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Relationship between Adenoidal Hypertrophy and Allergic Rhinitis in Children

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Abstract
Background: as a consequence of antigenic stimulation associated with chronic inflammation, the adenoids may enlarge so that they may almost fill the nasopharynx. Moreover, adenoid hypertrophy and allergic rhinitis can co-exist in the same patient and treating allergy may relieve patient's symptoms and thus avoid unnecessary surgery. **Objective:** this study aimed to determine the relationship between adenoid hypertrophy and allergic rhinitis in children based on clinical examination, nasal endoscopy and skin prick test. **Methods:** this was a prospective study included 50 children who were selected from many patients attended Otolaryngology Outpatient Clinic in Al-Azhar University Hospitals during the period from February 2018 to June 2018. All patients were signed an approved informed consent form before study enrollment. **Results:** the results of this study showed that there was no significant association between allergy and nasal obstruction neither measured by endoscopy, nor FRS. Furthermore, there was a significant negative correlation between allergy and adenoid volume measured only by endoscopy not by lateral X-ray nasopharynx. Supplementary, among all tested allergens, house dust and cotton dust allergy showed a significant negative association with the volume of adenoid. Moreover, all types of food and perennial allergens did not show significant correlations. **Conclusion**: this study showed that large adenoid may be associated with absence of allergy, whereas large turbinates may be associated with small adenoid. These findings may be helpful in clinical management of a child with nasal obstruction, so a detailed evaluation of the nose and nasopharynx is mandatory in each child with this complaint and it should be performed by nasal endoscopy. Consequently, the treatment should be geared toward the specific findings in that individual.
Keywords: adenoid hypertrophy, allergic rhinitis, relationship, skin prick test

Introduction

The adenoid is aggregate of lymphatic tissues, located at the junction of the roof and the posterior wall of the nasopharynx[(1)]. The adenoid is part of the ring that encircles the pharynx collectively defined as the Waldeyer's ring that includes the adenoid, the lingual tonsils, the two palatine tonsils and the lymphoid tissue situated on posterior wall of the pharynx [(2)]. The adenoid physiologically serves as a defense against respiratory antigens (microbes, allergens, etc) at the entry of upper aero-digestive tract having a significant role in the adaptive immune response [(3)]. As a consequence of antigenic stimulation associated with chronic inflammation, the adenoid may enlarge so that it may almost fill the nasopharynx [(4)]Adenoidal hypertrophy (AH) is detected in most of general pediatric population and constitutes one of the most frequent otorhinolaryngological indications for surgical intervention [(5)]. On the other hand, Allergic rhinitis (AR) is frequent in children, affecting up to 30% of the general population [(6)]. It is well known that children with allergic rhinitis usually have lymphoid hypertrophy of upper airway, mainly concerning the adenoids [(7)]. Furthermore, AH and AR in children have very similar clinical manifestations, mainly as nasal obstruction and snoring and are associated with impaired quality of life, failure to thrive and poor school performance [(8)]. AH and AR can co-exist in the same patient and treating allergy may relieve patient's symptoms and thus avoid unnecessary surgery [(9)]. It is mandatory to determine the cause of nasal obstruction before starting any treatment as it is a non-specific symptom associated with variety of disorders. Because of the location of adenoids in the posterior wall of nasopharynx, the measurement of both adenoid pad and airflow obstruction represents a challenge issue. Several modalities have been proposed such as acoustic rhinomanometry, endoscopy, intra-operative mirror rhinopharyngoscopy and radiographic assessments [(10)]. However, the most commonly used preoperative modality in

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clinical practice is lateral neck films and nasal endoscopy [(11)]. Diagnosis of AR is made based on history, clinical examination and by performing allergic tests for inhalant allergens such as skin prick test. The possible correlation between AH and AR has been investigated by many studies showing an increased incidence of pathological adenoid tissue enlargement in children with allergic rhinitis when compared to normal non-atopic children [(12)] Children with AH may usually have AR as well as, vice versa, children with AR may commonly have AH [(13)]. The aim of this study was to determine the relationship between adenoid hypertrophy and allergic rhinitis in children based on clinical examination, nasal endoscopy and skin prick test.

