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Preparedness and Knowledge Level of Family Physicians Regarding Anaphylaxis Diagnosis and Management

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ABSTRACT

Objective: Anaphylaxis is under-recognized and undertreated by physicians, indicating critical knowledge gaps. This study aimed to assess the knowledge levels of anaphylaxis among family physicians (FPs) as they are the primary first-line healthcare providers and identify the factors influencing their knowledge levels. **Materials and Methods:** A cross-sectional study using an internet-based Google Forms questionnaire was conducted among voluntary FPs in Sivas, Turkey. Demographic features, including age, years in practice, and career position, and knowledge related to the diagnosis and management of anaphylaxis in children were assessed. **Results:** A total of 140 FPs participated in the survey (34 [24.3%] general practitioners [GPs], 20 [14.3%] contracted family physicians [CFPs], 74 [52.9%] residents in training [RITs], and 12 [8.6%] specialists). The number of participants who correctly answered all questions regarding diagnosis, acute treatment, and epinephrine auto-injector use was 11 (7.9%), 52 (37.4%), and 27 (19.3%), respectively. In diagnosing anaphylaxis, 100 (72.5%) participants were unaware that anaphylaxis can occur without skin manifestations, and only 48 (34.8%) identified gastrointestinal symptoms as a possible anaphylaxis presentation. RITs (11, 14.9%) and specialists (2, 16.7%) had better performance on the questionnaire, with higher proportions of participants who answered all questions correctly, compared to GPs (2, 5.9%) and CFPs (1, 5.0%). Attendance at an educational activity in the last year was the only independent factor associated with answering all questionnaire items correctly. **Conclusion:** There is a need to improve anaphylaxis recognition and management among all FPs regardless of their career position and work experience, underlining the importance of regular and updated educational interventions.

Keywords: Family Physicians, Anaphylaxis, Knowledge, Diagnosis, Management.

Aile Hekimlerinin Anafilaksi Teşhisi ve Tedavisine İlişkin Hazırlık ve Bilgi Düzeyleri

ÖZ

Amaç: Anafilaksi hekimler tarafından yeterince tanınmamakta ve tedavi edilmemektedir. Bu da hekimlerdeki kritik bilgi boşluklarını göstermektedir. Bu çalışma, sağlık sisteminde birinci basamakta hizmet eden aile hekimlerinin (AH) anafilaksi bilgi düzeylerini değerlendirmeyi ve bilgi düzeylerine etkileyen faktörleri belirlemeyi amaçlamıştır. **Gereç ve Yöntem:** Gönüllüler arasında internet tabanlı Google Formlar anketi kullanılarak Sivas, Türkiye'deki AH'ler üzerinde kesitsel bir çalışma yapıldı. Yaş, meslekte çalışma yılı ve kariyer durumu dahil olmak üzere demografik özellikler, ve çocuklarda anafilaksin teşhisi ve yönetimi ile ilgili bilgileri değerlendirildi. **Bulgular:** Ankete toplam 140 AH'i katılmıştır (34 [%24.3] pratisyen hekim [PH], 20 [%14.3] sözleşmeli aile hekimi [SAH], 74 [%52.9] asistan ve 12 [%8.6] uzman). Tanı, akut tedavi ve epinefrin oto-enjektör kullanımına ilişkin tüm soruları doğru cevaplayanların sayısı sırasıyla 11 (%7.9), 52 (%37.4) ve 27 (%19.3) idi. Anafilaksi tanısında 100 (%72,5) katılımcı, anafilaksinin cilt belirtileri olmadan da oluşabileceğinin farkında değildi ve sadece 48 (%34.8) katılımcı, gastrointestinal semptomları olası bir anafilaksi sunumu olarak tanımladı. Asistanlar (11, %14.9) ve uzmanlar (2, %16.7) ankette daha iyi performans gösterdi ve tüm soruları doğru yanıtlayan katılımcıların oranı PH' lere (%2, %5.9) ve SAH' lere (%1, %5.0) kıyasla daha yüksekti. Geçen yıl bir eğitim faaliyetine katılım, tüm anket maddelerini doğru yanıtlamayla ilişkili tek bağımsız faktördü. **Sonuç:** Kariyer durumu ve iş deneyimlerine bakılmaksızın tüm aile hekimleri arasında anafilaksi tanıma ve yönetimini iyileştirmeye ihtiyaç vardır. Bu da her yıl düzenli ve güncellenmiş eğitimsel aktivitelere katılımın sağlanmasıyla olur.

