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ORIGINAL RESEARCH

Are Saudi Radiological Sciences Students Prepared for Emergencies? Exploring Knowledge, and Attitudes Towards Basic Life Support and Cardiopulmonary Resuscitation

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Purpose: This study aims to evaluate the preparedness of Saudi radiological sciences students for emergencies by assessing their awareness of cardiac arrest evaluation criteria, knowledge of Cardiopulmonary Resuscitation (CPR) and defibrillators, and attitudes towards performing CPR.

Methods: A cross-sectional descriptive study was conducted among students from the radiological sciences program at three Saudi universities. Using a well-established questionnaire, the study employed non-probability convenient sampling. Descriptive statistics were generated, and chi-square test examined associations between categorical variables and Basic Life Support (BLS) training status.

Results: Out of 367 students contacted, 261 participated (71.1% response rate). BLS training markedly enhances knowledge of the correct chest compression rate, with 50.9% of trained students demonstrating accurate understanding compared to 27.5% of untrained students ($P < 0.0001$). A significant correlation was found between BLS training and the ability to perform cardiac massage during cardiac arrest and respiratory standstill, with 44.1% of students demonstrating this knowledge ($P < 0.0001$). Notably, 80.8% of students without BLS training lacked knowledge of cardiac massage, compared to only 30.4% of those with training. Additionally, 30.6% of students were familiar with defibrillators, and 44.1% knew AED locations ($P = 0.0007$). Hesitation to perform CPR was mainly due to fear of mistakes (53.6%) and harm concerns (31.1%).

Conclusion: Our findings reveal significant gaps in knowledge, confidence, and preparedness for cardiac emergencies among Saudi radiological sciences students, with only 41.4% having completed BLS training. These results highlight the urgent need for comprehensive BLS education to.

Keywords: basic life support, awareness, undergraduate students, cardiopulmonary resuscitation, radiologic technology, public health, Saudi Arabia

Introduction

Cardiac arrest, a sudden and frequently lethal event, plays a significant role in global mortality rates, affecting individuals of all ages, including neonates and infants with cardiac conditions.[1] To mitigate the mortality associated with severe cardiac and respiratory emergencies, it is essential that healthcare professionals, including radiological sciences students in clinical training, maintain continuous access to updated emergency protocols. Basic Life Support (BLS), with a focus on Cardiopulmonary Resuscitation (CPR), is fundamental to surviving cardiac arrest.[2] CPR is an essential emergency procedure designed to ensure adequate breathing and blood circulation until the underlying cause of the cardiac arrest is

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treated. Therefore, early diagnosis, prompt and effective CPR, and timely defibrillation are critical for successful resuscitation outcomes.[3–8] Mastery of BLS can markedly reduce the fatality rate associated with cardiac arrest, particularly among those with cardiovascular disease. It is crucial that BLS knowledge is not limited to healthcare professionals but is also disseminated throughout the community, including medical staff and students.[9,10]

A survey conducted at the University of Jeddah in Saudi Arabia found that only 23.1% of medical students had attended a BLS training course. Furthermore, just 17.3% of students felt that their current knowledge of BLS was adequate.[11] Similarly, an Egyptian survey at Al-Azhar medical schools found that only 27% of students had attended BLS courses, with just 34.3% having completed one.[12] This trend of inadequate CPR training is widespread, as medical students in Europe have reported low confidence in performing BLS.[13] Furthermore, insufficient training has been documented among medical students in the UK, Oman, and Iran.[14–16]

Despite exhibiting positive attitudes toward CPR, non-medical university students generally lack adequate knowledge and awareness of its principles and application.[17] For instance, a study involving 406 students from non-medical colleges at King Faisal University in Al Ahsa, Saudi Arabia, revealed that 82.5% had poor knowledge of BLS.[18] Similarly, among 684 non-medical students in India, 93% were aware that BLS could save lives; however, 92% hesitated to perform it due to insufficient training and a resulting lack of confidence.[19] This disparity underscores a significant gap in emergency preparedness, where favorable attitudes and willingness to act in emergencies are not supported by the necessary competence to perform CPR effectively. The evident lack of adequate training and exposure to CPR education programs highlights the urgent need for targeted interventions to enhance both theoretical understanding and practical skills in this vital lifesaving procedure.[17]

The lack of BLS training, particularly CPR, in undergraduate curricula represents a critical shortfall in higher education. This deficiency poses significant risks to public health, emergency response capabilities, and overall community safety.[20] As students transition from college to the workforce and broader society, their ability to handle emergencies remains inadequate without mandatory BLS training. Integrating BLS and CPR training into undergraduate programs is both feasible and highly beneficial. Universities have the necessary infrastructure to provide this training and incorporating it into health or physical education requirements can ensure that all students graduate with these essential skills.[20] Integrating BLS and CPR training into the four-year radiological sciences curriculum is essential. The curriculum's first two years focus on preprofessional science and health courses, laying a foundational understanding necessary for advanced study. In the third and fourth years, students transition into their professional studies, which include various field and clinical experiences that provide hands-on training.[21–23] Incorporating BLS and CPR training during these clinical phases is crucial, as it ensures that students are not only theoretically prepared but also practically equipped to handle cardiac and respiratory emergencies. This integration enhances their readiness to respond effectively in real-world situations, ultimately improving patient outcomes and reinforcing the critical role of radiological sciences professionals in emergency healthcare. Research shows that even brief, focused training sessions can effectively equip students with the knowledge and confidence to perform CPR.[24]

Numerous studies have explored the knowledge and attitudes towards BLS among health profession students in various countries, including Pakistan,[10] India,[25] Nigeria,[26] Egypt,[12] and the UK.[27] In Saudi Arabia, similar assessments have been conducted among medical students at several universities, such as University of Jeddah,[11] Qassim University,[28] Jouf University,[29] Princess Nourah Bint Abdul Rahman University,[30] and Jazan University.[31] However, there is a notable gap in the literature specifically regarding the BLS knowledge and attitudes of radiological sciences students in Saudi Arabia. Despite the potential for these students to encounter emergency situations within clinical settings, BLS is not a required component of their curriculum. This lack of requirement raises concerns about their preparedness and confidence in responding to cardiac arrest situations. Given the increasing demand for emergency preparedness across healthcare disciplines, investigating the current level of BLS knowledge, awareness, and attitudes among radiological sciences students is both timely and essential.

