

Sensitization to house-dust mite and mite fauna in selected children's homes in Kütahya, Turkey

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The aim of this study was to determine the relationship between the house-dust mite allergy and prevalence of house-dust mites in dwellings of children who were tested for specific IgE against *Dermatophagoides pteronyssinus* (*D. pteronyssinus*) and *D. farinae* on the suspicion of allergic rhinitis, dermatitis and asthma. All dust specimens collected from children's houses were investigated under a light microscope. House-dust mites were found in 31.7% of houses of children with a specific IgE, while the rate was 27.5% in houses of those without a specific IgE. Overall, house dust specimens collected from a total of 92 houses were examined, and mites were found in 27 (29.3%) of them. Both Der p and Der f were found in 38 (92.7%), while mixed allergy (*D. pteronyssinus* + *D. farinae*) was found in 3 (7.3%). Der p allergy (100%) was found in all of the allergic children, while no child was found with specific IgE for Der f allergy, except in mixed allergies.

Key words: house-dust mite, mite, allergy, Turkey.

House-dust mites are astigmatid organisms and an inseparable part of modern human life¹. *Dermatophagoides pteronyssinus*, *D. farinae*, and *Euroglyphus maynei* are the most frequent species found in house dust. More species descending from the genera Tyrophagus, Acarus, Chortoglyphus, Glycyphagus, Lepidoglyphus, Suidasla, etc. are also found and generally named storage mites. Another important species is *Blomia tropicalis*, which is a common type seen alongside Pyroglyphid mites²⁻⁴.

A historic turning point in allergy research has been the discovery of mites as the primary allergens in houses⁵ and consequently, studies on biological-ecological properties and their allergenic structures have gained in momentum⁶⁻¹⁰. Mites are reported to cause some allergic diseases such as allergic asthma and atopic dermatitis in atopic people, particularly in industrialized societies^{11,12}.

To date, 19 different allergens from dust mite have been characterized and found to elicit varying degrees of IgE reactivity and T-cell responses. Several mite allergens are biochemically active, including hydrolytic and nonhydrolytic enzymes. These enzymes may accumulate in dust reservoirs¹³.

The group 1 and 2 allergens are found in abundant quantities in mite body extracts. Antigens other than group 1 and 2 are deemed as unstable and minor¹⁵. It is reported that enzymes that help the transformation of minor antigenic structures might be extracts of saliva remnants in food or protein discharges of supracoxal glands; soluble proteins that come out in body liquids after their termination might be considered within this scope². While group 1 is made of cysteine proteases, group 2 is made of epithelial secretions. The group 1 and 2 allergens of *Dermatophagoides* sp. induce high titers of IgE and Th2 cytokines in 80% of allergic patients¹⁵.

Tovey et al.¹⁶ report that more than 95% of the antigens coming from house-dust mite stem from their feces. They pointed out that these mites release 20 sets of feces a day¹³, and approximately 20% of components of excretions are made up of particles smaller than 5 µm, which can easily be inhaled while breathing^{13,17}.

It is reported that the correlation between the exposure of sensitized people to mite-antigen-containing house dust and ensuing specific IgE formation with allergic rhinitis symptoms is

very obvious¹⁸. Similarly, occurrence of asthma and atopic dermatitis is said to be possible with the formation of specific IgE¹².

Contraction of specific IgE-relevant allergic diseases by approximately 20% of the world population and 5-15% of children underlines the significance of mites and allergens¹⁹. In recent years, the rise in the spread and frequency of allergic diseases in developed and developing countries can be attributed to a 1% annual increase - especially in the young people - in their prevalence, rather than to the advance of diagnostic means²⁰.

The aim of this study was to determine the relationship between the house-dust mite allergy and prevalence of house-dust mites in the homes of children who were tested for specific IgE against *D. pteronyssinus* and *D. farinae* on the suspicion of allergic rhinitis, dermatitis and asthma.

