

An Important Source for Cat and House Dust Mite Allergens: Day-Care Centers

Kedi ve Ev Tozu Akarı Allerjenleri İçin Önemli Bir Kaynak: Anaokulları

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ABSTRACT Objective: Exposure to indoor allergens during childhood has been associated with an increased risk of sensitization. There is no data about indoor allergen levels in day-care centers in Turkey. We hypothesized that day-care centers (DC) would be relevant sources of cat and mite allergens. **Material and Methods:** Fifty-seven dust samples were collected from 19 DCs in İzmir, their gardens, and classrooms of the primary schools where the DCs are located in. A questionnaire about characteristics of DCs was completed. Fel d 1, Der p 1 and Der f 1 allergen levels were quantitated by enzyme-linked immunoassay. **Results:** Fel d 1 was detected in all, and mite allergens in 94.7% of the samples. Levels exceeding sensitization threshold level for cat and mite allergens were present in 73.7%, and 21.1% of DCs, respectively. Fel d 1 levels exceeding threshold level that might cause asthma exacerbation was detected in 21% of DCs. Fel d 1 levels in DCs and their gardens were higher than the classrooms of the same school. Der f 1 levels were identical in DCs, gardens and classrooms. Der p 1 concentration was higher in DCs with air-conditioning, than DCs without a ventilation system. Although there was no difference for Fel d 1 levels in DCs with or without carpeted floor, Fel d 1 concentrations in DCs with carpet were significantly higher than in classrooms with no carpet. **Conclusion:** Day-care centers in İzmir are important sources of indoor allergens that could cause sensitization or even allergic symptoms in children and their staff.

Key Words: Cats; Fel d 1 protein, felis domesticus; antigens, dermatophagoides; dermatophagoides pteronyssinus; dermatophagoides farina; allergens; child day care centers

ÖZET Amaç: Çocukluk çağında allerjenlere maruz kalınması, allerjik duyarlılıkta artışa neden olmaktadır. Ülkemizde iç ortam allerjen kaynağı olarak anaokullarının durumu hakkında yeterli bilgi yoktur. Bu çalışmanın amacı, kedi ve akar allerjenleri kaynağı olarak anaokullarının yerini araştırmaktır. **Gereç ve Yöntemler:** İzmir'de bulunan 19 anaokuluna ait anasınıfı ve oyun bahçelerinden ve aynı okullara ait 19 ilköğretim sınıfından toplam 57 toz örneği toplandı. Okullarla ilgili sorgulama formu dolduruldu. Fel d 1, Der p 1 ve Der f 1 düzeyleri enzimli immüno essey (ELISA) yöntemi ile ölçüldü. **Bulgular:** Fel d 1 anasınıflarının tümünde; Der p 1 ve Der f 1 ise %94,7'sinde ölçülebilir düzeylerde saptandı. Anasınıflarının %73,7'sinde duyarlılığa, %21,1'inde astım alevlenmesine neden olabilecek düzeyde Fel d 1, %21,1'inde ise duyarlılığa yol açacak düzeyde akar allerjisi vardı. Anasınıflarındaki ve oyun bahçelerindeki Fel d 1 düzeyleri, aynı okullara ait ilköğretim sınıflarındakinden daha yüksekti. Der f 1 düzeyleri, anasınıfları, oyun bahçesi ve sınıflarda benzerdi. Der p 1 düzeyleri, kliması bulunan anasınıflarında, kliması bulunmayan anasınıflarına oranla daha yüksekti. Fel d 1 düzeyleri halı bulunan ve bulunmayan anasınıflarında benzer olsa da, halı bulunan anasınıflarında, halı bulunmayan sınıflara göre daha yüksekti. **Sonuç:** Ölçülebilir düzeyde kedi ve ev tozu akarı allerjenleri İzmir'deki anaokullarında yaygın bir şekilde bulunmuştur. Anaokulları çocuklar ve anaokulu çalışanları açısından önemli bir allerjen kaynağıdır.

