Pediatric Rhinosinusitis: Its Predisposing Factors and Management

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Abstract

Objective: Rhinosinusitis is a prevalent disease in children that can cause many substantial physical symptoms and have a detrimental influence on their quality of life. This study aims to evaluate the predisposing factors, and management of pediatric rhinosinusitis patients.

Methods: A cross-sectional study using retrospective data from 324 pediatric rhinosinusitis patients was conducted. Demographics, predisposing factors, and management were recorded.

Results: Many of the affected patients (50.3%) were between 6 and 11 years old. The predisposing factors were allergic rhinitis (97.2%), asthma (27.2%), upper respiratory tract infection (24.4%), adenoid hypertrophy (17.9%), and gastro-oesophageal reflux disease (0.6%). A significant association was found between the age group with upper respiratory infection as a predisposing factor in pediatric rhinosinusitis (*P*-value .000). Most of our patients (99.7%) responded well to medical treatment, and 8.6% of them underwent surgical therapy, mainly adenotonsillectomy.

Conclusion: This study demonstrated that allergic rhinitis was the most established predisposing factor for pediatric rhinosinusitis, followed by asthma, upper respiratory tract infection, and adenoid hypertrophy. Medical therapy was the mainstay of treatment for pediatric rhinosinusitis patients.

Keywords: Allergic rhinitis, pediatric, predisposing factors, rhinosinusitis, upper respiratory tract infection

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INTRODUCTION

Pediatric rhinosinusitis is one of the common diseases that is multifactorial and most frequently underdiagnosed by the primary practitioner.[1,2] A European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) published in 2020 redefined rhinosinusitis in children as an inflammation of the nasal and paranasal passages characterized by 2 or more symptoms, 1 of which is either nasal blockage, obstruction, congestion or nasal discharge, facial pain or pressure, cough and reduction or loss of smell.[3] According to NICE guidelines and EPOS 2020, rhinosinusitis is classified into acute and chronic rhinosinusitis based on duration.[4-6]

The clinical manifestations of rhinosinusitis in children are difficult to recognize easily. Various studies have shown that 5%-13% of children with viral upper respiratory infections can progress into acute rhinosinusitis, with a number of these subsequently progressing into recurrent or chronic rhinosinusitis.[7-9] Children are more susceptible to serious sequelae from rhinosinusitis complications.[10] Pediatric rhinosinusitis is not a life-threatening condition, but when it is neglected or left untreated, it can intensely affect the school performance and sleep pattern of the children.[11] Even though pediatric rhinosinusitis is becoming more frequent, there is a paucity of information regarding its predisposing factors, and management. This study was conducted to determine the associations between demographic characteristics of pediatric rhinosinusitis patients, predisposing factors, and management of pediatric rhinosinusitis.

METHODS

This was a cross-sectional study using retrospective data of pediatric rhinosinusitis patients in a tertiary hospital for a period of 5 consecutive years. This study was carried out after obtaining National Medical Research Register Malaysia ethical board approval (NMRR-18-572-40977, date: 2018). Informed consent was obtained from the parents

of the patients who agreed to take part in the study. Children belonging to the age group of 1-18 years with a clinical diagnosis of rhinosinusitis presented at the Otorhinolaryngology department were enrolled in the study. The data collected included demographic details (age, gender, and race), associated predisposing factors (upper respiratory tract infection, asthma, allergic rhinitis, adenoid hypertrophy, GERD, established immunodeficiency, tonsillitis, epistaxis, or eczema), and clinical details of management (medical versus surgical). Age was categorized into 4 groups: infants (1 to 23 months), young children (2 to 5 years), children (6 to 11 years), and adolescents (12 to 18 years). The operational definition of conservative management consisted of the use of intranasal steroids, antibiotics, analgesics, antihistamines, oral steroids, and nasal decongestants. Various surgical management consisted of turbinoplasty, tonsillectomy, adenoidectomy, or adenotonsillectomy.

