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Original article (Orijinal araştırma)

House dust mite population in the bedrooms of people with dust mite allergy in the city of Ordu, Turkey[1]

Ordu (Türkiye)'da toz akar alerjisi olan kişilerin yatak odalarında toz akarı popülasyonu

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Abstract

House dust mites are a major source of allergens that are responsible for allergic symptoms such as asthma and atopic diseases. The warm and humid climate of Ordu, which is situated on the Black Sea coast of Turkey is highly suitable for the growth of house dust mites. Seasonal changes in the populations of the house dust mites were studied in five houses of dust-mite sensitive people with asthma between 2013 and 2015. Dust samples were obtained once a month to assess the monthly distribution of dust mites. House dust mites were isolated from samples by a wet-sieving method. Permanent slides were prepared for morphologically based species determination. The most abundant species were *Dermatophagoides pteronyssinus* (Trouessart, 1897) and *Dermatophagoides farinae* (Hughes, 1961) (Astigmata: Pyroglyphidae), 65.4 and 31.0% of the total count of mites, respectively. Dust mites can survive all year round and are widely distributed in different types of houses in the city of Ordu. The mite abundance reached its peak in all houses during August (26-28ºC and 64-78% RH). The discomfort for people who have a dust mite allergy may reach a peak specifically during this time and they need to take extra precautions to reduce exposure to dust mites as much as possible during this period.

Keywords: Allergy, *Dermatophagoides*, house dust mites, seasonal population fluctuation, Turkey

Öz

Ev tozu akarları, astım ve atopik dermatit gibi birçok alerjik simptoma neden olabilen ana alerjen kaynaklarından biridir. Türkiye'nin Karadeniz kıyısında yer alan Ordu şehrinin ılık ve nemli iklimi, ev tozu akarları için oldukça uygundur. Bu nedenle Ordu ilinde 2013-2015 yılları arasında, toz akarına duyarlı astımlı hastaların yaşadığı beş evde ev tozu akarı popülasyonundaki mevsimsel değişiklikler incelenmiştir. Toz akarı popülasyonundaki aylık değişimleri tespit etmek için, her evde ayda bir toz örneklemesi yapılmıştır. Akarlar ıslak- elek analiz yöntemiyle elde edilmiştir. Elde edilen türlerin morfolojik tür teşhisleri için preparatları yapılmıştır. Sonuçlar, en baskın türlerin *Dermatophagoides pteronyssinus* (Trouessart, 1897) ve *Dermatophagoides farinae* (Hughes, 1961) (Astigmata: Pyroglyphidae) olduğunu göstermiştir. Bu türler, toplam yoğunluğun sırası ile %65.4 ve %31.0 kadarını oluşturmuştur. Toz akarları, Ordu ilinde yıl boyunca tüm evlerde yaygın olarak bulunmuştur. Evlerdeki toz akar popülasyonunun ağustos ayında (26-28ºC ve %64-78 RH) en yüksek seviyelere ulaştığı da belirlenmiştir. Toz akarı alerjisi olanların özellikle bu süre zarfında şikayetleri artabilir ve ekstra önlemlere ihtiyaç duyabilirler.

Anahtar sözcükler: Alerji, *Dermatophagoides*, ev tozu akarları, mevsimlik popülasyon değişimi, Türkiye

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Introduction

House dust is often heavily contaminated with many allergens. One of the important allergenic components of house dust is dust mites (Colloff, 2009). The house dust mite was first suspected as a source of allergen in 1928 and has been recognized as an important cause of allergic disorders since 1964 (Voorhorst et al., 1964). In particular, the mite species, *Dermatophagoides pteronyssinus* (Trouessart, 1897) and *Dermatophagoides farinae* (Hughes, 1961) (Astigmata: Pyroglyphidae), have been shown to be important sources of inhalant and contact allergens associated with asthma and atopic diseases (Chew et al., 1999). They primarily live on dander (skin scales) shed from humans and household animal pets. Temperature and humidity are the major factors that influence the distribution and abundance of dust mites. Additional factors such as ventilation, floor level, orientation, age of home, or living habits of the occupants may contribute to the differences in indoor humidity that can influence the growth conditions of mites (Terra et al., 2004). A large number of studies on seasonal variation in house dust mite population have been carried out in many countries. Some of these studies were conducted in North America by Murray & Zuk (1979), Santiago De Compostela (Galicia, Spain) by Agratorres et al. (1999), Lithuania (Vilnius region) by Duatartiene (2001), northwestern Poland by Kosik-Bogacka et al. (2012) and India (South Assam) by Sharma et al. (2011). Population changes in dust mites have also determined in the different parts of Turkey by various researcher [Ozman-Sullivan & Celik, 2010 (Samsun); Aykut et al., 2013 (Bitlis and Muş Provinces)]. However, the seasonal dynamics of house dust mites in Ordu city have not been studied. Ordu is a seaside city and has a very humid climate. It is known that there is a direct relationship between relative humidity (RH) and house dust mite growth (Arlian et al., 1992). The aim of this work was to study the seasonal changes and abundance of the house dust mites in five houses of dust-mite sensitive people with asthma over two years between in the city of Ordu.

