

# Variability in Population Density of House Dust Mites of Bitlis and Muş, Turkey

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Received 19 October 2015; Accepted 3 February 2016

## Abstract

This study was conducted to investigate the relationship between the number of house dust mites/g dust and different physical and environmental variables. A total of 1,040 house dust samples were collected from houses in Bitlis and Muş Provinces, Turkey, between May 2010 and February 2012. Overall, 751 (72.2%) of dust samples were mite positive. The number of mites/g dust varied between 20 and 1,840 in mite-positive houses. A significant correlation was detected between mean number of mites and altitude of houses, frequency of monthly vacuum cleaning, number of individuals in the household, and relative humidity. No association was found between the number of mites and temperature, type of heating, existence of allergic diseases, age and structure of houses. A maximum number of mites were detected in summer and a minimum number was detected in autumn.

**Key words:** acarology, population dynamics, population ecology

House dust mites are the most significant sources of house dust allergens. Mites that cause allergies inside houses belong to Astigmata, now considered as a part of the Oribatida (Krantz and Walter 2009, Zhang 2011). The term “house dust mite” refers to mites in the family Pyroglyphidae whose biotope is house dust (Colloff 2009). The most frequently encountered mites in dust are *Dermatophagoides pteronyssinus*, *D. farinae*, and *Euroglyphus maynei* (Evans et al. 1961, Colloff 2009).

Temperate and humid environments (75–80% relative humidity [RH] and 25–30°C) are optimum conditions for house dust mites. House dust mites can be found in almost every indoor habitat and live in dust that accumulates in carpets, bedding, fabrics, quilts, blankets, and furniture. Due to their small size (100–350 µm), it is difficult to detect house dust mites with the naked eye (Mumcuoglu et al. 1999, Colloff 2009, Solarz 2009).

Skin scales of humans and animals, as well as yeasts, bacteria, grains and bread, are the basic food sources of house dust mites (Mumcuoglu et al. 1999, Gerson et al. 2003, Colloff 2009, Solarz 2009). The feces of house dust mites contain the allergens that cause allergic reactions, such as asthma and allergic rhinitis, but also atopic dermatitis and conjunctivitis (Colloff 2009). House dust mites are the most important factor affecting asthma in children (Oshima 1964, Voorhorst et al. 1964, Milhim et al. 1972, Solarz 1998, Colloff 2009).

After studies indicated that house dust mites cause allergic diseases such as asthma and allergies (Oshima 1964, Voorhorst et al.

1964, Milhim et al. 1972), researches focused on this point. Up to now numerous studies have been conducted on house dust mites in abroad (Mumcuoglu 1976, Vervloet et al. 1982, Colloff 1987, Arlian 1992, Bigliocchi and Maroli 1995, Franz et al. 1997, Hallas and Korsgaard 1997, Agratorres et al. 1999, Konishi and Uehara 1999, Mumcuoglu et al. 1999, Sanchez-Covisa et al. 1999, Modak and Saha 2002, Boquete et al. 2006, Zock et al. 2006, Solarz 2009, Henszel et al. 2010, Soltani et al. 2011) and in Turkey. The results obtained from studies conducted in Turkey are as follows: 67 of 290 (23.1%) houses in five provinces (Afyon, Uşak, Kütahya, Denizli, and Isparta) of western Anatolia (Çiftçi et al. 2006); 124 of 200 (62%) houses in Ankara Province (Sarica and Aktaş 1997); 22 of 64 (34%) houses in Bursa Province (Güleğen et al. 2005); 13 of 72 (18.05%) dust samples collected from houses in Kütahya Province (Akdemir and Gürdal 2005); 9 of 50 (18%) dust samples collected from carpet weaving workshop in Sivas Province (Aygan and Özçelik 2002); 173 of 300 (57.66%) dust samples collected from houses in Konya Province (Aldemir and Baykan 2004); and 79 of 176 dust samples (44.88%) that were collected from houses, hotels, and student dormitories in Diyarbakır province (Aykut et al. 2013) were reported positive with house dust mites.

