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ORIGINAL RESEARCH
Pediatric Allergy and Immunology

Retrospective evaluation of allergic diseases presenting to pediatric emergency department

Seda Çevik,[1] Uğur Altaş,[1] Zeynep Meva Altaş,[2] Elif Akman,[3] Yakup Söğütlü,[4] Mehmet Yaşar Özkars[1]

[1]Department of Pediatric Allergy and Immunology, Health Sciences University, Ümraniye Training and Research Hospital, İstanbul, Türkiye
[2]Public Health Directorate, Maltepe Provincial Health Directorate, İstanbul, Türkiye
[3]Department of Pediatrics, University of Health Sciences, Ümraniye Training and Research Hospital, İstanbul, Türkiye
[4]Department of Pediatric Emergency, University of Health Sciences, Ümraniye Training and Research Hospital, İstanbul, Türkiye

ABSTRACT

Objective: Allergic diseases represent one of the most common respiratory diseases globally, affecting not only adults but also children and adolescents. In our study, the files of pediatric patients admitted to the pediatric emergency department of a tertiary care hospital in Istanbul due to asthma, allergic rhinitis, atopic dermatitis, urticaria, and anaphylaxis were retrospectively reviewed, and the distribution of admissions according to months was analysed.

Material and Methods: The files of pediatric patients admitted to the pediatric emergency department of a tertiary hospital in İstanbul between January 2017 and December 2022 due to anaphylaxis, asthma, allergic rhinitis, atopic dermatitis, and urticaria were retrospectively reviewed. All patients were included in the study.

Results: In our study, 7.6% of the 1,087,174 patients aged 0–18 years who presented to the pediatric emergency department between January 2017 and December 2022 were diagnosed with asthma, allergic rhinitis, atopic dermatitis, urticaria, or anaphylaxis. When the emergency department admission rates were analysed, asthma was the most common (4.9%), followed by acute urticaria (2.7%), allergic rhinitis (0.08%), atopic dermatitis (0.03%), and anaphylaxis (0.01%).

Conclusion: Childhood allergic diseases, in particular, have emerged as a health problem with increasing prevalence worldwide in recent years. It was found that the highest number of asthma admissions occurred in January and December, while the lowest admissions were in July and August. Our study suggests a potential association between climate change and childhood allergic diseases. With further studies in different populations and regions, these findings may have important implications for developing effective strategies to prevent and treat these rapidly increasing diseases worldwide.

Keywords: Allergic diseases; allergic rhinitis; anaphylaxis; asthma; atopic dermatitis; pediatric emergency.

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ORCID ID

S.Ç.: 0000-0002-1124-4137; U.A.: 0000-0001-5871-2033; Z.M.A.: 0000-0003-0475-8946; E.A.: 0009-0005-8850-7782; Y.S.: 0000-0002-0411-6778; M.Y.Ö.: 0000-0003-1290-8318

[1]Sağlık Bilimleri Üniversitesi, Ümraniye Eğitim ve Araştırma Hastanesi, Çocuk Alerji ve İmmünoloji Bölümü, İstanbul, Türkiye; [2]Halk Sağlığı Müdürlüğü, Maltepe İlçe Sağlık Müdürlüğü, İstanbul, Türkiye; [3]Sağlık Bilimleri Üniversitesi, Ümraniye Eğitim ve Araştırma Hastanesi, Çocuk Sağlığı ve Hastalıkları Kliniği, İstanbul, Türkiye; [4]Sağlık Bilimleri Üniversitesi, Ümraniye Eğitim ve Araştırma Hastanesi, Çocuk Acil Bölümü, İstanbul, Türkiye

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Correspondence (İletişim): Dr. Seda Çevik. Sağlık Bilimleri Üniversitesi, Ümraniye Eğitim ve Araştırma Hastanesi, Çocuk Alerji ve İmmünoloji Kliniği, İstanbul, Türkiye.
Phone (Tel): +90 216 632 18 18 **e-mail (e-posta):** drsedacevik@hotmail.com

Çocuk acil servisine başvuran alerjik hastalıkların retrospektif değerlendirilmesi

ÖZET

Amaç: Alerjik hastalıklar, sadece yetişkinlerde değil, çocuk ve ergenlerde de küresel olarak en yaygın solunum yolu hastalıklarından birini temsil etmektedir. Çalışmamızda, İstanbul'da üçüncü basamak bir hastanenin çocuk acil servisine astım, alerjik rinit, atopik dermatit, ürtiker ve anafilaksi nedeniyle başvuran çocuk hastaların dosyaları retrospektif olarak incelenmiş ve başvuruların aylara göre dağılımı analiz edilmiştir.