Anahtar Kelimeler: Aile Hekimleri, Anafilaksi, Bilgi Düzeyleri, Tanı, Tedavi.

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INTRODUCTION

Anaphylaxis is an acute, life-threatening systemic hypersensitivity reaction that requires prompt recognition and treatment. Despite the publication of numerous international and national guidelines regarding anaphylaxis diagnosis and management, anaphylaxis continues to be under-recognized and the treatment is often inadequate, with an underutilization of adrenaline, even by healthcare professionals (Cardona et al., 2020; Prince et al., 2018). Furthermore, the majority of patients who are at high risk for anaphylactic reactions do not receive timely prescriptions for epinephrine auto-injectors (EAI) (Prince et al., 2018). Early diagnosis and proper management of this potentially life-threatening condition thus remain an important issue for international and national health associations.

Due to the rising prevalence of anaphylaxis in children and adults, there is a growing body of work in Turkey studying the recognition and treatment of anaphylaxis using an EAI among physicians, teachers, and families (Tuncel et al., 2021; Ercan et al., 2012; Arga et al., 2021; Topal et al., 2014). Family physicians (FPs) are the primary first-line healthcare providers and should thus be prepared for this medical emergency to reduce its associated mortality and morbidity. However, no studies have been conducted in Turkey on anaphylaxis knowledge among FPs, and very little is known regarding their awareness of EAI use in anaphylaxis management (Topal et al., 2014). Therefore, this study aimed to evaluate the baseline knowledge and awareness levels of FPs from different academic and employment positions in Sivas, Turkey, regarding the recognition of anaphylaxis symptoms in clinical scenarios, the use of epinephrine in acute treatment, and the role of EAIs in long-term treatment. We believe that our study will provide valuable data that not only highlight the current state of FP knowledge on anaphylaxis management but also contribute to the development of future training programs to improve patient care by identifying gaps in clinical practice and knowledge.

MATERIALS AND METHODS

Study type and procedure

A descriptive cross-sectional study employing the internet-based Google Forms was conducted among volunteer FPs of all career stages and employment positions in Sivas, Turkey. 140 (52.6%) of 266 family physicians working in the entire province of Sivas were included in the study. The participants included 1) residents in training (RITs) who were currently in a classical three-year continuous residency program at Sivas Cumhuriyet University Faculty of Medicine, 2) specialists who had graduated from the classical three-year continuous residency program and were practicing in a clinic, 3) general practitioners (GPs) who had not graduated from a classical three-year continuous training program but had graduated from medical school and actively worked as FPs in Sivas, and 4) contracted FPs (CFPs) who were currently in a standardized six-year part-time training program while actively working as

FPs, even though had not completed the classic three-year program to become a specialist. The latter six-year training program has been provided by the Ministry of Health in Turkey since 2010 (Yardımcı et al., 2016). The link to Google Forms was posted on various social media sites, and participants who provided their digital consent and submitted complete responses were included in the study. In the first part of the survey, participant demographic data, including age, number of years in practice, and professional position, were recorded. In the second part, clinical knowledge regarding the diagnosis and treatment of anaphylaxis and awareness of EAIs currently available in Turkey were assessed using an eight-item questionnaire (Table 1), which was prepared by an experienced allergist based on the World Allergy Organization and European Academy of Allergy and Clinical Immunology (EAACI) guidelines on anaphylaxis (Cardona et al., 2020; Muraro et al., 2022). The first question consisted of five clinical scenarios of possible anaphylaxis presentations (four of which were correct) to assess the diagnostic knowledge levels of the participants. The following five questions (Q2–Q6) focused on acute treatment knowledge, while the final two questions (Q7 and Q8) dealt with the name and dose of an EAI available in Turkey (Table 1). Those who identified all five clinical scenarios of anaphylaxis correctly in Q1 and those who answered Q2 to Q6 correctly were considered to have adequate knowledge levels in diagnosis and acute treatment, respectively. Those who answered the two questions regarding EAI (Q7 and Q8) correctly were considered to have an adequate EAI knowledge level. Participants were divided into four groups according to years of work experience: 0–5 years (1), 5–10 years (2), 10–20 years (3), and more than 20 years (4). The percentages of participants who had an adequate level of knowledge of diagnosis, treatment, and EAI use were analyzed and compared with various factors (e.g., years of work experience, academic degree, previous experience with an anaphylaxis case, participation in a training event in the last year) to identify any associations.

