

# Sensitization to inhaled allergens in children with allergic rhinitis

## Senzibilizacija na inhalacijske alergene kod djece s alergijskim rinitisom

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### Sažetak

**Introduction:** Allergic rhinitis is an inflammatory disease of the nasal mucosa that most often occurs in children and it is a growing global health problem.

**Aim:** Aim of the study was to examine the sensitization on inhalant allergens in children with allergic rhinitis and its association with asthma.

**Methods:** We performed a cross-sectional study using data from our hospital records (2018-2022). A total of 412 children with symptoms of allergic rhinitis participated in the study, aged from 4 to 17 years old. The presence of allergic rhinitis was evaluated by specialist of allergology, immunology and otorhinolaryngology. The diagnosis was made on personal and family history, physical examination of the patient, skin prick tests and laboratory parameters.

**Results:** Out of 412 children enrolled in the study, 205 (55.1%) were male. All were diagnosed with allergic rhinitis, while 168 (40.78%) were, in addition to allergic rhinitis, diagnosed with bronchial asthma 66.26% (N=273).

Hypersensitivity to the inhalant allergens according to positive skin prick test was found as follows: *Dermatophagoides pteronyssinus* (67.96%; N=280 subjects), *Ambrosia artemisiifolia* (62.87%; N=259 subjects), *Betula* (54.13%; N=223 subjects) *Corylus* (52.91%; N=218) and grass pollen (52.91%; N=218 subjects).

Hypersensitivity to the inhalant allergens according to higher levels of specific IgE was found as follows: *Dermatophagoides pteronyssinus* (66.26%; N=273), *Ambrosia artemisiifolia* (66.02%; N=272), *Betula* (57.52%; N=237), *Corylus* (55.34%; N=228), *Poa pratensis* (45.39%; N=187), *Artemisia vulgaris* (27.67%; N=114), *Phelum pratense* (25.46%; N=105), cat dander (28.64%; N=118) and dog dander (23.54%; N=87).

**Conclusion:** Our data suggest that sensitization on house dust mite has important role in development of allergic rhinitis. Most children have allergic rhinitis linked to asthma.

**Keywords:** allergic rhinitis, sensitization, inhalant allergens

**Short title:** Allergic rhinitis in children

### Abstract

**Uvod:** Alergijski rinitis upalna je bolest nosne sluznice koja se najčešće javlja kod djece i sve je veći globalni zdravstveni problem.

**Cilj:** Cilj istraživanja bio je ispitati senzibilizaciju na inhalacijske alergene kod djece s alergijskim rinitisom i njegovu povezanost s astmom.

**Metode:** Proveli smo studiju presjeka koristeći podatke iz naše bolničke dokumentacije (2018. – 2022. godine). U istraživanju je sudjelovalo ukupno 412 djece sa simptomima alergijskog rinitisa u dobi od 4 do 17 godina. Dijagnozu alergijskog rinitisa postavio je specijalist alergologije, imunologije i otorinolaringologije. Dijagnoza je postavljena na temelju osobne i obiteljske anamneze, fizikalnog pregleda bolesnika, kožnih prick testova i laboratorijskih parametara.

**Rezultati:** Od 412 djece uključene u istraživanje, njih 205 (55,1 %) bilo je muškog spola. Kod svih je dijagnosticiran alergijski rinitis, dok je kod njih 168 (40,78 %) uz alergijski rinitis dijagnosticirana i bronhijalna astma 66,26 % (N = 273).

Preosjetljivost na inhalacijske alergene prema pozitivnom kožnom prick testu utvrđena je za sljedeće: *Dermatophagoides pteronyssinus* (67,96 %; N = 280 ispitanika), *Ambrosia artemisiifolia* (62,87 %; N = 259 ispitanika), *Betula* (54,13 %; N = 223 ispitanika) *Corylus* (52,91 %; N = 218) i pelud trava (52,91 %; N = 218 ispitanika).

Preosjetljivost na inhalacijske alergene prema povišenim razinama specifičnih IgE protutijela utvrđena je za: *Dermatophagoides pteronyssinus* (66,26 %; N = 273), *Ambrosia artemisiifolia* (66,02 %; N = 272), *Betula* (57,52 %; N = 237), *Corylus* (55,34 %; N = 228), *Poa pratensis* (45,39 %; N = 187), *Artemisia vulgaris* (27,67 %; N = 114), *Phelum pratense* (25,46 %; N = 105), perut mačaka (28,64 %; N = 118) i perut pasa (23,54 %; N = 87).

