

TYPES OF IgE MEDIATED FOOD ALLERGY BASED ON SKIN PRICK TEST FOLLOWED BY FOOD PROVOCATION TEST IN EAST JAVA REGION-INDONESIA

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Abstract

Food allergy is medical condition when the immune system mistakenly perceives a particular food's ingredients as dangerous. The differences in the incidence and types of food allergens in different regions attract researchers to examine the foods that often cause allergies in Indonesia because it will help patients and clinicians to determine the types of food to be eliminated to reduce the impact of symptoms on patients. This study was conducted to know the most common types of food cause IgE-mediated food allergy based on skin prick followed by food provocation test. Our research was a descriptive retrospective study. Ages 0 to 18 were represented among the 143 samples that satisfied the inclusion criteria. The boy dominated the research subjects. The dominant age of the research subjects is 5-10 years. A total of 21 (14.7%) study subjects had parents and siblings with a history of atopy. This study showed that common food allergies were following eggs (25.2%), chocolate (20.3%), cow's milk (18.2%), chicken (17.5%), shrimp (14.7%), fish (12.6%), and fruit (10.5%). The result concludes that the most common food cause IgE-mediated food allergy in children in sequence: eggs, chocolate, cow's milk, chicken, shrimp, fish, and fruit.

Keywords: Food Allergy, Skin Prick Test, Provocation Test, Children, Good Health

1. Introduction

Globally, it is estimated that 4% of children suffer from a food allergy [3]. However, the data ranges from 1% to 10% because food allergy is described as an increasing disease over time. Around 2-10% of patients have food allergies in the United States of America, whereas, in children in the Canadian area, 7.1% of children have food allergies [15]. Meanwhile, in Indonesia, food allergies are around 5 to 11% [6].

Clinical history and physical examination are the basic methods for diagnosing food allergies. A skin prick test is recommended to identify the causative food in IgE-mediated food allergy [31][13]. Moreover, the oral provocation test is the gold standard for diagnosing food allergy, and the skin prick test is a prove of IgE-mediated sensitization [26][19].

Chen J et al. stated that estimates prevalence of food allergies worldwide would vary with different research methodologies and population factors [2]. The difference in incidence rates and different types of food allergens in several countries and regions attracts researchers to examine the foods that often cause

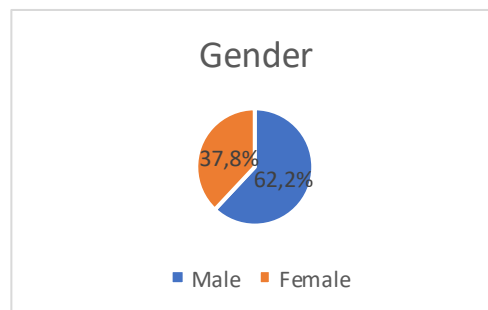
allergies in Indonesia, especially Surabaya, East Java. Knowing the types of food that often cause allergies will help allergic patients prevent eating the food causing it, thereby reducing the impact of symptoms and children's daily activities are not interfere [17]. In addition, knowing the food types will help clinicians determine the types of food to be eliminated when diagnosing patients.

2. Method

Our study used a retrospective method, with the types of descriptive research. We used secondary data, namely reading the data related to gender, age, family history of allergies, skin prick test results, and results of food provocation tests in allergy logbooks for food allergy patients at the clinic of Allergy-Immunology, Soetomo General Hospital in November 2021 until June 2022. The sampling technique used all samples that met the inclusion criteria. Variables will be collected in the Microsoft Excel application, processed using Statistical Package for the Social Sciences application, and presented in a table and diagram.