Patients and Methods

Ethical approval

All the clinical and surgical procedures were performed after confirmation from the Ethics Unite of the Faculty of Medicine, Al-Azhar University. All patients assigned confirmed consents in accordance with the Declaration of Helsinki.

Study design

This was a prospective study included 50 children who were selected from many patients attended otolaryngology outpatient clinic in Al-Azhar university hospitals. All patients signed an approved informed consent form before study enrollment.

Study population

During the period from February 2018 to June 2018 patients were suffering from hypertrophied adenoid tissue, presented clinically by mouth breathing, snoring, bilateral nasal obstruction and/or discharge and evidenced radiologically with plain x-ray film lateral view to the nasopharynx and by nasopharyngeal endoscopic examination in cooperative patients. Moreover, patients aged from two to twelve years presented with nasal obstruction whilst the adenoid hypertrophy represent the main cause were included. Otherwise, patients younger than 2 years old and older than 12 years old, recent facial trauma, significantly deviated septum, concomitant acute rhino sinusitis, current use of anti-allergic drugs, and patients with history of previous adenoidectomy were excluded.

Assessment of Nasal Obstruction:-

The assessment of nasal obstruction perception was evaluated in all the children by the faces rating scale (FRS). FRS ranged on an ordinal scale from 0 (less critical, such as nose completely patent) to 5 (more critical, such as nose completely obstructed FRS is an adaptation of the picture projection technique in which six faces are shown to a child.

Adenoidal Volume Assessment by Endoscopy: -

The patients were evaluated by nasal endoscopy for adenoid hypertrophy. AH was graded according to Parikh's classification that is based on the anatomic relationships between adenoid tissue and the vomer, soft palate, and torus tubaris.

AR assessment by endoscopy:-

Two endoscopic findings are found to be significant as indicators of the severity of the disease; the bluish discoloration of the inferior turbinate and presence of mucosal edema.

Skin Prick Test (SPT):-

Allergy was assessed by the presence of sensitization to the most common classes of aeroallergens using a skin prick test. Reactions to seasonal inhaled allergens including (mixed pollens, hay dust, cotton dust, and house dust), perennial allergens (mixed mold spores, dust mites, pigeon dust, and goat hair) and food allergens (wheat, egg, milk, maize, strawberry, banana and cacao) were assessed.All data were collected regarding obstructive and infectious complaints suggesting adenoid hypertrophy and history of allergy (allergic rhinitis, bronchial asthma and allergic conjunctivitis) in patients and their families. Then the results of skin prick test were added to each patient sheet.

The statistical analysis:

Data were analyzed by using Statistical Program for Social Science (SPSS) version 22.0. Quantitative data were expressed as mean±standard deviation (SD).

Qualitative data were expressed as frequency and percentage. Score of each item in the raw data was collected and put in word excel sheet to be analyzed by specialist in statistics.

The Spearman's rank correlation coefficient (R), which is defined as statistical measure of the strength of the relationship between paired data, was used to assess correlation between ordinal clinical variables, such as adenoids volume and nose obstruction on Friedman scale. A P-value of < 0.05 was considered statistically significant.

Results

Throughout the study period, we included 50 patients with unilateral or bilateral persistent nasal obstruction and discharge, noisy breathing, mouth breathing, and recommended for adenoidectomy operation. The demographic and clinical characteristics of patients are reported in **table 1**.