Statistical analysis

The data obtained from the questionnaires were analyzed using the software program SPSS, version 22.0 (SPSS, Inc., Chicago, IL, USA). Descriptive analysis was used to characterize the population. Variables were expressed as mean±standard deviation or percentage (sex, age, years in clinical practice, participation in training in the last year, and treatment of an anaphylaxis case). Different groups were compared using Kruskal–Wallis or Pearson's chi-square tests. Multivariate logistic regression analysis was used to identify factors associated with adequate anaphylaxis knowledge levels. For all two-sided significance tests, a *p*-value of less than 0.05 was considered significant. The G-Power 3.1 program was used to calculate the power for the sample size used and it was observed that the power for the 140 unit sample was 99% (Statistical power analysis).

Ethical considerations

All procedures performed in this study involving human participants complied with the ethical standards of Cumhuriyet University of Medicine in Sivas, Turkey and the 1964 Declaration of Helsinki. The Ethics Committee of Cumhuriyet University of Medicine approved this

study (approval number: 2022-04/36). Informed consent was obtained from all participants.

Table 1. Questionnaire regarding clinical knowledge level in the diagnosis and treatment of anaphylaxis (n=140).

Identification of patients with anaphylaxis (Diagnostic knowledge)	Acute treatment in ED and knowledge of epinephrine auto-injectors (Türetmeni knowledge)
Q1- Which of the following cases fulfills the diagnostic criteria for anaphylaxis?	Q2-First line therapy for anaphylaxis
a) Acute onset of skin (urticaria, erythema, pruritus) and respiratory symptoms (e.g., dyspnea, wheeze-bronchospasm, stridor).	Q3- Epinephrine dose and concentration during an anaphylactic reaction
b) Acute onset of skin symptoms and persistent gastrointestinal symptoms (e.g., vomiting, abdominal pain) that occur quickly following exposure to a known allergen.	Q4-Preferred route of administration during an anaphylaxis episode
c) Acute onset of progressive urticaria with significant angioedema.	Q5-Preferred anatomical position for administration
d) Acute onset of hypotension that occurs quickly following exposure to a known allergen.	Q6-Preferred anatomical position during an episode of anaphylaxis
e) Acute onset of bronchospasm that occurs quickly following exposure to a known allergen.	Q7- Knowledge of epinephrine auto-injector and the one currently available in Turkey (Penepin)
	Q8- Dose of epinephrine auto-injector (Penepin) in children and adults

RESULTS

A total of 140 FPs participated in this study, of whom 34 (24.3%) were GPs, 20 (14.3%) were CFPs, 74 (52.9%) were RITs, and 12 (8.6%) were specialists (Table 2). The median age of the participants was 34 years (range: 22–67 years). The GP group had the largest proportion of participants with more than 10 years of work experience (28/34, 82.3%) (Table 2). The sample was comprised of 77 (55.0%) females. The demographic characteristics of the physicians participating in the study were analyzed and compared according to their career positions, as shown in Table 2.

