

Sampling, Distribution, Dispersal

Mite Fauna Assessment in Houses of Two distinct Socioeconomic Groups From Southern Brazil

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Subject Editor: David Florin

Received 20 June 2017; Editorial decision 14 November 2017

Abstract

House dust mites (HDM) are the main source of aeroallergens worldwide, yet epidemiological differences between socioeconomic factors in association with this medical condition have not been studied in the south region of Brazil. To assess the prevalence of HDM in two socioeconomically distinct populations of patients with allergic asthma or rhinitis, the differences between samples from houses of high-income families and low-income families were analyzed. Mite samples were collected between July and December 2015, in Porto Alegre, Brazil. The HDM were *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* (Hughes; Acari: Pyroglyphidae). Also, other non-pyroglyphid house mites were identified in dust samples: *Tyrophagus putrescentiae* (Schränk; Acari: Acaridae), *Chortoglyphus arcuatus*, and *Cheyletus malaccensis*. Identification of species was performed through morphological keys with a stereomicroscope and a phase optical microscope. A total of 104 homes was evaluated (low-income group: $n = 53$; high-income group, $n = 51$). We found a total of 721 mites, representing 11 species, in 93 (89%) houses. In the remaining houses, no mites were found. We observed no significant differences of species composition between the groups studied. However, the number of mites was significantly higher in the low-income group ($P < 0.001$). *D. pteronyssinus* was the predominant species detected, with 286 mites (39.6%). *D. farinae* was not detected in any sample. Our results show that living-rooms from low-income families present higher numbers of HDM.

Key words: mite, house dust mite, allergy, asthma, environment

House dust mites (HDM) are the main sources of aeroallergens in the world (Ezequiel et al. 2001, Yu et al. 2014). They are abundantly present in house dust, and several studies have shown that HDM are the main triggers of allergic diseases (Miyamoto et al. 1968, Voorhorst et al. 1969, Van Bronswijk et al. 1973, Takeda et al. 2004, Navarro et al. 2008). HDM require relative air humidity of 55–60% and temperatures of approximately 25°C to survive (Serravallo et al. 1998, Yu et al. 2014). Regional and, local (and anthropogenic) climatic conditions are also fundamental in the development of mites, characteristics of which are responsible for the prevalence of each species (Navarro et al. 2008). Epidemiological studies show that the most prevalent HDM in tropical and subtropical countries are: *Dermatophagoides pteronyssinus* (Trouessart), *Dermatophagoides farinae* (Hughes; Acari: Pyroglyphidae), and *Blomia tropicalis* (Van Bronswijk 1973, Ziyaci et al. 2017). *D. pteronyssinus* has a cosmopolitan distribution, while *B. tropicalis* is restricted to tropical

and subtropical regions (Serravallo et al. 1998). The storage mite *Tyrophagus putrescentiae* (Schränk; Acari: Acaridae) has received attention as one of the leading causes of allergic asthma and allergic diseases and rhinitis in humans (Arlian et al. 1984, Liao et al. 2013a,b). Nuñez et al. (2016) described a strong induction of allergic inflammation in the lungs of mice. Also, other non-pyroglyphid house mites could be found in dust samples, e.g., *Chortoglyphus arcuatus* (Troupeau) and *Cheyletus malaccensis* (Oudemans) (Nascimento et al. (2016)).

Allergy is characterized by an immune response to antigens that can affect 20–30% of the world population at any one time (Serravallo et al. 1998). A significant increase of allergic diseases over the last decades has been observed, resulting in high burden of disease in many populations (Yazdanbakhsh et al. 2002, O'Connell 2004). Asthma is the most serious allergic disease and is strongly associated with HDM sensitization (Simons 1999).

