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Characterization of clinical features of monosensitized and polysensitized allergic rhinitis patients with pollen allergy

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ABSTRACT

Objectives: The present study evaluates the prevalence of monosensitization and polysensitization in patients with pollen-hypersensitive moderate-to-severe persistent allergic rhinitis (AR), and determines the clinical characteristics of the two phenotypes.

Methods: This retrospective cohort study included 160 patients with moderate-to-severe persistent AR among the 3,699 patients who presented to allergy outpatient clinics who were found to have hypersensitivity to pollen based on a skin prick test and/or allergen-specific IgE positivity. The patients were divided into two groups: monosensitized (hypersensitivity to pollen alone), and polysensitized (hypersensitivity to pollen and other allergens). Both groups were evaluated for allergen hypersensitivity, symptoms of AR, symptom frequency and comorbidities related to AR.

Results: Of the 160 patients, 83 (51.9%) were monosensitized and 77 (48.1%) were polysensitized. The mean age was 29.5 ± 10.7 yeasrs and 28.3 ± 8.3 years, respectively and the female-to-male ratio was 42/41 and 47/30 in the two groups. Nasal congestion was remarkably more common in the polysensitized patients than in the monosensitized patients ($p = 0.01$). Hypersensitivity to weed mix and Cupressus arizonica pollen identified with a skin prick test was significantly more common in the polysensitized patients than in the monosensitized patients ($p = 0.03$ and $p = 0.01$, respectively). The two groups were similar in terms of the prevalence of asthma and other comorbidities related to rhinitis ($p = 0.78$).

Conclusions: In this single-center study, the rates of monosensitization and polysensitization were found to be similar in patients with pollen-hypersensitive moderate-to-severe AR, and the clinical characteristics of the polysensitized phenotype were different from those of the monosensitized phenotype.

Keywords: Pollen allergy, allergic rhinitis, monosensitization, polysensitization, skin prick test

Allergic rhinitis (AR) is a non-infectious form of rhinitis affecting 10-30% of all adults, and is characterized by a runny nose, congestion, itching and sneezing. Epidemiological studies have reported an increasing global prevalence of AR. Severe AR significantly affects quality of life, sleep and work performance. It is often associated with asthma, and is the main risk factor for the development of the condition [1].

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AR is characterized by nasal inflammation, occurring as a result of IgE-mediated hypersensitivity reactions triggered by the inhalation of respiratory allergens. Nasal symptoms are generally accompanied by eye symptoms. The inhaled allergens associated with AR are airborne protein-based antigens such as pollens, the fecal particles of house dust mites, cockroach residues and animal hair [2].

Hypersensitivity to more than one structurally different allergen (polysensitization) is the most common phenotype in patients with AR. Polysensitization is of considerable clinical and epidemiological significance and has been reported to be responsible for more than 50% of respiratory allergies among patients. Polysensitized patients have been reported to have quite different clinical characteristics from monosensitized patients, with more severe symptoms and greater detriment to quality of life [3, 4]. Patients may remain monosensitized for years and polysensitization may never develop. It should be noted that nasal allergic inflammations resulting from exposure to structurally different allergens can lead to the development of different symptoms and clinical characteristics [5].

Airborne pollens are the main triggers of respiratory allergies. The prevalence of pollen hypersensitivity is increasing worldwide under the effects of global climate change [6]. Hypersensitivity to other inhaled allergens may be detected alongside pollen hypersensitivity in patients with AR. A review of literature revealed no study comparing the prevalence and clinical characteristics of pollen-hypersensitive monosensitized and polysensitized patients with AR. It is not known whether the clinical characteristics of pollen-hypersensitive polysensitized patients with AR differ from those of monosensitized patients.

We present here a retrospective analysis of the prevalence of monosensitization and polysensitization among the patients with pollen-hypersensitive moderate-to-severe persistent AR who presented to our outpatient clinic, and evaluate the clinical characteristics of the two phenotypes.

