



ORIGINAL ARTICLE

OPEN ACCESS

Alteration of triggers and symptoms by age group in childhood and adolescence anaphylaxis

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Received 19 May 2025; Accepted 30 August 2025

Available online 1 November 2025

KEYWORDS

allergens;
anaphylaxis;
children;
etiology;
diagnosis

Abstract

Background: Anaphylaxis is a severe, potentially fatal, systemic hypersensitivity reaction induced by various triggers.

Objective: Only a few studies have examined the clinical manifestations of childhood anaphylaxis across different age groups. We aimed to evaluate, according to age group and trigger, the clinical features of anaphylaxis in pediatric patients.

Methods: We retrospectively evaluated 130 children diagnosed with anaphylaxis over 11 years. **Results:** The median age of the patients was 10 years (min-max: 0.5-17.8), and 83 (63.8%) were male. Regarding age groups, 23 (17.7%) of the patients were infants, 26 (20%) were preschoolers, 31 (23.8%) were school-age children, and 50 (38.5%) were adolescents. Among the causes with known triggers, the most prevalent trigger was identified as food— affecting 44 (33.8%) cases—followed by drugs (34 cases, 26.2%) and venoms (18 cases, 13.8%). There was a statistically significant relationship between age groups and triggers ($p < 0.001$). The triggering role of drugs and venoms was found to be low in infants. Also, the infant group had significantly lower risks of venom-induced and drug-induced anaphylaxis compared to the adolescent group. The top three triggers identified in our patients were compared according to the system involved, and a statistically significant relationship was found between triggers and cardiovascular findings ($p = 0.006$).

Conclusion: The etiology of anaphylaxis may vary by age group. Depending on the trigger, it may also have different clinical manifestations.

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<https://doi.org/10.15586/aei.v53i6.1417>

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Introduction

Anaphylaxis is a severe, potentially fatal, systemic hypersensitivity reaction that develops rapidly and is typically induced by various triggers, including food, drugs, and venoms.¹ The epidemiological factors and triggers associated with anaphylaxis exhibit variation with age.¹ Notably, drugs and venoms represent the most common causes of anaphylaxis in adults, whereas food allergy is the most common cause of anaphylaxis in children.¹ The clinical manifestations of anaphylaxis are also dependent on triggers in children.²

Anaphylaxis is usually diagnosed if at least two organ systems are affected, with clinical manifestations including cutaneous, respiratory, cardiovascular, and gastrointestinal symptoms.³ In some cases, involvement of just one organ system (such as hypotension in the cardiovascular system) may be enough for diagnosis, and early adrenaline administration is fundamental for the management of anaphylaxis.^{3,4} There are currently no diagnostic criteria for anaphylaxis that are dependent on age.⁵ Diagnosing anaphylaxis in infants or toddlers can be challenging, as they may not be able to verbalize their symptoms, which may also be confused with normal infant conduct.⁵ Furthermore, adolescents differ from other age groups in their personal management of anaphylaxis because of the rapid and significant physical, emotional, and social changes that occur during this developmental period.⁶ A propensity for risk-taking, particularly among adolescents, has been identified as a contributing factor to the severity of reactions. This is predominantly associated with the underuse of adrenaline autoinjectors.⁷

There has been a notable increase in the incidence of anaphylaxis in children in recent years.¹ However, only a few studies have examined the clinical manifestations of childhood anaphylaxis across different age groups. The objective of the present study is to evaluate, according to age group and trigger, the clinical features of anaphylaxis in pediatric patients diagnosed at our clinic.

Methods

Children diagnosed with anaphylaxis in the pediatric immunology and allergy unit of Selçuk University Faculty of Medicine Hospital between January 2012 and January 2023 were included in this study. Demographic features, detailed information on symptoms and signs, the triggering factor, the presence of an adrenaline autoinjector, the presence of concomitant allergic disease, the location of anaphylaxis occurrence, and the severity of anaphylaxis and treatments were recorded from patients' files. Severity grading and diagnosis of anaphylaxis were based on criteria according to European Academy of Allergy and Clinical Immunology (EAACI) guidelines.^{3,8} The severity groups were categorized as follows: mild, moderate, and severe. In the absence of a proven causative agent, reactions were designated as idiopathic anaphylaxis. Patients aged between 0 and 18 years were included in the study and categorized into four groups based on their age at the time of diagnosis of anaphylaxis: over 12 (adolescents), 6-12 (school-age children), 3-5 (preschoolers), and 0-2 (infants) years. Ethical

approval was acquired from the Institutional Ethical Review Board of Selçuk University (approval number: #2022/328).

