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Title of the manuscript: Occupational allergy to dog among police dog trainers

Author names: Gülin G. Kesici, MD[1], Arzu Karataş, MD[2], İlhan Ünlü, Associate Professor[3], Engin Tutkun, Associate Professor[4]

[1]Ankara Atatürk Education and Research Hospital, Department of ENT, 06800, Ankara

[1]Ankara Occupational Diseases Hospital, Department of ENT, 06300, Ankara

[2] Başkent University, Department of Dermatology, 06790, Ankara

[1]Ankara Occupational Diseases Hospital, Department of Dermatology, 06300, Ankara

[3] Düzce University, Department of ENT, 81000, Düzce

[3]Ankara Occupational Diseases Hospital, Department of ENT, 06300, Ankara

[4] Bozok University, Department of Toxicology, 66100, Yozgat

[4]Ankara Occupational Diseases Hospital, Department of Toxicology, 06300, Ankara

Corresponding author: Gülin Gökçen Kesici, M.D.

Mailing adress:

Ankara Atatürk Education and Research Hospital, Çankaya, Ankara, 06800, Turkey

E-mail: gulingokcenmd@gmail.com

Contact phone number: +905058261851

Fax number: +90312-2912525

ABSTRACT

This study was aimed to reveal the prevalence of dog allergy and other common allergy and allergic symptoms in police dog trainers. Fifty-six police dog trainers and 150 workers as control group were included in this study. Medical records of dog trainers including respiratory, skin, eye symptoms and physical examinations and skin prick test results are compared with the medical records of control group. Positive SPT to dog was present in 21.4% of dog trainers, whereas the frequency of sensitization to dog in the control group was 1.3% ($p<0.001$). Dog allergy development risk is found 20 times greater in dog trainers than control group. In multiple logistic regression analysis it was found that atopy was associated with dog allergy likelihood. Sensitization to dog allergens is an important occupational problem for dog trainers.

Keywords: animal allergy; atopy; skin prick test; allergic rhinitis; sensitization

INTRODUCTION

Dog allergy is a worldwide problem that affects 5–10% of the adult population and is a common cause of asthma and allergic rhinitis[1-3]. Animal allergy as an occupational hazard was reported especially in animal laboratory workers. There are few studies on occupational dog allergy. The respiratory and cutaneous allergic symptoms in occupations that are exposed to animal proteins has been reported particularly in veterinarians, veterinary technicians, animal laboratory workers and pet shop workers[4-8]. The main sources of mammalian allergens are hair, dander, saliva and serum[9-10].

Allergy to mammals is usually caused by recurrent contact with mammalian allergens. It was determined that seventy percent of laboratory workers have developed allergies to animals in 2-4 years after exposure. In case of prolongation of exposure one third of sensitized individuals could develop occupational asthma[11]. In this situation atopy is a significant risk factor. Atopy is defined as an increased propensity to mount an IgE antibody response to low-dose environmental aeroallergens. Atopy is generally established by detection of IgE antibodies to common environmental allergens, such as pollen and house dust mite.

In the literature, dog allergies have been reported among pet shop workers, veterinarians, workers in animal hospital, in animal shelters, and animal caretakers[12-16]. There is no occupational allergy described in the literature in the profession group of police dog trainer.

In this article, we aimed to reveal the prevalence of allergic diseases in police dog trainers. Also we evaluated allergic symptoms, skin prick test results, dermatological, respiratory system findings of police dog trainers. In addition, we investigated factors that were associated with the presence of allergy among these participants. As a result of this study, we aimed to find out whether there is a need for preventive programs against allergic

and respiratory diseases among this occupational group in Turkey that is a country with a low pet-keeping rate.

MATERIALS AND METHODS

Study design and participants

This study was conducted in Ankara Occupational Diseases Hospital. In this hospital different occupational groups are routinely examined at certain times. Fifty six police dog trainers and 150 workers as control group were included in this study. Non-animal workers were selected as a control group from 5 different occupations (indoor workers). Medical records of dog trainers including respiratory, skin, eye symptoms and physical examinations and skin prick test results are compared with the medical records of control group. The study was carried out in accordance in the Declaration of Helsinki. Institutional ethic committee approved the study and written informed consent was obtained from all participants. There were no subjects that have dog as a pet at any time. Exclusion criteria of the study were taking antihistamine drugs in 15 days prior to hospital visit, severe common cold, dermatographism, and pregnancy.

Clinical history and examination

From each participant, we obtained demographic details, smoking history, family history of atopy (at least one parent or sibling), detailed information of animal contact, occupational and nonoccupational symptoms, pets at home, and animal contact during previous jobs or education, and medical and occupational history. Rhinorrhea, sneezing and nasal congestion were considered as allergic rhinitis; cough, wheezing and shortness of breath were considered as pulmonary symptoms; itchy rash and urticaria were considered as

skin symptoms; and eye itching and redness were considered as conjunctivitis. It was considered that symptoms as work-related if they started after exposure to dogs at work in dog trainers group.

