



# Allergy status in children with adenoid hypertrophy with and without serous otitis media

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## Abstract

**Introduction:** Serous otitis media (SOM) is one of the most common diseases of children which can lead to hearing loss and imbalance in many cases.

**Objective:** To evaluate the relationship between allergy status and SOM in children with adenoid hypertrophy and whether affected by age group.

**Materials and Methods:** This cross-sectional study was conducted on 103 children aged 1-15 years with grade III or IV adenoid hypertrophy ( $\pm$  SOM) who referred to ear, nose, and throat (ENT) clinic. Additionally, children were divided into two subgroups based on age category of below and above seven years. The allergy status in children with and without SOM was compared by measuring the total immunoglobulin E (IgE) level, serum eosinophil level and skin prick test (SPT).

**Results:** There was no difference in prevalence of mean absolute eosinophil count (127.3 versus 141.3 eosinophils/ $\mu$ L, respectively) ( $P=0.63$ ), mean total IgE level (68.2 versus 140 IU/L, respectively;  $P=0.119$ ) and positive SPT results (23.5% versus 28.4%, respectively;  $P=0.551$ ) between children with adenoid hypertrophy ( $\pm$  SOM).

**Conclusion:** It seems absolute eosinophil count, total IgE level and positive SPT results have no significant role in SOM of children with adenoid hypertrophy and maybe other factors are implicated in its occurrence.

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## Introduction

Serous otitis media (SOM) is characterized by collection of fluid in the middle ear with any sign and symptom of acute infection (1, 2). Approximately, 90% of children under school age have SOM and, on average, experience four episodes of SOM every year. In the USA, the annual prevalence of diagnosed episodes is 2.2 million, imposing more than \$4 billion on the health system. However, indirect expenses outgo this amount as the majority of these diseases are asymptomatic and remain undiagnosed. SOM can involve the majority of children between 6-month and 4-year through upper respiratory tract infections or spontaneously because of Eustachian tube dysfunction, following inflammatory responses caused by acute SOM. More than 50% of children experience SOM in the first year of life and 60% of children develop it in the second year of life. Risk factors that can

## Key point

SOM is one of the most common diseases in children. Predisposing factors in this disease is not clear yet. Although some studies showed the role of allergy in SOM, our results determined no significant difference in the role of allergy among children with adenoid hypertrophy with and without SOM by measurement of the total IgE level, serum eosinophil level and skin prick test.

increase the chance of SOM include low-age, seasonal conditions, exposure to secondhand smoke, male gender, and kindergarten environment (3). In previous studies, allergy was a major risk factor of SOM, as a multifactorial disease. There were some reports on the effectiveness of allergy treatment in preventing or limiting the duration of SOM (4). According to studies, neonates with allergy symptoms are five times more likely

to develop SOM. Allergy exposes the patients to sinusoidal infections and creates a suitable condition for bacterial growth and early inflammation(5). The higher incidence of SOM in allergic children indicates the role of allergy in SOM development and relapse (6). The current medical evidence supports the relationship between allergy and SOM, and introduces it as an allergic disease (7-9). Although adenoid hypertrophy is a cause of SOM, it does not necessarily lead to SOM (10).

### Objectives

The aim of this study was to examine the relationship between SOM and allergy status in patients with adenoid hypertrophy based on age category.

### Patients and Methods

#### Study design

This cross-sectional study was conducted in the ENT Clinic of Ali-Asghar hospital between 23 October 2017 and 23 August 2018. The participants were selected through the convenience sampling method. The sample size was estimated 47 at each group based on the study by Doner et al (11), alpha error of 0.05, and beta error of 0.2. Given the chance of sample loss, 103 patients were almost equally divided into each of the two groups of children with and without SOM. Children with adenoid hypertrophy were also divided into two subgroups based on age category; children aged 1 to 7 years and children aged 7 to 15 years old. Inclusion criteria were age of 1-15 years, allergic and rhinitis clinical symptoms, and adenoid hypertrophy grade 3 and 4 based on adenoid nasopharyngeal ratio obtained from lateral X-ray of nasopharynx (12). Exclusion criteria were asthma, congenital diseases, skeletal disorders, Patient with parasitic infections and underlying diseases, such as diabetes and cystic fibrosis. Demographic data, medical history, examination results and history of allergy were recorded by family practice resident. Additionally, allergy information of each patient was supervised by an allergist and clinical immunologist. After physical examination, all eligible participants underwent tympanometry by an audiologist and results were recorded. In this process, types A and C were considered negative and type B was considered positive to SOM (3).