Material and Methods

In this study, presence of any correlation between occurrence of house-dust mite and mite allergy was investigated in children admitted to Dumlupınar University Hospital Pediatric Clinic on the suspicion of allergic rhinitis, allergic dermatitis, and allergic asthma and who were tested for specific IgE against *D. pteronyssinus* and *D. farinae* in their blood sera.

The line-blot strip test employed in the study was developed by a private company (Allergy Screen™, R-Biofarm®) from culture medium extracts (AgCME), which passively binds the extract to nitrocellulosic membranes. The first two membranes of the test contain Der p (D1) (*D. pteronyssinus*) and Der f (D2) (*D. farinae*) antigens. Following a series of incubation processes, specific IgE presence in nitrocellulosic membranes becomes visible. Optical density of westernblot band images taken with a CCD camera (Rida X-Screen) were assessed with the help of a computer program (Rapid Reader Information Manager [Rel:380b]) and children with more than specific IgE amount of 0.35 IU/ml in their blood sera were classified as sensitized.

House dust collected from dwellings of 41 children diagnosed with a specific IgE against at least one of Der p or Der f antigens and dwellings of 51 children without any such findings were analyzed for presence of mites.

House dust was collected with a 1200-watt vacuum cleaner, using a separate dust-bag for each house, at a pace of 2 minutes per square meter. The area vacuumed in these houses included all personal and common household stuff such as beds, mattresses, pillows, linens, couches, and the flooring, so as to sample the conditions experienced by the subjects.

House dust samples were analyzed by two methods. In the first method, samples were analyzed as described by Spieksma and Spieksma-Boezeman²¹. As defined in the reference article, 5 g of samples were boiled with 90% lactic acid in a beaker, and then transferred to glass tubes to be centrifuged 4 times (300 g). The resulting supernatants were spread carefully over filter papers (Schleicher & Schuell-Black). In the second method, samples were analyzed as described by Solarz³. As defined in the reference article, 10 g dust samples were taken into a 600 ml beaker and saturated salty water was added over it with a couple of drops of washing detergent. These mixtures were spun in a magnetic mixer for an hour and separated from larger particles. The obtained suspensions were left floating for a full day, and dropped slowly over the filter paper, ensuring sediments stay out of the process. The filtrates were washed away with tap water to remove the salt. Some amount of saturated salty water equal to the substance taken from the beaker to the filter paper was added to the beaker again to be floated three times for 24 hours.

Filtrates deposited over filter papers in both methods were inspected under a stereo microscope for mites, which were collected with the help of a needle and preserved in a protective solution (15 ml glycerin + 90 ml distilled water + 300 ml 95% alcohol). To make the preparation, Hoyer solution (50 ml distilled water + 20 ml glycerin + 30 g gum arabicum + 200 g chloral hydrate) was used, and left for dehydration. Mites were identified under a light microscope using the classifications proposed by the authors²²⁻²⁴.

House-dust mites collected from dwellings of children with a positive or negative specific IgE in at least one allergen were analyzed and categorized with regard to their monthly occurrence, specific IgE, and location, with the help of SPSS (version 13.0) program (chi-square method). Data are given by months.

Prevalence of mites is also given (Tables I, II). Figure 1 also contains total dust samples and mite count by months.

Results

Forty-one children were subjected to the allergy test, and positive results for at least one antigen were found. Specific IgE against Der p and Der

f was found in 38 (92.7%) while only Der p antigen was found in 3 (7.3%). Only Der f antigen was not found in these children.