Of the sample, 66 (47.1%) participants stated that they had attended an educational activity on anaphylaxis in the last five years, while 31 (22.1%) reported having attended an educational activity in the last year. Among the professional groups, RITs had the highest proportion of participants who had attended an educational activity in the last year (n=25, 33.8%), while GPs had the lowest proportion of participants who had attended an educational activity in the last year (n=1, 2.9%) (Table 2). Seventy (50.0%) participants reported that they had never experienced a case of anaphylaxis, and 57 (40.7%) participants reported having actively treated anaphylaxis with epinephrine administration. The GP group had the highest percentage of participants (n=22, 64.7%) who had witnessed anaphylactic episodes, and the specialist group had the highest percentage of participants (n=9, 75.0%) who had treated anaphylactic episodes with epinephrine administration (Table 2).

Diagnostic knowledge levels were investigated by assessing the recognition of anaphylaxis symptoms in Q1 using five possible clinical scenarios, four of which were

true anaphylaxis presentations. Of the 140 physicians, only 11 (7.9%) identified all four true clinical scenarios, and 69 (49.3%) identified three out of four true clinical scenarios. RITs had the highest rate of correct responses (n=9, 12.2%; $p=0.045$), while the lowest rates of correct responses were observed in GPs (n=1, 2.9%; $p=0.221$) and CFPs (n=0, 0.0%; $p=0.158$) (Figure 1). Overall, the lowest correct response rate was observed in the third case scenario in Q1 (n=38, 27.5%), where 100 (72.5%) participants misdiagnosed skin manifestations (progressive urticaria and significant angioedema) without any other system involvement as anaphylaxis. The second-lowest correct response rate occurred in the second case scenario in Q1, where 48 (34.8%) participants did not recognize gastrointestinal symptoms accompanying skin reactions as one of the possible presentations of anaphylaxis (Figure 1A). There were no statistically significant differences between the professional groups in the percentage of correct responses in each Q1 clinical scenario (Figure 1A).

Of all participants, 134 (95.7%) knew that epinephrine was the first drug choice during acute treatment. However, only 119 (85.0%) preferred the recommended route (intramuscular), 100 (71.4%) knew the correct administration site of intramuscular epinephrine, and 85 (60.7%) knew the appropriate dose (0.01 mg/kg). Concerning the positioning of the patient during anaphylaxis, 35 (25.0%) participants answered incorrectly (Figure 1B). GPs had significantly lower percentages of correct responses in each acute treatment question (Q2–Q6) compared to the other professional groups. When the percentages of participants within each professional group who correctly answered all four acute

treatment questions (Q2–Q6) were compared, GPs had a significantly lower percentage (n=5, 15.2%; p=0.002) and specialists had a significantly higher percentage

(n=8, 66.7%; p=0.028) than all other professional groups (Figure 1B).

Table 2. Demographic characteristics of participants according to their career positions (n=140).

Characteristics	All responders n=140, (100%)	General practitioners n=34 (24.3%)	Contracted family physicians n=20 (14.3%)	Residents in training n=74 (52.9%)	Specialists n=12 (8.6%)	p
Female, n(%)	77(55)	15(44.1)	9(45.0)	45(60.8)	8 (66.7)	0.250
Age, year, median (min-max)	34(22-67)	43.6(25-67)	40.3(31-53)	28(22-39)	33.5 (28-41)	<0.001 ^{g,c,f}
Age n(%)						
20-30	75(53.6)	3(8.8)	0(0.0)	69(93.2)	3 (25.0)	<0.001 ^{g,c,f} 0.038 ^s
31-40	31(22.1)	8(23.5)	10(50.0)	5(6.8)	8 (66.7)	<0.001 ^{c,f,s}
41-50	26(18.6)	16(47.1)	9(45.0)	0(0.0)	1 (8.3)	<0.001 ^{g,c,f}
>50 years	8(5.7)	7(20.6)	1(5.0)	0(0.0)	0 (0.0)	<0.001 ^{g,f}
Years in practice n(%)						
1-5 years	64(45.7)	2(5.9)	0(0.0)	60(81.1)	2(16.7)	<0.001 ^{g,c,f} 0.035 ^s
6-10 years	29(20.7)	4(11.8)	7(35.0)	13(17.6)	5(41.7)	>0.05
11-20 years	27(19.3)	15(44.1)	6(30.0)	1(1.4)	5(41.7)	<0.001 ^{g,f} 0.04 ^s
>20 years	20(14.3)	13(38.2)	7(35.0)	0(0.0)	0(0.0)	<0.001 ^{g,f} 0.04 ^c
Have an educational activity, n(%)	66(47.1)	17(50.0)	10(50.0)	31(41.9)	8 (66.7)	>0.05
Had an educational activity in the last year, n(%)	31(22.1)	1(2.9)	3(15.0)	25(33.8)	2(16.7)	0.002 ^g <.0001 ^f
Have witnessed a case of anaphylaxis during clinical practice, n(%)	70(50.0)	22(64.7)	8(40.0)	31(41.9)	9(75.0)	0.049 ^g
Treated an anaphylaxis episode with epinephrine, n(%)	57(40.7)	15(44.1)	8(40.0)	25(33.8)	9(75.0)	0.011 ^s