Anahtar Kelimeler: Kediler; Fel d 1 protein, felis domesticus; antijenler, dermatofagoidler; dermatofagoides pteronissinus; dermatofagoides farine; allerjenler; çocuk gündüz yuva merkezleri

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Environmental exposure to indoor allergens during early childhood has been associated with an increased risk of allergic sensitization and asthma symptoms among susceptible children.^{1,2} Although the main exposure site to indoor allergens is likely to be in the house, schools and day-care centers where children spend a substantial part of their time may also be important sources for indoor allergens, which may affect children's health. The number of studies that have assessed allergen levels in day-care centers has increased over the past decade.³ Although detected levels of allergens in those studies are highly variable, published data show that exposure to indoor allergens in day care environments is quite common. Moreover, it is not unusual that allergen levels in these settings exceed thresholds that have been associated with allergic sensitization and asthma morbidity.³

Recently we found that, most sampled houses in İzmir had measurable levels of Fel d 1 even in the absence of indoor cats.⁴ The number of studies reporting the presence or levels of mite allergens in Turkish homes is also limited.⁵⁻⁷ However, there is currently no data available regarding indoor allergen levels in Turkish day-care centers. As the prevalence and severity of allergic disease are on the rise worldwide, it may be important to determine the level of allergen exposure in these environments where children spend a large part of their childhood.

The purposes of the present study were to assess and compare exposure to allergens from cat, as well as mites in public child-care facilities in İzmir, Turkey. We hypothesized that day-care centers (DCs) could be relevant sources of exposure to cat as well as mite allergens.

MATERIAL AND METHODS

DAYCARE CENTERS

In this cross-sectional study we evaluated indoor allergen levels in nineteen (14 located in urban areas including Karşıyaka, Buca, Konak, and Bornova; 5 located in rural areas including Seferihisar) public day-care centers situated in four different geographic areas of İzmir, representing the North

(Karşıyaka; n=5), the South (Buca and Konak; n=6), the East (Bornova; n=3), and the Southwest (Seferihisar; n=5) district of the city. At each facility, a questionnaire consisting of day-care properties was administered to the manager and observations were made of the sampled areas. All the managers of daycare centers were given informed consent and they agreed to participate in the study.

COLLECTION AND ANALYSIS OF DUST SAMPLES

A total of 57 dust samples were collected from day-care centers, their gardens, and as a control, classrooms of the school where day-care center is located in, using a 1200 watt vacuum cleaner between March 15-30, 2005. After collecting dust from 1 m² for 2 minutes, the filters were folded, transported to the laboratory in sealed plastic containers and stored at room temperature until analyzed.

EXTRACTION OF DUST SAMPLES AND ALLERGEN MEASUREMENT

Dust samples, each containing 100 mg fine dust, were extracted with 2 mL of PBS-0.5% Tween 20. After 2 hours of incubation at room temperature on a shaker, the extracts were centrifuged at 2500 rpm for 20 minutes at 4°C. The supernatants were stored at -20°C until analysis. Samples were assayed for dust mite allergens, *Dermatophagoides pteronyssinus* (Der p 1) and *Dermatophagoides farinae* (Der f 1), and cat allergen *Felis domesticus* (Fel d 1), and were quantitated by enzyme linked immunoassay (ELISA) (monoclonal antibody assays) as previously described.⁸ All reagents were obtained from Indoor Biotechnologies Inc. The results were expressed as micrograms of allergen per gram of sieved dust (µg/g). The limit of detection for mite allergens and Fel d 1 was 0.21 µg/g, and 0.03 µg/g, respectively. We used sensitization threshold levels at greater than 2 µg/g for Der p 1 and Der f1, and 1 µg/g for Fel d 1; and asthma exacerbation threshold level at greater than 8 µg/g for Fel d 1.⁹

STATISTICAL ANALYSIS

Data were presented as median and 25th-75th percentiles. As allergen data were not normally dis-

tributed, nonparametric Kruskal-Wallis and Mann-Whitney tests were used to compare median concentrations. Wilcoxon Signed Ranks test was used to compare allergen levels in dust samples collected from different parts of day-care centers, such as day-care center itself, its garden, and classroom of the school that day-care center was located in. Mc Nemar Test was used to compare day-care centers and classrooms exceeding sensitization threshold level for Fel d 1. The Fisher's Exact and Pearson Chi-Square tests were used to analyze the relationship between different characteristics of day-care centers and allergen levels exceeding sensitization and asthma exacerbation threshold levels. Data analyses were carried out using SPSS 10.0. A p value of less than 0.05 was considered significant.