**Zaključak:** Naši podaci upućuju na to da senzibilizacija na grinje iz kućne prašine ima važnu ulogu u razvoju alergijskog rinitisa. Većina djece ima alergijski rinitis udružen s astmom.

**Ključne riječi:** alergijski rinitis, senzibilizacija, inhalacijski alergeni

**Kratak naslov:** Alergijski rinitis kod djece

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### Introduction

Allergic rhinitis is an inflammatory disease of the nasal mucosa that most often occurs in children and is a growing global health problem. Prevalence in developed countries

reaches up to 40% in childhood and is constantly increasing [1]. In our country, there were 7 studies performed based on the ISAAC (International Study of Asthma and

Allergies in Childhood) questionnaire. The data from these studies showed that prevalence rates of allergic rhinitis in Croatia have been increasing over the last decade and a half up to 23% [2-8].

Allergic rhinitis significantly affects the quality of life, and it is a risk factor for the development of asthma [9]. Due to the epidemiological connection, common risk factors, similar immunopathology, and similar therapeutic approach together with asthma, allergic rhinitis is a syndrome of united airway disease [10, 11]. It is necessary to carry out diagnostic procedures for proof of asthma and allergic rhinitis, regardless of the symptoms the patient presents to the doctor.

According to the international ARIA (Allergic Rhinitis and its Impact on Asthma) guidelines, allergic rhinitis is a syndrome characterized by immunologically caused (IgE-dependent) inflammation of nasal mucosa after exposure to certain allergens. The most common triggers of an allergic reaction in the nasal mucosa are: inhaled allergens such as dust mite, grass, tree and weed pollen, mold, and animal allergens. Allergen sensitization varies according to the area: in Europe, the major burden allergens are birch or ragweed, and in tropical regions, the major allergen is house dust mites [12]. In addition to differences in allergen sensitization according to the area, sensitization patterns can change over time [12].

The symptoms are rhinorrhea, nasal obstruction and itching, sneezing, and postnasal drip, which are often accompanied by symptoms of allergic conjunctivitis [13]. It can be classified based on the duration of symptoms of diseases (intermittent, persistent) or the severity of the clinical picture (mild, moderate and severe).

In the treatment of patients, an important role has the education of the patient and family, the application of primary prevention measures (avoidance of allergens, environmental control measures), non-specific treatment measures (nasal lavage with physiological solution), the use of symptomatic therapy (decongestants - short-term use in adults), pharmacotherapy and by applying specific immunotherapy. Specific immunotherapy is an etiological therapy that can modify immunologically response to allergens (achieving tolerance) and influence the development of allergic diseases (e. g., development of asthma in patients with allergic rhinitis). Medicines used in the treatment of allergic rhinitis can be divided into several groups: mast cell stabilizers - chromones, antihistamines (local and systemic), anti-leukotrienes, and corticosteroids (local or so-called intranasal and systemic) [12].

Effective management of allergic rhinitis requires a precise identification of allergens that cause IgE-mediated nasal inflammation. Skin prick test (SPT) is considered a standard major diagnostic method because of its accuracy, reproducibility and affordability. SPT requires good-quality allergen extracts appropriate for each geographic area [13]. In addition to clinical history and *in vivo* SPT, determination of allergen-specific IgE in serum can be performed. The level of serum allergen-specific IgE in patients with allergic rhinitis usually correlates with SPT test results. Clinical history, SPT, and serum sIgE represent the standard work-up for di-

agnosis of allergic rhinitis and for deciding on allergen immunotherapy prescription in atopic patients [14].

This paper aims to examine sensitization to inhaled allergens in children with allergic rhinitis and its association with symptoms of asthma. We performed our study because of the importance of updated data about allergen sensitization patterns that help to guide effective allergy management.

## Material and Methods

We performed a cross-sectional study using data from our hospital records (2018-2022). A total of 412 patients with diagnosed allergic rhinitis, with or without asthma, were enrolled in the study.

Skin allergy testing was performed using the method of prick skin test for 7 inhalation allergens (*Dermatophagoides pteronyssinus*, *Ambrosia artemisiifolia*, *Corylus*, *Betula*, grass pollen, cat and dog dander). The pollen mixture allergens were chosen according to the pollen calendars of our area. As reference values for the assessment of skin reactivity, in comparison with the reaction to a specific allergen, control solutions were used. A solution of histamine HCl at a concentration of 10 mg/ml was used for positive control. A 50% solution of glycerol in saline was used as a negative control. A prick skin test was performed with a standardized lancet through a drop of allergenic preparation dripped on the volar side of the forearm in intervals of at least 3 cm. The lancet injection was made at an angle of 90°. The skin reaction (urtica) was read after 20 minutes: the largest diameter of the urtica was measured (D), then the diameter of the urtica perpendicular to the largest diameter (d), and the calculated mean value  $[(D+d)/2]$ . The mean diameter of the urtica of 3 mm or more with surrounding redness was evaluated as a positive skin test (KT+) and less than 3 mm as a negative skin test (KT-) [15].

