BMC Oral Health

RESEARCH

Open Access

First-aid knowledge among undergraduate and specialist dental students in Turkey: a cross-sectional study

Rahime Zeynep Erdem[1*] and Fatih Bedir[2]

Abstract

Background Dental professionals frequently treat patients with systemic conditions, and medical emergencies can occur during dental procedures, circumstances that underscore the importance of first-aid competence in dental training. In this study, specialist dental students refers to postgraduate students enrolled in accredited dental specialty programmes (e.g., orthodontics, endodontics, periodontics). This cross-sectional study aimed to evaluate and compare first-aid knowledge levels among pre-clinical (years 1–3), clinical (years 4–5), and specialist dental students enrolled in Turkish dental faculties, and to assess whether the proportion reporting formal first-aid training differed across these groups.

Methods Data were collected using a validated 23-item questionnaire (Cronbach's $\alpha = 0.87$) distributed via Google Forms (Google, Mountain View, CA, USA) across Turkish dental faculties in October 2023. A total of 1,093 students participated. Group comparisons were performed with Kruskal-Wallis and Mann-Whitney U tests; the Chi-square test was used for categorical variables. Binary logistic regression identified independent predictors of adequate knowledge. Effect sizes were calculated using eta-squared (η^2) and r.

Results A statistically significant difference in first-aid knowledge was identified across the three groups ($p < 0.001$). Adequate knowledge was demonstrated by 82.1% of specialist students, 61.8% of clinical students, and 41.7% of pre-clinical students. Overall, 35.5% of participants reported prior formal first-aid training, with the proportion differing significantly across groups ($p < 0.001$). Logistic regression identified training stage (specialist vs. pre-clinical: OR 5.39, 95% CI 3.32–8.77; clinical vs. pre-clinical: OR 2.15, 95% CI 1.61–2.85) and prior first-aid training (OR 1.40, 95% CI 1.06–1.84) as independent predictors. Sex was not significant ($p = 0.175$).

Conclusions First-aid knowledge in dental students is more closely tied to progression through training stages than to sex, yet the persistence of knowledge gaps among specialist students indicates that clinical seniority alone does not guarantee first-aid competence. These findings support treating first-aid proficiency as an outcome to be deliberately verified at successive stages of dental training rather than assumed to accrue with experience.

Keywords First aid, Dental students, Health knowledge, Attitudes, Practices, Education, Dental, Turkey

*Correspondence:
Rahime Zeynep Erdem
zeynepguvendi@hotmail.com
[1]Department of Restorative Dentistry, Faculty of Dentistry, Afyonkarahisar Health Sciences University, Afyonkarahisar, Turkey
[2]Department of Restorative Dentistry, Faculty of Dentistry, Recep Tayyip Erdoğan University, Rize, Turkey

© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Background

The European Resuscitation Council has defined first aid as the behaviours and care provided in the event of acute illness or injury, with the primary aim of preserving life, relieving pain, preventing further deterioration of health, and promoting recovery [1]. Every individual should be able to provide at least basic first aid until professional help arrives [1]. First-aid providers are defined as people with recognised training who fulfil three core duties: recognising the need for first aid, evaluating and providing care using appropriate skills, and knowing the limitations of the duty and when to request additional professional healthcare [2].

Accidents can occur at any time, whether in the home, at the workplace, at school, in public spaces, or during leisure activities, and the majority involve emergency situations requiring the help of others. Deaths from conditions such as airway obstruction and haemorrhage can in many cases be prevented by timely first-aid intervention [1]. Dental professionals work across a wide range of patient groups and clinical settings, and professional guidelines recommend that dental practitioners maintain competence in managing medical emergencies [1, 3].

Trainees who have not received adequate instruction in emergency management may be less prepared to respond when confronted with real emergencies [4, 5]. To the extent that such preparedness gaps exist, they may reflect the content and structure of the educational programme rather than individual student capacity.

Studies from multiple regions have reported inadequate first-aid and basic life support (BLS) knowledge among dental and medical students, with correct response rates often falling below 70% [3, 5–9]. Simulation-based training produces measurable short-term improvements, yet knowledge decays significantly within three to six months, underscoring the need for periodic refresher training [10–12]. The Turkish dental education system operates under a five-year undergraduate structure followed by competitive postgraduate specialty training. An institutional survey of 11 Turkish dental schools conducted in 2016 found that BLS was taught theoretically at all responding institutions, yet practical competency assessment was largely absent [9]. Whether a mandatory first-aid module is formally required under current regulations was not examined in this study; by contrast, some European dental education frameworks formally accredit BLS training, though cross-national comparisons are limited by regulatory heterogeneity. To the authors' knowledge, no published study has simultaneously compared first-aid knowledge across all three training stages (preclinical, clinical, and specialist) within the Turkish dental educational context.

The primary null hypothesis (H_{01}) was that there is no statistically significant difference in first-aid knowledge levels among pre-clinical, clinical, and specialist dental students enrolled in Turkish dental faculties. The secondary null hypothesis (H_{02}) was that the proportion of students who have received formal first-aid training does not differ significantly across these three groups.

Methods

Ethical approval and study design

This descriptive, cross-sectional observational study was conducted in accordance with the ethical principles of the Declaration of Helsinki [13]. Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Afyonkarahisar Health Sciences University, Faculty of Dentistry (Decision No: 2023 – 450; Date: 10.10.2023).

