



The Effects of Secondhand Smoke Exposure on Serum Immunoglobulin E Levels among Children of Elementary School

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Abstract

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BACKGROUND: Allergic diseases have been increasing in prevalence during the last decades and could be due to environmental exposure changes. Studies have shown that a leading smoke exposure implicated in alterations in humoral and cell-mediated immunity and the development of allergic conditions, including the production of serum immunoglobulin E (IgE).

AIM: The aim of the study was to determine the association between environmental secondhand smoke exposure and total IgE levels in serum among children of elementary school.

METHODS: An observational study with a cross-sectional approach. Children who were 10–12 years old (n = 86) were assessed using the ISAAC questionnaires and smoke exposure questionnaires. Blood samples were collected for the quantitative measurement of total IgE with the IMMULITE 2000 System analyzers by Prodia Laboratory.

RESULTS: In this study, carried out of 86 children with secondhand smoke exposure. In addition, the smoke exposure divided into two categories, rarely and often. There were 49 children (56.9%) shows higher than the standard of IgE levels. There was no statistically significant association between secondhand smoke exposure and IgE levels with p = 0.501.

CONCLUSION: Children with secondhand smoke exposure, asthma history, and rhinitis allergy showed higher than standard of IgE levels, but it was not statistically significant.

Introduction

Smoking has become a part of the lifestyle. Tobacco smoke exposure remains common and has been linked with an increased risk of multiple upper respiratory diseases, which causes severe conditions of various respiratory tract disorders and increases the dose of medicine therapy [1], [2]. Smoking activity not only bad for smokers but also has an impact for secondhand smoke. Significant impacts have been identified between tobacco smoke exposure and chronic sinusitis [3], asthma [4], allergic dermatitis, food allergy, and allergic rhinitis [5], [6].

Tobacco smoke contains irritants particle, such as sulfur dioxide, nitrogen that can affect the respiratory tracts and increase the activity of Th2 and immunoglobulin E (IgE) production. The high production of IgE caused by various mechanisms and local inflammation in the respiratory tract by smoke exposure. Therefore, frequents of smoke exposure, especially in the contact between tissues and allergen, could impact stimulating an immune system [7].

IgE is a mediator with a quick type of hypersensitivity, including asthma, allergic rhinitis, atopic dermatitis, and urticaria. The high production of

IgE stimulated the cell membrane with the interaction between allergens that can produce specific IgE, mast cells, or basophils [8], [9]. The potential factors of high IgE production are allergens and environmental factors, including smoke exposure. On the other hand, the disrupted epithelial junctions can enhance airway inflammation and facilitate the release of allergen granules [8]. This study aims to determine the association between environmental secondhand smoke exposure and total IgE levels in serum among children of elementary school.

Methods

The research design in this study was observational research with a cross-sectional approach to evaluate the effect of tobacco secondhand smoke exposure on serum IgE level among children of elementary school. The smoke exposure was classified into two categories rarely and often that collected by secondhand exposure questionnaires. We also collected the ISAAC questionnaires focusing on symptoms

of asthma, rhinitis, and eczema. The total IgE level examined from blood samples using the enzyme-linked immunosorbent assay (ELISA) method (ELISA kit for Human IgE total: Diagnostic Automation, Inc., Catalog No.: 1801Z). The result of IgE level divided into two categories are "higher than standard" and "normal" category. The value of the IgE level was categorized as "higher than standard" if the total IgE concentration was ≥ 100 IU/mL. Meanwhile, it was classified as "normal" if the total IgE concentration was < 100 IU/mL.

Subjects

According to sample size formulation by Lameshow and David, the researchers found the number of minimal sample size was 77 with consecutive sampling [10]. The inclusion criteria for this study were children who were 10–12 years old that already had informed consent from parents and free from helminth infection with feces examination by Kato method. Meanwhile, the exclusion criteria are children that have a history of severe allergies/anaphylaxis, consumed anti-allergic drugs. This research has received ethical clearance from the Faculty of Medicine and Health Sciences Universitas Muhammadiyah Yogyakarta with number 239/EP-FIKI-UMY/IV/2017.

Statistical analysis

The results in this study were managed electronically using SPSS software (Statistical Product for the Social Science)[®] version 23.0. The statistical analysis used Chi-square statistical test to identify the relationship between tobacco smoke exposure and IgE levels.

Results

Subject characteristics

The study was conducted on 86 students of 6th grade at Sukonandi Muhammadiyah Elementary School in Yogyakarta, Indonesia. The male students were 39 (45.3%) and the female student was 47 students (45.7%). Based on age, 10-year-old respondents were 8 students (9.3%), 11-year-old respondents were 64 students (74.4%), and 12-year-old respondents were 14 students (16.3%) (Table 1).

The IgE levels examination result showed two categorized in the normal IgE levels were 37 students (43.1%) and higher than the standard level of IgE were 49 students (56.9%). On the IgE examination, the mean total IgE level in the serum of all students was 508.2 IU/mL. The classification of IgE levels is shown in Figure 1.

