



Epidemiological Features, Clinical Manifestations, Diagnostic Approach and Quality of Life of Pediatric Patients with Allergic Rhinitis: A Narrative Study in a Children Hospital

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Abstract

Introduction: Allergic rhinitis affects a significant proportion of the population. This study aimed at determining the prevalence, sociodemographic features, clinical manifestations, diagnostic approach, comorbid illnesses, complications and quality of life in children referred to the outpatient clinic of "Allergic Rhinitis" in Penteli Children Hospital, Athens, Greece.

Patients and Methods: We analyzed 469 pediatric patients referred to the outpatient clinic of "Allergic Rhinitis" in Penteli Children Hospital, Athens, Greece from 26/01/2012 to 20/11/2020. The diagnostic procedure included the same questionnaire used at the time of diagnosis, endoscopy with rigid fiberoptic endoscope 2 mm, 7 mm, 0° and 30° field of view, Skin Prick Test, measurement of total blood serum IgE levels and eosinophils from nasal secretions and Radioallergosorbent Test (RAST), a blood test using radioimmunoassay test to detect serum specific IgE antibodies, to determine the substances a child is allergic to in some only non-diagnostic cases.

Results: A total of 469 pediatric patients were examined of which 337 were children diagnosed with allergic rhinitis. Children with allergic rhinitis represented 72% of all examined pediatric patients.

Allergic rhinitis was recorded as the one and only allergic disease in 59% of the children diagnosed with allergic rhinitis, concomitant asthma in 16% of them; atopic dermatitis in 8% and allergic conjunctivitis in 5%. Chronic urticaria was documented in 12% of the children diagnosed with allergic rhinitis.

There were 60% males and 40% female among the children with allergic rhinitis with male to female ratio of approximately 3:2.

Allergic rhinitis affected all pediatric age group and was peaked at the age group 11 to 14 years and 5 to 7 years accounted for 35% and 32% respectively.

There was positive family history of allergy in 54% of children with allergic rhinitis.

A total of 68% children with allergic rhinitis were living in urban setting while 32% of them were from rural setting. We received equal randomized samples from each group of children (urban group and rural group) in order to measure the real prevalence of allergic rhinitis in each group. The prevalence of urban population was 15%, with the prevalence of rural population was 11%, and the difference wasn't statistically significant between urban and rural residents.

Perennial allergic rhinitis was recorded in 64% of children with allergic rhinitis while seasonal allergic rhinitis was recorded in 36%.

Skin tests were important diagnostic tools, not being necessary the measurement of total IgE in plasma. Total blood serum IgE were measured in cases of non-diagnostic/negative skin test. Immunotherapy was effective in 100% of the patients.

The most frequent aeroallergen sensitization that resulted in positive skin prick test was trees; Plantain, Arizona cypress, Olive Tree 50% followed by Grass Mixture 32%, mites; Dermatophagoides Farina, *Acarus siro* 31%; Dermatophagoides pteronyssinus 33%; other grass pollen, weeds and flowers; Bermuda grass 23%; Timothy grass 15%; Cereal Mixture 15%; Pellitory 8%; *Parietaria*

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sp. 6%; Mugwort 5%; Goosefoot 5%; Rye 2%; fungi's (molds); *Penicillium notatum* 4%; *Candida albicans* 2%; *Cladosporium herbarum* 1%; *Alternaria alternata* 1% and Animal Dander (cat 12%; dog 8%).

Measurement of total blood serum IgE levels, eosinophils from nasal secretions and Radioallergosorbent Test (RAST) were performed in cases of non-diagnostic/or negative Skin Test (in 32% of the examined children). Total blood serum IgE levels were increased in 29% of the children with non-diagnostic or negative Skin test. Eosinophils from nasal secretions were increased in 22% of the children with non diagnostic or negative Skin test and thus in these cases the diagnosis was local allergic rhinitis. Radioallergosorbent Test (RAST) was diagnostic to the specific allergens a child is allergic to in 36% of the children with non diagnostic or negative Skin test.

In 59% of children with chronic urticaria demonstrated positive skin prick test to common aeroallergens.

Clinical presentations of allergic rhinitis in this study were mainly 78% nasal blockage, 67% runny nose, 15% recurrent sneezing and 14% nasal itching.

The most common complication was acute or chronic sinusitis 35%. Other common complications of allergic rhinitis were otitis media or Eustachian tube dysfunction 33%, 16% asthma, 10% sleep disturbance or apnea and 6% dental problems.

Major associated comorbid illnesses among the children were tonsils hypertrophy, adenoid hypertrophy and inferior turbinate hypertrophy which accounted for 58%, 49% and 52% respectively.

54% of asthmatic children were diagnosed allergic rhinitis, while 16% of allergic rhinitis children were diagnosed asthma.

The Odds Ratio (OR) for the Factor Structure of the Strengths' and Difficulties (SDQ) questionnaire was 1, 15.

The Odds Ratio (OR) for the Pittsburg Sleep Quality Index (PSQI) questionnaire was 6.

Treatment of allergic rhinitis leads to improvement on the clinical features in 91% patients. No significant improvements in clinical features were noticed in 9% patients. None of the studied patients reported worse clinical condition after treatment of allergic rhinitis. No mortality was recorded from allergic rhinitis in our study.

