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Atopic allergy to allergens inhaled by displaced people in Mosul City

Farah Younus Hussein[1], Israa Nadhim Lateef[1*], Enas Abdul Muneim Al-Layla[2]

1. General Sciences Department, College of Basic Education, University of Mosul, Iraq
2. Department of Biology, College of Science, University of Mosul, Iraq

** Corresponding author's E-mail: israanadhem@uomosul.edu.iq*

ABSTRACT

This study covered 100 displaced persons from Mosul city to which skin tests were applied as well as count of eosinophils, to detect allergy. Only 35 persons of both genders exhibited positive response to the used allergens with an increased number of eosinophils. 8 males and 27 females, and their ages ranged between 17-77 years. At testing the skin for the inhaled allergens, Saliceae trees recorded the highest overall percentage of allergy (60%), Betulaceae family recorded an overall percentage of allergy (45.7%) followed by Timothy overall percentage (42.9%), Salsola (34.3%), the combination of three trees including Corylus, Alnus and Betula (31.4%), the plant Artemisia (25.7%), *Urtica dioica* (22.9%), and finally *Fraxinus excelsior* (22.8%). Dogs and cats hairs recorded the highest percentage of allergy (51%) among epithelial tissue allergens, followed by horse hair (31.4%) and the least percentage was of feathers (8.6%). Houses dust mite when mixing the two types *Dermatophoides farina* and *D. pteronyssinus* recorded the highest percentage (45.7%). Among the fungi, *Alternaria alternate* recorded the highest percentage (37.1%), *Cladosporum herbarum* (34.2%) and the least percentage was related to the fungus *Aspergillus fumigatu* (28.6%). The studied sensitizers (except feathers) have significant difference at probability level of P < 0/05.

Keywords: Atopic allergy, Skin test, Differential WBC eosinophil count, Salicaceae, Epithelial tissues, House dust mite.

INTRODUCTION

Allergy is a reaction caused by hyperactivity of the immunity system to substances called Allergens such as pollen grains, insects, house dust mite, foods and medicines. The immunity reaction takes place in certain places of the body causing illnesses like asthma, runny nose, eczema, food allergy, or in various systems such as systematic allergy (Moral & Martinez- Naves 2017; Syed 2019). Atopic allergy is the first type which occurs due to the response of the body to allergens, and the antibodies (Ig E) play a big role in it. So that, the allergic body secretes this kind of antibodies dedicated for allergens and this is called the over- reaction of the people that have a family history of developing an allergy. Engagement of allergens and antibodies takes place on the mast cells; thus, these cells break down and emit substances like histamine, prostaglandin, and kinin resulting in itching and dilated capillary causing redness (Celakovska *et al.* 2019). Allergy has two factors of risk, the first one is the environment and what it has of airborne substances inhaled through the nose, or foodstuff that enters the body through the digestion system. The second one is the allergic person and his correlated factors such as age, sex, inheritance, and family history (Mandalari & Mackie 2018; Mansouritorghabeh *et al.* 2019). The increased pollen grains production by the winds and its ampleness in the air we breathe in the long run lead to more acute health consequences for allergic people (Damialis *et al.* 2019). Allergy from inhaled allergens cannot be avoided being in the air (Li *et al.* 2019). In the recent years allergy diseases have increased. In Europe allergic rhinitis -level have reached 17-29% and asthma 1.3- 11% among children and adults, whereas food allergy has reached 0.1- 6% (Fyhrquiest *et al.* 2019). In the USA asthma spreads in all age categories for both sexes: 8% in adults and 9% in children (Brock *et al.* 2019). The most common test to check allergy is performed by skin test where over one

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allergen are injected under the skin. The positive result is indicated by the appearance of a red circle around the injected allergen. The Differential WBC eosinophil count is also used (Christopher *et al*. 2019).

The present study aims to examine several types of inhaled allergens and the extent of their effect on or in association with sex and age of the displaced people in Mosul City, via a work kit supplied by a Turkish company.

