

# Associations between house dust mites and prevalence of asthma and allergic rhinitis among school-age adolescents in the south of Brazil

*Associações entre ácaros da poeira domiciliar e prevalência de asma e rinite alérgica em adolescentes em idade escolar no sul do Brasil*

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## ABSTRACT

**Background:** Allergic reactions resulting from exposure to environmental allergens are responsible for problems such as asthma and allergic rhinitis. House dust mites (HDMs) are one of the most important causes of allergic sensitization and a major source of allergens worldwide. **Objective:** To investigate associations between the presence of HDMs in the homes of adolescents aged 13 to 14 years and the prevalence of respiratory problems using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. **Methods:** A total of 103 adolescents from the city of Lajeado, south of Brazil, participated in the ISAAC Protocol, and 10 homes were sampled for dust collection. **Results:** Regarding the medical history of asthma and rhinitis, a prevalence of 14.7% of asthma was found, and 68.9% of the adolescents have already had rhinitis. The investigation of active asthma and rhinitis showed that 5.15% of adolescents had symptoms of asthma and 39.14% had symptoms of allergic rhinitis. Premature birth, low birth weight and smoking mother were shown to be risk factors for the development of asthma and allergic rhinitis. HDMs were mostly found on the carpet (46.80%), followed by bed (34.04%) and sofa (14.89%); curtains had the fewest mites (4.25%). *Dermatophagoides pteronyssinus* (46.0%) and *Dermatophagoides farinae* (31.91%) were the most frequently found species. **Conclusion:** The homes of adolescents with respiratory problems had a large number of HDMs.

**Keywords:** Allergy and Immunology, asthma, mites, dust, allergic rhinitis.

## RESUMO

**Introdução:** As reações alérgicas resultantes da exposição a alérgenos ambientais são responsáveis por problemas como asma e rinite alérgica. Os ácaros conhecidos como ácaros da poeira domiciliar (HDMs) são uma das causas mais importantes de sensibilização alérgica e representam uma das fontes de alérgenos mais importantes do mundo. **Objetivo:** O presente estudo tenta encontrar uma relação entre a presença de HDMs nas residências de adolescentes de 13 a 14 anos e a prevalência de problemas respiratórios, usando o questionário ISAAC (*International Study of Asthma and Allergies in Childhood*). **Método:** Participaram do Protocolo ISAAC 103 adolescentes da cidade de Lajeado (RS), dez domicílios foram amostrados para coleta de poeira. **Resultados:** Em relação à história clínica de asma e rinite, foi encontrada prevalência de 14,7% de asma, sendo que 68,9% dos adolescentes já apresentaram rinite. A investigação de asma e rinite ativa mostrou que 5,15% dos adolescentes apresentaram sintomas de asma e 39,14% apresentaram sintomas de rinite alérgica. Nascimento prematuro, baixo peso ao nascer e mãe fumante demonstraram ser fatores de risco para o desenvolvimento de asma e rinite alérgica. O local onde foi encontrado o maior número de ácaros foi tapete (46,80%), seguido de cama (34,04%), sofá (14,89%); cortina foi o local com menor número de ácaros encontrados (4,25%). *Dermatophagoides pteronyssinus* (46,0%) e *Dermatophagoides farinae* (31,91%) foram as espécies mais encontradas na poeira. **Conclusão:** As residências de adolescentes com problemas respiratórios apresentaram um maior número de HDMs.

**Descritores:** Alergia e Imunologia, asma, ácaros, poeira, rinite alérgica.

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## Introduction

Allergic reactions triggered by exposure to environmental allergens are responsible for the occurrence of problems such as asthma and allergic rhinitis.<sup>1</sup> The diseases caused by these reactions depend on genetic and environmental factors, and represent an important public health issue,<sup>2</sup> since they are a frequent cause of morbidity in the pediatric population.<sup>3</sup>

Allergic rhinitis is one of the most prevalent chronic diseases worldwide, with high impact on the quality of life of patients in different age groups.<sup>4</sup> Furthermore, its prevalence has increased over the years and is likely to be underestimated, since many individuals do not consider it a disease and thus do not seek medical help.<sup>5</sup> Even so, allergic rhinitis ranks among the 10 most frequent causes of demand for primary health care. Its major symptoms are nasal obstruction/pruritus, aqueous rhinorrhea, sneezing, and ocular symptoms.<sup>6</sup>