Also all of the dust samples (*n*: 117) from Samsun Province (Çelik and Sullivan 2009) and 57 dust samples out of 233 (24.46%) in Malatya Province (Atambay et al. 2006) collected from houses of individuals with allergic diseases were reported positive with house dust mites.

To the best of our knowledge, this is the first study that covers the investigation of the relationship between house dust mites and so many variables conducted in Turkey and neighbours with similar climate.

The aim of this study was to investigate the relationship between the number of house dust mites per gram dust and variables such as humidity, number of individuals in the household, altitude of the house, frequency of monthly vacuum cleaning, type of heating, existence of allergic diseases in the family, type of settlement, seasonality, temperature, as well as the structure and the age of house.

## Materials and Methods

This study was conducted in Bitlis (1,530 m altitude) and Muş (1,400 m altitude) Provinces in the Eastern Anatolian region of Turkey. A total of 130 houses (10 houses from each city center, five houses from each district in Bitlis and Muş Provinces, and five houses from each village in each district) were selected randomly (Fig. 1). Overall, 1,040 dust samples were collected in May, August, and October 2010, February, May, August, and October 2011, and February 2012. RH, the number of people in the household, altitude, frequency of monthly vacuum cleaning, type of heating, existence of allergic diseases in the family, type of settlement, season, temperature, and house structure and age were recorded.

A vacuum cleaner (Arçelik S 6355 1800 W, Turkey) was used to collect dust samples from carpets, fabrics, quilts, blankets, and furniture. A 1-m<sup>2</sup> surface area of each object was vacuumed for 2 min, and 1- and 0.5-mm mesh sieves were used to remove the large dust particles. After sieving, 1 g of dust was taken for examination. The dust samples were mixed with 25 ml of 90% lactic acid and the mixture was heated to near boiling. Small aliquots (5 ml) of the liquid mixture were transferred to Petri dishes and examined under a stereomicroscope (S8 APO; Leica, Wetzlar, Germany) to detect the house dust mites. The house dust mites were transferred to Hoyer's medium (50 ml distilled water, 20 ml glycerin, 30 g gum Arabic, and 200 g chloral hydrate), and permanent slides were prepared.

SPSS 15.0 for Windows (SPSS Inc., Chicago, IL) was used for the statistical analysis. The relationship between mite numbers per gram dust and selected parameters was determined using the multiple regression analysis. Also Mann-Whitney U test and Kruskal-Wallis test were used to determine the mean number of house dust mites per gram dust of each variable range. (Büyüköztürk et al. 2009).

## Results

House dust mites were found in 751 of the 1,040 samples examined (72.2%). The number of mites/g dust varied between 20 and 1,840 in mite-positive houses, and 7,810 mites were isolated.

According to multiple regression analysis, a significant effect of selected parameters was found on house dust mites population density ( $F=13.542$ ,  $df=9$ , 1030,  $P=0.000$ ). Respectively, altitude, number of monthly vacuuming, number of individuals in the household, and relative humidity were the most effective variables that affect the number of dust mites (Table 1).

A significant correlation was detected between the number of house dust mites and RH ( $P=0.01 < 0.05$ ; Table 1), as the number of house dust mites increased in parallel with RH. No house dust mites were found in houses with a RH of 1–20%. A mean of 146.5 house dust mites were found in houses with 21–40% RH, 159.3 in those with 41–60% RH, and 358 in those with 61–80% RH.

A positive correlation was found between the number of house dust mites/g dust and the altitude of the houses ( $P=0.000 < 0.05$ ; Table 1). 62.4 mites/g dust were found in houses located at 1,300–1,400 m; this value was 126.4 in houses located at 1,401–1,500 m, 206.7 in houses located at 1,501–1,600 m, and 237.6 in houses located >1,600 m altitude.

A positive correlation was found between the number of individuals in the household and the number of house dust mites/g dust ( $P=0.000 < 0.05$ ; Table 1). A mean of 158 house dust mites were found in houses with two to five individuals, 205.8 in houses with six to seven individuals, and 204.4 in houses where more than seven people were living together.

