

Influence of Aeroallergens on the Incidence of Conjunctivitis in Zagreb and Zagreb County

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ABSTRACT

The aim of this study was to determine the temporal and spatial variations of pollen spectra in the City of Zagreb and Zagreb County according to frequency of inhalation allergy and rhino-conjunctivitis in the adult population by setting allergen/patient relationship. The study was carried out at three inland sites in Croatia during four years (2003–2006). A number of 2,192 patients have been tested for allergy skin prick tests over the same period. The majority of patients allergic to pollen allergens were sensitized to allergens from the plant pollen which belong to the botanical family of grass 46.91%, ambrosia 42.07%, birch 25.66%, hazel 15.19% (with symptoms of rhinoconjunctivitis (42.5%), conjunctivitis (28.3%) and rhinitis (23.9%)). Increased symptoms in patients allergic to pollen allergens in the entire study period coincided with the presence of pollen in the air. Patients sensitized to dust mites have symptoms throughout the year with a slightly increased number of cases in April and June. In patients sensitized to fungi and mold spores and animal hairs, the number of cases with worsening of symptoms is equal during the same year.

Key words: aeroallergens, conjunctivitis, rhinitis, skin prick test

Introduction

Allergic rhino-conjunctivitis is an allergen-induced inflammatory response and account for 95% of the allergic eye disease in practice¹. The noninfective, seasonal (SAR) and perennial allergic rhino-conjunctivitis (PAR) are the most common types and result from an immunological response mediated by IgE. SAR is usually an acute or subacute disease that is characterized by peaks of self-limiting signs and symptoms (red eye, tearing, itching and mucous discharge) and is mostly due to tree, grass and weed pollens. PAR is less common than SAR and is related to animal dander, dust mites and less frequently to allergens such as cockroaches or mould spores. The symptoms are present all year with seasonal exacerbation depending on the individual sensitization. The hallmarks of this form are itching, redness and puffy eyes. Patients may also complain of tearing, mucous discharge, burning and swelling. However no symptom or sign is specific to SAR and PAR^{2–4}. Differences between SAR and PAR are primarily based on the duration of the disease. Symptoms are both nasal and non-nasal. The

most prominent nasal symptoms are itching, sneezing, rhinorrhoea and congestion.

Depending on the geographic and climatic region and vegetation, allergenic plants are characteristic for certain areas and the pollen concentrations of various plant species depend on the fenophase of each single species and most of all on the climatic and meteorological conditions of a certain area. It is precisely because of these specific characteristics that the hypersensitivity of patients to various types of pollen allergens differs according to the geographic regions. Thus, for instance, grass pollen, which is widely spread across the EU countries, causes regionally different percentage of hypersensitive persons. These differences in the numbers of hypersensitive persons result precisely from the climate diversities and local meteorological conditions. Plant pollen from the Betulaceae family (*Alnus*, *Betula* and *Corylus*) contributes significantly to the incidence of pollen allergies in Northern and Central Europe. A special problem in the

last two decades in Europe has been the hypersensitivity to ambrosia pollen (*Ambrosia* sp.). By its sudden territorial spreading from the East of the continent to the West and by high concentrations of the strong airborne allergenic pollen, it causes high level of hypersensitivity of the European population.

Allergic rhino-conjunctivitis is one of the most common syndromes with a prevalence ranging from 5% to 22% in the general population and commonly affects males and females of all ages^{5–7}. In England there are 13 to 14 cases per 1000 people each year⁸. Up to 1.3% of the US population has been reported to have allergic rhino-conjunctivitis⁹. SAR represents more than 90% of cases of allergic conjunctivitis. Perennial conjunctivitis is less common, but 80% of these patients have seasonal flares. Atopic allergic rhino-conjunctivitis is more common in adults, and vernal allergic conjunctivitis is more common in boys¹⁰. The aim of this study was to determine the temporal and spatial variations of pollen spectra in the City of Zagreb and Zagreb County according to frequency of inhalation allergy and rhino-conjunctivitis in the adult population by setting allergen/patient relationship.

