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Skin Prick Test Reactivity to Common Aeroallergens among Allergic Rhinitis Patients in Jordan

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The distribution and pattern of aeroallergens are significantly different between different countries and even in the different parts of the same country. The present study aims to evaluate the most common aeroallergens among allergic rhinitis patients in the city of Al-Karak, Jordan. A cross-sectional study was conducted at Department of Otorhinolaryngology, Mutah University, from March 2016-April 2018. Patients with a clinical diagnosis of allergic rhinitis were enrolled and Skin Prick Test (SPT) was performed using 11 common aeroallergens including, grass, weed, tree, mite, and mould in 140 patients. The results showed that the overall rate of sensitization to any allergen was 85.7%. It was shown that 69.3% of patients were poly-sensitized; while, 16.4% were sensitized to only one allergen. The majority of the common allergens were Olive tree pollen (51.4%), Dermatophagoides pteronyssinus (37.9%), respectively. Mould (Alternaria) was the least prevalent allergen (17.1%). The present study has shown the importance of Olive tree pollen which, is widely cultivated in Al-Karak, Jordan. The diagnosis of pollen allergen can be simplified by using a combination of a few common allergens.

Keywords: Aeroallergens, Allergic rhinitis, Jordan, Sensitization, Skin prick test.

Allergic rhinitis is one of the most prevalent chronic diseases that are common in 10-30% of adults and up to 40% in children[1]. Aeroallergens including pollens (plant pollens), fungi, animal dander, domestic mites, domestic animals, and insects are the most common to initiate allergic diseases[2]. One of the most obvious features of pollen allergy is their seasonal nature. Each spring, summer and autumn pollens are released from trees, grasses, and weeds. As a result, individuals have started experiencing allergic symptoms only when the pollen particles are distributed in the air and reach the nose and bronchial airway[3].

Avoiding allergen exposure is the first step in the management of allergic rhinitis, even when it

is not completely effective. Identifying the common allergen plays an important role in the diagnosis and treatment of allergic rhinitis. Choosing the most reliable and the most cost effective panel of allergen extracts for skin prick test (SPT) has a very important role in the diagnosis and treatment of allergic rhinitis. Moreover, the best formulation of inhalant allergen immunotherapy can be found by defining the most common allergens in each area[4]. The direct and indirect effects of allergic rhinitis include; the cost of treatment, impaired quality of life, and presence of co-morbidities that cause significant impact on the public health system[5, 6]. Common pollens causing allergies are different in different parts of the world and meteorological parameters (wind, temperature, solar radiation, humidity, and rainfall) have a strong impact on pollen concentration[7].

The majority of the studies have helped in identifying the most common allergens; however, studies on different parts of the body have not shown a unique pattern of sensitization[4]. The majority of the detailed epidemiological studies and clinical trials have been performed in Western Europe and North America[8], unlike the Middle East region[9]; although, AR and allergic asthma are global and increasing serious health problems[10]. The distribution and pattern of allergens are significantly different between different countries and even in the different parts of the same country[11]. A similar study was performed in Amman, the capital of Jordan to investigate the pattern of skin prick test reactivity to various aeroallergens among allergic rhinitis patients in 2011[12]. The present study aims to evaluate the prevalence of positive skin test to various common aeroallergens among allergic rhinitis patients in the City of Al-Karak, at the southern part of Jordan, to develop better methods for prevention and effective treatment of allergic rhinitis patients.

MATERIALS AND METHODS

Study Population and Design

A cross-sectional study was conducted at Al-Karak Teaching Hospital in the southern part of Jordan. It is the largest public and teaching hospital in the south affiliated with the Faculty of Medicine at The University of Mutah, Jordan. A total of 140 patients, including children and adults clinically diagnosed to have allergic rhinitis were recruited. These patients attended the Ear, Nose, and Throat Clinics at Al-Karak Teaching Hospital during March 2016 – April 2018.