Conclusion: Allergic rhinitis was reported in 72% of studied children and was frequently characterized by significant morbidity. Allergic rhinitis affected all pediatric age group and was peaked at age group 11 to 14 years and 5 to 7 years. There were associated epidemiological features, clinical manifestations, comorbid illnesses, complications and affectation of the quality of life in children.

Early referral is highly recommended to the specialist to avoid further complications. Further studies on the general population should be carried out in order to understand the pathophysiologic mechanisms of allergic rhinitis more comprehensively.

Keywords: Allergens; Allergic rhinitis; Epidemiology; Narrative study

Introduction

Allergic rhinitis affects a significant proportion of the European population. Currently, allergic rhinitis affects approximately 40% of children [1]. In childhood, allergic rhinitis is more common in boys than in girls.

While allergic rhinitis itself is not life-threatening (unless accompanied by severe asthma or anaphylaxis), morbidity from the condition is significant. Allergic rhinitis often coexists with other disorders, such as asthma [2-4].

Allergic rhinitis is also associated with asthma, otitis media or Eustachian tube dysfunction, acute or chronic sinusitis, nasal polyps, allergic conjunctivitis, and atopic dermatitis [5,6]. It may also contribute to learning difficulties, sleep disorders, and fatigue [7-9].

A detailed history is important in the evaluation of allergic

rhinitis.

This study aimed at determining the prevalence, sociodemographic features, comorbid illnesses, complications and quality of life in children referred to the outpatient clinic of "Allergic Rhinitis" in Penteli Children Hospital, Athens, Greece.

Patients and Methods

A cross-sectional retrospective study recruited 469 pediatric patients referred to the outpatient clinic of "Allergic Rhinitis" in Penteli Children Hospital, Athens, Greece over 9-year periods between 26/01/2012 and 20/11/2020.

Children who had allergic symptoms or urticaria underwent skin prick test to the common aeroallergens.

Initially, endoscopy with rigid fiberoptic endoscope 2 mm, 7 mm, 0° and 30° field of view was performed in all patients, in order

to exclude any pathology from nasal and paranasal cavities such as adenoid hypertrophy, inferior turbinate hypertrophy, nasal polyps and/or nasal septum deviation.

We reviewed the medical records and database of result of the skin prick test in all participants and the diagnosis of allergic rhinitis were confirmed by allergist, pulmonologist, and otolaryngologist. Demographic data including sex, age, atopic diseases, and the result of skin prick test to common aeroallergens were collected. The skin prick test included 21 aeroallergens (Plantain, *Arizona cypress*, Olive Tree, Timothy grass, Bermuda grass, Grass Mixture, Goosefoot, Pellitory, Mugwort, Cereal Mixture, Rye, *Parietaria* sp, *Penicillium notatum*, *Candida albicans*, *Cladosporium herbarum*, *Alternaria alternata*, Dermatophagoides pteronyssinus, Dermatophagoides farinae, *Acarus siro*, Dog, Cat). Histamine and normal saline were applied as positive (4+) and negative control (0). Between them is formed the scale 1+, 2+, 3+. All testing was performed by 2 investigators.

Measures and data

Questionnaires: The first questionnaire was based on the ECRHS II main questionnaire and included questions concerning the visit cause, symptoms that could be attributed to allergic reactions, triggering factors causing the symptoms and the characteristics of the reactions (season, place, etc.). All children were asked about nasal symptoms (sneezing, itchy nose, blocked or runny nose), the duration of symptoms and the association with other atopic disorders such as ocular manifestations, asthma, etc. Patients were also asked about their medical history, atopic family history and demographic details.

The second questionnaires were the Factor Structure of the Strengths' and Difficulties (SDQ) (Figure 7) and the Pittsburg Sleep Quality Index (PSQI) (Figure 8).

The Factor Structure of the Strengths' and Difficulties (SDQ) questionnaire is short and easy to use for early control of emotional and behavioral problems in children. It is an indicator of which patients will need further evaluation and intervention from an expert. It detects emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behavior, impact and total difficulties.

The Pittsburg Sleep Quality Index (PSQI) questionnaire is a standard sleep quality self-assessment questionnaire during the previous month. It studies seven clinically distinct subcategories of sleep difficulties, which are the subjective quality of sleep, sleep delay, the duration of sleep, sleep efficiency, sleep disorders, the use of hypnotics and the daily dysfunction.

In order to evaluate sleep and behavioral disorders in our children with allergic rhinitis, the parents of children who belonged to the age group 4 to 16 years old and who were diagnosed with allergic rhinitis completed the above two questionnaires. The study included two groups. The first group was 40 children diagnosed with allergic rhinitis and the second group was the control group (40 children).

In vivo tests: Skin Prick Test (SPT) was performed on the flexor surface of the forearm. A sample of various 21 inhalant allergens grass (Plantain, *Arizona cypress*, Olive Tree, Timothy grass, Bermuda grass, Grass Mixture, Goosefoot, Pellitory, Mugwort, Cereal Mixture, Rye, *Parietaria* sp., *Penicillium notatum*, *Candida albicans*, *Cladosporium herbarum*, *Alternaria alternata*, Dermatophagoides pteronyssinus, Dermatophagoides farinae, *Acarus siro*, Dog, Cat) were tested. The skin reaction of histamine is considered as criterion of positivity and is graded 4+, while the skin reaction of negative control or no reaction

is considered as negative and is graded 0. Between them is formed the scale 1+, 2+, 3+. Positive histamine and negative (saline) controls were used and results were measured after 30 min. An erythema less than 20 mm in diameter was defined as a positive (1+) SPT result. A wheal less than 3 mm in diameter accompanied by erythema greater than 10mm in diameter was defined as a positive (2+) SPT result. A wheal without pseudopods greater than 3 mm in diameter accompanied by erythema greater than 10 mm in diameter was defined as a positive (3+) SPT result. A wheal with pseudopods accompanied by erythema was defined as a positive (4+) SPT result.