Table 1: patient's general characteristics

Variable	Mean/Number	SD/IQR/%
Age	6.7	2.6
Sex Males	34	66%
Females	16	34%
Duration of symptoms (months)	12	6-20

Table 2: allergic conditions in cases

Allergic conditions	Percentage (%)	Number
Allergic rhinitis	42%	21
Bronchial asthma	28%	14
Allergic conjunctivitis	4%	2
No allergic condition	26%	13

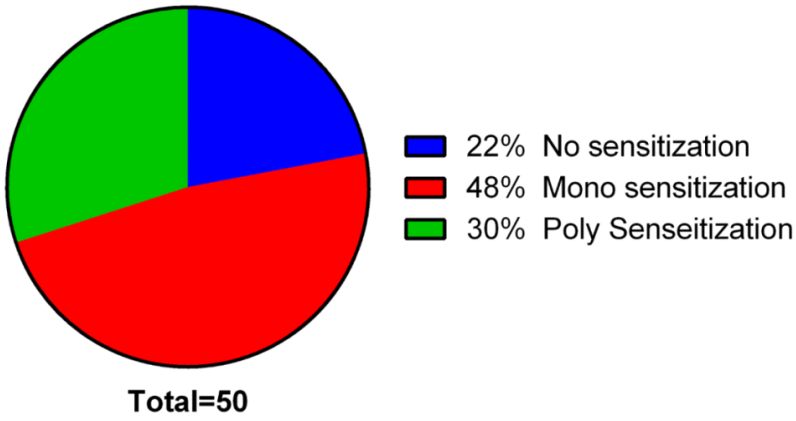

Fig.1: allergy status of adenoid children after skin prick test

The correlation with adenoid volume was tested with endoscope. Similarly, the correlation with nasal obstruction was tested once when measured by Friedman method and once when measured by FRS. The correlation with allergy was tested as whole with both mono-and poly-sensitized patients.

Table 3: distribution of patients among adenoid volume and nasal obstruction grades

Grades	Number	Percent %
		Nasal obstruction (Friedman)
Grade 1	9	18%
Grade 2	19	38%
Grade 3	22	44%
		Adenoid volume (Parikh's classification)
Grade 1	18	36%
Grade 2	14	28%
Grade 3	11	22%
Grade 4	7	14%
		Nasal obstruction(FRS)
Grade 0-1	2	4%
Grade 2	10	20%
Grade 3	23	46%
Grade 4	12	24%
Grade 5	3	6%

Fig.2: distribution of cases based on nasal obstruction classification of Friedman

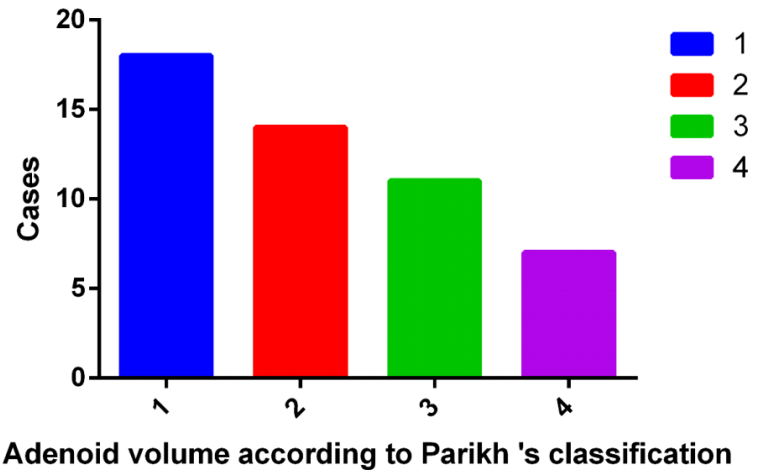

Fig3: distribution of cases according to Parikh's classification of adenoid volume

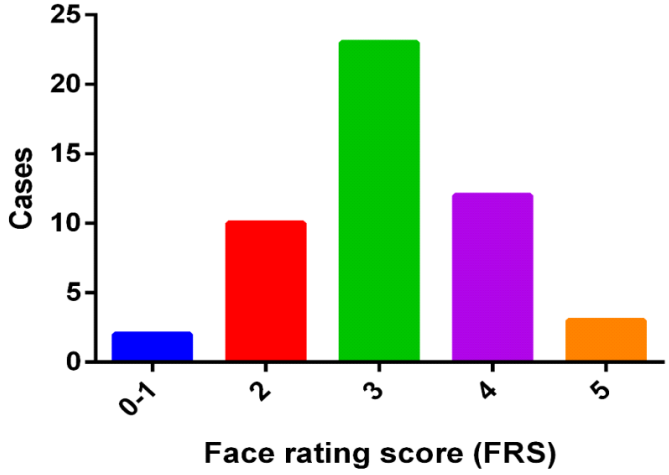

Fig. 4- Face Rating Score (FRS) according to Parikh's classification of adenoid volume

