



## ORIGINAL ARTICLE

# Sensitisation to aeroallergens among asthmatic and non-asthmatic adolescents living in a poor region in the Northeast of Brazil

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### KEYWORDS

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Immediate hypersensitivity;  
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### Abstract

**Objectives:** To assess the kind and frequency of sensitisation to aeroallergens (skin prick test - SPT) of asthmatic and non-asthmatic adolescents (13–14 years old) living in the city of Caruaru, Northeast of Brazil, and to analyse their exposure to some environmental factors.

**Method:** A case-control study was conducted with asthmatic (50) and non-asthmatic (150) adolescents diagnosed by the International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire. All were submitted to SPT with aeroallergens (house dust mites, cat and dog epithelium, cockroaches, moulds and grass) and completed a questionnaire to evaluate their environmental exposure.

**Results:** There were no significant differences between groups regarding gender, age, number of siblings and environmental exposure. Asthmatic subjects exhibited a higher frequency of positive SPTs than non-asthmatic subjects (54.0% vs 33.3%,  $p=0.009$ ) mainly due to *Periplaneta americana* (34.0% vs 12.7%,  $p=0.0007$  respectively) and *Canis familiaris* (20.0% vs 8.7%,  $p=0.029$ ).

**Conclusion:** Although sensitisation to aeroallergens was high among non-asthmatic adolescents, asthma was associated with parental history of atopic disease and sensitisation to *P. americana* and *Canis familiaris* but not to *D. pteronyssinus* showing that local studies are mandatory for the tailoring of appropriate management of allergic diseases.

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## Introduction

Asthma is the most prevalent chronic respiratory disease in children and constitutes a public health problem, particularly in industrialised nations.<sup>1</sup> It is a multiple triggering agent illness and its frequency and severity has been increasing in several parts of the world in recent years.<sup>2</sup> Observations from former East and West Germany revealed that allergies were more frequent in the developed West side.<sup>3</sup> Since then, the hygiene hypothesis has attempted to explain the high prevalence of allergic diseases in developed countries.<sup>4</sup> Developing countries have also experienced an increase in the prevalence of allergic diseases in recent years.<sup>5</sup> Different environmental exposures, including parasites, diet, hygiene, infections, exposure to airborne allergens and air pollution, in combination with genetic factors may be related to this occurrence.<sup>6</sup>

Differences between urban and rural areas regarding the prevalence of diseases have been observed in various parts of the world. Several hypotheses try to explain it. A British cross-sectional study evaluating skin prick test (SPT) to aeroallergens in asthmatic children showed a higher frequency of sensitisation to house dust mite and cat dander in individuals living in urban than those living in rural areas.<sup>7</sup> Similarly, a case-control study with children (6 to 13 years) from rural and urban areas in eastern Finland to assess the relation between environment and allergy found that rural living was associated with a reduction in allergen sensitisation and allergic diseases prevalence.<sup>8</sup>

In a previous study to evaluate asthma prevalence and related symptoms among adolescents living in Caruaru, in the poor and semi-arid region of Northeast Brazil, we observed higher prevalence among those living in the urban area in comparison to those living in the rural area.<sup>9</sup> Reasons for this result were not addressed in that study. Thus, the aim of the present study was to evaluate the relation between environmental exposure and frequency and kind of sensitisation to aeroallergens among adolescents, asthmatics and non-asthmatics, living in the city of Caruaru (urban and rural areas).

## Patients and methods

We studied adolescents (13–14 years old) regularly enrolled in public and private schools in the city of Caruaru, a poor countryside city in the state of Pernambuco, Northeast of Brazil. The country has 253,634,000 inhabitants (85.6% urban) living in a total area of 928.08 km<sup>2</sup>. Caruaru's latitude is 8°17'00" S and longitude 35°58'34" W. Gr, and it is at an altitude of 555m above sea level. Climate is hot semi-arid, low humidity (less than 30%) and with a mean annual temperature of 24°C (range 22°C to 30°C). Data collection occurred between February to June 2005. School selection was done by random cluster sampling between those which had students in the targeted age range, following a proportion of 70% students from public and 30% from private schools in the urban area. Assuming a 30% prevalence of positive SPTs in non-asthmatics, a sample size of 108 controls for 36 cases (3:1) was calculated to be able to find a 25% difference between groups with alpha and beta errors of 5% and 80% respectively.<sup>10</sup>

We chose to study 150 and 50 individuals in non-asthmatic and asthmatic groups. Asthmatic adolescents were defined as those who answered "yes" to the question "Have you had wheezing episodes in the last 12 months?" on the ISAAC (International Study of Asthma and Allergies in Childhood) asthma core written questionnaire (WQ) translated and validated for Portuguese (Brazil).<sup>11</sup> Non-asthmatic subjects were defined as those who answered "no" to all questions regarding the ISAAC asthma, rhinitis and eczema core WQ. The study was IRB approved and only those adolescents presenting a signed informed consent by their respective guardians were involved in the study.