Mites were found in 13 (31.7%) of house dust specimens taken from 41 households with positive specific IgE children. On the other hand, mites were found in 27.5% of

Table I. Presence of House-Dust Mites by Months (October 2005 - February 2006)

Sensitized children houses				Non-sensitized children Non-sensitized Children Houses				
Month	Sample	Neg (-)	Pos (+)	Month	Sample	Neg (-)	Pos (+)	Total (+)
Oct	2	2	0	Oct	2	1	1	1
Nov	2	1	1	Nov	2	1	1	2
Dec	2	2	0	Dec	2	2	0	0
Jan	2	2	0	Jan	2	2	0	0
Feb	3	3	0	Feb	3	3	0	0
Mar	2	1	1	Mar	3	2	1	2
Apr	4	4	0	Apr	5	3	2	2
May	6	4	2	May	5	3	2	4
June	6	4	2	June	5	3	2	4
July	2	0	2	July	3	2	1	3
Aug	2	1	1	Aug	4	3	1	2
Sept	3	1	2	Sept	4	3	1	3
Oct	2	1	1	Oct	3	2	1	2
Nov	1	0	1	Nov	2	1	1	2
Dec	0	0	0	Dec	2	2	0	0
Jan	1	1	0	Jan	2	2	0	0
Feb	1	1	0	Feb	2	2	0	0
Total	41	28	13		51	37	14	27

Table II. Mite Presence Frequency in Houses and Occurrences (October 2005 - February 2006)

Species or group	Houses of sensitized children		Houses of non-sensitized children	
	Ratio	Number of occurrence	Ratio	Number of occurrence
D. pteronyssinus	18.89	14	16.51	9
A. siro	5.55	9	2.32	7
G. domesticus	3.33	10	3.48	12
T. putrescentiae	8.89	16	6.48	11
L. destructor	5.55	10	7.55	14
Oribatidae	1.11	1	-	-
Unidentified	6.67	4	6.98	2
Total		64		51

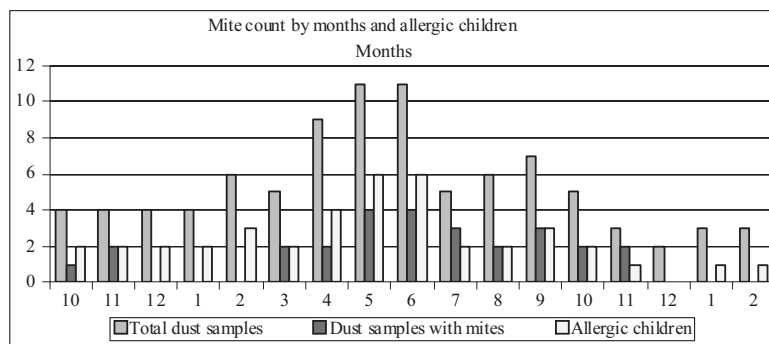


Fig. 1. Mite count by months and allergic children.

house-dust specimens taken from 51 children with negative Der p and Der f allergens. In total, 92 specimens from as many houses were examined and mites were found in 27 of them (29.4%).

Discussion

In many studies conducted thus far on the epidemiological and allergic properties of house-dust mites, species and distribution of mites varied by regions and time of the year. In Denmark, mites were found in 59% of all tested houses²⁵. In Norway, it was reported that mites were found especially in bedrooms²⁶. In Lithuania, Dautartiene²⁷ found *D. pteronyssinus* and *D. farinae* as the dominant species, and identified them in all the houses tested, except in the month of May. The scientist reported the occurrence of *D. pteronyssinus* as 74.3%, *D. farinae* 15.7%, *D. evansi* as 1.5%, *E. maynei* as 0.6%, *Cheyletus eruditus* as 3.8%, and *Glycyphagus domesticus* as 1.6%. In Spain, the occurrence of *Tyrophagus putrescentiae* was found as 22.4%, of *Lepidoglyphus destructor* as 14.9%, and of *D. pteronyssinus* as 14.8%²⁸.

In Brazil, Binotti et al.²⁹ reported that mites were found in 43.9% of house dust specimens and 56% of curtain dust specimens. In another study conducted in Brazil, the occurrence of mite species were found as: *Acarus siro* 1.5%, *D. farinae* 12.3%, *D. pteronyssinus* 15.6%, *E. maynei* 6.9%, Oribatid spp. 1.7%, and *Cheyletus* spp. 1.5%³⁰. In Panama, Terra et al.³⁰ found occurrences of *T. putrescentiae* as 0.2% and of *D. pteronyssinus* as 1.4%.