In vitro tests: The blood serum was analyzed for total IgE concentration and eosinophils from nasal secretions were measured in some cases of non-diagnostic/or negative skin tests.

The presence of serum specific IgE antibodies (sIgE) (Pharmacia[®]-Immuno CAP system, Phadia, Uppsala, Sweden) to allergens and measurement of eosinophils from nasal secretions were performed in only few cases of non-diagnostic/or negative skin tests. Radioallergosorbent Test (RAST) is a blood test using radioimmunoassay test to detect serum specific IgE antibodies, to determine the substances a child is allergic to. The procedure is perplexible with less sensitivity and more false negative results than SKIN test. As far as sIgE detection is concerned, a positive result to each allergen was defined only if the concentration of antibodies was higher than 0.35 kU/ml. The available allergens for sIgE were the same with SPT.

Diagnosis of allergic asthma and conjunctivitis was also confirmed by means of medical history, SPT and/or sIgE. Furthermore, asthmatic patients were evaluated with spirometry and direct airway challenge with inhaled methacholine.

Statistical analysis of the results was performed.

Results

A total of 469 pediatric patients were examined of which 337 were children diagnosed with allergic rhinitis. Children with allergic rhinitis represented 72% of all examined pediatric patients. This is a large number and is justified by the fact that all children referred to the outpatient clinic of "Allergic Rhinitis" are initially examined in the outpatient clinic of Otorhinolaryngology in our hospital.

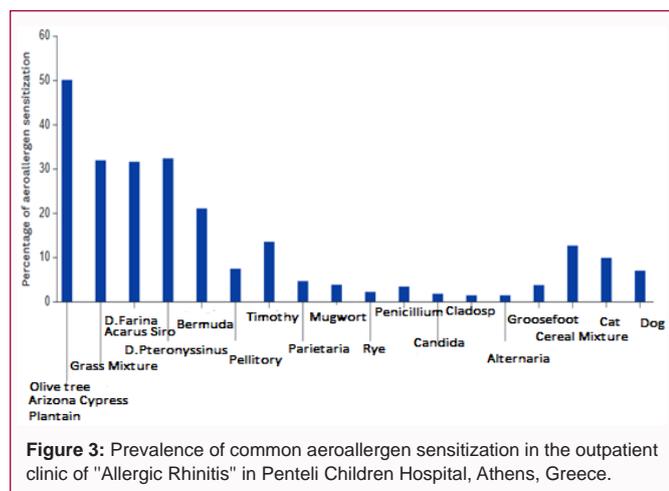
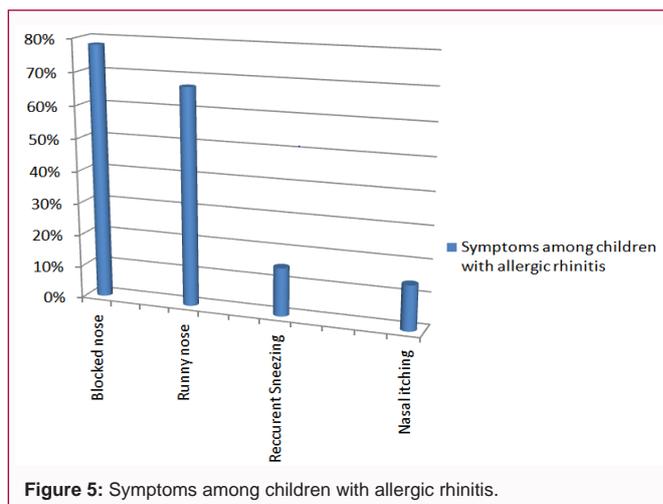
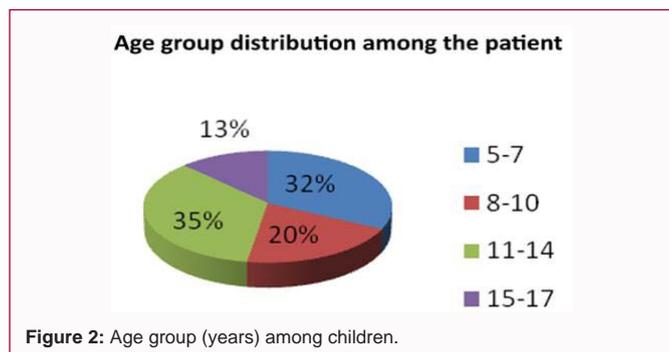
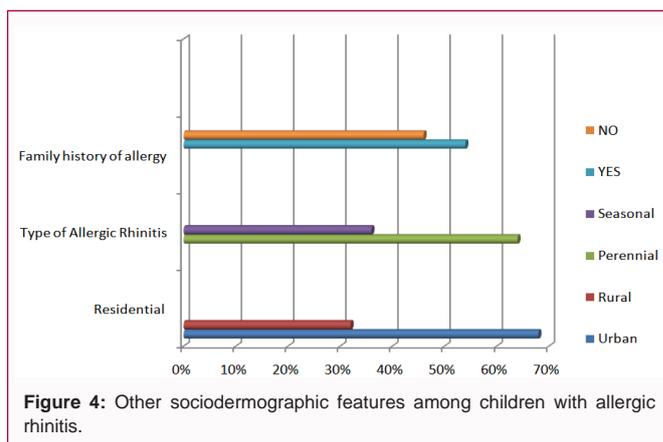
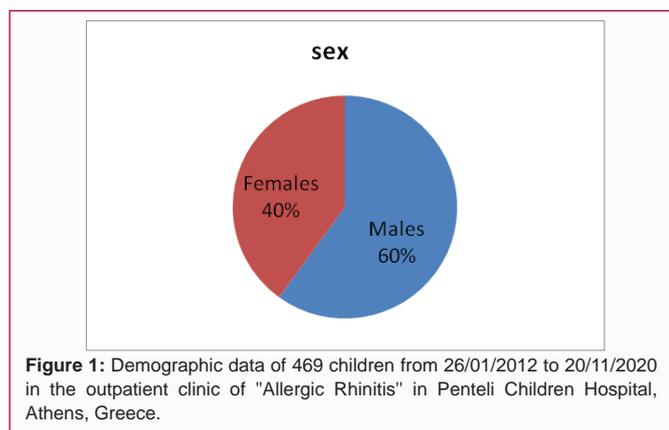
Allergic rhinitis was recorded as the one and only allergic disease in 59% of the children diagnosed with allergic rhinitis, concomitant asthma in 16% of them; atopic dermatitis in 8% and allergic conjunctivitis in 5%. Chronic urticaria was documented in 12% of the children diagnosed with allergic rhinitis.