METHODS

This retrospective cohort study included 160 adult patients with moderate-to-severe persistent AR who presented to the Ankara City Hospital Allergic Diseases outpatient clinics between April 1, 2022 and December 31, 2022, and who were found to have hypersensitivity to pollen based on a skin prick testing and/or allergen-specific IgE positivity. The study inclusion criteria were aged between 18-80 years, diagnosed with moderate-to-severe persistent AR, and identified with pollen hypersensitivity based on a skin prick test (grass and/or tree and/or weed and/or rye) and/or serum allergen-specific IgE positivity. Patients younger than 18 years, those with mild persistent AR and those without pollen hypersensitivity based on a skin prick test and/or serum allergen-specific IgE positivity were excluded from the study. Patients with moderate-to-severe persistent AR were identified using the ARIA (Allergic Rhinitis and its Impact on Asthma) criteria (symptoms of allergic rhinitis occurring at least 4 days a week over a period of at least 4 weeks, and symptoms resulting in sleep disorders, impairment in daily, entertainment and/or sport activities and/or impairment in school or work performance) [1].

Ethical approval was obtained from the Ankara City Hospital Ethics Committee (Date:18.01.2023, Decision no: E2-23-3263), and written informed consent was obtained from all study participants.

Skin Prick Tests

The skin prick tests made use of a standard panel consisting of grass mix *(Timothy, Orchard, june, Redtop, Meadow fescue, Perennial rye, Sweet vernal), Rye,* trees *(White birch, Olive tree, Salix nigra, Populus alba, Pinus strobus)*, weed mix *(Cocklebur, Rough pigweed, English plantain, Chenopodium album)* and *Mugwort, English plantain, Lamb's quarters, Short ragweed,* house-dust mites *(Dermatophagoides pteronyssinus and Dermatophagoides farinae),* cat and dog dander, cockroach *(Blatella germanica)* and molds *(Aspergillus fumigatus, Penicillium notatum, Alternaria alternata, Cladosporium herbarum)* (ALK®, Hørsholm, Denmark). A weal (edema with erythema) measuring at least 3 mm or greater in diameter than the negative control after 20 minutes was considered a positive reaction. Histamine dihydrochloride (10 mg/mL) was used for the positive control and physiological saline was used for the negative control.

Determination of Specific IgE and Total IgE Levels

The levels of allergen-specific IgE [Mite mix *(Dermatophagoides pteronyssinus, Dermatophagoides*

farinae, Dermatophagoides microceras, Lepidoglyphus destructor, Tyrophagus putrescentiae, Glycyphagus domesticus, Euroglyphus maynei, Blomia tropicalis) grass mix *(Viscum album, Festuca, Lolium temulentum, Phleum pratense, Poa pratensis),* weed mix *(Senecio vulgaris, Artemisia vulgaris, Plantago lanceolata, Chenopodium album, Silybum Marianum),* trees mix *(Quercus petraea, Ulmaceae, Platanus orientalis, Salix, Populus),* animal dander mix *(Cat, dog, horse, cow)* and mold mix *(Penicillium notatum, Cladosporium herbarum, Aspergillus, fumigatus, Candida albicans, Alternaria tenius)*] were quantified using the solid-phase, two-step chemiluminescent immunoassay system according to the manufacturer's instructions (Siemens, Immulite 2000 XP, USA). For allergen-specific IgE, the reference value was taken as > 0.35 kUA/L. Serum allergen-specific IgE levels were classified as follows: Class 0: 0-0.35 kUA/L; Class 1: 0.35-0.69 kUA/L; Class 2: 0.70-3.49 kUA/L; Class 3: 3.50-17.49 kUA/L; Class 4: 17.5-49.9 kUA/L; Class 5: 50–100 kUA/L; and Class 6: > 100 kUA/L. Total IgE levels were measured using a two-site sandwich immunoassay technology and direct chemiluminescence (Siemens, Atellica, IM 1600, Ireland).

The blood eosinophil count was determined from leucocyte measurements (Siemens Advia 2120i, Ireland).