Therefore, this study aims to evaluate the level of knowledge, awareness, and attitudes towards BLS among radiological sciences students at three Saudi universities: King Saud bin Abdulaziz University for Health Sciences (KSAU-HS),[21–23,32] the University of Jeddah (UJ), and Taibah University (TU). The specific objectives of this study are to: a) evaluate the awareness of radiological sciences students regarding the criteria for identifying cardiac arrest, as well

as the warning signs and symptoms of sudden cardiac arrest, b) assess their knowledge of CPR techniques and the use of defibrillators, and c) examine their attitudes towards performing CPR and responding to sudden cardiac arrest events.

Materials And Methods

Participants and Procedure

The study employed a descriptive cross-sectional questionnaire design conducted between February and March 2024 among Radiological Sciences students at the College of Applied Medical Sciences across three Saudi universities: KSAU-HS, UJ, and TU. The entire population of 367 Radiological Sciences students (46 from KSAU-HS, 96 from UJ, and 225 from TU) was invited to participate. The Raosoft® sample size calculator (Raosoft Inc).,[33] with a 5% margin of error and a 95% confidence level, recommended a total sample size of 188. To ensure proportional representation, the sample size was allocated based on the student population at each university, resulting in 42 students from KSAU-HS, 77 from UJ, and 143 from TU, calculated using the same sampling and power estimation methods. Participants were recruited through non-probability convenient sampling. The questionnaire was administered online using an electronic survey tool (Google Forms). To ensure that only designated radiology students had the opportunity to complete the survey, participation was restricted to students enrolled in the Radiological Sciences program from the 1st to 4th years, explicitly excluding interns. Recruitment was conducted through official Email lists and WhatsApp groups specifically associated with the Radiological Sciences program at the respective universities. These controlled channels helped verify that the invitations reached the intended target population, and students were required to confirm their year of study and program affiliation as part of the survey process.

Study Measures

Radiological Sciences students were requested to complete a well-established questionnaire, previously utilized and derived from the American Heart Association (AHA),[17] adhering to its guidelines.[34] This questionnaire underwent a review by three associate professors of Radiological Sciences and two assistant professors of Emergency Medical Services, all licensed by the Saudi Commission for Health Specialties (SCFHS). The review ensured that the questionnaire was tailored to our study demographics, clear, concise, and maintained a focused and purposeful approach. The self-administered questionnaire was divided into two main sections. The first section comprised six demographic questions regarding gender, age, university, college year, grade point average (GPA), and university name. The second section included 22 multiple-choice questions evaluating knowledge, skills, and attitudes towards BLS. This section aimed to assess participants' understanding of the following aspects:

a) Level of consciousness, respiratory signs, and cardiocirculatory evidence.
b) Clinical features of cardiac arrest, such as chest pain, breathing difficulties, and cyanosis.
c) Proper application of chest compressions (rate, location, depth) and the correct use of an automated external defibrillator (AED).

The correct answers included in the questionnaire were developed in accordance with the guidelines of the AHA,[35] ensuring alignment with established international standards for BLS and CPR.

Ethical Consideration

The local Institutional Review Board (IRB) of King Abdullah International Medical Research Center approved this research under protocol number SP23J/140/08. Participation in the study was entirely voluntary, and written informed consent was obtained from all participants before they completed the questionnaire. The consent form was included at the beginning of the Google Form questionnaire, requiring participants to carefully read and indicate their agreement by selecting an option before proceeding. All responses were kept anonymous and confidential, adhering to the principles of the Helsinki Declaration throughout the study. The electronic survey application generated a password-protected Microsoft Excel file without any identifying information about the participants.

Statistical Analyses

The statistical analysis was conducted in two distinct phases. The first phase involved descriptive analysis, presenting continuous data as counts and percentages. The second phase utilized the chi-square test to explore potential associations between categorical variables. These variables included cardiac arrest recognition, actions taken when witnessing a cardiac arrest, practical application of CPR, and knowledge of defibrillators. The analysis examined these factors in relation to whether the participants had received BLS training or not. All analyses were performed using SPSS version 23, with the threshold for statistical significance set at 0.05.

Results

Characteristics of the Participants

Table 1 presents the sociodemographic characteristics of Radiological Sciences students. Of the 367 students contacted, 261 participated, resulting in a response rate of 71.1%. The majority of participants were female (85.8%), while males constituted 14.2%. In terms of age distribution, 51% were between 18–20 years old and 49% were between 21–25 years old. Most participants were from TU (53.6%). Regarding their academic year, 6.9% were first-year students, 40.2% were second-year students, 28% were third-year students, and 24.9% were fourth-year students. Additionally, 75.1% of the participants had a GPA greater than 3.5 out of 5.

Cardiac Arrest Identification Criteria

Table 2 shows the identification of cardiac arrest findings among radiological sciences students who completed BLS training and those who did not. Of the 261 students who participated, 108 (41.4%) had completed BLS training, while 153 (58.6%) had not. Among the 108 students who completed BLS training, 28 (25.9%) received their training through university-offered courses, 26 (24.1%) participated in training provided by their school, and 23 (21.3%) attended courses conducted by trainers from the Ministry of Health. Regarding the evaluation of consciousness, 43.3% of participants believed that checking for responsiveness involves observing if there is "no response when called". There was no significant association between the participants' BLS training status and their understanding of consciousness evaluation

Table 1 Characteristics of the Participants

Variable		Total Sample = 261	
		n	%
Gender	Male	37	14.2
	Female	224	85.8
Age	18–20	133	51
	21–25	128	49
University	King Saud bin Abdulaziz University for Health Sciences (KSAU-HS)	44	16.9
	University of Jeddah (UJ)	77	29.5
	Taibah University (TU)	140	53.6
Academic Year	1st Year	18	6.9
	2nd Year	105	40.2
	3rd Year	73	28
	4th Year	65	24.9
Grade Point Average (GPA)	≤ 3.00–3.50	10	3.8
	3.51–4.00	29	11.1
	4.01–4.50	40	15.3
	4.50–5.00	127	48.7
	Prefer not to tell	55	21.1