Inclusion and Exclusion Criteria

The inclusion criteria were the diagnosis of current allergic rhinitis as defined by having sneezing or runny nose or nasal obstruction in the absence of a cold or flu in the last 12 months. The diagnosis of the patients was performed in the outpatient clinic of ENT by a specialist, patients included in the study if they agreed to participate and signed informed consent. The exclusion criteria included underlying disease such as cold, acute and chronic sinusitis, and patients taking antihistamine and corticosteroids drugs over the last two weeks or patients with a history of anaphylaxis and severe persistent asthma.

Ethical Consideration

This study was approved by the ethics (Ref. number 201829) and scientific committees of the faculty of medicine at Mutah University. The patients were provided with a consent form, research scientific details, and informative sheet before performing the test. The consent form was filled and signed by the patients.

Data Collection

The demographic details of the patients, smoking history, and family history of allergic disease was obtained by questionnaire.

Skin prick test

Skin prick testing with 11 standardized allergen extract from a commercial test kit (Stallergenes) was performed on all patients in accordance with published guidelines[13]. Skin test findings have a sensitivity of 80-97% and a specificity of 70-95%. The eleven tested inhaled allergens were; Cat pelt, Sasola-Kali, two strains of House dust mites (Dermatophagoides petronyssinus and Dermatophagoides farina), Cereal- mix (oat, wheat, barley, maize), Olive pollen, Grass mix, Mould (Alternaria), Dog fur, Compositae, and wall-pellitary. Allergens used in this study were chosen according to the regional plant species[14] and regional studies tested the common aeroallergens[12]. The tests were performed by a single trained and experienced physician to insure uniformity. Histamine hydrochloride (10mg/ml) and glycerol saline were used as positive and negative controls, respectively.

The skin prick test was performed on healthy skin on the volar surface of the forearm. The test sites were placed 20-30mm apart approximately 5 cm below the elbow and 5 cm above the wrist. A drop from each extract was applied to the skin (6 on the right and 5 on the left arm) and then the skin was pricked through each drop using a sterile lancet (Stallerpoint, Stallergenes). The mean wheal size was recorded after 15 minutes and SPT was regarded as positive with a wheal size of minimum 3-mm larger than the negative control.

Data Analysis

Microsoft excel was used to process and analyze data. The chi-square test was used to compare frequencies and independent sample t-test was used to compare means. A p-value of less than 0.05 was considered significant. The odds ratio and its 95% confidence intervals for potential risk factors for sensitization were assessed by univariate analysis and variables significantly associated with sensitization outcome in univariate analysis ($P< 0.05$) were included in the multivariate logistic regression model. The exposure variables included age group, gender, education level, smoking, and family history of allergy.

RESULTS

One hundred and forty patients were evaluated for skin prick test against 11 allergens. There were 73 females and 67 males evaluated for skin prick test response against common aero-allergens. The mean age of women and men were 51.86 and 45.61, respectively. Demographic and clinical characterization of the patients is presented in table 1. The median duration of allergic rhinitis was 3.5 years. Concomitant asthma was found in 23%, allergic conjunctivitis in 38%, eczema and atopic dermatitis in 15%, and food allergy in 4% of those patients with allergic rhinitis. A positive family history of allergic disease was found in 55% of the patients; while, 22.9% of the patients were active smoker and 39.3% of the patients were passive smokers.

Among patients with positive skin prick test, seasonal pattern was observed in 73% of the patients and perennial pattern was observed in 27%

Table 1. Demographic Profile of the Respondents

Demographic and Clinical characteristics of patients of Allergic Rhinitis		
Measure	Items	N (%)
Mean age ± SD	Male	45.6 % (± 23.6)
	Female	51.8 % (± 21.8)
Gender	Male	67
	Female	73
Education level	Primary school	24 (17.1 %)
	High school	40 (28.6 %)
	College	22 (18.7 %)
	University degree	54 (38.6 %)
Clinical history	Previous family history of allergic rhinitis	77 (55 %)
	Concomitant asthma	38 (27 %)
	Allergic conjunctivitis	32%
	Concomitant eczema	15%
	Food allergy	4%
	Seasonal	102 (73 %)
	Perennial	38 (27 %)
Smoking status	Current	32 (22.9 %)
	Passive	55 (39.3 %)
	Never	52 (37.1 %)
	X-smoker	1 (0.7 %)
Severity of disease	Mild	25%
	Moderate	30%
	Severe	45%