Asthma is characterized by several symptoms, such as wheezing, dyspnea, chest pain, and/or coughing, and by reduced expiratory airflow. These symptoms, as well as limited airflow, are characteristics that vary according to intensity and time elapsed. These variations are frequently triggered by factors such as exercising, exposure to irritating factors or allergens, changes in weather, or viral infections. According to the international recommendations of the Global Initiative for Asthma, asthma is a common chronic respiratory disease that affects approximately up to 20% of the global population.<sup>7</sup> Therefore, asthma and allergic rhinitis have close interrelations of pathophysiological, epidemiological, morphological, and clinical nature, and that is why they started to be considered as manifestations of the same pathological process: contiguous allergic inflammation of the airways.<sup>8</sup> In 2014 and 2015, a total of 126,626 hospitalizations for asthma were reported in Brazil, 63% of which occurred in children below 14 years old.<sup>9</sup> The largest incidence was in the northeastern region, with 55,876 cases; of those, 16,181 cases involved 1- to 4-year-old children. Ceará stands out in this scenario, with 6,432 cases.<sup>10</sup>

Due to the impact of allergic rhinitis and asthma on people's lives, the International Study of Asthma and Allergies in Childhood (ISAAC) can be considered an effective study method for the epidemiological diagnosis of these allergic diseases.<sup>11</sup> The ISAAC performed in Brazil showed that the mean prevalence

of symptoms related to allergic rhinitis was 29.6% among adolescents and 25.7% among school-age adolescents. Regarding symptoms related to active asthma, mean prevalence was 19.0 and 24.3% among adolescents and school-age adolescents, respectively. Brazil is in the group of countries that have the highest prevalence rates for asthma and allergic rhinitis worldwide.<sup>12</sup>

Mites are the most important cause of allergic sensitization, and differences have been observed both in their geographical distribution and in the sensitization profile.<sup>1</sup> House dust mites represent one of the most important sources of allergens worldwide. The mites *Dermatophagoides pteronyssinus* (Trouessart, 1897) and *Blomia tropicalis* (Bronswijck, Cock & Oshima, 1973) are the primary sensitizers of patients diagnosed with asthma and allergic rhinitis.<sup>13</sup>

The aim of the present study was to analyze the relationship between the presence of house dust mites in the homes of 13- and 14-year-old adolescents and the prevalence of allergic rhinitis and asthma, by using the ISAAC Protocol and collecting house dust. A larger amount of mites was expected to be found in the homes of adolescents that suffer from asthma or allergic rhinitis. Additionally, the percentage of these diseases found in the target population investigated in the city of Lajeado was expected to be similar to that of other cities in Brazil.

## Material and methods

### Study population and area

The present study was conducted in August, September, and November 2020, with 13- and 14-year-old adolescents from a public school in the city of Lajeado, state of Rio Grande do Sul (RS), Brazil. Lajeado is located in the Taquari River Valley, central region of the state of Rio Grande do Sul. This valley is comprised of 36 municipalities that cover an area of approximately 4,826.7 km<sup>2</sup> (1.71% of the state), according to data by the Statistics and Economy Foundation (Fundação de Economia e Estatística, FEE).<sup>14</sup>

### ISAAC Protocol

In order to investigate respiratory diseases, the written and supplementary questionnaires of the ISAAC Protocol were used and applied, with objective questions designed to check the presence

of respiratory diseases such as asthma, rhinitis, and eczema. Parents also answered questions regarding the characteristics of the homes where the adolescents lived, as well as diet and immunization, in order to keep track of factors that might be related to respiratory diseases. All parents agreed and signed an Informed Consent Form. Because the study was conducted during the pandemic period caused by SARS-CoV-2, the ISAAC questionnaire was set up on the Google Forms platform and was available for the adolescents' parents. In the ISAAC protocol, there are questions related to birth weight, breastfeeding period, immunization, characteristics of the house, and that is why the protocol was applied to the adolescents' parents, in order to have more accurate answers. During the research period, the school had 146 students aged between 13 and 14 years old, all of them received the link to access the questionnaire, but we had a return of 107 parents, with 73.28% of parents joining the study. However, of the 107 forms returned, four were disregarded, since they were incorrectly completed; thus, 103 questionnaires were validated in the study.