RESULTS

CHARACTERISTICS OF THE DAY-CARE FACILITIES

All DCs were located on the basement floor of a public primary school. Seventy four percent of the sampled DCs were situated in urban, and the remaining in rural areas. The mean year of construction for DCs was 1994; in average 26 years after the main building of the primary school had been constructed. The oldest DC was constructed in 1974. There were 19969 students and 768 teachers in primary schools, and 517 pre-school children and 28 teachers in the DCs. The main heating system was central heating. Forty two percent of the DCs had ventilation system. The majority of the DCs had carpeted floors. Either past or present signs of dampness were observed in 21% of the DCs. Although furred pets were not allowed in DCs, in the majority of gardens, at least one furred animal such as a cat or a dog was present. The main characteristics of day-care facilities were summarized in Table 1.

DISTRIBUTIONS OF ALLERGENS

Table 2 provides summary statistics for concentrations of the Fel d 1, Der f 1, and Der p 1 allergens in all 57 samples. Each allergen was detected in a great majority of sampled areas, ranging from 87.7% to 100%. Although cats were not allowed in

DCs, cat allergen was found in all samples. The highest median allergen concentration was for Der p 1, followed by Fel d 1 and Der f 1.

In nineteen day-care centers, measurable levels of Fel d 1 were detected in all collected samples (median 1.48 µg/g; range 0.24-8.4 µg/g). Mite allergens were present in 94.7% of the samples (Der p 1 0.42 µg/g; range 0.39-2.20 µg/g, and Der f 1 0.59 µg/g; range 0.22-2.51 µg/g). The highest Fel d 1 level was detected in DCs followed by DC gardens and classrooms of the school in which DCs were situated. Box plots for the distributions of the allergens were shown in Figure 1.

In fourteen (73.7%) out of nineteen DCs, detected Fel d 1 levels exceeded 1 µg/g, a threshold level that was previously reported to cause cat sensitization, whereas only 5.3% of classrooms had Fel d 1 exceeding this level ($p=0.00001$ Mc Nemar Test). Moreover in 21.1% of the DCs, Fel d 1 levels were higher than 8 µg/g; a level that might cause asthma exacerbation. Regarding mite allergens, levels exceeding a threshold that might cause sensitization (2 µg/g) were found in 21.1% of the DCs.

Both Fel d 1 and Der f 1 were found in higher concentrations in Karşıyaka, followed by Konak and Bornova for Fel d 1, and Konak for Der f 1. The highest Der p 1 level was detected in Buca. Detailed information about allergen concentrations in five different districts was summarized in Table 3. For Fel d 1, Der p 1, and Der f 1 levels, there was no difference between urban and rural DCs. Allergen distribution in urban and rural DCs was shown in Figure 2.

DCs' characteristics such as the age of the building, number of students, carpeted floors, age of the carpet, presence and the severity of dampness or mold at DCs' environment, presence or kind of animals, were not consistently related to the presence or levels of indoor allergens in each location (Table 4). Der p 1 concentration was higher in DCs with air-conditioning, than in DCs without a ventilation system (0.67 µg/g vs. 0.45 µg/g; $p=0.008$). Although there was no difference for Fel d 1 levels in DCs with or without carpet on the floor (Table 4), Fel d 1 concentrations in DCs

TABLE 1: Characteristics of day-care centers.

Characteristics	Karşıyaka n=5	Buca n=5	Seferihisar n=5	Bornova n=3	Konak n=1	Total n=19
Location	Urban, North	Urban, South	Rural, South West	Urban, East	Urban, South	
Year building constructed (mean±SD; range)	1973±27 (1931-1993)	1982±23 (1947-2001)	1978±31 (1927-2004)	1936±71 (1855-1990)	1926	1968±37 (1855-2004)
Year DC constructed (mean±SD; range)	1999±5.54 (1989-2002)	1993±10.90 (1974-2001)	1993±10.92 (1975-2004)	1993±5.19 (1990-1999)	1976	1994±9.36 (1974-2004)
Number of students in schools	5221	8300	1684	3814	950	19969
Number of teachers in schools	218	279	87	144	40	768
Number of children in DCs	130	93	115	125	54	517
Number of teachers in DCs	8	6	5	6	3	28
Heating system						
Stove	0	0	0	1	0	1(5.2%)
Central heating	5	5	5	2	1	18(94.7)
Electricity	0	1	0	0	0	1(5.2)
Air conditioning	4	3	0	1	0	8(42.1%)
Ventilation						
Present	4	3	0	1	0	8(42.1%)
Floor						
Stone	0	1	1	0	0	2(10.5%)
Wood	0	1	1	1	0	3(15.8%)
Carpet	5	3	3	1	0	12(63.2)
Other	0	0	0	1	1	2(10.5%)
Carpet						
Wool	0	1	0	0	0	1(5.2%)
Synthetic	5	2	3	1	0	11(57.9%)
Age of carpet (month) (mean ±SD; range)	31.2±6.5 (24-36)	16.7±12.7 (2-24)	13.7±9.0 (7-24)	60	-	25.58±15.57 (2-60)
Dampness						
Present	3	1	0	0	0	4(21%)