MATERIALS AND METHODS

Samples: the study included 100 persons who were displaced from Mosul City and for the period from September 2018 to September 2019. Needed tests were conducted on them to check for allergy. 35 person showed positive response for allergy from both sexes, including 8 males and 27 females, and their ages ranged between 17-77 years.

Allergy check tests

Skin test

Skin test was performed by subcutaneously injecting allergens under examination as in Fig. 1. These allergens were produced by a Turkish company. The spot of injection was sterilized by ethyl alcohol (70%), well dried, and then 0.05 mL of each allergen (antigen) was injected via 1-mL medical syringe (Rosenfield *et al.* 2015).

Differential WBC Eosinophil count

A 2-mL blood sample was taken from each patient, placed in a test tube containing ethylene diamine tetra acetic acid (EDTA), followed by dying the blood slide with Leishman's stain and counting eosinophils per 100 white blood cells (Mohamed & Ismail 2018).

Statistical Analysis

The ANOVA test (X^2) was used in the comparisons between groups at the significant level of 0.05 ($p \leq 0.05$; MacFarland & Yates 2016).

RESULTS AND DISCUSSION

The skin test is an important and authentic method to diagnose allergy diseases such as asthma, runny nose, and skin sensitivity (Heinzerling *et al.* 2013). In all respondents to allergens, it was found that they have 3 eosinophils / 100 cells (Al- Khalifa 2004). Nineteen different allergens were used as shown in Fig. 1. The highest percentage of allergy against the *Betulaceae* family in females was 25.9% between the ages of 28- 37 years old, and in males, was 12.5% between the ages of 17- 27 and 48-57 years old (Table 1). Bet v 1 was the main causative of allergy to the Betulaceae family, causing allergic rhinitis repeatedly (Olcese *et al.* 2019).

Brich and other trees related to Betulacea family (such as Hazal, Hornbeam, and Alder) were the most spread pollen grains in Europe causing allergic rhinitis and asthma with an allergy percentage of 80% (Biedermann *et al.* 2019). The present study recorded the highest rate (%) of allergy to the combination of the trees Corylus, Betula, and Alnus. In the age group of 28-37 year-olds, the rate in males and females were 25% and 11.11% respectively. The overall rate was 31.4% (Table 1), in disagreement with the study of Damilias *et al.* (2019) who studied the allergy to each of those trees separately, reporting that the allergy to Alnus was 20.9% in Spain and 32.3% in Turkey. In the case of Betula, the rates were 8.7%- 17% in Hungary, 18% in Italy, 46.1%-54% in Switzerland and 28% in Finland, whereas in the case of Corylus tree, the rates were 6.3%- 16.7% in Hungary and 46.7%- 47.2% in Switzerland. The rate of allergy increases against *Fraxinus excelsior*. It was 12.5% in males in the age groups of 28-37 and 48-57 year-olds, while 11.11% in females in the age group of 28-37 year-olds, by the overall rate of 22.8% (Table 1). This result is less than that obtained by Payandeh *et al.* (2019) who reported that 1445 persons by respiratory system diseases, the allergy rate to *Fraxinus excelsior* was %49.8 (621 persons). In Australia Damialis *et al.* (2019) reported a rate of allergy equals 17.6% which was close to the results of the present study.

Artemisia belongs to the family of Asteraceae which is one of the largest plant families (Stepalska *et al*., 2017). Pollen grains of *Artemisia* are of the most important aerial causatives of allergy all over the world (Grewling *et al.*, 2020). In China a study was conducted on 1013 persons allergic to *Artemisia* finding that 44.4% of them suffer allergic rhinitis and 55.6% suffer both allergic rhinitis and asthma (Cui & Yin 2019).