of the patients. Overall rating of sensitization to any allergen was observed in 85.7% of the patients, with 14.3% of the patients showing no reaction to any of the tested allergens. Out of all the patients, 69.3% were poly-sensitized; while, 16.4% were sensitized to only one allergen (Figure 1). The mean and median numbers of positive reactions were 3.5 ±1.8 and 3, respectively, among patients with positive skin prick tests. Moreover, Olive tree, Dermatophagoides pteronyssinus, and weed pollens (Compositae) were the most prevalent allergens (51.4%, 37.9%, 32.9%), respectively among the patients with allergic rhinitis (Table 2).

Among the study sample of patients, the percentage of the allergen group showed that outdoor allergens (80%) were the most common allergen group followed by indoor allergens (68.6%), weed pollen (60%),tree allergens (51.4%), mite (47.9%) and animal allergens (39.3%) (Figure 2). Among indoor allergens, Dermatophagoides pteronyssinus was the most common allergen (37.9%) followed by Dermatophagoides farina (30.7%), Animal dander (Cat hair 30% and Dog epithelia 23.6%); whereas, mould made the least prevalent allergens (17.1%) (Table 3). Among outdoor allergens, olive tree pollen (51.4%) made the most prevalent allergen followed by Weed pollen (Compositae (32.9%), Salsola Kali (32%)), and Grasses mixtures (24.3%). The least prevalent allergens in this group were Cereals mixture (17.9%). Among weed pollens, Compositae (32.9%) made the most frequent allergen; while, Wall pellitory (23.6%) was the least prevalent (Table 3). There was no statically significant difference observed in the rate of sensitization to other allergens between male and female patients (Table 2).

The results have shown that 69.3% of the patients were poly-sensitized to two or more allergens. Multi-allergen sensitization was due to many factors including, genetics, environmental factors, and cross-sensitization between closed species sharing common allergenic epitopes (30). More than 10% of the patients were sensitized to

Table 2. Prevalence of Positive Skin Prick Test to selected Allergens

Aeroallergen name	All patients (n=140)	Sex		p-value (Male vs. Female)
		Male (n=67)	Female (n = 7 3)	
Mites Dermatophagoides petronyssinus	37.9% *(53)	44.80% *(30)	31.50% *(23)	0.13
Mites Dermatophagoides farina	30.7% *(43)	29.90% *(20)	31.50% *(23)	0.21
Cereal-mix	17.9% *(25)	20.90% *(14)	15.10% *(11)	0.22
Olive pollen	51.4% *(72)	55.20% *(37)	47.90% *(35)	0.25
Grass mix	24.3% *(34)	17.90% *(12)	30.10% *(22)	0.15
Mould (Alternaria)	17.1% *(24)	14.90% *(10)	19.20% *(14)	0.16
Dog fur	23.6% *(33)	26.90% *(18)	20.50% *(15)	0.22
Compositae	32.9% *(46)	37.30% *(25)	28.80% *(21)	0.21
Wall-pellitary	23.6% *(33)	31.30% *(21)	16.40% *(12)	0.055
Sasola-kali	32.1 % *(45)	35.80% *(24)	28.80% *(21)	0.23
Cat pelt	30% *(42)	31.30% *(21)	28.80% *(21)	0.26

*(-) Number of patients

more than five allergens and the maximum number of allergens sensitized by the patients were eight reflecting co-sensitization between different groups of allergens (Figure 1).

Univariate analysis identified only education level was significantly associated with sensitization to olive pollen while other factors like age group, gender, smoking, family history failed to show significant sensitization to any other allergen (Table 4). For this reason, multivariate analysis was not used as most of the factors were insignificant.

DISCUSSION

The results of the present study have revealed a high rate of sensitization to any allergen (85.7%), which is similar to the previous study conducted in the same region[15] and higher than the studies conducted elsewhere[16]. Nearly 14% of patients showed no positive sensitivity reactions. In our study, skin prick test in patients with allergic rhinitis revealed a high incidence of plant pollen allergen and the most common was found to be olive tree pollen. These results are consistent with a local study conducted in Jordan[12]. Olive tree pollen was the second most common sensitizing allergen (68%) in a study from Italy[17]; whereas, it was one of the most common allergens in a study from Turkey[18].

