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Original Article

Association between bronchial asthma in atopic children and their number of siblings

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Abstract

Background The prevalence of asthma in children has increased in many countries. Environmental factors are believed to play an important role and an inverse relationship between number of siblings and atopic disorders has been observed.

Objective To assess for an association between bronchial asthma in atopic children and their number of siblings.

Methods A cross-sectional study was conducted from June to November 2010 in three elementary schools in Medan, North Sumatera. Trace cards from the Allergy-Immunology Indonesian Pediatric Association (IDAI) Working Group and questionnaires on the clinical history of atopy were used to screen children with the risk of atopy. The *International Study of Asthma and Allergies in Childhood* (ISAAC) questionnaire to screen for bronchial asthma was distributed to children aged 7-10 years with a history of asthma, allergic rhinitis or atopic dermatitis. Subjects were divided into two groups, those with <3 siblings and those with ≥3 siblings. Chi-square test was used to analyze differences in bronchial asthma prevalence between the two groups.

Results Ninety-six subjects enrolled in the study, with 48 subjects per group. The prevalence of bronchial asthma was significantly higher in atopic children who had <3 siblings than in children with ≥3 siblings (73.5% and 26.5%, respectively; P=0.04).

Conclusion Bronchial asthma was significantly more frequent in children with less than 3 siblings compared to those with 3 or more siblings. **[Paediatr Indones. 2014;54:289-93.]**

Keywords: *bronchial asthma, siblings, atopy*

The prevalence of childhood asthma has increased, especially in developed and western countries.[1] The reason for this increased remains unknown, but it is believed that environmental factors play an important role.[2,3] In 1989, the hygiene hypothesis was put forth, stating that there is a relationship between allergies and infections acquired during early childhood. This increase in asthma prevalence may be explained by the hygiene hypothesis, as it proposed that infection acquired during early childhood protects against the occurrence of atopy.[4]

A protective effect against the incidence of allergies was noted in families with 3 or more siblings.[5] Although the number of siblings might be related to the incidence of atopic disease, it does not explain the nature of the relationship.[6,7] The aim of this study was to assess for an association between bronchial asthma in atopic children and their number of siblings.

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Methods

This cross-sectional study was conducted from June to November 2010 in three State Primary Schools (SDN 060907, 064961 and 064980) in the District of Medan Maimun, Medan, North Sumatra Province. Inclusion criteria were children aged 7-10 years with a history of atopy, such as allergic dermatitis, allergic rhinitis and bronchial asthma. We excluded children with other lung disorders such as lung infections (tuberculosis, pneumonia, or rhinosinobronchitis) or obstructive lung diseases (emphysema, bronchitis, or bronchiectasis).

We used trace cards from the *Allergy-Immunology IDAI Working Group of Indonesian Pediatric Society* to detect any atopic risks. Trace cards assess for the symptoms of disorders such as atopic dermatitis, eczema, flushing, diarrhea, vomiting, colic, runny nose, wheezing, and asthma in the family (father, mother or sibling). Each family member is then described as either diagnosed, suspected, or never suffered from allergies. Each category was used to interpret the risk for atopic disorders, as low, medium or high. Trace cards were accompanied by clinical risk of atopy questionnaires, which consisted of several questions to detect symptoms of allergic rhinitis, atopic dermatitis and asthma.

To screen for and diagnose asthma, we used the standardized questionnaire by the *International Study of Asthma and Allergies in Childhood (ISAAC)*, an international organization that focuses on research and management of asthma and allergic diseases globally. The questionnaire was standardized by various countries using a uniform methodology. The ISAAC questionnaire consists of eight questions agreed upon by the ISAAC convention in Bochum, Germany to detect and assess asthma severity and other allergic diseases.[7]

We explained the study procedures to subjects and parents. Parents provided informed consent before the study. Children who were willing to participate underwent screening for the presence of atopic disorders using trace card questionnaires from the *Allergy-Immunology IDAI Working Group of Indonesian Pediatric Society*. Questionnaires were completed by parents. Based on the questionnaire results, those with a history of atopy underwent physical examinations to rule out the possibility of infection or obstructive pulmonary abnormalities. Children with no lung infection or obstruction were further consecutively stratified to one of two groups, based on their number of siblings. Group I had children with <3 siblings, while group II had children with ≥ 3 siblings. Each group consisted of 48 children and they all received *The International Study of Asthma and Allergies in Childhood* (ISAAC) questionnaires to screen for the incidence of asthma. Questionnaires were completed by parents.