Note: $-\text{Percentage of Responses}(\%) = \frac{\text{Number of Responses(n)}}{261} \times 100.$

Table 2 Identification of Cardiac Arrest

Finding	Total Sample = 261		BLS Training Completed = 108		BLS Training Not Completed = 153		P-value and Statistics
	N	%	n	%	n	%	
A) Conscious Evaluation							
1. No response when called	113	43.3	44	38.9	69	61.1	$\chi2$ = 0.0101, *df* = 3, P = 0.31
2. No response when touched	49	18.8	26	53.1	23	46.9	
3. Not moving at all	57	21.8	23	40.3	34	59.7	
4. I do not know	42	16.1	15	35.7	27	64.3	
B) Respiratory Evaluation							
1. Not having any respiratory movement	118	45.2	55	46.6	63	53.4	$\chi2$ = 0.0279, *df* = 4, P = 0.059
2. Not having any respiratory sound	31	11.9	14	45.2	17	54.8	
3. No air coming out of the individual's mouth	60	23	26	43.3	34	56.7	
4. Mirror not fogging up when placed in front of the individual's mouth	19	7.3	7	36.8	12	63.2	
5. I do not know	33	12.6	6	18.2	27	81.8	
C) Circulation Evaluation							
1. The lack of circulation signs	76	29.1	39	51.3	37	48.7	$\chi2$ = 0.0163, *df* = 2, P = 0.057
2. Not feeling a pulse in the vessels of the neck	127	48.7	51	40.2	76	59.8	
3. Not feeling a pulse in the vessels of the arm	58	22.2	18	31	40	69	

Note: −Percentage of Responses(%) $= \frac{\text{Number of Responses}(N)}{261} \times 100$;
−Percentage of Responses in asubgroup(%) $= \frac{\text{Number of Responses(n)}}{\text{Number of Responses}(N)} \times 100$.

(P = 0.31). With respect to the evaluation of respiration, 45.2% of participants believed that checking for breathing involves observing if there is "no respiratory movement." There was no significant association between the participants' BLS training status and their understanding of respiratory evaluation (P = 0.059). Regarding the evaluation of circulation, nearly half of the participants (48.7%) believed that checking for circulation involves observing if there is "no pulse felt in the neck vessels". There was no significant association between the participants' BLS training status and their understanding of circulation evaluation (P = 0.057).

Warning Signs and Symptoms of Sudden Cardiac Arrest

Figure 1 illustrates the overall awareness and recognition of cardiac arrest signs among radiological sciences students. The most commonly reported sign was loss of consciousness (60.5%), followed by chest pain (59.8%), discontinuation of circulation (55.9%), discontinuation of breathing (53.3%), and difficulty in breathing (51.8%).

Responses and Attitudes Towards Witnessing Sudden Death

Of the 261 students who participated, 67 (25.7%) reported having witnessed a sudden death before, while 194 (74.3%) had not. Among the 67 who had witnessed a sudden death, 41.8% observed it in a family member, 29.8% in a friend or acquaintance, and 28.4% in a stranger. Table 3 shows the attitudes and responses of the 67 radiological sciences students regarding their actions when witnessing sudden death situations. Only 13 (19.4%) were able to perform CPR. There was no significant association between the participants' BLS training status and their actions when witnessing sudden death situations (P = 0.153).

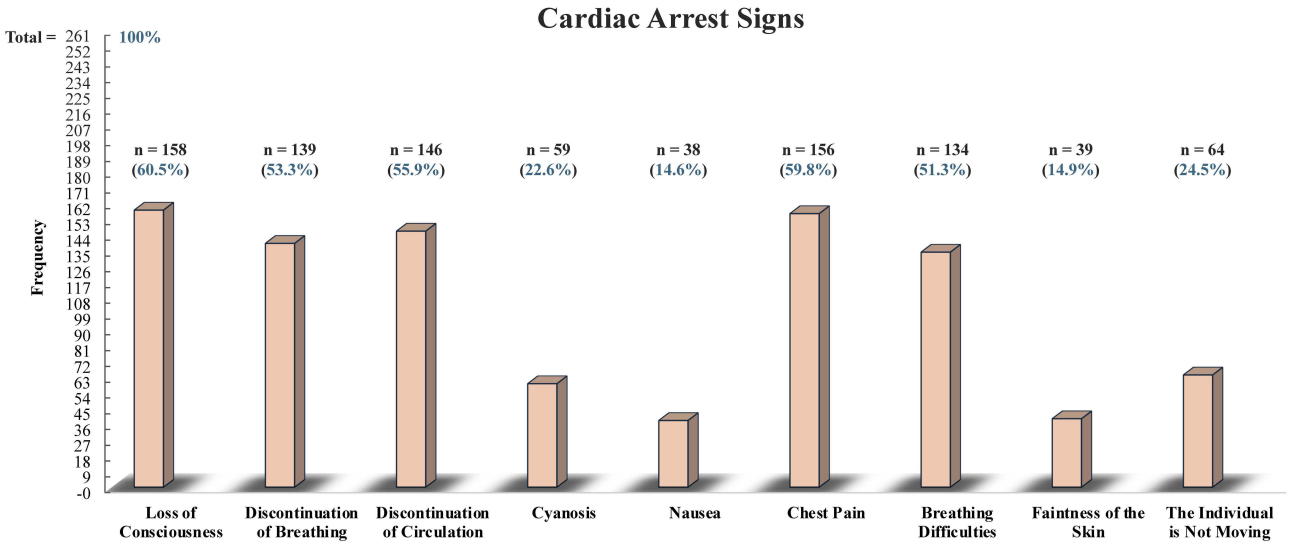

Figure 1 Recognition of Cardiac Arrest Signs Among Radiological Sciences Students.

