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Evaluation of olfactory function in children with allergic rhinitis and nonallergic rhinitis

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ABSTRACT

Objectives: Allergic rhinitis (AR) occurs when the symptoms of rhinitis arise as a result of allergen-induced nasal mucosal inflammation. In the presence of rhinitis symptoms without infection or an allergic reaction in the nose, non-allergic rhinitis (NAR) is considered. Adults with these diseases have increased frequency of olfactory dysfunction. The aim of the present study is to assess olfactory function in children with AR and NAR.
Methods: A total of 77 children (aged six to 18 years) with AR and NAR were included in the study. The control group consisted of 45 healthy children. Sniffin' Sticks test was applied to both groups. The association between odor scores and demographic, clinical, and laboratory results was investigated.
Results: Forty two patients had allergic rhinitis. No significant difference was observed between patients with rhinitis and healthy controls with respect to odor scores. No association was observed between odor scores and the severity of rhinitis and the laboratory results of the patient groups. Odor identification and total odor scores of the patients with rhinitis lasting for longer than three years were significantly lower than those in the patient group with rhinitis lasting for one to three years. In the AR and control groups, the odor scores were found to increase with age.
Conclusions: When compared with healthy children, children with allergic rhinitis and non-allergic rhinitis were not found to have reduced olfactory function. The duration of rhinitis may be associated with the olfactory dysfunction in children with rhinitis.

1. Introduction

Rhinitis is defined as the inflammation of the nasal mucosa, which is characterized by nasal congestion, nasal discharge, sneezing, and nasal itching [1]. Allergic rhinitis (AR) is an IgE-mediated inflammation of the nose caused by airborne allergens. It is the most common form of noninfectious rhinitis [1,2]. Allergic rhinitis is the most common allergic disease seen in children, and it is often accompanied by other allergic diseases. Non-allergic rhinitis (NAR) does not involve infectious agents or signs of atopy in the skin or blood. This disease is thought to be characterized by sensory nerve dysregulation or autonomic dysfunction in the nose [2]. Patients with AR and NAR compose the majority of chronic rhinoconjunctivitis cases [2]. The frequency of non-infectious rhinitis is 8.5% in children aged six to seven years and 14.6% in those aged 13–14 years [3]. This disease may negatively affect the social lives of children [4].

Olfactory dysfunction may emerge in some situations, such as in upper respiratory tract infections, sinonasal diseases, aging, and head trauma [5,6]. Olfactory dysfunction has been reported to be more common in adults with AR and NAR than in healthy subjects [6–10]. Although the mechanism remains unclear, nasal congestion had been previously thought to be responsible for the olfactory dysfunction [10,11]. Later, it was suggested that the olfactory dysfunction was due to nasal inflammation [10,12]. Olfactory dysfunction studies in patients with allergic rhinitis mostly involve adults [13]. The frequency of olfactory dysfunction in adults with allergic rhinitis is 20–40% [13]. In population-based studies, the frequency is 19% [14].

Although there are studies assessing olfactory function in adult patients with AR and NAR, olfactory function has not been studied in children with AR and NAR. The aim of this study is to compare olfactory function in children with non-infectious rhinitis with that in healthy children after measuring sensitivity via the skin test.

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2. Material and methods

2.1. Study group

Children (aged six to 18 years) who were admitted to the allergy and immunology clinic with reversible symptoms of rhinitis between April, 2014 and April, 2015 were included. Rhinitis diagnosis was performed according to Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines [1]. The following patients were excluded from the study: those with asthma (those with a history of asthma symptoms or evidence of asthma according to a pulmonary function test) or with a nasal anatomic structure disorder or active rhinosinusitis, those who had been receiving steroids, antihistamines, thyroid medication and/or anti-depressants for a month or longer, those who had undergone nasal surgery, and smokers. The irritant odors during smell test would trigger the asthma attacks so we have preferred to study on children without asthma. Seventy-seven patients meeting the aforementioned criteria were included in the study. Forty-five children aged six to 18 years without any ear-nose-throat symptoms and without clinical history of atopic disease were enrolled in the control group. Patients and control subjects were evaluated by an otorhinolaryngologist using nasal endoscopy. We did not include the control subjects and patients with nasal congestion or rhinorrhea to exclude the infection and obstructive factors. The current exclusion criteria were also applied for the control group.

The relationship between the symptoms and seasonality, severity, and duration of the symptoms were recorded. Hemogram and serum total IgE were measured, and a skin prick test was performed. The patients demonstrating sensitivity in the skin prick test were considered AR patients, and those without sensitivity were considered NAR patients.