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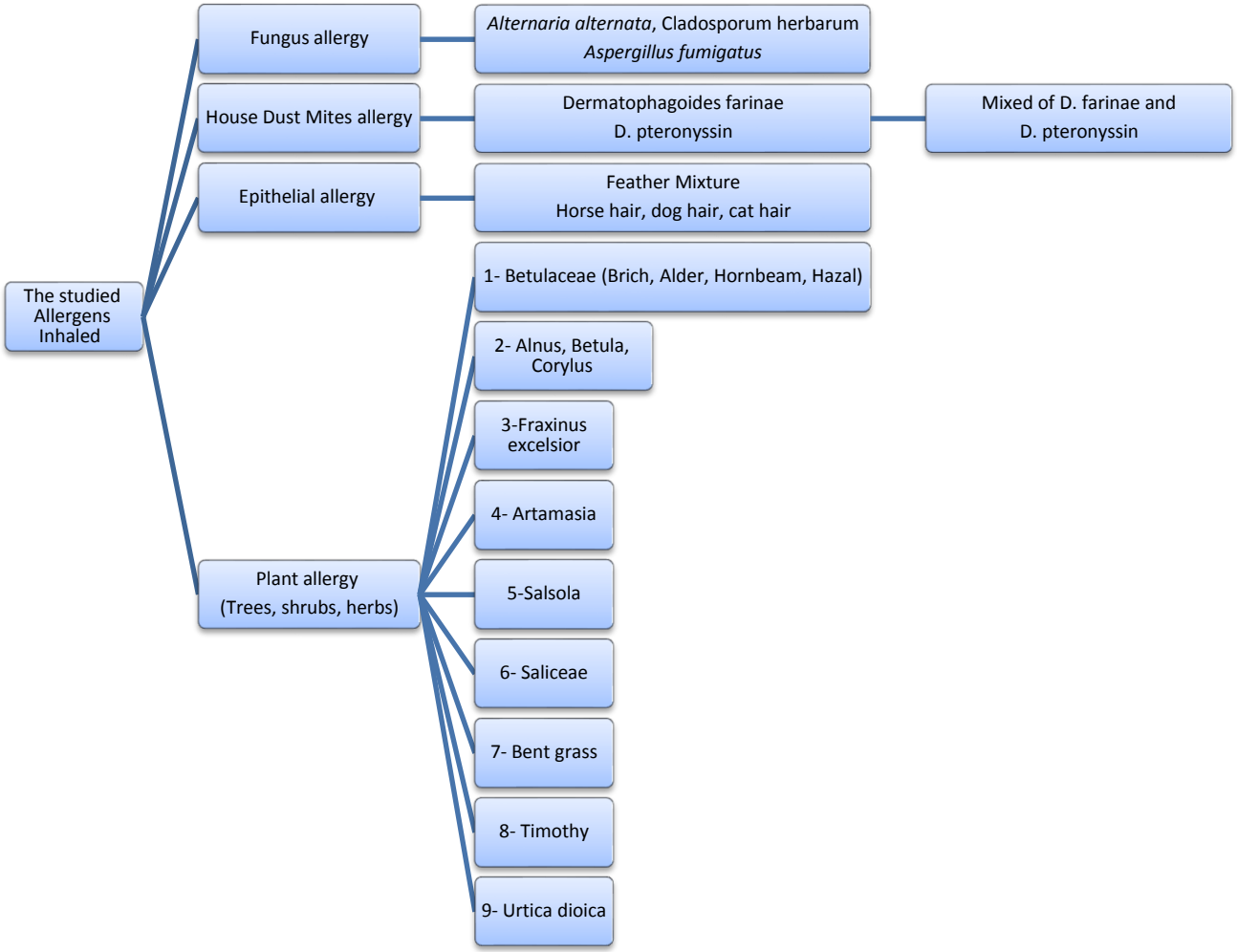

Fig. 1. Illustrating the used allergens to diagnose allergy.

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Table 1. Demonstrating relationships of sex and age to types with plants (*Betulaceae, Alnus, Betula, Corylus, Fraxinms excelsiot, Artamasia, Salsola, Urticadioica*).