Knowledge of CPR

Table 4 shows the knowledge and practical application of CPR among radiological sciences students who completed BLS training compared to those who did not. A significant association was found between the participants' BLS training status and their knowledge regarding the proper rate of chest compressions (ie, at least 100 times per minute) ($P < 0.0001$). Specifically, 50.9% of those with BLS training knew the proper rate of chest compressions, whereas only 27.5% of those without BLS training had this knowledge. There was no significant association between the participants' BLS training status and their knowledge regarding chest compression meaning ($P = 0.87$), proper compression location ($P = 0.43$), proper compression depth ($P = 0.25$), and the proper ratio of chest compressions to artificial ventilation during CPR ($P = 0.16$). Additionally, 115 students (44.1%) knew how to perform cardiac massage during cardiac arrest and respiratory standstill, as shown in Figure 2. Moreover, a significant correlation was found between the students' BLS training and their ability to administer cardiac massage in such emergencies ($P < 0.0001$). Specifically, 80.8% of students without BLS training were unaware of how to perform cardiac massage, compared to only 30.4% of those with BLS training who lacked this knowledge (Figure 2).

Table 3 Radiological Sciences Students' Attitudes and Responses to Their Actions When Witnessing Sudden Death Situations

Response		Total of those who witnessed sudden death situations = 67		BLS Training Completed = 28		BLS Training Not Completed = 39		P-value and Statistics
		N	%	n	%	n	%	
1	I began to give cardiac massage	17	25.4	9	52.9	8	47.1	$\chi 2 = 0.14$,
2	I conducted mouth to mouth ventilation (I respirated)	8	11.9	4	50	4	50	$df = 7$,
3	I both gave cardiac massage and conducted mouth to mouth ventilation (I gave CPR)	13	19.4	5	38.5	8	61.5	P = 0.153
4	I called an ambulance (911)	11	16.4	2	18.2	9	81.8	
5	I told somebody to call for help	8	11.9	6	75	2	25	
6	I called for help by telephone	4	6	1	25	3	75	
7	I just watched and left	4	6	0	0	4	100	
8	I do not know	2	3	1	50	1	50	

Note: −Percentage of Responses(%) $= \frac{\text{Number of Responses}(N)}{67} \times 100$;
−Percentage of Responses in asubgroup(%) $= \frac{\text{Number of Responses(n)}}{\text{Number of Responses}(N)} \times 100$.

Table 4 Practical Application of CardioPulmonary Resuscitation (CPR) Among Radiological Sciences Students

Item	BLS Training Completed = 108		BLS Training Not Completed = 153		P-value and Statistics
	n	%	n	%	
Chest Compression Meaning (*To apply strong compression to the chest at certain intervals (compress))*	54	50	80	52.3	$\chi 2$ =0.003, *df* = 4, P = 0.87
Compression Rate (*100 compressions/minute)*	55	50.9	42	27.5	$\chi 2$ = 0.068, *df* = 3, P <0.0001
Compression Location (*middle of the chest)*	65	60.2	104	68	$\chi 2$ = 0.005, *df* = 2, P = 0.43
Compression Depth (*5–6 cm)*	56	51.9	60	39.2	$\chi 2$ = 0.012, *df* = 3, P = 0.25
Compression / Ventilation Ratio (*30/2)*	49	45.4	52	34	$\chi 2$ = 0.011, *df* = 2, P =0.16

Note: $-\text{Percentage of Responses}(\%) = \frac{\text{Count of those who completed BLS Training}(n)}{108} \times 100; -\text{Percentage of Responses}(\%) = \frac{\text{Count of those who did not complete BLS Training}(n)}{153} \times 100;.$

Knowledge of Defibrillators

Table 5 presents the radiological sciences students' knowledge of defibrillators. Out of the 261 students surveyed, 80 (30.6%) were familiar with the defibrillator (a device used to restart a non-functioning heart). Additionally, 115 students (44.1%) knew the locations of AEDs or pacemakers. A significant correlation was observed between the students' BLS training and their awareness of AED or pacemaker locations (P = 0.0007). Specifically, 67.8% of students without BLS training were unaware of the locations, compared to only 32.2% of those with BLS training who lacked this knowledge.

Attitudes Towards CPR

Table 6 and Table 7 present the willingness to perform CPR in response to the sudden cardiac arrest of family members, friends, and strangers, categorized by various study variables. The majority of male students (over 70%) and more than half of the female students would call 911 if a family member, friend, or stranger suddenly felt faint or collapsed. Senior students aged 21–25 are more likely to call for help if a family member or friend suddenly feels faint or collapses, and

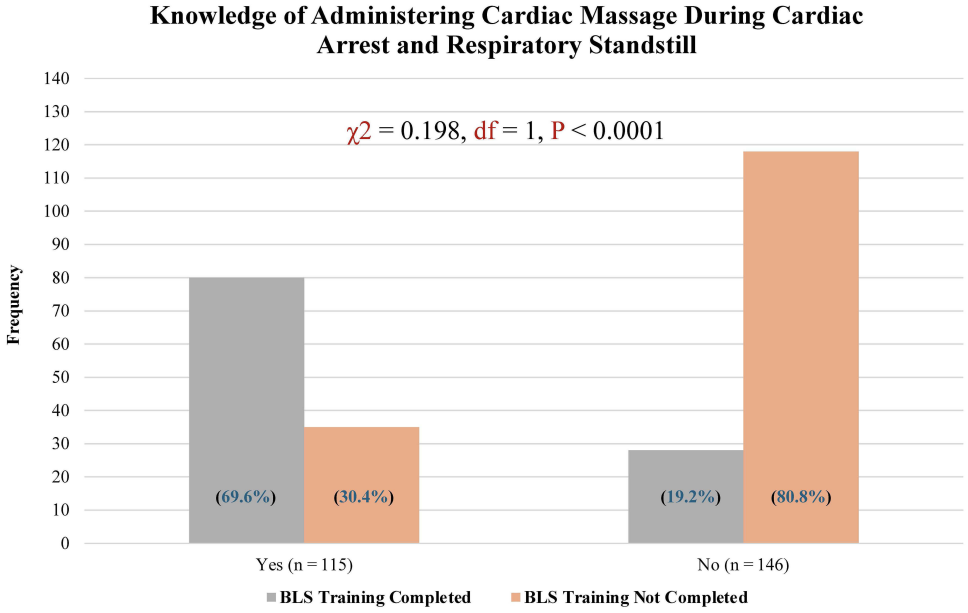

Figure 2 Knowledge of Radiological Sciences Students on Administering Cardiac Massage During Cardiac Arrest and Respiratory Standstill.

