

Number of siblings and allergic rhinitis in children

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Abstract

Background Allergic rhinitis is one of the most common chronic diseases of childhood. Recent studies have suggested that having fewer siblings was associated with allergic rhinitis and atopic diseases in children. Previous studies also indicated that older siblings was associated with higher incidence of allergic rhinitis.

Objectives To assess for a possible association between number of siblings and allergic rhinitis and to assess for an effect of birth order on allergic rhinitis in children.

Methods We performed a cross-sectional study among school children aged 7 to 15 years, in the West Medan District from July to August 2011. Children with moderate or high risk of allergy were included. Subjects were divided into two groups, those with <3 siblings or ≥ 3 siblings. Children with acute respiratory tract infections, septal deviation, choanal atresia, nasal polyps, nasal tumors, or nasal foreign body were excluded. Risk of allergy was determined using the *Indonesian Pediatrics Allergy Immunology Working Group* trace card scoring system. Identification of allergic rhinitis and evaluation of its severity were done by use of the *International Study of Asthma and Allergies in Childhood* (ISAAC) core questionnaire. Allergic rhinitis was diagnosed based on history, physical examination, and anterior rhinoscopy.

Results A total of 78 subjects were enrolled. Allergic rhinitis was significantly higher in children with <3 siblings than those with ≥ 3 siblings (OR 10.33; 95%CI 3.569 to 29.916). Furthermore, allergic rhinitis was significantly higher in first-born children than in their younger siblings ($P=0.0001$).

Conclusion Larger number of siblings and non-first-born children are associated with lower incidence of allergic rhinitis in children. [Paediatr Indones. 2016;56:1-7].

Keywords: allergic rhinitis, siblings, birth order, atopic

Allergic rhinitis is one of the most common atopic diseases and chronic disorders of childhood. Its incidence has increased over the past several decades in developed as well as developing countries for reasons that are poorly understood.¹⁻³ Prevalence and incidence of allergic rhinitis in Indonesia is not yet known. A study in school children aged 6 to 7 years in Semarang found the incidence of allergic rhinitis to be 11.5%.⁴ Another study in adolescents aged 13 to 14 years in Semarang reported the incidence of allergic rhinitis to be 17.3%.⁵ A retrospective study from patient medical records from the Allergy Immunology Clinic of the Children's Hospital, Denpasar, Bali (1996-2000) reported an allergic rhinitis incidence of 18.5% of total outpatient visits.⁶ The *International Study of Asthma and Allergies in Childhood* (ISAAC) phase 3 reported the prevalence of allergic rhinitis in Indonesia in children aged 6 to 7 years and 13 to 14 years to be 3.6% and 6.4%, respectively.⁷

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Over the past few decades in developed and developing countries, children's exposure to infection has diminished as a result of a westernized lifestyle, such as reduced number of siblings in a family, improved hygiene and sanitation, and frequent medical intervention in the form of antibiotic treatment and vaccinations.^{1,2} Family size in developed countries has decreased over the last century. At the same time, the prevalence of asthma and atopic disease in children has increased worldwide.² An epidemiological study of national birth data in the UK reported that the number of siblings in a family was a strong determinant of the incidence of allergic rhinitis (hay fever) in children and adolescents.⁸ A higher number of siblings exposes children to recurrent infections in early life, thus preventing the development of atopic diseases in children.^{2,8}

We aimed to investigate this association between number of siblings and allergic rhinitis, and to study the effect of birth order on allergic rhinitis in children.

Methods

We performed a cross-sectional study from July to August 2011 in children aged 7 to 15 years from The Perguruan Budaya elementary and junior high school in the West Medan District, Medan, North Sumatera Province.

We determined the risk of allergy using the *Indonesian Pediatrics Society - Allergy Immunology Working Group* trace card scoring system. Children who fulfilled the criteria of moderate or high risk of allergy were included. Biodata and ISAAC core questionnaires for allergic rhinitis were filled by parents of subjects aged 7 to 12 years, or by the subjects themselves if they were aged 13 to 15 years. Subjects' weights were measured using *Camry* scales with 0.1 kg accuracy, and heights were measured using a microtoise with 0.1 cm precision. Subjects underwent history-taking, physical examinations, and anterior rhinoscopy. Anterior rhinoscopy training was previously done in the Department of Otorhinolaryngology - Head and Neck Surgery in H. Adam Malik Hospital, Medan. Identification and severity of allergic rhinitis were obtained using the ISAAC core questionnaire.

Allergic rhinitis was diagnosed based on history, physical examination and anterior rhinoscopy. Children with acute respiratory tract infections, septal deviation, choanal atresia, nasal polyps, nasal tumors, or nasal foreign body were excluded. Subjects were divided into two groups based on having either <3 siblings or ≥ 3 siblings. We assessed the incidence of allergic rhinitis in both groups.