Age		17-27		28-37		38-47		48-57		58-67		68-77		Total percentage %
allergens		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀+♂
	+	1	5	0	7	0	1	1	1	0	0	0	0	
Betulaceae		%12.5	%18.5	%0	%25.9	%0	%3.7	%12.5	%3.7	%0	%0	%0	%0	16
(Brich،Alder،Hornbeam،Hazel)		3	1	3	4	0	4	0	1	0	1	0	2	45.7%
	-	%37.5	%3.7	%37.5	%14.8	%0	%14.8	%0	%3.7	%0	%3.7	%0	7.4%	
		1	2	2	3	0	1	1	1	0	0	0	0	
	+													
Three trees Mixed		%12.5	%7. 4	%25	%11.11	%0	%3.7	%12.5	%3.7	%0	%0	%0	%0	11
Alnus،Betula،Corylus		3	4	1	8	0	4	0	1	0	1	0	2	31.4%
	-	%37.5	%14. 8	%12.5	%٢9.6	%0	%14.8	%0	%3.7	%0	%3.7	%0	%7.4	
		0	2	1	3	0	1	1	0	0	0	0	0	
	+													
Flowering forest trees		%0	%7.4	%12.5	%11.11	%0	%3.7	%12.5	%0	%0	%0	%0	%0	8
Fraxinus excelsior		4	4	2	8	0	4	0	2	0	1	0	2	22.8%
	-	%٥0	%14. 8	%25	%29.6	%0	%14. 8	%0	%7. 4	%0	%3.7	%0	%7. 4	
		2	2	2	2	0	0	0	1	0	0	0	0	
	+													9
Artemisia		%25	%7.4	%25	%7.4	%0	%0	%0	%3.7	%0	%0	%0	%0	
	-	2	4	1	9	0	5	1	1	0	1	0	2	25.7%

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		%25	%14.8	%12.5	%33.33	%0	%18.5	%12.5	%3.7	%0	%3.7	%0	%7.4	
		2	2	2	3	0	1	0	1	0	0	0	1	
	+	%25	%7.4	%25	%11.11	%0	%3.7	%0	%3.7	%0	%0	%0	%3.7	
Salsola														12
		2	4	1	8	0	4	1	1	0	1	0	1	
	-													34.3%
		%25	%14. 8	%12.5	%29.6	%0	%14. 8	%12.5	%3.7	%0	%3.7	%0	%3.7	
		2	2	1	2	0	0	0	0	0	0	0	1	
	+													
		%25	%7.4	%12.5	%7.4	%0	%0	%0	%0	%0	%0	%0	%3.7	8
Urtica dioica														
		2	4	2	9	0	5	1	2	0	1	0	1	22.9%
	-													
		%25	%14.8	%25	%33.33	%0	%18.6	%12.5	%7.4	%0	%3.7	%0	%3.7	

