

Dermatophagoides sp. and IgE anti-*D. pteronyssinus* and *D. farinae* detection in a Venezuelan community at more than 2000 m above the sea level

A. RANGEL, S. SALMEN, J. MUÑOZ, F. GARCÍA* and M. HERNÁNDEZ

Institute of Clinical Immunology, Faculty of Medicine, University of Los Andes and *Pueblo Llano Hospital, Mérida, Venezuela

Summary

Background It has been reported that the concentration of *Dermatophagoides* sp. population, the main trigger of asthma in sensitized atopic subjects, is inversely related with altitude and probably directly with humidity and that this population are scarcely found over 1750 m above sea level.

Objective We studied the presence of *Dermatophagoides* sp. in a Venezuelan community between 2040 and 2600 m above sea level, and also the IgE response to *D. pteronyssinus* and *D. farinae* in atopic subjects living on that region.

Methods The presence of *Dermatophagoides* sp. was determined by microscopic identification of mites in dust, obtained by brushing the mattresses surface in 93 randomly selected houses between 2040 and 2600 m above sea level. The indoor relative humidity was also measured. The specific IgE serum levels were studied in 65 subjects classified as asthmatics, allergic non-asthmatics and non-allergic.

Results A mean concentration of 188 mites/g of room dust was determined in 82.4% of houses with an indoor relative humidity ranging from 89% and 92% independently of altitude. The density of *Dermatophagoides* sp. was sufficiently high to sensitize the atopic subjects, IgE levels were 6.8 PRU mean value for asthmatic, against 0.38 PRU in non-atopic.

Conclusions We conclude that: (a) *Dermatophagoides* sp. can be found up to 2600 m above sea level in a Venezuelan neotropical region where a high indoor relative humidity is characteristic of most dwellings; (b) sensitization by *D. pteronyssinus* and *D. farinae* were demonstrated in atopic subjects resident at that region.

Keywords: asthma, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Dermatophagoides* and altitude, *Dermatophagoides* sensitization

Clinical and Experimental Allergy, Vol. 28, pp. 1100–1103. Submitted 4 June 1997; revised 6 September 1997; accepted 4 April 1998.

Introduction

The most frequent agents of allergic reactions are some moulds, some pollens, pet dander, cockroaches and Pyroglyphidae family mites [1] amongst others. Multisensitization appears to be the constant but probably, the persistence of symptoms depends mainly on *Dermatophagoides pteronyssinus* sensitization. Eighty per cent of allergic subjects

have circulating antibodies against *Dermatophagoides* antigens (Der p 1 and Der p 2) [2,3] and probably they are the main triggers of asthma attacks [4].

There is enough evidence to confirm the relationship between *Dermatophagoides* sensitization and asthma. Moreover both, room cleaning to decrease *Dermatophagoides* density [5], and seasonal variation of antigen concentration [6] modify symptoms of atopic asthma patients [3,4,7] and bronchial hyperreactivity. Its optimal habitat includes the mattresses and the room dust [8] and the

Correspondence: S. Salmen, Instituto de Inmunología Clínica, PO Box 566, Mérida, 5101, Venezuela, South America.

available in modern houses, foster mite proliferation because of stable temperature ranging between 17 and 25 °C [9] and the humidity higher than 50% [9–12].

Studies on the conditions favouring Pyroglyphidae proliferation, especially in European countries, claim that those mites are not found above 1500 m in Germany [13], 1600 m in France [3], 1756 M at Italian Alps [14] and that counts of mites decreases as the altitude above the sea level increases, due to lower environmental relative humidity. Nevertheless, in New Mexico at 2160 m [15] and in the Swiss Alps at 3250 m [16]. *Dermatophagoides* antigens were found at such altitudes, however, the antigen concentrations were not sufficient to induce the clinical sensitization of asthma patients as judged by the levels of specific IgE detected, in Bogota at 2600 m above sea level, with very high relative humidity, Mulla *et al.* reported high density of mite in mattresses [17].

Conditions for survival of *Dermatophagoides* at the highlands of tropical region are not well very known. Our work shows the presence of *Dermatophagoides* and IgE sensitization against *D. pteronyssinus* and *D. farinae* in atopic patients at high altitude above the sea level at a neotropical region, in a Venezuelan community settled between 2040 and 2600 m.

Materials and methods

Settling of the study and sample size calculation

Pueblo Llano the town selected town for the study, is settled at the Venezuelan Andes (8°50' NL and 70°35' WL) at 2040 m above sea level, surrounded by little thorps located between 2180 and 2600 m, identified as Zones B, C, D, and E in Table 1. Mean annual temperature is 18 °C. The last census in the region showed 4200 inhabitants, living in 695

homes. The sample size was calculated using Venezuelan asthma prevalence (12%) [13] and was assumed that it could be as low as 4%, to asses the hypothesis that asthma prevalence, at that altitude, could be influenced by a low *Dermatophagoides* density. It was assumed that, in order to reach a 99% of confidence interval, the sample should include 107 homes (EPI-INFO) [18]. Enumerating all houses in a chart performed random selection.