The data had been analyzed using Statistical Package for Social Sciences v. 25.0 (IBM SPSS Corp.; Armonk, NY, USA) and for descriptive analysis, mean, SD, frequency, and percentage were used. An analytical statistical test was used to determine the association between variables. The chi-square test was used to analyze the association of age group, gender, race, predisposing factors, and type of management. In all statistical analyses, a P-value of <.05 (95% CI) was considered statistically significant.

RESULTS

A total of 324 pediatric rhinosinusitis patients were included in the study. Our data consisted of 58% male patients (188/324) and 42% female patients (136/324) with rhinosinusitis. In terms of age group, one hundred sixty-three patients (50.3%) belonged to the age group between 6 and 11 years old. One hundred twenty-three patients (38%) were between 12 and 18 years old. The patients from the age group of 1 to 23 months old were the least affected (1/324; 0.3%). Racial distribution indicated that the affected population was predominantly among Malay (75%) race, followed by Chinese (41/324; 12.7%), Indians (34/324; 10.5%) and others (6/324; 1.9%) as shown in Table 1 below. We evaluated the predisposing factors of pediatric rhinosinusitis patients in our study group as shown in Table 2 below.

Most common predisposing factor in pediatric rhinosinusitis patients was allergic rhinitis (97.2%). The other significant factors were asthma (27.2%), upper respiratory infection (24.4%), and adenoid hypertrophy (17.9%). Meanwhile, gastro-oesophageal reflux disease (GERD) was the least significant risk factor (0.6%) for pediatric rhinosinusitis and none of our study group patients were found with established immunodeficiency.

In our study group, asthma was frequently seen in patients around 2 to 5 years (40.5%), males (29.3%), and Malays (30.5%). Statistical evaluation revealed no significant association between age group, gender, and race with asthma as a risk factor in pediatric rhinosinusitis.

Based on the analysis of the association between demographic characteristics and upper respiratory tract infection (URTI), URTI commonly occurs in patients aged between 6 and 11 years (51.4%), males (25.0%), and Malays (39.7%) as shown in Table 3 below.

Statistical analysis by Fisher's Exact test revealed a significant association between age group and URTI as a predisposing factor in pediatric

Table 1. Distribution of the Pediatric Rhinosinusitis Patients by Demographic Characteristics (N = 324)

Demographic Factors	Frequency (n = 324)	Percentage (%)
Gender		
Male	188	58.0
Female	136	42.0
Age (years)		
01-23 months	1	0.3
2-05 years	37	11.4
06-11 years	163	50,3
12-18 years	123	38,0
Race		
Malay	243	75.0
Chinese	41	12.5
Indian	34	10.5
Others	6	1.9

Table 2. Distribution of Pediatric Rhinosinusitis Patients by Predisposing Factors (N = 324)

Variables	Categories	Frequency (n = 324)	Percentage (%)
Upper respiratory tract infection (URTI)	Yes	79	24.4
	No	245	75.6
Asthma	Yes	88	27.2
	No	236	72.8
Allergic rhinitis	Yes	315	97.2
	No	9	2.8
Adenoid hypertrophy	Yes	58	17.9
	No	266	82.1
Gastroesophageal reflux disease (GERD)	Yes	2	0.6
	No	322	99.4
Established immunodeficiency	Yes	0	0.0
	No	324	100.0
Tonsillitis	Yes	45	13.9
	No	279	86.1
Epistaxis	Yes	14	4.3
	No	310	95.7
Eczema	Yes	20	6.2
	No	304	93.8

Main Points

- *Pediatric rhinosinusitis is an often under-diagnosed clinical condition.*
- *Allergic rhinitis is the most common predisposing factor for pediatric rhinosinusitis.*
- *The mainstay of treatment for pediatric rhinosinusitis is conservative management.*

Table 3. Association Between Demographic Characteristics with Upper Respiratory Tract Infection (N = 324)

Demographic	Upper Respiratory Tract Infection						
	Yes		No				
Characteristics	N	%	n	%	χ^2	*df*	*P*
Age Group							
Infant (1 mth-23 mths)	1	100.0	0	0.0	19.092		.000[a]
Young Children (2-5 yrs)	19	51.4	18	48.6			
Children (6-11 yrs)	38	23.3	125	76.7			
Adolescent (12-18 yrs)	21	17.1	102	82.9			
Gender							
Male	47	25.0	141	75.0	0.093	1	.761
Female	32	24.4	104	75.6			
Race							
Malay	63	25.9	180	74.1	2.535		.464[a]
Chinese	9	22.0	32	78.0			
Indian	5	14.7	29	85.3			
Others	2	33.3	4	66.7			

[a]P-value from Fisher's Exact Test

rhinosinusitis, whereas there was no significant association between race and gender and URTI as a risk factor in pediatric rhinosinusitis.

