Comparison of house dust mites found on different mattress surfaces

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Background: House dust mites have been considered the most important source of allergens for humans. These allergens have been encountered at different indoor sites, mainly on mattresses and pillows.

Objective: To evaluate the number and different specimens of mites on Brazilian bunk-bed mattresses.

Methods: Dust samples were collected once using a standardized method on the upper mattress surface (US) and lower mattress surface (LS) (bed frame also included in the latter) of 58 mattresses.

Results: The total number of mite bodies on the LS was 3.5-fold higher than on the US, with a mean concentration of 932 mites per gram of fine dust (mites/g) on the US (range, 0–3,375 mites/g) and 3,254 mites/g on the LS (range, 125–14,500 mites/g) ($P < .001$). Additionally, the number of house dust mite bodies on the LS was 2.4 higher than on the US ($P < .001$); the mean concentration was 750 mites/g on the US (range, 0–2,875 mites/g) and 1,816 mites/g on the LS (range, 0–10,875 mites/g). Approximately 91% (n = 52) of the US and all LS dust samples had more than the limit of 100 mites/g. The most frequent family was Pyroglyphidae in both mattress surfaces, with *Dermatophagoides pteronyssinus* the most important species found. Storage mites, including Glycyphagidae ($P < .001$), Acaridae ($P < .001$), and other families ($P < .001$), also showed significant differences in the number of mites between both sample counts.

Conclusions: This study shows a significant difference in US and LS mite counts, with higher counts on the LS. Mite allergen avoidance should include the LS and bed frame as potential targets.

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INTRODUCTION

The mattress has been considered the most important source of house dust mite (HDM) allergens for humans, particularly in Brazil.[1–3] A previous study has shown a significant increase of 3 times in HDM allergen content on the lower mattress surface (LS) when compared with the upper mattress surface (US).[4] Therefore, we studied the number and different species of mites on the US and LS of mattresses in dwellings in a tropical city (Campinas, São Paulo, Brazil).

MATERIAL AND METHODS

Samples were collected once from each US and LS (in the LS, bed frame dust samples were also included) from a total of 58 dwellings in the southern Brazilian city of Campinas (47°04′40″W, 22°53′20″S; 680 m above sea level). Samples were collected between February 1996 and June 1997. Each mattress surface was vacuumed for 2 minutes (covering approximately 2 m^2) with a 1,000-W vacuum cleaner (Electrolux, Guarulhos, Brazil). A piece of fine linen cambric (10 × 10 cm), placed over the distal opening of the suction hose with the cleaning nozzle, trapped the aspirated dust. When a mattress cover was present, the cover sheet was removed before LS sampling. The larger particles in each dust sample were removed by sieving through a fine-mesh (500-μm) sieve. The fine dust passed through the sieve was weighed, cleared, and mounted in Hoyer medium before identification of the larvae, nymphs, and adults (body count) under a light microscope. The number of mites per slide was then extrapolated to a gram of dust using a previously performed correlation factor (data not shown).

Statistical analysis was performed using the Wilcoxon, Kruskal-Wallis, and χ^2 tests. The significance level was .05.

RESULTS

One sample showed a total mite number of 40,500 mites per gram of fine dust (mites/g), mainly of Glycyphagidae and Tarsonemidae mites. We could not explain this discrepancy, but the mattress was laid on newspaper and cardboard leaves directly on the wood floor. This sample was excluded from statistical analysis, which left 57 mattresses (total of 114 samples). The total number of mites counted on the LS (1,484 mites) was 3.5-fold higher than on the US (425 mites), with a mean concentration of mite bodies of 3,254 mites/g on the LS (range, 125–14,500 mites/g) and 932 mites/g on the US (range, 0–3,375 mites/g; $P < .001$; Fig 1). Additionally, the number of HDMs on the LS (828 mites) was 2.4 higher than on the US (342 mites; $P < .001$; Table 1). The mean HDM concentration was 750 mites/g on the US and 1,816 mites/g

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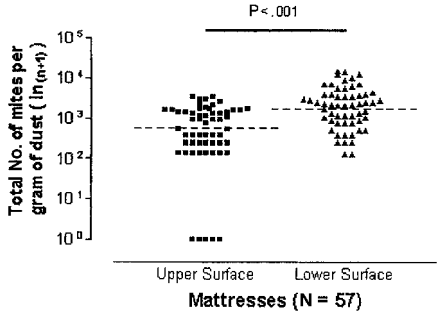

Figure 1. Total number of mites per gram of fine dust on mattress surfaces. Log scale of total mite bodies per gram of fine dust (n + 1) observed in a total of 114 Brazilian bunk-bed mattress dust samples (57 of each upper and lower surface). Dust from the bed frame was also included on the lower surface sample. Traced lines represent mean values.

on the LS. The observed range was 0 to 2,875 mites/g on the US and 0 to 10,875 mites/g on the LS. Approximately 91% (n = 52) of the US and all LS dust samples had more than 100 mites/g.