Skin prick testing

Skin prick tests (SPT) were performed using a common panel, including feather mix, cat epithelia, dog epithelia, cow epithelia, goat epithelia, poultry, Dermatophagoides pteronyssinus, Dermatophagoides farinae, Alternaria, Aspergillus fumigatus, tree and weed mix pollens, Ash (Fraxinus excelsior), walnut, willow tree (Salix caprea), poplar (populous alba), beech (fagus silvatica), pine tree, latex, wheat, cockroach allergen extracts, a positive control (histamine, 10 mg/mL), and a negative control (Allergopharma, Stockholm, Sweden). Allergens were applied on the volar side of the forearm using lancets. Skin prick test results were read after 15 minutes and were considered positive if the largest wheal diameter was at least 3mm and surrounded by erythema. Additionally, results of the negative control test were considered negative when the wheal diameter was less than 1 mm in the absence of erythema.

Statistical analyses

Data were analyzed using the SPSS version 21.0 software program (Statistical Package for Social Sciences v.21, IBM, Chicago, IL). Pearson Chi-Square test and Fisher's exact test were, where appropriate, used to investigate the association between categorical variables. The Student t test was used to compare continuous numerical variables between groups. To analyze risk of group odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated for each allergen in SPT. To predict skin prick test positivity to dog allergen, binary logistic regression was used for multivariate analysis of all potential predictors associated with sensitization to dog. All variables were forced to enter the equation in

regression models.

RESULTS

General Data

This study included 206 subjects, including 56 in the dog trainer group and 150 in the control group. There was no difference in age between groups (p: 0.835). There was no difference in the proportion of female proportion between groups (p: 0.295). Characteristics of the study population are shown in Table 1.

Control group characteristics

Of the control group (n=150), 10 (6.6%) were female and 140 (93.3%) were male. The mean age of control group was 33.18 years (standard deviation, SD;±14.83, min-max;18-75 years). The current smoking rate was 21.3%. Subjects in control group worked at 5 different facilities (indoor workers), and their workplaces were free of exposure to animals. No worker worked in outdoor work.

Of the control group (n=150), 44 (29.3%) subjects reported having rhinitis, 19 (12.6%) reported skin symptoms, 15 (10%) reported conjunctivitis, 6 (4%) reported ever having asthma.

Of the control group (n=150), 31 (20.6%) subjects were sensitized to at least 1 common allergen in skin prick test. A summary of the skin prick test results of the subjects is given on the Table 2.

Dog trainer group characteristics

Fifty-six dog trainer were examined. Of these 56 subjects, 1 (1.7%) was female and 55 (98.2%) were male. The mean age of dog trainer group was 33.6 years (SD;±6.37, min-

max;25-52 years). The current smoking rate was 10.7%. The mean working duration was 6.02 years (SD;±5.82, min-max;0.5-20 years).

Allergic symptoms were mainly reported by dog trainers. Of the dog trainers (n=56), 35 (62.5%) dog trainers reported ever having rhinitis, 13 (23.2%) reported skin symptoms, 7 (12.5) reported ever having conjunctivitis, 1 (1.7%) reported ever having asthma. 6 (10.7%) dog trainers reported work related symptoms. The distribution of symptoms according to the presence or absence of dog allergy is given in the Table 3.

Of the dog trainers (n=56), 37 dog trainers (66%) were sensitized to at least 1 common allergen in skin prick test. Of the sensitized subjects (37 cases), 1 (1.7%) was sensitized only to dog allergen. Twelve subjects were sensitized to dog allergen. There was cat-feeding history in the two participants' report. One of these participants had a positive SPT for cat. But no participant reported ever seeing dog in his or her homes. A summary of the skin prick test results of the subjects is given on the Table 2.

Table 2 and Figure 1 are showing the prevalence of positive skin prick test to common allergens in the dog trainer group and the control group. It was observed that a positive SPT to dog in 21.4% of dog trainer, whereas the frequency of sensitization to dog in the control group was 1.3% ($p<0.001$, odds ratio [OR]=20.18, 95% CI 4.35-93.60). Dog allergy development risk is found 20 times greater for dog trainers than control group.

Table 3 is showing comparison of characteristics of the dog trainer with and without dog allergy. Contrary to expectation, there was no statistically significant difference between the subjects with and without family history of atopic disorders in terms of sensitization to dog. Only rhinitis symptom was statistically significant more in the subjects with sensitization to dog, the other allergic symptoms were not. Reporting work-related allergic symptoms was related to positive skin prick test results to dog allergens by 83.3%. Two dog trainers with positive dog allergen SPT reported no clinical symptoms after exposure to dogs.

There was no statistically significant difference between individuals with and without dog allergy in terms of accompanying allergy other than aspergillus fumigatus allergy.

