Asthma and rhinitis symptoms in individuals from different socioeconomic levels in a Brazilian city

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ABSTRACT

*Allergy is considered to be caused by complex interactions between genetic and environmental factors. Socioeconomic status (SES) may be the most important environmental determinant of allergy because it determines the living environment, but few studies have addressed the causal role of SES in allergy. The aim of this study was to compare the prevalence of asthma and rhinitis symptoms in two SES groups in a Brazilian city. History of asthma and rhinitis symptoms was collected using the International Study of Asthma and Allergies in Childhood questionnaire. SES was determined by the Gallup method. Sera from subgroups of the individuals were used to determine total, anti–*Dermatophagoides pteronyssinus *and anti–*Blomia tropicalis *IgE. The prevalence of asthma and rhinitis symptoms was higher in the A and B (A&B) SES group than in the C, D, and E (C, D&E) SES group. Individuals with asthma and/or rhinitis were more frequently positive for anti–*B. tropicalis *and anti–*D. pteronyssinus *IgE than individuals without these symptoms. A positive association between total IgE levels and asthma and rhinitis symptoms was observed in the A&B SES group but not in the C, D&E SES group. Women reported more respiratory symptoms than men. These results revealed higher prevalence rates of asthma and rhinitis symptoms in individuals with higher SES and may provide support for the hygiene hypothesis, which attributes the high prevalence of respiratory allergies observed in individuals from developed countries to a low exposure to pathogens. The observed higher prevalence of asthma and rhinitis symptoms in women than in men could be attributed to differences in the perception of these symptoms or in exposures to allergens and protective pathogens.*

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Key words: Prevalence, asthma, rhinitis, IgE, *Blomia tropicalis*, *Dermatophagoides pteronyssinus*, socioeconomic level, allergy and gender

Respiratory allergies are common in many areas of the world and asthma and rhinitis are, indeed, the commonest chronic diseases in children of developed countries.[1] Asthma and rhinitis can have different etiologies; the type 1 hypersensitivity reaction plays the central role in their pathogenesis (see [Ref. 2] for review). The "International Study of Asthma and Allergies in Childhood" (ISAAC) program[3] and others[4] reported the prevalence of asthma symptoms to be higher in developed countries than in some developing countries, and that the highest and lowest rates were found in Scotland (36.7%) and India (1.6%), respectively. Strachan[5] found lower prevalence rates of asthma and atopy in farmers compared with urban inhabitants. These findings led to the formulation of the hygiene hypothesis, which attributed the decreased prevalence of allergic diseases in developing countries and in rural areas of industrialized countries to the high exposure to pathogens, and the high prevalence of allergy in developed countries to cleanness and low environmental pathogen burden.

Reported data on the relationship between socioeconomic status (SES) and atopy and/or allergic illnesses are controversial (see [Ref. 6] for review). Although some authors[7–9] have found the highest asthma morbidity and prevalence rates in less affluent minority communities, others authors[10–11] have found higher asthma prevalence rate in wealthier population groups, and the majority of these studies has been done in developed countries. In this study we report the prevalence of asthma and rhinitis symptoms in individuals from two SES groups and the levels total and specific anti–*Dermatophagoides pteronyssinus* and anti–*Blomia tropicalis* IgE in subgroups of the studied individuals.

MATERIALS AND METHODS

Study Population

Two SES groups in the city of Salvador, Bahia, Brazil, were investigated: an upper and upper-middle class

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group, composed of 228 individuals from 53 medical students' families, with socioeconomic status A or B (A&B SES group) and a group composed by 211 individuals from 48 low-income families, with socioeconomic status C, D, or E (C, D&E SES group). The families of the C, D&E SES group usually were selected because one of their members worked in a medical student home or building. The two groups were homogeneous in relation to age and sex. SES was determined by the Gallup method. This method is based on the parents' educational levels and home characteristics such as total room number and number of bedrooms, bathrooms, TVs, refrigerators, freezers, cars, etc. Histories of asthma and rhinitis symptoms were obtained using the phase-I International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. Each student filled out the questionnaire of one family from the A&B SES group and one family from the C, D&E SES group. Individuals who had episodes of wheezing and dry cough in the last year were considered positive for asthma. Individuals with sneezing and running nose in the last year were considered positive for rhinitis. Blood was taken from two subgroups of volunteers from both subject groups: 34 with history and 27 without history of respiratory symptoms. The work was approved by the Ethical Committee on Research of the Oswaldo Cruz Foundation, Salvador, Bahia, Brazil. Informed written consent was obtained from all study participants.