Allergens produced by mites can accumulate in homes causing allergic diseases (Colloff 2009). In one meta-analysis with 13,558 patients from 16 countries, a high prevalence of asthma associated with sensitization by HDM was observed (Calderón et al. 2015). In Brazil, household mite fauna studies have been conducted. Recently, in a study with inner-city children from southern Brazil, it was shown that *B. tropicalis*, *D. pteronyssinus*, and *D. farinae* were the most common positive skin-prick test HDM species (Roncadi et al. 2016). Another study (Serravallo et al. 1998) investigated the mite fauna present in the house dust of the city of Salvador/Bahia, in Brazil. Mites were found in 98% of the households studied, with *D. pteronyssinus*, *Cheyletus* sp., *B. tropicalis*, *D. farinae*, and *T. putrescentiae*, the most common species detected. Da Silva et al. (2003) found the presence of mites in 77.5% of the households in Juiz de Fora/Minas Gerais, in Brazil, with the main species being *D. pteronyssinus*, *D. farinae*, *Euroglyphus maynei* (Cooreman; Acari: Acaridae), *B. tropicalis*, and *T. putrescentiae*. Nascimento et al. (2016) investigated environmental and seasonal patterns in the distribution of mites, and again found *B. tropicalis* and *D. farinae* as the most prevalent mites species city of Lajeado in southern Brazil. Finally, in another Brazilian study, Baqueiro et al. (2006) investigated the presence of Der p 1 (*D. pteronyssinus* allergen) and Blo t 5 (*Blomia tropicalis* allergen), and mites in households and showed that 89% of the beds harbored at least one mite species. The species *B. tropicalis* was found in 71.8%, and *D. pteronyssinus* in 39.9% of the beds. *B. tropicalis* was found with a similar frequency in beds of the two socioeconomic groups. The species *D. pteronyssinus* was found more frequently in the beds of the wealthy than of the poor group. However, there are no studies published evaluating mite fauna in homes from different socioeconomic level in the south region of Brazil. Brazil is the largest Latin American country, with a rather distinct socioeconomic delineation, with high contrasts between high- and low-income groups. Our study raises some questions considering these two groups of different socioeconomic level: 1) Is the prevalence of mite species different between these groups?; 2) Is the number of HDM different between these groups?; and finally, 3) Are mites related to stored products more commonly found in low-income house families? These are questions that remain unanswered. Hence, the aim of our study was to describe the distribution and characteristics of the mite fauna in the houses of allergic patients, comparing both socioeconomic distinct urban populations (high- and low-income) in a capital city in Southern Brazil.

Methods

Selection of Subjects and Houses

This is an observational study, which included two distinct socioeconomic groups. Samples were collected, simultaneously in both groups, between July 2015 and December 2015, in the city of Porto Alegre, capital of the state of Rio Grande do Sul, Brazil.

All the houses selected for this study were houses of patients who had a medical diagnosis of asthma or allergic rhinitis verified by the medical records. Houses that underwent a general cleaning 48 hr before the collection were not included in the study. Two groups of distinct socioeconomic level were included. The high-income families (HIF) were classified as A and B, and the low-income families (LIF) as C, D and E, according to a questionnaire applied, using standardized Brazilian criteria which evaluates the socioeconomic level in Brazil (CDC 2008). These criteria evaluated variations in the levels of income in relation to possession of goods (television, automobile, bathroom, refrigerator) in the households as well as the

degree of education of the head of the family (illiteracy, high school, or tertiary education). Through a system of points, families are classified by means of value income, which is distributed in classes A, B, C, D, and E (A and B with high purchasing power and C, D, and E with degrees of lower purchasing power).

A 10-question questionnaire to characterize the home environment was also conducted by personal interview during the house researcher visit. The low-income families were from a suburb where the population health care is covered by the authors' academic institution. The high-income level group was selected from volunteers (undergraduate students, postgraduate students, and professors) of our institution. The questionnaire contained the following questions:

- 1) Are any residents diagnosed with asthma?
- 2) How many people live in the house?
- 3) Do you have a pet?
- 4) Do you have a window?
- 5) What is the relative humidity of the air?
- 6) What is the indoor temperature?
- 7) Are there any meals in the room?
- 8) Do you have carpet?
- 9) What was the material of the room floor?
- 10) What was the time of the collection of household dust?

Collection of House Dust Samples

House dust samples were collected in the living room (floor, sofa, and rug) with the aid of a vacuum cleaner (Mondial, Brazil) with an output power of 1.500 W. Aspiration was performed for 2 min, covering an area of 2 m². A filter paper placed in the collector bag of the vacuum cleaner was used for each home. After the collection, the filter paper with the house dust was placed in sterile pots and identified with the number of the residence, and stored in a refrigerator with a temperature at 5°C, until the taxonomic classification of the mites were performed (Serravallo et al. 1998, Binotti et al. 2003, Binotti et al. 2005).

Mite Identification

Samples were sent to the Laboratory of Acarology of UNIVATES, in Lajeado, RS, Brazil, for taxonomic classification and total count of mites. House dust samples were analyzed with the aid of tweezers and a stereomicroscope. Mites were isolated and mounted on glass slides in Hoyer's medium and maintained in an incubator for 10 d. Mite identification was performed through a phase optic microscope and by dichotomous keys (Flechtman 1973, Hughes 1976, Krantz 2009).

