CLINICAL STUDIES

Identification of the Domestic Mite Fauna of Puerto Rico.

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ABSTRACT . This study was conducted to identify the domestic mite fauna of Puerto Rico. A total of 57 dust samples were collected from mattresses in homes of 11 cities on the Island. The analysis of the samples revealed that 73.70% of the mattress samples had at least one mite species. The identified species include: *Dermatophagoides pteronyssinus* (45.6%), *Blomia tropicalis* (31.6%), *Cheyletus* sp. (19.3%), *Dermatophagoides farinae* (17.5%), *Euroglyphus maynei* (5.3%), *Dermatophagoides sibonei* (1.8%), *Dermatophagoides* sp. (1.8%), *Suidasia melanensis* (1.8%) and mite species that were not identified (5.3%). Differences in the geographical distribution of mites showed that only *Blomia tropicalis* is more frequently in the northern (43%) than in the southern region (19%) of Puerto Rico (OR 3.36, p<0.046). This finding can be explained by the fact that in the northern region the relative humidity is significantly higher that in the southern region (p<0.001). No significant differences were observed for other species or in the total mite counts between the northern and southern regions. The small sample size of this study may explain the lack of significance for some of the differences found. Nevertheless, our results indicate that the domestic mite fauna is composed of several clinically important species, their numbers are high enough to be considered in the sensitizing levels, and the diversity of these species is comparable to other observations in the Caribbean areas, and in the southern states in the continental US. Based upon our results, we recommend that when performing the skin test in Puerto Rico, extracts from the identified local domestic mite species be included in the allergen panel. This may prove useful in the aid for the diagnosis and management of atopic conditions. *Keywords Domestic mites, Blomia tropicalis,Euroglyphus maynei, Dermatophagoides siboney, Puerto Rico.*

Domestic mites are one of the most important sources of indoor allergens and their role as a risk factor in atopic diseases has been well established. (1,2,3) The earliest suggestion of the domestic mite as a possible source of allergens was made by Dekker in 1928 who recorded large numbers of unidentified mites in house dust, mainly collected from mattresses. (4) Forty years later Voorhorst *et al* established the major role played in house dust allergy by the domestic mite *Dermatophagoides pteronyssinus*. (5) These researchers discovered that in Europe this mite was present in large numbers in the majority of the houses examined and, since extracts of this mite produced similar skin test reactions in atopic patients as does the house mite, they concluded that *D. pteronyssinus* was associated with their reactions. These findings were later confirmed in the United States by Bullock *et al* (6) and Kawai *et al*, (7) and in Japan by Miyamoto *et al.* (8)

During the last two decades numerous and important findings in the study of the domestic mites have been published. For example, it has been demonstrated that the indoor humidity level, which is dependent upon the geographical region and the altitude, determines the distribution of domestic mites; the highest number of mites is found in the more humid areas. (9,10) Another relevant observation related to domestic mites is the levels of domestic mite infestation in mattresses which are associated with allergen sensibilization and triggering of clinical symptoms. (11) These authors demonstrated that 100 or more mites per gram of dust is a risk factor for sensitization in susceptible individuals. Clearly, the geographical distribution of the domestic mite fauna and

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its degree of diversity as well as the infestation levels on a particular geographic area is determined by its temperature and humidity. To this effect, species of the Pyroglyphidae, Acaridae and Glycyphagidae are considered to have cosmopolitan distribution. (12) However, certain species may predominate in different countries and it is possible that species variation can be found within countries. For example, the Pyroglyphid mites such as *D. pteronyssinus*, predominates over the other species in most countries where it has been described, specially in the coastal areas. Similarly, *E. maynei* has preference for the coastal areas of Europe and in the tropical areas of the world this mite is rare. In the case of *D. farinae* it predominates in areas which are far from the coast. In the tropical areas of the Caribbean islands, the mite fauna mainly consists of *Dermatophagoides farinae* and *D. pteronyssinus*. (13,14,15,16) Although certain species are abundant in some locations, they are completely absent in other areas with similar climate. This is the case of the *Dermatophagoides siboney* which has been reported only in Cuba. (17) In the Glycyphagidae species such as *L. destructor, Aleuroglyphus ovatus, Chortoglyphus arcuatus, Glycyphagus spp., Suidasia spp.* and *Blomia* spp., they have been reported in numerous house dust surveys. (18,19,20)

In view of the importance of the domestic mites as a risk factor for atopic conditions, the objective of this study was to define their occurrence, distribution, and relative abundance in Puerto Rico.