This prospective study was approved by the Ethics Committee of Ondokuz Mayıs University with the protocol no. 2014/691. Written informed consent was obtained from parents of the children who participated in the study.

2.2. Allergy and laboratory testing

For atopy measurement, a skin prick test was performed. Histamine (10 mg/ml) was used as a positive control in the skin prick test, whereas physiological serum was used as negative control. The wheal was measured 15–20 minutes after the allergen was applied to the skin. According to the physiological serum response, a wheal of 3 mm or greater was considered significant [15]. The following allergens were used in the skin prick test: tree mix (*Castanea vulgaris, Quercus robur, Fagus sylvatica ACE*), grass mix (*Anthoxant odoratum, Dactylis glomerata, Lolium pere me, Phleum protein France, Poa pratensis*), weeds (*Chenopodium album, Amaranthus retroflexus*), *Dermatophagoides farinae, Dermatophagoides pteronyssinus, Alternaria Alternate, Aspergillus mix, Blattella Germanica*, and cat feathers (Stallergenes SA, 92160 Antony, France). Hemogram measurements were performed using the Advia 2120 hematology system (Siemens, Germany). Serum IgE levels were measured using the nephelometry method (Nephelometry BN2 Siemens, Germany). Eosinophil count on the hemogram was recorded.

2.3. Olfactory testing

Patients and control subjects were evaluated by an otorhinolaryngologist, and a Sniffin' Sticks test was performed (Burghart GmbH in Wedel, Germany) [16]. The validity of this test in the Turkish adult population was confirmed, although it was not confirmed in Turkish children [5]. However this test was validated in German children [17]. The test includes a total of 12 odors. An odor identification (OI) score (0–12) and an odor discrimination (OD) score (0–12) were generated for all individuals, with 12 representing the highest score and 0 representing the lowest. A total odor (TO) score (0–24), which is sum of these two scores, was also generated.

Table 1
Demographic and clinical characteristics of the patients.

Demographic and clinical characteristics	Patients (n = 77)
Age (years)	
Median (min–max)	11 (6–18)
Male gender, [n (%)]	41 (53)
Atopy in skin prick test, [n (%)]	
Allergic rhinitis	42 (54)
Nonallergic rhinitis	35 (46)
Classification, [n (%)]	
Seasonal	34 (44)
Perennial	43 (56)
Severity, [n (%)]	
Mild	47 (61)
Moderate–Severe	30 (40)
Symptom duration, [n (%)]	
≤1 year	13 (17)
1–3 years	21 (27)
>3 years	43 (56)
Sensitivity [n (%)]	
Mite	33 (42)
Pollen	20 (25)
Other	2 (2.5)
Negative	35 (45)
Eosinophils (/mm^3) [median (min–max)]	330 (30–2430)
Total IgE (IU/mL) [median (min–max)]	149 (17–1350)

IgE: immunoglobulin E.

2.4. Statistical analysis

Data were analyzed by using the Statistical Package for Social Sciences (SPSS for Windows 20.0 Chicago, USA) program. Normality was assessed using the Kolmogorov–Smirnov test. Groups were compared using an independent t-test and the one-way ANOVA for normally distributed quantitative data. Data not showing normal distribution were analyzed using the Mann–Whitney U-test and Kruskal–Wallis test. Pearson's chi-squared test was used for the analysis of categorical data. For non-normally distributed data, the correlation between the variables was analyzed via Spearman correlation analysis. Results were presented as frequency, mean ± standard deviation and median (min–max). $p < 0.05$ was considered as significant difference. The Spearman rank correlation test was used to analyze the correlation.

3. Results

The median age in both patient (41 males, 36 females) and control groups (21 males, 24 females) was 11 years (ranging from six to 18 years in the patient group and seven to 18 years in the control group). Clinical and laboratory features of the patients are specified in Table 1. There was no statistically significant difference with respect to age or gender among groups (Table 2). The numbers of patients with a history of rhinitis for nearly one year, one to three years, and longer than three years were 13, 21, and 43, respectively. In the skin prick test, 20 patients had sensitivity only against mites, seven only

Table 2
Comparison of the demographic data and odor scores of patient and control groups.

	Patients (n = 77)	Controls (n = 45)	p
Age (years) [median (min–max)]	11 (6–18)	11 (7–18)	0.250
Gender (male/ female)	41/36	21/24	0.483
OI score [median (min–max)]	3 (0–7)	4 (0–9)	0.484
OD score [median (min–max)]	9 (1–12)	9 (2–11)	0.567
TO score (mean ± SD)	11.6 ± 3.1	11.5 ± 3.6	0.820

OI: odor identification OD: odor discrimination TO: total odor SD: standard deviation.