Features of houses and meteorology

Visits were made between March and May, during the transition between the rainy (April to July) and the dry season. Mean regional relative humidity and direct measuring inside and outside of each selected house verified temperature during the study. An environmental hygrometer (HYGRO-SYNTH) was used.

Houses are build in a that allow control of internal temperature. The mean altitude of room roofs is 2.53 m and are made of clay tiles. The mean relationship of ventilation of room/windows surface is 9.4% and windows are almost permanently closed.

Dermatophagoides sp. determination

To search for the presence of mites, dust was collected in 93 out of 107 selected houses by brushing 1.80 m² of mattress surface on each one of the selected rooms. Collected dust was passed through a steel sieve, placed in a sterile plastic Petri dish, and maintained at 4 °C until processed. Mites counts were performed by a flotation method as described [3]. Briefly, sample was adjusted to a concentration of 100 mg/mL in a saline saturated buffer, with 0.5 mL of 4% SDS, let settled by 5 min and after gentle shaking, observed under a stereoscopic magnifier (Wild Heerburg) mites counts

Table 1. Altitude, indoor relative humidity and mite room. Concentration/g of dust in a Venezuelan community

Zone	Altitude Mts.	Dwellings (n)	Mites in g of dust	Positive dwellings (%)	Relative humidity (%)
Main village	2040	47	200	93.6	86
Zone B	2.180	24	140	75	85
Zone C	2.210	11	150	72.7	85
Zone D	2.235	7	200	72.4	89
Zone E	2.600	4	250	100	92

* Correlation Coefficient between the number of *Dermatophagoides* g of dust and indoor relative humidity = 0.91.

** % of positive dwellings refers to the number of dwellings where mites were identified by microscopical examination.

were, expressed as number of mites by g of dust. Permission to gather dust was denied in the remaining 14 dwellings.

Specific anti-*D. pteronyssinus* and anti *D. farinae* IgE

Ninety-three subjects come for each participant household, older than 5 years were selected at random. Voluntaries were grouped, according to personal and family health history, in three categories: non-atopics and atopics, defined as the presence of specific serum IgE against both of the mites used and clinical family history of atopic disease, and without asthma and asthma patients, according to American Thoracic Society [19]. Serum IgE determination was performed in 65 subjects, by RAST (Phadebas-RAST, Pharmacia).

Results

A mean of 188 mites/g of dust were detected in 82.74% rooms of selected houses ranging from 140 to 250 mites/g of dust in 72.4–100% of houses, independently of the altitude over the sea level (Table 1). Outdoor environmental relative humidity fluctuated from 56 to 62%. Indoor relative environmental humidity fluctuated from 85 to 92%, this narrow variation of the indoor relative humidity had no important effect on mites count (Table 1). Nevertheless we found that mite densities were positively correlated (Correlation Coefficient = 0.91) with higher levels of indoor relative humidity.

Specific anti-*D. pteronyssinus* and anti-*D. farinae* IgE detection

Levels equal to or higher than 0.7 PRU/mL against *D. pteronyssinus* and *D. farinae* were taken as positive following manufacturer's instructions. Mean levels of specific IgE are depicted in Table 2. When positivity and negativity against *D. farinae* were correlated with atopic and non-

Table 2. Specific anti-*D. pteronyssinus* and anti-*D. farinae* IgE positive and negative subjects, classified as atopic and non-atopic categories

Categories	anti- <i>D. pteronyssinus</i> IgE n = 65		anti- <i>D. farinae</i> IgE n = 65	
	+	–	+	–
Non-atopics	4	37	3	38
Atopics without asthma	4	12	1	15
Asthma	5	3	6	2

Table 3. Specific serum IgE PRU values anti-*D. pteronyssinus* and anti-*D. farinae* in subjects classified as atopic and non-atopic categories

Categories	n	<i>D. pteronyssinus</i> PRU mean values	<i>D. farinae</i> PRU mean values
Non-atopic	42	0.385 (1.34)	0.173 (0.46)
Atopics without asthma	16	1.52 (3.27)	0.025 (0.08)
Asthma	8	6.8 (13.08)	6.370 (7.36)

atopic conditions, a X² of 4.00 was found, $P < 0.05$ and that of *D. pteronyssinus* was 0.01 (Fisher exact test, one tail). By comparing specific IgE levels for both antigens of non-asthmatic atopics and asthmatics a X² of 11.26 ($P = 0.007$) was found, suggesting a higher sensitization level against mites of individuals diagnosed with asthma (Table 3).

Discussion

This study shows the presence of *Dermatophagoides* sp. between 2040 and 2600 m above sea level, whose growing is probably helped, by the high indoor relative humidity (86%, SD 0.068), and the 24 h stable indoor temperature that showed fluctuations lower than 10%. Additional factors favouring mite growing are the low natural lighting and the scant ventilation of rooms.

As has been proposed, concentrations of 100 of mites/g of room dust are needed to sensitize an atopic patient [9]. In our study, we found a mean concentration of 188 mites/g of dust in 82.4% of houses. Which is enough to explain the specific IgE production in the atopic subjects studied. Five patients out of eight, classified as asthmatics, showed sensitization to *D. pteronyssinus* as did six out of eight against *D. farinae*. Besides, four out of 12 and one out of 15 of atopics, with allergic diseases other than asthma, showed to be sensitized against the same antigens. In contrast, only four and three out of 37 subjects classified as non-atopics, were sensitized against specific mite antigens. This explains the low IgE response of non-atopic subjects.