Statistical methods

Statistical analyses were performed using IBM's Statistical Package for the Social Sciences, version 23. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to verify the normality of variable distribution. The Mann-Whitney U test was used to compare nonnormally distributed data by groups of two or more. The Kruskal-Wallis H test was used to compare nonnormally distributed data by groups of three or more, and multiple comparisons were analyzed using the Dunn's test. Fisher's exact test, Yates's correction, Pearson's chi-squared test, and the Fisher-Freeman-Halton test were used to analyze the relationships between categorical data. The Bonferroni corrected Z-test was used for multiple comparisons of ratios. The impact of age groups on triggers and the duration of anaphylaxis were assessed using multinomial logistic regression analysis with odds ratio. Descriptors of quantitative data were presented as mean \pm standard deviation and median (min-max) and categorical data as frequency (%). A p-value of <0.05 was considered statistically significant.

Results

One hundred and thirty children diagnosed with anaphylaxis were included in this study. The median age of the patients was 10 years (min-max: 0.5-17.8), and 83 (63.8%) were male. Regarding age groups, 23 (17.7%) of the patients were infants, 26 (20%) were preschoolers, 31 (23.8%) were school-age children, and 50 (38.5%) were adolescents. About 23.1% of patients were found to have idiopathic anaphylaxis. Fifty-nine (45.4%) patients developed anaphylaxis within the first 15 minutes, and 77 (59.2%) patients were administered adrenaline at the time of anaphylaxis. Furthermore, 30 (23.1%) patients had a previously prescribed adrenaline autoinjector before visiting our outpatient clinic. A total of 28 (21.5%) patients experienced anaphylaxis while at the hospital. Fifty-five (42.3%) patients had a concomitant allergic disease, of which the most common were allergic rhinitis (17.7%) and asthma (17.7%). The prevalence of mild anaphylaxis was 6.2%, moderate anaphylaxis was 64.6%, and severe anaphylaxis was 29.2%.

Among the causes with known triggers, the most prevalent trigger was identified as food—affecting 44 (33.8%) cases—followed by drugs (34 cases, 26.2%) and venoms (18 cases, 13.8%). Regarding the drug trigger, for 18 (52.9%) cases, it was beta-lactam antibiotics (BLAs), 9 (26.5%) cases with nonsteroidal anti-inflammatory drugs (NSAIDs), and 1 (2.9%) case each involving alglucosidase alfa, radiocontrast media, tocilizumab, vancomycin, intravenous immunoglobulin, amphotericin B, and ondansetron (Figure 1). The features of the patients are summarized in Table 1.

Regarding the food trigger, for 11 cases (25%), it was tree nuts; 9 (20.5%), hen eggs; 9 (20.5%), cow's milk; 4 (9.1%), legumes; 3 (6.8%), fish; 2 (4.5%), fruits; 2 (4.5%), wheat; 2 (4.5%), seeds; 1 (2.3%), multiple foods; and 1 (2.3%), potatoes (Figure 1). The following clinical

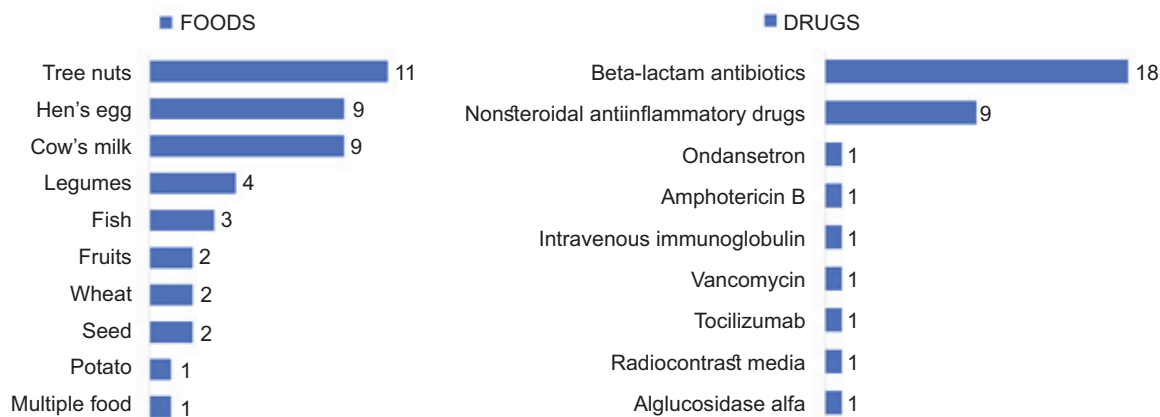


Figure 1 Food and drug triggers of anaphylaxis.