There were 60% males and 40% female among the children with allergic rhinitis with male to female ratio of approximately 3:2 (Figure 1).

Allergic rhinitis affected all pediatric age group and was peaked at the age group 11 to 14 years and 5 to 7 years accounted for 35% and 32% respectively (Figure 2).

There was positive family history of allergy in 54% of children with allergic rhinitis (Figure 4).

A total of 68% of children with allergic rhinitis were living in urban setting while 32% of them were from rural setting (Figure 4). We received equal randomized samples from each group of children (urban group and rural group) in order to measure the real



prevalence of allergic rhinitis in each group. The prevalence of urban population was 15%, with the prevalence of rural population 11%, and the difference wasn't statistically significant between urban and rural residents (P value <0.05).

Perennial allergic rhinitis was recorded in 64% of children with allergic rhinitis, while seasonal allergic rhinitis was recorded in 36% (Figure 4).

Skin tests were important diagnostic tools, not being necessary the measurement of total IgE in plasma. Total IgE in plasma were measured in cases of non-diagnostic/negative skin test. Immunotherapy was effective in 100% of the patients.

Immunotherapy, daily use of per-os sublingual sol sublivac FL x 24 ML for 3 years continuously for 3 years continuously, was performed in 10% of the patients and was effective in 100% of them.

Contraindication for immunotherapy is the use of beta-adrenergic blockers and the history of autoimmune diseases.

The most frequent aeroallergen sensitization that resulted in positive skin prick test was trees; Plantain, Arizona Cypress, Olive Tree 50% followed by Grass Mixture 32%, mites; Dermatophagoides Farina, *Acarus siro* 31%; Dermatophagoides Pteronyssinus 33%; other grass pollen, weeds and flowers; Bermuda grass 23%; Timothy grass 15%; Cereal Mixture 15%; Pellitory 8%; *Parietaria* sp.6%; Mugwort 5%; Groosefoot 5%; Rye 2%; fungi's (molds); *Penicillium notatum* 4%; *Candida albicans* 2%; *Cladosporium herbarum* 1%; *Alternaria alternata* 1% and animal dander (cat 12 %; dog 8%) (Figure 3).

Measurement of total blood serum IgE levels, eosinophils from nasal secretions and Radioallergosorbent Test (RAST) were performed in cases of non-diagnostic/or negative skin test (in 32% of the examined children).

Total blood serum IgE levels were increased in 29% of the children with non diagnostic or negative skin test. Eosinophils from nasal secretions were increased in 22% of the children with non diagnostic or negative skin test and thus in these cases the diagnosis was local allergic rhinitis. Radioallergosorbent Test (RAST) was diagnostic to the specific allergens a child is allergic to in 36% of the children with non diagnostic or negative Skin test.

In 59% of children with chronic urticaria demonstrated positive skin prick test to common aeroallergens.