Multiple Logistic Regression

A logistic regression was performed to ascertain the effects of age, smoking status, pet keeping, working duration, family history of atopic disorders and skin prick test positivity (against allergens other than the dog allergen) on the likelihood that dog trainers have dog allergy. The logistic regression model was statistically significant, p=0.039. The model explained 37.0% (Nagelkerke R^2) of the variance in the dog allergy and correctly classified 85.7% of cases. Skin prick test positivity (against allergens other than the dog allergen) was associated with dog allergy likelihood; age, smoking, cat keeping, bird keeping, working duration and family history of atopic disorders were not associated with dog allergy likelihood. The subjects with positive skin prick test against allergens other than the dog allergen were 27.81 times more likely to exhibit dog allergy than the subjects with negative skin prick test (95% CI 1.630-474.847, p=0.022). Having pets other than the dog was not associated with positive skin prick test to dog. (Table 4)

DISCUSSION

This study aimed to reveal the prevalence rate of allergic diseases among police dog trainers by using skin prick test. It has been estimated that sensitization to dog confirmed by skin prick test can cause rhinitis, eczema and asthma[17]. Skin prick testing (SPT) is informative and safe for detecting IgE-mediated allergen sensitization. No subject kept dogs at home in the past and current. For this reason, a potential confounder that keeping dog at home was excluded. Dogs were living always in the stations and trainers were not allowed to take dogs to their homes and trainers were spending time with dogs only in the workplace.

Thus, this study reflects the real effect of workplace exposure on the development of dog sensitivity. This is the first study investigating work-related symptoms and allergic sensitivity in dog trainers.

In this study it was found that sensitization to dog allergens was higher among dog trainers (%21.4) than control group (1.3%). Krakowiak et al. found allergies to animal (dog, cat, rat, mouse, rabbit, guinea pig and hamster) in 26% of zoo workers[18]. In many studies, it has been determined that animal workers have an increased risk of animal allergy[11,15,19,20]. Current study recommend that police dog trainers should also be accepted as animal workers in terms of allergy because they spend nearly all of their work time with dogs. Airborne dog allergens can be deposited in the workplace[21]. Additionally dog saliva is an allergen source for dog allergy. There is variability between the IgE-binding protein profiles of saliva from different dogs[22]. It has been found there are at least 12 protein bands in dog saliva that can be recognized by IgE of dog-allergic patients. Also it has been determined that there is a great variation in the IgE-binding profile, when investigating saliva from different dog breeds. On account of this, contact with many dogs and different breed dogs can increase the likelihood of allergy.

Other than dog allergies, weed was the allergen with the highest prevalence of sensitization among the dog trainers. Frequency of sensitization to weed differed significantly between dog trainers and controls (23.2% versus 9.3%). Also sensitization to cat, dermatophagoides pteronyssinus, aspergillus fumigatus, walnut, willow, pine, and cockroach were significantly more frequent in dog trainers than controls. (Table 2) Allergenic cross-reactivity between dog and cat was explored[23]. It was found that increased risk of sensitization to dogs 20.1–fold, to dermatophagoides pteronyssinus 3.4-fold, and to aspergillus fumigatus 11.4-fold in dog trainers group. There are also endotoxin or other microbial agent exposures from dogs. It has been found that mites feed on animal scales, so

sensitization to mite allergens may be due to occupational factors[21]. Also, dog trainers had a 4.8-fold increased risk of sensitization to walnut, a 5.6-fold increased risk of sensitization to willow. Dog trainers may contact to these allergens at work. The important question at this point is that whether the results of dog exposure specifically influence only the risks of dog allergy or the risks of allergy to multiple allergens. This study has been conducted in a country with a low pet-keeping rate. In this country, it has been found that dog allergen exposure due to passive transport is a less important problem in countries with low pet-keeping ratios[16]. Therefore, it was thought that results reflect the real effect of workplace exposure.

It was observed that the prevalence of rhinitis in dog trainers was higher than the control group. Respiratory, skin and eye symptoms were found similar between study and control groups. Although it was found that sensitization to dog allergen in 21.4%, work-related symptoms were declared in 33.9% of dog trainers. Nineteen animal workers with allergy symptoms had negative animal allergen SPT. While symptom and atopy rates were quite high, sensitivity to animal allergens was less than expected. Negative skin tests in symptomatic individuals may be due to non-IgE mediated mechanisms. Dog trainers reported frequent work-related symptoms in this study. Dog trainers have close contact with dogs; also dogs contain high levels of allergens such as mite and fungal allergens. Because of this, work-related symptoms may be occurred more frequently. So, dog trainers are exposed to a variety of allergens, which constitute a risk factor for allergic sensitization and symptoms. The presence of work-related symptoms could be explained by exposure to other allergens or non-specific irritants in the workplace. Two dog trainers with sensitization to dog (by using skin prick test) reported no clinical symptoms after exposure to dogs. Similarly in a laboratory workers study, it has been found that sensitization rates were 12.7 and 16.3%

exposed to mice and rats, respectively, and work-related complaints occurred in 33.7% and 37.8% of employees occupationally[24].