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Table 5 Radiological Sciences Students' Knowledge of Defibrillators

Item	Total Sample = 261		BLS Training Completed=108		BLS Training Not Completed=153		P-value and Statistics
	N	%	n	%	n	%	
A) Knowledge of Defibrillators:							
1. I have never heard of it	105	40.2	38	36.2	67	63.8	$\chi2$ = 0.0058, *df* = 3, P = 0.56
2. I have heard of it before but have not seen it	50	19.2	23	46	27	54	
3. It is a device supporting respiration	26	10	11	42.3	15	57.7	
4. It is a device to restart a heart that has stopped working	80	30.6	36	45	44	55	
B) Do you know where an Automated External Defibrillator (AED) or a pacemaker can be found?							
1. Yes	115	44.1	61	53	54	47	$\chi2$ = 0.0327, *df* = 1, P = 0.0007
2. No	146	55.9	47	32.2	99	67.8	

Note: $-\text{Percentage of Responses}(\%) = \frac{\text{Number of Responses}(N)}{261} \times 100; -\text{Percentage of Responses in asubgroup}(\%) = \frac{\text{Number of Responses(n)}}{\text{Number of Responses}(N)} \times 100.$

Table 6 Willingness to Perform Cardiopulmonary Resuscitation (CPR) in Response to a Family Members or Friends Sudden Cardiac Arrest

Variable		Responses to "If a Family Members or Friends Suddenly Felt Faint or Collapsed, What Actions Would you Take?"				
		Start with Cardiac compression	Call 911	Call Someone for Help	Just Watch and Leave	P-value and Statistics
		n (%)	n (%)	n (%)	n (%)	
Gender	Male (N= 37) Female (N= 224)	9 (24.3) 70 (31.3)	26 (70.3) 114 (50.9)	2 (5.4) 25 (11.2)	0 (0.0) 15 (6.7)	$\chi2$ = 0.0147, *df* = 3, P = 0.1
Age	18–20 (N= 133) 21–25 (N= 128)	40 (30.1) 39 (30.5)	73 (54.9) 67 (52.3)	9 (6.8) 18 (10.2)	11 (8.3) 4 (3.1)	$\chi2$ = 0.0186, *df* = 6, P = 0.0025
University	KSAU-HS (N= 44) UJ (N= 77) TU (N= 140)	12 (27.3) 25 (32.5) 42 (30)	28 (63.6) 42 (54.5) 70 (50)	3 (6.8) 6 (7.8) 18 (12.9)	1 (2.3) 4 (5.2) 10 (7.1)	$\chi2$ = 0.0252, *df* = 18, P = 0.8
Academic Year	1st Year (N= 18) 2nd Year (N= 105) 3rd Year (N= 73) 4th Year (N= 65)	3 (16.7) 31 (29.5) 24 (32.9) 21 (32.3)	12 (66.7) 51 (48.6) 40 (54.8) 37 (56.9)	0 (0.0) 13 (12.4) 8 (11) 6 (9.2)	3 (16.7) 10 (9.5) 1 (1.4) 1 (1.5)	$\chi2$ = 0.0315, *df* = 9, P = 0.07
Grade Point Average (GPA)	≤ 3.00–3.50 (N= 10) 3.51–4.00 (N= 29) 4.01–4.50 (N= 40) 4.50–5.00 (N= 127) Prefer not to tell (N= 55)	5 (50) 7 (24.1) 14 (35) 35 (27.6) 18 (32.7)	4 (40) 19 (65.5) 19 (47.5) 72 (56.7) 26 (47.3)	1 (10) 2 (6.9) 2 (5) 14 (11) 8 (14.5)	0 (0.0) 1 (3.4) 5 (12.5) 6 (4.7) 3 (5.5)	$\chi2$ = 0.0191, *df* = 12, P = 0.5

Note: Percentage of Responses in asubgroup(%) $= \frac{\text{Number of Responses(n)}}{\text{Number of Responses}(N)} \times 100$.
Abbreviations: KSAU-HS = King Saud bin Abdulaziz University for Health Sciences; UJ, University of Jeddah; TU, Taibah University;

less likely to simply watch and leave, compared to junior students aged 18–20 (P = 0.0025). Conversely, when a stranger experiences the same symptoms, senior students are less likely to call for help and also less likely to just watch and leave, compared to their junior counterparts (P = 0.002). No significant correlation was found regarding other study variables,

Table 7 Willingness to Perform Cardiopulmonary Resuscitation (CPR) in Response to a Stranger Sudden Cardiac Arrest

Variable		Responses to "If a Stranger Suddenly Felt Faint or Collapsed, What Actions Would you Take?"				
		Start with Cardiac compression	Call 911	Call Someone for Help	Just Watch and Leave	P-value and Statistics
		n (%)	n (%)	n (%)	n (%)	
Gender	Male (N= 37) Female (N= 224)	7 (18.9) 56 (25)	28 (75.7) 127 (56.7)	2 (5.4) 23 (10.3)	0 (0.0) 18 (8.0)	$\chi2 = 0.02$, $df = 3$, P = 0.1
Age	18–20 (N= 133) 21–25 (N= 128)	32 (24.0) 31 (24.2)	72 (54.1) 83 (64.8)	17 (12.8) 8 (6.3)	12 (9.0) 6 (4.7)	$\chi2 = 0.02$, $df = 6$, P = 0.002
University	KSAU-HS (N= 44) UJ (N= 77) TU (N= 140)	10 (22.7) 18 (23.4) 35 (25)	30 (68.2) 44 (57.1) 81 (57.9)	4 (9.1) 8 (10.4) 13 (9.3)	0 (0.0) 7 (9.1) 11 (7.9)	$\chi2 = 0.04$, $df = 2$, P = 0.49
Academic Year	1st Year (N= 18) 2nd Year (N= 105) 3rd Year (N= 73) 4th Year (N= 65)	5 (27.8) 27 (25.7) 15 (20.5) 16 (24.6)	8 (44.4) 55 (52.4) 48 (65.8) 44 (67.7)	3 (16.7) 12 (11.4) 8 (11) 2 (3.1)	2 (11.1) 11 (10.5) 2 (2.7) 3 (4.6)	$\chi2 = 0.02$, $df = 9$, P = 0.19
Grade Point Average (GPA)	≤ 3.00–3.50 (N= 10) 3.51–4.00 (N= 29) 4.01–4.50 (N= 40) 4.50–5.00 (N= 127) Prefer not to tell (N= 55)	3 (30) 6 (20.7) 12 (30) 26 (20.5) 16 (29.1)	3 (30) 20 (69) 21 (52.5) 81 (63.8) 30 (54.5)	3 (30) 2 (6.9) 5 (12.5) 11 (8.7) 4 (7.3)	1 (10) 1 (3.4) 2 (5) 9 (7.1) 5 (9.1)	$\chi2 = 0.0187$, $df = 1$, P = 0.48