Taken together our results allows us to conclude that: (a) *Dermatophagoides* sp. can be found up to 2600 m above sea level at this Venezuelan community settled in the neotropical region. (b) Its presence is favoured by the high indoor relative humidity (mean value was 82.5%). (c) Altitude is not enough to restrict the *Dermatophagoides* sp. development. (d) The ecological conditions in the neotropical region for *Dermatophagoides* sp. growing could be different

from those existing at similar altitudes in the temperate zone, and (e) The sensitization with *Dermatophagoides* by atopic subjects living between 2040 and 2600 m above sea level in that Venezuelan region, is similar to that reported for atopics at lower altitude.

Acknowledgements

The authors wish to thank María de la Paz Rondón and Alí Calderón for helping during the fieldwork. We are especially grateful to Dr Pedro Durant for the ecological interpretations and to Dr Gabriel Virella for review of the manuscript and for helpful discussions. This work was supported by the CDCHT-ULA grant M-461-94-07-A.

References

- Solomon WR, Mathews KP. Aerobiology and Inhalant Allergens. in Allergy. Principles and Practice. Elliot Middleton Jr, Charles E. Reed, Elliot F. Ellis (Eds), pp. 1143, Toronto, 1983.
- Van der Zee JS, Van Swieten P, Jansen HM, Aalberse RC. Skin test and histamine release with P1-depleted *Dermatophagoides pteronyssinus* body extracts and purified P1. *J Allergy Clin Immunol* 1988; 81:884-95.
- Vervloet D, Penaud A, Razzouk H *et al.* Altitude and house dust mite. *J Allergy Clin Immunol* 1982; 69:290-6.
- Peat JK, Tovey E, Toelle BG *et al.* House dust mite allergens: A major risk factor for childhood asthma in Australia. *Am J Respir Crit Care Med* 1996; 153:141-6.
- Woodfolk JA, Hayden M, Miller JD *et al.* Chemical treatment of carpets to reduce allergen: A detailed study of the effects of tannic acid on indoor allergens. *J Allergy Clin Immunol* 1994; 94:19-26.
- Sicco van der Heide MS, Monchy de JGR, Vries de K, Bruggin KTM, Kauffman HF. Seasonal variation in airway hyperresponsiveness and natural exposure to house dust mite allergens in patients with asthma. *J Allergy Clin Immunol* 1994; 93:470-5.
- Murray AB, Fergusson AC. Dust-free bedrooms in the treatment of asthmatic children with house dust or house dust mite allergy: a controlled trial. *Pediatrics* 1983; 71:418-22.
- Tovey ER, Chapman MD, Wells CW, Platts-Mills TAE. The distribution of dust mite allergen in the house of patients with asthma. *Am Rev Resp Dis* 1981; 124:630-5.
- Platts-Mills TAE, Weck AL. Dust mite allergens and asthma-A worldwide problem. *J Allergy Clin Immunol* 1989; 83:416-27.
- de Andrade AD, Bartal M, Birnbaum J *et al.* House dust mite allergen content in two areas with large differences in relative humidity. *Ann Allergy Asthma Immunol* 1995; 74:314-6.
- Custovic A, Taggart SC, Kennaugh JH, Woodcock A. Portable dehumidifiers in the control of house dust mites and mite allergens. *Clin Exp Allergy* 1995; 25:312-6.
- Spieksma FT. The house dust mite *Dermatophagoides pteronyssinus*, producer of the house dust allergen. Ph. D. Thesis, University of Lieden, Netherlands, 1967.
- Guhning H. Diagnosis and hyposensitization treatment of patients with house dust mite allergies in high mountain areas. *Z-Hautkr* 1988; 63:58-9.
- Boner AL, Niero E, Antolini I, Valletta EA, Gaburro D. Pulmonary function and bronchial hyperreactivity in asthmatic children with house dust mite allergy during prolonged stay in the Italian Alps (Misurina, 1756 m). *Ann Allergy* 1985; 54:42-5.
- Sporik R, Ingram JM, Price W *et al.* Association of asthma with serum IgE and skin test reactivity to allergens among children living at high altitude. *Am J Respir Crit Care Med* 1995; 151:1388-92.
- Walliser M, Stadler B. House dust mite allergen import into a naturally mite-free environment. *J Allergy Clin Immunol* 1994; 94:1073-4.
- Mulla S, Sanchez-Medina M, Charlet L, Reyes M. Species composition and population trends of mites in various climatic zones of Colombia. In: Mulla S and Sanchez-Medina M eds *Acaros en Colombia*. Bogota. Asociación Colombiana de Diabetes, 1980: 159-86.
- Dean J, Dean A, Burton A, Dicker R. Epi Info Version 5.1990.
- American Thoracic Society. Definitions and classifications of chronic bronchitis, asthma and emphysema. *Am Rev Respir Dis* 1962; 85:762-8.