Allergic rhinitis was defined as asymptomatic disorder of the nose induced by IgE-mediated inflammation relating to allergenic exposure in the nasal membrane.⁹ Symptoms of allergic rhinitis included runny nose (rhinorrhea), nasal obstruction, nasal itching and sneezing, all of which were reversible with or without treatment.⁹⁻¹¹ The ISAAC core questionnaire was a standardized questionnaire from worldwide ISAAC multicenter studies and used to assess the prevalence, frequency, and severity of disease. The ISAAC core questionnaire included modules for asthma, allergic rhinitis, and atopic dermatitis, and was divided into two age groups, 6-7 years and 13-14 years.¹² Positive results of anterior rhinoscopy were defined as having allergic rhinitis, with classic signs of nasal mucosal edema and pale bluish color, accompanied by a watery nasal discharge.¹³

The allergy trace card, developed by the *Indonesian Pediatrics Society - Allergy Immunology Working Group*, was a scoring system for predicting the risk of allergies in children based on history of atopic parents and siblings in one's family.¹⁴ For the purposes of our study, a sibling was defined as a child with the same biological father and mother. A family was defined as a nuclear family consisting of a father, a mother, and their children, whereas other family members were considered to be those living in the same home, but not included in the nuclear family.

Data analysis was done by Chi-square test to determine differences in the incidence of allergic rhinitis in the < 3 and ≥ 3 sibling groups. Data processing was performed with *SPSS software version 14.0*. The association between number of siblings and allergic rhinitis was expressed in odds ratio (OR) with a significance level of $P < 0.05$. Parents of study subjects provided informed consent for participation. This study was approved by the Research Ethics Committee, University of Sumatera Utara Medical School, Medan.

Results

A total of 78 subjects were enrolled, consisted of 35 subjects in the <3 siblings group and 43 subjects in the ≥3 siblings group. The study flow chart is shown in **Figure 1**.

The characteristics of subjects are shown in **Table 1**. Mean ages, weights, and heights were similar in both groups. We found seven overweight and two obese children in the <3 siblings group, and one overweight child in the ≥ 3 siblings group. Most subjects had moderate risk of allergies, with 85.7% and 88.4% in

the < 3 and ≥ 3 sibling groups, respectively. Nasal congestion and sneezing were the two most common symptoms of allergic rhinitis in both groups.

Chi-square analysis revealed that the group with fewer siblings had significantly greater risk of allergic rhinitis than the group with more siblings (OR 10.33) (**Table 2**).

Chi-square analysis also revealed a significant association between birth order and allergic rhinitis in children (**Table 3**), with first-born children having more allergic rhinitis than non-first-born children (P=0.0001).