Note: Percentage of Responses in asubgroup(%) $= \frac{\text{Number of Responses(n)}}{\text{Number of Responses}(N)} \times 100$.
Abbreviations: KSAU-HS, King Saud bin Abdulaziz University for Health Sciences; UJ, University of Jeddah; TU, Taibah University.

including gender, university, academic year, and GPA. The primary reasons reported for students hesitating to perform CPR on family members, friends, or strangers experiencing sudden cardiac arrest were fear of "making a mistake" (53.6%) and concerns about "causing harm, such as organ damage, bone fractures, or stopping a functioning heart" (31.1%).

Discussion

This cross-sectional study investigates the knowledge, awareness, and attitudes towards BLS among radiological sciences students at three universities in Saudi Arabia. To the best of our knowledge, this is the first study to specifically assess these aspects among radiological sciences students, both within Saudi Arabia and internationally. This study highlighted several key findings: firstly, 41.4% of the participants had completed BLS training. Secondly, while nearly half of the participants (48.7%) were able to correctly identify the criteria for cardiac arrest circulation evaluation, their overall responses lacked specificity and accuracy regarding the criteria for conscious and respiratory evaluation, indicating a gap in knowledge in these areas. Thirdly, more than half of the participants were able to specify the signs of cardiac arrest. Fourthly, among those who had witnessed sudden death situations, only 19.4% were able to perform CPR. The main reason for hesitation was the fear of "making a mistake." Additionally, over 70% of male students and more than half of female students reported they would call emergency services (911) if a family member, friend, or stranger suddenly felt faint or collapsed. Fifthly, participants with BLS training demonstrated significantly better knowledge of the proper rate of chest compressions, how to administer cardiac massage, and the locations of AEDs or pacemakers compared to those without BLS training. Lastly, only 30.6% of the participants were familiar with the use of a defibrillator.

The AHA recommends that all individuals, regardless of their field of study or specialization, receive BLS training.[35] In our study, 41.4% of participants reported having completed BLS training. This percentage is comparable to those

reported among students of medicine, dentistry, nursing, pharmacy, and health and rehabilitation sciences at Princess Nourah Bint Abdul Rahman University (41.9%),[30] but lower than the rates among medical, dentistry, and nursing students in their clinical years at King Khalid University (57.7%).[36] Additionally, this percentage is notably higher than those reported among medical students at various universities in Saudi Arabia: University of Jeddah (23.1%),[11] Qassim University (22.5%),[28] and Jazan University (19.4%).[31] Furthermore, it surpasses the rates reported among medical students in Jordan, Syria, and Iraq (21.7%),[4] Oman (35.2%),[15] Egypt (27%),[12] India (18.9%),[25] and Pakistan (14.7%).[37]

Moreover, BLS training has been recommended for all healthcare providers in the United States since 1966,[38] and most medical colleges in the United Kingdom have integrated BLS training into their curricula.[39] The literature and our findings reveal significant variability in BLS training rates among health profession students worldwide. This variability may be attributed to the busy academic schedule, high cost of the training course, lack of training centers in some countries and the current inadequate economic and educational levels.[4,36,40,41] Given that BLS training enhances knowledge,[40] and self-confidence in performing BLS when required,[42,43] it is imperative to encourage undergraduate health profession students to attend BLS training courses. The SCFHS recommends that students receive formal BLS training before graduation. Incorporating BLS training as a graduation requirement for radiological sciences students could significantly improve pre-graduation BLS competency.[36]

Early identification and intervention of cardiac arrest victims through the administration of CPR are critical components of BLS. This practice is essential for maintaining the patient's life until advanced medical care is available, and the patient can be transferred to a hospital for further treatment. Notably, the chances of survival decrease by 7–10% for every minute that CPR is delayed.[3,44] Our findings indicate a substantial knowledge gap in various aspects of BLS/CPR among radiological sciences students, as approximately half of the students demonstrated knowledge regarding the identification of cardiac arrest findings and the practical application of CPR. Specifically, only 30.6% of students knew the purpose of a defibrillator, and just 44.1% were aware of the locations of AEDs or pacemakers. These results align with national studies conducted among medical and health sciences students at several universities, which also indicate inadequate BLS/CPR knowledge. There is a need for improvement, particularly in understanding the correct chest compression locations for CPR and the principles of hands-only CPR, to enhance life-saving capabilities.[11,30,31] The observed knowledge deficiency may be attributed to several factors. Primarily, the lack of BLS training significantly hampers knowledge acquisition. Additionally, insufficient educational reinforcement negatively impacts knowledge retention.[11,45,46] Addressing these issues through enhanced training programs and continuous educational support is crucial for ensuring that students are well-prepared to perform effective CPR and use AEDs in emergency situations.