Table 1 Patient's characteristics.

Gender n, %	
Male	83, 63.8%
Female	47, 36.2%
Age at anaphylaxis (years)	10
Median (min-max)	(0.5-17.75)
Age groups n, %	
Infants	23, 17.7%
Preschoolers	26, 20%
School-age children	31, 23.8%
Adolescents	50, 38.5%
Trigger n, %	
Food	44, 33.8%
Drug	34, 26.2%
Idiopathic	30, 23.1%
Venom	18, 13.8%
Other	4, 3.1%
Duration of anaphylaxis development n, %	
0-15 minutes	59, 45.4%
15-30 minutes	15, 11.5%
30-60 minutes	19, 14.6%
>60 minutes	7, 5.4%
Idiopathic	30, 23.1%
Severity of anaphylaxis n, %	
Mild	8, 6.2%
Moderate	84, 64.6%
Severe	38, 29.2%
The administration of adrenaline n, %	77, 59.2%
Presence of adrenaline at outpatient visit n, %	30, 23.1%
Area of anaphylaxis	
In hospital	28, 21.5%
Out of hospital	102, 78.5%
Concomitant allergic disease n, %	
Allergic rhinitis	23, 17.7%
Asthma	23, 17.7%
Atopic dermatitis	11, 8.5%
Allergic conjonktivitis	5, 3.8%

presentation was observed, listed in order of frequency: cutaneous (91.5%), respiratory (77.7%), gastrointestinal (41.5%), neurological (20%), and cardiovascular findings (16.2%). Figure 2 presents the detailed signs and symptoms during anaphylaxis.

There was a statistically significant relationship between age groups and triggers ($p < 0.001$) (Table 2). In the infant and preschool age groups, the most common trigger was identified as food (82.6% and 46.2%, respectively). In the adolescent age group, the idiopathic anaphylaxis was most prevalent, accounting for 38% of cases. The triggering role of drugs and venoms was found to be low in infants. A statistically significant relationship was observed between age groups and the duration of anaphylaxis ($p = 0.023$) (Table 2). The analysis revealed that most anaphylaxis cases occurred within the first 15 minutes in the infant, preschool, school, and adolescent age groups (60.9%, 46.2%, 51.6%, 34%, respectively). When we excluded cases of idiopathic anaphylaxis, the time interval between the onset of symptoms and anaphylaxis with a known allergen was 30 minutes in 74 cases (74%), and symptoms developed within the first 15 minutes in 59 patients (59%). Table 2 presents the characteristics of patients with anaphylaxis, categorized by age groups.

The top three triggers identified in our patients were compared according to the system involved, and a statistically significant relationship was found between triggers and cardiovascular findings ($p = 0.006$). The prevalence rates of venom-induced anaphylaxis (VIA; 33.3%) and drug-induced anaphylaxis (DIA; 23.5%) were found to be higher than that of food-induced anaphylaxis (FIA; 4.5%) (Table 3). The features of patients with anaphylaxis categorized by trigger is illustrated in Table 3. The infant group had significantly lower risks of VIA and DIA compared to the adolescent group (OR: 0.039, 95% CI: 0.004-0.383; OR: 0.021, 95% CI: 0.002-0.194, respectively) (Table 4). The risk of developing VIA was also significantly lower in the preschool group compared to the adolescent group (OR: 0.063, 95% CI: 0.006-0.622) (Table 4). Table 4 presents the association of triggers with age groups.

