Original Article

Prevalence of Allergen Sensitization from Allergen Skin Prick Test Reactivities of Allergic Rhinitis Patients in the MSMC

Panuwat Wongwattana, MD[1], Pannipa Wiriyaamornchai, MD[1], Apisara Phuawongphat[2], Ploychanok Cherngwiwatkij[2], Parod Teantunyakij[2], Photsathorn Haetanurak, MD[1], Ravisara Opascharoenkij, MD[1]

[1] Department of Otolaryngology, Faculty of Medicine, Srinakharinwirot University, Nakhon Nayok, Thailand
[2] Medical Degree Program, Faculty of Medicine, Srinakharinwirot University, Bangkok, Thailand

Background: Allergic rhinitis is commonly found in Thailand and its prevalence seems to be higher in each area with the commonly found allergens and different characteristics of the population.

Objective: To study the prevalence of each type of allergen from a skin prick test carried out among patients with allergic rhinitis in HRH Princess Maha Chakri Sirindhorn Medical Center (MSMC), Nakhon Nayok Province, Thailand.

Materials and Methods: The study was conducted using a descriptive cross-sectional study design. Retrospective data were collected from the medical records of all patients with allergic rhinitis who took a skin prick test at the Department of Otolaryngology, MSMC between 1 April 2016 and 31 March 2021. The results of the prevalence of allergens were reported in terms of numbers and percentages. Skin prick tests giving positive results among patients with allergic rhinitis were compared to the test results of patients with allergic rhinitis and asthma.

Results: In total, 304 subjects diagnosed with allergic rhinitis who took a skin prick test met the criteria for inclusion in the present study, 207 were female (68.09%). Their mean age was 39.65±12.32 years old. The study found that 198 (65.13%) patients had positive results from of the test. The standardized mite mix was the most common allergen (55.92%), followed by American cockroach (37.82%), Johnson grass (5.59%), mixed Aspergillus (3.95%), and dog epithelium (1.32%). The patients with allergic rhinitis and asthma had a higher incidence of positive results than the patients with allergic rhinitis alone (risk difference was 13.36%, 95% CI 5.06 to 21.66, p-value = 0.005).

Conclusion: The present study revealed that the prevalence of a positive skin prick test response was 65.13% of patients diagnosed with allergic rhinitis. The standardized mite mix was the most frequently found allergen, followed by American cockroach, Johnson grass, mixed Aspergillus, and dog epithelium.

Keywords: Skin test; Allergens; Allergic rhinitis; Prevalence

J Med Assoc Thai 2022;105(Suppl.1): S100-6
Website: http://www.jmatonline.com

Allergic rhinitis is commonly found across the world[1,2], with a prevalence in adults of up to 40% worldwide[3]. In Asia, the prevalence is typically high: 53% in Malaysia[4], 50.1% in Taiwan[5], 27% in Korea[6], 25.6% in Singapore[7], and 42% in Thailand, according to a study conducted by Bunnag[8]. Allergic rhinitis occurs when the body reacts to allergens. Allergens stimulate the production of antigen specific IgE antibodies that can bind to mast cells, causing histamine release in the body and leading to signs and symptoms of allergic rhinitis[2]. Common symptoms of the diseases include an itchy nose, stuffed nose, sneezing or continuous sneezing, and rhinorrhea (thin, mostly clear nasal discharge), which may include other symptoms such as a reduced sense of smell, postnasal dripping; while the signs of the disease include swollen nasal mucosa, pale or dark nasal mucosa, clear mucous, polypoid mucosa, or a nasal polyp[1,2,9].

Diagnosis involves history taking and a physical examination or is performed through special tests, such as a skin prick test, intradermal test, or serum-specific IgE test[1,9]. The skin prick test typically gives a positive predictive value of 95 to 100%[10] and has a sensitivity and specificity greater than 80%[11-13].