Questionnaire development and validation

The questionnaire was adapted from the instrument developed by Pala et al. [14] for assessing first-aid knowledge in university students. The original questionnaire was modified to reflect clinical experiences relevant to dental students; questions were adjusted accordingly. Two faculty members with backgrounds in dental education and emergency medicine reviewed the adapted version for content validity [14]. Item-total correlations were examined and all items satisfied the accepted threshold ($r > 0.30$). Internal consistency was confirmed by a Cronbach's alpha coefficient of 0.87, indicating good reliability.

The final questionnaire comprised 23 items structured in two sections: (1) sociodemographic and background variables (age, sex, year of study, prior first-aid training, belief in the importance of first aid, self-reported willingness to intervene); and (2) first-aid knowledge items divided into two sub-fields 'Call for First Aid and Basic Practices' (items 1–7) and 'Medical Emergency Situations' (items 8–23). Two items (Q7 and Q22) were reverse-worded; these were reverse-scored prior to analysis. Each item was scored: correct = 2 points; 'I don't know' = 1 point; incorrect = 0 points. Total scores ranged from 0 to 46. This three-level scoring scheme followed the approach of the source instrument [14] and was adopted because, in a first-aid context, an incorrect answer and an 'I don't know' answer are not equivalent. An incorrect answer reflects a positive misconception that could translate into an inappropriate and potentially harmful intervention in a real emergency (for example, moving a patient with a suspected spinal injury), whereas an 'I don't know' answer reflects an absence of knowledge without an associated misconception, a state more likely to result in abstention from harmful action and in seeking professional help. Assigning incorrect responses the lowest weight (0), 'I don't know' an intermediate weight (1), and correct responses the highest weight (2) therefore captures this ordinal distinction between harmful

misinformation, knowledge gaps, and accurate knowledge; it also reduces the inflation of apparent competence that can arise when uncertain respondents guess and answer correctly by chance.

Participants and sampling

The questionnaire was created on Google Forms (Google, Mountain View, CA, USA) and distributed via WhatsApp groups to dental students across multiple Turkish faculties in October 2023. This was a convenience sample; no formal sample size calculation was performed prior to data collection, which is acknowledged as a methodological limitation. No data on the total number of students approached or response rates per faculty were collected, limiting assessment of representativeness. A total of 1,093 students completed the questionnaire in full and were included in the analysis.

For the primary analyses, participants were classified into three groups based on training stage: (1) pre-clinical students (years 1–3): didactic phase with limited patient contact; (2) clinical students (years 4–5): actively treating patients under faculty supervision; (3) specialist (postgraduate) students: enrolled in accredited dental specialty programmes (e.g., orthodontics, endodontics, periodontics) following completion of the undergraduate degree. For subgroup analyses, the pre-clinical cohort was further divided into year 1, year 2, and year 3 subgroups; the clinical cohort into year 4 and year 5 subgroups, yielding five undergraduate subgroups in total.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics (version 23.0; IBM, Armonk, NY, USA). Descriptive statistics were presented as mean ± standard deviation (SD), median, minimum, maximum, frequency (n), and percentage (%). The Shapiro-Wilk test was applied to assess normality; all groups departed significantly from normality ($p < 0.001$), confirming the appropriateness of non-parametric tests. Group comparisons were performed using the Kruskal-Wallis test and the Mann-Whitney U test for continuous variables, and the Chi-square test for categorical variables. Effect sizes were calculated using eta-squared (η^2) for Kruskal-Wallis comparisons and r ($r = Z/\sqrt{n}$) for Mann-Whitney U post-hoc comparisons. Cut-off values were determined using the Youden Index (ROC curve analysis). Binary logistic regression was performed to identify independent predictors of adequate first-aid knowledge. A p-value of < 0.05 was considered statistically significant.

Results

Demographic information

The study evaluated data from 1,093 undergraduate and specialist students enrolled in Turkish dental faculties in the 2023–2024 academic year. The sample comprised 696 females (63.7%) and 397 males (36.3%), of whom 655 (59.9%) were pre-clinical students, 304 (27.8%) clinical students, and 134 (12.3%) specialist students. The distribution of participants according to demographic and background variables is shown in Table 1.

First-aid knowledge questions

Table 2 presents the first-aid knowledge items, the distribution of response percentages, and the three items receiving the highest rates of incorrect answers across groups. A statistically significant difference was observed between groups in prior first-aid training and self-reported willingness to intervene ($p < 0.001$). Positive response rates to these items were lowest in the pre-clinical group and highest in the specialist group. All participants expressed a strong belief in the importance of first aid, with no significant difference between groups ($p = 0.771$) (Table 3).