This study was approved by the Ethics Committee of the Faculty of Medicine, University of North Sumatra. We used the *SPSS* software version 14.0 for data processing. Chi square test was used to compare bronchial asthma between the two groups. Results were considered to be statistically significant for P values <0.05.

Results

Of 705 children screened, 120 did not return the questionnaires. Of the 585 children who returned the questionnaires, 115 had a history of atopy. Ninety six children were consecutively sampled and divided into two groups: 48 children with <3 siblings and 48 children with ≥3 siblings. Using questionnaires to detect asthma, we found 14 asthmatic children (29.16%) in the group with <3 siblings and 5 asthmatic children (10.41%) in the group with ≥3 siblings.

Table 1 shows the characteristics of subjects. The majority of both groups were female with mean ages of 9.5 and 8.9 years. Mean weights were 24.9 kg and 25.2 kg and mean heights of subjects were 129 cm and 127 cm.

Table 2 shows a significant relationship between bronchial asthma and number of siblings (P=0.04).

Table 1. Characteristics of subjects

Characteristics	Group I < 3 siblings (n=48)	Group II ≥3 siblings (n=48)
Gender, n (%)		
Male	23 (47.9)	21 (43.8)
Female	25 (52.1)	27 (56.2)
Mean age (SD), years	9.5 (0.68)	8.9 (0.98)
Mean weight (SD), kg	24.9 (4.61)	25.2 (8.63)
Mean height (SD), m	1.29 (0.09)	1.27 (0.08)

Table 2. Prevalence of asthma based on number of siblings

Siblings	Asthma		P value
	Yes, n (%)	No, n (%)	
<3	14 (29)	34 (71)	0.04
≥3	5 (10)	43 (90)	

Table 3. Prevalence of asthma based on subjects' characteristics

Characteristics	Asthma		P value
	Yes (n = 19)	No (n = 77)	
Gender, n (%)			
Male	10	34 (44.2)	0.684
Female	9	43 (55.8)	
Mean age (SD), years	9.4	9.2 (0.90)	0.397
Mean weight (SD), kg	26.6	24.7 (7.45)	0.101
Immunization, n (%)			
Yes	11	38 (49.4)	0.681
No	8	39 (50.6)	
Pet ownership, n (%)			
Dog	3	10 (12.9)	0.842
Cat	4	14 (73.6)	
No	12	53 (68.8)	
Exclusively breastfed, n (%)			
Yes	2	54 (70.1)	0.001
No	17	23 (29.9)	
Pollution exposure, n (%)			
Yes	8	47 (62.1)	0.217
No	11	30 (37.9)	

The occurrence of bronchial asthma was significantly higher (29%) found in group I compared to group II (10%).

As shown in **Table 3**, a history of exclusive breastfeeding seems related with lower asthma prevalence ($P < 0.05$). Other characteristics, including gender, age, weight, immunization status, pet ownership, and exposure to pollution were not significantly related to the prevalence of asthma.

Discussion

Former studies have shown high prevalence rates of asthma symptoms in developed countries.[1] In Indonesia (2002), the prevalence was around 3% for children aged 6-7 years and 5.2% at ages 13-14 years.[8] Previous studies have reported that the prevalence of asthma in boys up to age 10 years was 1.5 to 2 times that of girls. However, studies in the US recently reported no difference in asthma prevalence based on gender.[8] We also did not find any significant association between gender and prevalence of asthma (52.6% of boys vs. 47.4% of girls).