Among our pediatric patients, the other predisposing factor, allergic rhinitis, was predominately seen among males (98.4%), the age group between 12 and 18 years (98.4%), and Chinese (97.6%). Statistical analysis revealed no significant association between age group, gender, and race with allergic rhinitis as a risk factor in pediatric rhinosinusitis.

In our study cohort, adenoid hypertrophy was predominantly found in males (18.1%), Malays (18.5%), and in the age group of patients between 6 and 11 years (23.3%). Fisher's Exact test revealed a significant association between age group and adenoid hypertrophy as a predisposing factor in pediatric rhinosinusitis whereas there was no significant association between race and gender and adenoid hypertrophy as a predisposing factor in pediatric rhinosinusitis.

The evaluation of the association between another predisposing factor, gastroesophageal reflux disease (GERD), and the demographic features of the patients showed GERD in patients around 12 to 18 years old (0.8%), males (1.1%), and Chinese (4.9%). Analysis by Fisher's Exact test revealed a significant association between race and GERD, whereas there was no significant association between age group and gender with GERD in pediatric rhinosinusitis. None of our study cohort patients had established immunodeficiency.

Among our study patients, tonsillitis commonly occurred in patients aged around 2 to 5 years (18.9%), males (14.4%), and Malays (15.6%). Statistical analysis revealed no significant association between age group, gender, and race with tonsillitis as a predisposing factor in pediatric rhinosinusitis.

Study results showed eczema was found in 6.9% of male patients, belonging to 2 to 5 years age group (10.8%), and in Malay race (7.0%).

Table 4. Distribution of Pediatric Rhinosinusitis Patients by Type of Management. (N = 324)

Variables	Categories	Frequency (n = 324)	Percentage (%)
Medical Management	Yes	323	99.7
	No	1	0.3
Surgical Management	Yes	45	13.9
	No	279	86.1

The analysis demonstrated an association between race and eczema in pediatric rhinosinusitis.

Among our pediatric patients, epistaxis was seen in females (4.4%), aged around 6 to 11 years (6.1%), and in Malays (4.9%). There was no significant association between age group, gender, and race with epistaxis as a predisposing factor in pediatric rhinosinusitis.

Concerning the management of pediatric rhinosinusitis patients, 99.7% of the pediatric rhinosinusitis patients received medical treatment initially. 13.9% of them underwent surgical management as shown in Table 4 below.

Most of the pediatric rhinosinusitis patients who were managed conservatively were given intranasal steroids and/or antihistamines. Further evaluation demonstrated that most of the pediatric rhinosinusitis patients who were managed medically were given antihistamines (97.8%), followed by nasal decongestants (31.8%), analgesics (31.8%), and antibiotics (8.6%), while the least number of pediatric rhinosinusitis patients (1.9%) were given oral steroids.

The most common surgical procedure performed was adenotonsillectomy (8.3%), followed by tonsillectomy (4.3%) and adenoidectomy (1.9%), while the least number of pediatric rhinosinusitis patients underwent turbinoplasty (0.3%). Adenotonsillectomy was performed in patients aged between 6 and 11 years (11.7%), females (8.8%), and Malays (9.1%). Analysis revealed no significant association between age group, race, and gender with adenotonsillectomy in pediatric rhinosinusitis. Tonsillectomy was performed in patients aged around 12 to 18 years (5.7%), males (4.8%), and Malays (4.9%). Adenoidectomy was performed in patients aged between 6 and 11 years (3.1%), females (3.7%), and Indians (5.9%). Turbinoplasty was commonly performed in patients aged around 12 to 18 years old (0.8%), males (0.5%), and Chinese (2.4%).

