Regional pollen load: Effect on sensitisation and clinical presentation of seasonal allergic rhinitis in patients living in Ankara, Turkey

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ABSTRACT

Background: Although *Gramineae* pollens are the main reason for seasonal allergy in many parts of Europe, the influence of regional flora on sensitisation and symptoms has always been a topic of interest. The aim of this study was to document the sensitisation to pollens and to evaluate their clinical importance in patients with seasonal allergic rhinitis living in Ankara/central Anatolia.

Methods: The study included those subjects with seasonal allergic rhinitis living in Ankara. Skin prick testing with a panel of common aeroallergens as well as grass, individual tree and weed pollens predominant in the region was performed. The patients were followed by symptom-medication scores during the same season in which regional pollens were also counted.

Results: The final eligible study consisted of 54 subjects (F/M: 26/28; mean age: 29.4 years). Trees were the most common pollen source consisting of 95 % of the total amount, followed by grasses (3 %) and weeds (2 %). Sensitisation to *Gramineae*, to at least one weed; and to tree pollens were 100 %, 85.2 % and 94.4 %, respectively. The most common positive skin tests among tree pollens were to *Oleaceae* (59.2 %), *Aesculus* (57.4 %); and *Tilia* (42.5 %) despite low pollen counts. *Chenopodiaceae* (88 %) and *Plantago* (63 %) were the most sensitised weed pollens, with high pollen counts. All patients had significant symptoms during May and June.

Conclusion: Although *Gramineae* pollens seem to be major allergens for seasonal allergic rhinitis in Ankara, the particular role of tree pollens and weed pollens cannot be discarded on symptom development in sensitised patients.

Key words: Pollen counts. Seasonal allergic rhinitis. Sensitisation. Allergy. Tree pollens. Weed pollens *Gramineae.* Anatolia. Turkey.

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INTRODUCTION

The prevalence of pollen allergy is presently estimated to be up 40 %. Exposure to allergens represents a key factor among the environmental determinants[1]. Although particular different plant species exist in varying regions, previous trials showed G*ramineae* pollens to be the major cause of seasonal allergic rhinitis (SAR) in our country affecting 1.3 %-6.4 % of the population in accordance with other European countries[2-10]. On the other hand, regional pollen load has also been reported to have major impact on the clinical presentation of seasonal respiratory allergies. As an example of this, subjects living in regions with overabundance of tree pollens reported having a high incidence of positive reactions to tree pollens as an important cause of SAR, although generally it is believed that tree pollens are not as allergic as *Gramineae* pollens[8].

Ankara is situated in central Anatolia at an altitude of 870 m above sea level with dominant steppe vegetation and is 70 km from natural *Pinus* forests. In the early years of the Republic of Turkey, there was an increase in plantation in Ankara owing to its arid properties. As a result of this development process of the city, today many species particularly of trees such as *Populus, Platanus, Acer, Cupressaceae/Taxaceaea, Fraxinus* as well as others with varying allergenic properties are seen in the city creating a high tree pollen load for allergic patients.

Many studies performed in Ankara region agreed that tree pollens comprised the majority of the pollen load whereas grass and weed pollens contributed less than 10 % of total yearly pollen counts[9-11]. These studies also pointed out the dominant individual pollens to which people were exposed in the region. Our recent trial showed a high sensitisation to a mixture of tree pollen in subjects with SAR living in the region[3]. However, the sensitivity rates to individualised pollens dominant in the region are not known and indeed whether this pollen load contributes significant symptoms in sensitised people living in our district.

In this study, we aimed to document the sensitisation rates to certain pollens dominant in the region which are selected according to the results of previous aeropalinologic trials performed in Ankara region and to evaluate the clinical importance of these sensitisations in patients with SAR living in Ankara. To do this, we followed subjects with isolated pollen allergy and living in Ankara city for at least three years and correlated the results with regional pollen counts.