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In the present study the rate of allergy to Artemisia was 25% in males and 7.4% in females in the age groups of 17- 27 and 28- 37 year-olds, by the overall rate of 25.7% (Table 1), which is less than its counterpart in Hungary (48.8%- 54.8%) and is almost in match to that of Switzerland (22.6%-28%), and higher than that in Portugal (17.6%) and Poland (12%; Damialis *et al.* 2019). Salsola is one of the most important causatives of allergic rhinitis in the desert and semi-desert areas (Tabesh *et al.* 2019). The results of the present study showed that the highest rate of allergy to Salsola was 25% in males of 17-27 and 28- 37 year-olds, while 11.11% in females of 28-37 (Table 1). These results do not in agreement with the result of Al- Shagahin *et al.* (2019), in Jordan who reported that the allergy rate was 35.8% in males and 28.8% in females of different ages. *Urtica dioica* belongs to the family of Urticaceae and is a medicinal plant known for a long time ago all over the world (Bakhshaee *et al.* 2017). Thaumatin- like protein and pectinestrase are of the causatives of allergy in *Urtica dioica*, in addition to the existence of weak relation between allergic rhinitis and pollen grains of *U. dioica* (Tiotiu *et al.* 2016). The present study recorded the highest rate of allergy in males (25%) of 17-27, while 7.4% in females of 17-27 and 28-37 year-olds (Table 1). A significant difference appeared for all the allergens in Table 1 with sex and age at the significant level of $p \leq 0.05$. The family of Salicaceae has more than 500 species existing mainly in Europe and North America. Poplar is the most common and spread among them. It also contains a high percentage of Salicylate precursors compound compared to others. Since the days of Hippocrates, Willow is used as a medicine, and a study showed that the most common effects related to Salicaceae bark are the negative effects on the digestive system, in addition to reporting some allergic reactions. Hence, some studies recommend caution when using Salicaceae (Oketch- Rabah *et al.* 2019). Table 2 illustrates that the highest allergy rate to Salicaceae trees was 37.5% in males, and 22.2% in females of 17-27 year-olds by the overall rate of 60%. These results were not in agreement with the study of Mansouritorghabeh *et al.* (2019), who reported that the rate in Iran was 10.9%, whereas in some countries of the Middle East such as Qatar and Oman, and also in Turkey, 0.5% and 3% respectively. Estimations indicate that herbage cover quarter the area of Earth, and pollen grains from herbage with house dust mite are among the most important airborne causatives of allergy especially in Europe (Batard *et al.* 2019). Allergy to herbage pollen grains is a global problem where allergy rate reaches 30% depending on the weather and the region. So, the present study addressed Bent grass allergy to recognize its rate in Mosul City. The Highest allergy rates were 25% in males and 14.8% in females of 17-27 year-olds, by the overall rate of 42.9% (Table 2), These results are close to their counterparts in Austria where allergy to herbage pollen grains constitutes over 50% of the allergy rate (Kmenta *et al.* 2017). Pollen grains of Timothy have high reactionary potential in patients who suffer food allergy. In Taiwan, a study was conducted on patients of asthma and allergic rhinitis during the period of 2014-2016, reporting that the allergy rate to Timothy was 10.3% in the allergic rhinitis and 9.8% in patients of asthma (Wang & Lue 2019). In addition, the Timothy pollen grains cause hay fever in warm temperate climates (Jung *et al.* 2018). The allergy rate to this herb in Iran reached 30.6% when a study was performed on 602 patients suffering allergy. The rate was 49.8% in males and 50.2% in females with an average age of 9 years old (Shoormasti *et al.* 2017).

In Austria, out of 64 children in the age group of 6-17 year-olds, the allergy rate to Timothy was 94%, and the reason was that the allergy to herbage pollen grain starts in early childhood (Douladiris *et al.* 2019). The present study found that the highest allergy rate was 25% in males and 14.8% in females of 17-27 year-olds, and the overall rate was 42.9% (Table 2). A significant difference appeared for all the allergens in Table 2 with sex and age at significant level of $p \leq 0.05$. Allergy diseases caused by exposure to animals are a common phenomenon around the world. Exposure to cats and dogs causes allergic rhinitis, allergic asthma and Urticaria (Gawlik *et al.* 2009). Feathers play an important role in stimulating allergic rhinitis (Valatabar *et al.* 2020). Allergy to feathers in Mosul City recorded only in females (11.11%) in the age group of 17-27 year-olds, and the overall rate was 8.6% (Table 3). This is not in agreement with the findings of Moradi *et al.* (2017) who reported that the allergy rate to feathers was 60.8% out of 1100 patients went through SPT test. Another study in Iran found that the allergy rate is 12.6%, i.e. 51 persons out of 502 patients (Ahmadiafshar *et al.* 2018). Horses are of the most important domesticated animals, used for transportation, entertainment and work. Horses were recognized as a main source of allergy to people who deal with them regularly (Gawlik *et al.* 2009). Equ. c 1 is considered the factor responsible for allergy in horses hair (Haka *et al.* 2019).

Table 3 illustrates the highest allergy rate to horse hair in males and it was 37.5% in the 28-37 year-olds. The rate was 11.11% in females in the age categories of 17-27 and 28-37 year-olds. The overall rate was 31.4%, which is not in line with that in Spain (12.3%).