#### Laboratory investigations

The CBC-diff test was carried out with an emphasis on eosinophils and the total immunoglobulin E (IgE) level was measured in a 5 mL blood sample. Based on the standard criteria, eosinophilia is classified as either mild (500–1500 eosinophils per microliter), moderate (1500 to 5000 eosinophils per microliter), or severe (greater than 5000 eosinophils per microliter) (13). In addition, the total IgE level is classified as either mild (500 IU per liter of blood), moderate (500-1000 IU per liter of blood), or severe (greater than 1500 IU per liter of blood)(14).

Moreover, the skin prick test (SPT) was administered

for some allergic agents (tree, lawn grass, fungus, mite, cockroach, dog, and cat). SPT is performed by placing a drop of the allergen extract, usually in the volar surface of the forearm, and then pricking the skin with a lancet. After 20 minutes of application, a positive result is defined as a wheal at least 3 mm larger than the negative control (15, 16).

#### Ethical issues

The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Iran University of Medical Sciences approved this study. The institutional ethical committee at Iran University of Medical Sciences approved all study protocols (IR.IUMS.FMD.REC.1396.951). Accordingly, written informed consent was taken from the parents of children. This study was extracted from M.D thesis of Farzad Mohseni at Iran University of Medical Sciences (Thesis#951171001).

#### Statistical analysis

Statistical analyses of continuous variables with normal distribution were expressed as mean  $\pm$  standard deviation (SD), and categorical variables were defined as proportions or ratios. Baseline characteristics of study participants were compared using independent *t* test or chi-square where appropriate. All statistical analyses were conducted using SPSS version 22.0 (IBM Corp., NY). Accordingly, *P* < 0.05 was considered statistically significant.

### Results

#### Basic features of participants

This study was performed on 103 children aged 1-15 years old (20-139 months), including 54 boys (52.4%) and 49 girls (47.6%). Frequency of clinical symptoms, such as clear rhinorrhea, nose itching, frequent sneezing, nasal congestion, chronic cough, and post nasal discharge, is illustrated in [Figure 1](#). The frequency of sensitivity to food allergens, such as cow milk, egg, peanut, sesame, shrimp, fish, wheat, soybean, and hazelnut, was also investigated ([Figure 2](#)).

According to the physical examination, 46 participants (44.7%) were in the non-SOM group and 57 participants (55.3%) in the SOM group. After clinical examination, Tympanometry showed that 52 patients (50.5%) were without SOM and 51 patients (49.5%) were with SOM. Among the boys, 26 patients (48%) did not have SOM and 28 patients (52%) had SOM. Among the girls, 26 patients (53%) did not have SOM and 23 patients (47%) had SOM.

According to the defined positive and negative levels of SPT (>3), 76 patients (73.7%) had negative test results and 27 patients (26.2%) had positive test results. In addition, 15 non-SOM patients (28.4%) and 12 SOM patients (23.5%) had positive SPT results. Therefore, there was no significant “between-group difference” in this regard (*P*=0.551). In terms of the age group, the participants were divided into two groups which 71 patients (68.9%) were