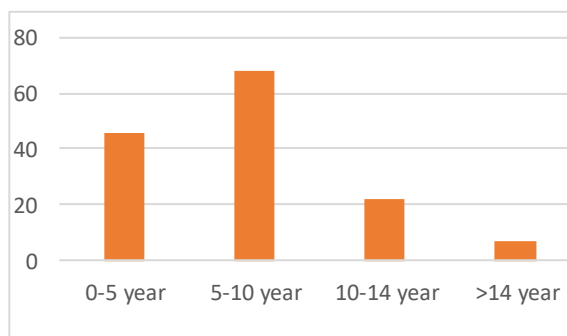
3. Result and Discussion

Diagram 5.1: Data Distribution of Research Subjects Based on Gender



Allergic sensitization is significantly high in males and will persist until puberty [16]. Our study showed that boys dominated food allergy patients; as many as 89 people (62.2%) and only 54 (37.8%) were female.

Diagram 5.2: Data Distribution of Research Subjects Based on Age



In our study, food allergy was dominated by children aged 5-10, with 68 patients (47.55%). Cow's milk often reaches tolerance at 2-3 years old. However, some foods, such as shrimp, reach tolerance in older children and sometimes persist throughout life [27].

Table 5.1: Data Distribution of Research Subjects Based on Family Atopy

Sibling (n=143)	Parent (n=143)		Total
	Positive	Negative	
Positive	21 (14.7%)	6 (4.2%)	27 (18.9%)
Negative	68 (47.5%)	48 (33.6%)	116 (81.1%)
Total	89 (62.2%)	54 (37.8%)	143 (100%)

Genetic factors may increase the risk of food allergies. Genetic factors are the talent for allergic diseases that both parents inherit [14]. If both parents do not have a history of allergies, then the possibility of children developing allergies is only 12.5%. A child's allergy probability will rise to 19.8% if one of the parents suffers from allergies. In addition, if there is a sibling with a history of allergies, the possibility of the child being allergic is 30%, and if both parents suffer from allergies, the possibility of the child suffering from allergies increases again to 42.9% [24]. In our study, 21 (14,7%) samples have parents and siblings with a history of atopy.

Table 5.2: All Allergens from Skin Prick and Provocation Test

Food Allergens	n (%)
Eggs	36 (25.2%)
Chocolate	29 (20.3%)
Cow's milk	26 (18.2%)
Chicken	25 (17.5%)
Shrimp	21 (14.7%)
Fish	18 (12.6%)
Fruit	15 (10.5%)

Eggs and cow's milk allergies are common in infants in Asia [10]. Lao-araya and Trakultivakorn reported that Thailand's three main food allergies are shrimp, milk, and eggs [9]. Based on this study, 25.2% of samples have a food allergy to eggs. In 29 study samples (20.3%), chocolate is the second most frequent allergen that triggers allergic reactions after eggs. Twenty-six samples (18.2%) had positive results for milk allergy.

Table 5.3: Cow's Milk Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	26 (18.2%)	40 (28.0%)	66 (46.2%)
Negative	22 (15.4%)	55 (38.4%)	77 (53.8%)
Total	48 (33.6%)	95 (66.4%)	143 (100%)

Children younger than 36 months old frequently have cow's milk allergies, and the prevalence is consistent across all age groups [25]. Siregar said that 89% percent of cow's milk allergies would be tolerant for children 2-3 years old [22]. According to our study, 18.2% of the samples had a cow's milk allergy. Compared to other

countries, the prevalence of cow's milk allergy is lower because many people in Indonesia do not like to drink cow's milk for various reasons, such as diarrhea, the smell of fishy milk, and others [1].

Table 5.4: Chocolate Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	29 (20.3%)	27 (18.8%)	56 (39.1%)
Negative	25 (17.5%)	62 (43.4%)	87 (60.9%)
Total	54 (37.8%)	89 (62.2%)	143 (100%)

The prevalence of chocolate allergy reaches 20.3%, and it is the second most common allergy. In allergic rhinitis patients at Dr. Cipto Mangunkusumo Hospital, the prevalence of chocolate allergy reaches 32% [5]. Chocolate allergy prevalence is relatively high in Indonesia. It is because the food from chocolate varies, and Indonesian children are very fond of chocolate.