Clinical presentations of allergic rhinitis in this study were mainly

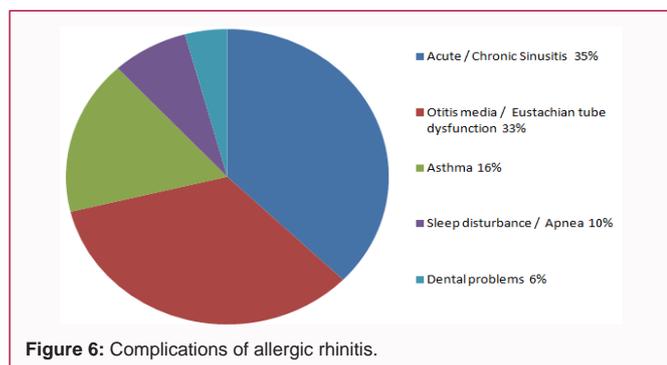
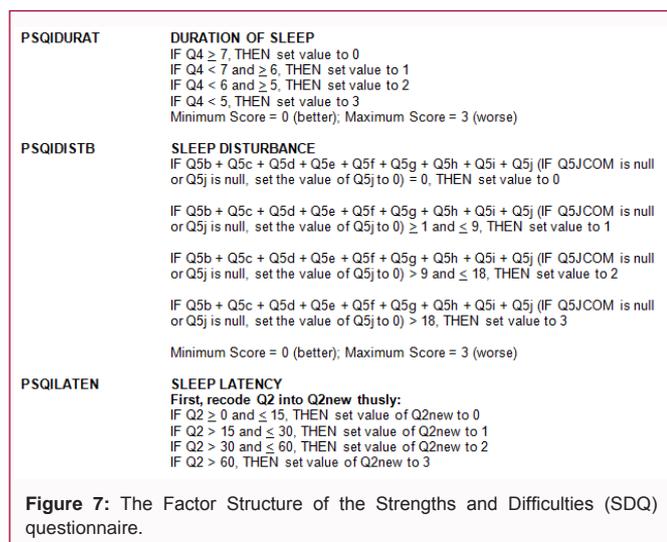


Figure 6: Complications of allergic rhinitis.



78% nasal blockage, 67% runny nose, 15% recurrent sneezing and 14% nasal itching (Figure 5).

The most common complication was acute or chronic sinusitis 35%. Other common complications of allergic rhinitis were otitis media or Eustachian tube dysfunction 33%, 16% asthma, 10% sleep disturbance or apnea and 6% dental problems (Figure 6).

Major associated comorbid illnesses among the patients were tonsils hypertrophy, adenoid hypertrophy and inferior turbinate hypertrophy which accounted for 58%, 49% and 52% respectively.

54% of asthmatic children was diagnosed allergic rhinitis, while 16% of allergic rhinitis patients was diagnosed asthma.

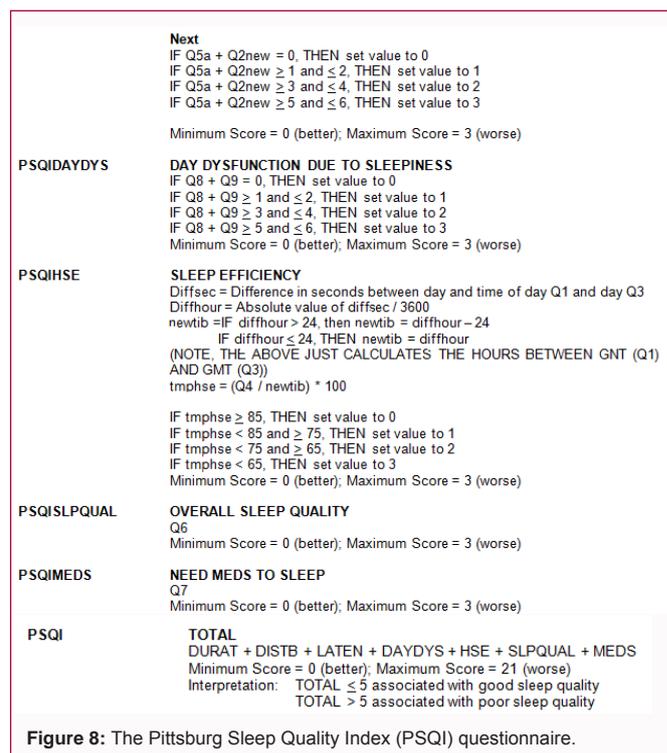
The Odds Ratio (OR) for the Factor Structure of the Strengths' and Difficulties (SDQ) questionnaire was 1, 15.

The Odds Ratio (OR) for the Pittsburgh Sleep Quality Index (PSQI) questionnaire was 6.

Treatment of allergic rhinitis leads to improvement on the clinical features in 91% patients. No significant improvement in clinical features was noticed in 9% patients. None of the studied patients reported worse clinical condition after treatment of allergic rhinitis. No mortality was recorded from allergic rhinitis in our study.

Discussion

Allergic rhinitis in children is still a global healthy problem with little or no recognition. In most cases children allergic rhinitis is commonly under diagnosed because the symptoms are frequently



attributed to a viral or recurrent flu. As a result of this most parents do not seek medical intervention.

A thorough history may help to identify specific triggering factors, suggesting an etiology for the allergic rhinitis.

Except history, laboratory tests are a useful in the diagnosis of allergic rhinitis. They include the following: Allergy skin prick tests (immediate hypersensitivity testing), which is an *in vivo* method of determining immediate (IgE-mediated) hypersensitivity to specific allergens and total serum IgE (neither sensitive nor specific for allergic rhinitis, but the results can be helpful in some cases when combined with other factors).

The causes of allergic rhinitis may differ depending on whether the symptoms are seasonal, perennial, or sporadic/episodic. Some patients are sensitive to multiple allergens and can have perennial allergic rhinitis with seasonal exacerbations.

They include the following:

Pollens (tree, grass, and weed), outdoor molds (for example, *Alternaria*, *Cladosporium*, *Aspergillus*, and *Penicillium*, which are prevalent in the dry and windy climates.

Two major house dust mite species are associated with allergic rhinitis. These are *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* and can be found in carpets, upholstered furniture, pillows and mattresses.

Allergy to indoor pets, such as cat and dogs are a common cause of perennial allergic rhinitis.