METHODS

Patients

The study was conducted in our tertiary care clinic located in Ankara between January and December 2004. The eligible study subjects were the patients who admitted to our outpatient clinic with symptoms of SAR. The subjects in whom pollen (*Gramineae* and/or tree and/or weed) allergy was demonstrated in skin prick tests (SPTs) and diagnosed as allergic rhinitis according to ARIA guidelines[13] and living in Ankara for at least 3 years consisted the final study group. The rationale for selecting the subjects living at least three years in Ankara was that clinical presentation to certain pollen might require up to 3 years of exposure. Subjects with concomitant allergy to perennial allergens such as house dust mites, cat, dog and cockroach in SPTs and those receiving allergen specific immunotherapy or not willing to participate to the study were not included. A verbal informed consent was obtained from each subject prior to study.

Table I

Pollens used in skin prick test panel

Gramineae	
Mixture of *Dactylis glomerata, Lolium perenne, Phleum pratense*	
Trees	
Cupresseceae/Taxaceae (Cypress)	*Salix* (Willov)
Pinaceae (Pine)	*Fraxinus* (Ash)
Acer (Maple)	*Aesculus* (Horse chestnut)
Populus (Poplar)	*Oleaceae* (Olive)
Platanus (Plane)	*Ulmus* (Elm)
Quercus (Oak)	*Tilia* (Linden)
Betulaceae (Birch)	
Weeds	
Plantago	
Chenopodiaceae/Amaranthaceae	
Compositae	

Study protocol

After enrolment to the study, demographic and disease characteristics were recorded (age; sex; family history of atopy; duration and severity of rhinitis; distribution of symptoms according to months; presence of asthma). Following this step, all subjects were asked to fill in a symptom-medication score on a daily basis and to return it at the end of year. During the same period, atmospheric pollen counts were assessed.

Skin prick tests

SPTs were performed using a common panel including *Dermatophagoides pteronyssinus, Dermatophagoides farinae*, grass, tree, and weed pollens (Table I), cat, dog, *alternaria*, *cladosporium* and cockroach allergen extracts (Allergopharma/Germany). Pollens for this study were selected according to the results of previous aeropalinologic trials conducted in Ankara and ten years cumulative pollen counts prepared by Ankara University Science Faculty (Fig. 1)[9-11]. Positive and negative controls were histamine