Seafood allergy is a typical food allergen in Asia-Pacific [21]. The prevalence of shrimp reaches 14.7%. In Thailand, shrimp are reported often to cause more allergic reactions in children aged 3 to 6 years [18]. Some seafood contains the protein tropomyosin, such as Arthropods (crustaceans, HDM, cockroaches) and mollusks. The protein arginine kinase and tropomyosin in seafood expose humans to seafood allergies through ingestion and inhalation [27].

Table 5.5: Shrimp Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	21 (14.7%)	32 (22.4%)	53 (37.1%)
Negative	31 (21.7%)	59 (41.2%)	90 (62.9%)
Total	52 (36.4%)	91 (63.6%)	143 (100%)

Fish allergy in Malaysia was reported in 19% of children [7]. Fish allergy in our study noted 18 children (12.6%). Fish allergy prevalence is high in several countries in Asia due to seafood consumption in Asia being well above the global average due to its coastal geographic location and rich seafood supply. It significantly impacts the sensitization of fish in Asians [28].

Table 5.6: Fish Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	18 (12.6%)	45 (31.5%)	63 (44.1%)
Negative	22 (15.4%)	58 (40.5%)	80 (55.9%)
Total	40 (28.0%)	103 (72.0%)	143 (100%)

Table 5.7: Eggs Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	36 (25.2%)	39 (27.2%)	75 (52.4%)
Negative	10 (7.0%)	58 (40.6%)	68 (47.6%)

Total	46 (32.2%)	97 (67.8%)	143 (100%)
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Our study reported that 36 (25.2%) children had eggs allergy. Eggs were the food that caused the most allergic reactions in our study. The most common allergen under 3 years old in Singapore is eggs [11]. In Malaysia, children aged <2 years are more sensitive to eggs and milk allergies [30]. Chicken eggs caused allergic reactions in 26.7% of children in Thailand in the food provocation test [23]. Eggs are allergens that are very difficult to avoid. After all, eggs are often present as an ingredient mixed with several other ingredients in one food. In Saudi food allergy, the sensitivity of egg white is higher than egg yolk [20].

Table 5.8: Chicken Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	25 (17.5%)	35 (24.5%)	60 (42.0%)
Negative	17 (11.9%)	66 (46.1%)	83 (58.0%)
Total	42 (29.4%)	101 (70.6%)	143 (100.0%)

Chicken is the most popular meat eaten in this country. However, reports of allergy to chicken are still rare. Our study noted that 25 (17.5%) children were positive for chicken allergy based on the skin prick test and provocation test results. These results are similar to the prevalence of chicken allergy in Korea, which is 11.7% [8]. As an IgE-mediated food allergy, chicken allergy can occur as a secondary allergy in a person who is already allergic to eggs or as a primary allergy to poultry. Allergic reactions that appear to chicken allergy are not only symptoms mediated by IgE, but non-IgE-mediated allergic reactions also appear in chicken allergic patients [29].

Frequently reported fruit allergies are associated with oral allergy syndrome, which is also associated with the pollen-fruit-vegetable syndrome. Allergic reactions are triggered when consumed from raw vegetables or fresh fruits. It causes fruit allergy and is often associated with cross-reactions due to homologous proteins in plant foods and pollen [4]. Table 5.9 15 (10.5%) children in this study had fruit allergies. In Singapore, it was reported that 6% of children had an anaphylactic reaction to fruit [12].

Table 5.9: Fruit Allergens

Skin Prick Test (n=143)	Provocation Test (n=143)		Total
	Positive	Negative	
Positive	15 (10.5%)	26 (18.2%)	41 (28.7%)
Negative	15 (10.5%)	87 (60.8%)	102 (71.3%)
Total	30 (21.0%)	113 (79.0%)	143 (100%)

4. Conclusion

The most common types of food that cause IgE-mediated food allergy based on skin pricks followed by food provocation test in the outpatient clinic of Allergy-Immunology, Department of Pediatric, Dr. Soetomo General Hospital in sequence, namely eggs, chocolate, cow's milk, chicken meat, shrimp, fish, and fruits.