The main treatments of allergic rhinitis involve the elimination, avoidance, or reduction of existing environmental allergens. Other treatments include the use of medications,

Correspondence to:
Wiriyaamornchai P.
Department of Otolaryngology, Faculty of Medicine, Srinakharinwirot University, 62 Moo 7 Ongkharak, Nakhon Nayok 26120, Thailand.
Phone: +66-37-395085 ext. 60703
Email: pw_pannipa@hotmail.com

How to cite this article:
Wongwattana P, Wiriyaamornchai P, Phuawongphat A, Cherngwiwatkij P, Teantunyakij P, Haetanurak P, Opascharoenkij R. Prevalence of Allergen Sensitization from Allergen Skin Prick Test Reactivities of Allergic Rhinitis Patients in the MSMC. J Med Assoc Thai 2022;105 (Suppl.1): S100-6.
doi.org/10.35755/jmedassocthai.2022.S01.00111

such as oral antihistamines, intranasal corticosteroids, nasal irrigation, and allergen immunotherapy[1,9].

The most important treatment for allergic rhinitis is allergen elimination and avoidance; however, in some patient's, observation of the allergens may be difficult, and an allergy test may be required, which will incur additional expenses, which may prohibit some patients from being able to access the right medical treatment. Further, different geographic areas of the country may have more frequently found allergens that are different to types found in other areas. Consequently, for the present study, the authors decided to study the skin prick test results of patients with in MSMC to obtain insights to be able to give advice to patients about the prevalence of the frequently found allergens in their area for their observation and avoidance of such allergens as disease stimulants. Most allergens causing the signs and symptoms of allergic rhinitis in our study population at the MSMC were existing environmental allergens, such as dust, dust mite, cockroach, animal dander, pollen, grass, and fungus.

Objective

To study the prevalence of each type of allergen from the allergy skin test results of patients with allergic rhinitis in the MSMC.

Materials and Methods

Study design and population

The present study was conducted using a descriptive cross-sectional design. Retrospective data were collected from the medical records of all patients with allergic rhinitis who had taken an allergy skin test at the Department of Otolaryngology, MSMC, Nakhon Nayok Province, Thailand and who had received a treatment between 1 April 2016 and 31 March 2021. Convenient sampling was used to select the participants in the study. The study inclusion criteria were: 1) patients aged 15 to 60 years old, 2) patients with a history of being diagnosed with allergic rhinitis, and 3) patients who had taken a skin prick test. Exclusion criteria were: 1) patients prohibited from taking a skin prick test, i.e., pregnant patients, patients with immunodeficiency, and patients with severe chronic underlying diseases, such as unstable angina; 2) patients who did not stop all oral allergy medications 7 days prior to testing; 3) patients who did not stop all oral steroids (systemic corticosteroid) 3 weeks prior to testing; and 4) patients whose skin prick test results did not detect any allergens. Withdrawal or termination criteria included when it became known after the allergy skin test that the patient had not stopped taking their oral allergy medications and oral steroids and had experienced severe allergy symptoms after undergoing the skin prick test. The sample size estimation was calculated by the one-sample proportion test formula[14]. A previous study showed that the prevalence of a positive result for the skin prick test was 89%[15]. We calculated that we required a sample size of 208 patients to provide 90% power to detect a difference of 10% at a two-sided alpha of 0.05.

The Human Ethics Committee of Srinakharinwirot University approved the study (SWUEC-026/2563E). Informed consent was waived given the retrospective nature of the study.

Procedures

The authors sought out the medical records of patients accessing allergic rhinitis services and who had taken a skin prick test at the Department of Otolaryngology, MSMC. The patients were selected according to the inclusion and exclusion criteria. Data in the record forms were collected, comprising patient information and skin prick test information. The skin prick test procedures applied throughout the study period used the same standard method used by otolaryngologists in the Department of Otolaryngology, as follows: 1) first, a patient's medication history is assessed. Here, all oral antihistamines must be stopped 7 days before the test, while all oral steroids (systemic corticosteroid) must be stopped 3 weeks before, except for topical medications, such as intranasal corticosteroid; 2) solution are prepared with extracts from various types of allergens to be tested, including a positive control (histamine) and negative control (diluent); 3) patients are asked to put their arms on a table, turn the inside part of their arms to face up, and raise the ends of their arms up. The test area where the solution is to be dropped on is cleaned using a cotton pad and alcohol and then left to dry; 4) the drop solutions are numbered in sequence to identify the various types of dropped solution. Then, the drop solution and the control medications are applied according to their identified numbers. A 27 gauge needle is used to gently prick the surface of the skin without causing bleeding but so that a small amount of the allergen will seep into the skin; 5) after doing the same thing with all the numbered solutions, all the other solution are assessed, as well as the positive control and normal negative control 15 to 20 minutes after pricking[16]; 6) while waiting for the results, the patients are periodically observed to assess the appearance of any allergy symptoms. If symptoms occur, treatment is given immediately; 7) after a period the results are interpreted. Here, upon reaching the set time-mark (15 to 20 minutes after pricking the skin), the size of the positive and negative controls are measured first; in case of a positive reaction, wheals and flares will occur. The size around the wheals is measured by recording their greatest diameter in millimeters. If the greatest diameter is equal to or more than 3 mm, it is considered a positive result, meaning the patient is allergic to that type of allergen[16]; 8) after the testing is completed, the patient's skin is wiped with alcohol to clean the area. Patients are required to sit and wait for another 20 minutes to see if they have any adverse symptoms in the case of a positive result in conjunction with a history of asthma or anaphylaxis. If no adverse symptoms are shown, the patient can be discharged.

