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Juniper-Pollen Monosensitivity; Correlation Between Airborne Pollen Concentrations and Clinical Symptoms In Denizli, Turkey

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Abstract

Objective: This study aimed to examine juniper-pollen levels in Denizli, Turkey, analyze the effect of meteorological factors on the airborne pollen concentrations, and determine the correlation between pollen counts and clinical symptoms in juniper-pollen monosensitive individuals.

Material and Methods: This study was conducted on 14 participants who were detected between 2008 and 2013 with juniper-pollen monosensitivity in the allergy clinic of our hospital. Patients were requested to fill an allergic rhinitis (AR) symptom score sheet daily, and the symptom score data were collected at regular weekly control periods. Juniper-pollen calendar was established using the volumetric method. Meteorological data were obtained from the local meteorology institute.

Results: Juniper pollination season was found to be between the fourth week of January and the fourth week of September. Peak juniper-pollen level was observed in March with 843 pollen grains per m3. Total symptom scores (TSS) of the participants showed significant correlation with the pollen levels (p=0.006, r=0.67). Pollen levels showed a positive correlation with temperature (p=0.002, r=0.739), a negative correlation with humidity (p=0.008, r=−0.653), and did not show any significant correlation with wind speed or precipitation levels.

Conclusion: Juniper-pollen counts show a significant and positive correlation with clinical symptoms in juniper-pollen monosensitizied individuals.

Keywords: Allergy, airborne pollen concentration, juniper pollen, sensitization

INTRODUCTION

Pollens are the most common allergens in the external environment. Geographical and climatic differences result in variations in the dominant allergenic pollens that exist in different regions. Therefore, determining the pollens present in the atmosphere in a specific region is of importance in the diagnosis, treatment, and follow-up of allergic diseases.

Juniper (*Juniperus*), the topic of the research done for this study, is a woody plant belonging to the family *Cupressaceae*. It has a wide geographic distribution among the Mediterranean countries. Its pollens cause allergic symptoms including rhinitis, conjunctivitis, and asthma (1). Juniper trees are also prevalent in Denizli province and its vicinity in Turkey. Our city, Denizli, is located in the southwestern part of Turkey and has a typical Mediterranean climate. During pollen season, high atmospheric concentrations of juniper pollens cause complaints in sensitive individuals. In our study, we aimed to examine juniper-pollen levels in our region, analyze the effect of meteorological factors on the airborne pollen concentrations, and determine the correlation between pollen counts and clinical symptoms in sensitive patients.

MATERIAL AND METHODS

Selection of Patients

At the outset of our study, we retrospectively reviewed information concerning 1478 patients who underwent allergy test in the allergy outpatient clinic of our hospital from 2008 to 2013. Among the 753 patients with positive allergy test results, 22 patients had juniper-pollen monosensitivity. These patients were contacted again, and they were informed about the study. Two patients did not volunteer to participate, and six patients had moved to another city; therefore,

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the study was planned to be conducted on 14 patients. Patients provided detailed medical history, and the severity of their complaints was recorded. Then, nasal endoscopic examination was performed to ensure that there were no additional nasal pathologies, such as rhinosinusitis, nasal polyp, or septum deviation. Next, a skin prick test was performed, and juniper-pollen monosensitivity was confirmed in all patients. All of the 14 patients eligible to participate were enrolled in the study. Ethics committee approval was received from the Pamukkale University clinical research ethics committee.

Clinical Data
Participating patients were asked to complete the AR symptom score sheet daily at the same time every day starting from January 1, 2014 (Table 1). On this sheet, patients were asked to answer six questions that assessed their symptoms and score the intensity of their symptoms on a grade from 0 to 3. Weekly control visits were planned for follow-up at which time symptom score data were collected.

Pollen Collection Method
The amount of juniper pollen in the atmosphere per mm^3 air was determined by the volumetric method from January 1, 2014, to December 31, 2014. For pollen collection, a Lanzoni VPPS 2000 (Lanzoni, Bologna, Italy) device placed on the roof of the hospital was used. Transparent bands within the device were replaced weekly, and they were then stained using glycerin gelatin with basic fuchsine and allocated to slides. Using these slides, pollen counting was performed by the Biology Department of Pamukkale University.

Meteorological Data
Meteorological data for Denizli province from January 1, 2014, to December 31, 2014, were obtained from the local meteorology institute. These data included daily, weekly, and monthly averages of temperature, precipitation, humidity, and wind speed.