### **House dust mite sampling**

After applying the ISAAC questionnaire, the homes of five adolescents with respiratory problems and five adolescents with no respiratory problems were randomly selected for house dust collection. Only five homes from each group were evaluated, because the study was conducted during the pandemic period caused by SARS-CoV-2. However, this sample represents more than 10% of the population of adolescents with and without respiratory problems. Dust samples were vacuumed from the following sites: sofa, mattress, carpet, and curtain. This sampling was performed using a portable Black & Decker Dust Buster 750W and 220V vacuum cleaner. Samplings were conducted for 9 minutes; on average, 3 minutes at the sofa and 2 minutes at the other sites. After sampling each site, the dust was removed from the vacuum cleaner using a medium-tipped brush (n. 16), individually kept in plastic pots, and stored under refrigeration at 7°C until the samples were screened.<sup>15</sup>

### **Screening of house dust and species identification**

Dust was screened using a Leica - S6E-LED 2500 stereoscopic microscope, and the mites found were

removed using a thin-tipped brush and mounted onto slides in Hoyer's medium.<sup>16</sup> Mounted slides were maintained in a drying furnace for a period of 10 days, for clarification of specimens and medium drying. Specimens were identified using a Zeiss Imager.Z2 phase-contrast optical microscope and dichotomous keys provided by Hughes, Flechtmann, and Krantz & Walter.

### **Data analysis**

The questionnaire answers were analyzed using SPSS 10, performing a multiple regression analysis. Descriptive statistics was performed treating the adolescents who were part of the study as parameters, and the data obtained were presented as percentages.

### **Ethical aspects**

This study was approved by the Research Ethics Committee of Universidade do Vale do Taquari - Univates (CAAE: 28747220.4.0000.5310).

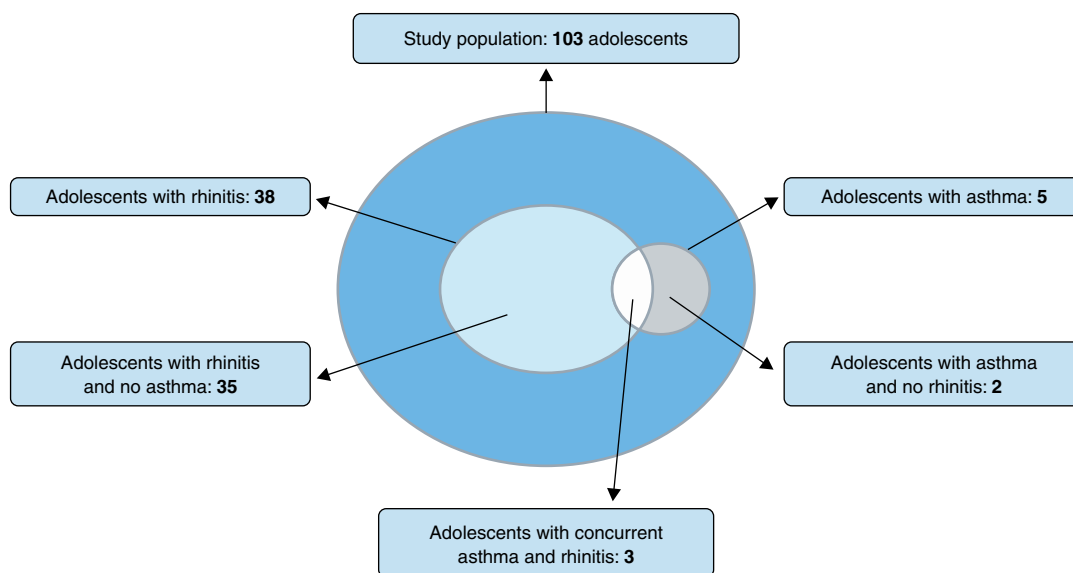
## **Results**

### **ISAAC Protocol**

Regarding the clinical history of asthma and rhinitis, 14.7% have already had asthma, and 68.9% have already had rhinitis. In the investigation of active asthma and rhinitis, 5.15% of the adolescents had at least one to three wheezing episodes in the previous 12 months, interference of wheezing with sleep in the previous year, and nocturnal cough, which characterized the presence of symptoms of asthma. Regarding rhinitis, 39.14% of the adolescents has had the following problems in the previous 12 months: sneezing, running nose, or blocked nose without having the flu or a cold, and this problem was also followed by lacrimation or itchy eyes, thus characterizing active rhinitis.