The multivariate logistic regression analysis revealed a significant role of skin prick test positivity (against allergens other than the dog allergen) was associated with dog allergy likelihood. Age, smoking, working duration, pet seeing and family history of atopic disorders found not an independent risk factor for the development of sensitization to dogs. Although there aren't pre-employment SPT of workers, it has been asserted that skin prick test positivity is associated with atopy. Of the sensitized subjects (37 cases), 1 (1.7%) was sensitized only to dog allergen. In a study about occupational allergy, it was found that other factors associated with atopy, such as having a positive skin test response for house dust mite or pollen and a number of positive allergy test results, likewise showed positive associations with occupational sensitization to laboratory animals[25].

Risk factors for developing allergic sensitization to dogs have not been fully elucidated. The main risk factor for the development of laboratory animal allergy identified to be atopy[15,26]. Atopic subjects were found to be up to 12 times more likely to have laboratory animal allergy. In the multivariate logistic regression analysis, having a positive skin prick test created an increase in the odds by a factor of 27.8 (95% CI, 1.6-474.8). In other words, in our study, subjects with positive SPT have 27.8 times higher risk of dog allergy.

Key question is that how can we predict the risk of developing dog allergy after exposure. Although atopy appears to be the main risk factor for occupational allergy, establishing atopy is generally considered inadequate for pre-employment selection because atopy is common in industrialized countries[27]. Algorithm defined by Liccardi and colleagues can be used to detect the susceptible subjects to dog allergy before working with dogs.[28,29] In that algorithm it was suggested that subjects should be evaluated by SPT, specific IgEs and further molecular diagnosis. That molecular diagnosis is done by evaluation of specific IgEs

using micro-array technique for lipocalins and albumins; and gives opportunity to evaluate the possibility of cross-reactions between allergens of different animals. Atopic individuals should be identified pre-employment, screening and counseling should be applied periodically. Prevention programs as legal requirements should base on medical check-ups. These check-ups should include questionnaires and medical examination. Also educations, engineering controls, administrative controls should be made. Work practices should be planned to minimize allergen exposure. Regular washing of the pet, use of denaturants for reservoirs, HEPA air filtration, and regular vacuuming may reduce risk of sensitization by lowering allergen loads.

Selecting hypoallergenic dog breeds as police dogs can be the solution of this occupational health problem but previous studies have been reported that there is no dog breed can be considered as hypoallergenic[30,31].

Further studies will be needed to clarify whether working with different breed dogs increases the risk of allergies. Longitudinal studies are needed for determining all of risk factors. This study is the first study to investigate the presence of sensitization to dogs and common allergens in police dog trainers.

Conclusions

Current study indicates that allergic disease is a serious occupational health concern for police dog trainers. Dog trainers are exposed to a variety of different breed dogs that may constitute a risk factor for allergic sensitization and symptoms.

Conflict of Interest

There are no conflicts of interest or any financial interests in connection with this paper.

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REFERENCES

1. Gergen PJ, Arbes SJ Jr, Calatroni A, Mitchell HE, Zeldin DC. Total IgE levels and asthma prevalence in the US population: results from the National Health and Nutrition Examination Survey 2005-2006. J Allergy Clin Immunol 2009;124:447-453.
2. Linneberg A, Nielsen HN, Madsen F, Frølund L, Dirksen A, Jørgensen T. Pets in the home and the development of pet allergy in adulthood. The Copenhagen Allergy Study. Allergy 2003;58:21-26.
3. Heinzerling L, Frew AJ, Bindslev-Jensen C, Bonini S, Bousquet J, Bresciani M, et al. Standard skin prick testing and sensitization to inhalant allergens across Europe--a survey from the GALEN network. Allergy 2005;60: 1287-1300.
4. Krakowiak A, Wiszniewska M, Krawczyk P, Szulc B, Wittczak T, Walusiak J, et al. Risk factors associated with airway allergic diseases from exposure to laboratory animal allergens among veterinarians. Int Arch Occup Environ Health 2007;80:465-475.
5. Seward JP. Occupational allergy to animals. Occup Med 1999;14: 285-304.
6. Ferraz E, Arruda LK, Bagatin E, Martinez EZ, Cetlin AA, Simoneti CS, et al. Laboratory animals and respiratory allergies: the prevalence of allergies among laboratory animal workers and the need for prophylaxis. Clinics 2013;68:750-759.
7. Renstrom A, Olsson M, Hedren M, Johansson SG, van Hage M. Pet shop workers: exposure, sensitization, and work-related symptoms. Allergy 2011;66:1081-1087.

8. Nicholson PJ, Mayho GV, Roomes D, Swann AB, Blackburn BS. Health surveillance of workers exposed to laboratory animal allergens. Occupational medicine 2010;60:591-597.

9. Chapman MD, and Wood RA. The role and remediation of animal allergens in allergic diseases. J Allergy Clin Immunol 2001;107:414-421.

10. Heutelbeck AR, Junghans C, Esselmann H, Hallier E, Schulz TG. Exposure to allergens of different cattle breeds and their relevance in occupational allergy. Int Arch Occup Environ Health 2009;82:1123-1131.