Frequently, HDMs (Pyroglyphidae family) were found on both mattress surfaces (80.5% on the US and 55.8% on the LS), with *Dermatophagoides pteronyssinus* the most important species counted (86.0% and 88.3%, respectively, of Pyroglyphidae adult mites; Table 1).

There was a significant difference in the number of *D pteronyssinus* ($P = .03$) and also a significant difference in the number of *Dermatophagoides* spp nymphs on both mattress surfaces ($P < .008$). Because of the low count of *D farinae* bodies, statistical analysis was not performed. There was also a low count of *Euroglyphus maynei* bodies on samples (12.7% of adult Pyroglyphidae mites on the LS and 13.1% on the US samples).

Besides HDMs, storage and other mite counts on dust samples slides were 7.9 times higher on the LS (656 mites) than on the US (83 mites; $P < .001$). All other families showed differences in mite counts, which were highly significant on the LS. The significance between mattress surfaces was $P < .001$ for Glycyphagidae, Acaridae, and other families, including Cheyletidae, Tarsonemidae, Pyemotidae, Eriophyidae, Demodicidae, Heterocheylidae, and the suborders Oribatida and Gamasida (families unidentified). Statistical analysis was not performed on all genera except *Dermatophagoides*, including all families of the other family groups listed above, because of the relatively low number of mite bodies observed on samples.

Furthermore, the families Glycyphagidae and Cheyletidae represented 3.1% and 19.9% and 2.6% and 9.6% of the US and LS total mites, respectively. Acaridae represented 2.8% and 5.1%, whereas Tarsonemidae represented 6.3% and 4.4% of the US and LS total mites, respectively. Finally, Pyemotidae represented 0.5% and 4.0% on the US and LS, respectively (Table 1). These data showed that Tarsonemidae was the second most prevalent family on the US. Mites and eggs were present on both surfaces and were significantly higher on the LS ($P < .001$).

Blomia tropicalis (Glycyphagidae) and *Tyrophagus putrescentiae* (Acaridae) were the most frequent storage mites found in dust samples, representing 8.4% (161 mites) and 2.7% (52 mites) of the total mite count on both surfaces, respectively (Table 1). In addition, *B tropicalis* represented 1.2% and 10.5% of all US and LS total mites, respectively, whereas *T putrescentiae* represented 1.2% and 3.2%, respectively.

Evaluation of mattress types showed that foam mattress was the most common mattress (n = 50; 86.2%) found. Coil mattress (n = 7; 12.0%) and one cotton-made mattress (1.7%) were also observed. Only 6 mattresses (10.3%) were covered by a fitted sheet, made mainly of cotton. None was zippered or had an internal plastic layer. Furthermore, bunk-beds were made mainly of wood (n = 44; 75.9%) and metal (n = 9; 15.5%). Four mattresses were directly placed on the floor (6.9%). Only one was a box spring bed (1.7%).

No statistical differences were observed between mattresses or bed types. Furthermore, no difference was observed in mite count when a mattress cover, carpet, rug, curtain, or animals were present in the bedroom. There was, however, a significant increase in Glycyphagidae mite count on the US samples collected between July and December (a shorter period showed no statistical difference) ($P = .02$). Also, a significantly higher count of Glycyphagidae and Pyemotidae mites on samples collected from houses was observed (higher on the LS; $P < .001$). Finally, mites from other families were also significantly higher in US samples from houses ($P = .02$).

DISCUSSION

Data show that the LS and bed frame are important indoor sources of mites and must be more carefully studied. As far as we know, one article has shown a 3 times higher mite allergen concentration on the LS when compared with the US.[4] The authors describe a significant increase in the Der p 1 and Der f 1 allergen levels on bed basement ($P < .001$), with an average of 48.3 μg/g (or approximately 2,415 mites/g). Similarly, we herein observed a 2.4 times higher HDM count on the LS (plus bed frame) when compared with the US. However, herein we analyze the different mite families and observe that not only HDM number is increased on the LS but also the number of other mite families, such as Glycyphagidae, Acaridae, and others.

Storage mites are frequently found in tropical house dust samples, particularly in Brazil.[3–6] Despite the fact that Campinas shows a high air humidity (40%–90%) and temperature (average, 25°C), annual rates that benefit HDM reproduction,[5] storage mites herein represented only 5.9% of the US total mite number compared with 25.0% on the LS. Another point is that Glycyphagidae mites were statistically more present on samples collected from July to December, which in Brazil is mainly the springtime.