The patients were divided into two groups as monosensitized and polysensitized, based on the results of the skin prick test and/or serum allergen-specific IgE levels. Patients with pollen hypersensitivity alone were defined as monosensitized (grass pollen and/or tree pollen and/or weed pollen and/or rye pollen) and those with hypersensitivity to both pollens and structurally different antigens (hypersensitivity to house dust mites and/or fungi and/or cat/dog and/or cockroach) were defined as polysensitized.

Statistical Analysis

IBM SPSS Statistics (Version 26.0. Armonk, NY: IBM Corp.) was used for the statistical analysis. The fitness of the variables to normal distribution was tested visually (histogram and probability graphs) and using analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Among the descriptive statistics, normally distributed variables were expressed as mean and standard deviation, variables without normal distribution were expressed as median and interquartile ranges, and ordinal variables were expressed as frequencies. An independent samples t-test was used to compare normally distributed variables and a Mann-Whitney U test was used to compare variables without normal distribution between the pollen-hypersensitive monosensitized and polysensitized patients with AR. The differences between variables were tested with a Chi-square test or Fischer's exact test (the latter was used when the cell value did not meet the assumptions of the Chi-square test). A p - value of less than 0.05 was considered statistically significant.

RESULTS

The medical charts of 407 patients with moderate-to-severe persistent allergic rhinitis, randomly selected from among 3,699 patients examined in a single allergy outpatient clinic between April 1, 2022 and December 31, 2022, were reviewed. No hypersensitivity to any allergen was determined in 48% (n = 195) of the patients based on a skin prick test and/or allergen-specific IgE measurement, while 12.7% (n = 52) had no pollen hypersensitivity. The study thus continued with 160 patients (39.3%) who met the study inclusion criteria and who had pollen hypersensitivity based on a skin prick test and/or serum allergen-specific IgE positivity. The mean age of the patients was 28.9 ± 9.6 years and the female-to-male ratio was 89:71. The mean duration of AR symptoms was 59.7 ± 45.4 months.

Of the 160 patients, 83 (51.9%) were monosensitized and 77 (48.1%) were polysensitized. The mean age was 29.5 ± 10.7 and 28.3 ± 8.3, respectively and the female-to-male ratio was 42/41 and 47/30 in the two groups (p = 0.96 and p = 0.18, respectively). The duration of AR symptoms did not differ between the two groups (p = 0.72). The analysis of symptom frequency revealed that although the rate of patients with symptoms during the pollen season was higher among the monosensitized patients, the rate of those with seasonal (pollen season) and perennial (throughout the year) symptoms and perennial symptoms with seasonal exacerbations did not differ significantly between the two groups (p = 0.29). Non-smokers constituted the majority in both groups (p = 0.73). Although the prevalence of asthma was higher among

Table 1. Characteristics of the study population

	Monosensitized n = 83	Polisensitized n = 77	*p value**
Sex (F/M)	42/41	47/30	0.18
Age (years), (Mean±SD)	29.5 ± 10.7	28.3 ± 8.3	0.96
Duration of rhinitis (months), median (min-max)	48 (3-240)	48 (3-180)	0.72
Frequency of the symptoms, n (%)			
Perennial	23 (31.1)	23 (33.8)	0.29
Seasonal	40 (54.1)	29 (42.6)	
Perennial but seasonally exacerbated	11 (14.9)	16 (23.5)	
Smoking history, n (%)			
Non-smoker	21 (61.8)	23 (65.7)	0.73
Smoker	13 (38.2)	12 (34.3)	
Rhinitis-related comorbitidies, n (%)			
None	76 (91.6)	67 (87)	0.78
Asthma	4 (4.8)	7 (9.1)	
CRS with NP	2 (2.4)	2 (2.6)	
CRS without NP	1 (1.2)	1 (1.3)	
Symptoms, n (%)			
Runny nose	68 (81.9)	64 (84.2)	0.7
Sneezing	66 (79.5)	59 (78.7)	0.89
Itchy nose	33 (40.2)	24 (31.6)	0.25
Postnasal drip	34 (41)	30 (40)	0.9
Nasal obstruction	32 (38.6)	44 (57.9)	**0.01**
Conjuctivitis	46 (55.4)	36 (47.4)	0.31
Cough	11 (13.3)	7 (9.1)	0.4
Prick test positivity, n (%)	80 (96.4)	75 (97.4)	0.51
Pollen allergen spesific IgE positivity, n (%)	15 (18.1)	13 (16.9)	0.91
Total IgE (IU/ml), median (min-max)	111 (3.9-275.5)	234 (28.6-1494.4)	0.06
Eosinophil (cell/mcL), median (min-max)	170 (0-840)	170 (10-740)	0.73