The asthma-rhinitis association rate in the population of adolescents of the present study was 3.09% (Figure 1). The highest rhinitis prevalence was observed in June, accounting for 44.4% of the cases. The month with the lowest prevalence was November, with 7.4% (Figure 2).

The prevalence of asthma or allergic rhinitis was observed to decrease proportionally with increased birth weight: 100% for adolescents with birth weight



**Figure 1**  
Asthma-rhinitis association rate in 13- to 14-year-old adolescents

between 1,500 and 1,999 g had either asthma or allergic rhinitis; from 2,000 to 2,499 g, the prevalence found was 40%; and from 2,500 to 3,499 g, the prevalence was 39.68%. Additionally, in adolescents who were born with over 3,500 g, the prevalence of either asthma or allergic rhinitis dropped to 34.48%.

Regarding the birth of adolescents, 50% of those who were born prematurely, either through normal delivery or C-section, had respiratory problems in the present study. Among the group of adolescents who were not born prematurely, those who were born through C-section had a prevalence of 34.42% of these problems, and those who were delivered through normal labor had a prevalence of 42.42%.

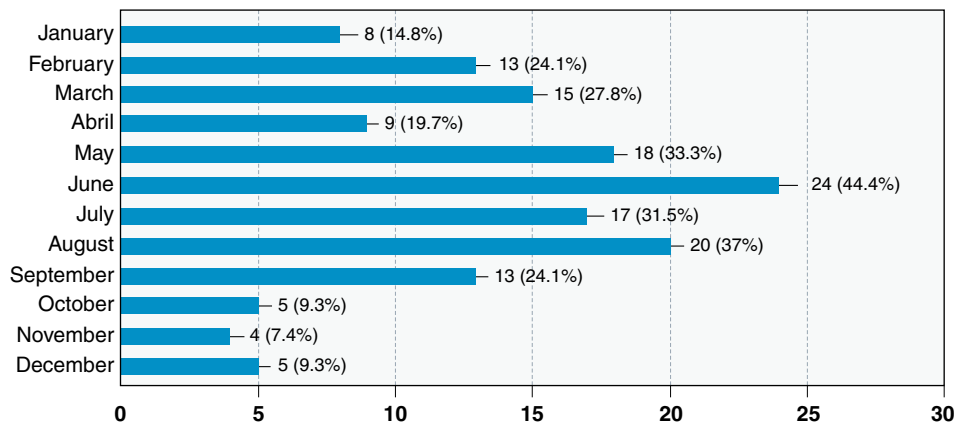
The prevalence of asthma and allergic rhinitis in adolescents whose mothers were former or current smokers was 54.54%. On the other hand, the prevalence was 32.98% in the group of adolescents whose mothers were non-smokers. In homes of adolescents with visible mold stains on the walls or ceiling, the prevalence of respiratory problems investigated in the present study was 50%, while the prevalence in the other homes was 31.08%.

### House dust mites

The initial study hypothesis was corroborated by the findings in the present study: there was a higher number of mites in the homes of adolescents who had asthma or allergic rhinitis. A total of 47 dust mites were found, collected from the homes of 13- and 14-year-old adolescents (Table 1). Of this total, 74.47% were found in homes of adolescents with respiratory problems, and 25.53% were found in homes of adolescents with no respiratory problems.

No mites were found in two of the 10 homes where house dust was sampled, and these two homes belonged to adolescents with no respiratory problems.

The site with the highest number of mites was the carpet (46.80%), followed by bed (34.04%) and sofa (14.89%); curtains were the site with the lowest number of mites (4.25%). The six species identified in the present study belong to three families: *Pyroglyphidae*, *Glycyphagidae*, and *Cheyletidae*. *Dermatophagoides pteronyssinus* (46.80%) and *D. farinae* (31.91%) accounted for 78.71% of the total individuals found.