Table 1 Distribution of participants according to variables

Variable		*N*	%
Gender	Female	696	63.7
	Male	397	36.3
Age (years)	18–20	407	37.3
	21–23	490	44.8
	≥ 24	196	17.9
Training stage	Pre-clinical	655	59.9
	Clinical	304	27.8
	Specialist	134	12.3
Prior first-aid training	Yes	388	35.5
	No	705	64.5
Believes first aid is important	Yes	1080	98.8
	No	13	1.2
Can intervene if needed	Yes	373	34.1
	No	720	65.9

Table 2 Distribution of answers to first-aid knowledge scale by group

Question	Response	Pre-clinical *n* (%)	Clinical *n* (%)	Specialist *n* (%)	
Basic first-aid call and basic applications (Q1–7)					
Q1 The three most important steps in first aid: assessment of airway, respiration, and circulation.	Incorrect	27 (4.1)	13 (4.3)	8 (6.0)	
	I don't know	138 (21.1)	22 (7.2)	4 (3.0)	
	Correct	490 (74.8)	269 (88.5)	122 (91.0)	
Q2 Primary objectives of first aid: maintain vital functions, prevent deterioration, facilitate recovery.	Incorrect	13 (2.0)	14 (4.6)	1 (0.7)	
	I don't know	48 (7.3)	11 (3.6)	0 (0.0)	
	Correct	594 (90.7)	279 (91.8)	133 (99.3)	
Q3 Eliminating danger to life is a primary objective of first aid.	Incorrect	76 (11.6)	36 (11.8)	7 (5.2)	
	I don't know	71 (10.8)	24 (7.9)	6 (4.5)	
	Correct	508 (77.6)	244 (80.3)	121 (90.3)	
Q4 First action at accident scene: create a safe environment by identifying potential hazards.	Incorrect	14 (2.1)	11 (3.6)	2 (1.5)	
	I don't know	58 (8.9)	12 (3.9)	4 (3.0)	
	Correct	583 (89.0)	281 (92.4)	128 (95.5)	
Q5 Open airway and apply pressure to heavy bleeding before leaving patient to call 112.	Incorrect	57 (8.7)	30 (9.9)	17 (12.7)	
	I don't know	114 (17.4)	33 (10.9)	8 (6.0)	
	Correct	484 (73.9)	241 (79.3)	109 (81.3)	
Q6 When calling emergency ambulance, explain: location, caller, incident description, number of patients, condition, help received.	Incorrect	11 (1.7)	3 (1.0)	0 (0.0)	
	I don't know	50 (7.6)	14 (4.6)	2 (1.5)	
	Correct	594 (90.7)	287 (94.4)	132 (98.5)	
Q7† Conscious patient with spinal injury should be allowed to move. (Reverse-scored) abc	Incorrect	13 (2.0)	9 (3.0)	3 (2.2)	
	I don't know	83 (12.7)	16 (5.3)	1 (0.7)	
	Correct	559 (85.3)	279 (91.8)	130 (97.0)	
Medical emergencies sub-field (Q8–23)					
Q8 Non-traumatic shock: open airway, lay supine, raise legs 30–60 degrees.	Incorrect	27 (4.1)	22 (7.2)	10 (7.5)	
	I don't know	330 (50.4)	119 (39.1)	31 (23.1)	
	Correct	298 (45.5)	163 (53.6)	93 (69.4)	
Q9 Asthmatic with shortness of breath: use previously prescribed inhaled bronchodilator.	Incorrect	46 (7.0)	11 (3.6)	4 (3.0)	
	I don't know	292 (44.6)	63 (20.7)	13 (9.7)	
	Correct	317 (48.4)	230 (75.7)	117 (87.3)	
Q10 Suspected stroke: assess facial drooping, arm drop, speech disorder, last seen normal.	Incorrect	9 (1.4)	4 (1.3)	1 (0.7)	
	I don't know	312 (47.6)	108 (35.5)	35 (26.1)	
	Correct	334 (51.0)	192 (63.2)	98 (73.1)	
Q11 abc Chest pain / suspected MI: give chewable aspirin and call 112.	Incorrect	157 (24.0)	70 (23.0)	43 (32.1)	
	I don't know	382 (58.3)	126 (41.4)	33 (24.6)	
	Correct	116 (17.7)	108 (35.5)	58 (43.3)	
Q12 Anaphylaxis: call 112 immediately; administer prescribed adrenaline injector.	Incorrect	44 (6.7)	18 (5.9)	0 (0.0)	
	I don't know	455 (69.5)	98 (32.2)	10 (7.5)	
	Correct	156 (23.8)	188 (61.8)	124 (92.5)	
Q13 Hunger, trembling, sweating, restlessness: hypoglycaemia; give sugary food/drink; call 112 if no improvement in 10–15 min.	Incorrect	87 (13.3)	29 (9.5)	6 (4.5)	
	I don't know	233 (35.6)	55 (18.1)	10 (7.5)	
	Correct	335 (51.1)	220 (72.4)	118 (88.1)	
Q14 b Dehydration from excessive exercise: give electrolyte-rich drink.	Incorrect	111 (16.9)	59 (19.4)	17 (12.7)	
	I don't know	283 (43.2)	74 (24.3)	16 (11.9)	
	Correct	261 (39.8)	171 (56.3)	101 (75.4)	
Q15 Eye exposed to toxic chemicals: flush with water for 15 min, call emergency services.	Incorrect	18 (2.7)	5 (1.6)	0 (0.0)	
	I don't know	173 (26.4)	49 (16.1)	13 (9.7)	
	Correct	464 (70.8)	250 (82.2)	121 (90.3)	
Q16 ac Open wounds and bleeding: apply direct pressure until bleeding stops.	Incorrect	126 (19.2)	55 (18.1)	25 (18.7)	
	I don't know	222 (33.9)	72 (23.7)	15 (11.2)	
	Correct	307 (46.9)	177 (58.2)	94 (70.1)	
Q17 Severe external bleeding: tourniquet only by specially trained personnel.	Incorrect	15 (2.3)	12 (3.9)	7 (5.2)	
	I don't know	123 (18.8)	56 (18.4)	20 (14.9)	
	Correct	517 (78.9)	236 (77.6)	107 (79.9)	

