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The impact of age, gender, family history of allergy, clinical symptoms, and duration of illness on flare diameter of skin prick test

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ABSTRACT

Introduction: Skin prick test (SPT) is a method for diagnosing IgE-mediated allergen sensitization. Although the sensitivity and specificity are quite good, false positive and false negative results are possible. The diameter of the wheal and flare of each allergen can affect the skin prick test measurement, especially if the results of the examination overlap. Because of the usage of the SPT and the emphasis on quality control of health services recently, several variables that can affect the results of SPT must be considered. This study aims to analyze the effect of age, gender, family history of allergy, clinical symptoms, and illness duration on SPT's flare diameter.

Method: This is a cross-sectional study conducted from 2015 to 2020 in Surabaya, Indonesia. Children with possible allergies were tested with a skin prick test at the allergy immunology outpatient clinic of the Dr. Soetomo General Academic Hospital. Inclusion criteria were ≤ 18 years old children, possibly diagnosed with allergies, who had skin prick test. Children with incomplete medical record data were excluded. The Chi-square test or Fisher exact test to determine the relationship between the independent and dependent variables for nominal data. The p-value was declared significant if $P<0.05$ to determine the effect between variables on flare diameter on skin prick test. We use SmartPLS to analyse the relationships simultaneously to compare relationships with the regression analysis.

Result: Age, gender, clinical symptoms, and duration of illness did not show a significant effect. In contrast, the flare diameter determined by SPT and the presence of an allergic family had a significant correlation ($p = 0.017$). Therefore, the appropriate distance between allergens must be specified to prevent overlap of SPT flare diameters.

Conclusion: Member of family allergy affects the diameter of the flare on skin prick test.

Keywords: Skin prick test, flare diameter, distance allergens.
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INTRODUCTION

Skin prick test (SPT) has become a method for diagnosing the presence of IgE-mediated allergen sensitization.[1] The sensitivity and specificity of the SPT are quite good, but the possibility of false positives and false negatives can still occur.[2] The diameter of the wheal (lump) and flare (redness) in each allergen can affect and correlate with the SPT measurement. The most typical mistake is placing the SPT reagents too closely together (2 cm), causing the wheal and flare to overlap and become impossible to distinguish visually.[3,1] Age, gender, and illness duration should all be considered in studies on the distance between instillation points.[4] The factors that affect the outcomes of SPT are also taken into consideration, along with increasing the usage of SPT and paying attention to quality control of health services. The variables that affect the outcomes of SPT should also be taken into consideration due to the growing use of SPT and the focus on quality control of health services.

SPT examination has been known since 1860. This examination is still the method of choice for a variety of type I allergic reaction symptoms, including drug and food allergies, urticaria, asthma, rhinoconjunctivitis, and atopic dermatitis.[1] The diagnosis of SPT develops as the incidence of allergies in children increases. The increasing prevalence of allergic diseases globally has occurred in around 30-40% of the world's population and is influenced by one or more allergic conditions. The increase in cases primarily affects young people. About 87 million people in Europe suffer from allergies, with one in four youngsters experiencing the most of this increase.[5]

The SPT's positive results and reactivity are influenced by age and gender. SPT examination should be performed on children over the age of 6 months, although it can be done at a younger age. Different reactivity can be caused by the place of the skin where the SPT is conducted. The dorsal surface of the forearm is more reactive than the volar surface. More typically, the volar region of the forearm, 5 cm from the wrist and 3 cm from the antecubital fossa is employed.[6] Various SPT recommendations worldwide propose a gap of at least 2 cm between allergen instillation spots to avoid overlapping allergic reactions and cross-

reactivity amongst allergens.[3,1] The recommended SPT distance ranges from 2 to 5 cm. However, this does not rule out the likelihood of false positive reactions in adjacent locations.[7] The flare mechanism is closely related to the hypersensitivity reaction. After the instillation of allergens, mediators released by mast cells induce axonal reflexes by direct stimulation of c-fibers. This process will induce the release of neurogenic peptides and mast cell mediators from subsequent mast cells. The release will trigger the formation of flares.[8,9]

Standardization of the SPT and standard panels for different geographic locations is recommended worldwide to enable better comparisons for diagnostic purposes. The existence of overlapping flares will cause a cross-reaction with the adjacent allergen or vice versa, causing false positives or false negatives. This encourages researchers to discover the necessary standard distance between allergens so that the distance between the relevant allergens can be used as a reference so that when a skin prick test is performed, the examination findings do not overlap.

The main objective of this study was to determine the effect of age, gender, duration of illness, family history of allergies, and clinical symptoms on the flares diameter of skin prick test in children with suspected allergies.

METHODS

This is a cross-sectional study conducted from 2015 to 2020 in Surabaya, Indonesia. Children with possible allergies were tested with a skin prick test at the allergy immunology outpatient clinic of the Dr. Soetomo General Academic Hospital. We obtained ethical feasibility from the Research Ethics Committee from the Clinical Research Unit of the Faculty of Medicine, Universitas Airlangga, Indonesia (Number 0844/LOE/301.4.2/III/2022). The study sample was all children with suspected allergies referred to allergy subspecialists at the Pediatric Allergy Immunology Outpatient Clinic. Skin prick tests were used to establish the diagnosis of allergy.