ELISA for Total, Anti–*B. tropicalis*, and Anti–*D. pteronyssinus* IgE

Total IgE was detected by capture ELISA using wells of flat-bottom polystyrene plates (COSTAR 3590, Flat Bottom, polystyrene; Costar, Cambridge, MA) containing nitrocellulose disks (Bio-Rad Laboratories, Hercules, CA), sensitized with 4 μg/mL of an human anti-IgE antibody (Pharmingen, San Diego, CA). Plates were blocked with 0.15 M of phosphate-buffered saline (PBS), pH 7.2, containing 20% of dried skimmed milk (DSM) and 0.05% of Tween 20 (Sigma, St. Louis, MO) overnight, at 4°C. Sera were diluted 1:10 in PBS containing 10% of DSM and 0.05% of Tween 20 and incubated overnight at 4°C. A goat anti-human IgE–peroxidase conjugate (Sigma) and an anti-goat immunoglobulin–peroxidase conjugate (Dako A/S, Glostrup, Denmark) were diluted at 1:2000 and 1:10.000, respectively, and incubated for 60 minutes at room temperature. An antigen concentration curve was obtained by using human IgE (Research Diagnostics, Inc., Flanders, NJ).The results were expressed in International Units (IU). A pool of allergic patients' sera with positive prick test for dust mites was used as positive control. Umbilical cord serum from a nonatopic mother was used as a negative control. Anti–*D. pteronyssinus* and anti–*B. tropicalis* IgE were detected by commercial ELISA kits (DPC, Los Angeles, CA). Sera with results above 0.35 kU/L, as determined by the manufacturer's instructions, were considered positive.

Statistical Analysis

Data were analyzed with the use of the EPI-INFO and the Statistical Package for the Social Sciences Computer Program (2001; SPSS, Chicago, IL). The chi-square test for linear trend in proportions was used to analyze the variation of the prevalence of asthma and rhinitis symptoms according to the socioeconomic level. The chi-square test with the Yates' correction was used to test the associations between study group and asthma and rhinitis symptoms, sex, and age. For all of the analysis, values of $p < 0.05$ were considered statistically significant.

RESULTS

The Prevalence of Asthma and Rhinitis Symptoms Differs in the Individuals of the Two Socioeconomic Groups

The ISAAC questionnaire was applied to 228 individuals from the A&B SES group and 211 individuals from the C, D&E SES group. The two groups were similar with respect to age and sex. Although the A&B SES group consisted mainly of families of socioeconomic level A and B, the C, D&E SES group consisted of families of socioeconomic level C, D, and E (Table 1). Forty-four percent of individuals from the A&B SES group and 32.4% individuals from the C, D&E SES group had asthma and rhinitis symptoms ($p < 0.01$). The prevalence of asthma was 21.1% in the A&B SES group and 12.1% in the C, D&E SES group ($p < 0.01$). Rhinitis also was more prevalent in individuals from the first group (32.5%) than from individuals from the second group (18.8%; $p < 0.001$; Table 2). A positive association was observed between social classes and history of asthma and/or rhinitis in individuals from the C, D&E SES group (classes C, D and E; Fig. 1) but not the A&B SES group (classes A and B). Symptoms of asthma and/or rhinitis were more frequent in women than men in the whole population studied (43.3% versus 29.2%, respectively; $p < 0.004$) and within the A&B SES group ($p < 0.05$) and the C, D&E SES group ($p < 0.03$; Table 3).