Material and Methods

Study area and houses

Experiments were conducted in the bedrooms of five houses (A, B, C, D and E) of dust mite sensitive people in Ordu (Turkey) during 2013 to 2015. Brief characteristics of each house are as follows:

A: The apartment is on the fourth floor of a block house and about 20 years old. The bed is about 5 years old, while the carpet is 10 years old. The bedroom is heated with gas. The inhabitant of this apartment is highly sensitive to house dust and 25 years old.

B: The apartment is on the third floor of a block house and about 45 years old. The bed is about 15 years old. Carpet is about 5 years old. The bedroom is heated with stove. The inhabitant with asthma of this apartment is 70 years old.

C: The apartment is on the fourth floor of a block house and about 15 years old. The bed is about 20 years old. Carpet is about 10 years old. The room is heated with gas. The inhabitant of this apartment is highly sensitive to house dust and 25 years old. The home is shared with a dog.

D: The apartment is on the fourth floor of a block house and about 20 years old. The bed is about 20 years old and used for sleeping except during August. Carpet is about 5 years old. The room is heated with gas. The inhabitant with asthma of this apartment is 21 years old.

E: The apartment is on the second floor of a block house and about 15 years old. The bed is about 1 year old. There is no carpet in the room. The room is heated with gas. The inhabitant with asthma of this apartment is 13 years old.

The temperature and RH in the bedroom of each house were measured and recorded daily using a data logger (CEM DT-172). These data were used to calculate the mean monthly temperature and RH.

Dust sample collection

Dust samples were obtained once a month from August 2013 until August 2015 in one house (A) and from August 2013 till July 2014 in four houses (B, C, D, E). House dust samples were taken from the entire surface of the mattress (about 3 m^2) (van Strien et al., 2002) and, carpet or floor near the bed (about 2 m^2). The samples were collected with a portable vacuum cleaner for 2 min/m^2 (Ozman-Sullivan & Celik, 2010; Zeytun et al., 2015).

A new bag for each vacuuming was used. After each vacuuming, the dust bag was taken out, placed in a plastic bag and brought to the laboratory for analysis (Wassenaar, 1988). The samples were usually analyzed within 24 h. Dust samples that were examined later were stored in a refrigerator at 4ºC.

Mite isolation and enumeration

The large particles were removed from each dust sample. House dust mites were isolated from 1 g fine dust by a wet-sieving method adapted from Natuhara (1989). The mites within the samples were stored in 70% alcohol. All mites were counted and mounted whether they were alive, dead or physically damaged. The percentage of each species detected during the sampling period was calculated as follows:

Percentage of each species (%) = (Number of each mite species / Total mite number) × 100.

Mite density was reported as number of mites/g dust.

Mite preparation and identification

Specimens were cleared using lactophenol and then mounted using Hoyer's medium on microscope slides and dried for 5 to 7 d in an oven at 50ºC according to the method of Krantz & Walter (2009). The mites were identified to species level using a Leica DM 2500 phase contrast microscope. The identification of mites was made according to the appropriate keys (Fain et al., 1990; Solarz, 2010; Solarz et al., 2016).

Confirmation of species identification was made in University of Michigan, Department of Ecology and Evolutionary Biology, USA by Dr. Pavel B. Klimov.

Results and Discussion

The monthly distribution of dust mite numbers (mites/g dust) in house A in 2013-2015 and in houses B, C, D, E in 2013-2014 in Ordu city, and weekly temperature and RH during the study are given in Figure 1-5.