Table 2 (continued)

Question	Response	Pre-clinical *n* (%)	Clinical *n* (%)	Specialist *n* (%)	
Q18 Head trauma with dizziness, headache, nausea, visual impairment or confusion: call emergency services.	Incorrect	7 (1.1)	7 (2.3)	0 (0.0)	
	I don't know	105 (16.0)	23 (7.6)	2 (1.5)	
	Correct	543 (82.9)	274 (90.1)	132 (98.5)	
Q19 Suspected spinal cord injury: recommend cervical collar.	Incorrect	45 (6.9)	23 (7.6)	5 (3.7)	
	I don't know	174 (26.6)	52 (17.1)	19 (14.2)	
	Correct	436 (66.6)	229 (75.3)	110 (82.1)	
Q20 Electric shock: cut victim from current with a board or plastic object.	Incorrect	10 (1.5)	7 (2.3)	5 (3.7)	
	I don't know	108 (16.5)	30 (9.9)	5 (3.7)	
	Correct	537 (82.0)	267 (87.8)	124 (92.5)	
Q21 Heat stroke: give fluid drinks if no nausea or vomiting.	Incorrect	74 (11.3)	29 (9.5)	7 (5.2)	
	I don't know	383 (58.5)	142 (46.7)	48 (35.8)	
	Correct	198 (30.2)	133 (43.8)	79 (59.0)	
Q22† Apply pressure to abdomen and chest of drowning person to remove swallowed water. (Reverse-scored)	Incorrect	409 (62.4)	195 (64.1)	82 (61.2)	
	I don't know	194 (29.6)	85 (28.0)	38 (28.4)	
	Correct	52 (7.9)	24 (7.9)	14 (10.4)	
Q23 Chemical poisoning: remove all clothing, wash body thoroughly with plenty of water.	Incorrect	119 (18.2)	58 (19.1)	19 (14.2)	
	I don't know	382 (58.3)	155 (51.0)	49 (36.6)	
	Correct	154 (23.5)	91 (29.9)	66 (49.3)	

"a" Top 3 incorrect for pre-clinical; "b" for clinical; "c" for specialist; "†" reverse-scored item; bold = highest incorrect rate per group

Table 3 Comparison of demographic data and knowledge questions between groups

Variable		Pre-clinical c	Clinical b	Specialist a	*p* value
Gender	Female	417	182	97	—
	Male	238	122	37	—
Age (years)	18–20	398	8	0	—
	21–23	243	244	4	—
	≥ 24	14	52	130	—
Prior first-aid training	Yes	155 (23.7%)	134 (44.1%)	99 (73.9%)	< 0.001***< 0.001***
	No	500 (76.3%)	170 (55.9%)	35 (26.1%)	
Believes FA important	Yes	646	301	133	**0.771***
	No	9	3	1	
Can intervene	Yes	182 (27.8%)	119 (39.1%)	72 (53.7%)	**< 0.001***
	No	473 (72.2%)	185 (60.9%)	62 (46.3%)	
Basic field (Q1–7)	Min–Max	4–14	6–14	9–14	**< 0.001 ¥**
	Mean ± SD	12.5 ± 1.71	12.8 ± 1.47	13.25 ± 1.21 bc	
Medical emerg. (Q8–23)	Min–Max	2–30	13–30	18–32	**< 0.001 ¥**
	Mean ± SD	21.68 ± 3.67	23.73 ± 3.75 c	25.89 ± 3.05 bc	
Total (Q1–23)	Min–Max	6–44	23–44	28–46	**< 0.001 ¥**
	Mean ± SD	34.18 ± 4.65	36.53 ± 4.55 c	39.13 ± 3.70 bc	

* Chi-square test; ¥ Kruskal-Wallis test. Superscripts: a difference with specialist $p < 0.05$; b with clinical; c with pre-clinical

A statistically significant difference in first-aid knowledge was identified among the three groups ($p < 0.001$). Specialist students demonstrated the highest level of first-aid knowledge, while pre-clinical students exhibited the lowest (Table 3). Cut-off values determined via the Youden Index were 13 for 'Call for First Aid and Basic Practices', 23 for 'Medical Emergency Situations', and 36 for the total score. Statistically significant differences were observed across all three variables ($p = 0.004$, $p < 0.001$, and $p < 0.001$, respectively). Adequate first-aid knowledge was identified in 82.1% of specialist students, 61.8% of clinical students, and 41.7% of pre-clinical students (Table 4).

Subgroup analyses in the pre-clinical and clinical groups

No statistically significant differences were observed in either subscale score or the total questionnaire score among subgroups within the pre-clinical group (years 1, 2, and 3) or within the clinical group (years 4 and 5), as shown in Table 5.