Statistical Analysis

Mite collection data were presented as absolute (*n*) and relative (%) frequencies for the two different income groups. The mean and standard deviation ($\pm$ SD) of the mites collected for each income group were derived. The associations between the outcome variables were tested by chi-square test. Statistical significance was considered for values of *P* < 0.05. Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences, version 17.0, Inc, Chicago, Canada) software.

Ethical Aspects

The Research Ethics Committee of our institution approved this study (#1.075.768/2015). All subjects included read and signed an Informed Consent Form.

Results

Low- and High-Income Homes

A total of 104 houses were included (low-income group, $n = 53$; high-income group, $n = 51$). The characteristics of the two groups studied are described in Table 1. Low-income families had lower purchasing and education level compared to the high-income group ($P < 0.001$), with higher population density per home ($P < 0.001$). Cooler house temperatures were observed in the high-income group ($P < 0.002$). The low-income group had significantly fewer windows in the house ($P < 0.001$), different rug material in the living room ($P < 0.001$) and more domestic animals ($P < 0.001$) (Table 1).

Mite Fauna

Mite numbers in the living room were significantly higher in the low-income families compared to the high-income group ($P < 0.001$). *Glycyphagus destructor* (Schränk) species was found only in the low-income group ($P < 0.001$). *D. pteronyssinus* was the most common species in both studied groups. *D. farinae* was not found in any sample collected. *E. maynei* and *C. malaccensis* were the second and third most commonly HDM found, respectively, in both groups (Fig. 1). The remaining families where no mites were collected (11% of the total sample, with 2% in the low-income group and 9% in the high-income group) is not differ significantly from the rest of the sample as far as educational level of the family, presence of domestic animals, temperature, humidity, windows in the living room and rug in the living room. Results of mite prevalence in both groups (low-income and high-income groups) are shown in (Fig. 2).

Discussion

Our study is the first study to report a complete HDM analysis of dust from households in Brazil, including two distinct socioeconomic groups. Some of the species identified in our study have been reported in the southeast and northeast regions of Brazil (Serravallo et al. 1998, Ezequiel et al. 2001, Binotti et al. 2003, Sousa et al. 2005).

We did not find any significant differences among the HDM species composition collected between the groups. *D. pteronyssinus* was, as expected, the most predominant species in our study, as already shown in previous studies (Serravallo et al. 1998, Binotti et al. 2001, Sousa et al. 2005). One study from Israel shows that *D. pteronyssinus* concentration in house dust accounts for 75 to 92% of HDM detected (Feldman-Muhsam et al. 1985). Another study has shown the predominance of *D. pteronyssinus* in all regions of Brazil (Binotti et al. 2001).

The number of mites in low-income houses was higher than in high-income houses. This finding might be explained in this group by more meals served in the living room, higher human density in the households, and more rugs in the living rooms made of materials such as wool, fiber, and fabric which retain HDM in larger numbers (de Boer et al. 1996). The human skin scales forms protein substrates that are favorable for HDM growth and reproduction as the skin scales are a major food source for mite (de Oliveira et al. 1999). *G. destructor* (Schränk), a mite frequently found in storage products (Serravallo et al. 1998), was only found in the low-income family group.

Moreover, we have also observed the occurrence of *C. malaccensis* (Oudemans), which is a predatory mite from the Cheyletidae family, found in many parts of the world, and also associated with parasitism (Ezequiel et al. 2001). Studies from rural areas around the world showed that *C. malaccensis* were the most common mite found (Palyvos et al. 2008, Heikal 2015). In one case report from Midwest Brazil, *C. malaccensis* species was responsible for dermatological manifestations (Ezequiel et al. 2001). The detection of this mite may be explained by the same reasons discussed above about *G. destructor* increased prevalence.

Domestic animals seem to increase the number of HDM in households (Clarke et al. 2015). Another important finding concerns the amount of windows in the rooms, where the low-income group has a reduced amount compared to the other group, considering that the windows are responsible for indoor air circulation, which could be partially responsible for the growth of mite fauna.