A total of 72 dust samples were examined and all houses sampled were found to be infested with house dust mites. A total of 1,143 mite specimens in various developmental stages were collected during the study.

A total of 1105 mites were identified to the species level. This group included *D. pteronyssinus, D. farinae, Lepidoglyphus destructor* (Schrank, 1781), *Chortoglyphus arcuatus* (Troupeau, 1879). The 38 damaged mites were identified only to the genus level as *Cheyletus* sp*., Dermatophagoides* sp*., Tyrophagus* sp*.* and *Rhizoglyphus* sp*.*

The most abundant species were *D. pteronyssinus* and *D. farinae*. They constituted 65.4% (748) and 31.0% (354) of the total count of mites collected from the bedrooms, respectively. The next six rare mite species and their abundance were *L. destructor* at 0.2% (2), *C. arcuatus* 0.1% (1), *Cheyletus* sp.1.8% (21), *Dermatophagoides* sp. 0.9% (10), *Tyrophagus* sp. 0.4% (5) and *Rhizoglyphus* sp. 0.2% (2).

In house A, the mite population reached the highest with 33 mites/g dust in the first year and 35 mites/g dust in the second year on August (26.2ºC and 65.4% RH, and 26.9ºC and 73.0% RH, respectively). During the study, the lowest mite population density was recorded between March-June. The mite population ranged between 12 and 16 mites/g dust during this period (21.9-23.8ºC; 53.8-74.8% RH) (Figure 1). A total of 465 mite specimens in various developmental stages were determined. They were; *D. pteronyssinus* (251 ♀♀, 20 ♂♂, 12 tritonymphs, 8 protonymphs), *D. farinae* (95 ♀♀, 31 ♂♂, 5 tritonymphs, 14 protonymphs), *L. destructor* (1 ♂), *Cheyletus* sp. (14 ♀♀), *Tyrophagus* sp. (2 ♀♀, 1 tritonymphs), *Rhizoglyphus* sp. (1 ♂), and *Dermatophagoides* sp. (5 ♀♀, 2 ♂♂, 3 larvae).

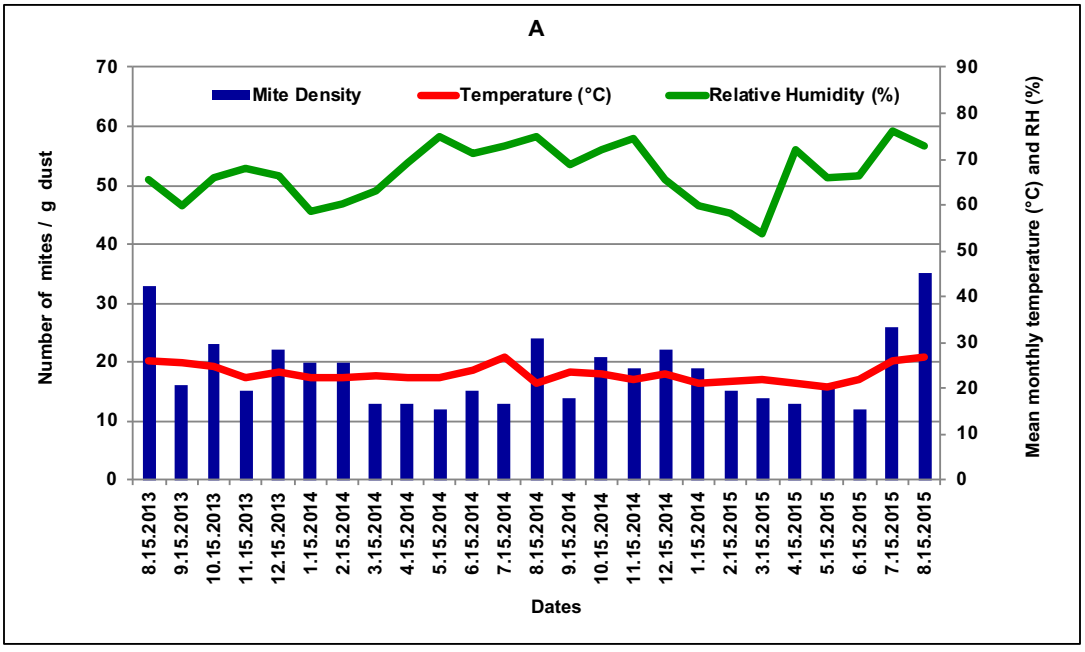

Figure 1. Number of mites/g dust in the house A in the city of Ordu between 2013 and 2015.