*p^g= p value between the general practitioners and others, p^f=p value between contracted physicians and others, p^c=p value between residents in training and others, p^s=p value between the specialists and others.

The final two questions (Q7 and Q8) assessed knowledge of the EAI currently available in Turkey. Most participants (n=126, 90%) claimed that they had heard of the EAI. However, the name and correct pediatric and adult doses of the EAI device currently available in Turkey were known by only 60 (42.9%) and 27 (19.3%) participants, respectively. The RIT group had the highest proportion (n=40, 54.1%; p=0.016) while the GP group had the lowest proportion (n=9, 26.5%; p=0.002) of participants who knew the correct name of the EAI device. Regarding the correct pediatric and adult doses of these devices, the highest percentages of correct responses were seen in the RIT (n=19, 25.7%; p=0.042) and specialist (n=4, 33.3%; p=0.063) groups, while the lowest percentage of correct responses occurred in the GP group (n=2, 5.9%; p=0.023) (Figure 2). When analyzing participants with an adequate EAI knowledge level, or those who answered both Q7 and Q8 correctly, RITs (25.7%, p=0.042) and specialists (33.3%, p=0.197) had the highest percentage while GPs (5.9%; p=0.023) had the lowest percentage of participants with adequate knowledge (Figure 2).

When we compared the participants with adequate knowledge by years of work experience, participants with less than five years of experience had higher

proportions of adequate knowledge levels, particularly in diagnostic knowledge (n=2, 50.0%; p<0.001) (Table 3). The relationship between adequate knowledge and the physicians' age, clinical experience (encountering an anaphylaxis case with or without epinephrine treatment), and attendance at educational sessions in the last year were evaluated (Table 4). The percentage of participants with adequate knowledge of both diagnosis (n=10, 13.3%) and EAIs (n=20, 26.7%) was highest in the younger age group (aged 20–30 years). A significant decrease in the percentage of adequate knowledge level regarding acute treatment was noted with increasing age, especially in the older age groups (aged>40 years) when compared to younger age groups (aged<40 years) (Table 4). The adequate knowledge level percentages regarding acute treatment and EAIs were higher among participants with anaphylaxis clinical experience with or without epinephrine treatment compared to those without experience, though these findings were not statistically significant (Table 4). Participants who had an educational activity on anaphylaxis in the last year had a significantly higher percentage of adequate diagnostic, acute treatment, and EAI knowledge than those who did not (p=0.007, p=0.023, p=0.038, respectively) (Table 4).