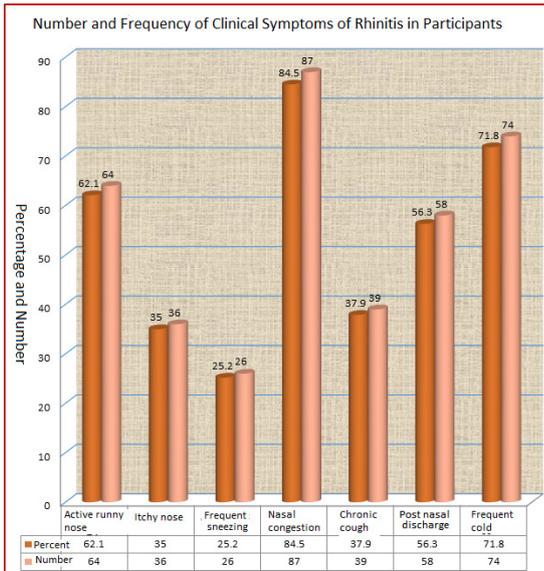


Figure 1. Number and frequency of clinical symptoms of rhinitis in participants

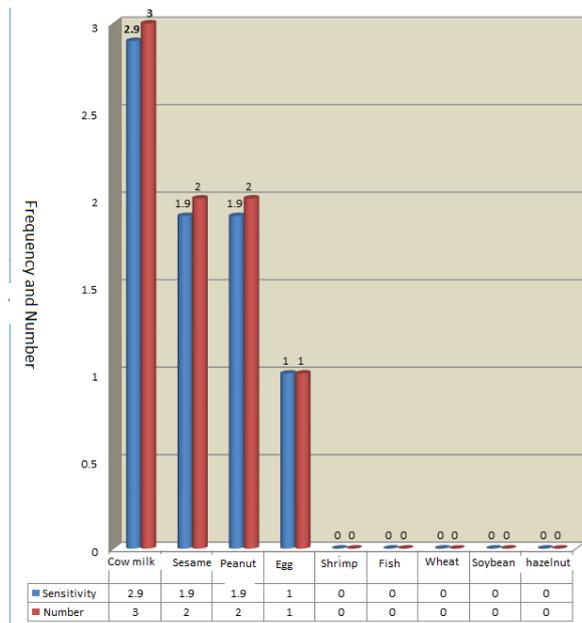


Figure 2. Number and frequency of food allergy (based on medical history) in patients under investigation.

younger than 7 years old and 32 patients (33.1%) were older than seven years old. In the first group (younger than seven years old), 42.3% of the participants were without SOM and 57.8% had SOM (Table 1).

In the age group of below seven years old, the allergy and the prick test results were positive in eight cases with SOM and eight cases without SOM, indicating no significant “between-group difference” ( $P=0.774$ ). In the age group of above seven years old, the allergy and the prick test results were positive in four participants with SOM and seven participants without SOM, indicating no significant

“between-group difference” ( $P=0.37$ ).

**Evaluation of mean absolute eosinophil count between 2 groups**

The mean absolute value of eosinophils was 134.3/ $\mu\text{L}$  of blood. According to the results, 97% had normal eosinophilia and 3% had mild eosinophilia; however, 3% of the participants did not have SOM. Given the eosinophilia intensity, the mean absolute eosinophils count in children without SOM was 141.3/ $\mu\text{L}$  of blood; whereas, this rate was 127.3/ $\mu\text{L}$  of blood in children with SOM. There was no significant between-group difference in the mean absolute eosinophil count ( $P=0.63$ ; Table 2).

The mean absolute eosinophil count in the first age group was 100.2/ $\mu\text{L}$  in patients without SOM and 116.9/ $\mu\text{L}$  in patients with SOM, indicating no significant between-group difference ( $P=0.538$ ; Table 2).

In the age group of above 7 years old, the mean absolute eosinophil count was 69.7 cells/ $\mu\text{L}$  in cases with SOM and 198.7 cells/ $\mu\text{L}$  in cases without SOM, indicating no significant “between-group difference” ( $P=0.713$ ).

**Evaluation of the mean blood IgE level between two groups**

Since the [normal] mean total IgE level is 103.9 IU/L, five participants were in the abnormal range, out of which two patients had SOM (Table 3).

Based on the defined IgE level, the mean total IgE level is 140 IU/L in children without SOM and 68.2 IU/L in children with SOM. Therefore, there was no significant difference between the two groups in the mean total IgE level ( $P=0.119$ ).

The mean total IgE level in the first age group was 85.4 IU/L in patients without SOM and 50.1 IU/L in patients

Table 1. Evaluation of skin prick test between 2 groups

Age	Prick test (N)	Serous otitis media		P value <sup>a</sup>
		Yes (n=51)	No (n=52)	
<7 years (n=71)	Positive	8	8	0.774
	Negative	33	22	
$\geq 7$ years (n=32)	Positive	4	7	0.372
	Negative	6	15	
Total (n=103)	Positive	12	15	0.551
	Negative	39	37	

<sup>a</sup> Fisher’s exact test.

Table 2. Evaluation of mean absolute eosinophil count

Age	Serous otitis media		P value <sup>a</sup>
	Yes (n=51)	No (n=52)	
<7 years (n=71)	116.9	100.2	0.528
$\geq 7$ years (n=32)	169.7	198.7	0.713
Total (n=103)	127.3	141.3	0.630

<sup>a</sup> Independent t test.

**Table 3.** Evaluation of mean blood IgE level

Age	Serous otitis media		P value <sup>a</sup>
	Yes (n=51)	No (n=52)	
<7 years	50.1	85.4	0.175
≥7 years	140.7	213.1	0.618
Total	68.2	140	0.119

<sup>a</sup> Independent t test.

with SOM, indicating no significant between-group difference ( $P=0.175$ ; Table 3).

In the age group of above 7 years old the mean total IgE was 231.1 in participants without SOM and 140.7 in participants with SOM, indicating no significant between-group difference ( $P=0.618$ ).