11. Elliott L, Heederik D, Marshall S, Peden D, Loomis D. Incidence of allergy and allergy symptoms among workers exposed to laboratory animals. Occupational and environmental medicine 2005;62:766-771.

12. Samadi S, Heederik DJ, Krop EJ, Jamshidifard AR, Willemse T, Wouters IM. Allergen and endotoxin exposure in a companion animal hospital. Occupational and environmental medicine 2010;67:486-492.

13. Krakowiak A, Krawczyk P, Szulc B, Wiszniewska M, Kowalczyk M, Walusiak J, et al. Prevalence and host determinants of occupational bronchial asthma in animal shelter workers. International archives of occupational and environmental health 2007;80:423-432.

14. Susitaival P, Kirk JH, Schenker MB. Atopic symptoms among California veterinarians. American journal of industrial medicine 2003;44:166-171.

15. Hollander A, Doekes G, Heederik D. Cat and dog allergy and total IgE as risk factors of laboratory animal allergy. The Journal of allergy and clinical immunology. 1996;98:545-554.

16. Yilmaz I, Oner Erkekol F, Secil D, Misirligil Z, Mungan D. Cat and dog sensitization in pet shop workers. Occupational medicine 2013;63:563-567.

17. Ronmark E, Perzanowski M, Platts-Mills T, Lundback B. Different sensitization profile for asthma, rhinitis, and eczema among 7-8-year-old children: report from the Obstructive Lung Disease in Northern Sweden studies. Pediatric allergy and immunology: official publication of the European Society of Pediatric Allergy and Immunology 2003;14:91-99.

18. Krakowiak A, Palczynski C, Walusiak J,Wittczak T, Ruta U, Dudek W, et al. Allergy to animal fur and feathers among zoo workers. International archives of occupational and environmental health 2002;75:113-116.

19. Draper A, Newman Taylor A, Cullinan P. Estimating the incidence of occupational asthma and rhinitis from laboratory animal allergens in the UK, 1999-2000. Occupational and environmental medicine 2003;60:604-605.

20. Kruize H, Post W, Heederik D, Martens B, Hollander A, van der Beek E. Respiratory allergy in laboratory animal workers: a retrospective cohort study using pre-employment screening data. Occupational and environmental medicine 1997;54:830-835.

21. Spieksma FT. Cultures of house-dust mites on animal skin scales. Allergologia et immunopathologia 1976;4:419-428.

22. Polovic N, Waden K, Binnmyr J, Hamsten C, Grönneberg R, Palmerg C, et al., Dog saliva - an important source of dog allergens. Allergy. 2013;68:585-592.

23. Apostolovic D, Sanchez-Vidaurre S, Waden K, Curin M, Grunström J, Gafvelin G, et al. The cat lipocalin Fel d 7 and its cross-reactivity with the dog lipocalin Can f 1. Allergy 2016;71:1490-1495.

24. Schmid K, Jungert B, Hager M, Drexler H, et al. Is there a need for special preventive medical check-ups in employees exposed to experimental animal dust?. International archives of occupational and environmental health 2009;82:319-327.

25. Krop EJ, Heederik DJ, Lutter R, de Meer G, Aalberse RC, Jansen HM, et al. Associations between pre-employment immunologic and airway mucosal factors and the development of occupational allergy. The Journal of allergy and clinical immunology 2009;123:694-700.

26. Matsui EC, Krop EJ, Diette GB, Aalberse RC, Smith AL, Eggleston PA. Mouse allergen exposure and immunologic responses: IgE-mediated mouse sensitization and mouse specific IgG and IgG4 levels. Annals of allergy, asthma & immunology 2004;93:171-178.

27. Burney P, Malmberg E, Chinn S, Jarvis D, Luczynska C, Lai E. The distribution of total and specific serum IgE in the European Community Respiratory Health Survey. The Journal of allergy and clinical immunology 1997;99:314-322.

28. Liccardi G, Calzetta L, Barrile A, Giorgino FM, Sapio C, Rogliani P. Is the risk of developing atopic sensitization and bronchial asthma in animal laboratory workers preventable in well-defined susceptible individuals? Journal of occupational health 2017; 59:310-311.

29. Liccardi G, Bilo MB, Manzi F, Piccolo A, Di Maro E, Salzillo A. What could be the role of molecular-based allergy diagnostics in detecting the risk of developing allergic sensitization to furry animals? Eur Ann Allergy Clin Immunol 2015; 47:163-167.

30. Vredegoor DW, Willemse T, Chapman MD, Heederik DJ, Krop EJ. Can f 1 levels in hair and homes of different dog breeds: lack of evidence to describe any dog breed as hypoallergenic. The Journal of allergy and clinical immunology 2012; 130:904-909 e907.

31. Nicholas CE, Wegienka GR, Havstad SL, Zoratti EM, Ownby DR, Johnson CC. Dog allergen levels in homes with hypoallergenic compared with nonhypoallergenic dogs. Am J Rhinol Allergy 2011; 25:252-256.