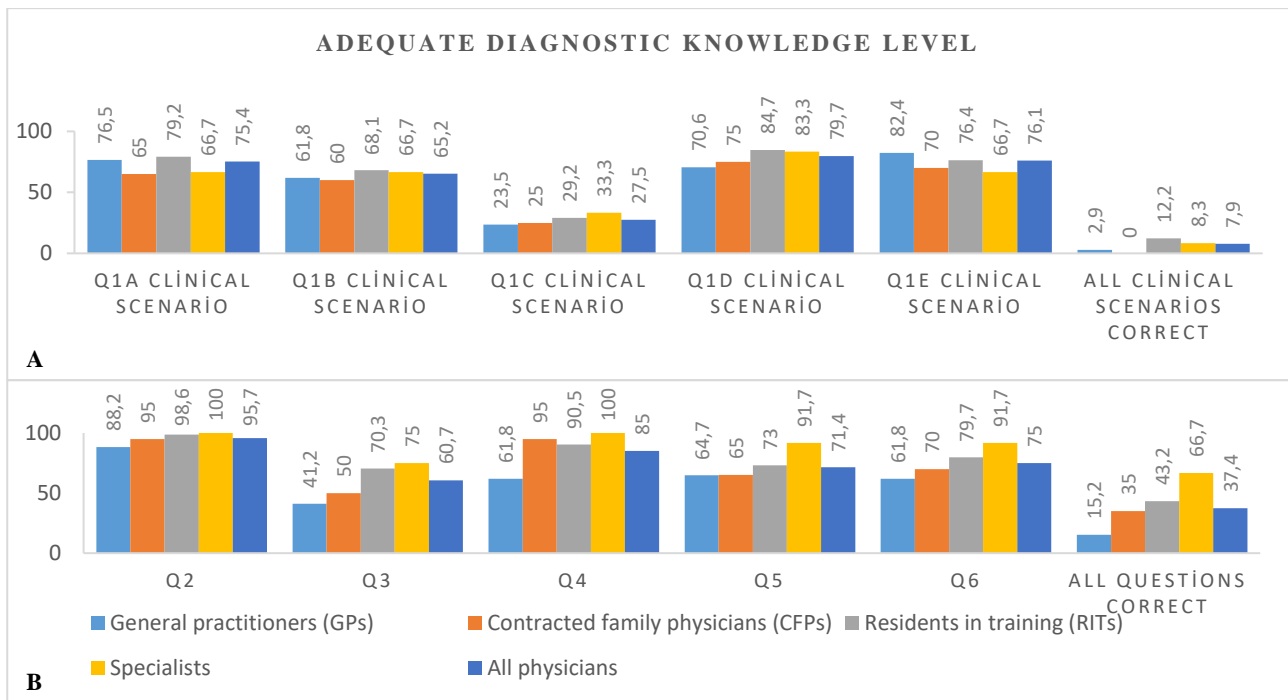


Figure 1. a) Percentage of correct response to clinic scenarios in question 1 (Q1) regarding diagnostic knowledge by family physicians from different career positions, b) Percentage of correct response to questions (Q2-Q6) regarding acute treatment knowledge by family physicians from different career positions.

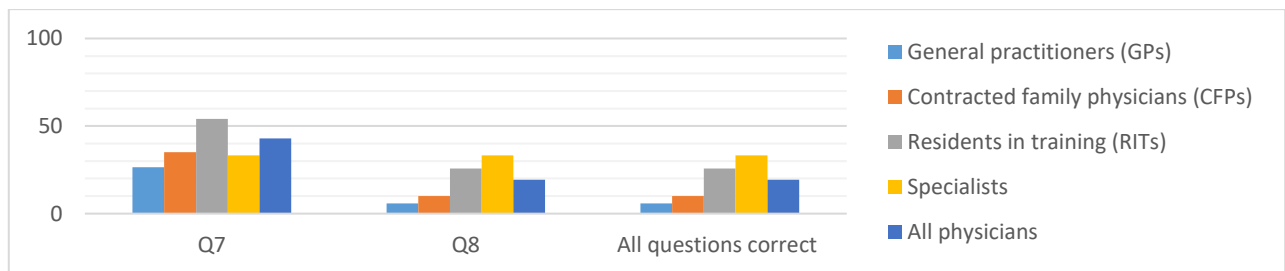


Figure 2. Percentage of correct response to questions (Q7-Q8) regarding epinephrine auto-injector knowledge by family physicians from different career positions.

The RITs (n=11, 14.9%) and specialists (n=2, 16.7%) demonstrated better performance in the entire questionnaire, with higher proportions of participants who answered all questions correctly, when compared to the GPs (n=2, 5.9%) and CFPs (n=1, 5.0%).

When the factors associated with answering all items in the questionnaire correctly underwent logistic regression analysis, attendance at an educational activity in the last year was found to be the only independent factor associated with participants who answered all questions correctly (p=0.021) (Table 5).