All selected individuals were submitted to SPT as previously described<sup>12–14</sup> with standardised allergens (*Dermatophagoides pteronyssinus*, *Periplaneta americana*, *Blattella germanica*, dog and cat epithelia, and a fungal and grass mix) along with positive (10 mg/ml histamine) and negative control (0.5% phenol and glycerin solution). The extracts were provided by Diater (distributed by ALC-Alergia Clínica Laboratorial e Comércio Ltda-São Paulo-Brazil). A positive SPT was defined as a wheal size equal to or greater than 3 mm above the negative control.<sup>12–14</sup>

Environmental exposure to some risk factors and/or aeroallergens was assessed through a questionnaire comprising questions on personal (gender), family (only child, atopic father/mother) and environmental information (pets, moulds, passive smoking, wood/coal cooking).<sup>15</sup> Schoolchildren who were using any medications which could affect the outcome of SPT and patients undergoing an asthmatic crisis were excluded from the study. The association between sensitisation to the allergens tested and asthma in both groups was evaluated by bivariate analysis. It would have been appropriate if sensitisations were co-related with disease severity but it was not possible because we studied a general population sample. The strength of this association was assessed by the Odds Ratio (OR) and 95% confidence interval (95%CI). The Chi-square test with Yates' correction was employed to determine statistical significance. The Mantel-Haenszel Chi-square test was performed to compare the place of living: urban or rural.

## Results

Except for having an atopic parent there were no significant differences between asthmatic and non-asthmatic adolescents regarding gender, age or number of siblings and environmental exposure (Table 1).

The frequency of positive SPT to at least one aeroallergen was significantly higher among asthmatic adolescents in comparison to non-asthmatics (Table 2). The frequency of sensitisation to the different allergens was similar in both groups except for *Periplaneta americana* and *Canis familiaris* which were significantly higher among the asthmatic adolescents. Sensitisation to *Periplaneta americana* was higher in the rural area.

## Discussion

The association between being asthmatic and having atopic parents has been widely demonstrated, and the positive history of familial allergy has been pointed out as a

**Table 1** Associated factors to asthma presentation in asthmatic (n=50) and non-asthmatic (n=150) adolescents living in Caruaru, Northeast Brazil—Odds ratio (OR) and 95% Confidence intervals (95%CI)

	Asthmatic N (%)	Non-asthmatic N (%)	Total N (%)	OR (95%CI)	p
<b>Male*</b>					
Only child	4 (8.0)	7 (4.6)	11 (5.5)	1.78 (0.41–7.18)	0.28
Atopic father/mother	18 (36.0)	25 (16.7)	43 (21.5)	2.54 (1.27–5.27)	0.01
Pets (indoor/outdoor)	35 (70.0)	116 (77.3)	151 (75.5)	0.68 (0.33–1.40)	0.29
Mould	6 (12.0)	11 (7.4)	17 (8.5)	1.71 (0.60–4.89)	0.37
Passive smoking	12 (24.0)	44 (29.3)	56 (28.0)	0.76 (0.36–1.59)	0.46
Wood/coal cooking	11 (22.0)	28 (18.7)	39 (19.5)	0.81 (0.35–1.92)	0.26

\*Fisher's exact test.

**Table 2** Frequency of positive skin prick test (SPT) to aeroallergens among asthmatic and non-asthmatic adolescents living in Caruaru, Northeast Brazil: Odds ratio (OR) and 95% Confidence interval (95%CI)

	Asthmatics N (%)	Non-asthmatics N (%)	Total N (%)	OR (95%CI)	p
Positive SPT	27 (54.0)	50 (33.3)	77 (38.5)	2.4 (1.2–4.5)	0.0093
<i>D. pteronyssinus</i>	14 (28.0)	25 (16.7)	39 (19.5)	1.9 (0.9–4.1)	0.079
<i>Blatella germanica</i>	8 (16.0)	18 (12.0)	26 (13.0)	1.4 (0.6–3.4)	0.466
<i>Periplaneta americana</i>	17 (34.0)	19 (12.7)	36 (18.0)	3.6 (1.7–7.6)	0.0007
Fungus mix*	3 (6.0)	4 (5.0)	7 (3.5)	2.3 (0.2–13.8)	1.00
<i>Canis familiaris</i>	10 (20.0)	13 (8.7)	23 (11.5)	2.6 (1.1–6.5)	0.029
<i>Felis domesticus*</i>	3 (6.0)	9 (6.0)	12 (6.0)	1.0 (0.3–3.9)	1.00

\*Fisher's exact test.

predictive factor for asthma.<sup>16,17</sup> Among all the risk factors evaluated in this study, only the presence of an allergic parent was associated with asthma: 37.5% for asthmatics vs 19.1%, for non-asthmatics (OR: 2.51, 1.27–5.27. Table 1).