The allergy skin test solution used at the MSMC consists of seven types of test substances: a positive control, negative control, American cockroach, standard mite mix, mixed Aspergillus, dog epithelium, and Johnson grass (ALK

Abello, New York, USA).

Statistical analysis

Descriptive statistics were used to analyze the basic data, and categorical data were reported in the form of numbers and percentages. Continuous data were reported using the mean and standard deviation. The prevalence and 95% confidence intervals were calculated to estimate the prevalence of the skin prick test results among the patients. Pairwise comparison of the prevalence between the groups of patients with allergic rhinitis and patients with allergic rhinitis and asthma were performed by Fisher's exact test. Missing data were managed by listwise deletion. STATA version 14.0 (College station, TX) was used in the analysis. A p-value of less than 0.05 was considered statistically significant.

Results

In total, 366 patients were identified with allergic rhinitis and who had taken a skin prick test, of whom 62 were excluded from the study according to the exclusion criteria (e.g., skin prick test results were not detected). Consequently, the remaining 304 patients with allergic rhinitis were included in this study. Their mean age was 39.65±12.32 years old. There were 97 men (31.91%) and 207 women (68.09%). Information related to the patients' level of education, underlying diseases, history of drug allergies, history of taking a skin prick test, disease diagnosis, history of undergoing surgery, and complications from the skin prick test is shown in Table 1.

In the present study, 304 cases took a skin prick test, with 198 patients (65.13%, 95% CI 59.48 to 70.48) showing positive results from at least one type of test solution, while 106 patients (34.87%, 95% CI 29.52 to 40.52) did not show positive results from all the test solutions, except for the positive control, as seen in Figure 1.

The standardized mite mix allergen yielded the highest number of positive results (55.92%) followed by American cockroach (37.82%), Johnson grass (5.59%), and mixed Aspergillus, (3.95%), while the dog epithelium allergen

Table 1. Baseline characteristics of the patients included in the study

Variables	Total n (%) n=304	AR n (%) n=246	AR with asthma n (%) n=58	*p*-value
Gender				
Male	97 (31.91)	78 (31.71)	19 (32.76)	0.887
Female	207 (68.09)	168 (68.29)	39 (67.24)	
Education level				
Primary school	3 (0.99)	3 (1.22)	0	0.261
Secondary school and high school	95 (31.25)	78 (31.71)	17 (29.31)	
Bachelor's degree	197 (64.80)	160(65.04)	37 (63.79)	
Higher	9 (2.96)	5 (2.03)	4 (6.90)	
Comorbidity				
No	277 (91.12)	225 (91.46)	52 (89.66)	0.615
Yes	27 (8.88)	21 (8.54)	6 (10.34)	
History of drug allergies				
No	290 (95.39)	235 (95.53)	55 (94.83)	0.735
Yes	14 (4.61)	11 (4.47)	3 (5.17)	
Diagnosis				
AR only	252 (82.89)	205 (83.33)	47 (81.03)	0.519
AR with CRSsNP	47 (15.46)	36 (14.63)	11 (18.97)	
AR with CRSwNP	5 (1.64)	5 (2.03)	0	
History of nasal or sinus surgery				
No	301 (99.01)	243 (98.78)	58 (100)	1.000
Yes	3 (0.99)	3 (1.22)	0	
Complications from skin prick test				
No	304 (100)	246 (100)	58 (100)	-
Yes	0	0	0	

AR = allergic rhinitis; CRSsNP = chronic rhinosinusitis without nasal polyps; CRSwNP = chronic rhinosinusitis with nasal polyps

yielded the lowest number of positive results (1.32%), as seen in Figure 2.