A negative correlation was detected between the number of house dust mites/g dust and monthly vacuum cleaning ( $P=0.000 < 0.05$ ; Table 1). The mean number of house dust mites was 387.2 in houses cleaned twice monthly, 280 in houses cleaned three times monthly, 281 when cleaned four times, and 161.4 when cleaned five times or more monthly.

No significant correlation was detected between the type of heating and the number of house dust mites/g dust ( $P=0.886 > 0.05$ ; Table 1). The mean number of house dust mites was 168.4 in houses with central heating and 176.7 in houses heated with a wood burning stove.

No significant correlation was observed between the presence of allergic diseases in the family and the number of house dust mites/g dust ( $P=0.718 > 0.05$ ; Table 1). However, the mean number of mites/g dust was higher in houses of individuals with allergic diseases (201.2) than the houses of individuals without such symptoms (175.1).

According to the Kruskal-Wallis test, a significant correlation was detected between the type of settlement and the number of house dust mites/g dust ( $P=0.000 < 0.05$ ). Houses in the center of the cities contained a mean of 86.2 mites, those in the districts contained a mean of 181.6, and those in villages contained a mean of 218.6 house dust mites (Fig. 2). The mean number of house dust mites in houses of Bitlis Province was higher (210.8) than that in houses located in Muş Province (149.6).

In both investigated houses of Bitlis and Muş Provinces, mean number of house dust mites was higher in summer (August) and spring (May) than in autumn (October) and winter (February) (Figs. 3 and 4). No significant difference was found between inside temperature and the number of house dust mites/g dust ( $P=0.339 > 0.05$ ; Table 1). However, an increase in the number of house dust mites that parallels the increase in inside temperatures has been observed: 145.5 at 10–15°C, 177.9 at 16–20°C, 184.9 at 21–25°C, and 187.3 at >25°C.

No significant differences were found between construction type of the house and the number of house dust mites/g dust ( $P=0.102 > 0.05$ ; Table 1). The mean number of house dust mites was 161.5 in homes made of soil-based materials, 182.7 in ferroconcrete houses, 216.5 in apartment flats, and 180.6 in barracks. No significant correlation was observed between house age and the number of house dust mites/g dust ( $P=0.497 > 0.05$ ; Table 1). The mean number of house dust mites was 242.6 in 1–5-year-old houses, 173 in 6–10-year-old houses, 190.5 in 11–15-year-old houses, 162 in 16–20-year-old houses, and 174.5 in houses >21-years-old.

## Discussion

In this study 72.2% of dust samples were positive with regards of mites. This value varies between 56–100% in studies conducted



Fig. 1: Area of Turkey where the study on house dust mites was conducted.

abroad (Bigliocchi and Maroli 1995, Hallas and Korsgaard 1997, Agratorres et al. 1999, Konishi and Uehara 1999, Sanchez-Covisa et al. 1999, Zock et al. 2006, Solarz 2009, Soltani et al. 2011) and 18–94.44% in Turkey (Sarica and Aktaş 1997, Aygan and Özçelik 2002, Aldemir and Baykan 2004, Akdemir and Gürdal 2005, Güleğen et al. 2005, Çiftçi et al. 2006, Aykut et al. 2013, Zeytun et al. 2015). As is seen, our findings are consistent with previous studies.

According to our results, number of house dust mites increased in parallel with RH. These results are consistent with studies done in several countries (Colloff 1987, Arlian 1992, Mumcuoglu et al. 1999, Arlian et al. 2001; Sanchez-Ramos et al. 2007, Soltani et al. 2011).