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Table 2. Demonstrating relations of sex, age and allergy to the trees of Salicaceae, Bent grass and Timothy.

Age / allergens		17-27		28-37		38-47		48-57		58-67		68-77		Total percentage %
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀+♂
Tree Salicaceae	+	3 37.5%	6 22.2%	2 25%	4 14.8%	0 0%	3 11.11%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	1 3.7%	21 60%
	-	1 12.5%	0 0%	1 12.5%	7 26%	0 0%	2 7.4%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	1 3.7%	
Bent grass	+	2 25%	4 14.8%	1 12.5%	3 11.11 %	0 0%	1 3.7%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	2 7.41%	15 42.9%
	-	2 25%	2 7.4%	2 25%	8 29.62%	0 0%	4 14.81%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	0 0%	
Timothy	+	2 25%	4 14.8%	1 12.5%	3 11.11%	0 0%	2 7.41%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	1 3.7%	15 42.9%
	-	2 25%	2 7.4%	2 25%	8 29.62%	0 0%	3 11.11%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	1 3.7%	

Table 3. Demonstrating relations of sex, age and allergens of epithelial tissues (feather, horse hair, dogs' hair and cats' hair).

Age / allergens		17-27		28-37		38-47		48-57		58-67		68-77		Total percentage %
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀+ ♂
Feather Mixture	+	0 0%	3 11.11%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	3 8.6%
	-	4 50%	3 11.11%	3 37.5%	11 40.7%	0 0%	5 18.5%	1 12.5%	2 7.4%	0 0%	1 3.7%	0 0%	2 7.4%	
Horse hair	+	0 0%	3 11.11%	3 37.5%	3 11.11%	0 0%	1 3.7%	1 12.5%	0 0%	0 0%	0 0%	0 0%	0 0%	11 31.4%
	-	4 50%	3 11.11%	0 0%	8 29.63%	0 0%	4 14.8%	0 0%	2 7.4%	0 0%	1 3.7%	0 0%	2 7.4%	
Dog hair	+	2 25%	5 18.5%	2 25%	5 18.5%	0 0%	1 3.7%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	1 3.7%	18 51.4%
	-	2 25%	1 3.7%	1 12.5%	6 22.22%	0 0%	4 14.8%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	1 3.7%	
Cat hair	+	2 25%	3 11.11%	3 37.5%	6 22.22%	0 0%	2 7.4%	1 12.5%	0 0%	0 0%	0 0%	0 0%	1 3.7%	18 51.4%
	-	2 25%	3 11.11%	0 0%	5 18.5%	0 0%	3 11.11%	0 0%	2 7.4%	0 0%	1 3.7%	0 0%	1 3.7%	

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Turkish authors found that the allergy rate was 12.8% for workers in the field of horse race. A British study was conducted on 6500 British children of 7 years old, reporting that allergy rate to horse hair equals to 1.4% (Gawlik *et al.* 2009; Moosavi 2018; Hamilton-Ekeke 2019; Jazideh 2020; Mesbah 2021; Fiuzat 2021).

Allergy to cats and dogs hairs affects 10% to 20% of the population of the globe, and the most spread allergy causing agent in cats is Fel d 1, whereas the agents causing allergy in dogs are Can f 1, Can f 2, Can f 3 and Can f 5 (Chan & Leung 2018). Table 3 illustrates the highest rate of allergy to dogs' hair which was 25% in males and 18.5% in females of 17-27 and 28-37 year-olds.

The overall rate was 51.4%. Cat hair recorded a highest rates of allergy equals to 37.5% in males and 22.22% in females of 28-37 year-olds, by an overall rate of 51.4% for each one of them. This is not in agreement with the rate reported in some countries of Asia such as Sri Lanka where the allergy rates to cats and dogs were 12.2% and 8.9% respectively. In Zhengzhou, China, the allergy rates to cats and dogs were 30.8% and 34.5% respectively (Chan & Leung 2018). A significant difference appeared for all the allergens with sex and age except for feathers at significant level of $p \leq 0.05$.