High Level of Total Blood IgE Is Associated with Asthma and Rhinitis Symptoms Only in the Individuals from the A&B SES Group

Sera from 35 individuals suffering from asthma and rhinitis symptoms and from 26 normal individuals were examined for total IgE concentration. Total IgE concentrations were markedly higher among individuals with a clinical history of asthma and/or rhinitis in the A&B SES group. This association was not observed

Table 1 **Characterization of the studied groups**

Variable	A&B SES Group* (*n* [%])	C, D&E SES Group# (*n* [%])	Whole Studied Population (*n* [%])	*p* Value§
Sex				
Male	104 (45.5)	92 (43.8)	196 (44.6)	0.74
Female	124 (54.5)	119 (56.2)	243 (55.4)	
Total	228 (100.0)	211 (100.0)	439 (100.0)	
Age (yr)				
>20	107 (46.9)	88 (41.7)	195 (44.4)	0.31
<21	121 (53.1)	123 (58.3)	244 (55.6)	
Total	228 (100.0)	211 (100.0)	439 (100.0)	
Socioeconomic status				
A	122 (54.7)	0 (0)	122 (29.3)	<0.0001
B	101 (45.3)	0 (0)	101 (24.3)	
C	0 (0)	74 (38.3)	74 (17.8)	
D	0 (0)	99 (51.3)	99 (23.8)	
E	0 (0)	20 (10.4)	20 (4.8)	
Total	223 (100.0)	193 (100.0)	416 (100.0)	

**A&B SES group = group composed of individuals with socioeconomic status A or B.*
#C, D&E SES group = group composed by individuals with socioeconomic status C, D or E.
§The chi-square test with Yates' correction was used to test the statistical differences in sex, age, and socioeconomic status distribution between the studied groups.

Table 2 **Frequency of history of asthma and rhinitis symptoms according to the study groups**

Respiratory Symptoms and Presence	Groups		Total *n*	*p** Value
	A&B SES# (*n* [%])	C, D&E SES§ (*n* [%])		
Asthma and rhinitis				
Yes	102 (44.7)	67 (32.4)	169	0.01
No	126 (55.3)	140 (67.6)	266	
Asthma				
Yes	48 (21.1)	25 (12.1)	73	0.01
No	180 (78.9)	182 (87.9)	362	
Rhinitis				
Yes	74 (32.5)	39 (18.8)	113	0.001
No	154 (67.5)	168 (81.2)	322	
Total	228 (100.0)	207 (100.0)	435	

**The chi-square test with Yates' correction was used to test the association of asthma and rhinitis symptoms with the studied groups.*
#A&B SES = group composed by individuals with socioeconomic status A or B.
§C, D&E SES = group composed by individuals with socioeconomic status C, D or E.

in the C, D&E SES group (Fig. 2 *A*). Anti--*D. pteronyssinus* IgE was found in 77.3% of individuals with asthma and/or rhinitis and in 9.1% of individuals without asthma and/or rhinitis ($p < 0.0001$) and anti–*B. tropicalis* IgE was found in 65.0% of individuals with asthma and/or rhinitis and in 22.2% of individuals without asthma and/or rhinitis ($p < 0.01$; Fig. 2, *B* and *C*).

DISCUSSION

In this work, high prevalence rates of asthma and rhinitis symptoms were observed in Salvador inhabitants. A study performed in a Salvador slum[12] found prevalence rates of asthma and/or rhinitis similar to the rates observed in the C, D&E SES group of this study. We found that 65.0 and 77.3% of individuals with asthma and/or rhinitis symptoms had high levels

of anti–*B. tropicalis* and anti–*D. pteronyssinus* IgE, respectively, and Medeiros and collaborators,[13] in the same city, found 57.9% of asthmatic patients with high levels of anti–*D. pteronyssinus* IgE antibodies. The adequacy of the ISAAC questionnaire for the identification of allergic individuals can be deduced from (1) the strong association found in this work between specific IgE antibodies and the histories of asthma and rhinitis symptoms and (2) the fact that the allergic individuals of this study and those studied by Medeiros and collaborators[13] (hospital-based data) had similar prevalence rates of specific IgE antibodies.