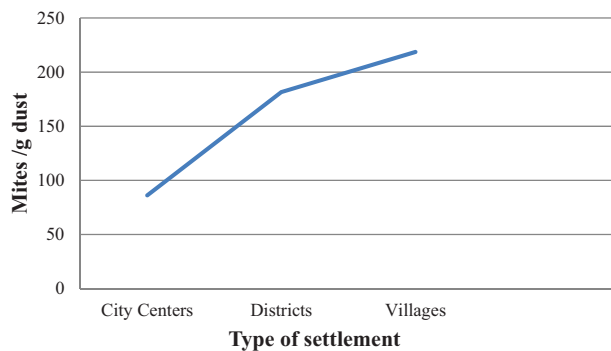
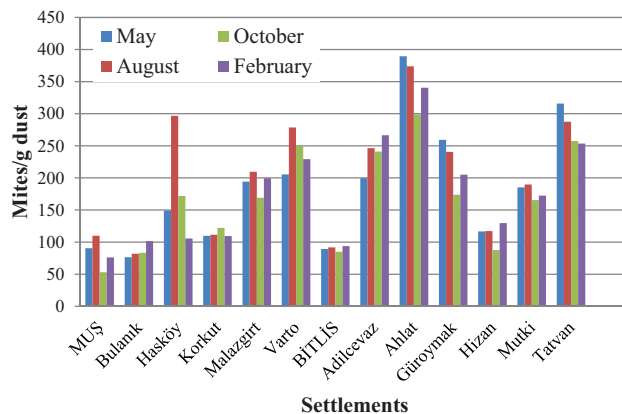
In this study, number of mites per gram dust increased in parallel with altitude. These findings differ from those of previous studies in which fewer mites (Mumcuoglu 1976, Vervloet et al. 1982) and lower prevalence and sensitization to house dust mites (Platts-Mills et al. 1989) were found at higher altitudes. This may be because the districts in Bitlis Province (Adilcevaz, Ahlat, and Tatvan) are located on the shores of Van Lake, with a high altitude and RH. Especially, from October to May, the average RH of Adilcevaz, Ahlat, and Tatvan districts rise above 70% (Kadı et al. 2009).

We found a positive correlation between the number of individuals in the household and house dust mites found in those household. Skin scales of humans and animals are the most important food source for house dust mites (Mumcuoglu et al. 1999, Colloff

**Table 1.** Multiple regression analysis of house dust mites per gram dust with physical and environmental variables

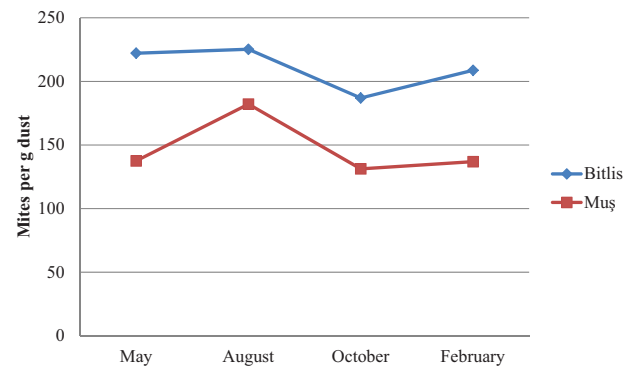
| Variables                     | Unstandardized coefficients |        | Standardized coefficients | <i>t</i> | Significance |
|-------------------------------|-----------------------------|--------|---------------------------|----------|--------------|
|                               | B                           | SE     | Beta                      |          |              |
| Altitude                      | 59.873                      | 7.487  | .243                      | 7.997    | .000*        |
| Monthly vacuuming             | −58.404                     | 11.090 | −.165                     | −5.267   | .000*        |
| Number of individuals         | 39.656                      | 11.249 | .112                      | 3.525    | .000*        |
| Relative humidity             | 33.503                      | 12.957 | .095                      | 2.586    | .010*        |
| Indoor temperature            | 9.750                       | 10.190 | .029                      | .957     | .339**       |
| Construction type of houses   | 8.734                       | 5.330  | .050                      | 1.639    | .102**       |
| Presence of allergic diseases | 5.752                       | 15.920 | .011                      | .361     | .718**       |
| Age of houses                 | −3.989                      | 5.867  | −.023                     | −.680    | .497**       |
| Type of heating               | 3.704                       | 25.831 | .005                      | .143     | .886**       |

\*Significant, \*\* Nonsignificant

**Fig. 2.** Mean number of house dust mites of different settlement type.**Fig. 3.** Mean number of house dust mites of investigated settlements in different periods.

2009), and more skin scales are produced from a greater number of people (Colloff 2009). We found negative correlation between monthly vacuum cleaning and number of house dust mites. The same observation has been reported previously by Modak and Saha (2002) and Aycan et al. (2007).