Olive trees were widely cultivated all over Jordan and several Middle Eastern countries for ornamental and business purposes. It has been estimated that between 20-50% of households in Jordan are cultivating 10-20 olive trees each. It is well known that olive tree pollen contributes to the development and deterioration of allergic diseases[12]. Among weed pollens, Compositae (32.9%) made the most frequent allergen; while, Salsola Kali (32%) and Wall pellitory (23.6%) were the least prevalent. Allergic sensitization to grass pollen in this study is 24.3%, which is less than reported in other studies from countries like

Table 3. Prevalence of Positive Skin Prick Test to selected Allergens among different age groups

Aeroallergen name	Age (year)					p-value
	17-Jan (n=11)	18-30 (n=22)	31-45 (n=37)	46-65 (n=37)	66+ (n=33)	
Mites Dermatophagoides petronyssinus	27.3% *(3)	40.9% *(9)	40.5% *(15)	35.1% *(13)	39.40% *(13)	0.39
Mites Dermatophagoides farina	18.2% *(2)	31.8% *(7)	32.4% *(12)	21.6% *(8)	42.40% *(14)	0.24
Cereal-mix	27.3% *(3)	18.2% *(4)	21.6% *(8)	10.8% *(4)	18.20% *(6)	0.41
Olive pollen	72.7% *(8)	40.9% *(9)	37.8% *(14)	64.90% *(24)	51.50% *(17)	0.035
Grass mix	27.3% *(3)	22.7% *(5)	21.6% *(8)	16.2% *(6)	36.40% *(12)	0.33
Mould (Alternaria)	18.2% *(2)	22.7% *(5)	16.2% *(6)	10.8% *(4)	21.20% *(7)	0.42
Dog fur	18.2% *(2)	36.40% *(8)	18.9% *(7)	13.5% *(5)	33.30% *(11)	0.13
Compositae	45.5% *(5)	45.5% *(10)	21.6% *(8)	27% *(10)	39.40% *(13)	0.16
Wall-pellitary	27.3% *(3)	18.2% *(4)	27% *(10)	13.5% *(5)	33.30% *(11)	0.3
Sasola-kali	45.5% *(5)	27.3% *(6)	29.7% *(11)	21.6% *(8)	45.50% *(15)	0.27
Cat pelt	36.4% *(4)	22.7% *(5)	37.8% *(14)	29.7% *(11)	24.20% *(8)	0.3

*(-) Number of patients

Table 4. Odds Ratio and Confidence Interval for factors associated with sensitization to aeroallergens based on Univariate analysis[a]

SPT with Allergens	Gender OR,95%CI	Smoking OR,95%,CI	family history Of Allergy OR ,95%,CI	Education level OR,95%,CI	Age OR,95%CI
Mites Dermatophagoides petronyssinus	0.567 (0.285-1.131)	1.163 (0.519-2.605)	1.612 (0.804-3.236)	0.783 (0.383-1.600)	0.941 (0.475-1.863)
Mites Dermatophagoides farina	1.081 (0.526-2.220)	0.695 (0.284-1.703)	0.800 (0.389-1.644)	0.718 (0.341-1.514)	1.069 (0.521-2.195)
Cereal-mix	0.672 (0.281-1.604)	0.815 (0.279-2.37)	0.710 (0298-1.690)	1.133 (0.450-2.855)	0.611 (0.245-1.473)
Olive pollen	0.747 (0.384-1.453)	0.789 (0.358-1.74)	0.659 (0.337-1.287)	2.074 [b] (1.019-4.223)	1.779 (0.910-3.475)
Grass mix	1.977 (0.888-4.400)	0.371 (0.120-1.149)	0.767 (0.353-1.663)	0.573 (0.259-1.264)	1.168 (0.539-2.532)
Mould (Alternaria)	1.353 (0.556-3.292)	0.261 (0.058-1.175)	0.785 (0.325-1.892)	0.450 (0.184-1.098)	6.817 (0.339-1.974)
Dog fur	0.704 (0.322-1.541)	1.167 (0.443-2.768)	0.515 (0.233-1.134)	0.274 (0.122-0.617)	0.924 (0.423-2.017)
Compositae	0.678 (0.334-1378)	0.751 (0.316-1.787)	0.844 (0.416-1.713)	0.729 (0.350-1.519)	1.000 (0.494-2.025)
Wall-pellitary	0.431 (0.192-0.965)	1.107 (0.443-2.768)	1.147 (0.521-2.522)	1.267 (0.546-2.938)	0.924 (0.423-2.017)
Sasola-kali	0.724 (0.355-1.474)	0.948 (0.406-2.216)	0.794 (0.390-1.617)	1.234 (0.578-2.633)	1.068 (0.525-2.171)
Cat pelt	0.885 (0.429-1.823)	0.889 (0.372-2.128)	0.496 (0.238-1.032)	1.062 (0.495-2.282)	0.761 (0.369-1.573)