Material and Methods

Aerobiological research

The study was carried out at three inland sites in Croatia during four years (2003–2006). The samplers were placed in Zagreb, Samobor and Ivanić Grad. The distance between monitoring sites is about 30 km. These locations differed in terms of their geographic location and topography (Table 1). Seven-day Hirst volumetric pollen and spore traps were used for pollen sampling^{11,12}. The sampler absorbs 10 L air *per* min. It is supplied with a timer to move the adhesive tape (2 mm/h) to which pollen grains adhere. The tape was removed twice weekly, cut to a length corresponding to 24-h pollen sampling applied onto glass slide.

Pollen concentration was expressed as pollen grain count/m³ air. In order to define the main pollen period, the study was limited by eliminating days with minimal pollen concentrations at the start and end of pollen season. These nonestimated periods accounted for 2.5% of total pollen concentration, both at the start and at the end of pollen season.

Epidemiological research

A number of 2,192 patients have been tested, who, over a period of four years attended the »Jordanovac« University Hospital for Pulmonary Diseases, and the Polyclinics for Respiratory System Diseases (Črnomerec Health Centre, Novi Zagreb Health Centre and Velika Gorica Health Centre) for allergy skin prick tests. The patients selected for the research purposes were those who came for the allergy test for the first time. All the patients were sent to tests by the authorised primary-care doctor according to their place of residence, who carried out the first assessment of the allergy problems. Every patient was asked to fill in the questionnaire which contained 29 questions. The questionnaire served to gather as many data as possible about the patient and the character of the problems. The skin allergy test was performed by the prick method. A standard inhalation set of allergens of the Institute of Immunology, Zagreb, was used including: negative control (0.9% NaCl solution), positive control (histamine 1 mL/mg), house dust, *Dermatophagoides pteronyssinus*, tree pollen mixture, grass pollen mixture, weeds pollen mixture, ambrosia, moulds mixture, *Alternaria*, animal hair, cockroach allergens (*Blattella germanica*). The persons who had positive skin reaction to tree or weed mixture were additionally tested to individual allergens. For the trees the pollen of hazel (*Corylus*), birch (*Betula*), alder (*Alnus*), oak (*Quercus*), acacia (*Robinia*), willow (*Salix*), poplar (*Populus*), and ash (*Fraxinus*) was used. Individual weeds pollen included: ambrosia (*Ambrosia*), wormwood (*Artemisia*), plantain (*Plantago*), dandelion (*Taraxacum*) and sorrel (*Rumex*).

TABLE 1
SAMPLING SITE CHARACTERISTIC

Site	Location	Altitude (m)	Location of sampler (m above ground level)	Site characteristic
Zagreb	45° 49' N, 15° 59' E)	157	19.7	urban – city (about 1,000,000 inhabitants)
Samobor	45° 48' N, 15° 43' E	168	18.5	small town (about 36,000 inhabitants)
Ivanić Grad	45° 43' N, 16° 24' E	101	17.3	rural location (about 15,000 inhabitants)

TABLE 2
BASIC DATA ON PATIENTS

	Gender		Age group			Age at which first allergy occurs			Place of residence	
	Male	Female	18–30	31–50	51+	<5	6–15	>16	Urban	Rural
Number	972	1220	807	980	405	183	426	1583	1704	488
%	44.34	55.66	36.81	44.70	18.49	8.34	19.44	72.22	77.73	22.27

Results and Discussion

In the period from 2003–2006 the questionnaires were processed as well as the findings of allergy testing to the standard series of inhalant allergens in the total of 2,192 patients. The basic data on the patients are presented in Table 2. The table shows that according to the gender share the females prevailed in the sample of sensitized persons. Similar results were found in the studies from Spain, Austria, Switzerland and Kosovo^{13,14}. In other studies from the available literature a prevalence of allergic male persons was recorded regarding the gender share. The multi-centric analysis of 1,459 patients from Poznan (Northern Poland) has shown also that the male persons prevailed in the sample of the allergic persons and they were almost double (62.5%) the number of females (37.5%)¹⁵. The majority of allergic persons belonged to the age group of 31–50 years, followed by the age group of 18–30 years regarding the number of patients. In the papers of authors who, apart from adult population included also children, the majority of allergic persons belonged to the age groups of 20–30 years of age, 16–35, 20, i.e. 2–19^{14–17}.