Statistical Analysis
Data were analyzed with The Statistical Package for Social Sciences (SPSS) version 21.0 (IBM Corp.; Armonk, NY, USA) software. Continuous variables were expressed as mean±standard deviation, and categorical variables were expressed as count and percentage. Correlations between continuous variables were analyzed with Pearson correlation analysis. Evaluation of variables with different scales and intervals was made after standardization (standard *z* scores). A p value of <0.05 was accepted as a statistical level of significance.

RESULTS

Patient Population
All 14 patients included in the study (7 females, 7 males; mean age: 43.6±10.3 years) had symptoms of rhinitis and conjunctivitis, and 4 patients (28.6%) had symptoms of asthma. According to the patients' medical histories, all required medical treatment during allergy season; 11 patients (79%) had remarkable improvement in allergy symptoms with medical treatment, and 3 patients (21%) had no relief of their symptoms despite medical treatment.

Pollen Count
Juniper pollination started in the fourth week of January and continued until the fourth week of September. Total atmospheric juniper-pollen count in Denizli province from January 1, 2014, to December 31, 2014, was measured as 1912 pollen grains per m^3. Peak juniper-pollen level was observed in March with 843 pollen grains per m^3. When pollination started in the fourth week of January, atmospheric pollen count was measured as 2 pollen grains per m^3. Peak pollen count on a weekly basis was reached in the fourth week of March, with 228 pollen grains per m^3. Pollen levels started to decrease during April and May. Total pollen count in September was 2 pollen grains per m^3. During October, November, December, and the first three weeks of January, no juniper pollen was detected in the atmosphere (Figure 1). In our study, the juniper-pollen threshold level was detected as 36 pollen grains per m^3.

Table 1. Allergic rhinitis symptom score sheet

	No symptoms	Mild symptoms	Moderate symptoms	Severe symptoms
Nasal congestion	0	1	2	3
Nasal discharge	0	1	2	3
Headache	0	1	2	3
Post-nasal drainage	0	1	2	3
Sneezing	0	1	2	3
Nasal itching	0	1	2	3

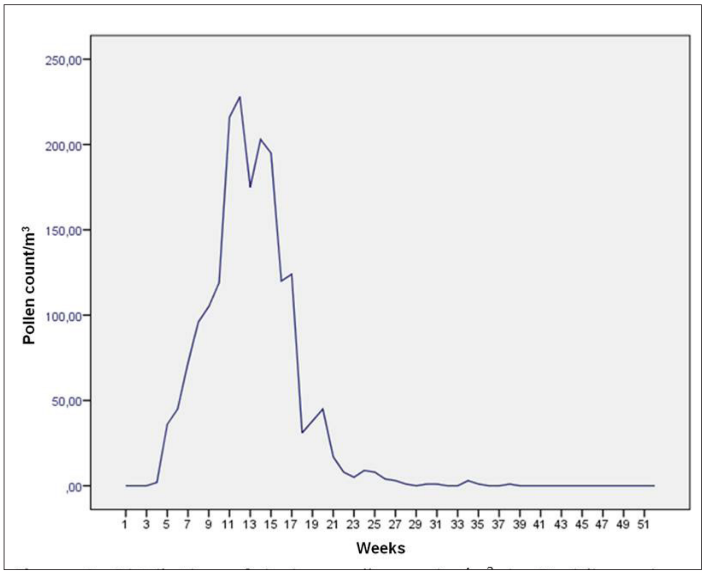

Figure 1. Distribution of juniper-pollen grains per m^3 in Denizli province according to weeks between January 1, 2014, and December 31, 2014

Correlation of Meteorological Parameter and Pollen Count
Figure 2 shows the increase in mean air temperature at the start of juniper pollination and at the time when pollination reached its peak. A statistically significant positive correlation was observed between weekly mean temperature values and weekly pollen count (p=0.002; *r*=0.739).

As shown in Figure 3, an increase in humidity levels was related to a decrease in pollen counts (Figure 3). A statistically significant negative correlation was observed between weekly mean humidity levels and weekly pollen count (p=0.008; *r*=−0.653).

No statistically significant correlation was observed between precipitation levels or wind speed and pollen count (p>0.05).