The distribution of children according to the volume of adenoid and the presence of allergy (including mono or poly sensitization) was shown in **fig.5.**

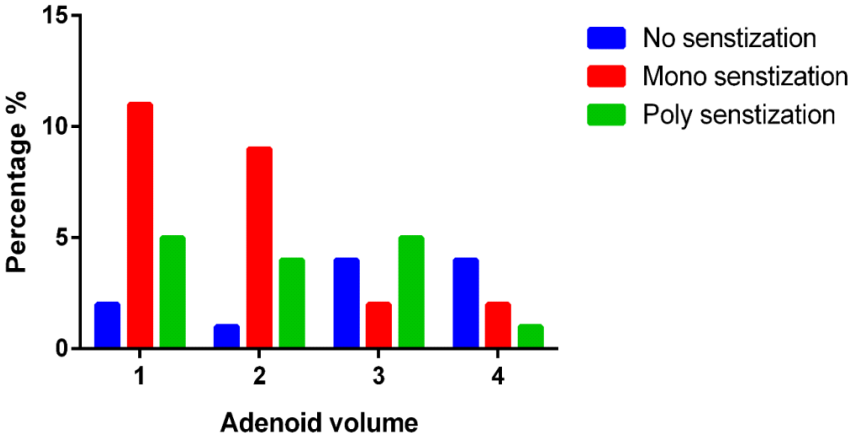

Fig.5: distribution of allergic status according to Parikh's classification of adenoid volume

Interestingly, there was a significant negative correlation between allergy and adenoid volume (measured by endoscopy) (R= -0.302, P= 0.033) (**Table 4).** 4).

Table 4: correlation between adenoid volume and allergy

Variable		Nasal endoscope (adenoid volume)
Allergy	Correlation Coefficient	-0.302
	P value	0.033*
	N	50

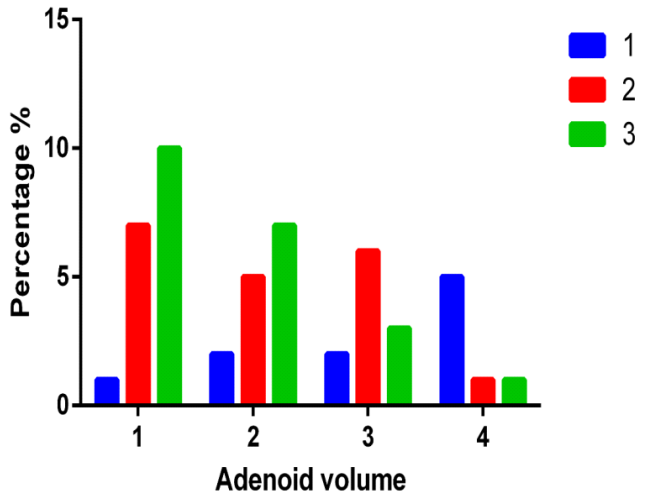

Fig. 6: distribution of nasal obstruction according to Parikh's classification of adenoid volume

There was a significant negative correlation between nasal obstruction (measured by endoscopy) and adenoidal volume (measured by endoscopy) (R= -0.321, P= 0.023). However, Putting the nasal obstruction (measured by the FRS) into consideration, there was a significant positive association between it and adenoidal volume (measured by endoscopy) (R= -0.462, P= 0.001) **(Table 5).**

Table 5: correlation between nasal obstruction and adenoid volume

Variable		Nasal endoscope
Nasal Obstruction (Friedman)	Correlation Coefficient	-0.321
	P value	0.023
	N	50
Nasal Obstruction (FRS)	Correlation Coefficient	0.462
	P value	0.001
	N	50

Putting the allergy in the consideration, there was no significant association between allergy and nasal obstruction measured by endoscopy (R= 0.054, P= 0.711 nor FRS (R= 0.127, P= 0.381) **(Table 6)**.