The Der f 23 protein, responsible for allergy in *D. farinae* (He *et al.* 2019) recorded a highest rate of allergy (25%) in males of 17-7 year-olds, and 18.6% in females of 28-37, by the overall rate of 34.3% (Table 4) which is not in agreement with those in China (77.7%) by *D. farinae* (Chen *et al.* 2019). *D. pteronyssinus* recorded a highest allergy rate in males (25%) and in females (14.8%) of 28-37 year-olds; by the overall rate of 31.4% (Table 4). However, Der p1, Der p2 and Der p23 are the responsible proteins of allergy (Ogburn *et al.* 2017). This result is not in agreement with the allergy rate recorded in China (78.5%; Chen *et al.* 2019) and also with those (42.5%) reported by Altia & Hussen (2011).

When injecting both *D. farinae* and *D. pteronyssinus* into a patient, the allergy rate was higher than that when injecting each one alone. The highest allergy rate in males was 37.5% in 17-27 year-olds, while in females it was 18.5% in 28-37 year-olds. The overall rate was 45.7% (Table 4) which was not in agreement with that in China when injecting both antigens into individuals suffering from allergic rhinitis (75%; Chen *et al.* 2019). The results of present study also disagrees with Souza Lima *et al.* (2018) in Brazil using Skin prick test, who reported that the allergy rate to *D. Pteronyssinus* was 89.2% in 66 out of 74 patients. In addition, the allergy rate in their study to *D. farianae* was 74.3% (55 out of 74 patients) and in the case of *D. Pteronyssinus,* it was even higher, which was in disagreement with the present study.

A significant difference appeared in all allergens in Table 4 with sex and age at significant level of $p \leq 0.05$. Exposure to spore and hyphae particles is similar to that of allergy inducing substances. These particles may hurt the respiratory tract by the way of producing toxins, enzymes and volatile organic compounds (Holme *et al*. 2020).

Alternaria alternata, a fungus, is an important agent for developing asthma compared to other allergens like pollen grains and dust mite (Gabriel *et al.*, 2016). Advancement in gene technology has contributed to identifying the main component causes of allergy by distinguishing them from different fungi sources. In the case of *A. alternate,* the causative is allergenin, *A. alternata* (rAlt a1) and andenolaser Alt a6 (rAlt a6; Celakovsca *et al*. 2019). *A. alternate* recorded the highest allergy rate in males (25%) of 17-27 and 28-37 year olds, while 14.8% in females of 28-37 year-olds. The overall allergy rate was 37.1% (Table 5).

In the case of *Cladosporium herbarum,* another fungus, the causative of allergy is the dehydrogenase (r Cla) (Celakovska *et al.* 2019). The fungus recorded the highest allergy rate in male (12.5%) of 17-27 and 28-37, and also in females (22.22%) of 17-27 year-olds.

The overall rate was 34.2% (Table (5).

In the case of *Aspergillus fumigatus,* the next fungus, Asp. F 1,2,3,4 and 6 are the proteins stimulating allergy (Chelakovska *et al.* 2019). This fungus recorded the highest allergy rate in males (12.5%) of 17-27 and 28-37, and in females (11.11%) of 28-37 and 38-47 year-olds. The overall rate was 28.6% (Table 5).

Payandeh *et al.* (2019) in their study, conducted in Meshed, Iran found that *A. alternate* is responsible for 16.1% of rhinitis, 34.8% of asthma and 21.5% of both rhinitis and asthma, whereas *Clad. herbarum* recorded 0% among patients of rhinitis and asthma. A significant difference appeared for all the allergen in Table 5 with sex and age at significant level of $p \leq 0.05$.

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Table 4. Demonstrating relations of sex, age and house dust mite (*Dermatophagoides farinae*، *D. pteronyssinus*).