[a] Abbreviations CI, Confidence Interval; OR, Odds Ratio
[b] Significant Level (P<0.05)

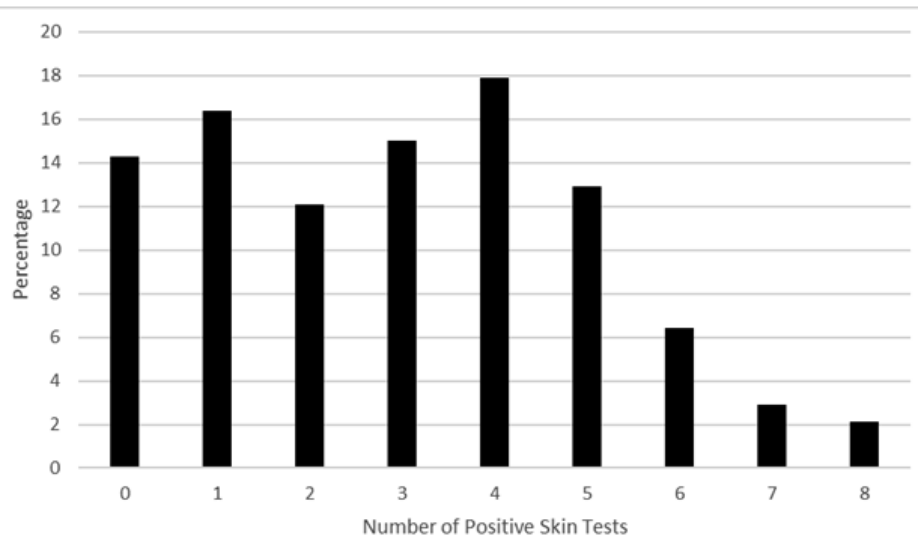

Fig. 1. Percentage of patients by number of positive skin tests responses

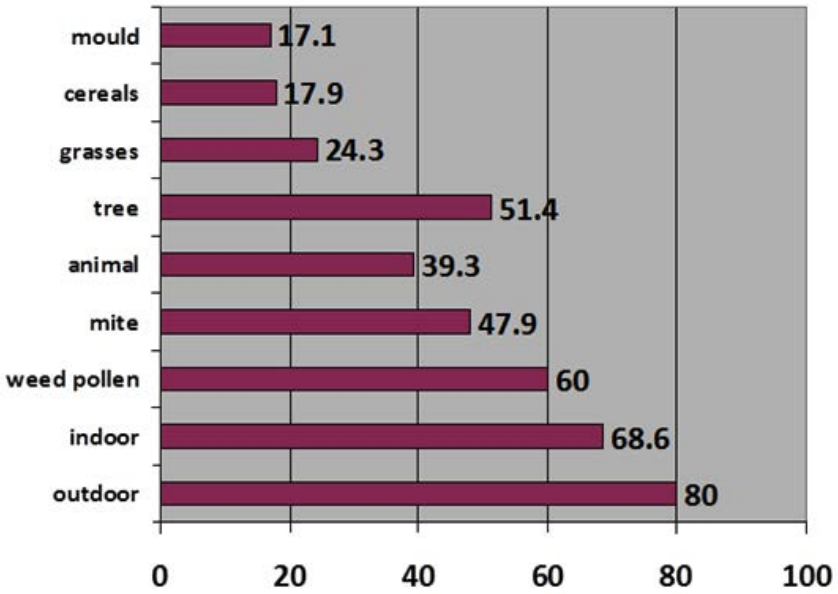

Fig. 2. Percentage of allergen groups among study sample

Iran[19], Netherlands[20], and Germany[21]; however, it was similar to study from UAE[22].

Among indoor allergens, house dust mite was the most prevalent allergen with Dermatophagoides pteronyssinus as the most common allergen (37.9%) followed by Dermatophagoides farina (30.7%). Higher rate of sensitization to dust mites has also been reported in other studies from humid regions like Thailand[23] and Malaysia[24] and from hot and dry regions like Kuwait[25] and Qatar[26]. However, the climate of Jordan is dry and moderate and is known for this particular allergy. The possible reason of increased prevalence of rhinitis could be increased use of air conditioners that make the environment favorable for mites.

In the present study, sensitization rate to cat allergen was found to be 30%, which is in contrast to studies from USA and Japan, which showed a higher rate of sensitization to cat allergens[27]. Cats can be found in almost every area of Jordan; although, only a few families in Jordan keep cats as pets in their homes. It is known that cat allergy can be a major problem even for those who do not own them[28] because the dander is being carried on the clothing of people and shed in public places, who have cats. Therefore, cat dander is considered a component of house dust allergen, even in the absence of cat in the homes. Sensitization rate to dog allergen was found to be 23.6%, which is similar to a study done recently in Islamabad[15]. These results were in contrast to studies done in countries like USA and Sweden refer to the fact that in these countries more than 60% of the households keep pets and more than 161 million of these pets were dogs and cats[29].

About 14% of the patients showed no response to any of the tested allergens. This is lower than other studies that reported a higher rate 58% of patients with negative SPT reactivity[30]. The explanation for these negative results could be due to the lower sensitivity less than 100% of the SPT and the patients allergic to particular allergens were not tested in the study or not yet identified[15]. Data