Materials and Methods.

Dust sampling. Dust samples collected from 57 mattresses using a modified hand-held vacuum cleaner at a rate of 2 min/m^2. covering the entire surface of the mattress. The dust was stored at 4°C in sealed plastic bags until analyzed as previous described, (21) mite identification was conducted under the light microscope. Homes were selected on the basis of availability and were visited only once. Humidity and temperature readings were obtained by using a battery operated digital hygrometer Thermometer (Dew Point, Fisher Scientific, Pittsburgh, PA) in each sample site. The instrument was allowed to equilibrate according to the vendor's instructions and the temperature and relative humidity were recorded in each residence. In addition, at each home a small questionnaire was applied to obtain basic epidemiological data such as the presence of carpets in the bedroom and living rooms, age of the mattress from which the sample was taken, use of mattress encasings and knowledge about domestic mites. Collection of dust was conducted in August, 1994.

Data analysis. Data entry and analysis was carried out by using an electronic spreadsheet as a main platform. Statistical analysis were conducted using EPIINFO 6.0 (Pan American Health Organization). Frequency distributions were carried out for all variables. Arithmetic means were calculated for the temperature, humidity, age of the mattress, age of the house and persons living in the household. Student t test was used to assess the significance of the difference of means between total mite counts and regions of Puerto Rico, between temperature and humidity of the regions of Puerto Rico, Pearson's correlation coefficients, and their 95 percent confidence limits were used to assess the relationship between age of the mattress and total mite counts. Assessment of association between domestic mite species and geographical was carried out by using 2x2 tables, the odds ratio (OR) were used as a measure of association, Cornfield's 95 percent confidence intervals for the odds ratio and the Woolf test were used (22,23).

Results

Climatological data. Dust from 57 mattresses was collected in 11 cities of Puerto Rico. Table 1 lists the cities from which dust was collected, region in which it was categorized, and number of samples per site. Table 2 summarizes the number of samples collected and temperature and humidity conditions at the time of collection between the northern and southern regions of Puerto Rico. Significant differences in the relative humidity were observed between the northern and southern regions of Puerto Rico.

Table 1. Cities of Puerto Rico from with dust samples from mattresses were obtained

City	Region	# Samples	Percent
Arecibo	North	8	14.0
Canovanas	North	6	10.5
Guánica	South	4	7.0
Guayama	South	7	12.3
Hormigueros	South	5	8.8
Lajas	South	4	7.0
Lares	North	7	12.3
Loiza	North	2	3.5
Mayagüez	South	3	5.3
Ponce	South	4	7.0
San Juan	North	7	12.3
Totals 11		57	100

Table 2. Summary of number of samples obtained and climatological data in the Northern and Southern regions of Puerto Rico at collection sites

Regions	Samples	%	Mean temperature (C)	Mean relative humidity (%)
North	30	52.6	84.6±6.9†	63.7±6.5
Sorth	27	27.4	88.2±2.5	54.6±6.8
Totals	57	100		

† Significant at p> 0.001

Identification and quantitation of mite species. Seven different species of domestic mites and one predator species were identified under the light microscopy (Table 3).The most abundant species found was *Dermatophagoides pteronyssinus* followed by *Blomia tropicalis*, *D. farinae* and *Euroglyphus maynei.* Also it was observed that one or more species were found in 64.9% of the homes sampled (Table 4). The most frequent combination of mite species found in the dust samples analyzed was *D. pteronyssinus* and *B. tropicalis* followed by *D. pteronyssinus* and *D. farinae.*

Mite counts. Twenty six percent of the homes sampled had total mite counts less than 100 mites per gram of dust. This count included mites of clinical importance as well as predator and unidentified species. It was observed that total mite counts greater than 100 mites/gram of dust were detected in 33.3% of the homes (Table 5). Total counts greater than 100 mites per gram of dust of the domestic mite *D. pteronyssinus*, *B. tropicalis* and *D. farinae* were found in 26.3%, 14.0% and 10.5% of the samples.