The present study found that among the 58 patients (19.07%) with allergic rhinitis and asthma, 47 patients (81.03%) had positive results for at least one type of test solution. The standardized mite mix allergen yielded the highest number of positive results (72.41%) followed by American cockroach (51.72%), Johnson grass (6.90%), mixed Aspergillus (3.45%), and dog epithelium (0%).

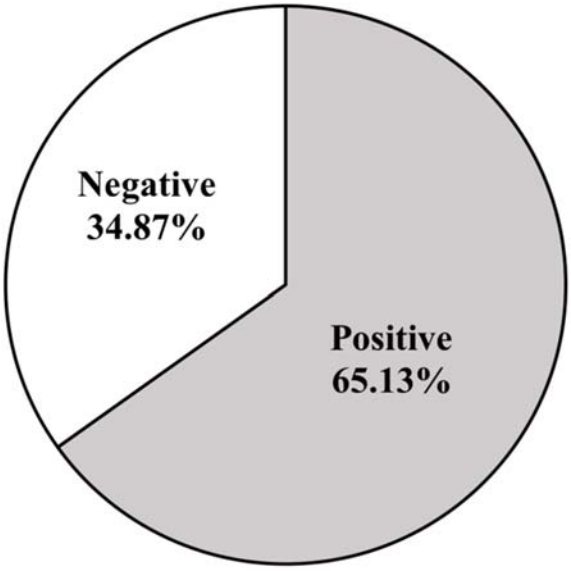

Figure 1. Skin prick test results of patients with allergic rhinitis.

Among the 246 patients with allergic rhinitis only, 151 patients (61.38%) had positive results for at least one type of test solution. The standardized mite mix allergen yielded the highest number of positive results (52.03%) followed by American cockroach (34.56%), Johnson grass (5.28%), mixed Aspergillus (4.67%), and dog epithelium (1.62%), as seen in Figure 3.

Comparison between the patients with allergic rhinitis and the patients with allergic rhinitis and asthma revealed that the patients with allergic rhinitis and asthma had higher positive results from at least one type of allergen from the skin prick test than the patients with allergic rhinitis only (risk difference was 13.36%, 95% CI 5.06 to 21.66, p-value = 0.005).

Discussion

The skin prick test was used as an allergy test in this study as it is a safe test with few systemic side effects. The type of allergens that can be detected with this test are inhalants, food, drugs, and occupational allergens[16,17]. This method is a convenient screening method with a reasonable price for diagnosing allergies. It utilizes the IgE-mediated reaction and has high sensitivity and specificity[16,18].

In this study, there was a high rate of positive results to at least one allergy skin test solution (65.13%). Indoor allergens were the leading causes of allergy among the sample cohort, with the standardized mite mix the most