Table 4 Comparison of groups based on Youden Index cut-off values

Domain (cut-off)		Pre-clinical *N* (%)	Clinical *N* (%)	Specialist *N* (%)	*p* value*
Basic field (≥ 13)	Adequate	378 (57.7)	184 (60.5)	98 (73.1)	**0.004**
	Inadequate	277 (42.3)	120 (39.5)	36 (26.9)	
Medical emerg. (≥ 23)	Adequate	286 (43.7)	202 (66.4)	114 (85.1)	**< 0.001**
	Inadequate	369 (56.3)	102 (33.6)	20 (14.9)	
Total (≥ 36)	Adequate	273 (41.7)	188 (61.8)	110 (82.1)	**< 0.001**
	Inadequate	382 (58.3)	116 (38.2)	24 (17.9)	

* Chi-square test

Table 5 Subgroup analysis: pre-clinical and clinical student groups by year of study

Group		Basic (Q1–7)	Medical emerg. (Q8–23)	Total (Q1–23)
Year 1 (*n* = 171)	Min–Max	4–14	2–29	6–43
	Mean ± SD	12.42 ± 1.68	21.60 ± 3.72	34.02 ± 4.59
Year 2 (*n* = 294)	Min–Max	7–14	12–30	23–44
	Mean ± SD	12.47 ± 1.75	21.50 ± 3.55	33.98 ± 4.56
Year 3 (*n* = 190)	Min–Max	7–14	13–30	21–44
	Mean ± SD	12.61 ± 1.68	22.03 ± 3.82	34.64 ± 4.83
Pre-clinical p value ¥		**0.351**	**0.364**	**0.339**
Year 4 (*n* = 159)	Min–Max	6–14	13–30	23–44
	Mean ± SD	12.70 ± 1.61	23.29 ± 4.08	35.99 ± 4.95
Year 5 (*n* = 145)	Min–Max	9–14	13–30	26–44
	Mean ± SD	12.92 ± 1.30	24.21 ± 3.30	37.12 ± 3.99
Clinical p value §		**0.348**	**0.051**	**0.066**

¥ Kruskal-Wallis test; § Mann-Whitney U test

Table 6 Comparison of first-aid knowledge adequacy with training, belief and willingness to intervene

Variable		Adequate	Inadequate	*p* value*
Prior first-aid training	Yes	245 (42.9%)	143 (27.4%)	**< 0.001**
	No	326 (57.1%)	379 (72.6%)	
Believes FA is important	Yes	566 (99.1%)	514 (98.5%)	**0.317**
	No	5 (0.9%)	8 (1.5%)	
Can intervene	Yes	239 (41.9%)	134 (25.7%)	**< 0.001**
	No	332 (58.1%)	388 (74.3%)	

* Chi-square test

Predictors of first-aid knowledge adequacy

A statistically significant association was identified between adequate knowledge and prior first-aid training ($p < 0.001$) (Table 6). Among participants who had received first-aid training, 42.9% demonstrated adequate knowledge; among those without training, 72.7% had inadequate knowledge. No significant difference in adequacy was observed by belief in the importance of first aid ($p = 0.317$). Knowledge adequacy differed significantly by self-reported willingness to intervene ($p < 0.001$): 74.3% of those who said they would intervene had adequate knowledge, compared with 41.9% of those who said they would not.

Binary logistic regression identified training stage and prior first-aid training as independent predictors of adequate knowledge (Table 7). Compared with pre-clinical students, specialist students were more than five times as likely to have adequate knowledge (OR = 5.39, 95% CI 3.32–8.77, $p < 0.001$), and clinical students were approximately twice as likely (OR = 2.15, 95% CI 1.61–2.85, $p < 0.001$). Prior first-aid training was also a significant predictor (OR = 1.40, 95% CI 1.06–1.84, $p = 0.017$). Sex was not a significant predictor ($p = 0.175$).

Discussion

The primary null hypothesis (H_{01}), that there would be no statistically significant difference in first-aid knowledge among pre-clinical, clinical, and specialist dental students, was rejected. The secondary null hypothesis (H_{02}), that the proportion of students with formal first-aid training would not differ significantly across groups, was also rejected. The observed pattern (highest adequacy among specialist students, followed by clinical then pre-clinical students; Table 4) may reflect the accumulation of clinical experience across training stages, though the cross-sectional design cannot distinguish this from cohort differences in prior education, self-selection into advanced programmes, or other unmeasured factors. The

Table 7 Binary logistic regression: independent predictors of adequate first-aid knowledge ($n = 1,093$)

Variable	OR	95% CI	*p*
Training stage (ref: Pre-clinical)			
Clinical students	**2.15**	**1.61–2.85**	**< 0.001**
Specialist students	**5.39**	**3.32–8.77**	**< 0.001**
Prior first-aid training (ref: None)	**1.40**	**1.06–1.84**	**0.017**
Female sex (ref: Male)	1.20	0.92–1.55	0.175
Model fit			
Chi-square (df = 4) = 100.1	**—**	**—**	**< 0.001**
Nagelkerke $R^2 = 0.066$	—	—	—

OR Odds ratio, *CI* Confidence interval. Reference: pre-clinical students. Outcome: total score ≥ 36. Bold p-values: $p < 0.05$

consistency of this gradient across both training stage and prior formal training exposure nonetheless provides a basis for curricular interpretation.

Before interpreting these findings further, it is important to establish their institutional context. First-aid competence in clinical environments is ultimately the responsibility of supervising academic staff and licensed practitioners, not of students. The knowledge gaps identified in this study therefore reflect primarily on curricular provision and institutional responsibility rather than on individual student performance.