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References

- [1] Candra Y, Setiarini A, Rengganis I. 2015. 'Gambaran Sensitivitas Terhadap Alergen Makanan'. *Jurnal Makara Kesehatan*. vol.15(1): 44-50.
- [2] Chen J, Hu Y, Allen KJ, Ho MH, Li H, 2011. 'The prevalence of food allergy in infants in Chongqing, China'. *Pediatr Allergy Immunol*. vol. 22(4):356-60.
- [3] Elghoudi A, Narchi H. 'Food allergy in children-the current status and the way forward'. *World J Clin Pediatr*. vol. 11(3):253-269.
- [4] Harsono G, Munasir Z, Siregar SP, Suyoko HD, Kurniati M, Evalina R, Palupi RD. 2007. 'Faktor yang Diduga Menjadi Resiko Pada Anak dengan Rinitis Alergi di RSUD. Cipto Mangunkusumo Jakarta'. *Jurnal Kedokteran Brawijaya*. vol. 23(3).
- [5] Hassan AKG, Venkatesh YP. 2015. 'An overview of fruit allergy and the causative allergens'. *Eur Ann Allergy Clin Immunol*. vol. 47(6): 180-187.
- [6] Hendra. 2020. 'Peran Imunoterapi Pada Tatalaksana Alergi Makanan'. *Jurnal Kedokteran Raflesia*. vol. 6(2).
- [7] Ibrahim IS, Baharudin N, Isa MR, Ismail IH, Mohamed-Yassin MS, Kamarudin IK, Abdul Latiff AH, Zahedi FD, Ali A, Arshad AI. 2013. 'Adaptation, Translation and Validation of the Food Allergy Quality of Life Questionnaire-Parent Form (FAQLQ-PF): The Malay Version'. *Children (Basel)*. vol. 8(11): 1050.
- [8] Kwon J, Kim J, Cho S, Noh G, Lee SS. 2013. 'Characterization of food allergies in patients with atopic dermatitis'. *Nutrition Research Practice*. vol. 7(2): 115-21.
- [9] Lao-araya M, Trakultivakorn M. 2011. 'Prevalence of Food Allergy Among Preschool Children in Northern Thailand'. *J Clin Immunol*. vol. 127(2).
- [10] Lee A, Thalayasingam M, Lee B. 2013. 'Food allergy in Asia: how does it compare'. *Asia Pac Allergy*. vol. 3(1): 3-14.
- [11] Lee AJ, Shek LP. 2014. Food allergy in Singapore: opening a new chapter. *Singapore Med J*. vol. 55(5): 244-7.
- [12] Liew WK, Chiang WC, Goh AE, Lim HH, Chay OM, Chang S, Tan JH, Shih E, Kidon M. 2013. 'Paediatric anaphylaxis in a Singaporean children cohort: changing food allergy triggers over time'. *Asia Pac Allergy*. vol. 3(1): 29-34.
- [13] Lubis A, Barlianto W, Endaryanto A, Harsono, A. 2017. 'Compatibility of Clinical Manifestation with Skin Prick Test Result and Food Provocation Test in Food Cross Reaction'. *Berkala Ilmu Kesehatan Kulit dan Kelamin*. vol. 29(2): 106-116.
- [14] Paramita A, Budiono, Endaryanto A. 2015. 'Riwayat Alergi Pada Orang Tua, Pola Penyusuan Asi, dan Penyakit Alergi Atopi pada Bayi dan Anak Balita: Penelitian Case Control di Poli Anak RSUD Dr. Soetomo. Juxta. vol. 7(1): 59-66.
- [15] Putera AM, Irwanto, Maramis MM. 2020. 'The Success of Elimination Diet in Indonesian Children with Food Allergy: The Role of Caregiver's Stress, Family Activities, and Coping'. *Sys Rev Pharm*. vol. 11(11): 1604-1611.