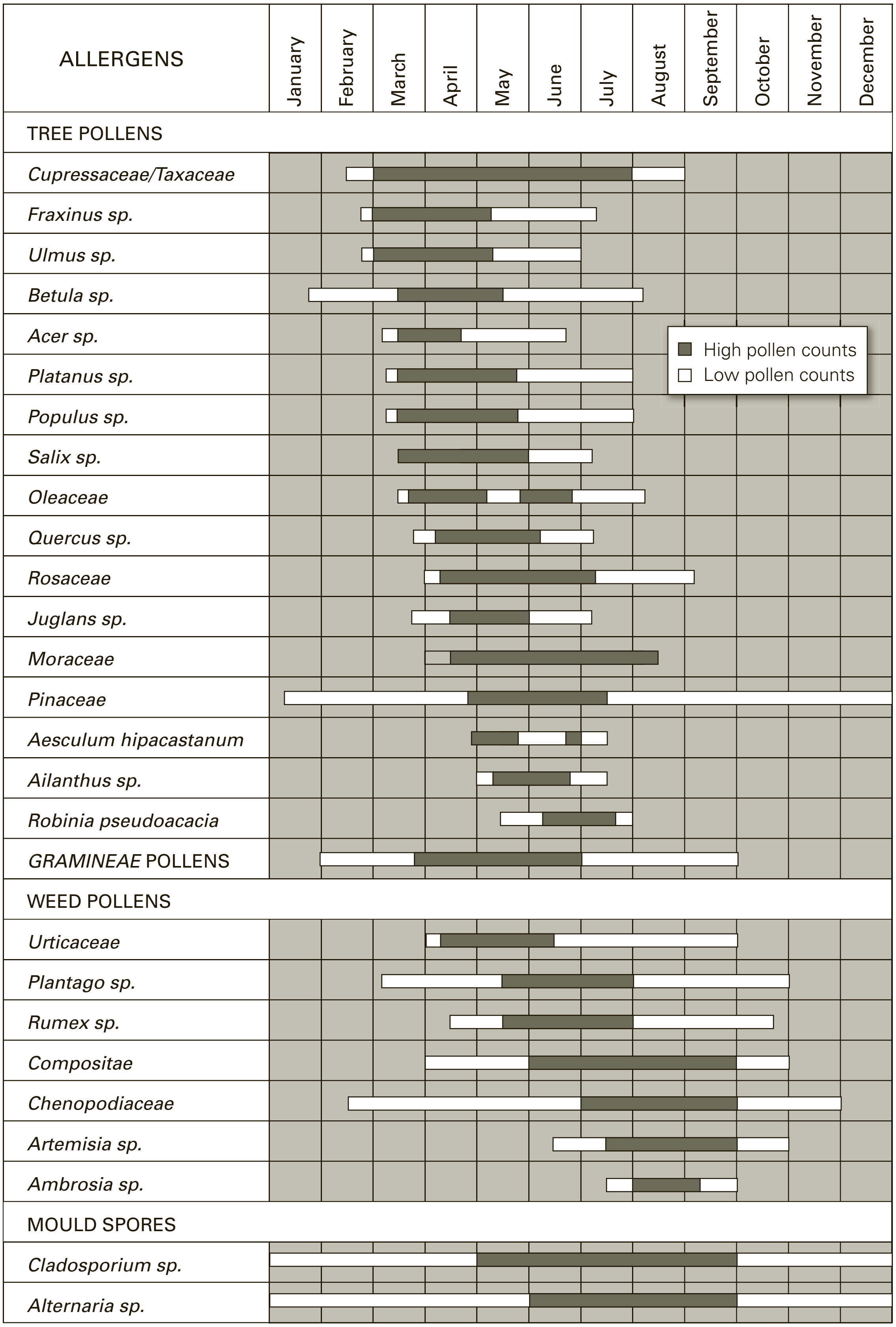


Figure 1.—Ten years of cumulative pollen counts for Ankara. High pollen counts Low pollen counts.

(10 mg/ml) and phenolated glycerol saline, respectively. Skin testing was performed by puncture method and a mean wheal diameter of 3 mm or greater than with the control solution was considered positive.

Pollen counts

Airborne pollen grains were counted in Ankara atmosphere from January to December 2004. The Burkard (Burkard manufacturing, Rickmansworth, Herts, UK) seven-day recording volumetric spore trap was used for sampling. The trap was installed on the roof of the Science Faculty building of Ankara University, which is 15 m high. The orifice was 80 cm above roof level. The pollen was sucked at an airflow rate of 10 litres per minute onto tapes which were coated with a thin film of vaseline-paraffin wax in toluene. The tape was then mounted in glycerine jelly. The twelve transverse stripes were counted on each slide, at a magnification of ×400. Counts were made at two-hour intervals and total daily counts were converted to number of pollen grains per cubic metre of air. Pollens were counted daily by the Palynological Laboratory in the Department of Biology of Ankara University.

CLINICAL EVALUATION

Symptom-medication scores

A symptom-medication score method was used to determine whether symptoms were associated with pollen counts. The subjects were asked to record their symptom and medication scores in the presence of symptoms and/or medication use. Symptoms for rhinitis and asthma were scored as follows:

"0": no symptoms,
"1": mild symptoms not disturbing daily activities of the subjects and not requiring medication
"2": moderate symptoms moderately disturbing daily activities and requiring medication
"3": severe symptoms which disturb patient's daily activities and require intensive medication for palliation.

Medication scores were filled for each drug consumed for the previous 24 hours. One point was given for each drug consumption except that of nasal steroids scored as 2 points and total medication score was scored as sum of points for each drug. Total monthly symptom and medication scores were used in the analysis of the data. The patients were instructed to use medications in accordance with the international guidelines[13].