Although mortality of allergic rhinitis is rare, morbidity is significant, because of its complications, which include: Asthma, acute or chronic sinusitis, otitis media or Eustachian tube dysfunction, sleep disturbance or apnea and dental problems (overbite).

Table 1: Scoring symptom scores on the SDQ for 4 years to 17 years old.

	Not True	Somewhat True	Certainly True
Emotional problems scale			
Often complains of headaches... (I get a lot of headaches...)	0	1	2
Many worries... (I worry a lot)	0	1	2
Often unhappy, downhearted... (I am often unhappy...)	0	1	2
Nervous or clingy in new situations... (I am nervous in new situations...)	0	1	2
Many fears, easily scared (I have many fears...)	0	1	2
Conduct problems scale			
Often has temper tantrums or hot tempers (I get very angry)	0	1	2
Generally obedient... (I usually do as I am told)	2	1	0
Often fights with other children... (I fight a lot)	0	1	2
Often lies or cheats (I am often accused of lying or cheating)	0	1	2
Steals from home, school or elsewhere (I take things that are not mine)	0	1	2
Hyperactivity scale			
Restless, overactive... (I am restless...)	0	1	2
Constantly fidgeting or squirming (I am constantly fidgeting...)	0	1	2
Easily distracted, concentration wanders (I am easily distracted)	0	1	2
Thinks things out before acting (I think before I do things)	2	1	0
Sees tasks through to the end... (I finish the work I am doing)	2	1	0
Peer problems scale			
Rather solitary, tends to play alone (I am usually on my own)	0	1	2
Has at least one good friend (I have one good friend or more)	2	1	0
Generally liked by own children (Other people my age generally like me)	2	1	0
Picked on or bullied... (Other children or young people pick on me)	0	1	2
Gets on better with adults than with other children (I get on better with adults than with people my age)	0	1	2
Prosocial scale			
Considerate of other people's feelings (I try to be nice to other people)	0	1	2
Shares ready with other children... (I usually shares with others)	0	1	2
Helpful if someone is hurt... (I am helpful if someone is hurt...)	0	1	2
Kind to younger children (I am kind to younger children)	0	1	2
Often volunteers to help others... (I often volunteer to help others)	0	1	2

The management of allergic rhinitis consists of the following:

Environmental allergen avoidance, pharmacologic management (oral antihistamines, decongestants, or both and an intranasal steroid spray for patients with chronic symptoms). Immunotherapy may be considered more strongly with severe disease, poor response to pharmacotherapy and environmental control, and the presence of comorbid conditions or/and complications.

Prevalence of allergic rhinitis in children in this study was high, similar to prevalence rate in other previous studies [10-12].

The prevalence of allergic rhinitis that is recorded in children world widely is low. A majority of parents and children underestimate this condition. Thus, they are treated occasionally by their family pediatrician for upper respiratory tract infection. Moreover, many parents do not seek medical intervention.

In this study male preponderance was observed with male to female ratio of approximately 3:2, which is in agreement with other study [13]. This however differs from other studies with female or

equal sex preponderance [14,15].

In this study allergic rhinitis was peaked at the age group 11 to 14 years and 5 to 7 years accounted for 35% and 32% respectively; however majority of the pediatric patients in previous studies were preschool children [16,17]. This may be due to increased number of associated comorbid illnesses such as adenoid with tonsillar hypertrophy of allergic rhinitis at this age group which prompted parent to attend a specialist. Allergic rhinitis is also associated with severe symptoms which are exacerbated by acute viral infections forcing parents to seek specialist medical cares.

Many children in this study had family history of allergy. Similar findings were noted in previous study [18].

Blocked nose showed significant association with adenoid hypertrophy in children in this study. In our study, high percentage of children had rhinorrhea, nasal blockage, recurrent sneezing and nasal itching and these findings are similar to other studies on allergic rhinitis [19,20].

Table 2: Scoring the SDQ impact supplement.

	Not at all	Only a little	A medium amount	A great deal
Parent report:				
Difficulties upset or distress child	0	0	1	2
Interfere with HOME LIFE	0	0	1	2
Interfere with FRIENDSHIPS	0	0	1	2
Interfere with CLASSROOM LEARNING	0	0	1	2
Interfere with LEISURE ACTIVITIES	0	0	1	2
Teacher report:				
Difficulties upset or distress child	0	0	1	2
Interfere with PEER RELATIONS	0	0	1	2
Interfere with CLASSROOM LEARNING	0	0	1	2
Self to report:				
Difficulties upset or distress child	0	0	1	2
Interfere with HOME LIFE	0	0	1	2
Interfere with FRIENDSHIPS	0	0	1	2
Interfere with CLASSROOM LEARNING	0	0	1	2
Interfere with LEISURE ACTIVITIES	0	0	1	2

Table 3: Categorising SDQ scores for 4 to 17 years old.