A positive association between high SES was found for childhood eczema and for atopy in the United States, Italy, Britain, and East Germany.[14–16] In developing countries, Addo-Yobo[17] found a positive association of SES with atopy and exercise-induced bronchospasm, and Nascimento-Carvalho and collaborators[18] reported that children attending a private hospital had more allergies than children attending a public hospital, who had more pneumonia. Mielck and collaborators[19] stated that severe asthma is found more frequently in people of low SES than of high SES, and asthma prevalence rates, as detected in population-based works, are higher in individuals of high SES. However, several other authors did not find significant associations between SES and prevalence of respiratory allergies.[7–9,20] The association of high levels of SES and prevalence of asthma and rhinitis symptoms, found in this study, is consistent with the former authors' findings and indirectly provides support for the hygiene hypothesis.

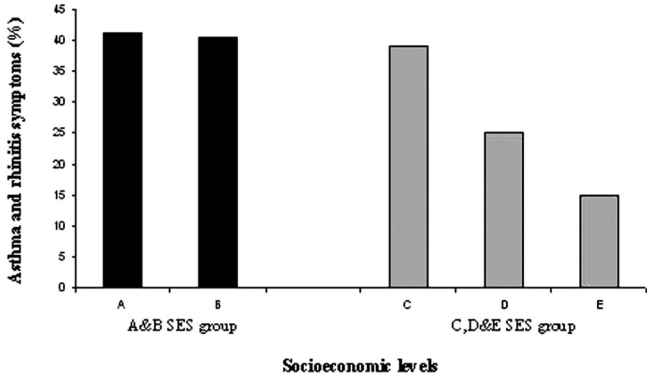

Figure 1. *Prevalence of asthma and/or rhinitis symptoms according to socioeconomic level in the studied groups. The prevalence of asthma and/or rhinitis symptoms was correlated with socioeconomic level in 223 individuals of the A&B SES group and in 192 individuals of the C, D&E SES group (*$p < 0.01$; chi-square test; test for linear trend in proportions).*

The hygiene hypothesis[5,21,22] suggested that the high burdens of viruses and intracellular bacteria, which frequently cause childhood infections in developing countries, would deviate the early childhood Th2-biased, atopy-prone immune system to a Th1 immune system, which may protect against the development of allergies.[23–25] Parasites, despite inducing strong Th2-type responses with production of IL-4, IL-5, and IL-13 and consequently increasing the IgE synthesis, have been reported also to provide protection against allergy.[26–28] Regulatory ILs[29,30] produced in the chronic phase of helminth infections could mediate protection against allergy.[31] Although fecal examination for intestinal parasites were not done in all subjects of the present work, fecal samples of 90 individuals of the C, D&E SES group were examined (unpublished data, Laboratorio de Acarologia e Alergia, 2004) and they had high prevalence of intestinal helminthes (27.1% for *Trichuris trichiura*, 15.7% for *Ascaris lumbricoides* and 5.7% for *Schistosoma mansoni*).

The wealthy individuals living in developing countries have lifestyles similar to those living in developed countries. They live in areas with high standards of sanitation in clean houses; have adequate access to antibiotics and vaccination; and have reduced exposure to viral, bacterial, and helminth infections, which could, according to the hygiene hypothesis, make them more likely to develop allergies.

The finding of a positive association between high levels of IgE and asthma and rhinitis symptoms in the A&B SES group but not in the C, D&E SES group can be attributed to the absence of other causes of IgE stimulation (*e.g.*, intestinal helminth infections) apart from environmental allergens in the former group. However, in the C, D&E SES group, the elevated IgE levels may be attributable to both allergen- and parasite-specific IgE and therefore would be found frequently elevated in parasite-infected, nonallergic indi-

Table 3 **Frequency of clinical history of asthma and rhinitis symptoms according to gender**

Asthma and Rhinitis Symptoms	Total			A&B SES Group			C, D&E SES Group		
	Female *n* (%)	Male (*n* [%])	*p* Value	Female (*n* [%])	Male (*n* [%])	*p* Value	Female (*n* [%])	Male (*n* [%])	*p* Value
Present	104 (43.3)	57 (29.2)	0.004	62 (50.8)	38 (36.9)	0.05	42 (35.6)	19 (20.6)	0.03
Absent	136 (56.7)	138 (70.8)		60 (49.2)	65 (63.1)		76 (64.4)	73 (79.4)	

The chi-square test with Yates' correction was used to test the association between asthma and rhinitis symptoms and gender in the study groups.