Severity of rhinitis

Severity of rhinitis was determined according to ARIA guidelines[13]. Intermittent AR is defined as experiencing symptoms for < 4 days/week or < 4 consecutive weeks. Persistent AR is defined as symptoms occurring > 4 days/week and > 4 consecutive weeks. In addition, a severity scale of mild to moderate-severe according to effects of symptoms on sleep and daily activities was used.

Statistical analysis

Nominal values were expressed as n (%) with inter-group differences determined by Chi-square test. Continuous variables were given as mean ± SEM. Symptom and medication scores were given as a mean of total sum in a month (total sum/number of days in that month). As the symptom and medication scores showed non-homogeneous distribution, within-group comparisons were made by Wilcoxon signed-ranks test. All directional p values were two-tailed and significance was assigned to values lower than 0.05. Statistical analysis was performed by Statistical Package for Social Sciences (SPSS, v. 11.0 for Windows, Chicago, IL, USA).

RESULTS

Study group

The final study group consisted of 54 subjects (F/M: 26/28; mean age: 29.4 years) with SAR. Demographic and disease characteristics are shown in Table II. The majority had allergic rhinitis alone (41; 75.9 %) and had mild intermittent rhinitis on admission (23; 42.6 %).

Skin prick tests

Sensitisation to *Gramineae,* to at least one weed; and to tree pollens were 100 %, 85.2 % and 94.4 %, respectively. The majority of the subjects (44; 81.5 %) had allergy to *Gramineae*, weed and tree pollens concomitantly, eight (14.8 %) had allergy to both *Gramineae* and weed pollens and only two (3.7 %) subjects had allergy to *Gramineae* pollens alone.

The most common positive SPTs among tree pollens were as follows: *Oleaceae* (olive) (32; 59.2 %), *Aesculus* (horse chestnut) (31; 57.4 %); Tilia (linden) (23; 42.5 %) and *Platanu*s (plane) (16; 29.6 %). Among weed pollens, the patients were mainly sensitised to plantain (34; 63 %) and Chenopodium (48; 88 %) pollens.

Pollen counts

A total of 145345 pollen grains/m^3 were counted in Ankara atmosphere in 2004. Trees were the most common pollen source consisting of 95 % (138 200 grains/ m^3/year) of the total amount and were followed by grasses (3 %; 4309 grains/ m^3/year) and weeds (2 %; 2816 grains/ m^3/year). The most prominent individual pollens from January to April were tree pollens (*Cupresseceae; Pineceae; Quercus; Populus; Betula; Fraxinus; Salix; Acer, Platanus*); from May to July were *Gramineae*, *Pineceae* and *Cupresseceae/Taxaceae* pollens; and in July and August were *Gramineae*, and weed pollens (*Plantago, Chenopodiaceae/Amaranthaceae, Compositae*) (Table III).

Table II

Characteristics of study population

Variables	
n	54
Gender (F/M) n (%)	26/28 (51.8/48.2)
Age (mean ± SEM) (years)	29.4 ± 1.4
Duration of diseases (mean ± SEM) (years)	6.3 ± 0.7
Family history of atopy n (%)	31 (57.4 %)
Diagnosis n(%)	
Allergic rhinitis	41 (75.9 %)
Allergic rhinitis + asthma	13 (24.1 %)
Severity of rhinitis on admission n (%)	
Mild intermittent	23(42.6 %)
Mild persistent	15 (27.8 %)
Moderate-severe intermittent	2 (3.7 %)
Moderate-severe persistent	14 (25.9 %)

Table III

Distribution of pollen counts (pollen/m^3) according to months in Ankara atmosphere in 2004