In the majority of the patients the allergy symptoms occurred for the first time after the age of sixteen. Most of the patients, 86.72%, were sensitive to pollen, 36.45% to mites; 2.46% to spores of fungi and mould, and 5.1% of persons to other allergen groups which include allergens of cockroaches, feathers, and animal hair. The majority of patients allergic to pollen allergens were sensitized to allergens from the plant pollen which belong to the botanical family of grass 46.91%, ambrosia 42.07%, birch 25.66%, hazel 15.19% (Table 3). Similar results were found also in the abovementioned references. In the papers by the authors from Greece, it was also grass pollen to which the largest number of persons was sensitized (40.4%)¹⁸, then from Kosovo (52.1%)¹⁴, Northern Spain (97.46%), 88% in Zaragoza¹⁹, 55.9% in Badajoz¹³, as well as in other European countries (Germany, Great Britain, Austria, Poland, France)²⁰. Grass pollen antigens when they come into contact with oral, nasal or ocular mucosa are quickly released, causing symptoms in sensitized individuals. Grass pollen usually cause symptoms in the

TABLE 3
RESULTS OF SKIN PRICK TESTS TO INHALANT ALLERGENS

	Sensitized patient (%)
Pollen	86.72
Alnus	4.94
Corylus	15.19
Betula	25.66
Quercus	2.10
Poaceae	46.91
Ambrosia	42.07
Mites	36.45
Spores	2.46
Other	5.10

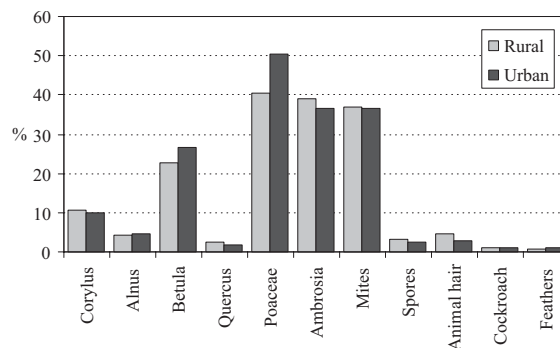


Fig. 1. Comparison of percentage share of patients allergic to certain allergens from rural and urban environments.

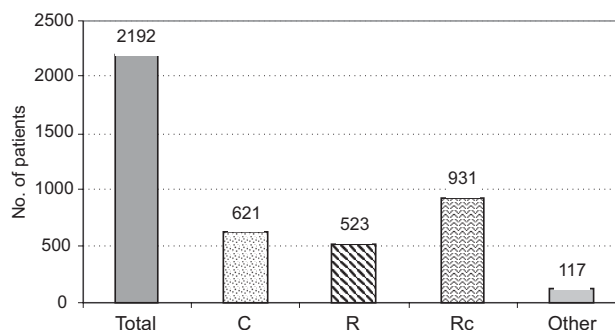


Fig. 2. Proportion of patients with symptoms of allergic conjunctivitis, rhinitis and rhinoconjunctivitis. C – conjunctivitis; R – Rhinitis; Rc – Rhinoconjunctivitis.

nasal mucosa and conjunctiva, although there is evidence that they can cause asthma attacks, inducing inflammatory response that includes T cells, mast cells and eosinophils. The majority of our patients had symptoms of rhinoconjunctivitis (931; 42.5%), followed by conjunctivitis (621; 28.3%) and rhinitis (523; 23.9%). A small number of patients (117; 5.3%) had allergy on the skin (Figure 2). In the United States the prevalence of allergic rhinitis varies from 8% to 43% according to age. Approximately 70% of patients with allergic conjunctivitis have an associated atopic disease such as allergic rhinitis or atopic dermatitis²¹. Allergic rhinitis alone can affect between 20% and 40% of non-exercising population from South Africa. Result of epidemiological study of allergy and atopy in athletes from South Africa documented that 21.4% athletes have seasonal allergic rhinoconjunctivitis, 7.5% persistent allergic rhinoconjunctivitis, and 21% both seasonal and persistent allergic rhinoconjunctivitis²². In another study 16.8% Swiss athletes from different sports were reported to suffer from rhinoconjunctivitis²³.