TABLES

Table 1. Characteristics of the study population

	Dog trainer group (n=56)	Control group (n=150)	p
Characteristics of the population			
Age (y), mean±SD (min-max)	33.6±6.37 (25-52)	33.18±14.83 (18-75)	0.835
Sex (female/male)	1/55	10/140	0.295
Data from clinical history			
Smoking, yes (%)	6 (10.7%)	32 (%21.3)	0.080
Ex-smoker	12 (21.4%)	44 (29.3%)	0.257
Family history of atopy, n (%)	17 (30.3%)	31 (20.61%)	0.143
Time of dog work, year±SD (min-max)	6.02±5.82 (0.5-20)	-	
Pet seeing (any kind of pets at home)			
Bird in the home	4 (7.1%)	9 (6.0%)	0.764
Cat in the home	2 (3.5%)	12 (8.0%)	0.261
Allergic symptoms			
Rhinitis	39 (69.6%)	44 (29.3%)	**<0.001**
Rhinoconjunctivitis	7 (12.5%)	15 (10%)	0.605
Allergic skin symptoms	13 (23.2%)	19 (12.6%)	0.063
Asthma	1 (1.7%)	6 (4%)	0.435
Work related symptoms	19 (33.9%)	0(0%)	**<0.001**

Student t test, Pearson Chi-Square test.

Table 2. The comparison of dog trainer group and control group in terms of the results of SPT.

Skin prick test	Dog trainer group (n=56)	Control group (n=150)	p value	OR	95% CI
Dog	12 (%21.4)	2 (%1.3)	**<0.001**	20.18	4.35-93.60
Feather	1 (%1.7)	0 (%0)	0.272	0.982	0.94-1.01
Cat	10 (%17.8)	9 (%6)	**0.009**	3.406	1.30-8.89
Cow	1 (%1.7)	0 (%0)	0.272	0.982	0.94-1.01
Poultry	2 (%3.5)	3 (%2)	0.615	1.815	0.29-11.15
Goat	3 (%5.3)	1 (%0.6)	0.062	8.434	0.85-82.85
Der p.	7 (%12.5)	6 (%4)	**0.047**	3.429	1.09-10.69
Der f.	5 (%8.9)	6 (%4)	0.174	2.353	0.68-8.04
Alternaria	6 (%10.7)	5 (%3.3)	0.073	3.480	1.01-11.90
Asp. fum.	4 (%7.1)	1 (%0.6)	**0.020**	11.462	1.25-104.89
Tree pollen	2 (%3.5)	1 (%0.6)	0.180	5.519	0.49-62.09
Weed	13 (%23.2)	14 (%9.3)	**0.018**	2.937	1.28-6.72
Ash	6 (%10.7)	8 (%5.3)	0.213	2.13	0.70-6.44
Walnut	5 (%8.9)	3 (%2)	**0.036**	4.80	1.10-20.81
Willow	4 (%7.1)	2 (%1.3)	**0.048**	5.69	1.01-31.99
Poplar	1 (%1.7)	1 (%0.6)	0.471	2.709	0.16-44.06
Beech	2 (%3.5)	1 (%0.6)	0.180	5.519	0.49-62.09
Pine	5 (%8.9)	0 (%0)	**0.001**	0.911	0.83-0.98
Latex	2 (%3.5)	0 (%0)	0.073	0.964	0.91-1.01
Wheat	2 (%3.5)	2 (%1.3)	0.298	2.741	0.37-19.94
Cockroach	4 (%7.1)	2 (%1.3)	**0.048**	5.692	1.01-31.99

Der p: Dermatophagoides pteronyssinus; Der f: Dermatophagoides farina; Asp. fum: Aspergillus fumigatus; OR: odds ratio; CI: confidence interval. Odds ratio Chi-Square Test.

Table 3. Comparison of the dog trainer with and without dog allergy in dog trainer group.