	January	Febr.	March	April	May	June	July	August	Sept.	Octob.	Novem.	Decemb.	TOTAL
Grasses													
Gramineae	0	0	9	131	2321	219	564	904	15	0	146	0	**4309**
Trees													
Acer*	0	0	7540	11456	274	0	0	0	0	0	0	0	**19270**
Betulaceae*	17	15	46	3118	423	7	2	0	0	3	0	3	**3634**
***Aesculus**	0	0	0	17	22	213	43	0	0	0	0	0	**295**
Cup./Tax*.	13	420	22872	6982	6322	534	88	0	0	3	2	0	**37354**
Fraxinus	27	15	612	0	146	3	0	0	0	0	0	0	**803**
Oleaceae*	0	0	0	2	26	10	0	0	0	0	0	0	**38**
***Pinaceae**	104	60	70	2458	21582	10322	474	20	70	43	22	20	**35245**
Platanus	0	0	425	5809	1307	51	0	0	0	0	0	0	**7592**
***Populus**	0	14	8762	9976	24	3	0	0	0	2	0	0	**18781**
***Quercus**	43	9	9	2749	1814	114	0	0	0	19	0	7	**4764**
***Salix**	0	0	398	755	728	0	0	0	0	3	0	0	**1884**
Tilia*	0	0	0	0	0	41	10	2	0	2	0	0	**55**
***Ulmus**	0	7	721	2	12	2	0	0	0	10	2	0	**756**
Weeds													
Artemisia	0	0	0	0	0	0	58	0	0	85	3	0	**146**
Chen./Amar.	0	0	5	3	7	95	724	94	53	29	5	0	**1015**
Compositae	0	0	5	48	41	17	128	12	15	5	0	0	**271**
Plantago	0	0	0	0	185	729	206	2	2	0	0	0	**1124**
Rumex	0	0	0	10	3	7	41	0	0	2	0	0	**63**
Urtica	0	0	0	0	14	83	100	0	0	0	0	0	**197**

*Mildly allergic trees: *Cupresseceae/Taxaceae Populus; Salix; Quercus, Aesculus; Pinaceae, Ulmus.*
**Moderately allergic trees: *Fraxinus; Platanus.*
***Highly allergic trees: *Acer; Betulaceae; Oleceae, Tilia.*

Pollen counts vs sensitisation

Details of comparison of pollen counts and sensitisation rates of various pollens are shown in Table IV. Among tree pollens, the most common sensitizers were *Oleaceae*, *Aesculu*s, *Tilia*, *Platanus* and *Acer*. Among them, *Acer* and *Platanus* were the second and fifth, respectively, in contributing to tree pollen load in Ankara atmosphere. On the other hand, *Oleaceae, Tilia* and *Aesculus* were among the ones with lowest atmospheric pollen counts in Ankara in 2004 (Table III).

Symptom-medication scores

Twenty patients returned symptom-medication scores. The minority of the subjects showed symptoms in January and February followed by an increase starting from March. In March only six patients revealed symptoms and medication use with mean scores of 1.1 and 1.6/month, respectively. The majority of the subjects (n = 18 and 19 for May and June, respectively) showed symptoms with mean symptom scores of 1 and 0.9 in May and June 2004, respectively (Fig. 2). There was also an increase in medication use in these months. In July, where there was a peak of weed pollens and 75 % reduction in *Gramineae* pollens, eight patients had symptoms requiring medication. In August and September, symptoms and medication use persisted in a small number of subjects despite a decrease in symptoms and medication use.