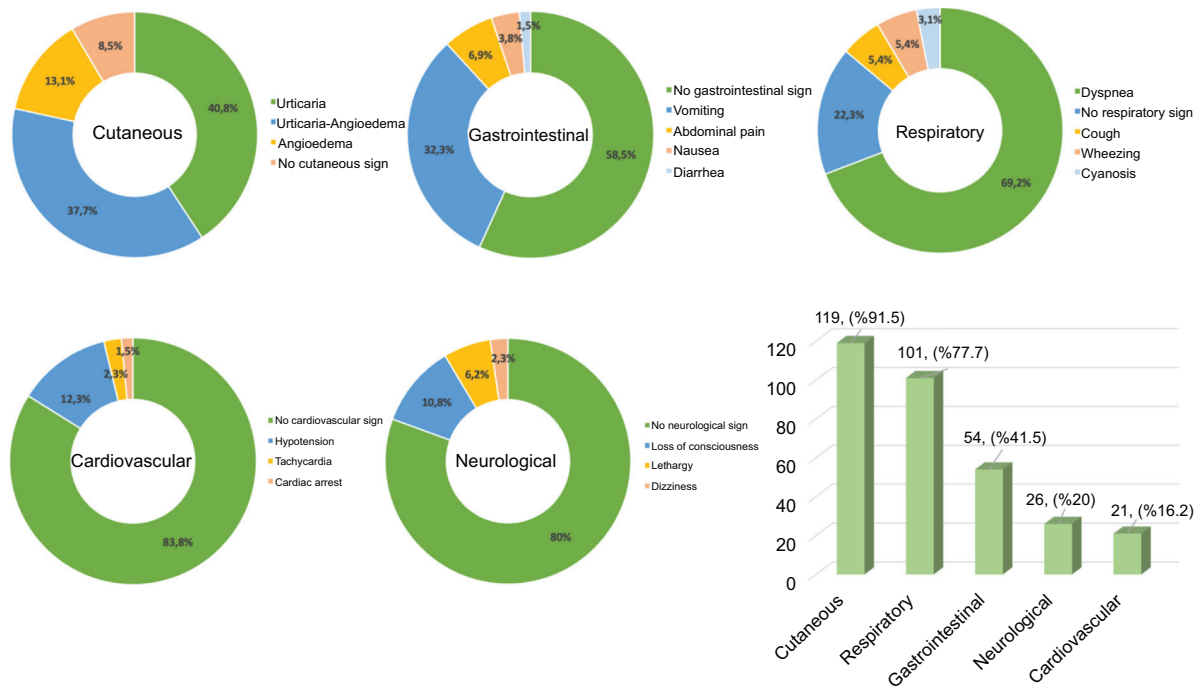


Figure 2 Signs and symptoms during anaphylaxis.

Discussion

The present study constitutes an evaluation of pediatric anaphylaxis cases according to age and trigger over 11 years. As demonstrated in previous studies involving children,^{9,10} the present study found that more than half of the cases (83, 63.8%) were male. The role of gender in the pathogenesis of anaphylaxis remains to be elucidated.¹¹ However, anaphylaxis manifests more frequently in boys until the age of 10-15 years; afterward, a higher incidence is observed in girls.¹⁰ The present study revealed a high male-to-female ratio in all groups, encompassing infants, preschool children, school-age children, and adolescents. The most prevalent findings were cutaneous symptoms (91.5%), followed by respiratory (77.7%), gastrointestinal (41.5%), neurological (20%), and cardiovascular (16.2%) findings. These findings are consistent with the literature.^{9,10}

A multicenter study of Korean children revealed that food (74.7%) was the most frequent cause of anaphylaxis, followed by drugs and radiocontrast media (10.7%) and idiopathic factors (9.2%).¹² A study conducted across Asia examined the etiology of anaphylaxis in 689 pediatric patients.¹³ The study revealed that food (62%) was the most prevalent trigger, followed by idiopathic factors (22%) and drugs (10%).¹³ Fifty-nine centers across Europe reported that in 889 children with anaphylaxis, food was responsible for 64.9% of cases, insect venom for 20.2%, and drugs for 4.8%.¹⁴ The findings of research conducted in two different Turkish cities indicated that the most prevalent causative agents, in order, were food, drugs, and venoms.^{9,15} We found that the most common trigger was food, followed by drugs, idiopathic factors, and venoms.