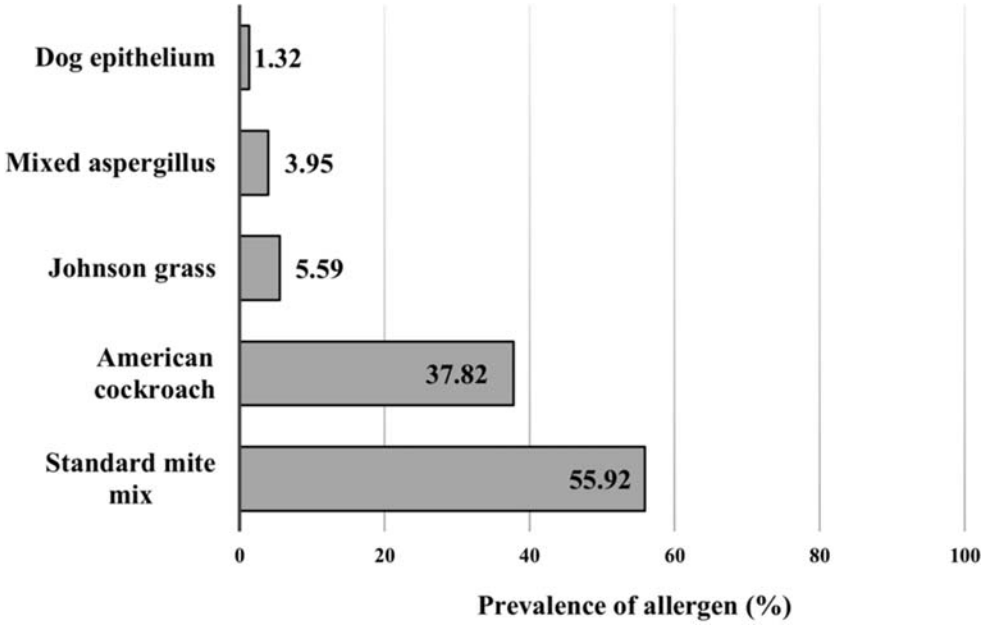

Figure 2. Prevalence of allergens found from the allergy skin test among the included patients.

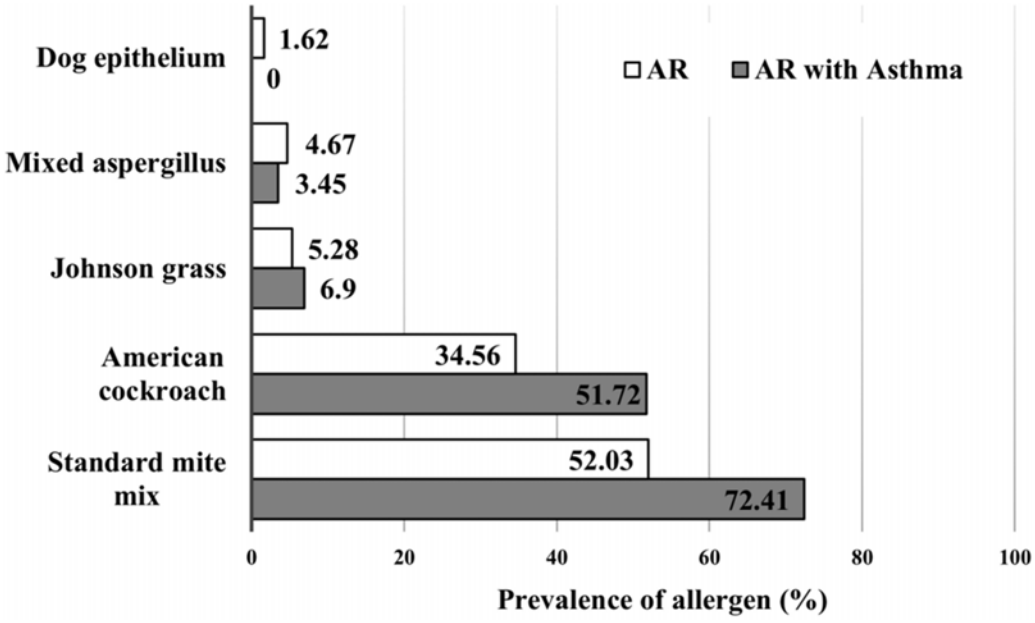

Figure 3. Positive test results from the allergy skin test among the patients with allergic rhinitis (AR) and asthma and the patients with allergic rhinitis only

frequently found allergen (55.92%), followed by American cockroach (37.82%), Johnson grass (5.59%), mixed Aspergillus (3.95%), and dog epithelium (1.32%), respectively. This is consistent with many study reports in Thailand[18,19], which also found that dust mite was the most found allergen, followed by American cockroach. Comparing the results with other countries in Asia, such as Malaysia[20], the most frequently found allergen was also house dust mite, and in India too[21], where the house dust mite was the most frequently found allergen followed by cockroach and Alternaria.

However, the findings from this study revealed lower rates for the less common allergens: Johnson grass (5.59%), mixed Aspergillus (3.95%), and dog epithelium (1.32%). This is different from other study reports in Thailand[12,19], which suggested that allergens such as Johnson grass (37%)[19] and cat allergen (37.8%)[15] have a higher prevalence compared to in this study. This may be due to the different environmental characteristics in the study areas and the popularity of having house pets in each area.