- [16] Rosário CS, Cardozo CA, Neto HJC, Filho NAR. 2021. 'Do gender and puberty influence allergic diseases?'. *Allergologia et Immunopathologia*. vol 49(2).
- [17] Salsabila HY, Azwin Mengindra Putera AM., Baskoro A. 2021. 'Correlation between nutritional status and children's activity with food allergy: A cross-sectional study'. *Annals of Medicine and Surgery*. vol. 68: 102652.
- [18] Santadusit S, Atthapaisalsarudee S, Vichyanond P. 2005. 'Prevalence of adverse food reactions and food allergy among Thai children'. *J Med Assoc Thai*. vol. 88(8): 27-32.
- [19] Savitri CMA, Lubis, AMP, Soegiarto G. 2018. 'Food allergies in children: a comparison of parental reports and skin prick test results'. *Paediatrica Indonesiana*. vol. 58:59-65.
- [20] Shakoor Z, Almogren A, Mohammed R, Hasanato W, Zahid B. 2014. 'Screening for hen's egg and chicken meat specific IgE antibodies in Saudi patients with allergic disorders'. *Afr Health Sci*. vol. 14(3): 634-40.
- [21] Shek LP, Cabrera-Morales EA, Soh SE, Gerez I, Ng PZ, Yi FC, Ma S, Lee BW. 2010. 'A population-based questionnaire survey on the prevalence of peanut, tree nut, and shellfish allergy in 2 Asian populations'. *The Journal of Allergy and Clinical Immunology*. vol. 126(2): 324-31, 331.e1-7.
- [22] Siregar SP. 2001. 'Alergi Makanan pada Bayi dan Anak'. *Sari Pediatri*. vol. 3(3): 168-174.
- [23] Sripramong C, Visitsunthorn K, Srisuwatchari W, Pacharn P, Jirapongsananuruk O, Visitsunthorn N. 2022. 'Food sensitization and food allergy in allergic Thai patients from a tertiary care center in Thailand'. *Asian Pacific Journal of Allergy and Immunology*. vol. 40(2): 147-154.
- [24] Suwoyo S, Rahmanningtyas I. 2017. 'Hubungan Pemberian ASI Eksklusif dengan Kejadian Alergi pada Bayi dan Anak Usia 7-60 Bulan di RSIA Kota Kediri'. *Jurnal Ilmu Kesehatan*. vol. 4(2): 41 – 50.
- [25] Tanukusumah M, Kurniati N, Amelia N. 2015. 'Prevalensi Alergi Makanan pada Anak Usia Kurang dari 3 Tahun di Jakarta Berbasis Survei dalam Jaringan/Online'. *Sari Pediatri*. vol.16(5).
- [26] Valenta R, Hochwallner H, Linhart B, Pahr S. 2015. 'Food allergies: the basics'. *Gastroenterology*. vol. 148(6): 1120-1131.

- [27] Wai CYY, Leung NYH, Chu KH, Leung PSC, Leung ASY, Wong GWK, Leung T. 2020. 'Overcoming Shellfish Allergy: How Far Have We Come?'. *Int J Mol Sci.* vol. 21(6): 2234.
- [28] Wai CYY, Leung NYH, Leung ASY, Wong GWK, Leung TF. 2021. 'Seafood Allergy in Asia: Geographical Specificity and Beyond'. *Front Allergy.* vol. 2.
- [29] Wanniang N, Codreanu-Morel F, Kuehn A, Morisset M. 2022. 'Poultry Meat allergy: a Review of Allergens and Clinical Phenotypes'. *Curr Treat Options Allergy.* vol. 9: 187–203.
- [30] Yadav A, Naidu R. 2015. 'Clinical manifestation and sensitization of allergic children from Malaysia'. *Asia Pac Allergy.* vol. 5(2): 8-83.
- [31] Yu W, Freeland D, Nadeau K. 2016. 'Food allergy: immune mechanisms, diagnosis, and immunotherapy'. *Nat Rev Immunol.* vol. 16(12): 751–765.