In house B, the highest (48 mites/g dust) and lowest (11 mites/g dust) mite numbers were observed in August (27.9ºC and 77.2% RH) and January (22.1ºC and 51.6% RH), respectively. The total number of mites (247) obtained during the sampling period was the highest of all the houses (Figure 2). A total of 247 mite specimens in various developmental stages were determined in this house during the study. They were *D. pteronyssinus* (136 ♀♀, 52 ♂♂, 12 tritonymphs, 5 protonymphs), *D. farinae* (25 ♀♀, 10 ♂♂, 3 tritonymphs, 1 protonymph), *C. arcuatus* (2 ♀♀) and *L. destructor* (1 ♂).

In house C, the highest population density was observed in August (67 mites/g dust) (26.9ºC and 65.3% RH) and the lowest in January (9 mites/g dust) (21.8ºC and 58.3% RH) (Figure 3). A total of 238 mite specimens in various developmental stages were determined in this house during the study. They were *D. pteronyssinus* (80 ♀♀, 35 ♂♂, 1 tritonymphs, 2 protonymphs), *D. farinae* (83 ♀♀, 23 ♂♂, 6 tritonymphs, 7 protonymphs) and *Cheyletus* sp. (1 ♀).

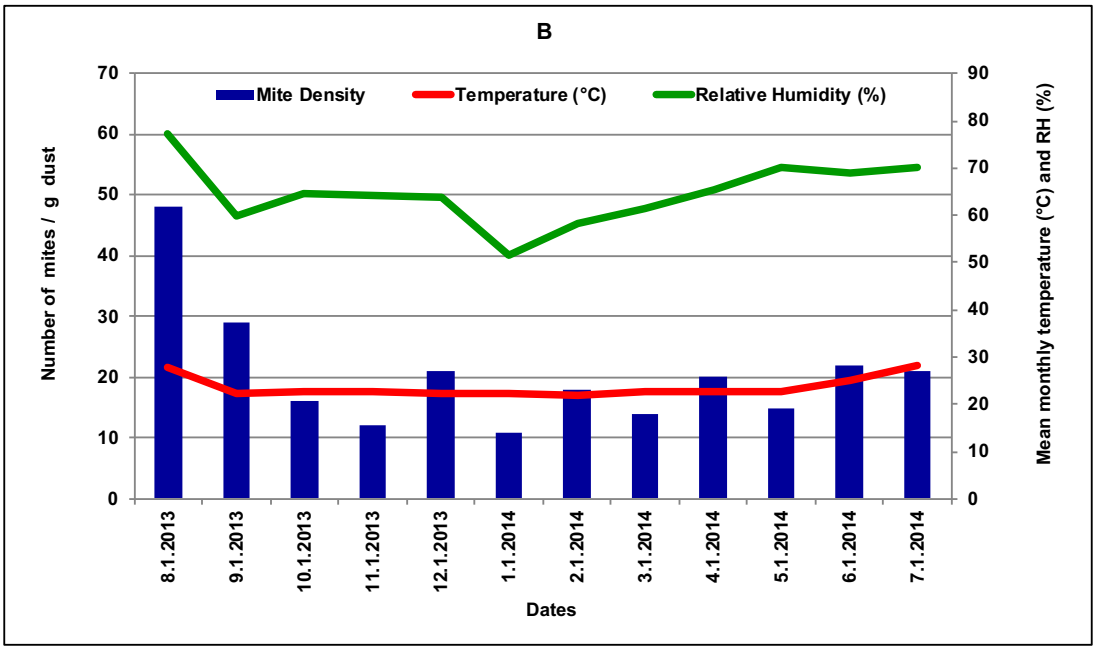

Figure 2. Number of mites/g dust in the house B in the city of Ordu between 2013 and 2014.