Table 3. Distribution of participants having adequate knowledge level of anaphylaxis regarding diagnosis, acute treatment, and EAI currently available in Turkey by years of work experience (n=140).

Adequate knowledge	<5 years	5-10 years	10-20 years	>20 years	p
Diagnosis	2(50.0)*	0(0)	0(0)	0(0)	<0.001*
Acute treatment	2(50.0)*	8(50.0)	7(26.9)	3(15.8)	0.390*
EAI knowledge	1(25.0)*	1(6.3)	3(11.5)	3(15.0)	0.415*

Table 4. Factors associated with highest percentage of adequate knowledge levels in the questionnaire regarding diagnosis, acute treatment and EAI among participants(n=140).

Factors associated with adequate knowledge	Regarding diagnosis knowledge (Q1)	p	Regarding Acute treatment knowledge (Q2-Q6)	Regarding EAI knowledge (Q7-Q8)	p
Have witnessed an anaphylaxis episode		0.753			0.520
Yes, n(%)	6(8.6)		26(37.7)	15(21.4)	
No, n(%)	5(7.1)		26(37.1)	12(17.1)	
Have treated an anaphylaxis episode with epinephrine		0.760			0.661
Yes, n(%)	4(7.0)		22(39.3)	12(21.1)	
No, n(%)	7(8.4)		30(36.1)	15(18.1)	
Have an educational activity in the last year		0.007			0.038
Yes, n(%)	6(19.4)		17(54.8)	10(32.3)	
No, n(%)	5(4.6)		25(32.4)	17(15.6)	
Participants' age					
20-30 years, n(%)	10(13.3)	0.010	32(42.7)	20(26.7)	0.017
31-40 years, n(%)	1(3.2)	0.277	15(48.4)	3(9.7)	0.124
41-50 years, n(%)	0(0.0)	0.099	5(20.0)	4(15.4)	0.576
>50 years, n(%)	0(0.0)	0.395	0(0.0)	0(0.0)	0.154

Table 5. Factors associated with answering all items in the questionnaire correctly(n=140).

Variable	OR (95% CI)	p
Resident in training	0.06(0.132-4.748)	0.811
Have an educational activity in the last year	5.3(0.089-0.822)	0.021
Year of work experience (<5 years)	0.04(0.221-6.506)	0.833
Age (20-30 years)	0.941(0.317-29.852)	0.332

DISCUSSION

Prompt recognition of clinical signs and symptoms of anaphylaxis is critical for diagnosis. In our study, nearly half of the participants misdiagnosed one and more scenarios. Compared to previous studies, the percentage of respondents with inadequate diagnostic knowledge levels was higher in our study, underlining a critical gap in FPs' knowledge (Arga et al., 2021; Muraro et al., 2022; El-Sayed et al., 2021; Alvarez-Perea et al., 2017). Different educational programs between countries and specialties, as well as the availability of educational resources and different evaluation methods, may have influenced physicians' knowledge and practice of anaphylaxis.

The most common clinical presentations of anaphylaxis are cutaneous, combined with respiratory, cardiovascular, and/or gastrointestinal symptoms (Cardona et al., 2020). However, exceptional clinical presentations of anaphylaxis have been reported in previous studies, in which bronchospasm or cardiovascular collapse, including profound hypotension, were possible without any cutaneous or respiratory manifestations (Fustiñana et al., 2021; Turner et al., 2019; Brown et al., 2013). However, in our study, the most often reported manifestations were skin symptoms, and the majority of the participants were unaware that anaphylaxis can occur without skin manifestations (El-Sayed et al., 2021; Fustiñana et al., 2021). Furthermore, gastrointestinal manifestations were

the least identified symptoms, as has also been reported in previous studies (El-Sayed et al., 2021; Turner et al., 2019; Brown et al., 2013). Failure to associate these manifestations with anaphylaxis may cause delays in recognition and immediate epinephrine administration, which is crucial for recovery and the prevention of complications (Cardona et al., 2020).