In Turkey, Çiftçi et al.³² reported occurrence of *D. pteronyssinus* as 23.1% and found it as the main species in the Pyroglyphidae family. Researchers³² found the occurrence of *Chortoglyphus arcuatus* as 5.2%, *Tyrophagus* spp. as 2.8%, Oribatidae spp. as 2.1%, *L. destructor* as 1%, *Histiostoma* spp. as 0.7%, and *D. farinae* as 0.7%.

In our study, mites were found in 29.4% of the houses, with the occurrences as: *D. pteronyssinus* 17.7%, *A. siro* 3.9%, *T. putrescentiae* 7.7%, *G. domesticus* 3.4%, and *L. destructor* 6.6. The specific locations of the mites among the house segments could not be identified, since such classification was not made at the dust collection phase.

In Denmark, Warner et al.⁹ found mite allergy in 35% of children with asthma, and sensitization for house-dust mite as 17%, for storage mite as 2%, and for both house-dust and storage mites as 16%. Mites were found in 48% of homes of the sensitized children. However, even though specific IgE against *A. siro* was found in these children, this species was not found in the dust specimens. In Italy, a study reported 74% sensitization against *D. pteronyssinus* and 75% sensitization against *D. farinae* in atopic children¹⁰. In Turkey, in the houses of those with mite allergy, *D. pteronyssinus* was found in 27.5% of the specimens, and antigenic structures in 71.4%^{33,34}. While Gülbahar et al.³³ found *D. farinae* antigenic structures in 23% of the specimens, Çiftçi et al.³⁴ found *D. farinae* occurrence as 0.7% among randomly selected houses. Among those who were subjected to specific IgE test, 17.1% Der p, 9.8% Der f, and 73.2% both Der p and Der f antibodies were found.

Overall, both Der p and Der f allergy were found in 92.7%, only Der p in 7.3%, and only Der f was not found. House-dust mites were found in 31.7% of homes of atopic children, and in 27.5% of homes of non-atopic children. It was concluded that sensitization against Der p and Der f is important ($p < 0.05$). Only Der f antibody was not detected in children and *D. farinae* was not found in house dust. Although a previous study³⁶ reported no *D. farinae* in Kütahya, Çiftçi et al.³² reported its presence in 0.7% of their specimens. The difference may be attributed to different sampling methods.

It is reported that with the start of heating of houses during winter months and corresponding reduction in humidity, the mite population declined; after the end of this period, mites are observed to multiply, with a peak in mid-summer^{27,36}. The survey was conducted by examining house-dust specimens under microscope after performing allergy tests on subjects. The seasonal population variances are interpreted to be in accordance with epidemiological traits of the mites. The mite species reported are in line with those previously found, with the addition of Oribatid spp. and absence of *Cheyletus* spp³⁶.

In children living in city centers, mite sensitization is found to be high, while in rural areas it was found to be low^{37,38}. Chang et al.³⁸ found

increasing sensitization for *D. pteronyssinus* in China with increasing age. They found no significant correlation between regional and increasing age comparisons.

In conclusion, house-dust mites were found in 31.7% of houses of children having specific IgE, and in 27.5% of houses of children with no specific IgE. No statistically significant correlation was determined ($p > 0.05$). Similarly, Tavernier et al.³⁵ also found no significant divergence in the amount of *D. pteronyssinus* allergen between houses of sensitized and non-sensitized individuals. In 13 of the 41 children with proven specific IgE, there were allergic findings; *D. pteronyssinus* was detected in the homes of two, and *G. domesticus* in the home of one. The observed mite species were *D. pteronyssinus*, *T. putrescentiae*, *A. siro*, *L. destructor*, *G. domesticus* and Oribatid spp., and no relation to allergic sensitization was found. It is advisable to analyze the level of endotoxin in house-dust samples and investigate its relationship to Der p and Der f sensitization.