Table 6: correlation between allergy and nasal obstruction

Variable		Nasal 0bstruction	
		Friedman	FRS
Allergy	Correlation Coefficient	0.054`	0.127
	P value	0.711	0.381
	N	50	50

Among all tested allergens, house dust and cotton dust allergy showed a significant negative association with the volume of adenoid (measured by endoscopy) with R = -0.458 (P = 0.001 and R = -0.283 (P =0.046), respectively. All types of food and perennial allergens did not show significant correlations.

Discussion:

Allergic diseases in children are mostly manifested as asthma, allergic rhinitis (AR) and atopic dermatitis (AD). AH and allergic diseases are the most common cause of morbidity in childhood **(14).** They added that AH presence in patients with allergic rhinitis was evaluated by previous studies **(15)**. However, the literature is limited regarding the relationship between AR, and presence of AH. The results of this study showed that 42% of cases showed associated allergic rhinitis, 28% of cases showed associated bronchial asthma, 4% of cases showed associated allergic conjunctivitis and 26% of cases showed no associated allergic conditions. Furthermore, about 3o% of children were poly sensitized to different allergens. Mono-sensitized patients were 48%. No sensitization result was in 22% of patients. Also, there was no significant association between allergy and nasal obstruction neither measured by endoscopy, nor FRS. The present study found that the volume of adenoid was inversely related with the grade of the anterior nasal obstruction clinically, so it could seem that if the nose is closed, the adenoid does not enlarge. Furthermore, there was a negative correlation between allergy and adenoid volume measured by nasal endoscopy. Children with AH grade 4 had a least allergic results, either mono or poly sensitization. There was a significant positive correlation between nasal obstruction and adenoidal volume (measured by FRS). However, when measuring the nasal obstruction by Friedman grading, negative association resulted. This is due to the nature of assessing the nasal obstruction according to Friedman grading. In assessment of nasal obstruction according to Friedman, we focus on the anterior nasal obstruction (inferior turbinate hypertrophy). Supplementary, among all tested allergens, house dust and cotton dust allergy showed a significant negative association with the volume of adenoid. Moreover, all types of food and perennial allergens did not show significant correlations. The results of the present study are in consistence with those of **Nuhoglu *et al***. They compared the size of adenoid in 52 children with AR and in 56 children with non-allergic rhinitis, calculating the adenoid/rhinopharynx ratio measured on the lateral radiographs. The adenoid/rhinopharynx ratio was very significantly high in the non-allergic patients. These authors suggested that there could be a cellular immune defect in allergic children, which does not cause the enlargement of adenoid. This might be explained with the hypothesis that allergic patients have a Th2 polarization and consequently, a deficiency in T-helper 1 cell activity and interferon production **(23).** Similarly, with our results, the most common sensitivity in patients with AH was to house dust mite. On the other hand, house dust sensitivity was significantly less frequent compared to children without AH **(24)**. Furthermore, **Modrzynski and Zawisza** compared skin prick test sensitivities of patients with and without AH and found that pollen and mold sensitivities were more common in the group of patients with AH. This study evaluated sensitivities to other allergens in patients with house dust mite sensitivity**(16).** Airborne allergens may overstimulate the immune system at the adenoidal level. In fact, it was shown that adenoids were involved in IgE-mediated sensitization with local differentiation of IgE-producing plasma cells constituting a probable source of mucosal B cells for the upper airways**(25)**. Moreover, allergic subjects have a different distribution of mast cells, the main effective cell in allergic inflammation, into tonsillar tissue in comparison with normal subjects so mast cells in the inter follicular area might be promptly activated by direct contact with CD4_ T cells**(26)**. Children with AH were characterized by impaired immunologic parameters, persisting also after adenoidectomy for a long time**(27)**.The results of the present study would seem to show that large turbinates rarely are associated with large adenoid as well as large adenoid rarely is associated with