Gereç ve Yöntemler: Ocak 2017–Aralık 2022 tarihleri arasında İstanbul'da üçüncü basamak bir hastanenin çocuk acil servisine anafilaksi, astım, alerjik rinit, atopik dermatit ve ürtiker nedeniyle başvuran çocuk hastaların dosyaları retrospektif olarak incelendi. Tüm hastalar çalışmaya dahil edilmiştir.

Bulgular: Çalışmamızda Ocak 2017–Aralık 2022 tarihleri arasında çocuk acil servisine başvuran 0–18 yaş arası 1.087.174 hastanın %7,6'sı astım, alerjik rinit, atopik dermatit, ürtiker ve anafilaksi tanısı almıştır. Acil servise başvuru oranları analiz edildiğinde, astım en sık görülen hastalıktır (%4,9). Bunu akut ürtiker (%2,7), alerjik rinit (%0,08), atopik dermatit (%0,03) ve anafilaksi (%0,01) takip etmiştir.

Tartışma: Özellikle çocukluk çağı alerjik hastalıkları son yıllarda tüm dünyada prevalansı artan bir sağlık sorunu olarak ortaya çıkmıştır. Astım başvurularının en fazla Ocak ve Aralık aylarında, en az ise Temmuz ve Ağustos aylarında olduğu tespit edilmiştir. Çalışmamızda iklim değişikliği çocukluk çağı alerjik hastalıkları ile ilişkilendirilmiştir. Farklı bölgelerdeki farklı popülasyonlarda yapılacak ileri çalışmalarla, bu bulguların dünya çapında hızla artan bu hastalıkların önlenmesi ve tedavisi için etkili stratejilerin geliştirilmesi açısından önemli etkileri olabilir.

Anahtar Kelimeler: Alerjik hastalıklar; alerjik rinit; anafilaksi; astım; atopik dermatit; pediatrik acil.

INTRODUCTION

Allergic diseases represent one of the most common respiratory diseases globally, not only in adults but also in children and adolescents (1). The complexity and severity of allergic diseases continue to increase, especially in children, resulting in significant healthcare expenditures and an increased burden on patients' quality of life (2).

Asthma, a chronic non-communicable disease characterised by reversible obstruction and inflammation of the airways, affects more than three hundred million people worldwide, especially children (2, 3). Large differences have been observed in the prevalence of asthma between countries and communities, ranging from 1.5% to 15.6% (4, 5). These variances may be the result of interactions between environmental and genetic elements (6, 7). The frequency of allergic rhinitis (AR) is significant, impacting over 10–40% of the global populace, and has seen a rapid rise in recent years (8, 9). A seasonal change in AR has been defined. In contrast to hot climates, more cases of AR symptoms have been observed in cold climates (10). Atopic dermatitis (AD) is a persistent inflammatory skin condition primarily occurring during early childhood. Lately, the occurrence of AD has been approximated to affect 15–20% of children globally (11). Urticaria is a prevalent condition that may occur due to allergic and non-allergic factors (12). Its occurrence is higher in the first years of life and decreases with age (13). While infections are believed to be the primary trigger for most cases in children, it is thought that 50–60% of acute urticaria cases are idiopathic (12–14). Associations between acute urticaria and environmental elements such as humidity, temperature and pollution have been established, but associations with other factors such as pollen and mould have not been previously reported (14, 15). According to the World Health Organisation's definition in ICD-11, anaphylaxis is a severe systemic hypersensitivity reaction that develops suddenly with life-threatening airway, respiratory or circulatory problems and is usually associated with skin and mucosal changes (16). In the latest study report of the European Association of Allergy and Clinical Immunology (EAACI), the lifetime prevalence of anaphylaxis was found to be 0.3% (17). Although it varies according to region and society, the most common causes of anaphylaxis are foods, drugs and insect stings (18).