The adequacy rates observed in this study are broadly consistent with, and in some groups lower than, those reported in prior surveys of first-aid knowledge among healthcare students, although direct comparisons are constrained by differences in instruments, cut-off criteria, and study populations. Among general university students in Turkey, Çalışkan et al. reported that 72.6% demonstrated adequate first-aid knowledge using the same questionnaire instrument [14]. Joseph et al. found that among students in health-related programmes, 13.8% had good knowledge, 68.4% moderate, and 17.8% insufficient [8]. Studies among medical faculty students have similarly identified widespread inadequacy, highlighting a consistent need for improvement across healthcare education [6]. University students not enrolled in health-related programmes demonstrate even lower levels of first-aid knowledge [15, 16].

What might explain this gradient? Available evidence from India and Saudi Arabia suggests that postgraduate dental students tend to outperform undergraduates in emergency knowledge assessments [5, 7], a pattern also observed in the present study, and one that points toward the role of cumulative clinical experience. Clinical students treat patients of varying ages with and without systemic conditions, and may encounter emergencies such as syncope, hypotension, allergic reactions, angina, or cerebrovascular events during treatment [17]. Specialist students are presumed to benefit from greater clinical complexity and extended patient exposure, though these programme-level characteristics were not directly assessed in this study. Importantly, however, advanced training stage did not eliminate knowledge gaps: even among specialist students, 17.9% had inadequate total scores, and recognition of acute myocardial infarction management (Q11) was below 50% in all three groups. The persistence of knowledge gaps even among higher-stage learners is consistent with the hypothesis that clinical exposure alone may be insufficient without accompanying structured first-aid instruction, though longitudinal data would be required to test this directly.

A second dimension of H_{02}, the distribution of formal first-aid training across groups, warrants direct attention. Only 35.5% of participants had received any prior formal first-aid training. For contextual reference, general-population surveys from high-income countries have reported CPR or first-aid training rates ranging from 45% in Norway [18] to 79% in Sweden [19], though these figures reflect different populations and training contexts and are not directly comparable to the present dental student sample. A 2016 survey of 11 Turkish dental schools found that while BLS was covered theoretically at all responding institutions, practical examinations were not routinely conducted, and only one school reported that students could successfully perform BLS [9]. Whether this pattern persists across the now substantially larger number of Turkish dental faculties is unknown, but it offers a plausible structural explanation for the low self-reported training prevalence observed here. Dental faculties, academic staff, and curriculum committees, as the parties responsible for designing and delivering dental education, are well placed to consider how structured first-aid instruction might be more systematically integrated into undergraduate and postgraduate programmes.

The question of what form this integration might take is informed by simulation-based research from comparable dental education contexts. Al-Sebaei [10], in a single-institution study, reported that a role-play simulation module for emergency management was associated with knowledge gains, with repeated participation linked to higher OSCE pass rates, though the absence of a concurrent control group limits causal interpretation. Kishimoto et al. [12], in a study of practising dentists in Japan, found that knowledge and confidence declined

measurably in the months following initial simulation training, suggesting that periodic retraining may be necessary to sustain competency, though whether the same decay pattern applies to dental students in different educational contexts requires direct investigation. These findings are consistent with a small but growing body of evidence suggesting that structured simulation-based training may improve emergency management skills among dental professionals [10, 12], though larger controlled trials in undergraduate settings are needed before firm curricular recommendations can be made. Beyond knowledge acquisition, situational simulation teaching has been shown to improve dental students' clinical competency and objective structured clinical examination (OSCE) performance [20], and OSCE-based and virtual assessment formats are increasingly used to evaluate such competencies in dental education [21]; these approaches offer plausible mechanisms for the staged verification of first-aid competence proposed here, while still requiring formal evaluation in the specific context of emergency preparedness.

Beyond knowledge levels, the data also reveal a concerning gap between competence and willingness to act. Among those who said they would not intervene in a first-aid situation, 41.9% actually had adequate knowledge, a finding consistent with prior reports that a substantial proportion of medical students, despite possessing the necessary knowledge, lack confidence to perform first aid and basic life support [22]. Inadequate training has been proposed as a contributing factor to such confidence deficits [22, 23], though the relative contributions of training content, frequency, and practical component cannot be disentangled in cross-sectional data. This suggests that curriculum reform should attend not only to knowledge content but also to the design of experiential components that build students' confidence in applying that knowledge under realistic conditions. Consistent with this, a recent cross-sectional study of dental students reported that adequate knowledge of medical emergencies did not necessarily translate into perceived confidence in managing them, reinforcing the view that knowledge and the readiness to act are distinct constructs that may require different educational interventions [24].