CRS = Chronic sinusitis, NP = nasal polyp.
*$p < .05$ was considered statistically significant

polysensitized patients (n = 7 vs n = 4), the prevalence rates of asthma and other comorbidities related to AR [Chronic sinusitis (CRS) with nasal polyp (NP) and CRS without NP] were similar between the two groups ($p = 0.78$). The most common symptoms were runny nose (81.9%), sneezing (79.5%) and eye symptoms (conjunctivitis) (55.4%) among the monosensitized patients, and runny nose (84.2%), sneezing (78.7%) and nasal congestion (57.9%) among the polysensitized patients. Although itchy nose, sneezing and eye symptoms were more common in the monosensitized patients than in the polysensitized patients, the difference between the two groups was not statistically significant ($p = 0.25$, $p = 0.89$, and $p = 0.31$, respectively). In contrast, nasal congestion was a remarkable symptom that was more common in the polysensitized patients than in the monosensitized patients ($p = 0.01$) (Table 1).

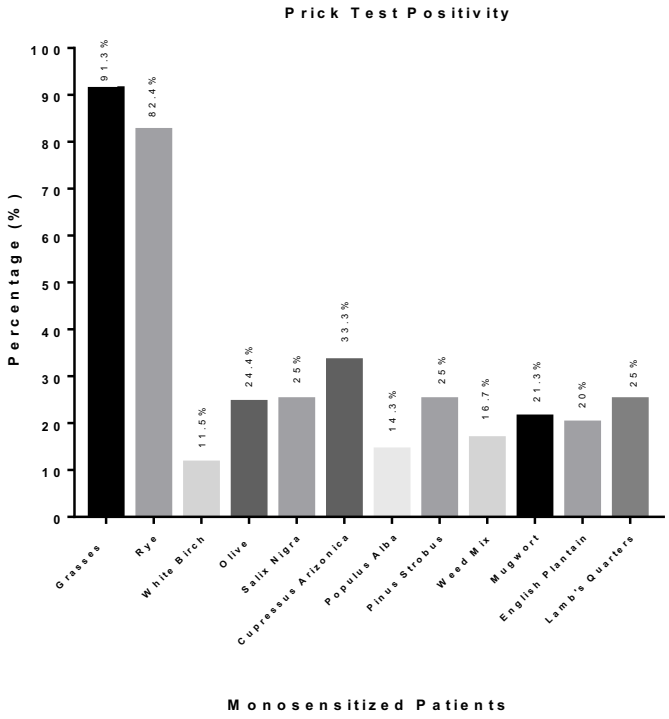

Fig. 1. Prevalence of pollen allergen positivity based on a skin prick test in monosensitized patients.

A positive skin prick test to pollen was found in 96.4% of the monosensitized patients and 97.4% of the polysensitized patients, while the rate of pollen-specific IgE positivity was 18.1% and 16.9%, respectively. Although the total IgE was higher in the polysensitized patients, there was no statistically significant difference between the two groups ($p = 0.06$), and the serum eosinophil count of the groups was also similar ($p = 0.73$) (Table 1).