Studying the effect of meteorological factors on childhood allergic diseases is of great importance as it may help to allocate resources for the control and prevention of allergic diseases. In our study, the files of pediatric patients admitted to the pediatric emergency department of a tertiary care hospital in Istanbul due to asthma, allergic rhinitis, atopic dermatitis, urticaria and anaphylaxis were retrospectively reviewed, and the distribution of admissions according to months was analysed.

MATERIALS AND METHODS

Research Design and Sampling

The study was descriptive and retrospective in design. The files of pediatric patients admitted to the pediatric emergency department of a tertiary hospital in Istanbul between January 2017 and December 2022 due to anaphylaxis, asthma, allergic rhinitis, atopic dermatitis, and urticaria were retrospectively reviewed. All patients were included in the study. The distribution of admissions to the pediatric emergency department according to months was analysed. This study was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants.

Table 1. Distribution of admissions to pediatric emergency departments with a diagnosis of asthma by months (2017-2022)

Months	Number (n)	Percentage (%)
January	6977.0	13.2
February	4524.0	8.6
March	4789.0	9.1
April	3865.0	7.3
May	3295.0	6.2
June	2871.0	5.4
July	2364.0	4.5
August	2484.0	4.7
September	3762.0	7.1
October	5496.0	10.4
November	5361.0	10.2
December	7022.0	13.3
Total applications	**52810.0**	**100.0**

Table 2. Distribution of admissions to pediatric emergency department with a diagnosis of acute urticaria by months (2017–2022)

Months	Number (n)	Percentage (%)
January	1657.0	5.7
February	1469.0	5.1
March	1848.0	6.4
April	2062.0	7.1
May	2361.0	8.2
June	2898.0	10.0
July	3192.0	11.1
August	3279.0	11.4
September	2725.0	9.4
October	2885.0	10.0
November	2320.0	8.0
December	2151.0	7.5
Total applications	**28847.0**	**100.0**

Statistical Evaluation

SPSS (Statistical Package for Social Sciences for Windows 25.0) programme was used for data analysis and recording. Number (n) and percentages (%) were used for descriptive data.

Ethics Committee

Ethics committee approval was obtained from the Health Sciences University Ümraniye Education and Research Ethics Committee on 23/02/2023 with decision number 34.

Table 3. Distribution of admissions to pediatric emergency departments with a diagnosis of allergic rhinitis by months (2017–2022)

Months	Number (n)	Percentage (%)
January	46.0	5.3
February	46.0	5.3
March	71.0	8.2
April	76.0	8.8
May	67.0	7.8
June	51.0	5.9
July	38.0	4.4
August	56.0	6.5
September	68.0	7.9
October	133.0	15.4
November	159.0	18.5
December	50.0	5.8
Total applications	**861.0**	**100.0**

RESULTS

In our study, there were 1,087,174 patients aged 0–18 years who presented to the Pediatric Emergency Department between January 2017 and December 2022. During the same period, emergency department admissions due to asthma, allergic rhinitis, atopic dermatitis, urticaria, and anaphylaxis constituted 7.6% (n=83,018) of all admissions.

Between 2017 and 2022, the number of emergency department visits due to asthma was 52,810. Pediatric emergency visits due to asthma accounted for 4.9% of all emergency visits. Hospital visits due to asthma increased the most in January (13.2%) and December (13.3%) (Table 1).

Between 2017 and 2022, the number of emergency admissions due to acute urticaria was 28,847. Pediatric emergency admissions for acute urticaria were 2.7% of all emergency admissions. Hospital admissions for acute urticaria increased in July (11.1%) and August (11.4%) (Table 2).

Between 2017 and 2022, the number of emergency admissions due to allergic rhinitis was 861. Pediatric emergency admissions due to allergic rhinitis were 0.08% of all emergency admissions. Emergency admissions due to allergic rhinitis increased in October (15.4%) and November (18.5%) (Table 3).

Between 2017 and 2022, the number of emergency admissions due to atopic dermatitis was 345. Pediatric emergency admissions due to atopic dermatitis were 0.03% of all emergency admissions. Admissions due to atopic dermatitis increased in March (12.5%) and April (13.3%) (Table 4).

Between 2017 and 2022, the number of emergency admissions due to anaphylaxis was 155. Pediatric emergency admissions due to anaphylaxis were 0.01% of all emergency admissions. Admissions due to anaphylaxis increased in October, November (14.2%) and December (11.6%) (Table 5).