This study has several methodological strengths, which should nonetheless be weighed against clear limits to inference. First, the sample size ($n = 1{,}093$) and recruitment from multiple faculties give the study a broader base than single-institution surveys, in the specific sense that the responses are not tied to the curriculum or teaching culture of one school. This breadth should not, however, be read as national representativeness. Because participants were reached by convenience through student WhatsApp groups, without a defined sampling frame, faculty-level response rates, or a record of the geographic distribution of respondents, the sample cannot be assumed to mirror the population of Turkish dental students in its institutional, regional, or sex composition; self-selection toward students with greater interest in first aid is also possible. The findings are therefore best interpreted as indicative of broad patterns across training stages rather than as precise, nationally generalizable estimates of knowledge prevalence. The design is, in addition, cross-sectional, so the data constitute a single snapshot: they describe how the three training stages differed as they coexisted in October 2023, not how knowledge changes within individual students as they advance, and they cannot capture decay or consolidation of first-aid knowledge over time. The instrument itself demonstrated good internal consistency (Cronbach's $\alpha = 0.87$), with all items meeting the accepted item-total correlation threshold ($r > 0.30$). Second, the simultaneous enrolment of pre-clinical, clinical, and specialist students within a single cross-sectional design (a structure that, to the authors' knowledge, has not been previously reported in the Turkish dental education literature) enables a direct gradient comparison that single-group or single-institution studies cannot provide. Third, the application of multivariable logistic regression to identify independent predictors of knowledge adequacy yielding odds ratios of 5.39 (specialist vs. pre-clinical) and 2.15 (clinical vs. pre-clinical) moves beyond descriptive comparison and provides effect-size data of potential relevance to curriculum planning.

Several limitations should be noted. First, as noted above, the cross-sectional design precludes causal inference about how knowledge evolves within students as they progress through training. Second, practical first-aid skills were not assessed, which raises the question of how closely the questionnaire responses map onto the actual teaching objectives of first-aid education. The instrument captures cognitive outcomes, that is, recognition of the correct course of action, whereas the ultimate objective of first-aid training is competent performance under real conditions, comprising not only knowledge but also psychomotor skill and the willingness to act. Item-level responses should therefore be read as a proxy for, rather than a direct measure of, attainment of these objectives: a correct answer indicates that the relevant knowledge objective is likely met, an 'I don't know' response signals an unmet knowledge objective without a competing misconception, and an incorrect answer signals a misconception that may actively undermine the performance objective. The gap between knowledge and willingness observed here, discussed earlier in this section, illustrates this divergence, since a response can satisfy the knowledge objective while leaving the behavioural objective unmet. Consequently, a knowledge-based questionnaire cannot substitute for performance-based evaluation,

and future studies should align assessment more directly with the intended objectives by incorporating simulation-based or OSCE-style methods that test skill execution and decision-making alongside knowledge. Third, as discussed above in relation to representativeness, the convenience sampling strategy and the absence of faculty-level response-rate and geographic data limit the generalisability of the findings. Fourth, age and training stage are strongly collinear in this sample (97% of specialist students were aged ≥ 24, compared with 2% of pre-clinical students), and age was not included as a separate covariate in the logistic regression, as it is largely subsumed by training stage; the Nagelkerke R^2 of 0.066 further indicates that the model explains a modest proportion of variance in knowledge adequacy, suggesting that factors not measured in this study such as quality of clinical teaching or prior healthcare experience also contribute substantially. Fifth, no formal sample size calculation was performed prior to data collection; however, the statistically significant logistic regression model and the large observed group differences suggest that the achieved sample was adequate to detect the primary effects of interest. Sixth, potential confounders including institutional differences in teaching quality and prior training received outside the formal curriculum were not accounted for. Finally, the ROC-derived cut-off values represent working categories with no external criterion for validation and should be interpreted accordingly, and the absence of prospective registration in a trial registry is acknowledged as a methodological limitation. Taken together, these limitations bound the claims that can be made but do not negate the contribution of the study. Within the constraints of a cross-sectional, convenience-based design, the work provides one of the first multi-faculty characterisations of how first-aid knowledge is distributed across the full sequence of dental training in Turkey, from the pre-clinical years to specialist level, and it identifies training stage and prior formal training as the factors most strongly associated with knowledge adequacy. Its importance is therefore principally hypothesis-generating and curricular rather than confirmatory: it offers a defensible empirical basis for treating first-aid competence as a trainable, stage-dependent outcome that warrants explicit verification during dental education, and it provides effect-size estimates and a measurement approach on which adequately powered, multi-centre, and longitudinal studies can build.

Conclusions

The central message of this study is conceptual rather than descriptive: in dental trainees, first-aid competence behaves as a function of the stage reached in training rather than of clinical seniority in itself, and it is not reliably conferred by accumulated clinical exposure alone. The reasonable extension of this outcome is that first-aid proficiency is best treated as an explicit, trainable, and stage-dependent learning outcome, one to be deliberately taught and verified at successive points of dental education rather than presumed to develop on its own. Framed in this way, the findings are transferable beyond the sampled setting: they provide a rationale, applicable to dental curricula generally, for building staged verification of first-aid competence into the structure of training and for testing whether doing so narrows the distance between knowing the correct action and being prepared to perform it.

Abbreviations

BLS	Basic life support
CI	Confidence interval
CPR	Cardiopulmonary resuscitation
MI	Myocardial infarction
OR	Odds ratio
OSCE	Objective structured clinical examination
ROC	Receiver operating characteristic
SD	Standard deviation

Acknowledgements

Not applicable.

Authors' contributions

R.Z.E.: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. F.B.: Conceptualization, Methodology, Data curation, Writing – review & editing. All authors read and approved the final version of the manuscript.

Funding

Not applicable.

Data availability

"Datasets are available from the corresponding author on reasonable request."