In the pediatric population, food is the most common cause of anaphylaxis.¹ Furthermore triggers of anaphylaxis

show geographical and age-related differences, underlining the significance of identifying causative factors based on regional data.¹⁶ A retrospective cross-sectional study conducted in Thailand over a 10-year period identified food as the most common trigger, with shrimp and fried insects being the predominant culprits.¹⁶ A study from Europe indicated that peanuts were the most prevalent food allergen, followed by wheat, hazelnut, hen's egg and cow's milk.¹⁴ In a 20-year retrospective study conducted in Italy, the most common foods associated with FIA were tree nuts (30%), milk (19%), eggs (15%), peanuts (12%), and fish and crustaceans (7%).¹⁰ In a study of 991 Korean pediatric patients with anaphylaxis, the top three food allergens were milk (28.4%), egg white (13.6%), and tree nuts (13.2%).¹² In a study from Türkiye, the most commonly reported food allergens in pediatric patients with anaphylaxis were cow's milk, tree nuts, and hen eggs (39.4%, 16% and 14.9%, respectively).⁹ The importance of tree nut allergy in general is that it is a lifelong condition, and it increases the risk of a severe reaction.^{17,18} In our study, among food allergies, the most trigger factor was tree nuts, followed by cow's milk and hen eggs (25%, 20.5%, and 20.5%, respectively).

Another common cause of anaphylaxis is drugs. In the context of previous research on anaphylaxis in the pediatric population, DIA ranged widely from 5% to 33%.⁹ BLAs were the main causative agents in children with DIA in our study, a finding consistent with prior studies in children.^{9,12} Nonetheless, some studies revealed that NSAIDs were the most prevalent causative drugs.^{19,20} In the present study, in the category of drug allergies, the most prevalent trigger factor was identified as BLAs, followed by NSAIDs.

It is estimated that 1.5% to 34% of all cases of anaphylaxis are caused by venom.²¹ In our study, 13.8% of anaphylaxis in pediatric patients are triggered by venom, which

Table 2 Characteristics of patients with anaphylaxis categorized according to age groups.

	Age groups				Total	p
	Infants	Preschoolers	School-age children	Adolescents		
Age median (min-max)	1 (0.5-1.83) ^c	3.58 (2.08-5.5) ^c	10 (6-11.58) ^b	15 (12-17.75) ^a	10 (0.5-17.75)	<0.001***
Gender n, (%)						
Female	6 (26.1)	11 (42.3)	9 (29)	21 (42)	47 (36.2)	0.414*
Male	17 (73.9)	15 (57.7)	22 (71)	29 (58)	83 (63.8)	
Trigger n, (%)						
Food	19 (82.6) ^a	12 (46.2) ^b	7 (22.6) ^{b,c}	6 (12) ^c	44 (33.8)	<0.001**
Drug	1 (4.3) ^a	10 (38.5) ^b	8 (25.8) ^{a,b}	15 (30) ^{ab}	34 (26.2)	
Venom	1 (4.3)	1 (3.8)	8 (25.8)	8 (16)	18 (13.8)	
Idiopathic	0 (0) ^a	3 (11.5) ^{ab}	8 (25.8) ^b	19 (38) ^b	30 (23.1)	
Other	2 (8.7)	0 (0)	0 (0)	2 (4)	4 (3.1)	
Severity of anaphylaxis n, (%)						
Mild	3 (13)	1 (3.8)	3 (9.7)	1 (2)	8 (6.2)	0.268**
Moderate	13 (56.5)	19 (73.1)	16 (51.6)	36 (72)	84 (64.6)	
Severe	7 (30.4)	6 (23.1)	12 (38.7)	13 (26)	38 (29.2)	
Duration of anaphylaxis development n, (%)						
0-15 min	14 (60.9)	12 (46.2)	16 (51.6)	17 (34)	59 (45.4)	0.023**
15-30 min	4 (17.4)	4 (15.4)	1 (3.2)	6 (12)	15 (11.5)	
30-60 min	4 (17.4)	6 (23.1)	4 (12.9)	5 (10)	19 (14.6)	
>60 min	1 (4.3)	1 (3.8)	2 (6.5)	3 (6)	7 (5.4)	
Idiopathic	0 (0) ^a	3 (11.5) ^{ab}	8 (25.8) ^b	19 (38) ^b	30 (23.1)	
Cutaneous signs and symptoms n, (%)	19 (82.6)	25 (96.2)	28 (90.3)	47 (94)	119 (91.5)	0.329**
Gastrointestinal signs and symptoms n, (%)	14 (60.9)	13 (50)	12 (38.7)	15 (30)	54 (41.5)	0.067*
Respiratory signs and symptoms n, (%)	14 (60.9)	20 (76.9)	24 (77.4)	43 (86)	101 (77.7)	0.124*
Cardiovascular signs and symptoms n, (%)	1 (4.3)	2 (7.7)	7 (22.6)	11 (22)	21 (16.2)	0.113**
Neurological signs and symptoms n, (%)	7 (30.4)	2 (7.7)	8 (25.8)	9 (18)	26 (20)	0.166**
The administration of adrenaline n, (%)	15 (65.2)	14 (53.8)	16 (51.6)	32 (64)	77 (59.2)	0.600*

