upon request from the corresponding author.

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