In addition, the study comparing common allergens in the patients with allergic rhinitis and asthma and the patients with allergic rhinitis showed no differences between the two groups of patients. The standardized mite mix was the most common allergen found among both groups, followed by American cockroach, Johnson grass, and mixed Aspergillus, which corresponded to Tongloh's[19] study in Thailand, which suggested that house dust mite was the most frequent allergen found, followed by American cockroach, Johnson grass, and Burmuda, respectively. There was also no difference in the type of allergens in both groups of patients, when comparing the results to those from the study of Farrokhi[22], who also reported finding no common allergen differences in allergic rhinitis and asthma patients.

Based on this study, patients with allergic rhinitis and asthma were associated with a positive result from the skin prick test with statistical significance ($p<0.005$). There were 47 patients with allergic rhinitis and asthma in our study who gave positive results from the skin prick test, accounting for 81.03% of the patients in this group, while 151 patients with allergic rhinitis only gave positive results, accounting for 61.38%, consistent with the study by Rasool et al, who reported a rate of 86.4% positive results from the skin prick test among patients with allergic rhinitis and asthma and 68.5% for patients with allergic rhinitis only[23].

The present study was conducted among a big group of participants, who were examined by specialists in otolaryngology, thus making the data more reliable, and suitable to be applied as a database for future studies that may seek to investigate any trends in the changes in the prevalence of aeroallergens. Besides, the data could be used for studying the relationship among various types of allergens, the relationship between asthma and various types of allergens and the signs and symptoms in patients with different types of allergies. The results also provide information about common allergens for informing the advice

given to patients with allergic rhinitis in the MSMC. However, it should be noted that the prevalence of allergens in other areas of the country may differ due to the different environments and characteristics of the population in different regions.

There were some limitations in this study to note. First, some data were lacking regarding allergic rhinitis, such as the severity and whether it was persistent or involved intermittent symptoms, because of the retrospective observational nature of our study design. Second, the number of allergens used for the skin prick test was limited to only the five most common aeroallergens. Thus, the prevalence of allergic rhinitis in this study might be lower than the actual overall prevalence. Further study including other allergens is required.

Conclusion

The present study revealed that the prevalence of a positive skin prick test response was 65.13% of patients with allergic rhinitis in the MSMC. The standardized mite mix was the most frequently found allergen, followed by American cockroach, Johnson grass, mixed Aspergillus, and dog epithelium.

What is already known on this topic?

The prevalence of common allergens among patients with allergic rhinitis worldwide and in Thailand has been reported by various studies. The authors investigated the prevalence of each type of allergen in the MSMC for providing patients with advice and information.

What this study adds?

The standardized mite mix and American cockroach were the most common allergens among patients with allergic rhinitis in the MSMC.

Acknowledgements

The authors would like to express their gratitude and appreciation to all the professors, residents, nurses, and practical nurses in the Department of Otolaryngology MSMC who provided assistance and who participated in making this research study successful.

This study was supported by a research grant from the MSMC, Faculty of Medicine, Srinakharinwirot University (Grant No. 164/2564).