Age / allergens		17-27		28-37		38-47		48-57		58-67		68-77		Total percentage %
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀+♂
Home dream *Dermatophagoides farinae*	+	2 25%	2 7.4%	1 12.5%	5 18.5%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	0 0%	0 0%	0 0%	12 34.3%
	-	2 25%	4 14.8%	2 25%	6 22.22%	0 0%	4 14.8%	1 12.5%	1 3.7%	0 0%	1 3.7%	0 0%	2 7.4%	
Home dream *D. pteronyssinus*	+	1 12.5%	1 3.7%	2 25%	4 14.8%	0 0%	1 3.7%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	0 0%	11 31.4%
	-	3 37.5%	5 18.5%	1 12.5%	7 25.9%	0 0%	4 14.8%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	2 7.4%	
Mixed of *D. farinae* and *D. pteronyssinus*	+	3 37.5%	3 11.11%	2 25%	5 18.5%	0 0%	1 3.7%	1 12.5%	1 3.7%	0 0%	0 0%	0 0%	0 0%	16 45.7%
	-	1 12.5%	3 11.11%	1 12.5%	6 22.22%	0 0%	4 14.8%	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	2 7.4%	

Table 5. Demonstrating relations of sex, age and fungi (*Aspergillus fumigatus*, *Cladosporium herbarum*, *Alternaria alternata*).

Age / allergens		17-27		28-37		38-47		48-57		58-67		68-77		Total percentage %
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀+♂
Alternaria alternata	+	2 25%	1 3.7%	2 25%	4 14.8%	0 0%	3 11.11%	0 0%	0 0%	0 0%	0 0%	0 0%	1 3.7%	13 %37/1
	-	2 25%	5 18.5%	1 12.5%	7 25.9%	0 0%	2 %7.4	1 12.5%	2 %7.4	0 0%	1 3.7%	0 0%	1 3.7%	
Cladosporum herbarum	+	1 12.5%	6 22.22%	1 12.5%	2 %7.4	0 0%	1 3.7%	0 0%	1 3.7%	0 0%	0 0%	0 0%	0 0%	12 %34/2
	-	3 37.5%	0 0%	2 25%	9 33.33%	0 0%	4 14.8%	1 12.5%	1 3.7%	0 0%	1 3.7%	0 0%	2 %7.4	
Aspergillus fumigatus	+	1 12.5%	1 3.7%	1 12.5%	3 11.11%	0 0%	3 11.11%	0 0%	0 0%	0 0%	0 0%	0 0%	1 3.7%	10 %28/6
	-	3 37.5%	5 18.5%	2 25%	8 29.6%	0 0%	2 %7.4	1 12.5%	2 %7.4	0 0%	1 3.7%	0 0%	1 3.7%	

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Turkish authors found that the allergy rate was 12.8% for workers in the field of horse race. A British study was conducted on 6500 British children of 7 years old, reporting that allergy rate to horse hair equals to 1.4% (Gawlik *et al.* 2009; Moosavi 2018; Hamilton-Ekeke 2019; Jazideh 2020; Mesbah 2021; Fiuzat 2021). Allergy to cats and dogs hairs affects 10% to 20% of the population of the globe, and the most spread allergy causing agent in cats is Fel d 1, whereas the agents causing allergy in dogs are Can f 1, Can f 2, Can f 3 and Can f 5 (Chan & Leung 2018). Table 3 illustrates the highest rate of allergy to dogs' hair which was 25% in males and 18.5% in females of 17-27 and 28-37 year-olds. The overall rate was 51.4%. Cat hair recorded a highest rates of allergy equals to 37.5% in males and 22.22% in females of 28-37 year-olds, by an overall rate of 51.4% for each one of them. This is not in agreement with the rate reported in some countries of Asia such as Sri Lanka where the allergy rates to cats and dogs were 12.2% and 8.9% respectively. In Zhengzhou, China, the allergy rates to cats and dogs were 30.8% and 34.5% respectively (Chan & Leung 2018). A significant difference appeared for all the allergens with sex and age except for feathers at significant level of $p \leq 0.05$.

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