Data analysis

Inclusion criteria were ≤ 18 years old children, possible diagnosed with allergies who had skin prick test. Children with incomplete medical record data were excluded. Before analyzing the data, a matching process on age, gender, duration of illness, family history of allergies, and clinical symptoms. The skin prick test data were obtained from the medical records of pediatric allergy-immunology outpatient clinic of Dr. Soetomo General Hospital from January 2015 to December 2020. Prior to data analysis, a matching process was conducted using age, gender, duration of illness, family history of allergies, family members with a history of allergies, number of children and clinical symptoms. In this present study, a total of 509 subjects met inclusion criteria. The data would be sorted, coded, and entered into the Statistic program for social science (SPSS) 18 version software. We used the Chi-square test or Fisher exact test to determine the relationship between the independent and dependent variables for nominal data. The p-value was declared significant if $P<0.05$ to determine the effect between variables on flare diameter on skin prick test. We use SmartPLS to analyse the relationships simultaneously to compare relationships with the regression analysis.

RESULTS

This study enrolled 509 kids who had allergies or were thought to have allergies, and we found 58.5% were boys. Children aged 6 to 10 made up the majority of the age group, with a mean age of 5.4 years. In 78.8% of children, an allergy history in the family was discovered. The majority of the kids (52.3%) were the family's firstborn. 33.2% of kids had allergies in either both parents or just one parent. As many as 9% of kids have a family history of allergies. Before the SPT was checked, the child had

Table 1. Baseline characteristics of children with suspected allergies.

Variables	Number (n = 509)	%
Gender		
Boys	298	58.5
Girls	211	41.5
Age at present SPT, mean (SD) years	5.4 (3.41)	
Age Category		
< 1 year old	38	7.5
1-5 t years old	201	39.5
6-10 years old	212	41.7
>10 years old	58	11.4
Duration of symptoms, mean (SD) months	41.1 (35.45)	
Family history of allergies		
Present	401	78.8
None	108	21.2
Family members with a history of allergies		
One of the parents	169	33.2
Both parents	169	33.2
Siblings	46	9
Others family	17	3.4
None	108	21.2
Children		
First	266	52.2
Second	168	33.0
Third	62	12.2
Fourth	11	2.2
Fifth	2	0.4

Table 2. Effect between variables on flare diameter on skin prick test.

Variables	P
Gender	0.991
Age	0.884
Long of illness	0.916
Clinical symptoms	0.273
Member of family allergy	0.017

symptoms for an average of 32 months.

Age, gender, clinical symptoms, and duration of illness did not show a significant effect (Table 2). It is important to set the proper distance between allergens to prevent flare diameter overlap during the skin prick test since there was a significant relationship between the flare diameter of the skin prick test and family history of allergy (p = 0.017).

DISCUSSION

Both industrialized and developing nations are seeing an increase in the prevalence of allergy disorders worldwide. Allergy disorders include asthma, allergic rhinitis, anaphylaxis, food allergies, drug or insect allergies, eczema, and urticaria.[10] About 9.2 million children aged 0 to 4 years old in the United States had allergic dermatitis in 2018. While there are 2.6 million or 7.6% of children aged 1 to 18 who have food allergies.[11] According to several Asian studies, between 1.3 and 4.8% of Thai children between the ages of 3 and 7 have food allergies. While in China, it was discovered that 7.7% of infants and toddlers had food allergies. Boys experience allergies at a higher rate than girls.[12] In this study, more male patients had allergy symptoms than female patients. This is consistent with earlier research. Most samples are between 6 and 10 years old, a little older than in earlier research. Different demographic characteristics may become the reason for this.

People with allergies develop allergies (atopy). If both parents have allergies, the likelihood of the child developing allergies is higher than if just one parent has allergies.[13] Children with Asian parents in Australia have a three-fold increased risk of allergies at age 12 compared to children with non-Asian parents.[12] In this study, the first offspring made up most of the samples with a family history of allergies.

There was a significant association between the SPT mean wheal diameters (MWD) and asthma at all ages and for both genders. However, the strength of this association was age and gender-dependent. For SPTs, the strength of the association between MWD and asthma increased with increasing age. Boys were significantly more likely to express clinical symptoms for any given SPT, particularly in early life. This difference between males and females appeared to diminish with age and was no longer significant by age 11.[7] The prevalence of atopy decreases with increasing age.[14] Gender was the only significant predictor of respiratory allergies at the evaluation at 5 years. Allergy in both parents is an independent predictor of eczema and allergic disease until age 2 and 5.[15] Age and gender must be considered when interpreting the results of allergy tests in the context of asthma during childhood.[6]

Children with food allergies are usually already on an elimination diet based on parental knowledge or recommendations from clinicians. The elimination diet will decrease the allergic sensitization of the food tested on the SPT. The duration of a food elimination diet can affect the width of the diameter of both wheal and flare. SPT flare size was significantly larger in children who failed oral food challenges (OFC) to egg, cow's milk and peanut, but larger flare size was not associated with epinephrine requirement. Flare size, in addition to wheal, may serve as a valuable predictive indicator for OFC outcomes.[16]

The SPT confirms sensitization to a specific allergen. However, its clinical relevance must be interpreted based on the medical history and clinical symptoms. The clinical relevance of SPT results varies, depending on the allergen utilized, and the population tested. The degree of skin test reactivity can be decreased in subjects with chronic illnesses such as renal failure or cancer.[1] Limitation of this study was used secondary data. Future research should be use primary data with a prospective cohort method.

CONCLUSION

Age, gender, clinical symptoms, and duration of illness did not affect the flares diameter of the skin prick test. Member of family allergy affects the diameter of the flare on skin prick test. The appropriate distance between allergens must be specified to avoid overlap of flare diameter of the skin prick test.

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CONFLICT OF INTEREST

The author declared that there is no conflict of interest in the research and writing of the publication.

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AUTHOR CONTRIBUTION

All authors contributed equally in conducting the study as well as writing and revising the manuscript

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