Geographical distribution. The geographical distribution of the clinically important domestic mite species was found to be heterogeneous. Significant differences were observed in the mite distribution between the northern and southern regions of Puerto Rico. These differences were noticeable only for *B. tropicalis* and *Cheyletus* species. In the case of *B. tropicalis*, the northern region had 3.36 times more mites than the southern region (Table 6). No significant differences were obtained between the northern and southern regions in the mean mite counts (Table 7). However, when the distribution of the clinical important mite species was analyzed, we observed a wide variation among the 11 cities studied (Table 8). It was noticed that *B. tropicalis* was the dominant mite species in Arecibo. This city had also a high temperature with the highest relative humidity of the 11 cities sampled. In the case of *D. pteronyssinus,* it was found in higher frequency in samples collected in San Juan, Lajas, Lares and Loiza. In the latter, which showed the highest temperature with a relatively high humidity, *D. pteronyssinus* was found in 100% of the houses sampled. Furthermore, the city of Loiza had the highest Pyroglyphidae count of all of the cities with a mean of 640 mites per gram of dust. In the case of the Glyphagidae, Arecibo had the highest count with a mean of 200 mites per gram of dust. An even distribution of domestic mite species was observed in other cities Hormigueros, Guayama and Ponce. The altitude seemed not to affect the domestic mite geographical distribution (Table 9).

Household characteristics. Our data shows that 68.4% of the persons interviewed had a family member suffering from allergies, and that 43.9% had some knowledge about domestic mites and their biological importance (Table 10). However only 7% did use mattress or pillow encasings. The presence of household risk factors involved with the growth of domestic mites such as carpets in the living rooms and bedrooms were present in low frequencies. For the presence of carpets in the living rooms was 14.0%, and for carpets in the bedrooms was 15.8%.

Discussion

Our results show that the domestic mite fauna of Puerto Rico is diverse and several of the species found are important as sensitizing agents in susceptible patients. These include *Dermatophagoides pteronyssinus*, *D. farinae*, *D. siboney*, *Euroglyphus maynei* and *Blomia tropicalis*. The diversity and frequency of the mite fauna can be explained by the fact that Puerto Rico has a hot and humid climate which provides a perfect environment for the growth of a diverse domestic mite fauna. No particular influences by the altitude were observed in the distribution of mite species. The average total mite count of 189.9 mites per 100 mg of dust (1,628 mites per gram) found in our study appears to be on the mid ranges of the published ranges of 27 to 4,293 mites per gram of dust. (24) We observed that counts greater than 100 mites per gram of dust were found in 33.36% of the samples analyzed and at these levels, domestic mites are a risk factor for the appearance of symptoms in susceptible individuals. (1)

Members of the Pyroglyphidae (*D. pteronyssinus, D. farinae, D. siboney* and *E. maynei*) family are known to be important sources of sensitizing agents. (25) We have been able to demonstrate that the sensitization levels in Puerto Rican asthmatics and atopic dermatitis patients to some of these mite species including *D. pteronyssinus, D. farinae* and *E. maynei* are relatively high. (26,27) Results obtained in the present survey correlate with these observations. The mite *D. pteronyssinus* was the most abundant species of this family was found in 45.6% of the homes sampled. This finding is in agreement with