DISCUSSION

Pediatric rhinosinusitis is a common clinical condition presented to primary care and otorhinolaryngology clinics. Diagnosis of pediatric rhinosinusitis is challenging due to its diverse clinical presentation and predisposing factors. Our study results showed that allergic rhinitis was a major predisposing factor (97.2%) in pediatric rhinosinusitis patients. Consistent with our findings, a population-based study by Orb et al and the study by Sedaghat et al found that allergic rhinitis is a vital contributing aspect and a comorbid problem with pediatric chronic rhinosinusitis.[12,13] The retrospective cohort study by Sedaghat et al reported that pediatric patients with allergic rhinitis and chronic rhinosinusitis had the same aeroallergen sensitivity profile.[9,13]

Upper respiratory tract infection was found to be another predisposing factor for rhinosinusitis, affecting 24.4% of our study patients. This is similar to the prospective longitudinal study by Marom et al which showed that 8% of upper respiratory tract infections were complicated by acute bacterial sinusitis.[14] It is challenging to differentiate between upper respiratory tract infection and rhinosinusitis in children due to the overlap of symptoms. A study by DeMuri also reported that acute sinusitis is generally preceded by upper respiratory infection. The upper respiratory infection causes nasal and paranasal sinus mucosal inflammation, which obstructs sinus ostia and sinusitis.[15]

Among our pediatric rhinosinusitis patients, 22.7% had asthma. Various epidemiological studies have shown the coexistence and comorbidity between rhinosinusitis and asthma.[16-18] Similar to our results, a study by Fuller et al revealed that 27% of status asthmatic patients were found to have abnormal sinus radiographs indicating sinusitis.[19] The association between rhinosinusitis and asthma is controversial, whether these are 2 different pathological issues or a part of the "united airway disease".[20] Previous clinical studies suggested that the coexistence of pediatric rhinosinusitis and asthma may result from complex immunological mechanisms and that the treatment of rhinosinusitis can improve asthma symptoms and vice versa.[16,18,21]

In our study cohort, adenoid hypertrophy was another predisposing factor affecting 17.9% of pediatric rhinosinusitis patients, mainly in the age group between 6 and 11 years. The role of adenoid in the etiopathogenesis of pediatric rhinosinusitis may be as a pathogenic reservoir or by causing mechanical obstruction and diminishing the mucociliary clearance of the sinus lining.[22] The retrospective study by Shin et al suggested that in pediatric rhinosinusitis, adenoids act as a reservoir for pathogenic bacteria.[23]

Gastroesophageal reflux disease was found in a minority (0.6%) of our pediatric rhinosinusitis patients. In contrast to this, a retrospective study by Nation et al demonstrated 40% of pediatric rhinosinusitis patients had GERD.[24] Beatrice et al in their cross-sectional study, diagnosed chronic rhinosinusitis in 41.7% of children with dyspepsia.[25]

Our study results showed a significant association between pediatric rhinosinusitis in children belonging to the Malay race and eczema. The racial predominance could be due to the higher prevalence of atopic dermatitis among Malaysian Malay children, as shown in the study by Goh et al.[26] The link between rhinosinusitis and eczema can be explained by the "atopic march", a sequence of disorders in which atopic dermatitis is associated with other comorbidities, such as allergic rhinitis and asthma in childhood.[27] A large-scale study by Paller et al demonstrated that the prevalence of chronic rhinosinusitis was significantly higher in children with atopic dermatitis.[28] This co-existence of type 2 inflammatory diseases was described as being due to the sharing of similar inflammatory pathways and genetic risk factors.