	Original three to band categorisation			Newer four to band categorisation			
	Normal	Borderline	Abnormal	Close to average	Slightly raised ('slightly bowered)	High (/Low)	Very high (very low)
Parent completed SDQ							
Total difficulties score	0 to 13	14 to 16	17 to 40	0 to 13	14 to 16	17 to 19	20 to 40
Emotional problems score	0 to 3	4	5 to 10	0 to 3	4	5 to 6	7 to 10
Conduct problems score	0 to 2	3	4 to 10	0 to 2	3	4 to 5	6 to 10
Hyperactivity score	0 to 5	6	7 to 10	0 to 5	6 to 7	8	9 to 10
Peer problems score	0 to 2	3	4 to 10	0 to 2	3	4	5 to 10
Prosocial score	6 to 10	5	0 to 4	8 to 10	7	6	0 to 5
Impact score	0	1	2 to 10	0	1	2	3 to 10
Teacher completed SDQ							
Total difficulties score	0 to 11	12 to 15	16 to 40	0 to 11	12 to 15	16 to 18	19 to 40
Emotional problems score	0 to 4	5	6 to 10	0 to 3	4	5	6 to 10
Conduct problems score	0 to 2	3	4 to 10	0 to 2	3	4	5 to 10
Hyperactivity score	0 to 5	6	7 to 10	0 to 5	6 to 7	8	9 to 10
Peer problems score	0 to 3	4	5 to 10	0 to 2	3 to 4	5	6 to 10
Prosocial score	6 to 10	5	0 to 4	6 to 10	5	4	0 to 3
Impact score	0	1	2 to 10	0	1	2	3 to 10
Self completed SDQ							
Total difficulties score	0 to 15	16 to 19	20 to 40	0 to 14	15 to 17	18 to 19	20 to 40
Emotional problems score	0 to 5	6	7 to 10	0 to 4	5	6	7 to 10
Conduct problems score	0 to 3	4	5 to 10	0 to 3	4	5	6 to 10
Hyperactivity score	0 to 5	6	7 to 10	0 to 5	6	7	8 to 10
Peer problems score	0 to 3	4 to 5	6 to 10	0 to 2	3	4	5 to 10
Prosocial score	6 to 10	5	0 to 4	7 to 10	6	5	0 to 4
Impact score	0	1	2 to 10	0	1	2	3 to 10

Consequently morbidity was affected many of our children. Qualities of life that were often affected include impaired social life, sleep disturbances, daytime sleepiness and irritability, as described in

the literature till date [20].

The most frequent aeroallergen sensitization that resulted in positive skin prick test was trees; Plantain, Arizona Cypress, Olive

Table 4: Results of the Factor Structure of the Strengths and Difficulties (SDQ) questionnaire.

	Allergic Rhinitis group	Control group
Index of overall difficulties within normal values (<14)	31	32
Index of overall difficulties except normal values (≥ 14)	9	8
Total	40	40

The Odds Ratio (OR) for SDQ questionnaire: 1, 15

Table 5: Results of the Pittsburg Sleep Quality Index (PSQI) questionnaire.

	Allergic Rhinitis group	Control group
PSQI<5	24	36
PSQI ≥ 5	16	4
Total	40	40

The Odds Ratio (OR) for PSQI questionnaire: 6

Tree 50% followed by Grass Mixture 32%, mites; Dermatophagoides Farina, *Acarus siro* 31%; Dermatophagoides Pteronyssinus 33%; other grass pollen, weeds and flowers; Bermuda grass 23%; Timothy grass 15%; Cereal Mixture 15%; Pellitory 8%; *Parietaria* sp.6%; Mugwort 5%; Goosefoot 5%; Rye 2%; fungi's (molds); *Penicillium notatum* 4%; *Candida albicans* 2%; *Cladosporium herbarum* 1%; *Alternaria alternata* 1% and animal dander (cat 12%; dog 8%).

Trees followed by mixed grasses and mites were the highest percentage of common aeroallergen sensitization. Similarly to previous study of common causative allergens among allergic rhinitis patients in Greece, mixed grasses were among the most common allergens in our country [21].

Environmental factors were responsible for increased risk of allergic rhinitis in children like dusts, fumes exhausts from vehicle, environmental tobacco smoke exposure and moulds and perfume in other studies [22-24]. In our study the above environmental factors are not related to allergic rhinitis.

This study demonstrated that 59% of children with chronic urticaria had positive skin prick test to common aeroallergens. The various previous studies also reported the positive skin prick test to aeroallergens and food allergens in patient with chronic urticaria about 27.4% to 64% [25-37].

Skin Prick Test shows 99%, 9% sensitivity and specificity in the diagnosis of each allergen. Contraindications in our study were the recent per os use of antihistamines and /or intravenous corticosteroids. Nasal corticosteroids were not prohibitive for performing the skin test. Our patients returned for examination 14 days after the treatment discontinuation of above agents.

Radioallergosorbent Test (RAST) is a blood test using radioimmunoassay test to detect the presence of serum specific IgE antibodies (sIgE) (Pharmacia[®]-Immuno CAP system, Phadia, Uppsala, Sweden) to substances and determines the allergens a child is allergic to. The procedure is perplexible with less sensitivity and more false negative results than Skin test. As far as sIgE detection is concerned, a positive result to each allergen was defined only if the concentration of antibodies was higher than 0.35 kU/ml. The available allergens for sIgE were the same with SPT.

In our study, measurement of total blood serum IgE levels, eosinophils from nasal secretions and Radioallergosorbent Test (RAST) were performed in cases of non-diagnostic/or negative Skin Test (in 32% of the examined children), as referred in the literature.

Total blood serum IgE levels were increased in 29% of the children with non diagnostic or negative skin test. Eosinophils from nasal secretions were increased in 22% of the children with non diagnostic or negative skin test and thus in these cases the diagnosis was local allergic rhinitis. Radioallergosorbent Test (RAST) was diagnostic to the specific allergens a child is allergic to in 36% of the children with non diagnostic or negative skin test.