Min-max: minimum-maximum; min: minute; *Pearson's Chi-Square Test; **Fisher-Freeman-Halton Test; ***Kruskal-Wallis H Test, a-c. There is no difference between age groups with the same letter in each row.

is slightly lower with the rates (15.9%-22.4%) reported in Türkiye.^{9,15} In the context of Türkiye and European populations, venoms have been identified as a significant contributing factor to anaphylaxis.^{9,14,15} Conversely, in Asia, VIA has been reported to be uncommon.¹³

There was a notable shift in triggers from food to venoms and drugs from infancy to early adolescence, after which the pattern of triggers was stable.²² Serbes et al.¹⁵ found that VIA and DIA are most common in children aged 7-11 years, while FIA is most common in infants under 1 year. Yagmur et al.⁹ showed that there was a decline in the prevalence of FIA from the infantile period to the adolescent period. Conversely, there was an increase in the prevalence of DIA, drugs being the most frequent trigger detected in the adolescent period.⁹ Another study from Türkiye corroborates the findings of other studies;

as age increased, a decrease in the frequency of FIA was observed, while a concomitant increase in the rate of DIA was noted ($p = 0.01$ and $p = 0.01$, respectively).²³ In our study, infants had significantly lower risks of DIA and VIA compared to the adolescent group. Tarczoń et al. observed cardiovascular symptoms in all children with DIA studied and found that patients with VIA were significantly more likely to have cardiovascular symptoms than those with FIA.² Serbes et al.¹⁵ also illustrated that DIA is associated with more cardiovascular involvement than FIA. We did not find any relationship between cardiovascular symptoms and age groups. In our study, DIA and VIA were very rare in infants, but cardiovascular symptoms were more frequently observed with these two forms of anaphylaxis.

The literature indicates that signs and symptoms of anaphylaxis generally appear within 30 minutes in the case of

Table 3 Characteristics of patients with anaphylaxis categorized according to trigger.

	Food	Drug	Venom	p
Age median (min-max)	2.17 (0.5-16) ^b	11.25 (0.58-17.75) ^a	11.54 (1.75-17) ^a	<0.001**
Gender n, (%)				
Female	14 (31.8)	16 (47.1)	6 (33.3)	0.356***
Male	30 (68.2)	18 (52.9)	12 (66.7)	
Duration of anaphylaxis development n, (%)				
0-15 min	22 (50)	20 (58.8)	14 (77.8)	0.391*
15-30 min	6 (13.6)	5 (14.7)	3 (16.7)	
30-60 min	11 (25)	7 (20.6)	1 (5.6)	
>60 min	5 (11.4)	2 (5.9)	0 (0)	
Idiopathic	0 (0) ^a	0 (0) ^a	0 (0)	
Severity of anaphylaxis n, (%)				
Mild	3 (6.8)	3 (8.8)	1 (5.6)	0.124*
Moderate	31 (70.5)	18 (52.9)	7 (38.9)	
Severe	10 (22.7)	13 (38.2)	10 (55.6)	
Cutaneous signs and Symptoms n, (%)	40 (90.9)	32 (94.1)	15 (83.3)	0.422*
Gastrointestinal signs and Symptoms n, (%)	19 (43.2)	18 (52.9)	7 (38.9)	0.558***
Respiratory signs and Symptoms n, (%)	33 (75)	26 (76.5)	12 (66.7)	0.750*
Cardiovascular signs and Symptoms n, (%)	2 (4.5)	8 (23.5)	6 (33.3)	0.006*
Neurological signs and Symptoms n, (%)	7 (15.9)	7 (20.6)	8 (44.4)	0.058*
The administration of Adrenaline n, (%)	24 (54.5)	22 (64.7)	10 (55.6)	0.642***

Min-max: minimum-maximum; min: minute; *Fisher-Freeman-Halton Test; ** Kruskal-Wallis H Test; *** Pearson's Chi-Square Test, a-b. There is no difference between age groups with the same letter in each row.