Table 4. Distribution of admissions to pediatric emergency departments with a diagnosis of atopic dermatitis by months (2017–2022)

Months	Number (n)	Percentage (%)
January	27.0	7.8
February	33.0	9.6
March	43.0	12.5
April	46.0	13.3
May	26.0	7.5
June	25.0	7.2
July	42.0	12.2
August	21.0	6.1
September	22.0	6.4
October	18.0	5.2
November	27.0	7.8
December	15.0	4.3
Total applications	**345.0**	**100.0**

Table 5. Distribution of admissions to pediatric emergency department with a diagnosis of anaphylaxis by months (2017–2022)

Months	Number (n)	Percentage (%)
January	11.0	7.1
February	12.0	7.7
March	13.0	8.4
April	6.0	3.9
May	10.0	6.5
June	9.0	5.8
July	13.0	8.4
August	15.0	9.7
September	9.0	5.8
October	17.0	11.0
November	22.0	14.2
December	18.0	11.6
Total applications	**155.0**	**100.0**

DISCUSSION

Child health has become an increasingly important issue day by day. In particular, childhood allergic diseases have emerged as a health problem with an increasing prevalence worldwide in recent years. In this context, it is crucial to examine patients aged 0–18 years admitted to the pediatric emergency department concerning allergic diseases, both to guide health policies and to develop treatment strategies. In this study, the distribution of admission rates of pediatric patients with allergic diseases by month between January 2017 and December 2022 was analysed. This analysis provides an important perspective that will help us understand the seasonal and temporal changes in allergic diseases in children.

In our study, 7.6% of the 1,087,174 patients aged 0–18 years who presented to the pediatric emergency department between January 2017 and December 2022 had asthma, allergic rhinitis, atopic dermatitis, urticaria, and anaphylaxis. When the emergency department admission rates were analysed, asthma was the most common (4.9%), followed by acute urticaria (2.7%), allergic rhinitis (0.08%), atopic dermatitis (0.03%), and anaphylaxis (0.01%).

It was found that the highest number of asthma admissions occurred in January and December, while the lowest number of admissions was in July and August. Lam et al. (19) observed that low temperature and humidity during the cold season were associated with more hospital admissions for asthma in Hong Kong. Reports have indicated that asthma reaches its peak during the winter and spring seasons and exhibits a negative correlation with both temperature and humidity (20). In the study conducted by Altaş et al. (21), the highest number of visits for patients aged 0–5 years occurred in December and January, and the lowest numbers occurred in July and August. For patients aged 6–11 years, the highest number of admissions occurred in December and January, while the lowest occurred in July and August. In patients aged 12–18 years, the highest number of visits was in January and March, with the lowest in June, July, and August. In a study by Qi et al. (22), it was stated that the main reason for increased asthma admissions in the autumn and winter months might be increased viral infections or cold weather, with the most common admissions in November and December. Climatic conditions can directly impact allergic diseases. For instance, cold temperatures notably suppress the immune system by decreasing lung function and capacity (23), thereby facilitating the survival and transmission of respiratory viruses, increasing respiratory inflammation, and narrowing airways, all of which contribute to the onset and worsening of asthma (24).

In our study, pediatric emergency department visits due to allergic rhinitis were 0.08% of all emergency department visits. It was found that admissions to the emergency department due to allergic rhinitis increased in October and November. In a study conducted by Qi et al. (22), it was found that most of the admissions due to allergic rhinitis occurred in November and December. These results were thought to be related to the decrease in air temperatures. Chen BY et al. (25) reported that among all children with allergic rhinitis, more experienced symptoms in cold months, and fewer experienced symptoms in hot months.

In our study, pediatric emergency admissions due to atopic dermatitis were 0.03% of all emergency admissions. Admissions due to atopic dermatitis increased in March and April. In another study, it was found that low ambient temperature and relative humidity may exacerbate AD symptoms in children (26).

Noh et al. (27) reported a negative correlation between temperature and atopic dermatitis symptoms. Fleischer et al. (28) found that increasing temperature caused an increase in hospital visits for atopic dermatitis. In our study, the frequency of hospital admission was high in the spring months when the temperature began to rise.