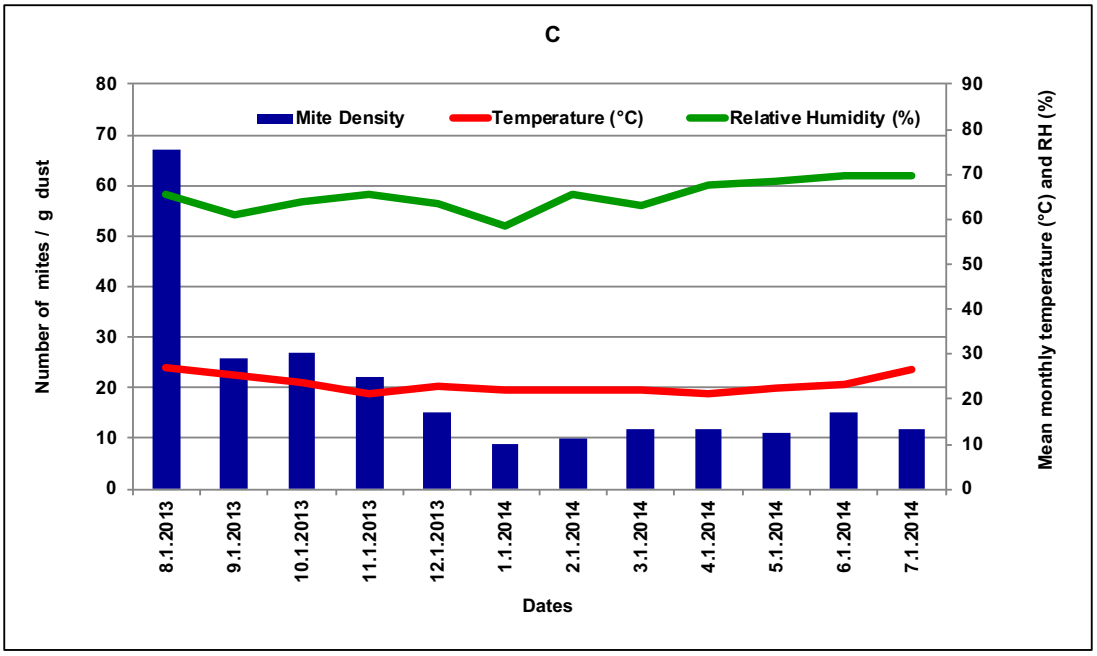

Figure 3. Number of mites/g dust in the house C in the city of Ordu between 2013 and 2014.

In house D, the dust mite density was highest (27 mites/g dust) in August (26.9ºC and 59.33% RH) and May (22.6ºC and 59.1% RH). The lowest mite population was 3 mites/g dust in January (24.3ºC and 59.4% RH) (Figure 4). A total of 171 mite specimens in various developmental stages were determined in this house during the study. They were *D. pteronyssinus* (48 ♀♀, 55 ♂♂, 8 tritonymphs, 4 protonymphs), *D. farinae* (37 ♀♀, 10 ♂♂, 3 tritonymphs, 1 protonymphs), *C. arcuatus* (1 ♂), *Cheyletus* sp. (1 ♀), *Tyrophagus* sp. (2 ♀♀) and *Rhizoglyphus* sp. (1 ♀).