Table 1. Characteristics of the houses between the low- and high-income groups ($n = 104$)

Characteristics of the houses	Low-income		High-income		P
	$n = 53$	%	$n = 51$	%	
Educational status of the household					
Illiterate/incomplete basic education	7	13.7	0	0	<0.001
Basic education	11	21.6	1	1.9	
Elementary school	27	52.9	3	5.7	
High school	6	11.8	6	11.3	
Higher education	—	—	43	81.1	
Population density (>3 people)	27	52.9	12	22.6	<0.001
Domestic animals	39	76.5	19	35.8	<0.001
Dog	30/39	76.9	16/19	84.2	0.390
Cat	20/39	51.3	5/19	26.3	0.060
Others	4/39	10.3	0	0	0.190
Humidity ($\leq 75\%$)	46	90.2	38	77.6	0.073
Temperature ($\leq 25^\circ\text{C}$)	21	41.2	35	71.4	0.002
Meals in the living room	38	74.5	43	81.1	0.280
Sleeping in the living room	30	58.8	27	50.9	0.270
Windows in the living room	43	84.3	53	100.0	<0.001
Rug in the living room	19	37.3	26	49.1	0.150
Synthetic/leather	5	26.3	18	69.2	<0.001
Wool/fiber/fabric	14	73.7	8	30.8	

Low-income: homes of socioeconomic level C, D, and E. High-income: homes of socioeconomic level A and B. The family was evaluated according to a questionnaire applied, using one standardized Brazilian criteria, which evaluates the socioeconomic level in Brazil (CDC 2008).

	Family	Species	Total N (%)	High-income N (%)	Low-income N (%)
House dust mites	Pyroglyphidae	<i>Dermatophagoides pteronyssinus</i>	286 (39.8)	123 (43.0)	163 (57.0)
		<i>Euroglyphus maynei</i>	128 (17.6)	59 (46.1)	69 (53.9)
	Acaridae	<i>Tyrophagus putrescentiae</i>	201 (28.0)	17 (8.5)	184 (91.5)
Storage mites	Glycyphagidae	<i>Blomia tropicalis</i>	27 (3.8)	19 (70.4)	8 (29.6)
		<i>Glycyphagus destructor</i>	11 (1.5)	0 (0.0)	11 (100.0)
		<i>Glycyphagus domesticus</i> (De Geer)	1 (0.1)	0 (0.0)	1 (100.0)
Others mites	Cheyletidae	<i>Cheyletus malaccensis</i>	51 (7.1)	16 (31.4)	35 (68.6)
		<i>Cheyletus eruditus</i> (Schränk)	3 (0.3)	3 (100.0)	0 (0.0)
		<i>Cheletomimus (Hemychyletia) gracilis</i> (Fain)	1 (0.1)	0 (0.0)	1 (100.0)
	Chortoglyphidae	<i>Chortoglyphus arcuatus</i>	9 (1.3)	7 (77.8)	2 (22.2)

Fig. 1. Taxonomic classification of mites identified in the houses include in the study. The analysis was divided into three groups of mites (house dust mites, storage mites and other mites), followed by the family and species, showing the total number of mites collected and identified, also according to the family incomes. Figure diagram modeled from [Portnoy et al. \(2013\)](#).

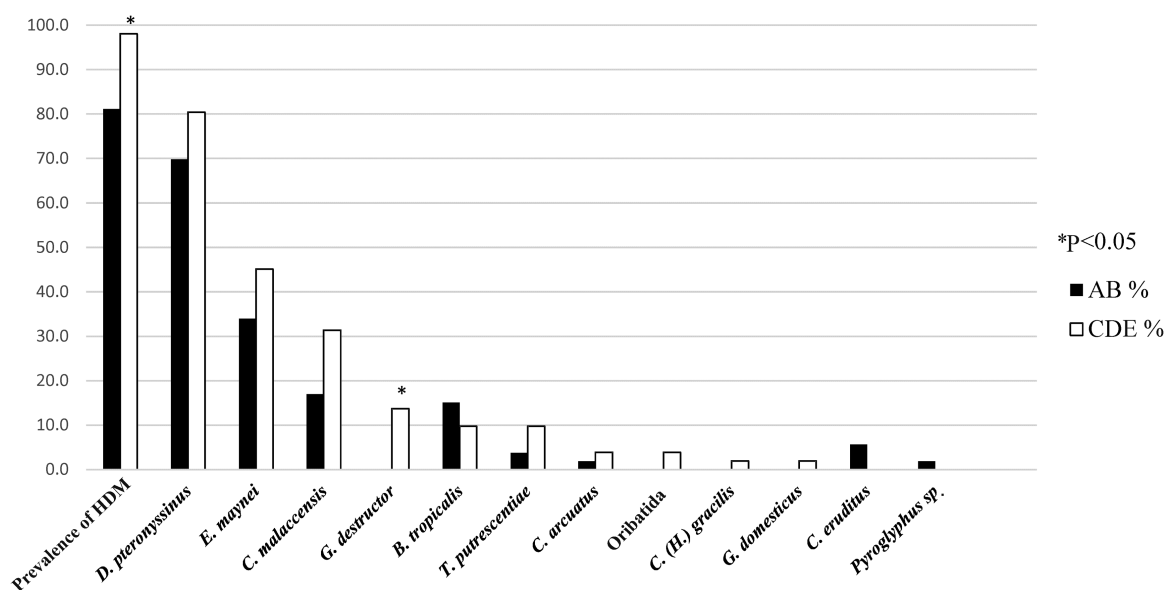


Fig. 2. Prevalence of mites in house dust identified between the groups studied. The black vertical bars represent the high-income groups (A and B) while the white vertical bars represent the low-income groups (C, D, and E).