Local Allergic Rhinitis (LAR) is a novel concept defining clinical allergic rhinitis with no evidence of systemic sensitization to aeroallergens. In this unique condition, the allergic response is confined to the nasal mucosa and can be demonstrated using different methods such as the Immunoglobulin-E (IgE) level in the nasal secretions, Nasal Provocation Test (NPT), or Basophil Activation Test (BAT) with specific allergens or more sophisticated molecular diagnostic techniques. Furthermore, local allergic rhinitis can be relieved by interventions used to treat systemic allergic conditions such as antihistamines or anti-IgE monoclonal antibodies. Last but not least, several small studies demonstrated the efficacy of allergen immunotherapy for ameliorating LAR symptoms.

The treatments of allergic rhinitis in our study were allergen avoidance, medical intervention and surgical treatment of comorbid illnesses and complications.

Allergens control requires aggressive environmental control which is effective [28]. Medical treatment included intranasal steroid and/or antihistamines and depending on the clinical features.

Surgical treatment was performed in this study in children with adenoid hypertrophy, tonsillar hypertrophy and turbinate hypertrophy. Surgical treatments are for patients with comorbid illnesses, complications and refractory to medical therapy as referred in the literature [29,30].

Other form treatments such as immunotherapy desensitization is used in our study only for a few cases (10%) with severe disease, poor response to pharmacotherapy and environmental control, and the presence of comorbid conditions or /and complications, as recommended. Immunotherapy, daily use of sublingual sol Sublivac FL \times 24 ML for 3 years continuously, was effective in all children in our study. The results of immunotherapy were evident in the first six months. Effective was the therapy if the child remained asymptomatic for six months, after the immunotherapy discontinuation. If not, reevaluation of the allergens with new Skin Prick Test was performed. The effectiveness was measured by clinical and laboratory response (decrease of total blood serum IgE levels).

In this study population, allergic rhinitis in children had significant comorbid illnesses and/or complications such as adenoid and tonsillar hypertrophy, inferior turbinate hypertrophy, allergic conjunctivitis, acute or chronic sinusitis, otitis media or Eustachian tube dysfunction, asthma, sleep disturbance or apnea and dental problems (overbite) in different percentages. Many other studies reported different percentage of associated comorbid illnesses and/or complications [31].

In our study 54% of asthmatic children were diagnosed allergic rhinitis, while 16% of allergic rhinitis children were diagnosed asthma. This result was similar to the previous study that found 55% to 75% of asthmatic patients had allergic rhinitis while 13.9% to 25% of allergic rhinitis patients had asthma [32].

The association of allergic diseases with psychological problems

and behavioral disorders in children is existing. There is stronger association with allergic rhinitis and atopic dermatitis and weaker association with asthma. The mechanisms are common to allergic diseases and to psychological and behavioral problems [33].

Allergic rhinitis is more than just a stuffy nose. It is associated with poor sleep quality and embarrassment from the sufferer (runny nose, sneezing, itching) and inability to perform as well as possible at school. They lead to bad interaction with classmates.

Medication helps them to maximize the performance and increases their productivity [34].

In order to evaluate sleep and behavioral disorders in our children with allergic rhinitis, the parents of children who belonged to the age group 4 to 16 years old and who were diagnosed with allergic rhinitis completed two questionnaires, the Factor Structure of the Strengths' and Difficulties (SDQ) (Figure 7) and the Pittsburg Sleep Quality Index (PSQI) (Figure 8). Exclusion criteria were immunotherapy, high degree of tonsil or adenoid hypertrophy, post-traumatic or congenital abnormalities of the nose, other diseases of the nose and sleep apnea of other etiology. The study included two groups. The first group was 40 children diagnosed with allergic rhinitis and the second group was the control group (40 children).

The Factor Structure of the Strengths' and Difficulties (SDQ) questionnaire is short and easy to use for early control of emotional and behavioral problems in children. It is an indicator of which patients will need further evaluation and intervention from an expert. It has been translated into 40 languages. There is an official, standard Greek translation [35]. It detects emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behavior, impact and total difficulties.

The Odds Ratio (OR) for SDQ questionnaire was 1, 15 (Table 4).

The Pittsburg Sleep Quality Index (PSQI) questionnaire is a standard sleep quality self-assessment questionnaire during the previous month. It has been translated into 52 languages [36]. There is an official, standard Greek translation [37]. It studies seven clinically distinct subcategories of sleep difficulties, which are the subjective quality of sleep, sleep delay, the duration of sleep, sleep efficiency, sleep disorders, the use of hypnotics and the daily dysfunction.

The Odds Ratio (OR) for PSQI questionnaire was 6 (Table 5).

Despite of high percentage rate of morbidity in our patients, there was no associated mortality to allergic rhinitis in children in our study.

Conclusion

Allergic rhinitis was reported in 72% of studied children and was frequently characterized by significant morbidity. Allergic rhinitis affected all pediatric age group and was peaked at the age group 11 to 14 years and 5 to 7 years. Moreover, there was delayed presentation in the participants. There were associated epidemiological features, clinical manifestations, comorbid illnesses, complications and affectation of quality of life in children. Early referral is highly recommended to the specialist to avoid further complications. Further studies on the general population should be carried out in order to understand the pathophysiologic mechanisms of allergic rhinitis more comprehensively.

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