analysis showed no significant statistical difference in the rate of sensitization between male and female patients (Table 2). This result was inconsistent with a study that revealed that the prevalence rate of sensitization towards outdoor allergens was higher in males than females[25]. However, another study showed no difference in sensitization to outdoor allergens between male and female patients[15].

In the present study, data analysis did not reveal statically differences in rate of sensitization to selected allergens between younger and older patients with allergic rhinitis, except for olive

pollen allergens. The prevalence rate of olive pollen sensitization was higher for two age groups (1-17 and 46-65 years), as compared to other age groups (Table 3). The results of present study differ from a study that showed higher prevalence of indoor allergens like mite among the young patients[25].

Used univariate analysis, we did not find any association between sensitization to common allergens and age, gender, education level , smoking and family history of allergy except the association between education level and olive pollen allergen. Previous studies showed that a family history of allergic disease, education level increased significantly the risk of sensitization, whereas the opposite was observed with active smokers[31].

In the present study, the most prevalent symptoms were nasal obstruction, sneezing, facial pain and post nasal drip, each of them present in more than two third of the patients. Allergic rhinitis severity can be assessed using a visual analogue scale in mild, moderate and severe[32]. Sensitized patients expressed a higher VAS score in term of allergy symptoms than nonsensitized patients.

CONCLUSION

The present study evaluated the most common aeroallergens among allergic rhinitis patients in the city of Al-Karak, Jordan. The results have depicted the significance of olive tree pollens and mites and the poly-sensitization pattern among the residents of Al-Karak city in Jordan. The results also suggest the use of these allergens in any diagnostic or therapeutic strategy for the treatment of allergic rhinitis patients. It has been shown that a diagnosis of pollen allergen can be simplified by using a combination of a few common aeroallergens including the olive tree and house dust mites.

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