The distribution of pollen hypersensitivity in the skin prick test in the monosensitized patients was as follows: grass pollen (91.3%), rye pollen (82.4%),

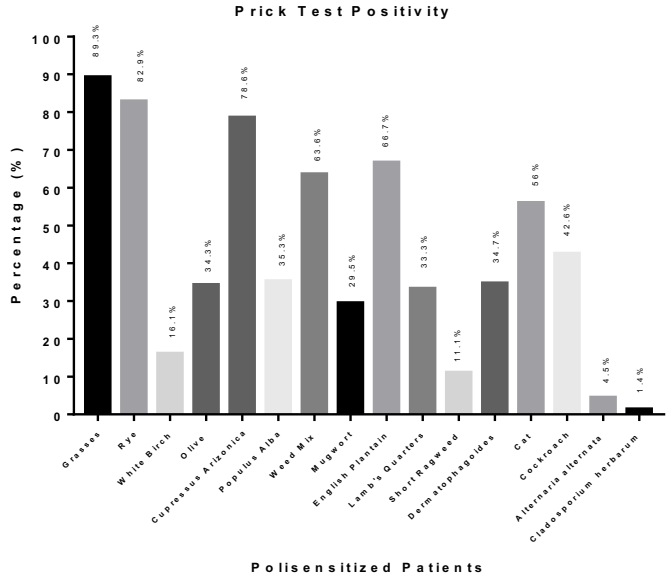

Fig. 2. The prevalence of pollen allergen positivity based on a skin prick test of polysensitized patients.

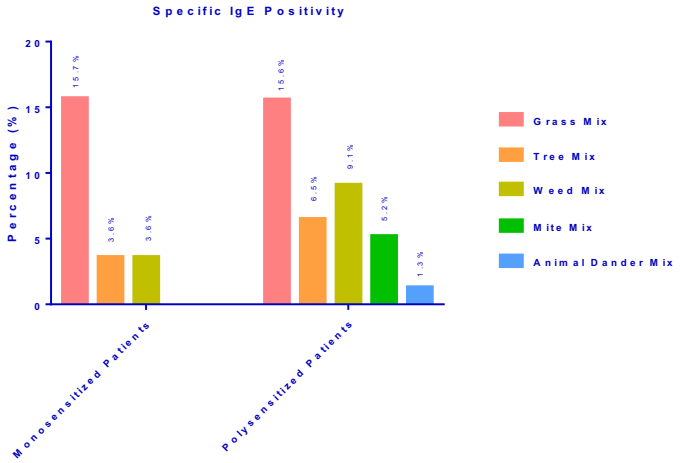

Fig. 3. Distribution of pollen-specific IgE positivity in monosensitized and polysensitized patients.

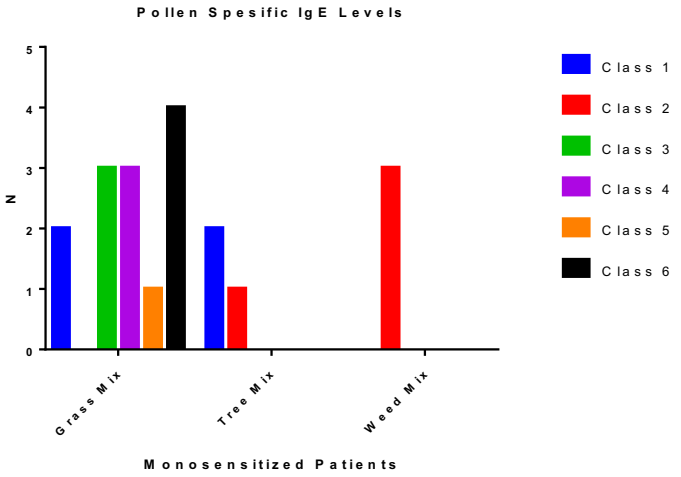

Fig. 4. Distribution of pollen-specific IgE levels in monosensitized patients.

White birch pollen (11.5%), olive pollen (24.4%), Salix nigra pollen (25%), Cupressus arizonica pollen (33.3%), Populus alba pollen (14.3%), Pinus strobus pollen (25%), Weed mix pollen (16.7%), Mugwort pollen (21.3%), English plantain pollen (20%) and Lamb's quarters pollen (25%) (Fig. 1).