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Bousquet J, Hellings PW, Agache I, Bedbrook A, Bachert C, Bergmann KC, et al. ARIA 2016: Care pathways implementing emerging technologies for predictive medicine in rhinitis and asthma across the life cycle. Clin Transl Allergy 2016;6:47.
2. Min YG. The pathophysiology, diagnosis and treatment of allergic rhinitis. Allergy Asthma Immunol Res 2010;2:65-76.
3. Katelaris CH, Lee BW, Potter PC, Maspero JF, Cingi C, Lopatin A, et al. Prevalence and diversity of allergic rhinitis in regions of the world beyond Europe and North America. Clin Exp Allergy 2012;42:186-207.
4. Lim FL, Hashim Z, Than LT, Md Said S, Hisham Hashim J, Norback D. Asthma, airway symptoms and rhinitis in office workers in Malaysia: Associations with House Dust Mite (HDM) Allergy, Cat Allergy and Levels of House Dust Mite Allergens in Office Dust. PLoS One 2015;10:e0124905.
5. Hsu SP, Lin KN, Tan CT, Lee FP, Huang HM. Prenatal risk factors and occurrence of allergic rhinitis among elementary school children in an urban city. Int J Pediatr Otorhinolaryngol 2009;73:807-10.
6. An SY, Choi HG, Kim SW, Park B, Lee JS, Jang JH, et al. Analysis of various risk factors predisposing subjects to allergic rhinitis. Asian Pac J Allergy Immunol 2015;33: 143-51.
7. Zuraimi MS, Tham KW, Chew FT, Ooi PL, David K. Home exposures to environmental tobacco smoke and allergic symptoms among young children in Singapore. Int Arch Allergy Immunol 2008;146:57-65.
8. Bunnag C, Jareoncharsri P, Tantilipikorn P, Vichyanond P, Pawankar R. Epidemiology and current status of allergic rhinitis and asthma in Thailand — ARIA Asia-Pacific Workshop report. Asian Pac J Allergy Immunol 2009;27:79-86.
9. Seidman MD, Gurgel RK, Lin SY, Schwartz SR, Baroody FM, Bonner JR, et al. Clinical practice guideline: Allergic rhinitis. Otolaryngol Head Neck Surg 2015;152(1 Suppl):S1-43.
10. Frati F, Incorvaia C, Cavaliere C, Di Cara G, Marcucci F, Esposito S, et al. The skin prick test. J Biol Regul Homeost Agents 2018;32(1 Suppl 1):19-24.
11. Bernstein IL, Li JT, Bernstein DI, Hamilton R, Spector SL, Tan R, et al. Allergy diagnostic testing: an updated practice parameter. Ann Allergy Asthma Immunol 2008;100(3 Suppl 3):S1-148.
12. Oppenheimer J, Nelson HS. Skin testing. Ann Allergy Asthma Immunol 2006;96(2 Suppl 1):S6-12.
13. Bousquet J, Heinzerling L, Bachert C, Papadopoulos NG, Bousquet PJ, Burney PG, et al. Practical guide to skin prick tests in allergy to aeroallergens. Allergy 2012;67:18-24.
14. Ye T, Yi Y. Sample size calculations in clinical research, third edition, by Chow SC, Shao J, Wang H, Lokhnygina Y. Stat Theory Relat Fields 2017;1:265-6.
15. Bunjean K, Sukkasem K, Noppacroh N, Yamkaew N, Janthayanont D, Theerapancharern W, et al. Prevalence of allergic rhinitis and types of sensitized allergen in adult at Wat Intaram community, Hua Raeu, Phra Nakhon Si Ayutthaya District, Phra Nakhon Si Ayutthaya Province, Thailand. J Med Assoc Thai 2012;95 Suppl 5:S63-8.
16. Heinzerling L, Mari A, Bergmann KC, Bresciani M, Burbach G, Darsow U, et al. The skin prick test -

European standards. Clin Transl Allergy 2013;3:3.
17. Skin tests used in type I allergy testing Position paper. Sub-Committee on Skin Tests of the European Academy of Allergology and Clinical Immunology. Allergy 1989;44:11-59.
18. Pumhirun P, Towiwat P, Mahakit P. Aeroallergen sensitivity of Thai patients with allergic rhinitis. Asian Pac J Allergy Immunol 1997;15:183-5.
19. Tongloh S. Allergen skin test reactivities in children with allergic rhinitis allergic conjunctivitis atopic dermatitis ans asthma at Surin hospital. Med J Srisaket Surin Buriram Hos 2011;26:263-73.
20. Asha'ari ZA, Yusof S, Ismail R, Che Hussin CM. Clinical features of allergic rhinitis and skin prick test analysis based on the ARIA classification: a preliminary study in Malaysia. Ann Acad Med Singap 2010;39:619-24.
21. Shyna K, Veena Kumari M, Divya Krishnan K, Abdul Azeez V. Clinical profile and skin prick test analysis in children with allergic rhinitis of North Kerala, India. Int J Contemp Pediatr 2018;5:372-6.
22. Farrokhi S, Gheybi MK, Movahed A, Tahmasebi R, Iranpour D, Fatemi A, et al. Common aeroallergens in patients with asthma and allergic rhinitis living in southwestern part of Iran: based on skin prick test reactivity. Iran J Allergy Asthma Immunol 2015;14:133-8.
23. Rasool R, Shera IA, Nissar S, Shah ZA, Nayak N, Siddiqi MA, et al. Role of skin prick test in allergic disorders: a prospective study in kashmiri population in light of review. Indian J Dermatol 2013;58:12-7.