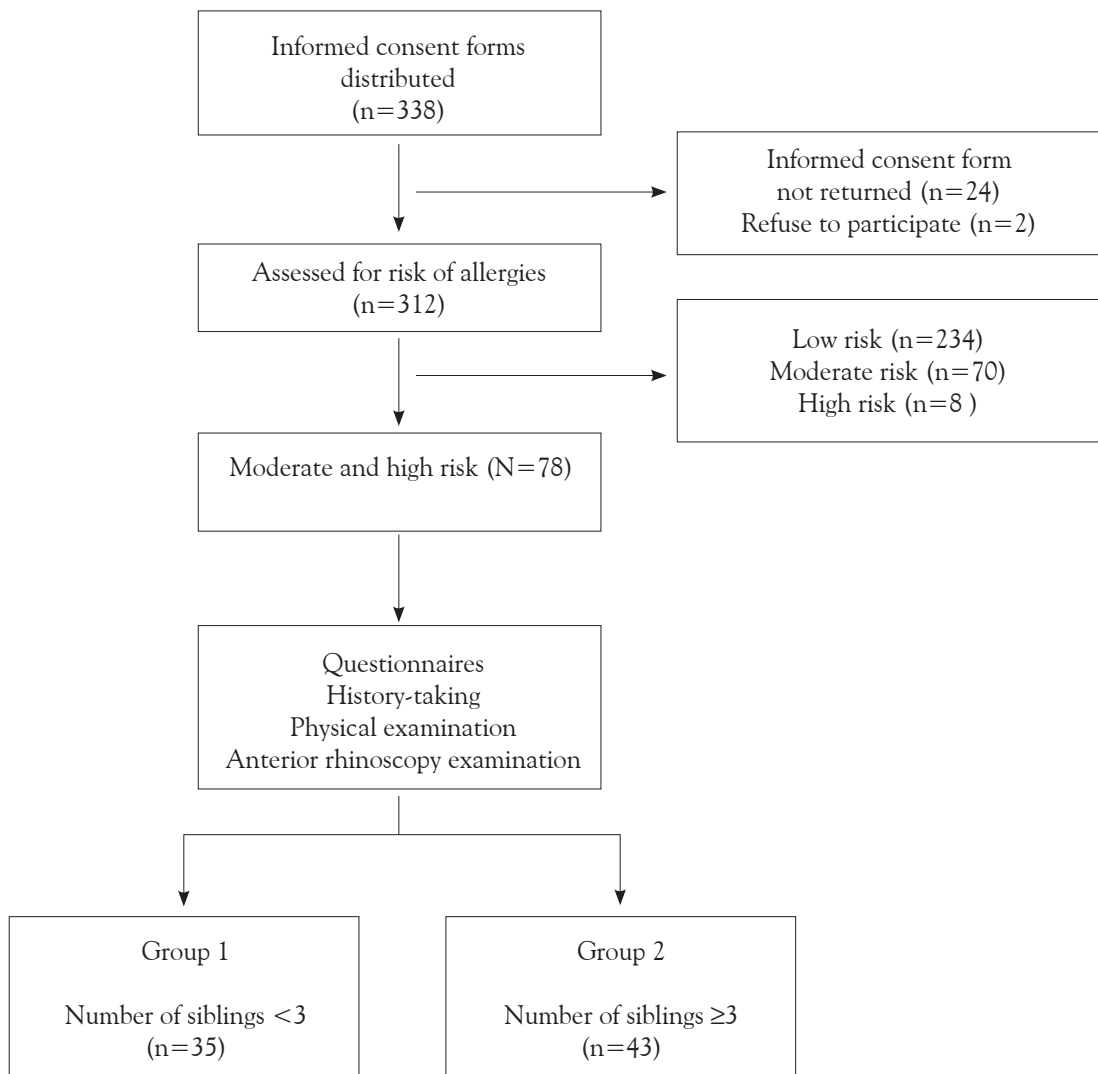


Figure 1. Study flow chart

Table 1. Characteristics of subjects

Characteristics	Number of siblings	
	< 3 (n = 35)	≥ 3 (n = 43)
Gender, n		
Male	14	23
Female	21	20
Mean age (SD), years	13.2 (1.72)	12.9 (1.44)
Mean body weight (SD), kg	39.6 (7.07)	37.8 (6.66)
Mean body height (SD), cm	145.8 (6.81)	146.4 (8.59)
Nutritional status, n		
Mild malnutrition	3	4
Normal	23	38
Overweight	7	1
Obese	2	0
Bedroom sharing with sibling(s), n		
Yes	29	35
No	6	8
Living with other family members, n		
Yes	12	10
No	23	33
Risk of allergy, n		
Moderate	30	38
High	5	5
Clinical symptoms, n		
Rhinorrhea	28	12
Sneezing	28	10
Nasal blockage	16	6
Nasal itching	15	7
Conjunctivitis	15	9

Table 2. Association between number of siblings and allergic rhinitis

Number of siblings	Allergic rhinitis, n		Total	OR (95% CI)
	Yes	No		
< 3	28	7	35	10.33 (3.569 to 29.916)
≥ 3	12	31	43	

Table 3. Association between birth order and allergic rhinitis

Birth order	Allergic rhinitis, n		Total	P value
	Yes	No		
1	28	9	37	0.0001
2	9	12	21	
3	3	9	12	
4	0	6	6	
5	0	2	2	

Discussion

We found a significant relationship between children with fewer siblings (<3 siblings) and greater prevalence of allergic rhinitis, compared to children with more sib-

lings (≥ 3 siblings). Twenty-eight children (80.0%) from the group of <3 siblings suffered from allergic rhinitis, compared to only 12 children (28%) from the group of ≥3 siblings. Subjects with < 3 siblings were 10 times more likely to suffer allergic rhinitis than those with ≥3 siblings (OR 10.33; 95%CI 3.5 to 29.9). This finding supports the hygiene hypothesis, first proposed by Strachan in 1989 based on his study in the UK, who found an increased prevalence of allergic rhinitis in children with a smaller number of siblings.⁸ Smaller number of siblings in a family is a phenomenon commonly found in today's society.^{2,15} The hygiene hypothesis states that a clean and modern lifestyle affects the immune response by increasing a person's vulnerability to atopic disease. Modern lifestyles, identified by a small number of siblings in a family, reduced cross-infection, and less microbial exposure, are believed to be key factors that increase atopic diseases.^{8,16} A cross-sectional study was conducted in 1995 in schoolchildren in Leipzig, East Germany, and reported that the prevalence of allergic rhinitis increased from 2.3% to 5.1% within the period of 1991-92 to 1995-96.¹⁷