previous surveys in the area which describe this mite as the most abundant in the Caribbean region. (28) Another member of the Pyroglyphidae family, *D. farinae* was found in 17.5% of the samples. An unexpected finding was the identification of *Euroglyphus maynei* in Puerto Rico, and in numbers sufficiently high to cause sensitization (mean 106.67 per 100 gms of dust) in susceptible patients. This is mainly because geographically, this species is common in coastal areas of Europe. (29,30,31) In the Americas, *E. maynei* has been described in south America and in few studies in the United States. (32,33,34) Although this observation report variability in its abundance, Arlian *et al* found *E. maynei* in higher numbers in homes in Texas. In our study 5.3% of the households had *E. maynei* (Table 3). The percent of homes with this species may seem, but *E. maynei* may play an important role in sensitizing susceptible individuals. (35) One of the most important findings in the present survey is that we confirm our previous report on the presence *D. siboney*, outside Cuba.(36) Not much is known about this species however, it may contribute to the total mite allergen counts since its clinical importance has been clearly demonstrated by Ferrándiz *et al.* (37) Our data clear demonstrates that the Pyroglyphid mites are dominant family in the mite fauna in Puerto Rico since they contributed to 72% of the total mite counts which is well the reported limits. (38)

The Glycyphagidae (*B. tropicalis*) species also had an important contribution to the total mite count in Puerto Rico. Analysis of the data showed that the second most abundant domestic mite species found in dust was *B. tropicalis*, and was the most abundant species found in the northern region of Puerto Rico, specially in the city of Arecibo. This domestic mite was identified in 31.6% of the samples analyzed (Table 3), and the mite counts had a range between 40 to 1200 mites per gram. The presence of *B. tropicalis* in dust from houses in tropical and subtropical regions of the world has been described since 1973. (39,40) Since then, this species has been increasingly identified in dust samples throughout the world. In the United Sates, *B. tropicalis* has been described in the south coastal regions of the United States, as a codominant species with *D. pteronyssinus*. (41,42) More recently, in a multicenter study, *B. tropicalis* has been described in Louisiana, Tennessee, Texas, Florida and California. (43) In Central and South America, *B. tropicalis* has been described in surveys conducted in Guatemala, (44) Costa Rica, (45) Colombia, (46) Venezuela, (47) and Brasil. (48) In the Caribbean, *B. tropicalis* has been reported only in Barbados and Cuba. (49,50) In addition, this mite has been identified also Taiwan and Hong Kong. (51,20). Evidence supporting the clinical importance of *B. tropicalis* in allergic disease has been provided by several authors. For example, Arruda *et al* demonstrated the presence of *B. tropicalis* specific IgE antibodies in asthmatic children and the RAST activity in this population was moderate to high indicating sensitization to this mite. (52) In other studies similar results have been presented by Fernández-Caldas *et al*, (1988, 1990) and Gabriel *et al* (1982). (53)

Of the species identified *B. tropicalis* showed a

Table 3. Taxa and number collected of domestic mites in 57 homes throughout Puerto Rico

Taxa	Mean (range) of mites per gram of dust	Frequency (n) of mite species found in dust	% Houses with mites
Astigmata			
Pyroglyphidae			
Dermatophagoides pteronyssinus	238.5 (440-1200)	26	45.6
D. farinae	252.0 (40-560)	10	17.5
D.siboney	200.0 (na)	1	1.8
Euroglyphus maynei	106.7 (40-160)	3	5.3
Dermatophagoides sp.	40 (na)	1	1.8
Glycyphagidae			
Blomia tropicalis	157.8 (40-1200)	18	31.6
Acaridae			
Suidasia sp.	40	1	1.8
Unidentified	40	3	5.3
Prostigmata			
Cheyletidae			
Cheyletus melacensis	50.9 (40-120)	11	19.3

Table 4. Frequency of number of mitespecies found in mattresses throughout Puerto Rico

Number of mite species	Frequency (n)	Percent	Cumulative
0	15	26.3	26.3
1	22	38.6	64.9
2	12	21.1	86.0
3	5	8.8	94.7
4	2	3.5	98.2
5	1	1.8	100
Total	57	100	

Table 5. Quantification of household total mite count and mite species

	Mite species				
Mites per gram of dust	*D. pteronyssinus*	*D. farinae*	*B. tropicalis*	*E. maynei*	Total mite count
0	19.3†	82.5	68.4	94.7	40.4
1-100	19.3	7.0	17.5	1.8	26.3
>100	26.3	10.5	14.0	3.5	33.3

†Expressed in percent of homes

Table 6. Odds ratio for the presence of domestic mite each species for the Northern and Southern regions of Puerto Rico