The diagnosis of allergic rhinitis was made based on personal and family anamnesis, clinical history images, laboratory findings, and skin testing performed with the prick method. Total and specific IgE serum levels were measured. Specific IgE serum levels were measured for 9 inhalation allergens (*Dermatophagoides pteronyssinus*, *Ambrosia artemisiifolia*, *Phelum pratense*, *Poa pratensis*, *Artemisia vulgaris*, *Corylus*, *Betula*, cat and dog dander).

The results are presented textually. We used descriptive statistics to describe the characteristics of variables of individual investigated groups, and the data of categorical variables were presented as a number and proportion (%). Because we performed a cross-sectional study from our hospital records study, no consent from patients and their parents was required.

## Results

Out of 412 children enrolled in the study, 205 (55.1%) were male. Participants were aged from 4 to 17 years (mean 10.8 years old). All patients were diagnosed with allergic rhinitis, while 168 (40.78%) were, in addition to allergic rhinitis, diagnosed with bronchial asthma.

Hypersensitivity to the inhalant allergens according to positive skin prick test was found as follows: *Dermatophagoides pteronyssinus* (67.96%; N=280 subjects), *Ambrosia artemisiifolia* (62.87%; N=259 subjects), *Betula* (54.13%; N=223 subjects) *Corylus* (52.91%; N=218) and grass pollen (52.91%; N=218 subjects).

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## Discussion

According to the results of our study, there is no significant difference between sexes (male children N= 205; 55.1%). The results of other studies conducted in the world are controversial. Some studies reported that male sex is strongly associated with the sensitization to inhalation allergens [16, 17], while other studies do not confirm this difference [18]. The reasons for these differences between the sexes in some studies are not well known and should be considered in future research.

In almost half of the respondents, an association with asthma symptoms was found [11, 13]. Similar results were confirmed in multiple studies [19, 20]. The impact of allergic rhinitis on asthma is largely acknowledged today. The reason for this impact is that nasal and bronchial mucosa share similar inflammatory changes in allergic patients ("united airway disease") [11].

Sensitization to inhalation allergens was tested by skin allergy prick test (SPT) and serum levels of total and specific IgE. The results of the skin prick test show that ambrosia (*Ambrosia artemisiifolia*) and house dust (*Dermatophagoides pteronyssinus*) allergens have the most important role in children with allergic rhinitis. The results of specific IgE show that children with allergic rhinitis are sensitized to house dust mites (66.26%; N=273) and ambrosia (66.02%; N=272). In addition to ambrosia and dust mites, *Betula* (57.52%; N=237), *Corylus* (55.34%; N=228), and *Poa pratensis* (45.39%; N=187) are also important when speaking of allergic rhinitis.

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According to multiple studies, house dust mite allergy is one of the most prevalent worldwide, and the most common clinical manifestations developed in house dust mite allergic patients are allergic rhinitis and asthma [12, 21]. Allergen sensitization varies according to the area and can change over time [12]. Lifestyle factors, such as increased time spent indoors, can also influence the sensitization pattern and could be why house dust mites play an important role. Changes in climatic factors (temperature, wind speed, humidity, thunderstorms, desert dust, etc.) can prolong the pollen season and create new sources of pollen due to new invasive species [22]. An earlier start of pollen season and a significant increase in the number of days with high pollen counts have been noticed in Munich, Germany, over the last three decades [23].

Sporik et al. conducted a prospective study that proved that children exposed to high levels of inhaled allergens have a higher risk of developing sensitization and asthma symptoms [24]. In later studies, in addition to exposure to high levels of inhaled allergens, the influence of their elimination on the development of sensitization was also examined. The results indicate that in the case of implementation of allergen elimination measures in the prevention of atopy, the onset of sensitization is delayed [24]. Because of the above, allergen elimination measures are recommended in disease prevention or reducing the symptoms of the disease.

## Conclusion

In conclusion, the obtained data show that the most important inhalation allergens in allergic rhinitis are house dust mites and *Ambrosia artemisiifolia*. This data shows the sensitization pattern of our area. Knowing the sensitization pattern can help us to guide effective allergy management. In implementing measures to prevent allergic diseases to avoid exposure to allergens, education by medical professionals (doctors and medical nurses) is crucial.

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## Nema sukoba interesa.

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