Correlation of Symptom Scores and Pollen Count
When pollination started in the fourth week of January, 2 of the 14 pa-

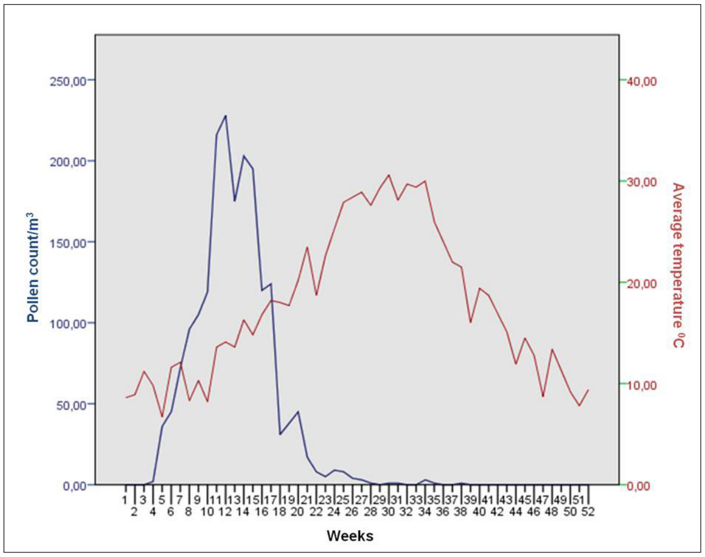

Figure 2. Distribution of juniper-pollen grains per m³ and mean air temperature in Denizli province in 2014. A statistically significant positive correlation was observed between weekly mean temperature and weekly pollen count (p=0.002; r=0.739)

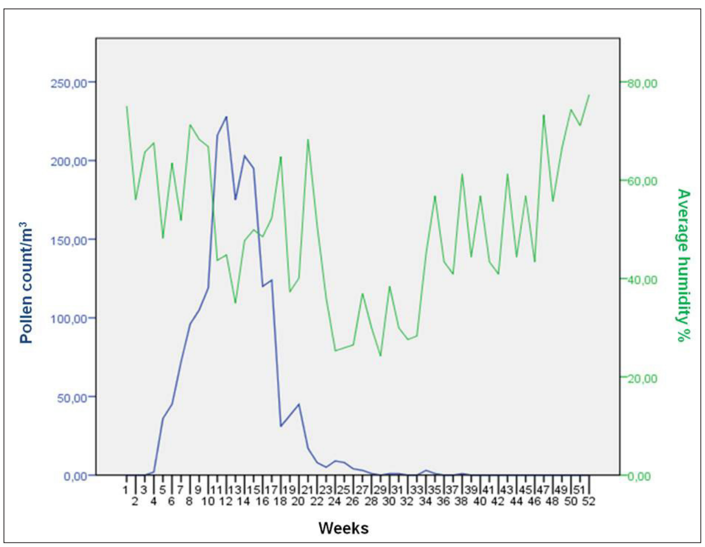

Figure 3. Distribution of juniper-pollen grains per m³ and mean humidity levels in Denizli province in 2014. A statistically significant negative correlation was observed between weekly mean humidity levels and weekly pollen count (p=0.008; r=–0.653)

tients developed mild AR symptoms. The average TSS of the two patients was 1.71 at that time. In the first week of February, pollen count was 36 pollen grains per m³, and all of the patients developed AR symptoms. The average TSS was 9.12. In the first week of March, when the pollen count was 105 pollen grains per m³, TSS was 12.98, which was the maximum level. Despite the increase in pollen count in the proceeding weeks, patient symptom scores did not show a notable change (Figure 4). Due to a decrease in the number of patients who were being followed up, starting from the second week of April, symptom scores were not included in the analysis. A statistically significant positive correlation was observed between the weekly average symptom score and the weekly pollen count (p=0.006; *r*=0.67).

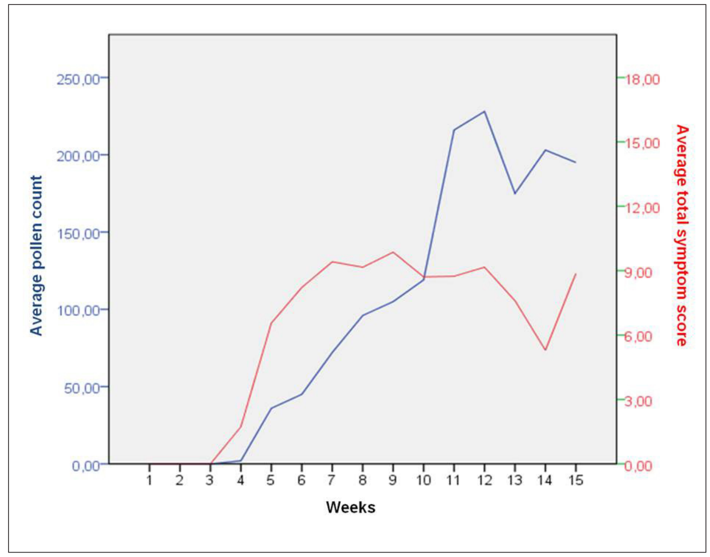

Figure 4. Average total symptom scores and pollen counts according to weeks. A statistically significant positive correlation was observed between the weekly average symptom score and the weekly pollen count (p=0.006; r=0.67)

DISCUSSION

Each plant has a pollinating period that is more or less the same from year to year. On the other hand, weather conditions can affect the amount of pollen produced in a specific year. This study was planned to determine juniper-pollen levels and analyze the effect of meteorological factors on the airborne juniper-pollen counts in Denizli, Turkey, which has the characteristics of a Mediterranean climate.