Previous studies have consistently shown that a significant majority (>70%) of students in medical, dental, and nursing programs advocate for the inclusion of BLS training in their curricula, reflecting a strong positive attitude toward the importance of BLS training.[36,40,47,48] Additionally, research by Al-Mohaissen (2017) demonstrated that BLS training conducted within the university setting yields superior outcomes compared to external training programs.[30] In the current study, only 25.9% of radiological sciences students received BLS training through university-offered courses. This aligns with previous findings reported among medical, dental, and nursing students, indicating a similar trend.[36]

Our findings revealed that only 25.7% of radiological sciences students reported having witnessed a sudden death, and of those, only 19.4% were able to perform CPR. Similar results were found in another study, where approximately 26% of medical, dental, and nursing students encountered situations requiring the use of BLS.[36] Other studies have identified key barriers to performing BLS, including lack of knowledge, inadequate training, and limited practical experience.[13,36,43] In contrast, our study found that the majority of radiological sciences students preferred calling 911 over performing CPR. The primary reasons for this hesitation were fear of "making a mistake" (53.6%) and concerns about "causing harm, such as organ damage, bone fractures, or stopping a functioning heart" (31.1%). Evidence suggests that willingness to perform BLS can be increased through effective training programs.[36,41,49]

Limitations & Future Research

The limitations of this study arise primarily from not examining the barriers to attending BLS training among radiological sciences students. Additionally, the utilization of non-probability sampling limits the generalizability of our findings. Although this study examined BLS awareness, knowledge, and attitudes among radiological sciences

students, it did not assess their actual BLS skills. Since many participants had not previously undergone BLS training and demonstrated low levels of knowledge, it is likely that their practical BLS skills are also insufficient. Future research should focus on identifying the obstacles to attending BLS training and assessing BLS skills in practice. Such research should be complemented by the implementation of effective BLS educational programs. Additionally, future research should consider increasing the sample size or adopting alternative sampling methods to enhance statistical power and ensure more reliable and generalizable findings. Furthermore, future research should include a practical component to assess the ability of radiological sciences students to effectively apply CPR knowledge in real-world scenarios. While this study highlights the importance of adequate knowledge among radiological sciences students, particularly during emergencies such as cardiac arrest in interventional imaging procedures, incorporating practical tests will help evaluate whether knowledge translates into effective practice.

Conclusions

This study highlights suboptimal knowledge in BLS among Saudi radiological sciences students, indicating a critical need for intervention. Despite some awareness, significant gaps persist in confidence, practical application, and familiarity with essential BLS procedures, such as CPR and defibrillator use. These deficiencies underscore the importance of implementing comprehensive, targeted BLS training programs tailored to the unique needs of radiological sciences students. Such initiatives should focus on bridging knowledge gaps, enhancing practical skills, and fostering confidence to ensure students are adequately prepared to respond effectively to cardiac emergencies. Addressing these challenges is vital to improving emergency preparedness and ultimately saving lives.

Abbreviations

BLS, Basic Life Support; CPR, Cardiopulmonary Resuscitation; KSAU-HS, King Saud bin Abdulaziz University for Health Sciences; UJ, University of Jeddah; TU, Taibah University; AHA, American Heart Association; SCFHS, Saudi Commission for Health Specialties; GPA, Grade Point Average; AED, Automated External Defibrillator; IRB, Institutional Review Board.

Data Sharing Statement

Data are available on reasonable request. To access data, researchers are welcome to contact the corresponding author.

Ethics Approval and Consent to Participate

The ethics committee of the King Abdullah International Medical Research Center granted approval for this study, designated as Study Number: SP23J/140/08. This research was conducted without the support of any specific grants from funding agencies in the public, commercial, or not-for-profit sectors. The authors have declared that there are no conflicts of interest associated with this study. Should the revised manuscript be accepted for publication by the Editor, the authors will secure the necessary copyright permissions for the use of any figures. No further data will be shared. Furthermore, we confirm that written informed consent was obtained from all participants in the study, adhering to the ethical principles outlined in the Declaration of Helsinki.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors declare that they have no conflicts of interest in this work.