Despite the fact that the presence of specific IgE has no relation to house-dust mites, it may be concluded that presence of mites in houses of children with antibodies may be triggering allergic reactions. Taking into account the dust specimen collection days in Kütahya, house-dust mites are observed to multiply in non-winter months, with the main species being *D. pteronyssinus*. Although Der f antigen was not found in isolated formations, it is advisable to specify its fauna through investigation of house-dust specimens in a future study.

REFERENCES

- Nadchatram M. House dust mites, our intimate associates. *Trop Biomed* 2005; 22: 23-37.
- Arlian LG, Platts-Mills AE. The biology of dust mites and the remediation of mite allergens in allergic disease. *J Allergy Clin Immunol* 2001; 107: 406-413.
- Solarz K. The allergenic acarofauna of house dust from dwellings, hospitals, libraries and institutes in Upper Silesia (Poland). *Ann Agric Environ Med* 1998; 5: 73-85.
- Fernandez-Calds E, Puetra L, Caraballo L, Lockey RF. Mite allergens. In: Lockey RF, Bukantz SC, Bousquet J (eds). *Allergens and Allergen Immunotherapy* (3rd ed) Revised and Expanded. New York: Marcel Dekker Inc; 2004: 251-271.
- Voorhorst R, Spieksma-Boezeman MI, Spieksma FT. Is a mite (*Dermatophagoides* sp.) the producer of the house-dust allergen? *Allerg Asthma (Leipzig)* 1964; 10: 329-334.
- Mumcuoglu KY. House dust mites in Switzerland. *J Med Ent* 1976; 13: 361-373.
- Fain A, Guerin B, Hart BJ. Mite and allergic diseases. *Allerbio* 1990; Varennes en Argonne.
- Dusbabek F. Population structure and dynamics of the house dust mite *Dermatophagoides farinae* (Acarina: Pyroliphidae) in Czechoslovakia. *Folia Parasitol (Praha)* 1975; 22: 219-231.
- Warner A, Boström S, Möller C, Kjellman NI. Mite fauna in the home and sensitization to house-dust and storage mites. *Allergy* 1999; 54: 681-690.
- Verini M, Rossi N, Verrotti A, Pelaccia G, Nicodema A, Chiarelli F. Sensitization to environmental antigens in asthmatic children from a central Italian area. *Sci Total Environ* 2001; 270: 63-69.
- Bloomfield SF, Stanwell-Smith R, Crewel RW, Pickup J. Too clean, or not too clean: the hygiene hypothesis and home hygiene. *Clin Exp Allergy* 2006; 36: 402-425.
- Howieson S. *Housing and asthma*. England: Spon Press; 2005: 6-23.
- Custovic A, Simpson A. Dust mite. *Encyclopedia of Respiratory Medicine* 2006; 4: 54-59.
- Kirchhoff C, Osterhoff C, Young L. Molecular cloning and characterization of HE1, a major secretory protein of the human epididymis. *Biol Reprod* 1996; 54: 847-856.
- Thomas WR, Smith W. Towards defining the full spectrum of important house dust mite allergens. *Clin Exp Allergy* 1999; 29: 1583-1587.
- Tovey ER, Chapman MD, Platts-Mills TA. Mite faeces are major source of house dust allergens. *Nature* 1981; 289: 592-593.
- Custovic A, Woodcock H, Craven M, et al. Dust mite allergens are carried on not only large particles. *Pediatr Allergy Immunol* 1999; 10: 258-260.
- Bousquet J, Cauwenberge P, Khaltaev N, Aria Workshop Group, World Health Organization. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol* 2001; 5: 147-166.
- World Health Organization. Prevention of Allergy and Allergic Asthma. Based on WHO/WAO Meeting on the Prevention of Allergy and Allergic Asthma, Geneva, 2002. Geneva, Switzerland: WHO Document Production Service; 2003.
- Beasley R, Keil U, von Mutius E, Pearce N. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC *Lancet* 1998; 351: 1225-1232.
- Spieksma FT, Spieksma-Boezeman MI. The mite fauna of house dust with particular reference to the house-dust mite *Dermatophagoides pteronyssinus* (Trouessart, 1897) (Psoroptidae: Sarcoptiformes). *Acarologia* 1967; 9: 226-241.
- Hart BJ, Fain A. Morphological and biological studies of medically important house-dust mites. *Acarologia* 1988; 29: 284-295.
- Fain A, Guerin B, Hart BJ. Mite and allergic diseases. *Varennes en Argonne: Allerbio* 1990; 1-190.
- Colloff MJ, Spieksma M. Pictorial keys for the identification of domestic mites. *Clin Exp Allergy* 1992; 22: 823-830.