Immediate and accurate treatment with epinephrine is critically important for survival in anaphylaxis.^{1,2} In our study, the percentage of participants with adequate knowledge level regarding acute treatment with epinephrine was higher than those reported in several previous studies, though still lower than recommended. (Cardona et al., 2020; Tuncel, et al., 2021; González-Díaz, et al., 2021, Yildiz et al., 2022). Concerning patient positioning during anaphylaxis, patients experiencing anaphylaxis should lie flat with their legs elevated to ensure adequate venous return which is recommended by international guidelines (Muraro et al., 2022; Shaker. et al., 2020). Consistent with the findings of a recent study by Wijekoon et al. (Wijekoon, et al., 2021), 25% of the participants did not know the correct positioning of the patient during anaphylaxis in our study. Therefore, the importance of adherence to current published national and international guidelines, which provide critical information such as medication descriptions, route of administration, dosing, and the correct anatomical position of the patient during anaphylaxis, should be emphasized to avoid failures in treatment.

Current guidelines recommend that individuals who have experienced anaphylaxis and those at risk of anaphylaxis should be prescribed and carry an EAI at all times for emergency use (Cardona et al., 2020; Muraro et al., 2022). As has been reported in previous studies, the awareness and knowledge level of EAIs was inadequate among participants in this study (Prince et al., 2018; Topal et al., 2014; González-Díaz, et al., 2021; Yildiz et al., 2022).

We analyzed and compared the percentages of FPs with adequate knowledge regarding diagnosis, acute treatment, and EAIs, our results indicate that older age and longer duration of work experience did not significantly influence knowledge of anaphylaxis, similar to the results of a previous study in Turkey (Topal et al., 2014; Yildiz et al., 2022). In contrast to recent study by Arga et al. (2021), having clinical experience with or without epinephrine treatment had no statistically significant impact on the rates of adequate knowledge among participants in our study. When the factors associated with adequate knowledge regarding diagnosis, acute treatment, and EAIs were analyzed by logistic regression, attendance at an anaphylaxis educational activity in the last year was found to be the only independent factor. This finding may explain the differences in knowledge between RITs and GPs, as the percentage of participants who attended educational activities in the last year was highest among RITs while lowest among GPs. Our analysis also showed that specialists who had graduated from a three-year continuous training program at a university demonstrated a higher rate of adequate knowledge compared to GPs and CFPs. This discrepancy among FPs could potentially be attributed to better clinical training or more opportunities to participate in educational activities relating to anaphylaxis at conferences and academic sessions in the three-year residency program. The Turkish Ministry of Health has been increasing its efforts to provide university-affiliated training programs to GPs, but our study revealed that these efforts have not led to adequate clinical knowledge and awareness of anaphylaxis, highlighting the urgent need to review and improve this situation. All FPs, and particularly GPs and CFPs, should be informed of and encouraged to follow the international guidelines for anaphylaxis diagnosis and treatment and participate in yearly educational activities such as conferences and academic sessions.

Limitations of study

The limited sample size and use of a self-administered online survey method, both of which have significant drawbacks such as some physicians' refusal to respond, and internet and technical issues, limit the scope of our research. Another limiting factor is the inability to compare different specialties and the time elapsed since the last anaphylaxis educational activity experience (except for five years) due to a lack of data.

CONCLUSION

Our findings illuminated a tremendous gap in the knowledge and preparedness of FPs regarding anaphylaxis, with higher frequencies of deficiencies found among GPs and CFPs. A large proportion of the participants appeared to be unaware of the diagnostic criteria for anaphylaxis and the recently updated EAACI recommendations for anaphylaxis management, particularly regarding EAI use. Additionally, as knowledge level was found to decrease over time, more effective guidance and national training programs should be provided at regular intervals as part of physician continuing education to maintain knowledge levels that are complete and current. Despite our study having a local setting, its findings could be beneficial to healthcare authorities when developing educational interventions to fill the identified gaps in knowledge.

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Conflict of Interest

The authors have indicated that they have no potential conflicts of interest.

Author Contributions

Plan, design: SM, NKS; **Material, Methods, and data collection:** SM, NKS; **Data analysis and comments:** SM, NKS; **Writing and corrections:** SM, NKS.

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