**Figure 2**  
Prevalence of allergic rhinitis throughout the year

**Table 1**

House dust mite families and species found in the homes of 13- and 14-year-old adolescents in the south of Brazil

Family/species	Sofa	Bed	Rug	Curtain	Total
Pyroglyphidae					
<i>Dermatophagoides pteronyssinus</i>	6	5	9	2	22
<i>Dermatophagoides farinae</i>	1	7	7	–	15
<i>Euroglyphus sp.</i>	–	1	2	–	3
Glycyphagidae					
<i>Blomia tropicalis</i>	–	–	1	–	1
<i>Glycyphagus destructor</i>	–	2	–	–	2
Cheyletidae					
<i>Cheyletus malaccensis</i>	–	1	3	–	4
Total	7	16	22	2	47

## Discussion

The initial study hypothesis was corroborated by the findings: the percentages of allergic rhinitis and asthma found in the target population investigated in the city of Lajeado were similar to those found in other cities in Brazil. In a study conducted by Toledo<sup>17</sup>

in São Paulo with 13- and 14-year-old adolescents, also applying the ISAAC Protocol, the prevalence of asthma and rhinitis were similar to those of the present study. Prevalence values of asthma and rhinitis were 6.8% and 37.6%, respectively.



At phase three of the ISAAC, the following prevalence values of active asthma were found in 13- and 14-year-old adolescents in the following cities of Rio Grande do Sul: Passo Fundo (20.5%), Porto Alegre (18.2%), and Santa Maria (15.3%).<sup>18</sup> Fernandes et al.,<sup>19</sup> in a study conducted in the city of Pelotas, observed prevalence values of asthma and allergic rhinitis symptoms of 19.8% and 35.3%, respectively.

Silva et. al.,<sup>20</sup> who investigated the prevalence of asthma and rhinoconjunctivitis in 13- and 14-year-old adolescents in Florianópolis, state of Santa Catarina, Brazil, observed an association between these two diseases in 4.5% of the adolescents. Percentage that is close to the association found in our study (3.09%).

A study conducted by Esteves et al.<sup>21</sup> also showed that May, June, July, and August were the months when symptoms of rhinitis worsened, which might be explained by the fact that this is a colder period, with lower humidity, thus increasing the concentration of aeroallergens. A study on house dust conducted by Nascimento et al.<sup>15</sup> found a lower number of mites in the summer compared to winter, autumn, and spring months, thus showing that colder months and higher presence of mites, in fact, are related to the worsening of rhinitis symptoms.

In our study, adolescents with a lower birth weight had a higher prevalence of respiratory problems, and this corroborates the study conducted by Fernandes et. al.,<sup>22</sup> who showed that symptoms of asthma were associated with birth weight less than 2,500 g. A study conducted by Neto et. al.<sup>23</sup> has already shown also that being born prematurely is a risk factor for asthma and allergic rhinitis.

Dermatological reactions after being in contact with mites of the family Cheyletidae have already been described by Yoshikawa<sup>24</sup> and Ezequiel et al.<sup>25</sup> However, their clinical importance has been poorly acknowledged due to the lack of available commercial extracts to perform skin-prick tests. Additionally, *Cheyletus malaccensis*, found in the house dust collected, has already been reported as a predator of *Dermatophagoides farinae*, which indicates its association with dust mites, as a potential predator to be used in the biological control of dust mites and stored product mites.<sup>26</sup> A study conducted by Dutra et al.<sup>27</sup> in Porto Alegre, state of Rio Grande do Sul, Brazil, evaluating mite fauna in house ecosystems, found that *D. pteronyssinus* was the most frequently found species too, with prevalence value of 39.6%.

A cross-sectional study conducted by Li et al.<sup>28</sup> with 6,304 patients who had asthma and/or rhinitis showed that the severity of rhinitis and asthma was significantly correlated to the skin index of sensitization against the mites *D. pteronyssinus*, *D. farinae* and *Blomia tropicalis* by performing hyperresponsiveness tests. This reinforces the findings regarding the association of a higher presence of mites in homes of adolescents with respiratory problems.

## Conclusions

In conclusion, the prevalence of allergic rhinitis in the age group studied, in the city of Lajeado, is similar to that of other regions in the state of Rio Grande do Sul and Brazil. The prevalence of asthma, on the other hand, was lower compared to that of these locations. Premature birth, low birth weight, and smoking mother were shown to be risk factors for the development of asthma and allergic rhinitis. Homes of adolescents with respiratory problems had a higher number of house dust mites, which can be explained by the fact that these adolescents are more prone to having asthma and allergic rhinitis.

The results found can be used as information for the development and implementation of strategies for preventing sensitization against house dust mites. They are also important for conducting practices related to allergic diseases associated with these mites.

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