Prevalence of asthma varies widely around the world. These differences may be due to variations in the diagnostic criteria used for asthma. To overcome this problem, a multicenter study conducted with ISAAC questionnaires developed a uniform definition of asthma and a standardized questionnaire.[7]

Our study attempts to explain the relationship between the prevalence of asthma in children with a history of atopy and their number of siblings. We found a significant relationship between the prevalence of asthma and the number of siblings, as 14 of 48 children with < 3 siblings showed symptoms of asthma based on the ISAAC questionnaire (**Table 2**). The influence of lower number of siblings on the prevalence of asthma is not fully understood. According to the hygiene hypothesis, exposure to infection in early childhood influences regulatory T cells and alters the balance of T helper 1 (Th1) and T helper 2 (Th2) cells. Exposure to microbes increases Th1 responses and reduces Th2 responses. Th1 cells are associated with a response to infection by producing interferon-γ, while Th2 cells are associated with an atopic immune response by inducing IgE production and the maturation of mast cells, basophils and eosinophils.[1,9]

Other mechanisms that might explain the relationship of asthma and allergies with number of siblings are changes in levels of IgE, atopy and tolerance of immune responses during pregnancy. Pregnancy has been observed to reduce the response of maternal atopy by inducing immune tolerance and may decrease the risk of atopy in subsequent offspring.[10] A British study assessed IgE levels in umbilical cords of newborns and found a decrease in IgE levels with increasing number of births. This finding points to a potential influence of number of siblings on the incidence of allergies that started in utero.[11]

A US study suggested that exposure to infections and other factors such as immunization, pets, breastfeeding and pollution affect the incidence of allergy. The relationship between immunizations and the occurrence of allergy is not clearly understood.[12] A Japanese study found that DPT vaccination increased the incidence of atopy in the future, however, this result was not supported by a number of other studies.[13] One study even stated that Bacillus Calmette Guerin (BCG) vaccination can inhibit the development of atopy.[13] We found that 11 children (22%) with DPT immunizations had asthma based on the ISAAC questionnaire, but the association was not significantly different from those without DPT immunizations.

Close contact with pets such as dogs and cats are believed to have a protective effect against allergic disease. Increased IL-10 and IL-13, as well as reduction of allergic sensitization and atopic dermatitis was found in children exposed early to pets such as dogs.[14] Furhtermore, a study in New Zealand found a synergistic interaction between exposure to pets and lower risk of atopy in children and adults.[15] In contrast, we found no significant association between pet ownership (dogs, cats) to prevalence of asthma.

We found a significant association between the lower prevalence of asthma and exclusive breastfeeding. Relationship of breastfeeding with the incidence of allergy has been discussed in various studies. Exclusive breastfeeding until the age of 6 months is believed to influence the immune response. A number of studies have reported that exclusive breastfeeding for 4-6 months prevents the onset of atopy and asthma in children.[16] A study in Sweden found that exclusive breastfeeding prevented the development of allergic diseases such as atopic dermatitis, asthma, and allergic rhinitis.[17] However, another study of 200 newborns found that breastfeeding ≥9 months was associated with increased prevalence of atopic dermatitis and food allergy.[18]

Exposure to pollution is thought to influence allergic disease. Studies that assessed the relationship of pollution and cigarette smoke exposure to the incidence of allergies found that exposure to pollution and cigarette smoke were prenatal risk factors for wheezing and asthma in children at preschool age.[19] In our study, however, 8 (15%) children exposed to pollution were found to have asthma, based on the ISAAC questionnaire, but the association was not significant.

A limitation of our study was that spirometry, as the gold standard test to confirm asthma in children, was not done, so there is a possibility of asthma misdiagnoses. Further studies using complete examinations including spirometry, peak flow meters and skin prick tests are needed to confirm the diagnosis of asthma and allergies.

In conclusion, we observe that significantly more atopic children in the <3 siblings group have asthma than those in the ≥3 siblings group.

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