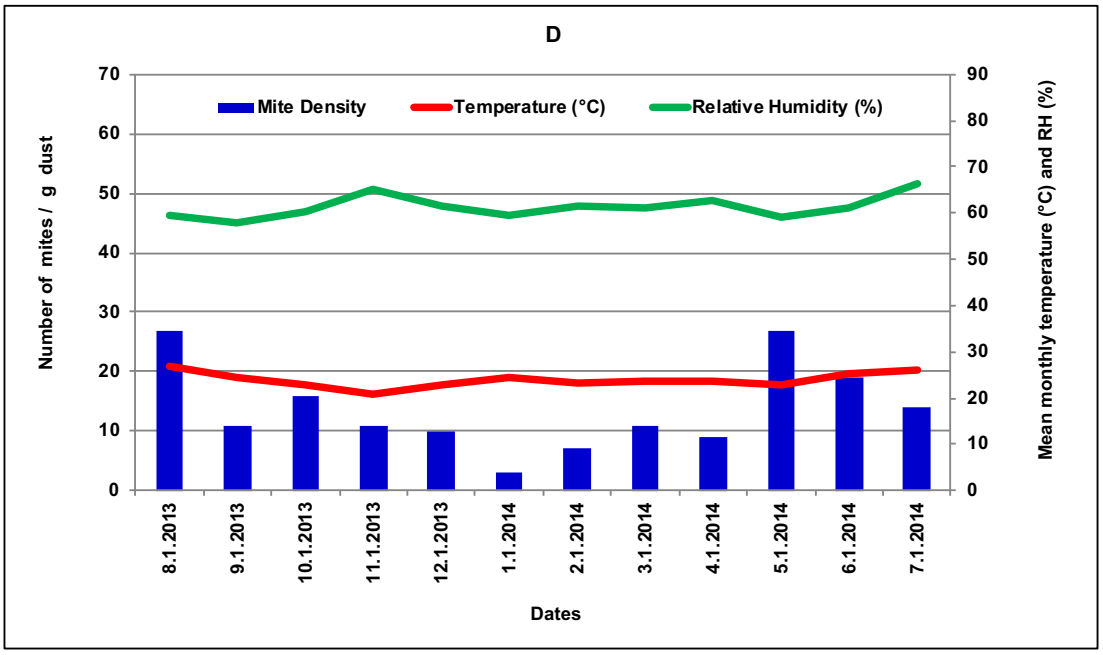

Figure 4. Number of mites/g dust in the house D in the city of Ordu between 2013 and 2014.

In house E, the mite density peaked in August (9 mites/g dust) (28.4ºC and 77.4% RH). The total mite number (22) obtained during the sampling period was the lowest of all the houses (Figure 5). A total of 22 mite specimens in various development stages were determined in this house during the study. They were *D. pteronyssinus* (9 ♀♀, 9 ♂♂, 1 tritonymphs) and *Cheyletus* sp. (3 ♀♀).

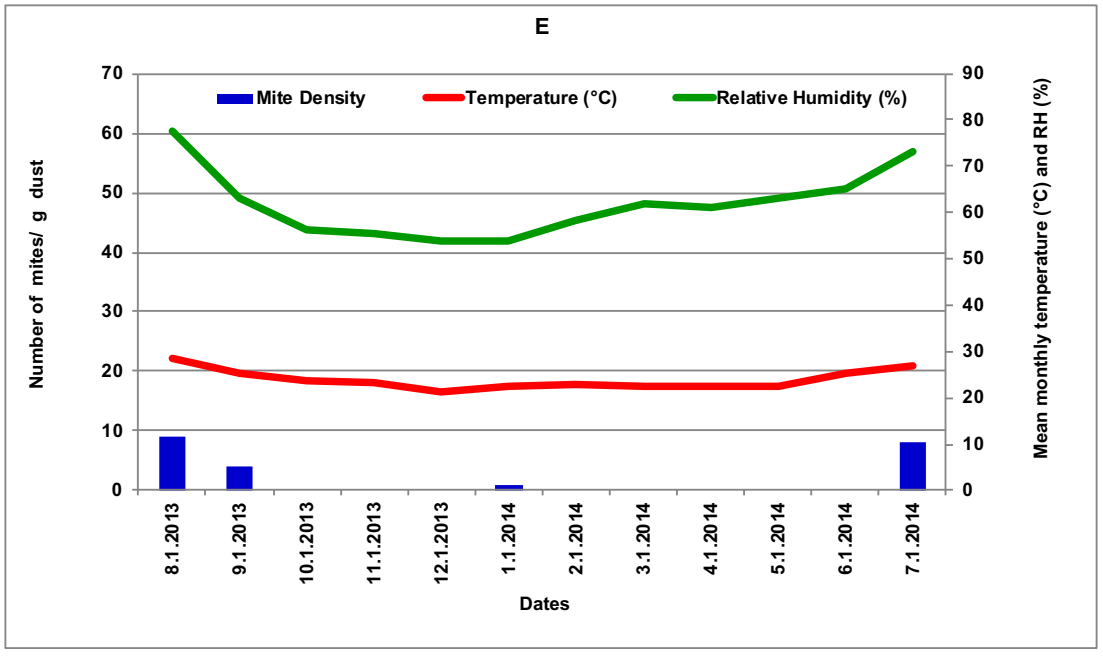

Figure 5. Number of mites/g dust in the house E in the city of Ordu between 2013 and 2014.

The total number of mites obtained from house A, B, C, D and E during the sampling period was 465 (215 in first year and 250 in second year), 247, 238, 171 and 22, respectively.