In our study, pediatric emergency department admissions due to acute urticaria were 2.7% of all emergency department admissions. Admissions increased in July and August. In their study on acute urticaria, Konstantinou et al. (14) found that the incidence of acute urticaria in Heraklion showed a marked and statistically significant seasonal trend, peaking in December and from February to May. Qi et al. (22) evaluated presentations of allergic skin diseases as a whole (including atopic dermatitis, acute and chronic urticaria, and angioedema) and found that the most frequent presentations occurred in July and August, with the lowest presentations in January and February. The peak presentation period aligns with our study.

Pediatric emergency admissions due to anaphylaxis were 0.01% of all emergency admissions. Admissions due to anaphylaxis increased in October, November, and December. In the study by Mullins, except for anaphylaxis resulting from insect stings (more common in summer months), there was no noticeable seasonal difference (29). In a study by Alkanhal et al. (30), it was found that adult and pediatric anaphylaxis cases were more common in the summer months in Saudi Arabia, where summer and winter months coexist. In our study, the cause of reaction in patients who developed anaphylaxis was not evaluated.

In our study, climate change was associated with childhood allergic diseases. With further studies in different populations and regions, these findings may have important implications for developing effective strategies to prevent and treat these rapidly increasing diseases worldwide. Since allergic diseases constitute approximately 8% of emergency admissions, healthcare professionals working in emergency departments should keep their knowledge up-to-date regarding the approach and management of allergic diseases. The periodic increase in emergency admissions particularly highlights the importance of awareness of allergens and management strategies for these diseases in emergency health services.

Limitations of Our Study

Initially, certain risk factors (such as food, pollen, animal epithelium, and medications) that could potentially contribute to allergic diseases and childhood attacks were not incorporated into this study due to insufficient data. Secondly, demographic characteristics of the patients presenting to the emergency department were not evaluated. The large number of patients can be considered a strength of the study.

Ethics Committee Approval: The study was approved by Health Sciences University Ümraniye Training and Research Ethics Committee (date: 23.02.2023, number: 34).

Authorship Contributions: Concept – YS, EA; Design – UA; Supervision – MYÖ; Fundings – MYÖ; Materials – EA; Data collection and/or processing – SÇ, ZMA; Analysis and/or interpretation – ZMA; Literature review – UA, SÇ; Writing – SÇ; Critical review – SÇ, YS.

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REFERENCES

1. Bloom B, Jones LI, Freeman G. Summary health statistics for U.S. children: National Health Interview Survey, 2012. Vital Health Stat 10 2013;258:1–81.
2. Asher I, Pearce N. Global burden of asthma among children. Int J Tuberc Lung Dis 2014;18:1269–78.
3. GBD 2015 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1603–58.
4. Masoli M, Fabian D, Holt S, Beasley R; Global Initiative for Asthma (GINA) Program. The global burden of asthma: Executive summary of the GINA Dissemination Committee report. Allergy 2004;59:469–78.
5. Van Wonderen KE, Van Der Mark LB, Mohrs J, Bindels PJ, Van Aalderen WM, Ter Riet G. Different definitions in childhood asthma: How dependable is the dependent variable? Eur Respir J 2010;36:48–56
6. Nishimura KK, Galanter JM, Roth LA, Oh SS, Thakur N, Nguyen EA, et al. Early-life air pollution and asthma risk in minority children. The GALA II and SAGE II studies. Am J Respir Crit Care Med 2013;188:309–18.
7. Oh SS, White MJ, Gignoux CR, Burchard EG. Making precision medicine socially precise. Take a deep breath. Am J Respir Crit Care Med 2016;193:348–50.
8. Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). Allergy 2008;63(Suppl 86):8–160.
9. Wang XD, Zheng M, Lou HF, Wang CS, Zhang Y, Bo MY, et al. An increased prevalence of self-reported allergic rhinitis in major Chinese cities from 2005 to 2011. Allergy 2016;71:1170–80.