Although there wasn't any significant association between the type of heating and the number of house dust mites/g dust, houses heated with wood burning stove contained more mites than central heating houses. The abundance of house dust mites in houses heated with wooden stoves was similar with observations of other studies, which showed that houses heated with wooden stoves host more mites than centrally heated houses (Güleğen et al. 2005, Aycan et al. 2007). Wood burning stoves are used for heating, cooking, and

**Fig. 4.** Mean number of house dust mites belonging to whole investigated houses of Bitlis and Muş Provinces in different periods.

boiling water. Thus, these activities would increase inside RH possibly resulting in elevated mite numbers.

No significant correlation was observed between the presence of allergic diseases in the family and the number of house dust mites/g dust. These results are in conflict with results of other researchers (Oshima 1964, Voorhorst et al. 1964, Milhim et al. 1972, Hallas and Korsgaard 1997, Mumcuoglu et al. 1999, Boquete et al. 2006, Atambay et al. 2006).

In this study, we found that houses in the center of the cities contained a mean of 86.2 mites, those in the districts contained a mean of 181.6, and those in villages contained a mean of 218.6 house dust mites. It has already been reported that rural houses contain more mites than urban houses (Franz et al. 1997, Henszel et al. 2010) and that the quantity of mite antigens in farmer's houses is higher than that of urban residences (Radon et al. 2000). It may be that the higher number of inhabitants per house in villages, high location altitude, wooden stoves and fewer vacuuming of houses in these localities are responsible for the higher number of house dust mites.

Mean number of house dust mites in houses was higher in summer and spring than in winter and autumn. This is consistent with other studies, which found that houses contained more house dust mites in spring and summer than in autumn and winter (Mumcuoglu 1976, Mumcuoglu et al. 1999, Cai and Wen 1989, Solarz 1997, Sun and Lue 2000, Podder et al. 2009, Aykut and Yilmaz 2010, Henszel et al. 2010).

No significant correlation was found between the number of house dust mites per gram dust and indoor temperatures. These results are in conflict with results of other researchers (Mumcuoglu et al. 1999, Sanchez-Ramos and Castanera 2005, Colloff 2009, Solarz 2009).

No significant differences were found between construction type and age of the house and the number of house dust mites. It has been reported that basement and ground-level houses host more house dust mites than upper floors (Wickman et al. 1993), but no correlation between house type and the number of house dust mites has been reported (Sarica and Aktaş 1997). Some studies have reported that the number of house dust mites increases with increasing house age (Modak and Saha 2002, Henszel et al. 2010); however, other studies reported no such relationship (Konishi and Uehara 1999, Aycan et al. 2007). The results we obtained about construction type and age of the houses are consistent with previous studies.

In conclusion, different indoor and outdoor factors influence the quantity of house dust mites inside a house and play important roles in the development of allergic symptoms in genetically predisposed individuals. According to these findings, high altitude, increase of individuals in household, decrease of monthly vacuuming, and high relative humidity effect the increasing of house dust mites per gram dust. Considering these factors will help patients with allergies to better avoid and eliminate house dust mites and house dust mite allergens. We couldn't persuade the inhabitants to collect dust samples from bedrooms. Studies that include bedrooms and other variables could give more comprehensive results. In the light of the results of this research, further studies might be conducted to investigate the precautions to house dust mites and their allergens.

## Acknowledgments

This study was supported by the Research Fund of Atatürk University (BAP-168 2009/235) and was part of the PhD dissertation of Dr. M. Aykut, supervised by Professors O. K. Erman and S. Doğan. We are grateful to Professor Kosta Y. Mumcuoglu of The Kuvın Center of Infectious and Tropical Diseases, Faculty of Medicine, Hebrew University, Jerusalem, Israel, for help throughout the study. We are grateful to Fuat Elkonca, a research assistant at Muş Alparslan University, Education Faculty, Educational Sciences Department, Muş, and Dr. İsmail Yıldız, Dicle University, Department of Biostatistics, Diyarbakır, Turkey, for their help with the statistical analyses.

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