The highest density of mites (67 mites/g dust) was observed in house C and the lowest (1 mite/g dust) in house E. The person with asthma who lived in house E was highly sensitive to the house dust. It was observed that he took many precautions such as cleaning air vents and ducts, routine cleaning, using of synthetic, hypoallergenic, washable bedding and pillows and special vacuum cleaners to reduce his exposure to indoor dust. It is hypothesized that because of this, the number of mites/g dust in this house was lower than the others. Although completely eliminating dust mites from a given apartment is virtually impossible, their numbers can be reduced by adopting some of the precautionary measures as those mentioned above.

The people who lived in the other houses (A, B, C and D) were also sensitive to house dust. They also took many precautions to reduce exposure to indoor dust. It is also hypothesized that because of this reason, the number of mites in these houses was lower than expected.

Living mites were found all year around in all houses. This is consistent with the results from northern Poland (Racewicz, 2001), Vilnius Region (Duatartiene, 2001) and Turkey (Tatvan) (Aykut et al., 2013).

The mean monthly number of mites changed depending on the room temperature and RH. When we compared the results, the dust mite population was generally higher in August (26-28ºC and 64-78% RH) in all houses. Alternatively, the lowest density was observed in January (21-22ºC and 51-58% RH) in all houses except in house A. These results are consistent with the results obtained by various researchers from other parts of Turkey including Budak (1984) and Kalpaklıoğlu et al. (1997). An increase in the number of mites was observed between June and September in Hasköy (Muş) and November in Dağdibi (Muş) by Aykut et al. (2013) when the outside mean monthly temperature and RH were generally above 20ºC and 50%, respectively. However, the same researchers found that mite numbers were high during the whole year in one house and lowest in August-October in the second house in Tatvan (Bitlis). The mite number was highest from June to September (temperature and RH unspecified) in Kütahya (Akdemir & Gürdal, 2005). In contrast, Ozman-Sullivan & Celik (2010) found that *D. pteronyssinus* had the highest population density in September (temperature and RH unspecified) in Samsun which is another city along the Black Sea coast in Turkey.

Mumcuoglu et al. (1999) found that the highest prevalence of mites occurred in April-November and May-November with a maximum temperature ranging between 30 and 32ºC and RH 45% or above. Sharma et al. (2011) detected higher mite population during the summer and early autumn in South Assam, India. The mean atmospheric temperature and RH of this part of India ranges from 29 to 32ºC and 90 to 94%, respectively. Kosik-Bogacka et al. (2012) examined the seasonal dynamics of mite populations in dust samples collected from sleeping places in northwestern Poland. The mite numbers were high in October to December and low in April to June corresponding to the highest and lowest temperature (24.5 and 19.0ºC) and RH (90 and 68%).

In the current study, *Cheyletus* sp. which is known as one of the major predators of house dust mites were also detected in the dust samples. In accordance with other studies conducted in Turkey, Poland, Chile, Lithuania (Franjola & Malonnek, 1995, Duatartiene, 2001; Racewicz, 2001; Solarz, 2001; Akdemir & Gürdal, 2005; Ozman- Sullivan & Celik 2010), the total number of cheyletid mites obtained during the sampling period was quite low (21 mites, 1.8%) in Ordu. The frequency of *Cheyletus* spp. in house dust samples was higher (20.0-48.5%) in other parts of the world (Montealegre et al., 1997; Baqueiro et al., 2006; Sharma et al., 2011; Kosik-Bogacka et al., 2012). According to Ree et al. (1997) and Henszel et al. (2010), these mites can only develop with particularly high RH and therefore are more common in the tropics than in Europe.

Our results show that the mite abundance reached its peak in each house during August in Ordu. The average temperature and RH during this period in the Ordu homes varied from 26 to 28ºC and 64 to 78% RH, respectively. It is known that dust mites develop optimally at temperatures between 25 to 30ºC and RH between 75 to 95% (Arlian et al., 1990; Collof, 2009).

It was also shown that house dust mites can survive all year round in the city because the mean room temperature and RH during the study in all houses were generally within the optimum range for growth and development of dust mites.

The inhabitants of the sampled houses were sensitive to house dust and accordingly took many precautions to reduce exposure to indoor dust. Given this, it is considered that the number of mites in these houses were lower than expected.

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