Table IV

Sensitisation rates and pollen counts of trees and weed pollens

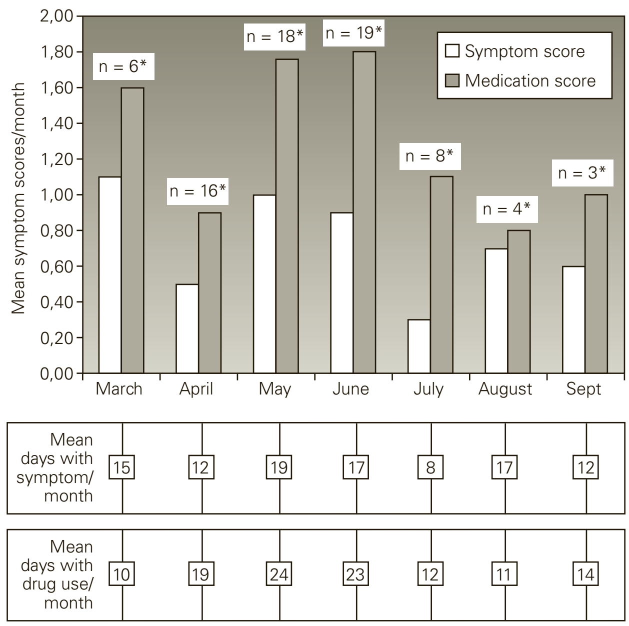
Pollens	Total number (grain/m^3/year)	Sensitisation rate in SPTs n(%)
Gramineae	4309	54 (100)
Trees		
*Cup./Tax.**	37354	2 (3.6)
*Pinaceae**	35245	8 (14.5)
*Acer****	19270	14 (25.5)
*Populus**	18781	12 (21.8)
*Platanus***	7592	16 (29.1)
*Quercus**	4764	8 (14.5)
Betula ***	3634	10 (18.2)
*Salix**	1884	9 (16.4)
*Fraxinus***	803	11 (20)
*Aesculus**	295	31 (56.2)
*Oleaceae****	38	32 (58.2)
*Ulmus**	756	10 (18.2)
*Tilia****	55	23 (41.8)
Weeds		
Plantago	1124	34 (63)
Chen./Amar.	1015	48 (88)
Compositae	271	NP
Urtica	197	NP
Artemisia	146	19 (35.2)
Rumex	63	NP

*Mildly allergic.
**Moderately allergic.
***Highly allergic.
NP: not performed.

DISCUSSION

In this study, we have shown that sensitisation to *Gramineae* pollens was the leading cause for SAR in the region. Our data also revealed that regional tree pollen load as well as certain plantation with low pollen counts had a particular contribution to both sensitisation and clinical presentations of seasonal allergy in subjects living in Ankara. Our results also highlighted the clinical significance of weed allergy in our region.

Regarding geographic and climate properties, plantation in Turkey is similar to the south-eastern part of Europe. This similarity also reflects to clinical



*Only patients who demonstrated symptoms were included.

Figure 2.—Symptoms and medications scores in patients with SAR.

expression. As a result of this, *Gramineae* pollen allergy has been reported to be the main reason for seasonal allergy in our country[2-6] in accordance with a recent study conducted in many countries of Europe within the frame work of GA²LEN[14]. Our current clinical data also showed that *Gramineae* pollen was the leading allergen influencing the patient with SAR in the central part of our country, Ankara region.

Despite being located in the central part of the country, plantation in Ankara also resembles the Mediterranean region with some differences particularly in weeds and some trees such as olive. Subjects living in regions with overabundance of tree pollens were reported to have a high incidence of positive reactions to tree pollens as an important cause of SAR[15-17]. In this sense, despite the fact that *Gramineae* pollens are the main cause of SAR all around the country as well as in our city, the role of tree pollens on seasonal allergy needs to be clarified in our region as Ankara city is rich in several trees such as poplar, pine, plane, horse chestnut, maple, cypress and others. Emphasizing this, our recent trial supported a high sensitisation rate to a mixture of tree pollens in subjects with SAR living in the region[3].