The distribution of allergen hypersensitivity in the polysensitized patients was as follows: grass pollen (89.3%), rye pollen (82.9%), White birch pollen (16.1%), olive pollen (34.3%), Cupressus arizonica pollen (78.6%), Populus alba pollen (35.3%), Weed mix pollen (63.6%), Mugwort pollen (29.5%), English plantain pollen (66.7%), Lamb's quarters pollen (33.3%), Short ragweed pollen (11.1%), house dust mites (34.7%), cat (56%), cockroach (42.6%), Alternaria (4.5%) and Cladosporium (1.4%) (Fig. 2). A comparison of pollen hypersensitivity in the monosensitized and polysensitized patients based on a skin prick test showed hypersensitivity to weed mix and Cupressus arizonica pollen to be significantly more common among the polysensitized patients than the monosensitized patients ($p = 0.03$ and $p = 0.01$, respectively).

One striking finding was that hypersensitivity to weed mix identified through the skin prick test was more common among the polysensitized patients with seasonal AR symptoms, while hypersensitivity to Cupressus Arizonica and Lamb's Quarters was significantly more common than the monosensitized patients with perennial symptoms ($p = 0.008$, $p = 0.03$, and $p = 0.01$, respectively).

Among the serum pollen-specific IgE values, grass mix pollen positivity was the most common (15.7% vs 15.6%) in both the monosensitized and polysensitized groups ($p = 0.6$). Furthermore, tree mix and weed mix specific-IgE positivity were more common among the polysensitized patients than the monosensitized patients but not statistically different ($p = 0.23$, $p = 0.05$, respectively). Furthermore, 5.2% and 1.3% of polysensitized patients were identified with house dust mite and animal dander mix specific IgE positivity, respectively (Fig. 3). Figs. 4 and 5 presents the serum specific IgE levels of the monosensitized and polysensitized patients. No significant difference

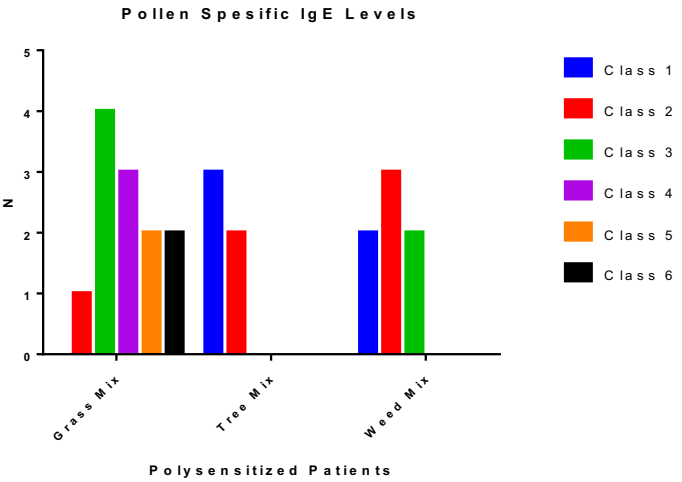

Fig. 5. Distribution of pollen- and non-pollen allergen specific IgE levels in polysensitized patients.

was found in the grass mix, tree mix and weed mix-specific IgE levels of the two groups ($p = 0.7$, $p = 1$, and $p = 0.3$, respectively).

DISCUSSION

IgE-mediated immune response can vary among those exposed to environmental aeroallergens and hypersensitivity to a single allergen (monosensitization), or multiple allergens (polysensitization) may occur. Monosensitized and polysensitized patients also differ in terms of their immune responses. It has also been reported that polysensitized patients exhibit different clinical characteristics to monosensitized patients [7]. This has necessitated the characterization of monosensitized and polysensitized patients in epidemiological studies. There has, however, been no study to date identified comparing the prevalence and clinical characteristics of monosensitized and polysensitized patients who present to allergy outpatient clinics with pollen-hypersensitive AR. The present study can thus be considered the first retrospective cohort study conducted on this subject.

According to general population data, the rate of polysensitized patients ranges from 20% to 90%. In a cohort study by Arbes *et al*. analyzing the results of the skin prick test screening of 10,863 people, no hypersensitivity to any allergen was reported in 45.7% while 15.5% were classified as monosensitized and 38.8% as polysensitized [8]. In our review of literature, the reported rate of polysensitization among patients who presented with respiratory allergies was 27.5%, 73.5%, 62%, 31% and 74.3%, respectively [5, 9-12].