count

TABLE 1: count.

Severity of dampness									
Mild	0	0	0	0	0	0	0	0	0
Moderate	3	1	0	0	0	0	0	0	4(21%)
Severe	0	0	0	0	0	0	0	0	0
Mold									
Present	2	1	0	0	0	0	0	0	3(15.8%)
Severity of mold									
Mild	2	1	0	0	0	0	0	0	3(15.8%)
Moderate	0	0	0	0	0	0	0	0	0
Severe	0	0	0	0	0	0	0	0	0
Cockroach									
Present	0	1	0	0	1	0	0	0	2(10.5%)
Any furred animal									
Present	5	2	4	4	3	1	1	1	15(79%)
Type of animal									
Mouse	3	1	2	2	3	1	1	1	10(52.6%)
Rat	3	1	1	1	2	1	1	1	8(42.1%)
Cat	5	2	4	4	1	1	1	1	13(68.4%)
Dog	4	2	4	4	1	1	1	1	12(63.2%)

* DC: Day-care.

TABLE 2: Summary of allergen concentrations from all collected samples (day-care center, DCs' garden and classroom, n=57).

Allergen	Unit	%Positive*	Mean	Std. Deviation	Minimum	Maximum	Median	Percentiles 25	75
Fel d 1	µg/g	100	1.36	2.31	0.03	8.40	0.45	0.22	1.17
Der f 1	µg/g	87.7	0.58	0.55	0.00	2.51	0.41	0.39	0.47
Der p 1	µg/g	98.2	0.74	0.41	0.00	2.70	0.64	0.52	0.89

*Samples with detectable allergens.

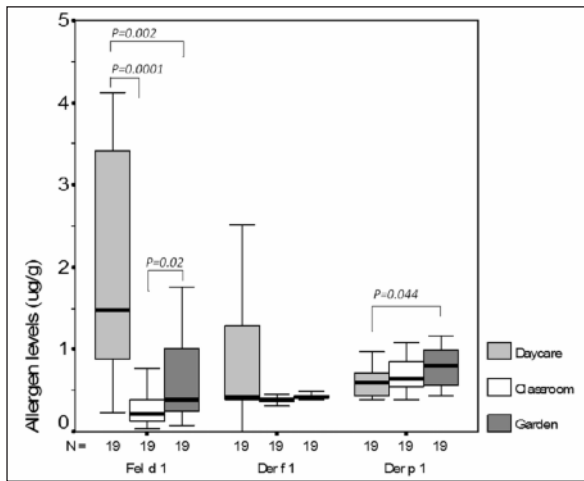


FIGURE 1: Distribution of indoor allergen concentrations in day-care centers (DCs), their gardens, and classrooms. Values were given as median and 25th-75th percentiles. All concentrations are in micrograms per gram. Fel d 1 levels in DCs and their gardens were higher than the classrooms of the same school (1.48 µg/g; 0.72-4.12, 0.39 µg/g; 0.22-1.04, and 0.22 µg/g; 0.11-0.44, respectively, $p=0.0001$). Der p 1 levels were higher in the gardens than in the DCs (0.81 µg/g; 0.54-0.99 vs. 0.59 µg/g; 0.43-0.70, $p=0.044$). Although Der f 1 levels in DCs were slightly higher (0.42 µg/g; 0.39-1.58 vs. 0.4 µg/g; 0.32-0.41) than levels detected in classrooms ($p=0.05$), Der f 1 levels were similar in DCs (0.42 µg/g; 0.39-1.58), their gardens (0.42 µg/g; 0.40-0.47), and classrooms (0.40 µg/g; 0.32-0.41).

with carpeted floors were significantly higher than in classrooms with no carpet (2 µg/g; 1.25-2.00 vs. 0.23 µg/g; 0.13-0.42, $p=0.002$).