	Dog Trainer group (56)		
	Dog allergy + (n=12)	Dog allergy – (n=44)	p values
Age, years (±SD)	32.08±4.87	34.02±6.71	0.355
Sex (male)	12/12	43/44	0.786
Smoking			
Current smokers, n(%)	2(16.6%)	4(9.0%)	0.599
Ex-smokers, n(%)	3(25.0%)	9(20.4%)	0.734
Pet seeing			
Bird in the home	1(8.3%)	3(6.8%)	0.630
Cat in the home	1(8.3%)	1(2.2%)	0.386
Skin prick test positivity (another allergy from the dog allergy)	11(91.6%)	25(56.8%)	**0.026**
Family history of atopic disorders	4(33.3%)	13(29.5%)	0.529
Working years, (mean±SD)	3.9±4.94	6.6±5.96	0.159
Symptoms			
Rhinitis	11(91.6%)	28(63.6%)	**0.061**
Rhinoconjunctivitis	0(0%)	7(15.9%)	0.140
Allergic skin symptoms	2(16.6%)	11(25.0%)	0.544
Asthma	1(8.3%)	0(0%)	0.214
Work related symptoms	10(83.3%)	9(20.4%)	**<0.001**
SPT positivity, n(%)			
Feather	0(0%)	1(2.2%)	0.786
Cat	4(33.3%)	6(13.6%)	0.114
Cow	1(8.3%)	0(0%)	0.214
Poultry	0(0%)	2(4.5%)	0.614
Goat	1(8.3%)	2(4.5%)	0.522
Der p.	3(25%)	4(9.0%)	0.326
Der f.	3(25%)	2(4.5%)	0.060
Alternaria	2(16.6%)	4(9.0%)	0.599
Asp. fum.	4(33.3%)	0(0%)	**0.001**
Tree pollen	0(0%)	2(4.5%)	0.614
Weed	3(25%)	10(22.7)	0.869
Ash	3(25%)	3(6.8%)	0.105
Walnut	2(16.6%)	3(6.8%)	0.289
Willow	1(8.3%)	3(6.8%)	0.630
Poplar	0(0%)	1(2.2%)	0.786
Beech	0(0%)	2(4.5%)	0.614
Pine	2(16.6%)	3(6.8%)	0.289
Latex	0(0%)	2(4.5%)	0.614
Wheat	1(8.3%)	1(2.2%)	0.386
Cockroach	0 (0%)	4 (9.0%)	0.567

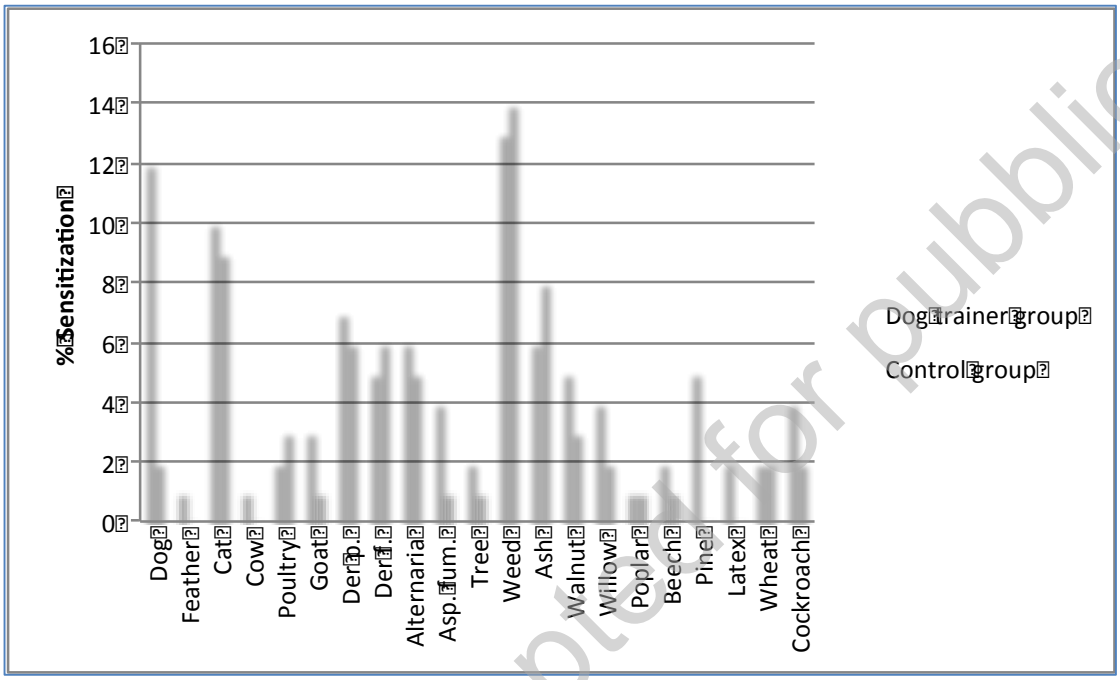
Student t test, Fisher's Exact Test, Pearson Chi-Square.

Table 4. Multivariate analysis (logistic regression) of factors for development of sensitization to dogs.

Risk factor	OR	95% CI	p value
Age	0.91	0.734-1.149	0.458
Smoking	0.50	0.020-12.415	0.674
Working duration	1.17	0.918-1.503	0.201
Pet seeing			
Bird in the home	14.417	0.367-565.830	0.154
Cat in the home	0.624	0.013-30.060	0.812
Family history of atopic disorders	0.35	0.062-2.002	0.239
Skin prick test positivity (another allergy from the dog allergy)	27.81	1.630-474.847	**0.022**

OR: odds ratio; CI: confidence interval

FIGURE



Der p: Dermatophagoides pteronyssinus; Der f: Dermatophagoides farina; Asp. fum: Aspergillus fumigatus

Figure 1. The rate of sensitization against 21 common allergens in dog trainer group and control group.