25. Mosbech H, Veggerby C, Steensen M, et al. House dust mite allergens and mite allergy in Copenhagen dwellings, a cross-sectional study. *Ugeskr Laeger* 1998; 160: 2550-2551.
26. Dotterud LK, Van TD, Kvammen B, Dybendal T, Elsayed S, Falk ES. Allergen content in dust from homes and schools in northern Norway in relation to sensitization and allergy symptoms in schoolchildren. *Clin Exp Allergy* 1992; 27: 252-261.
27. Dautartiené A. Seasonal changes in house dust mites. *Ekologija* 2001; 2: 3-7.
28. Vidal C, Boquete O, Gude F, et al. High prevalence of storage mite sensitization in a general adult population. *Allergy* 2004; 59: 401-405.
29. Binotti RS, Oliverira CH, Santos JC, Binotti CS, Munizjro Prado AP. Survey of acarine fauna in dust samplings of curtains in the city of Campinas, Brazil. *Braz J Biol* 2005; 65: 25-28.
30. Terra SA, Silva DA, Sopelete MC, Mendes J, Sung SJ, Taketomi EA. Mite allergen levels and acarologic analysis in house dust samples in Uberaba, Brazil. *J Invest Allergol Clin Immunol* 2004; 14: 232-237.
31. Miranda RJ, Quintero D, Almanza A. House dust mites from urban and rural houses on the lowland Pacific slopes of Panama. *Systematic & Applied Acarology* 2002; 7: 23-30.
32. Çiftçi IH, Cetinkaya Z, Atambay M, Kiyıldı N, Aycan OM, Daldal N. House dust mite fauna in western Anatolia, Turkey. *Korean J Parasitol* 2006; 44: 259-264.
33. Gülbahar O, Mete N, Kokuludag A, Sin A, Sebik F. House dust mite allergens in Turkish homes. *Allergy* 2004; 59: 231-241.
34. Çiftçi IH, Çetinkaya Z, Aktepe OC, et al. The relation between house dust allergens and specific IgE. *Med J Kocatepe* 2004; 5: 29-32.
35. Tavernier G, Fletcher G, Gee I, et al. IPEADAM study: indoor endotoxin exposure, familial status, and some housing characteristics in English children. *J Allergy Clin Immunol* 2006; 117: 656-662.
36. Akdemir C, Gürdal H. Kütahya'da ev tozu akarları. *Türkiye Parazitoloj Derg* 2005; 29: 110-115.
37. Schram-Bijkerk D, Doekes G, Boeve M, et al. Nonlinear relations between house dust mite allergen levels and mite sensitization in farm and nonfarm children. *Allergy* 2006; 61: 640-647.
38. Chang JW, Lin CY, Chen WL, Chen CT. Higher incidence of *Dermatophagoides pteronyssinus* allergy in children of Taipei city than in children of rural areas. *J Microbiol Immunol Infect* 2006; 39: 316-320.