### Discussion

SOM is one of the most common diseases in children. There is some controversial opinion about predisposing factors in this disease. Our results determined no significant difference in the role of allergy among children with adenoid hypertrophy ( $\pm$ SOM), although some studies showed the role of allergy in OME.

As opposed to our findings, El-Sharnoby et al in 2017 investigated that allergy status was a positive risk factor for SOM. In that study, 80 patients including 60 children in the range of 2-15 years old, who were diagnosed with type 2 SOM through tympanometry were enrolled and evaluated based on the clinical symptoms and total IgE level but nothing about prick skin test. They showed that the total IgE level in patients with SOM was higher than the controls and there was a significant relationship between IgE level and SOM development ( $P=0.001$ ) (5). In addition, Quaranta et al investigated the role of chronic rhinitis in development of SOM in 81 patients with adenoid hypertrophy aged 4-15 years old. All patients were examined in terms of exact history of medical examination with nasopharyngeal endoscopy, skin test, nasal cytology, and hearing assessment. That study showed that chronic rhinitis was observed in more than 70% of children with adenoid hypertrophy and 60% of them had SOM. They also found that SOM was positively correlated with neutrophils ( $P=0.01$ ) and mast cells ( $P=0.022$ ), and was negatively correlated with eosinophil ( $P=0.02$ ) and bacterium ( $P=0.02$ ) (10) which has no emphasis on role of allergy. In an Italian study, Passali et al selected 100 children with clinical allergy aged between 5-9 years old. Their SPT's results were showed that 50 patients were positive for fungus, 34 patients were positive for grass, and 16 patients were positive for *Parietaria* as well as the middle ear effusion was seen in 45 children with myringotomy. They found that there is a significant relationship between SOM and the symptoms of allergic rhinitis ( $P<0.001$ ) (17).

Similar to our results, the study by Souter et al demonstrated no difference in the prevalence of allergic diseases such as rhinoconjunctivitis, asthma, or eczema

among children with and without otitis media with effusion (18). In addition, a large cross-sectional study by Roditi et al was performed on patients younger than 18 years old with clinical criteria of allergic rhinitis and SOM. That study was found that age is an effective factor in the relationship between allergic rhinitis and SOM. Similar to our results, they showed no significant correlation between allergy and SOM in children younger than 6 years ( $P=0.745$ ); however as opposed to our study, this correlation was significant in children older than 6 years ( $P<0.001$ ) (19).

According to the previous studies, the clinical and laboratory symptoms of allergy are higher in children with SOM than in children without SOM, regardless of having adenoid hypertrophy or not. To the best of our knowledge, this study for the first time investigated this comparison in the children with adenoid hypertrophy, who were candidate for adenoidectomy. Our results did not reveal no significant difference in eosinophil count, total IgE level and positive SPT results in children with and without SOM. Maybe, allergy has no role in the development of SOM in children with adenoid hypertrophy, which can emphasize other underlying causes.

Based on the past results, other factors, such as frequent infections, anatomic structure, number of children, using breast milk or formula, going to kindergarten, socioeconomic status, gastroesophageal reflux, having stimulating foods, fast foods, or food preservatives, low physical activity and obesity, air pollution, stress, sound pollution, and telecommunication pollution, are among the underlying causes of SOM development in patients with adenoid hypertrophy. These factors affect the role of allergy in developing SOM in some patients (3, 4). Further long-term, prospective, observational studies should be designed to determine the association between other factors in the development of SOM in children with adenoid hypertrophy.

### Conclusion

In conclusion, investigating allergy in children with adenoid hypertrophy, who were candidate for adenoidectomy, showed no significant difference in the role of allergy between children with SOM and children without SOM based on the SPT, absolute eosinophil count, and IgE level. Our study showed allergy has no role in the development of SOM in children with adenoid hypertrophy; therefore, other underlying factors should be considered in such patients.

### Limitations of the study

In the current study, we faced some limitations. Firstly, the cross-sectional design of the study distorted the establishment of a causal relationship. Second limitation of this study is its small sample size, as these kinds of studies require larger sample sizes to achieve an adequate statistical power.

**Authors' contribution**

JKZ, GHB, MBA, FDF, FM and BGH were the principal investigators of the study. JKZ, GHB, BGH, MBA, FDF and RS were included in preparing the concept and design. GHB, BGH, and FDF revisited the manuscript and critically evaluated the intellectual contents. All authors participated in preparing the final draft of the manuscript, revised the manuscript and critically evaluated the intellectual contents. All authors have read and approved the content of the manuscript and confirmed the accuracy or integrity of any part of the work.

**Conflicts of interest**

The authors declare that they have no competing interests.

**Ethical considerations**

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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