Table 1. Characteristics of the study population

	Dog trainer group (n=56)	Control group (n=150)	p
Characteristics of the population			
Age (y), mean±SD (min-max)	33.6±6.37 (25-52)	33.18±14.83 (18-75)	0.835
Sex (female/male)	1/55	10/140	0.295
Data from clinical history			
Smoking, yes (%)	6 (10.7%)	32 (%21.3)	0.080
Ex-smoker	12 (21.4%)	44 (29.3%)	0.257
Family history of atopy, n (%)	17 (30.3%)	31 (20.61%)	0.143
Time of dog work, year±SD (min-max)	6.02±5.82 (0.5-20)	-	
Pet seeing (any kind of pets at home)			
Bird in the home	4 (7.1%)	9 (6.0%)	0.764
Cat in the home	2 (3.5%)	12 (8.0%)	0.261
Allergic symptoms			
Rhinitis	39 (69.6%)	44 (29.3%)	**<0.001**
Rhinoconjunctivitis	7 (12.5%)	15 (10%)	0.605
Allergic skin symptoms	13 (23.2%)	19 (12.6%)	0.063
Asthma	1 (1.7%)	6 (4%)	0.435
Work related symptoms	19 (33.9%)	0(0%)	**<0.001**

Student t test, Pearson Chi-Square test.

Table 2. The comparison of dog trainer group and control group in terms of the results of SPT.

Skin prick test	Dog trainer group (n=56)	Control group (n=150)	p value	OR	95% CI
Dog	12 (%21.4)	2 (%1.3)	**<0.001**	20.18	4.35-93.60
Feather	1 (%1.7)	0 (%0)	0.272	0.982	0.94-1.01
Cat	10 (%17.8)	9 (%6)	**0.009**	3.406	1.30-8.89
Cow	1 (%1.7)	0 (%0)	0.272	0.982	0.94-1.01
Poultry	2 (%3.5)	3 (%2)	0.615	1.815	0.29-11.15
Goat	3 (%5.3)	1 (%0.6)	0.062	8.434	0.85-82.85
Der p.	7 (%12.5)	6 (%4)	**0.047**	3.429	1.09-10.69
Der f.	5 (%8.9)	6 (%4)	0.174	2.353	0.68-8.04
Alternaria	6 (%10.7)	5 (%3.3)	0.073	3.480	1.01-11.90
Asp. fum.	4 (%7.1)	1 (%0.6)	**0.020**	11.462	1.25-104.89
Tree pollen	2 (%3.5)	1 (%0.6)	0.180	5.519	0.49-62.09
Weed	13 (%23.2)	14 (%9.3)	**0.018**	2.937	1.28-6.72
Ash	6 (%10.7)	8 (%5.3)	0.213	2.13	0.70-6.44
Walnut	5 (%8.9)	3 (%2)	**0.036**	4.80	1.10-20.81
Willow	4 (%7.1)	2 (%1.3)	**0.048**	5.69	1.01-31.99
Poplar	1 (%1.7)	1 (%0.6)	0.471	2.709	0.16-44.06
Beech	2 (%3.5)	1 (%0.6)	0.180	5.519	0.49-62.09
Pine	5 (%8.9)	0 (%0)	**0.001**	0.911	0.83-0.98
Latex	2 (%3.5)	0 (%0)	0.073	0.964	0.91-1.01
Wheat	2 (%3.5)	2 (%1.3)	0.298	2.741	0.37-19.94
Cockroach	4 (%7.1)	2 (%1.3)	**0.048**	5.692	1.01-31.99

Der p: Dermatophagoides pteronyssinus; Der f: Dermatophagoides farina; Asp. fum: Aspergillus fumigatus; OR: odds ratio; CI: confidence interval. Odds ratio Chi-Square Test.

Table 3. Comparison of the dog trainer with and without dog allergy in dog trainer group.

	Dog Trainer group (56)		
	Dog allergy + (n=12)	Dog allergy – (n=44)	p values
Age, years (±SD)	32.08±4.87	34.02±6.71	0.355
Sex (male)	12/12	43/44	0.786
Smoking			
Current smokers, n(%)	2(16.6%)	4(9.0%)	0.599
Ex-smokers, n(%)	3(25.0%)	9(20.4%)	0.734
Pet seeing			
Bird in the home	1(8.3%)	3(6.8%)	0.630
Cat in the home	1(8.3%)	1(2.2%)	0.386
Skin prick test positivity (another allergy from the dog allergy)	11(91.6%)	25(56.8%)	**0.026**
Family history of atopic disorders	4(33.3%)	13(29.5%)	0.529
Working years, (mean±SD)	3.9±4.94	6.6±5.96	0.159
Symptoms			
Rhinitis	11(91.6%)	28(63.6%)	**0.061**
Rhinoconjunctivitis	0(0%)	7(15.9%)	0.140
Allergic skin symptoms	2(16.6%)	11(25.0%)	0.544
Asthma	1(8.3%)	0(0%)	0.214
Work related symptoms	10(83.3%)	9(20.4%)	**<0.001**
SPT positivity, n(%)			
Feather	0(0%)	1(2.2%)	0.786
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Figure 1

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