Table 4 Association of triggers and duration of anaphylaxis development between age groups.

	Infants	Preschoolers	School-age children
Trigger	OR (%95 CI)	OR (%95 CI)	OR (%95 CI)
Drug	0.021 (0.002-0.194)	0.333 (0.094-1.181)	0.457 (0.114-1.831)
Venom	0.039 (0.004-0.383)	0.063 (0.006-0.622)	0.857 (0.198-3.713)
Idiopathic	-	0.079 (0.017-0.377)	0.361 (0.092-1.417)
Other	0.316 (0.036-2.75)	-	-
Duration of anaphylaxis development	OR (%95 CI)	OR (%95 CI)	OR (%95 CI)
15-30 min	0.81 (0.19-3.449)	0.944 (0.218-4.088)	0.177 (0.019-1.638)
30-60 min	0.971 (0.218-4.323)	1.7 (0.42-6.881)	0.85 (0.193-3.739)
>60 min	0.405 (0.038-4.335)	0.472 (0.044-5.106)	0.708 (0.104-4.807)
Idiopathic	-	0.224 (0.054-0.929)	0.447 (0.153-1.306)

OR: Odds ratio; CI: Confidence interval. The odds ratio was calculated for age groups, with the adolescent group as the reference. In terms of trigger types, the "food" trigger was taken as the reference, and in terms of the duration of anaphylaxis development, the "0-15 minutes" was taken as the reference.

food allergies and even sooner in the case of parenteral drugs or insect stings.¹⁷ European data also reveal that 80.5% of reactions occur within 30 minutes after allergen exposure.¹⁴ In addition, they showed that the time interval between exposure and the onset of symptoms was found to be 55.1% within the first 10 minutes and 25.4% within 30 minutes after exposure.¹⁴ A comparison of groups of elicitors revealed that FIA appeared in a delayed pattern, with 13.9% of reactions occurring between 30 and 60 minutes, 7.9% until 2 hours after exposure to the allergen.¹⁴ A significant proportion of reactions that occurred at a late stage were reported in cases of anaphylaxis caused by drugs.¹⁴ Serbes

et al. illustrated that the VIA was considerably quicker than drug and food triggers.¹⁵ In our study, the time interval between allergen exposure and the onset of symptoms was 15 minutes in 45.4% of all cases and 11.5% within 30 minutes. The present study has demonstrated that the duration of anaphylaxis in both DIA and FIA is found to be almost identical. Furthermore, it was demonstrated that VIA is marginally earlier than DIA and FIA. We found a statistically significant relationship between age group and the duration of anaphylaxis development ($p = 0.023$) (Table 2).

Delayed use of adrenaline after anaphylaxis increases the risk of hospitalization and biphasic reactions, and most

of those who die from anaphylaxis do not receive adrenaline in time.⁵ Prompt diagnosis and first-line treatment with adrenaline are crucial. Leung et al. reported that in 60% of anaphylaxis cases, adrenaline was administered.¹³ In Serbes et al.'s¹⁵ study, only 47.6% of children with anaphylaxis were given adrenaline. Our findings indicated that intramuscular adrenaline was administered at the time of anaphylaxis in 59.2% of cases, and only 23.1% of patients had prescribed adrenaline autoinjectors when they were referred to our outpatient clinic. We believe that increasing awareness of anaphylaxis among caregivers and healthcare professionals, as well as educating them on the prevention and management of anaphylaxis, will result in increased use of adrenaline autoinjectors.

The present study has several limitations. Firstly, it was retrospective, and secondly, the diagnosis of anaphylaxis was made on the basis of clinical findings. These limitations were mitigated by the following measures: the medical records of all patients were examined by the same allergy and immunology specialists in a standardized manner. There are only a limited number of studies in the literature reporting the alteration of triggers and symptoms by age group in childhood and adolescent anaphylaxis. We believe that our study makes a significant contribution to the literature.

In conclusion, the etiology of anaphylaxis may vary by age group. Depending on the trigger, it may also have different clinical manifestations. In the management and diagnosis of anaphylaxis, the usage of adrenaline and prescribed adrenaline autoinjectors in primary care should be increased through education of healthcare professionals.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its supplementary material files. Further enquiries can be directed to the corresponding author.

Author Contributions

All authors contributed equally to this article.

Conflict of Interest

The authors declare no potential conflicts of interest with respect to research, authorship, and/or publication of this article.

Funding

None.

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