Mite species	Odds ratio	CI 95%	P
D. pteronyssinus			
D. farinae	0.32	0.06-1.64	0.1
B. tropicalis	3.36	0.87-13.71	0.04†
E.maynei	-	0.00-2.03	0.1
D. siboney	-	0.00-16.29	0.038
Cheyletus sp.	5.36	0.90-41.19	0.030†

†Significant at p>0.05%

significant variation with respect to its distribution between the northern and southern regions of Puerto Rico (Table 6). Furthermore, this species was the dominant mite in the northern city of Arecibo (Tables 8 and 9). In part this finding could be explained by the fact that the mean temperature was significantly higher in the northern cities than in those in the southern region (Table 2). In the case of *D. pteronyssinus*, this mite species was the predominant in the city of Loiza where 100% of the samples had representatives of this species. Similar findings were observed in Lares. Interestingly, these latter two cities are quite distinct with respect to altitude and coastal location. Our results indicate also that there was absence of particular trend in the mite fauna geographical distribution in coastal and mountainous cities. In addition, analysis of the data strongly suggests that the abundance of *Blomia tropicalis* in northern areas is greater than in the southern regions of Puerto Rico (OR 3.36). Similar finding was observed for the predator mite *Cheyletus* species (OR 5.36). The absence of domestic mites in 23.6% of the homes surveyed is not an unexpected finding

Table 7. Comparison of the mean mite count between nothern and southern regions of Puerto Rico

	Mean ± mites gram/dust		
Mite species	North (n=30)	South (n=27)	P
Mean mite counts	189.33+323.76	133.33+211.95	0.63
Dermatophagoides pteronyssinus	166.66+298.24	44.44+81.01	0.11
D. farinae	16.0+66.93	75.5+169.46	0.09
Blomia tropicalis	77.3+220.07	19.25+44.8	0.06
Cheyletus malacensis	16.0+28.95	80.00+10.67	0.02
Euroglyphus maynei	0	11.82+38.13	0.6
Suidasia sp.	40.0+7.30	0	0.34

Table 8. Relative frequency of domestic mites in 11 cities of Puerto Rico

	Mite Species				
City	*D. pteronyssinus*	*D. farinae*	*E. maynei*	*D. siboney*	*B. tropicalis*
Arecibo	37.0†	-	-	-	62.5
Canovanas	33.0	-	-	-	33.3
Guanica	25.0	50.0	-	-	-
Guayama	43.0	-	29.0	14.3	43.3
Hormigueros	40.0	-	20.0	-	20.0
Lajas	50.0	-	-	-	-
Lares	71.4	25.0	-	-	43.9
Loiza	100.0	50.0	-	-	50.0
Mayagüez	67.0	67.0	-	-	33.3
Ponce	36.8	50.0	5.2	2.1	26.3
San Juan	57.0	14.2	-	-	29.0

†Percent of homes.

since is commonly reported in previous surveys by Yoshwkawa (1979) and others. (54,55) Most homes (38.6%) were inhabited by a single mite species and few homes were co-inhabited by several species (data not shown). The most frequent combination of species found were *D. pteronyssinus* and *B. tropicalis.*

Although 43.9% of the persons interviewed indicated some knowledge on domestic mites, our data suggests that an active educational program should be aimed towards the use of mattress and pillow encasings to prevent sensitization and appearance of allergic symptoms in susceptible individuals. No correlationships were observed between total mite counts and age of the mattresses, number of persons living in the household and age of the house.

This study had a small sample size, however the results strongly indicate that the domestic mite fauna of Puerto Rico is diverse and is similar to that previously described for the subtropical and tropical regions of the world including the southern coastal regions of the United States (Florida and Louisiana). Because of this mite species diversity and the total mite counts in the households are high enough to cause sensitization, susceptible allergic individuals may be at high risk for exacerbations of their conditions. Based on the characteristics of the domestic mite fauna in Puerto Rico, we suggest the inclusion of extracts from *Dermatophagoides pteronyssinus, D. farinae, Euroglyphus maynei* and *Blomia tropicalis,* in the allergen panel in the routine skin prick test for allergies. Further studies should be conducted in areas such as Cataño and other ports of entry of imported grains. It is possible that other domestic mite species such as *Lepidoglyphus destructor, Auleroglyphus ovatus* and *Chortoglyphus arcuatos* may be found. In addition, studies analyzing the seasonal variation of the most important species of domestic mites should be conducted.