This study showed that pollen composition generally reflected the vegetation of gardens, parks, and roadsides in the city. Thus, pollens of cypress, pines, and maple and poplar trees had the highest contribution to the regional pollen load. Regarding the sensitisation rates, our results indicated that 94.4 % of the study subjects had positive SPT to at least one of the tree pollens. However, sensitisation rates did not seem to correlate with pollen counts as the higher sensitisation rates for trees were caused by tress such as *Oleaceae*, *Aesculu*s, and *Tilia* with the lowest pollen counts in the city. Pollens of olive tree are known to be highly allergenic[18], yet, as there is no olive tree in the city and the olive tree is found very commonly on the southern and western coasts of Turkey, finding a high *Oleaceae* sensitivity rate in skin testing was one of the most surprising data in our study. Supporting our data, another study from Eskis¸ehir, whose climate and vegetation is very close to Ankara, also showed that *Oleaceae* family had the highest sensitivity (22 %) in patients with seasonal allergy[19]. One explanation could be cross-reactivity between *Oleaceae* and *Fraxinu*s, which is frequent in Ankara as they are in the same family. Another is that long distance transport might be responsible for sensitisation in areas far from the source of pollen[1]. A further speculation could be sensitisation to olive pollen during vacation(s) to these regions, which was not investigated in this study. On the other hand, despite low atmospheric pollen counts of *Aesculus* and *Tilia*, we also observed high sensitivity rates (over 40 % of each) to these pollens. *Tilia* is primarily insect pollinated and of little allergenic importance in North America[18]. However, our results indicated that these plants cause significant sensitisation in the residents of our city where both trees are frequently encountered which emphasized the re-direction of policy for new plantation in the region.

On the other hand, regarding the correlation between skin test reactivity and regional pollen counts, we obtained low to moderate sensitisation rates to pollens of cypress and pine trees. *Cupresseceae/Taxaceae* allergy has been reported to be common in the south of France and Italy and regarded to cause a significant sensitisation[20]. However, our result showed a very low sensitisation rate to *Cupresseceae/Taxaceae*. A possible explanation for this discrepancy could be using of different pollen extracts.

Regarding clinical presentations of the subjects, despite the fact that few subjects revealed symptoms in early spring, especially in March, both medication and symptom scores were, however, close to those in May and June. Regarding the very low counts for *Gramineae* pollens in March, this result suggested that in a susceptible person, exposure to tree pollens in high amounts might be responsible for clinical presentation. Trees with high pollen counts in March were *Cupresseceae/Taxaceae; Populus; Acer; Ulmus; Fraxinus; and Platanus*. Regarding the low clinical impact of exposure to Poplar tree pollens in sensitised subjects[21] and allergenic properties of other tree pollens[8,22], we may assume that *Acer, Platanus* and *Fraxinus* pollens could be the main reason for clinical presentations in this month[19].

Generally, it is believed that weeds are an important pollen source with highly allergenic properties in the American continent. In our country, weeds are found to be clinically important in Mediterranean and Aegean Sea coasts of the country[23]. However, our data also strengthen the clinical importance of some weed pollens such as *Plantago* and *Chenopodiaceae Amaranthaceae* in our particular region On the other hand, finding a higher rate for weed sensitivity when skin test applied by individual weed allergens in comparison to another study performed in our region also emphasizes the importance of doing skin testing on individual allergen bases[24].

Thus, the results of the current study carry important information related to associations with regional pollen counts/plantation and sensitisation/symptom development in subjects with SAR and living in Ankara/central Anatolia. Besides *Gramineae* pollens, some tree and weed pollens also have a particularly important effect on the clinical profile of the sensitised patient for our region. This study has also shown us that not only the trees with high pollen counts but also some insect pollinated trees such as *Aesculus*, and *Tilia* might have a significant contribution to sensitisation. This data points out the necessity of preventive measures to be taken by means of selection of the plantation in the region in the future. For the definite determination of sensitivity rates of the individual pollens in subjects living in Ankara, in addition to *Gramineae* pollens, SPT panels should also include particular tree pollens such as *Cupresseceae/Taxaceae*, *Acer, Populus*, *Aesculus*, *Tilia* and *Platanus* and particular weed pollens such as *Plantago* and *Chenopodiaceae/Amaranthaceae*.

ACKNOWLEDGEMENT

The authors thank Allergopharma/Germany for providing skin prick testing materials and Suzan Kısa and Gülay Ülger for performing skin prick tests.

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