Our results are consistent with those of a previous retrospective study on 2,511 children which reported that the risk of allergic rhinitis and eczema decreased in children who had ≥3 older siblings. A larger number of siblings was associated with a significant protective effect on the incidence of allergic rhinitis.¹⁸ Several other studies also reported a significant decrease in the prevalence of allergic rhinitis associated with increased number of siblings.¹⁹⁻²⁵ We also found a lower incidence of allergic rhinitis in younger siblings, compared to older siblings. This finding was in line with previous studies that having older siblings was a protective factor against allergic rhinitis.^{18,20,24} A large cohort study from the *West Midlands General Practice Research Database* (WMGPRD) conducted on 29,238 children reported a low incidence of allergic rhinitis in subjects with older siblings. However, the relationship was not significant in subjects with younger siblings.²² This finding supports the theory that pregnancy reduces the maternal atopy response by inducing immune tolerance (tolerance induction hypothesis), in which the risk of atopy in subsequent pregnancies is reduced.^{26,27}

Svanes *et al.* found that children who shared a bedroom with siblings increased the chance of cross-infection, thus escalating the sibling effect on the

incidence of atopy. For the same reason, the presence of other family members living in a same house provides a greater protective effect on the incidence of atopic diseases, particularly in allergic rhinitis.²³ In our study, most of our subjects reported that they shared bedrooms with their siblings.

The *American Academy of Pediatrics* (AAP) recommends that family history of atopy be used to identify infants/children at high risk of atopic diseases.²⁸ A multicenter study by the *European Community Respiratory Health Survey* (ECRHS) reported that the protective effect of environmental factors, such as family size and sharing bedrooms with siblings, were significant only in subjects with a parental history of atopy. The relationship was not significant in the children with no history of parental atopy.²³ In this study, we used the allergy trace card scoring system to predict the risk of allergies in children based on history of atopy in their parents and siblings. Our findings suggest that both groups of subjects were comparable in terms of the risk of allergies.

An effective and thorough history-taking is essential to making a diagnosis of allergic rhinitis.^{3,9-11,13} The history should include the pattern, duration, symptom variations throughout a year, other associated symptoms, response to treatment, presence or absence of comorbidities, as well as exposure to environmental and other triggers.¹¹ The skin prick test is the most sensitive and specific test to identify specific IgE in allergic rhinitis patients.^{11,13,29} In this study, we did not perform specific IgE examinations. However, according to the recommendations by the *Allergic Rhinitis and its Impact on Asthma* (ARIA) Workshop in 2001, a standard questionnaire can be used as a diagnostic tool for allergic rhinitis, especially in developing countries.⁹ We used the ISAAC core questionnaire to identify and evaluate the severity of allergic rhinitis symptoms. Several studies reported the ISAAC questionnaire to have high specificity for identifying subjects suffering allergic rhinitis.^{30,31} Validation of the ISAAC questionnaire in a study of Swiss school children reported a high positive predictive value (PPV) and specificity values ranging from 77.5% to 97.6%.³²

Anterior rhinoscopy examination is indicated in all cases of allergic rhinitis.¹⁰ In allergic rhinitis, anterior rhinoscopy examination reveals the classic signs of nasal mucosal swelling (edema) and pale bluish nasal

mucosa accompanied with nasal secretions.^{9,13} Nasal polyps and nasal anatomical abnormalities such as septal defects, tumors, and foreign bodies in the nose can accompany or show clinical manifestations similar to that of allergic rhinitis.¹¹ As such, we performed anterior rhinoscopy to diagnose allergic rhinitis, as well as to exclude nasal polyps, septal defects, nasal tumors, and foreign bodies. We found no nasal abnormalities in our subjects.

Our study was conducted in children aged 7 to 15 years, as allergic rhinitis is most prevalent in school-aged children.⁹⁻¹¹ Approximately 30% of allergic rhinitis cases develop during adolescence, and more than 80% of cases encounter the ailment before the age of 20 years. Allergic rhinitis is more common in males.³³ In this study, we found that our subjects' mean age was around 13 years in both groups, with comparable allergic rhinitis in both sexes.

Several studies reported an association between nutritional status and the incidence of atopic diseases.³⁴⁻³⁶ Some studies have reported conflicting results on the effect of overweight and obesity on the risk of developing atopic diseases. Visness *et al.* found an association,³⁴ but other studies did not.^{37,38} We found more overweight and obese children in the group of <3 siblings than in the group of ≥ 3 siblings. However, we did not find any association, due to the small number of subjects.

Limitations of our study were its small sample size and not adjusting for other variables, such as day-care attendance and history of childhood infections. However, previous studies consistently reported a significant relationship between number of siblings and allergic rhinitis, independent of day-care attendance and history of infections.^{20,21}

Our study shows that the larger number of siblings is associated with the lower incidence of allergic rhinitis, and non-first-born birth order is associated with lower incidence of allergic rhinitis. Further study with a larger sample size is needed to evaluate the relationship of number of siblings on the incidence of allergic rhinitis and to adjust for other risk factors that may affect the incidence of allergic rhinitis in children.

Conflict of interest

None declared.

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