allergy. A possible interpretation might be that severe anterior nasal obstruction, mainly caused by allergy, affects the passage of allergens able to stimulate adenoid tissue to enlarge. Also, infections may play a more important role in the absence of allergy.on the other hand, **Modrzynski and Zawisza** conducted a study comparing two separate groups: the study group consisted of 436 children (4–9 years) with AR and/or asthma and/or atopic dermatitis and sensitization to house dust mites, and the control group consisted of 229 non-atopic children. The probability of AH was statistically more significant only in children with AR [(16)]. Furthermore, **Kjellman *et al.*** notified that family history of atopy in 276 children (1-16 years old) undergoing adenoidectomy [(17)].These results were explained based on ‘‘as the child’s immune system develops between the 1st and 4th year of life, those with an atopic predisposition begin to express allergic disease in response to allergen exposure, resulting in symptoms [(18)]. **Almqvist *et al.*** observed that the presence of eczema, but not asthma or rhinitis, was an independent predictor of the onset of sensitization by age 5 years [(19)]. on the other hand, two other studies conducted by **Gerber *et al***. and **Raphael *et al***. reported that allergy was more frequent in children with AH, but the differences observed were fairly insignificant[(2o,21)]. In spite of our study reported that negative correlation between allergy and adenoid size, **Modrzynski *et al.*** reported that the size of adenoid was markedly larger in AR group compared to control group[(16)]. This controversy may be elucidated as our study evaluated children with mean age of 6.7 years and standard deviation of 2.6 years whilst the volume of the adenoid increases with age, and reaches maximal volume in the age group of 5–6 years, followed by a gradual decrease in volume by the age of 8–9 years[(22)].

Limitations of our study

The main limitation of the present study is the absence of immunologic parameters useful to better understand the meaning of the data. Therefore, further immunologic studies should be performed to address this issue. Another issue to be considered could be the evaluation of tonsil hypertrophy and the possible impact of AH on tonsil volume. Further randomized studies assess with larger sample size assess other confounders are needed.

In conclusion

This study showed that large adenoid may be associated with absence of allergy, whereas large turbinates may be associated with small adenoid. These finding may be helpful in clinical management of a child with nasal obstruction, so a detailed evaluation of the nose and nasopharynx is mandatory in each child with this complaint and it should be performed by nasal endoscopy. Consequently, the treatment should be geared toward the specific findings in that individual.

References

1. **Dores GM, Huycke MM, Devesa SS *et al.* (2010):** Primary cutaneous adenoid cystic carcinoma in the United States: incidence, survival and associated cancers, 1976 to 2005. Journal of the American Academy of Dermatology, 63:71-78.
2. **Licameli G, Lawton M, Kenna M *et al.* (2012):** Long-term surgical outcomes of adenotonsillectomy for PFAPA syndrome. Archives of Otolaryngology Head and Neck Surgery, 138:902-906.
3. **Adegbiji WA, Olajide GT, Olajuyin AO *et al.* (2018):** Pattern of allergic rhinitis among children in Ekiti, Nigeria. Int. J. Pediatr. Otorhinolaryngol, 106:75-79.
4. **Bozkurt G, Dizdar SK, Korkut AY *et al.* (2015):** Adenoid vegetation in children with allergic rhinitis. Turkish Archives of Otorhinolaryngology, 53:168-172.
5. **Cho KS, Kim SH, Hong SL *et al.* (2018):** Local atopy in childhood adenotonsillar hypertrophy. Am. J. Rhinol. Allergy, 32:160-166.
6. **Cingi C, Gevaert P, Mosges R *et al.* (2017):** Multi-morbidities of allergic rhinitis in adults: European Academy of Allergy and Clinical Immunology Task Force Report. Clinical and Translational Allergy, 7:17-25.
7. **Di Francesco RC and Alvarez J (2016):** Allergic rhinitis affects the duration of rapid eye movement sleep in children with sleep-disordered breathing without sleep apnea.

International Forum of Allergy & Rhinology, 6:465-471.