Although the data in literature on allergic patients varies depending on the studied population and the study region, all report polysensitization to be more common in this patient population. It has been speculated that monosensitized patients develop hypersensitivity to other allergens over time. In a retrospective analysis of 165 monosensitized children, Silvestri *et al*. reported that 43.6% became polysensitized during follow-up, and also that hypersensitivity to house dust mites, and to a lesser extent, pollen, acts as a triggering factor for the development of polysensitization [13]. It does not seem feasible, however, to directly compare the data derived from different studies. In a review of epidemiological and clinical studies, Calderon *et al*. highlighted that the rate of polysensitization is in the range of 51-81% [14]. In the present study involving a cohort of 3,699 patients, moderate-to-severe persistent allergic rhinitis was identified in 11% of the sample, and pollen hypersensitivity was found in 39.3% of these patients based on a skin prick test and/or allergen-specific IgE measurement, with 51.9% being monosensitized and 48.1% polysensitized. Monosensitization and polysensitization rates that are close to each other appear as a different finding to those reported in literature.

Allergen immunotherapy is the sole treatment method with the ability to change the natural course of allergic disorders. That said, the presence of hypersensitivity to multiple structurally different allergens (polysensitization) in patients presenting to the allergy outpatient clinic with moderate-to-severe persistent AR can make decisions of whether or not to deliver immunotherapy challenging. The symptoms of AR may not be seasonal in patients with pollen hypersensitivity and may occur throughout the year. Knowing patient-specific clinical characteristics can guide the therapy, and is of particular importance in the selection of the allergen as the specific target of immunotherapy in patients with hypersensitivity to pollens and structurally different allergens (i.e. house dust mite, animal dander) associated with perennial symptoms. For the above reasons, real-life, multicenter and observational studies named POLISMAIL (Polysensitization Impact on Allergen Immunotherapy) have been conducted to characterize polysensitized patients in clinical practice [3]. The first study in this series investigated the clinical characteristics of 418 polysensitized patients, and identified 220 patients with AR and 198 patients with AR accompanying asthma, with a median allergen hypersensitivity score of 3.65. Nasal symptoms were found to be more severe in the polysensitized patients than in the monosensitized patients, and the identified allergen hypersensitivities were grass pollen (76.4%), Parietaria pollen (38.9%), birch pollen (38.3%), olive pollen (26.7%), cypress pollen (9.6%), ragweed pollen (23.3%), house dust mites (47.4%), cat dander (22.5%), dog dander (13.2%), and Alternaria (10.4%) (15). In the present study, grass pollen, rye pollen, Cupressus arizonica and weed mix in the pollen group,

and cat dander and cockroach were the most commonly observed allergens in the polysensitized patients.

Studies in literature have reported that polysensitized patients exhibit different clinical characteristics to monosensitized patients, with a particular negative impact on quality of life [16]. One study reported that polysensitized patients develop more severe symptoms than monosensitized patients, and polysensitization has been found to be associated with a higher frequency of concurrent asthma than monosensitization [16]. The present study identified no difference between monosensitized and polysensitized patients in terms of the presence of asthma and other comorbidities related to AR.

In their study, Ciprandi *et al*. [17] reported polysensitized patients to have higher rhinitis symptom scores than monosensitized patients, but no difference in the symptom durations of monosensitized and polysensitized patients. The higher symptom scores, indicating symptom severity, among the polysensitized patients were attributed to the contribution of perennial allergens to the development of chronic inflammation. It was observed that irritative symptoms (runny nose, sneezing and itchy nose) and conjunctivitis were more common among monosensitized patients than polysensitized patients, although the rate of nasal congestion was similar in the two groups [17]. The symptom severity of the two groups could not be compared in the present study due to retrospective nature of the study and the lack of accessible data related to the symptom severity. The most common symptoms, however, were runny nose, sneezing and conjunctivitis in the monosensitized patients, and itchy nose, sneezing and nasal congestion in the polysensitized patients. In contrast to the above-mentioned study, the rate of nasal congestion in the present study was significantly higher in the polysensitized patients than in the monosensitized patients.