According to the type of residence (rural, urban) the share of patients allergic to a certain type of allergen is very uniform. The majority of persons in both environments were allergic to grass pollen allergens (rural 40.51%; urban 50.35%), ambrosia (39.05%; 36.63%), to allergens of mites (36.97%; 36.44%), birch pollen (22.82%; 26.76%) etc.. There are no statistically significant differ-

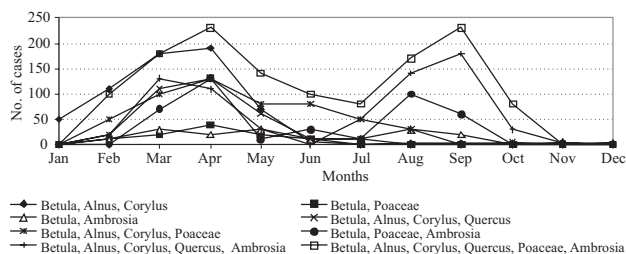


Fig. 3. Number of cases and time of worsening symptoms in patients polysensitized to pollen allergens.

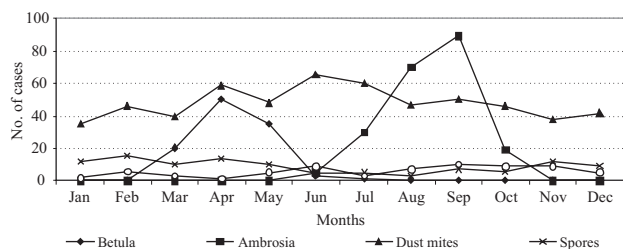


Fig. 4. Number of cases and time of worsening symptoms in patients monosensitized to inhalant allergens.

ences in the shares among patients allergic to individual allergens who live in rural and urban areas (Figure 1).

Increased symptoms in patients allergic to pollen allergens in the entire study period coincided with the presence of pollen in the air. For example, most people were more sensitized to pollen allergens (*Betula*, *Alnus*, *Corylus*, *Poaceae* and *Ambrosia*) with worsening of symptoms in March and April (the highest concentration of *Alnus*, *Corylus* and *Betula* pollen in the air), then May

and June (the highest concentration of pollen grass), and August, September (the highest concentration of ragweed pollen). It is similar to people who are allergic to pollen allergens other combinations (Figure 3). In monosensitized patients to worsening symptoms of pollen allergens occurs during pollination only concerned plant. For example, worsening of symptoms in patients sensitized to birch pollen allergens, occur from March to May with the largest number of cases in April (the highest concentration of birch pollen) while in patients allergic to ragweed pollen deterioration occurs from July to October with most cases in September. Patients sensitized to dust mites have symptoms throughout the year with a slightly increased number of cases in April and June. In patients sensitized to fungi and mold spores and animal hairs, the number of cases with worsening of symptoms is equal during the same year (Figure 4).

Conclusion

The knowledge on the biology and ecology of allergenic organisms is important for the carrying out of efficient measures regarding the control of allergens in the environment, including the prevention of allergic diseases. Furthermore, providing information on the movement of allergens, especially pollen, by means of mass media (radio, TV, daily press, web pages) is of great help to persons allergic to this type of allergens. In this way such persons can organise their daily activities in such a way as to avoid as much as possible the contact with allergens, and by planning their holidays at the flowering times of plants to the pollen of which they are allergic may greatly help in the control of their symptoms.

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UTJECAJ AEROALERGENA NA POJAVU KONJUNKTIVITISA U ZAGREBU I ZAGREBAČKOJ ŽUPANIJI

S A Ž E T A K

Cilj ovog rada bio je odrediti vremenske i prostorne varijacije peludnog spektara u Gradu Zagrebu i Zagrebačkoj županiji te učestalost pojave inhalacijskih alergija i rinokonjunktivitisa u odrasle populacije postavljanjem odnosa alergen/pacijent. Istraživanje je provedeno na tri kontinentalne lokacije u Hrvatskoj tijekom četiri godine (2003–2006). Istraživanje je kroz cijelo razdoblje provedeno na 2192 pacijenata koji su alergološki testirani kožnim ubodnim testom. Većina pacijenata alergičnih na peludne alergene bili su senzibilizirani na alergene iz peluda koji pripadaju botaničkoj obitelji trava 46,91%, zatim ambrozije 42,07%, breze 25,66%, lijeske 15,19% (sa simptomima rinokonjunktivitisa (42,5%), konjunktivitisa (28,3%) i rinitisa (23,9%). Pogoršanje simptoma u bolesnika alergičnih na peludne alergene u cijelom promatranom razdoblju poklopila se s prisutnosti peluda u zraku. Pacijenti senzibilizirani na grinje imali su simptome tijekom cijele godine s nešto povećanim brojem slučajeva u travnju i lipnju.