Surprisingly, *D. farinae* was not collected in any of the houses included in our study. This is an interesting finding, considering that this species is a cosmopolitan mite, who occurs in humid regions and

it is the second most common species worldwide, including in Latin America ([Mumcuoglu et al. 1988](#), [Arlian et al. 2002](#)). A possible explanation for the high occurrence of *D. pteronyssinus* and absence

of *D. farinae* is the environment conditions related to both species. *D. pteronyssinus* thrives from around 16 to 35°C, with air humidity around 75% (Arlian et al. 1996). *D. farinae*, on the other hand, does not grow well in milder temperatures, such as 24°C (mean temperature found in our study) and requires a temperature close to the human body temperature in order to develop (Arlian et al. 1996). In the city of Salvador/Brazil, only 8% of the mites found were *D. farinae*, thus reinforcing the low frequency of this species in Brazil (Serravallo et al. 1998).

E. maynei was the second most prevalent species in the samples. This is an abundant and predominant species in milder temperature climates, as seen in southern Brazil (Morgan et al. 2015).

Regarding the Glycyphagidae family that contains many species of allergy-causing mites, a low number of *B. tropicalis* species was found. This is a widely reported species in tropical climates (Roncáda et al. 2016). Since Porto Alegre is a city located in the subtropical zone, with a mean temperature of 19.4°C (Käffer et al. 2010), there are not many favorable conditions for the mite to survive indoors. Epidemiological surveys in the South-American continent demonstrate that *D. pteronyssinus* and *B. tropicalis* species alternate their predominance according to environmental factors (Serravallo et al. 1998).

From the clinical point of view, allergen sensitization is a diagnostic tool for atopy in children and adults. We have previously demonstrated that children with asthma ($n = 127$) and healthy controls ($n = 124$) show that 80% of skin-prick tests for aeroallergens were positive for the most common HDM (*D. pteronyssinus* and *B. tropicalis*, including *D. farinae*) (Roncáda et al. 2016). One other study from southern Brazil reported the same results (Guilherme et al. 2011). Positive skin-prick tests for *D. farinae* in our patients with asthma are probably explained by antigenic cross-reaction with *D. pteronyssinus*. Other reports from other regions of Brazil with aeroallergen sensitization show the same pattern of HDM positivity, including *D. pteronyssinus*, *D. farinae*, *B. tropicalis*, and *C. malaccensis* (Guilherme et al. 2011).

Recognizing the mite fauna of a particular socioeconomic group is important for researchers and health professionals, enabling more specific understanding of the types of HDM that a certain group is possibly being exposed and sensitized to. In addition, these results also support the development of more specific skin-prick tests in patients with allergy, increased precision of allergen panels in different geographical regions, and finally a reduction in the cost of tests so as to become more available. We believe this is the first study analyzing the relationship between the different HDM fauna found in the house of allergic patients in Brazil, particularly when distinct socioeconomic backgrounds are considered. The interaction between different HDM in the same environment is a very complex scenario and further studies aiming to better understand the association of HDM flora detected and allergic sensitization in different regions of large countries such as Brazil are needed.

Our study has some limitations. Studies with larger samples of houses may generate more robust and sensible results in this area, but our sample size seems to present a broad panel of HDM fauna in the groups studied for a 1-yr period. We also did not perform skin-prick tests in the subjects studied. It is known that virtually all patients with allergic diseases from our city are sensitized to *D. pteronyssinus* (Roncáda et al. 2016). Although considered a safe procedure, there is a very small risk of allergic reactions to the test, which precluded from performing the tests in the households. Moreover, the analysis of the association between allergic sensitization to every mite detected in the house of allergic patients would be

an interesting study to better understand the complex relationship between HDM and expression of the disease.

In conclusion, our study showed that allergic patients with low-income level generally have higher quantity of mites in their houses yet some common HDM (*D. farinae*) that would be expected can be absent. While quantities may differ, no differences in the distribution of HDM species composition appeared to be associated with socioeconomic level.

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