DISCUSSION

This is the first national study run to investigate some important indoor allergen levels in day-care centers in Turkey. We demonstrated for the first time that day-care centers in our country might also be important sources of allergen exposure for children. The main finding of this study is that detectable levels of Fel d 1, Der f 1, and Der p 1 were commonly found in day-care facilities. In 2005, the

year when this study was conducted, there were 765 day-care centers with 22565 enrollments and 1553 teachers in Izmir, Turkey (Turkey’s Statistical Year Book 2005: <http://www.turkstat.gov.tr>). Thus, our study included about 2.48 % of all DCs in Izmir at that time point. In 2010, there are 1176 day-care centers with 58 973 enrollments and 1874 teachers (Turkey’s Statistical Year Book 2010: <http://www.turkstat.gov.tr>). Considering these data and our findings in the present study, we can suggest that the DCs’ environment may have important effects on a large population in an age when sensitization can occur.

As can be extrapolated from Table 2, most of the sampled areas had detectable indoor allergen levels. Mite allergens were present in more than 94% of sampled DCs. This is approximately twice the rate reported for houses located in Izmir.⁵ It is well established that ambient relative humidity is a key environmental factor that influences mite populations, and dust mite allergen levels are strongly associated with humidity levels. In the studied facilities, the highest average concentrations were detected in Brazil and in some humid regions in the United States.¹⁰⁻¹² In contrast, very low dust mite allergen levels have been found in colder and drier climates.¹³⁻¹⁵ Average yearly humidity in Izmir is 57.9%. In March, when this study was conducted, the average monthly humidity was 61.7% (Data from Turkey’s Statistical Year Book 2010: <http://www.turkstat.gov.tr>). To survive and thrive, dust mites require a relative humidity of air greater than 55% for a sufficient period of time because water vapor in air is their main source of water.³ As Izmir’s relative humidity favors the increase of mite populations, it was not surprising to find mite allergens so frequently in DCs.

TABLE 3: Allergen levels in day-care centers (DCs) in different locations. Values were given as median and minimum and maximum. Kruskal-Wallis test was used to compare allergen levels in different districts.

Allergen	Karşıyaka n=5	Buca n=5	Seferihisar n=5	Bornova n=3	Konak n=1	p value
Fel d 1 (µg/g)	2.70 (1.16-8.4)	1.02 (0.32-4.12)	0.72 (0.24-8.4)	1.48 (1.04-8.4)	1.66	0.288
Der f 1 (µg/g)	1.72 (0.39-1.96)	0.41 (0.22-0.72)	0.42 (0.0-2.51)	0.42 (0.39-0.43)	0.99	0.595
Der p 1 (µg/g)	0.62 (0.47-0.87)	0.64 (0.49-2.20)	0.45 (0.0-0.97)	0.62 (0.4-0.66)	0.43	0.399

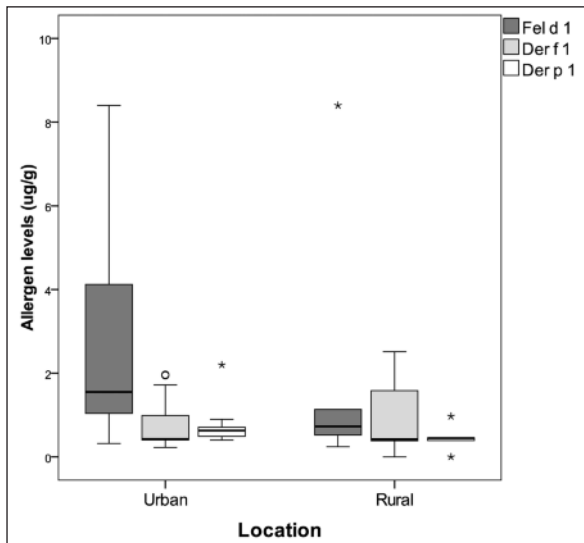


FIGURE 2: Allergens levels in urban vs rural day-care centers (DCs). Fel d 1 levels detected in urban DCs were higher than in rural levels (1.55 µg/g; 0.32-8.4 vs. 0.72 µg/g; 0.24-8.4, p=0.177 Mann Whitney U test). Der f 1 and Der p 1 levels were almost identical..