Regarding the management of pediatric rhinosinusitis, most of our patients were treated conservatively. Most of our patients (97.8%) received oral second-generation antihistamines and children above the age of 2 years (97.3%) were given intranasal corticosteroids. Other medications, like local nasal decongestants, were prescribed for short periods along with nasal saline douching. As such, there is no consensus on pediatric rhinosinusitis management. Various previous studies indicated that the mainstay management of pediatric rhinosinusitis is conservative.[4,9] As mentioned in the "NICE" guidelines, antibiotics may be indicated only when acute bacterial rhinosinusitis lasts more than 10 days.[5] Chronic rhinosinusitis is treated with the avoidance of allergens, nasal douching, antihistamines, and intranasal corticosteroids. A Cochrane systematic review by Harvey et al suggested that saline irrigation is beneficial as an adjunctive treatment in pediatric rhinosinusitis.[29] Surgical intervention is indicated in pediatric rhinosinusitis patients who are recalcitrant to appropriate medical management or have complications.[6,9] The various types of surgical procedures include adenoidectomy, functional endoscopic sinus surgery, and balloon sinuplasty.[2,4,30] Current literature recommended adenoidectomy as the first line of surgical treatment for younger children with refractory rhinosinusitis.[3,6,9,11] Functional endoscopic surgery is beneficial in older children with refractory rhinosinusitis or a previous adenoidectomy.[5,6,9,30]

The study's potential limitations were that the study only involved 1 hospital, which may not be representative of the country's population, and it was a retrospective study with a few missing data.

CONCLUSION

Our data indicate that allergic rhinitis is the most established predisposing factor among pediatric rhinosinusitis patients, followed by asthma, upper respiratory tract infection (URTI), and adenoid hypertrophy. Conservative medical treatment was the mainstay of management in pediatric rhinosinusitis patients. The findings of this study emphasize that controlling these risk factors can expedite the timely diagnosis and appropriate treatment of pediatric rhinosinusitis. This will reduce the associated complications and morbidity as well as the economic burden on the health care system.

Ethics Committee Approval: This study was approved by the institutional ethics board (National Medical Research Register Malaysia, Approval no. NMRR-18-572-40977, dated May 2018).

Informed Consent: Informed consent was obtained from the parents of the patients who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

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REFERENCES

1. Leo G, Incorvaia C, Cazzavillan A, Consonni D. May chronic rhinosinusitis in children be diagnosed by clinical symptoms? *Int J Pediatr Otorhinolaryngol*. 2015;79(6):825-828. [CrossRef]
2. Ramadan HH. Chronic rhinosinusitis in children. *Int J Pediatr*. 2012;2012:573942. [CrossRef]
3. Fokkens WJ, Lund VJ, Hopkins C, et al. Executive summary of EPOS 2020 including integrated care pathways. *Rhinology*. 2020;58(2):82-111. [CrossRef]
4. Quintanilla-Dieck L, Lam DJ. Chronic rhinosinusitis in children. *Curr Treat Options Pediatr*. 2018;4(4):413-424. [CrossRef]