Table 9. Altitude, temparature, humidity and populational densities of clinically important domestic mites species in eleven cities of Puerto Rico

	Ecological Conditions			Pyroglyphidae†		Glyciphagidae‡		Total Mite Counts
City	Altitude mts. above sea level	Temp. mean ± SD (C°)	Relative humidity (%)	Mean ± SD gram of dust	Range	Mean ± SD gram of dust	Range	Mean ± SD gram of dust
Arecibo	270	83.2±1.5	69.6±2.0	45.0±84	0-240	200±411.8	0-1440	245±491.0
Canovanas	100	87.9±4.7	65.7±7.4	26.7±48.4	0-120	40±62.0	0-120	66.6±60.2
Guanica	178	86.8±1.6	56.5±6.2	80±108.3	0-240	NF	0-240	80.0±108.3
Guayama	360	87.3±0.3	60.6±2.7	108±107.6	0-280	51.4±68.1	0-360	160.0±138.6
Hormigueros	100	87.3±1.17	50.2±7.1	184±368.3	0-840	8.0±17.9	0-880	192.0±386.2
Lajas	162	92.7±1.9	48.8±3.4	110±170.8	0-360	NF±	0-360	110.0±170.9
Lares	700	78.5±10.0	60.2±4.3	326±400.95	0-1080	40.0±61.1	0-1080	365.7±372.9
Loiza	100	94.3±5.6	62.2±8.0	640±848.5	40-1240	40.0±56.6	120-1240	680.0±791.9
Mayagüez	397	89.2±1.6	53.2±5.3	226±241.1	0-480	40.0±69.3	120-480	266.7±189.0
Ponce	75	86.7±2.8	54.11±9.1	160±269.3	0-560	46.0±76.3	0-560	160.0±269.3
San Juan	180	86.7±2.4	64.6±3.7	200±284.7	0-760	17.14±31.4	0-840	217.1±307.1

†Including *Dermatophagoides pteronyssinus, D. farinae D. siboney and Euroglyphus maynei*
‡Including *B. tropicalis.*
NF=Not found

Resumen

Este estudio se realizó con el objetivo de identificar la fauna de ácaros domésticos en Puerto Rico. Un total de 57 muestras de polvo de colchón fueron tomadas en 11 ciudades de la Isla. El análisis de las muestras demuestran que el 73.70% de estas tenían por lo menos una especie de ácaros domésticos. Las especies identificadas incluyen: *Dermatophagoides pteronyssinus* (45.6%), *Blomia tropicalis* (31.6%), *Cheyletus* sp. (19.3%), *Dermatophagoides farinae* (17.5%), *Euroglyphus maynei* (5.3%), *Dermatophagoides sibonei* (1.8%), *Dermatophagoides* sp. (1.8%), *Suidasia melanensis* (1.8%) y otras no identificadas (5.3%). Se notó que en la distribución geográfica de las especies identificadas, solamente *Blomia tropicalis* fué el ácaro doméstico mas frecuente en muestras de polvo de la región norte (43%) que de la región sur (19%) de Puerto Rico (OR 3.36, p<0.046). Esta observación se puede explicar por el hecho que én la región norte, la humedad relativa es mas alta que en la región sur (p<0.001). Nuestros resultados indican que

la fauna de ácaros domésticos de Puerto Rico está compuesta de varias especies las cuales son de importancia clínica y sus números son lo suficientemente altos para que se consideren como niveles sensibilizantes, y que la diversidad de especies es comparable a otras observaciones realizadas en el Caribe y en el sur de los Estados Unidos. En base a nuestros resultados, recomendamos que cuando se realizen las pruebas cutáneas para las alérgias en Puerto Rico, extractos de las especies locales sean incluidas en el panel utilizado. Esto podrá ser útil para el diagóstico y manejo de condiciones atópicas.

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