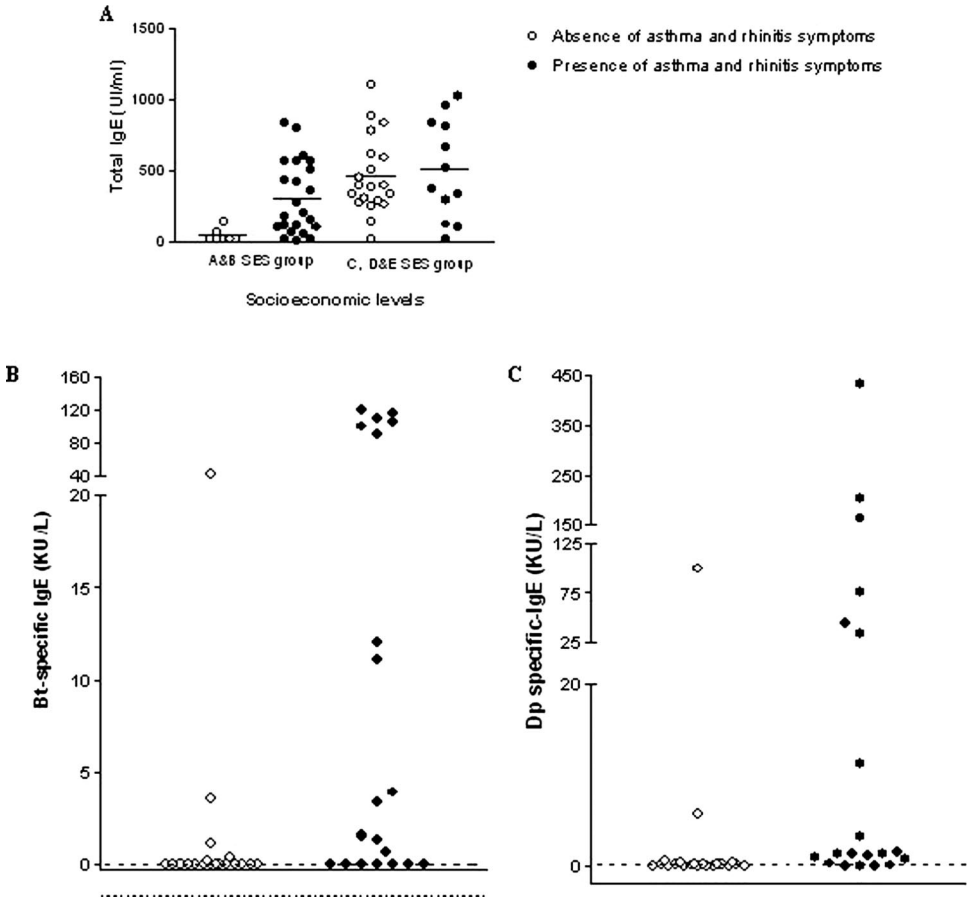

Figure 2. *Total and specific IgE anti–*D. peteronyssinus *and* B. tropicalis *in subgroups of the studied groups. (A) Serum concentration of total IgE (IU/mL). Lines represent the total IgE means obtained in the studied groups; (B and C)* B. tropicalis*– and* D. pteronyssinus*–specific IgE levels (kIU/L) of individuals from the studied groups according to the presence or absence of asthma and/or rhinitis symptoms. Lines represent the assay cutoff of the studied groups as recognized by the kit manufacturer (DPC).*

viduals. Similar findings have already being described elsewhere.[32–34]

In this study, symptoms of asthma and/or rhinitis were higher in women than in men for both socioeconomic levels. Similar findings have already being reported.[35,36] This finding could be attributed to a higher perception of symptoms by women than by men and/or to putative differences in exposure to allergens. Additional work should be performed in populations larger than this study to clarify these points.

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