We cannot completely explain the observed discrepancy between the US and LS. However, the large number of mites

Table 1. Mite Body Counts on Mattress Surfaces from Dwellings in Campinas, São Paulo, Brazil

Family	No. (%) of mites			*P* value
	Upper surface	Lower surface	Total	
Suborder Acaridida	367 (86.3)	1,199 (80.8)	1,566 (82.0)	<.001
Family Pyroglyphidae	342 (80.5)	828 (55.8)	1,170 (61.3)	<.001
Larvae	103 (24.2)	240 (16.2)	343 (18.0)	.06
Dermatophagoides spp-nymphs	132 (31.1)	266 (17.9)	398 (20.8)	.008
Dermatophagoides pteronyssinus	92 (21.6)	256 (17.2)	348 (18.2)	.03
Euroglyphus maynei	14 (3.3)	37 (2.5)	51 (2.7)	.17
Dermatophagoides farinae	1 (0.2)	27 (1.8)	28 (1.5)	. . .
Sturnophagoides brasiliensis	. . .	2 (0.1)	2 (0.1)	. . .
Family Glycyphagidae	13 (3.1)	295 (19.9)	308 (16.1)	<.001
Larvae	8 (1.9)	127 (8.6)	135 (7.1)	. . .
Blomia tropicalis	5 (1.2)	156 (10.5)	161 (8.4)	. . .
Gohieria fusca	. . .	12 (0.8)	12 (0.6)	. . .
Family Acaridae	12 (2.8)	76 (5.1)	88 (4.6)	.003
Larvae	2 (0.5)	13 (0.9)	15 (0.8)	. . .
Tyrophagus putrescentiae	5 (1.2)	47 (3.2)	52 (2.7)	. . .
Suidasia pontifica	5 (1.2)	16 (1.1)	21 (1.1)	. . .
Suborder Actinedida	56 (13.2)	273 (18.4)	329 (17.2)	<.001
Family Tarsonemidae	27 (6.3)	65 (4.4)	92 (4.8)	.28
Family Cheyletidae	11 (2.6)	142 (9.6)	153 (8.0)	<.001
Family Demodicidae	10 (2.3)	2 (0.1)	12 (0.6)	. . .
Family Eriophyidae	6 (1.4)	4 (0.3)	10 (0.5)	. . .
Family Pyemotidae	2 (0.5)	59 (4.0)	61 (3.2)	. . .
Family Heterocheyletidae	. . .	1 (0.1)	1 (0.0)	. . .
Suborder Oribatida	2 (0.5)	11 (0.7)	13 (0.7)	. . .
Suborder Gamasida	. . .	1 (0.1)	1 (0.0)	. . .
Total egg count	223 (38.0)	364 (62.0)	587 (100.0)	<.001
Total mite body count	425 (100.0)	1,484 (100.0)	1,909 (100.0)	<.001

found on the LS can be partly explained by the darkness and "security" at this microhabitat and the fact that this surface was only sporadically cleaned. However, these factors were not analyzed.

Fungi and human dander are frequently observed on mattress dust samples through the optic microscope.[7] As far as we know, there is no study that shows differences of biological material from the US and LS. However, theoretically, human dander should be more frequently found on the US. This could partly explain why HDMs (mainly *Dermatophagoides*), which are known as dander-feeding mites, were more prevalent on the US than on the LS.

Despite the fact that HDMs were the most frequent mites observed on the LS, storage mites and others, such as Cheyletidae and Pyemotidae, were also more prevalent on the LS than the US. This might indicate that the in locus microhabitat should be partly different on both mattress surfaces. Furthermore, an analysis of most infested dust samples (more than 4,000 mites/g) on the LSs showed no noticeable or significant difference among them or among other, less infested LS samples.

Both HDMs and storage mites have been associated with human sensitization.[8–10] There are many different indoor sources of mite allergens, usually mattresses, pillows, sofas, and rugs.[2,3,5] Despite these different sources, data herein confirm that the LS should also be considered as a potential source of mite allergens.[2]

Unfortunately, frequency of US and LS cleaning and mattress or mattress cover ages were not evaluated. However, a study performed in the same city showed that the analyzed mattresses had an average of 3.9 years of use.[11] Data herein strongly suggest that the use of fully encased, zippered mattress covers with internal plastic layers should be encouraged.

Finally, because Glycyphagidae mites, mainly *B tropicalis*, have been widely found on dust samples in tropical areas, we believe that this family should also be considered as HDMs in tropical countries.[3,6,7]

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