Fel d 1 was detected in all of day-care facilities, even though pets were not allowed in DCs. This finding is consistent with other studies that have reported the presence of pet allergens in places where dogs and cats would not be present, such as schools.¹⁶ Currently, it is a well known en-

tity that animal allergens can be present in environments in which no animals reside.³ Several studies worldwide have demonstrated that levels of cat and dog allergens in day-cares and schools correlate with the number of children and staff who have either dogs or cats at home or have frequent contacts with those pets. The number of pet owners at school or day-care centers is one of the strongest predictors of increased cat and dog allergen levels in these settings.^{3,15,17-19} While cat ownership is unknown in this study, cats were present in 68% of DC gardens. As we previously reported, stray cats are common in İzmir, and even this alone may explain why all DCs have detectable cat allergens.⁴

In day-care centers, cat allergens are frequently detected, but the levels of exposure vary greatly.³ In general, Fel d 1 is at low levels in these settings. Nonetheless, although the magnitude of exposure tends to be low, studies have demonstrated that allergen levels in educational facilities can be higher than in houses where no pets are present.²⁰ Moreover, it is not uncommon that Fel d 1 levels in DCs sometimes exceed thresholds that have been associated with allergic sensitization (1.0 µg/g) or asthma symptoms in sensitized individu-

TABLE 4: Associations between the characteristics of day-care centers and allergen levels.

DCs' Characteristics		Fel d 1	p	Der f 1	p	Der p 1	p
Age of the building	Before 1960	1.40 µg/g (0.32-8.40)	0.287	0.85 µg/g (0.38-1.96)	0.798	0.41 µg/g (0.39-2.20)	0.367
	1961-1990	1.48 µg/g (0.24-2.70)		0.42 µg/g (0.0-1.72)		0.69 µg/g (0.0-0.85)	
	After 1991	1.30 µg/g (0.34-8.40)		0.42 µg/g (0.22-2.51)		0.56 µg/g (0.45-0.97)	
Age of DC	Before 1995	1.03 µg/g (0.24-2.70)	0.188	0.42 µg/g (0.0-1.72)	0.704	0.62 µg/g (0.0-0.85)	0.933
	After 1995	1.55 µg/g (0.32-8.40)		0.42 µg/g (0.38-2.51)		0.56 µg/g (0.39-2.20)	
Air-conditioning	Present (n=8)	1.55 µg/g (0.32-8.40)	0.561	0.42 µg/g (0.22-1.96)	0.967	0.67 µg/g (0.54-2.20)	0.008
	Absent (n=11)	1.13 µg/g (0.24-8.40)		0.42 µg/g (0.0-2.51)		0.45 µg/g (0.0-0.97)	
Carpet	Present (n=12)	1.32 µg/g (0.32-8.40)	0.524	0.47 µg/g (0.22-2.51)	0.583	0.51 µg/g (0.39-2.20)	0.674
	Absent (n=7)	1.48 µg/g (0.24-4.12)		0.42 µg/g(0.0-1.58)		0.62 µg/g (0.0-0.97)	
Dampness	Present (n=4)	5.55 µg/g (0.34-8.40)	0.228	1.07 µg/g (0.22-1.96)	0.582	0.74 µg/g (0.63-0.90)	0.089
	Absent (n=15)	1.15 µg/g (0.24-8.40)		0.42 µg/g (0.0-2.51)		0.49 µg/g (0.0-2.20)	
Any pets	Present (n=15)	1.48 µg/g (0.24-8.40)	0.841	0.42 µg/g (0.0-2.51)	0.230	0.62 µg/g (0.0-2.20)	0.617
	Absent (n=4)	1.32 µg/g (0.73-4.12)		0.40 µg/g (0.38-0.54)		0.54 µg/g (0.39-0.70)	
Observed cat	Present (n=13)	1.15 µg/g (0.24-8.40)	0.597	0.72 µg/g (0.0-2.51)	0.160	0.62 µg/g (0.0-2.20)	0.430
	Absent (n=6)	1.55 µg/g (0.73-8.40)		0.40 µg/g (0.38-0.52)		0.54 µg/g (0.39-0.70)	
Cockroach	Present (n=2)	4.35 µg/g (0.32-8.40)	0.947	0.55 µg/g (0.39-0.72)	0.790	1.30 µg/g (0.40-2.20)	0.690
	Absent (n=17)	1.48 µg/g (0.24-8.40)		0.42 µg/g (0.0-2.51)		0.59 µg/g (0.0-0.97)	