Declarations

Ethics approval and consent to participate

This study was approved by the Non-Interventional Clinical Research Ethics Committee of Afyonkarahisar Health Sciences University, Faculty of Dentistry (Decision Date: 10.10.2023; Decision No: 2023 – 450). Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 2 January 2025 / Accepted: 1 July 2026
Published online: 07 July 2026

References

1. Zideman DA, Singletary EM, Borra V, Cassan P, Cimpoesu CD, De Buck E, et al. European Resuscitation Council Guidelines 2021: first aid. Resuscitation. 2021;161:270–90.
2. Monsieurs KG, Nolan JP, Bossaert LL, Greif R, Maconochie IK, Nikolaou NI, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Sect. 1. Executive summary. Resuscitation. 2015;95:1–80.
3. Haas DA. Management of medical emergencies in the dental office: conditions in each country, the extent of treatment by the dentist. Anesth Prog. 2006;53(1):20–4.

4. Jevon P. Medical emergencies in the dental practice poster: revised and updated. Br Dent J. 2020;229(2):97–104.
5. Mukherji A, Singh MP, Nahar P, Bhuvaneshwari S, Goel S, Mathur H. Competence of handling medical emergencies among dental graduates and post-graduate students - a cross-sectional questionnaire study. J Indian Acad Oral Med Radiol. 2019;31(2):107–16.
6. Abbas A, Bukhari SI, Ahmad F. Knowledge of first aid and basic life support amongst medical students: a comparison between trained and untrained students. J Pak Med Assoc. 2011;61(6):613–6.
7. Al-Shamiri HM, Al-Maweri SA, Shugaa-Addin B, Alaizari NA, Hunaish A. Awareness of basic life support among Saudi dental students and interns. Eur J Dent. 2017;11(4):521–5.
8. Joseph N, Kumar G, Babu YR, Nelliyanil M, Bhaskaran U. Knowledge of first aid skills among students of a medical college in Mangalore city of South India. Ann Med Health Sci Res. 2014;4(2):162–6.
9. Oktay I. Basic life support education in Turkish dental schools. J Biomed Res. 2016.
10. Al-Sebaei MO. Evaluating the use of role-play simulations in teaching management of medical emergencies in the dental clinic. BMC Med Educ. 2023;23(1):831.
11. Khami MR, Yazdani R, Afzalimoghaddam M, Razaghi S, Moscowchi A. Medical emergency management among Iranian dentists. J Contemp Dent Pract. 2014;15(6):693–8.
12. Kishimoto N, Ujita T, Tran SD, Sanuki T, Seo K. Simulation training for medical emergencies: evaluation of dentists' long-term learning skills and confidence. Eur J Dent Educ. 2024;28(2):689–97.
13. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191–4.
14. Pala SÇ, Metintaş S, Güneş D, İnci E, Sakarya AO, Taşkıran UÇ, et al. Üniversite öğrencilerinde ilk yardım bilgi düzeyi ölçeği geçerlilik ve güvenilirliğinin değerlendirilmesi. Paramedik Acil Sağlık Hizm Derg. 2023;4(1):14–25.
15. Khan A, Shaikh S, Shuaib F, Sattar A, Samani SA, Shabbir Q, et al. Knowledge attitude and practices of undergraduate students regarding first aid measures. J Pak Med Assoc. 2010;60(1):68–72.
16. Al-Khamees NA. A field study of first aid knowledge and attitudes of college students in Kuwait University. Coll Stud J. 2006;40(4):916–27.
17. Öztürk DN, Karaca İR. Diş hekimliği açısından riskli sistemik hastalıklar ve bu hastalıklara bağlı oluşabilecek acil durumlar. Atatürk Üniv Diş. Hek Fak Derg. 2016;26(2):157–63.
18. Bakke HK, Steinvik T, Angell J, Wisborg T. A nationwide survey of first aid training and encounters in Norway. BMC Emerg Med. 2017;17(1):6.
19. Axelsson AB, Herlitz J, Holmberg S, Thorén AB. A nationwide survey of CPR training in Sweden: foreign born and unemployed are not reached by training programmes. Resuscitation. 2006;70(1):90–7.
20. Tan EC, Hekkert KD, van Vugt AB, Biert J. First aid and basic life support: a questionnaire survey of medical schools in the Netherlands. Teach Learn Med. 2010;22(2):112–5.
21. Gupta S, Mishra S, Behl S, Srikant N, Mascarenhas R. Knowledge of handling medical emergencies among general dental practitioners pan India: a cross-sectional survey. BMC Res Notes. 2023;16(1):221.
22. Shenoy KM, Alkhelaiwi TM, Alasiri AH, Hejazi BR, Alkathiri KR, Ansari SH, et al. The knowledge, attitude and perceived confidence in handling medical emergencies among dental students. Minerva Dent Oral Sci. 2024;74(2):77–84.
23. Wu JH, Lin PC, Lee KT, Liu HL, Lu PY, Lee CY. Situational simulation teaching effectively improves dental students' non-operational clinical competency and objective structured clinical examination performance. BMC Med Educ. 2024;24(1):533.
24. Lin PY, Tsai YH, Chen TC, Hsieh CY, Ou SF, Yang CW, et al. The virtual assessment in dental education: a narrative review. J Dent Sci. 2024;19(Suppl 2):S102–15.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.