Regarding the issue of lifelong monosensitization, studies have reported functional T regulatory cell defects in polysensitized patients and higher IL-10 and IFN-γ levels in monosensitized children than in polysensitized children [18], which supports the notion that monosensitization and polysensitization are two different phenotypes. There is thus a need for large cohort studies providing a comparative evaluation of the immunological and clinical characteristics of monosensitized and polysensitized patients. There has been no large cohort study in literature to date comparing monosensitized and polysensitized patients and their experience with pollen-related complaints. Our present preliminary data as a pilot, retrospective cohort study.

The type of allergens involved also seems to be related to the clinical characteristics of AR. It has been demonstrated that each structurally different allergen is associated with different immunological, inflammatory, functional and clinical consequences [3]. For this reason, the presence of hypersensitivity alongside perennial allergens in polysensitized patients with pollen hypersensitivity suggests that the symptoms in polysensitized patients may differ from those observed in monosensitized patients.

Studies in literature have reported that approximately 50% of patients with allergic rhinitis are hypersensitive to any pollen allergen, and that the prevalence of pollen allergies has doubled in recent years [19]. One study determined pollen hypersensitivity in 72% patients with moderate-to-severe persistent AR. In European countries in particular, grass pollen is reported to be responsible for 40% of cases of pollen allergy [20]. A study conducted in Mexico, consistent with previous studies, reported higher rates of polysensitization and house dust mite hypersensitivity, accompanied by at least one pollen hypersensitivity (one of Lamiales, Fagales, and Cupressales). In contrast, in European countries, the rate of hypersensitivity to tree pollen is four times the hypersensitivity associated with grass pollen [21]. In the present study, hypersensitivity to grass pollen took first place in both groups, while the positive reaction to weed mix and Cupressus arizonica pollens was remarkably higher among the polysensitized patients than the monosensitized patients.

AR is traditionally divided into two groups, being seasonal and perennial, depending on the frequency of symptoms throughout the year. Pollens are the leading allergen causing to symptoms of seasonal allergic rhinitis. That said, some patients who are hypersensitive to pollens may exhibit perennial symptoms due to the fact that some plants have prolonged pollination periods, that pollen seasons vary from one country to another, and based on such factors as the presence of

polysensitization. In support of this observation, studies in literature have reported perennial symptoms (throughout the year) in 44.6% of patients with AR and pollen allergies [18]. In the present study, the majority of patients exhibited seasonal AR symptoms, while only 28.7% had perennial AR symptoms, although monosensitized and polysensitized patients were similar in terms of symptom frequency. Interestingly, the present study observed that the Cupressus arizonica and Lamb's quarters pollen positivity identified through a skin prick test increased perennial symptoms and weed mix pollen positivity, and increased seasonal symptoms in polysensitized patients.

Limitations

The main limitations of the present study are its retrospective study design and the small number of patients in the study cohort. Due to retrospective nature of the study, the absence of symptom scores and quality of life parameters in the patient charts is another limitation.

CONCLUSION

Polysensitized patients with pollen hypersensitivity exhibit different clinical characteristics to those identified in monosensitized patients. Weed mix and Cupressus arizonica pollen positivity would appear to be associated with the development of different clinical characteristics. The authors consider the present study to be an important pilot study that contributes to literature in the sense that there has, as yet, been no prospective cohort study in literature comparing the clinical characteristics of monosensitized and polysensitized patients with pollen hypersensitivity. The authors stress that there is a need for large cohort studies of patients with pollen allergy to investigate this issue further.

Authors' Contribution

Study Conception: ŞS; Study Design: ŞS; Supervision: ŞS; Funding: ŞS; Materials: DÖÇ; Data Collection and/or Processing: DÖÇ; Statistical Analysis and/or Data Interpretation: ŞS; Literature Review: DÖÇ; Manuscript Preparation: ŞS and Critical Review: ŞS.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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