DC: Day-care center.

als (8.0 µg/g).²¹ The highest average concentrations have been found in US and Swedish schools, and levels as high as 11.3 µg/g for Fel d 1 have been reported.²² In this study, we found that Fel d 1 levels exceeding sensitization threshold level were present in more than 70% of DCs. Moreover, 21% of DCs had Fel d 1 levels exceeding threshold level that may cause asthma exacerbation in sensitized subjects. In this study, sensitization threshold levels for mite allergens rarely exceeded the threshold level in sampled DCs. Moreover, none of the median concentrations exceeded a threshold (>10 µg/g) that has been associated with asthma symptoms. Previous studies showed that Der f 1 and Der p 1 were found in low levels in many schools and day-care facilities.³ Reported mite allergen levels are often similar or slightly lower than in corresponding local homes.²³⁻²⁵ Similarly, Der p 1 levels detected in houses in İzmir were slightly higher (2 µg/m²; 0.4–5.4) than Der p 1 levels reported in this study. Nevertheless, we found that more than 20% of DCs had mite allergen levels exceeding threshold level for sensitization.⁵

Although Fel d 1 and Der f 1 allergen concentrations were higher in DCs located in Karşıyaka, followed by Konak and Bornova for Fel d 1; and Konak for Der f 1; and the highest Der p 1 level was detected in Buca, there were no significant differences regarding allergen levels between different districts. There were also no differences for Fel d 1, Der p 1, and Der f 1 levels, between urban and rural DCs.

Levels of cat allergens varied with the location of sampling. The cat allergen levels were significantly higher in day-care centers than in their gardens and classrooms of the primary schools (Figure 1). Possible explanations are that all DCs were located on the basement floor of a public primary school with more than 60% with carpeted floors. However, most of the classrooms were located on the first stage of the buildings, with no carpet on the floors. These findings suggest that in the pres-

ence of stray cats in the garden and with carpeted floors, it is not surprising to have higher levels of cat allergen in DCs than in primary school classrooms. Although there was no difference for Fel d 1 levels in DCs with or without carpet on the floor (Table 4), Fel d 1 concentrations in DCs with carpeted floors were significantly higher than in classrooms with no carpet (2 µg/g; 1.25-2.00 vs. 0.23 µg/g; 0.13-0.42, respectively. $p=0.002$). Cat and dog allergen levels have generally been found in higher levels in carpeted and upholstered areas.^{13,16,24,26} However, this relationship with carpeted floor was not present in all studies.¹¹

Although mite levels tend to exhibit seasonal fluctuations that parallel those in ambient relative humidity, additional factors, including human activities and heating, ventilation, and air conditioning may also influence indoor air humidity levels.³ In keeping with this data, we found that Der p 1 concentration was higher in DCs with air-conditioning system for ventilation (0.67 µg/g vs. 0.45 µg/g; $p=0.008$). The presence of dampness also caused higher levels of mite allergens in DCs (0.72 µg/g vs. 0.40 µg/g for Der f 1, and 0.74 µg/g vs. 0.49 µg/g for Der p 1, see Table 4). Although it has been reported that dust mite allergen levels in day-care centers tend to be higher in carpeted areas, in this study such a relationship was not documented.^{23,27,28}

In summary, this study provides evidence that detectable levels of Fel d 1, Der f 1, and Der p 1 are commonly found in day-care facilities. Day-care centers in İzmir, Turkey may be an important source of indoor allergens that could cause sensitization or even allergic symptoms in children and the staff of day-care centers, perhaps as important as houses. The authors think that it is worth to run new studies to characterize allergen exposures in day-centers in other regions of the country, to identify modifiable predictors of allergen levels, and to examine relationships between allergen exposures in day-care facilities and health outcomes in children and day-care workers.

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