8. **Colavita L, Miraglia Del Giudice M, Stroscio G *et al.* (2015):** Allergic rhinitis and adenoid hypertrophy in children: is adenoidectomy always really useful? Journal of Biological Regulators and Homeostatic Agents, 29:58-63.
9. **Dogru M, Evcimik MF and Calim OF. (2017):** Does adenoid hypertrophy affect disease severity in children with allergic rhinitis?. Head and Neck Surgery, 274:209-213.
10. **Lou Z (2018):** Adenoid hypertrophy in children and allergic rhinitis. Head and Neck Surgery, 275:831-832.
11. **Evcimik MF, Dogru M, Cirik AA *et al.* (2015):** Adenoid hypertrophy in children with allergic disease and influential factors. Int. J. Pediatr. Otorhinolaryngol., 79:694-697.
12. **Pagella F, De Amici M, Pusateri A *et al.* (2015):** Adenoids and clinical symptoms: Epidemiology of a cohort of 795 pediatric patients. Int. J. Pediatr. Otorhinolaryngol., 79:2137-2141.
13. **Warman M, Granot E and Halperin D. (2015):** Improvement in allergic and nonallergic rhinitis: A secondary benefit of adenoidectomy in children. Ear Nose and Throat Journal, 94(22):224-227.
14. **Di Berardino F and Romagnoli M (2011):** Adenoidal hypertrophy and allergic rhinitis. Pediatric Allergy and Immunology, 22:646-646.
15. **Ameli F, Brocchetti F, Tosca MA *et al.* (2013):** Adenoidal hypertrophy and allergic rhinitis: is there an inverse relationship? American Journal of Rhinology and Allergy, 27:5-10.
16. **Modrzynski M and Zawisza E (2007):** An analysis of the incidence of adenoid hypertrophy in allergic children. International Journal of Pediatric Otorhinolaryngology, 71:713-719.
17. **Kjellman NI, Synnerstad B and Hansson L (1976):** Atopic allergy and immunoglobulins in children with adenoids and recurrent otitis media. Acta Pædiatrica, 65:593-600.
18. **Sih T and Mion O (2010):** Allergic rhinitis in the child and associated comorbidities. Pediatric Allergy and Immunology, 21: 107-113.
19. **Almqvist C, Li Q, Britton W *et al.* (2007):** Early predictors for developing allergic disease and asthma: examining separate steps in the 'allergic march'. Clinical and Experimental Allergy, 37: 1296-1302.
20. **Gerber VK (1966):** The importance of allergy in hypertrophy of the nasopharyngeal tonsil. Vestnik. Otorinolaringologii, 28:52-56.
21. **Raphael G and Kaliner M (1987):** Allergy and the pharyngeal lymphoid tissues. Otolaryngologic Clinics of North America, 20:295-304.
22. **Akcay A, Kara CO, Dagdeviren E *et al.* (2006):** Variation in tonsil size in 4- to 17-year-old schoolchildren. Journal of Otolaryngology, 35:6-12.
23. **Nuhoglu C, Nuhoglu Y, Bankaoglu M *et al.* (2010):** A retrospective analysis of adenoidal size in children with allergic rhinitis and nonallergic idiopathic rhinitis. Asian Pacific Journal of Allergy and Immunology, 28:13143.
24. **Evcimik MF, Dogru M, Cirik AA *et al.* (2015):** Adenoid hypertrophy in children with allergic disease and influential factors. International Journal of Pediatric Otorhinolaryngology, 79:694-697.
25. **Papatziamos G, Van Hage-Hamsten M, Lundahl J *et al.* (2006):** IgE-positive plasma cells are present in adenoids of atopic children. Acta. Oto-Laryngologica, 126:180-185.
26. **Yokoi H, Okayama Y, Niyonsaba F *et al.* (2006):** Comparison of human tonsillar mast cell localization and ultrastructural observations between IgE-mediated allergic and nonallergic donors. Allergy Asthma Proc., 27(5):415-21.
27. **Zielnik-Jurkiewicz B and Jurkiewicz D (2002):** Implication of immunological abnormalities after adenotonsillotomy. International Journal of Pediatric Otorhinolaryngology, 64:127-132.