In recent years, Cupressaceae family pollen has been mentioned as one of the most common pollen group in the Mediterranean region (2). In a multi-centered study conducted by Sposato et al. that included 2258 patients, the prevalence of sensitization to *Cupressaceae (Cypress pollen)* was found to be 16.1% in northern Italy, 32.7% in southern Italy, and 62.9% in central Italy (3). In that study, 17.2% of the Cupresseacea-sensitized patients were found to be monosensitizied. In another study from Izmir, Turkey, Sin et al. (4) reported the rate of sensitivity to *Cupressaceae pollen* as 14.1%, but only one patient (0.22%) was monosensitizied. In our study, among 753 patients with positive prick test results, juniper-pollen sensitivity together with extensive pollen allergy was present in 98 patients (13.03%), and juniper-pollen monosensitivity was present in 22 patients (2.92%).

Among individuals with extensive pollen allergies, the positivity rate for *Cupressaceae* pollen is high because the allergic proteins of this pollen show similarity to other pollen families (5). Sin et al. reported that sensitivity to *Cupressaceae* was accompanied by sensitivity to grass pollen in 86% of the patients and sensitivity to olive tree pollen in 72% of the patients (4). In our study, we found that juniper pollination started in January. The previous studies about pollen calendar of Denizli have demonstrated that the pollen season of olives from the *Oleaceae* family starts from the first week of April and continues until mid-July, and the pollen season for grass from the *Gramineae* family starts in the first week of March and continues until September (6-7). Therefore, the period starting from January, the start of pollination, until the end of February is an isolated pollen season for juniper pollen because there is no concurrent presence of other pollens during this time.

All allergens in nature have different aeroallergen threshold levels. This characteristic property is an indicator of the allergenic strength of pollens. Brito et al. (8-9), in different studies, reported that the threshold level was 162 pollen/m^3 for olive pollen and 35 pollen/m^3 for grass pollen. In our study, we found that the juniper-pollen threshold level that caused symptom development in all the patients was 36 pollen grains per m^3. Although the atmospheric juniper-pollen load was at low concentrations, the sensitivity reactions that it induced in all patients indicate that it has high allergenicity. Additionally, we found a positive correlation between atmospheric juniper-pollen count and average symptom scores. This direct relationship between pollination and clinical symptoms in patients with monosensitivity to juniper pollen shows that juniper-pollen sensitivity can be used in studies related to diagnosis, treatment, and follow-up.

Meteorological factors influence pollen levels and patient symptom scores (10). Pollen counts tend to be the highest on warm, windy, dry days and lowest during rainy, chilly periods. In our study, air temperature was the strongest meteorological parameter, and it positively correlated with pollen counts. We also detected that high humidity levels adversely affect the pollination. However, precipitation levels and wind speed did not show any correlation with pollen counts or patient symptom scores. Although increases in precipitation levels were associated with reduced pollen counts, their correlation was not statistically significant. Wind speed did not to show remarkable fluctuation over the whole year, and it varied between 1.2 m/s and 1.7 m/s. This might be the reason why we could not find a correlation between wind speed and pollen counts. These results are consistent with the results of the study related to Poaceae pollens conducted by Aboulaich et al. (11).

In conclusion, there are a notable number of patients who have juniper-pollen sensitivity. We have determined that juniper-pollen counts show a significant and positive correlation with clinical symptoms in juniper-pollen monosensitizied individuals. We believe that the studies conducted with a specific pollen group in a specific region can contribute to diagnose and develop new treatments in allergic diseases.

Ethics Committee Approval: Ethics committee approval was received for this study from the Pamukkale University Research Ethics Committee on 05 November 2013.

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - F.Ş., E.M., B.T.; Design - F.Ş., B.T.; Supervision - E.M., B.T.; Materials - E.M., F.Ş., B.T.; Data Collection and/or Processing - F.Ş.; Analysis and/or Interpretation - E.M., B.T.; Literature Search - F.Ş., E.M., B.T.; Writing Manuscript - F.Ş., E.M., B.T.; Critical Review - B.T.

Conflict of Interest: The authors have no conflicts of interest to declare.

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