The population enrolled in this study was constituted by low socioeconomic level adolescents characterized by having siblings (94.5%), owning pets (indoor/outdoor; 75.5%) and exposed to passive smoking (28.0%) and to wood/coal stove (19.5%) (Table 1). According to some authors, the reduction in family size could represent improvement in domicile and personal cleanliness, thereby diminishing opportunities of virus cross infection between young children supposedly involved in the protection against the clinical expression of allergies.<sup>18</sup> In this study, we did not observe any association between the number of siblings and prevalence of asthma, although this sample was not calculated for this purpose.

We found a sensitisation prevalence of 54% to at least one aeroallergen in asthmatic children. Similar results were observed by Pastorino et al who used the same standardised aeroallergens.<sup>19</sup> In general, Brazilian studies reporting the frequency of sensitisation had been carried out in specific populations like asthmatics and patients with allergic rhinitis.<sup>20–23</sup> In a national study among Brazilian children and adolescents treated in allergy departments, there was a sensitisation prevalence of 66.6% for *D. pteronyssinus* and 60% for *D. farinae*.<sup>20</sup> Another study observed levels of 95% and 92% of sensitisation to *D. pteronyssinus* and *D. farinae*, respectively.<sup>21</sup> Sensitisation to *Periplaneta americana* was 55% among children and adults with asthma and/or

rhinitis.<sup>22</sup> However, Medeiros et al evaluating asthmatic adults living in slums in the city of Salvador, Bahia, observed 38.1% of sensitisation to *D. pteronyssinus*.<sup>23</sup> We observed higher levels of sensitisation in non-asthmatic teenagers (33%).

*Dermatophagoides pteronyssinus* has been widely identified, as well as in Brazil, as a major aetiological agent for allergies due to its universal distribution and high capacity for sensitisation. The high level of cross-reactivity of *D. pteronyssinus* with *D. farinae* led us to choose only the former.<sup>24</sup> A study carried out in the city of Recife-PE (Northern coast of Brazil), almost 100 km from Caruaru, with a humid climate, found 70% sensitisation to *D. pteronyssinus* among asthmatic subjects.<sup>25</sup> As shown in Table 2, the frequency of sensitisation for *D. pteronyssinus* among asthmatic adolescents was low (28.0%) and not different from non-asthmatics (16.7%). Would these results be due to genetic background or secondary to low level of exposure to *D. pteronyssinus*? Caruaru's climate is semi arid (low humidity) and hot all year long. Applying the same methodology, Pastorino et al have observed 36.9% of sensitisation for *D. pteronyssinus* among the adolescents they evaluated in São Paulo and Nova Iguaçu (Southern Brazil). Although the exposure to this mite was not quantified in our study, we speculate that Caruaru's climate was not propitious to the proliferation of these allergens.

Other intriguing data observed in our study was the frequency of sensitisation for cockroaches. Cockroaches are found throughout the world and are more common in urban areas with low housing standards.<sup>26,27</sup> About one third of

asthmatic adolescents were identified as sensitised for *Periplaneta americana*, significantly higher than non-asthmatics (Table 2). It was more than twice that observed by Pastorino et al (15.8%).<sup>19</sup> Lopes et al,<sup>28</sup> in a study in the city of Recife to assess cockroach sensitisation in asthmatic and non-asthmatic children observed high frequency of sensitisation for *P.americana* among the former than the latter (27.6% versus 2.4%, respectively). *P. americana* is a cockroach which has predominantly outdoor habits and is frequently associated with rural areas where there is not an adequate waste collection. Although it was not the aim of this study, certainly we can speculate that adolescents from Caruaru are more exposed to this allergen than those living in Recife.

With regard to the sensitisation for *B.germanica*, there were no differences between asthmatics and non-asthmatics (16% versus 12%, respectively) and similar to those observed by Pastorino et al (13.4%).<sup>19</sup> However, in Recife, it was significantly higher among severe asthmatics (27.6% versus 4.8%, respectively).<sup>28</sup>

The sensitisation to *Canis familiaris* was significantly higher among the asthmatic adolescents in comparison to the non-asthmatics (20.0% versus 8.7%, respectively), although exposure levels were similar for both (Table 1). Pastorino et al found 9.5% of asthmatic adolescents sensitised in the Southern region of Brazil.<sup>19</sup> Lower level of sensitisation was observed regarding sensitisation for cat (Table 2).

The association between owning a pet and the risk of developing allergic sensitivity remains controversial. A review on sensitisation to animals examined the results from recent studies and has suggested that owning a dog does not provoke the development of sensitisation to dog dander and may even protect individuals from developing such sensitisation.<sup>29</sup> A descriptive study, however, found a significantly higher prevalence of allergies among families who kept animals in the home.<sup>30</sup> The divergent results may stem from the season and/or frequency and/or intensity of the exposure.

In conclusion, in a low socioeconomic level population living in the countryside city of Caruaru, in the state of Pernambuco (Brazil), asthma was associated with parental history of atopic disease and sensitisation to *P.americana* and *Canis familiaris* but not to *D. pteronyssinus*, showing that local studies are mandatory for the tailoring of appropriate management of allergic diseases.

## Conflict of interest

The authors have no conflict of interest to declare.

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