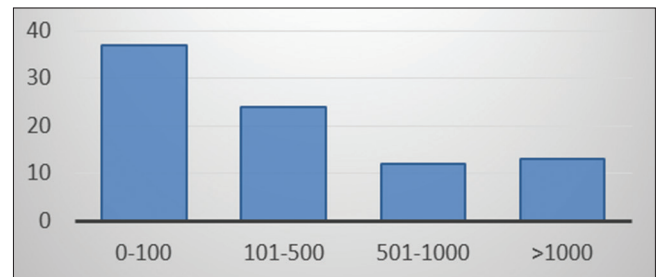


Figure 1: The result of IgE examination (IU/mL)

All children were reported that they obtained secondhand smoke exposure. The highest exposure to secondhand smoke was in public places. The association between exposure and IgE levels was shown in Table 2.

Table 1: Subjects' characteristics

Characteristic	n	Percentage
Gender		
Male	39	45.3
Female	47	45.7
Age		
10 years	8	9.3
11 years	64	74.4
12 years	14	16.3
Immunoglobulin E level		
Normal	37	43.1
Higher than standard	49	56.9
Secondhand smoke exposure		
Rarely	37	43.1
Often	49	56.9
Place exposure		
Home	40	46.5
Public	46	53.5
Rhinitis		
Yes	72	83.7
No	14	16.3
Asthma		
Yes	22	25.6
No	64	74.4

According to ISAAC questionnaires, the researcher identified the allergic disease symptoms of asthma and allergic rhinitis that influenced the IgE level with Chi-square. Based on the report, there were no statistically significant associations showed in Tables 3 and 4.

Table 2: The relationship between smoke exposure and immunoglobulin E serum

Parameter	Immunoglobulin E normal	Immunoglobulin E higher than standard	P-value
SHS			
Rarely	15	22	0.501
Often	22	27	CI 0.352–1.987 OR 0.837

Discussion

In this study was participated by 86 students. All students were exposed to secondhand smoke caused by public smokers and family smokers. In the family area, the research by Warren *et al.* [11] show the data about a variety of secondhand smoke exposure children in their homes varies from 27.6% in Africa, 34.3% in Southeast Asia, 50.6% in Western Pacific, and up to 77.8% in Europe.

Table 3: The relationship between allergic rhinitis history and IgE serum

Parameter	IgE normal	IgE higher than standard	p-value
Allergic rhinitis			
No	6	8	0.055
Yes	31	49	CI 0.862–24.001 OR 4.548

IgE: Immunoglobulin E.

Children are the most susceptible population on the harmful effects of tobacco smoke. Although there were many evidences showing that tobacco smoke exposure is detrimental to children's health. Besides that, the impact of tobacco smoke exposure on the regulation of IgE that mediated by immune responses to specific allergens has not been well documented [12].

Table 4: The relationship between asthma history and IgE serum

Parameter	IgE normal	Higher than standard	p-value
Asthma			
No	30	34	0.291
Yes	7	15	CI 0.680–5.258 OR 1.891

IgE: Immunoglobulin E.

The different explanation above, in this study, showed that the highest exposure to secondhand public places was 53.5%. In line with the research in Korea conducted by Hwang *et al.* conclude that exposure to secondhand smoke in public places is higher than at home. Although smoking policies decreased in smoke tobacco exposure, children were exposed significantly not only in their homes but also in schools, restaurants, child-care house facility, cars, buses, and other public places [13].

This study showed that children with total serum higher than the standard of IgE levels were 56.9%. The high standard level in line with research by Se-Ryun Kwon *et al.* showed that a high prevalence of allergic rhinitis, asthma, and atopic dermatitis in subjects exposed to passive smoking, compared to subjects not exposed to passive smoking. However, the difference was significant only for atopic dermatitis [9].

The secondhand tobacco smoke exposure association with IgE levels was not statistically significant ($p = 0.501$). It is similar to the study in Taiwan showed that there was no effect of tobacco smoke exposure with IgE levels [12]. In the Shargorodsky study, there was no influence between tobacco smoke exposure and IgE levels. Moreover, he revealed that exposure to contradictory tobacco smoke decreased IgE levels [1].

The other literature concluded that in allergic conjunctivitis cases, individuals with exposure to pet(s) and smoke at home were more likely to have high IgE levels compared to those who were not exposed [14]. Moreover, hereditary and lifestyle factors, such as farming environment, smoking, family members, body weight, or frequency of colds, significantly influenced the development of allergen-specific IgE in adolescents [15], [16].

This study invents the children with asthma and rhinitis history had higher than the standard level of IgE serum but not statistically significant ($p = 0.055$,

$p = 0.219$). It is different from the study by Froidure *et al.* [17] that showed an epidemiological association between IgE production and asthma. It is caused by allergen-specific IgE as mediate asthmatic responses in allergic individuals. Furthermore, the relationship between IgE responses and clinical expression of asthma integrated several co-factors influencing airway reactivity and asthma persistency.

Conclusion

Children with secondhand smoke exposure, asthma history, and rhinitis allergy showed higher than standard level IgE. However, it was not statistically significant.

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