5. Ramadan HH, Chaiban R, Makary C. Pediatric rhinosinusitis. *Pediatr Clin North Am*. 2022;69(2):275-286. [CrossRef]
6. Badr DT, Gaffin JM, Phipatanakul W. Pediatric rhinosinusitis. *Curr Treat Options Allergy*. 2016;3(3):268-281. [CrossRef]
7. Otto WR, Paden WZ, Connors M, et al. Suppurative intracranial complications of pediatric sinusitis: a single-center experience. *J Pediatr Infect Dis Soc*. 2021;10(3):309-316. [CrossRef]
8. Shahid SK. Rhinosinusitis in children. *ISRN Otolaryngol*. 2012;2012:851831. [CrossRef]
9. Siddiqui Z, Tahiri M, Gupta A, Kin Nam RH, Rachmanidou A. The management of paediatric rhinosinusitis. *Int J Pediatr Orl*. 2021;147:110786. [CrossRef]
10. Kim NN, Marikar D. Antibiotic prescribing for upper respiratory tract infections: NICE guidelines. *Arch Dis Child Educ Pract Ed*. 2020;105(2):104-106. [CrossRef]
11. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. *Rhinology*. 2020;58(Suppl S29):1-464. [CrossRef]
12. Orb Q, Curtin K, Oakley GM, et al. Familial risk of pediatric chronic rhinosinusitis. *Laryngoscope*. 2016;126(3):739-745. [CrossRef]
13. Sedaghat AR, Phipatanakul W, Cunningham MJ. Prevalence of and associations with allergic rhinitis in children with chronic rhinosinusitis. *Int J Pediatr Orl*. 2014;78(2):343-347. [CrossRef]
14. Marom T, Alvarez-Fernandez PE, Jennings K, Patel JA, McCormick DP, Chonmaitree T. Acute bacterial sinusitis complicating viral upper respiratory tract infection in young children. *Pediatr Infect Dis J*. 2014 ;33(8):803-808. [CrossRef]
15. DeMuri GP, Eickhoff JC, Gern JC, Wald ER. Clinical and virological characteristics of acute sinusitis in children. *Clin Infect Dis*. 2019;69(10):1764-1770. [CrossRef]
16. Poddighe D, Brambilla I, Licari A, Marseglia GL. Pediatric rhinosinusitis and asthma. *Respir Med*. 2018;141:94-99. [CrossRef]
17. Vujnovic SD, Domuz A. Epidemiological aspects of rhinitis and asthma: comorbidity or united airway disease [Internet]. Asthma Diagnosis and Management - Approach Based on Phenotype and Endotype. *InTech*. 2018. [CrossRef]
18. Chang CC. Sinusitis, rhinitis, asthma, and the single airway hypothesis. *Dis Sinuses*. 2013;5:173-194.
19. Fuller CG, Schoettler JJ, Gilsanz V, Nelson MD, Church JA, Richards W. Sinusitis in status asthmaticus. *Clin Pediatr*. 1994;33(12):712-719. [CrossRef]
20. Giavina-Bianchi P, Aun MV, Takejima P, Kalil J, Agondi RC. United airway disease: current perspectives. *J Asthma Allergy*. 2016;9:93-100. [CrossRef]
21. Ramaswamy US, Patel VA, Lee SE. Managing chronic rhinosinusitis in severe asthma. *Curr Opin Pulm Med*. 2021;27(1):23-28. [CrossRef]
22. Belcher R, Virgin F. The role of the adenoids in pediatric chronic rhinosinusitis. *Med Sci (Basel)*. 2019;7(2):35. [CrossRef]
23. Shin KS, Cho SH, Kim KR, et al. The role of adenoids in pediatric rhinosinusitis. *Int J Pediatr Orl*. 2008;72(11):1643-1650. [CrossRef]
24. Nation J, Kaufman M, Allen M, Sheyn A, Coticchia J. Incidence of gastroesophageal reflux disease and positive maxillary antral cultures in children with symptoms of chronic rhinosinusitis. *Int J Pediatr Orl*. 2014;78(2):218-222. [CrossRef]
25. Beatrice M, John A, Ahmed L, Peter M. Prevalence of chronic rhinosinusitis in children with dyspepsia–A cross sectional study. *Egypt J Ear Nose Throat Allied Sci*. 2016;17(3):139-142. [CrossRef]
26. Goh YY, Keshavarzi F, Chew YL. Prevalence of atopic dermatitis and pattern of drug therapy in Malaysian children. *Dermatitis*. 2018;29(3):151-161. [CrossRef]
27. Simpson EL. Comorbidity in atopic dermatitis. *Curr Dermatol Rep*. 2012;1(1):29-38. [CrossRef]
28. Paller AS, Mina-Osorio P, Vekeman F, et al. Prevalence of type 2 inflammatory diseases in pediatric patients with atopic dermatitis: Real-world evidence. *J Am Acad Dermatol*. 2022;86(4):758-765. [CrossRef]
29. Harvey R, Hannan SA, Badia L, Scadding G. Nasal saline irrigations for the symptoms of chronic rhinosinusitis. *Cochrane Database Syst Rev*. 2007;3(3):CD006394. [CrossRef]
30. Vasco CTC, Morais HC, Avelino MAG. Systematic review of the literature on surgical treatment of chronic rhinosinusitis in children: what is the best approach? *Rev Paul Pediatr*. 2020;38:e2018068. [CrossRef]