10. Kao CC, Huang JL, Ou LS, See LC. The prevalence, severity and seasonal variations of asthma, rhinitis and eczema in Taiwanese schoolchildren. Pediatr Allergy Immunol 2005;16:408–15.
11. Nutten S. Atopic dermatitis: Global epidemiology and risk factors. Ann Nutr Metab 2015;66(Suppl 1):8–16.
12. Zuberbier T, Aberer W, Asero R, Bindslev-Jensen C, Brzoza Z, Canonica GW, et al. The EAACI/GA(2) LEN/EDF/WAO Guideline for the definition, classification, diagnosis, and management of urticaria: The 2013 revision and update. Allergy 2014;69:868–87.
13. Poulos LM, Waters AM, Correll PK, Loblay RH, Marks GB. Trends in hospitalizations for anaphylaxis, angioedema, and urticaria in Australia, 1993-1994 to 2004-2005. J Allergy Clin Immunol 2007;120:878–84.
14. Konstantinou GN, Papadopoulos NG, Tavladaki T, Tsekoura T, Tsilimigaki A, Grattan CE. Childhood acute urticaria in northern and southern Europe shows a similar epidemiological pattern and significant meteorological influences. Pediatr Allergy Immunol 2011;22:36–42.
15. Gilles S, Akdis C, Lauener R, Schmid-Grendelmeier P, Bieber T, Schäppi G, et al. The role of environmental factors in allergy: A critical reappraisal. Exp Dermatol 2018;27:1193–200.
16. World Health Organization. International classification of diseases. 11th revision. Available at: https://icd.who.int/en. Accessed Mar 17, 2023.
17. Panesar SS, Javad S, de Silva D, Nwaru BI, Hickstein L, Muraro A, et al. The epidemiology of anaphylaxis in Europe: A systematic review. Allergy 2013;68:1353–61.
18. Doğru M, Bostancı İ. Anafilaksi ve anafilaksideki gelişmeler. Çocuk Derg [Article in Turkish] 2011;11:43–53.
19. Lam HC, Li AM, Chan EY, Goggins WB 3rd. The short-term association between asthma hospitalisations, ambient temperature, other meteorological factors and air pollutants in Hong Kong: A time-series study. Thorax 2016;71:1097–109.
20. Lee YC, Ju HJ, Kwon JW, Bae JM. Seasonality of allergic diseases: Real-world evidence from a nationwide population-based study. Immun Inflamm Dis 2020;8:360–2.
21. Altaş U, Söğütlü Y, Altaş ZM, Özkars MY. Seasonal pattern of emergency department visits by children with asthma. East Mediterr Health J 2023;29:789–95.
22. Qi Y, Shi P, Chen R, Zhou Y, Liu L, Hong J, et al. Characteristics of childhood allergic diseases in outpatient and emergency departments in Shanghai, China, 2016-2018: A multicenter, retrospective study. BMC Pediatr 2021;21:409.
23. LaVoy EC, McFarlin BK, Simpson RJ. Immune responses to exercising in a cold environment. Wilderness Environ Med 2011;22:343–51.
24. Kaminsky DA, Bates JH, Irvin CG. Effects of cool, dry air stimulation on peripheral lung mechanics in asthma. Am J Respir Crit Care Med 2000;162:179–86.
25. Chen BY, Chan CC, Han YY, Wu HP, Guo YL. The risk factors and quality of life in children with allergic rhinitis in relation to seasonal attack patterns. Paediatr Perinat Epidemiol 2012;26:146–55.
26. Kim YM, Kim J, Han Y, Jeon BH, Cheong HK, Ahn K. Short-term effects of weather and air pollution on atopic dermatitis symptoms in children: A panel study in Korea. PLoS One 2017;12:e0175229.
27. Noh SR, Kim JS, Kim EH, Jeon BH, Kim JH, Kim YM, et al. Spectrum of susceptibility to air quality and weather in individual children with atopic dermatitis. Pediatr Allergy Immunol 2019;30:179–87.
28. Fleischer AB Jr. Atopic dermatitis: The relationship to temperature and seasonality in the United States. Int J Dermatol 2019;58:465–71.
29. Mullins RJ. Anaphylaxis: Risk factors for recurrence. Clin Exp Allergy 2003;33:1033–40.
30. Alkanhal R, Alhoshan I, Aldakhil S, Alromaih N, Alharthy N, Salam M, et al. Prevalence triggers and clinical severity associated with anaphylaxis at a tertiary care facility in Saudi Arabia: A cross-sectional study. Medicine (Baltimore) 2018;97:e11582.