References

1. Marino BS, Tabbutt S, MacLaren G. et al. Cardiopulmonary resuscitation in infants and children with cardiac disease. *Circulation*. 2018;137(22): e691–e782. doi:10.1161/cir.0000000000000524
2. Tipa RO, Bobirnac G. Importance of basic life support training for first and second year medical students--a personal statement. *J Med life*. 2010;3 (4):465–467.
3. Almesned A, Almeman A, Alakhtar AM, et al. Basic life support knowledge of healthcare students and professionals in the Qassim University. *Int J Heal Sci*. 2014;8(2):141–150. doi:10.12816/0006080
4. Alkarrash MS, Shashaa MN, Kitaz MN, et al. Basic life support awareness among medical undergraduate students in Syria, Iraq, and Jordan: a multicenter cross-sectional study. *Int J Emerg Med*. 2023;16(1):44. doi:10.1186/s12245-023-00521-0
5. Riva G, Ringh M, Jonsson M, et al. Survival in Out-of-hospital cardiac arrest after standard cardiopulmonary resuscitation or chest compressions only before arrival of emergency medical services: nationwide study during three guideline periods. *Circulation*. 2019;139(23):2600–2609. doi:10.1161/circulationaha.118.038179
6. Makarov L, Komoliatova V, Fedina N, Solokhin Y. Prevalence of out-of-hospital sudden cardiac death in Moscow in 2005–2009. *Adv Epidemiology*. 2015;2015:1–6. doi:10.1155/2015/310878
7. Bircher NG, Chan PS, Xu Y, Ahagwtg I. Delays in cardiopulmonary resuscitation, defibrillation, and epinephrine administration all decrease survival in in-hospital cardiac arrest. *Anesthesiology*. 2019;130(3):414–422. doi:10.1097/aln.0000000000002563
8. Krammel M, Schnaubelt S, Weidenauer D, et al. Gender and age-specific aspects of awareness and knowledge in basic life support. *PLoS One*. 2018;13(6):e0198918. doi:10.1371/journal.pone.0198918
9. Chandrasekaran S, Kumar S, Bhat SA, Chandrasekaran V, Shabbir M, Chandrasekaran VP. Awareness of basic life support among medical, dental, nursing students and doctors. *Indian J Anaesth*. 2010;54(2):121–126. doi:10.4103/0019-5049.63650
10. Zaheer H, Haque Z. Awareness about BLS (CPR) among medical students: status and requirements. *JPMA J Pak Méd Assoc*. 2009;59(1):57–59.
11. Alghamdi YA, Alghamdi TA, Alghamdi FS, Alghamdi AH. Awareness and attitude about basic life support among medical school students in Jeddah University, 2019: a cross-sectional study. *J Fam Med Prim Care*. 2021;10(7):2684–2691. doi:10.4103/jfmpc.jfmpc_2557_20
12. Ghanem E, Elgazar M, Oweda K, et al. Awareness of basic life support among Egyptian medical students; a cross-sectional study. *Emerg*. 2018;6 (1):e36.
13. Freund Y, Duchateau FX, Baker EC, et al. Self-perception of knowledge and confidence in performing basic life support among medical students. *Eur J Emerg Med*. 2013;20(3):193–196. doi:10.1097/mej.0b013e328355fd59
14. Mastoridis S, Shanmugarajah K, Kneebone R. Undergraduate education in trauma medicine: the students' verdict on current teaching. *Méd Teach*. 2011;33(7):585–587. doi:10.3109/0142159x.2011.576716
15. Albadi S, Al-Hadi H, Nadar SK. Knowledge and attitudes toward basic life support among Medical Students in Oman. *Indian J Crit Care Med*. 2020;24(7):599–600. doi:10.5005/jp-journals-10071-23475
16. Akhlaghdoust M, Safari S, Davoodi P, et al. Awareness of Iranian medical sciences students towards basic life support; a cross-sectional study. *Arch Acad Emerg Med*. 2021;9(1):e40–e40. doi:10.22037/aaem.v9i1.1231
17. Alnajjar H, Hilal RM, Alharbi AJ, et al. Evaluation of awareness, knowledge, and attitudes towards basic life support among non-medical students at two academic institutions in Jeddah, Saudi Arabia. *Adv Méd Educ Pr*. 2020;11:1015–1021. doi:10.2147/amep.s271130
18. Mousa O, Atiyah MA, Hussain AA, AlBahrani Q, Abdelrahem AS. Basic life support awareness among non-medical students at king faisal university, Al Ahsa, Saudi Arabia. *J Nurs Educ Pr*. 2022;13(1):1. doi:10.5430/jnep.v13n1p1
19. Maddala R, Pojala K. Evaluation of knowledge, awareness, and attitude toward basic life support among the non-medical students: a cross-sectional study. *Natl J Physiol Pharm Pharmacol*. 2023;1. doi:10.5455/njppp.2023.13.07359202331072023
20. of ME Faculty of Medicine S-LD, of Kelaniya U, Kodikara KG. Best practices of basic life support training in undergraduate medical education: a guide to medical teachers. *Educ Med J*. 2022;14(4):91–97. doi:10.21315/eimj2022.14.4.8
21. Alshamrani KM, Alkenawi AA, Kaifi R, et al. Burnout among Saudi radiological sciences undergraduate students during COVID-19 pandemic: a cross-sectional study. *Psychol Res Behav Manag*. 2022;15:1637–1648. doi:10.2147/prbm.s372251
22. Alshamrani KM, Ghulam EM, Alattas M, et al. Transition to remote/hybrid learning during the COVID-19 pandemic among Saudi students of the college of applied medical sciences: a cross-sectional study. *Front Med*. 2023;10:1257589. doi:10.3389/fmed.2023.1257589
23. Alshamrani KM, Khan MA, Alyousif S. Assessment of radiological sciences students' and interns' long-term retention of theoretical and practical knowledge: a longitudinal panel study. *Adv Med Educ Pract*. 2021;12:1549–1559. doi:10.2147/amep.s346802
24. Greif R, Lockey A, Breckwoldt J, et al. European resuscitation council guidelines 2021: education for resuscitation. *Resuscitation*. 2021;161:388–407. doi:10.1016/j.resuscitation.2021.02.016
25. Kumar HH, Upadhya P, Ashok P, Chowdari G, Niranjan G, Dinesh B. A cross-sectional study on awareness and perception about basic life support/ cardio-pulmonary resuscitation among undergraduate medical students from coastal South India. *Int J Med Public Heal*. 2013;3(3):146. doi:10.4103/2230-8598.118951
26. Okonta K, Okoh BN. Theoretical knowledge of cardiopulmonary resuscitation among clinical medical students in the University of Port Harcourt, Nigeria. *Afr J Méd Heal Sci*. 2015;14(1):42. doi:10.4103/2384-5589.153391
27. Willmore RD, Veljanoski D, Ozdes F, et al. Do medical students studying in the United Kingdom have an adequate factual knowledge of basic life support? *World J Emerg Med*. 2019;10(2):75. doi:10.5847/wjem.j.1920-8642.2019.02.002

28. Mansour A, Alsager AH, Alasqah A, et al. Student's knowledge, attitudes, and practices related to cardiopulmonary resuscitation at Qassim University, Saudi Arabia. *Cureus*. 2019;11(11):e6169. doi:10.7759/cureus.6169
29. Alsharari AO, Alduraywish A, Al-Zarea EA, Salmon NI, Sheikh MSA. Current status of knowledge about cardiopulmonary resuscitation among the university students in the Northern Region of Saudi Arabia. *Cardiol Res Pr*. 2018;3687472. doi:10.1155/2018/3687472
30. Al-Mohaissen MA. Knowledge and attitudes towards basic life support among health students at a Saudi Women's University. *Sultan Qaboos Univ Méd J*. 2017;17(1):e59–65. doi:10.18295/squmj.2016.17.01.011
31. Ahmad A, Akhter N, Mandal RK, et al. Knowledge of basic life support among the students of Jazan University, Saudi Arabia: is it adequate to save a life? *Alex J Med*. 2018;54(4):555–559. doi:10.1016/j.ajme.2018.04.001
32. Kaifi R, Subahi A, Alqarni S, Jaddawi A, Alghamdi A, Alshamrani KM. The Impact of COVID-19 on radiological science students and interns at King Saud bin Abdulaziz University for Health Sciences: cross-Sectional Study. *Adv Méd Educ Pract*. 2023;14:563–571. doi:10.2147/amep.s407289
33. R I. Sample Size Calculator by Raosoft Inc. Available from: http://www.raosoft.com/samplesize.html. Accessed August 2, 2023.
34. Neumar RW, Shuster M, Callaway CW, et al. Part 1: executive summary: 2015 American heart association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2015;132:S315–S367. doi:10.1161/cir.0000000000000252
35. Merchant RM, Topjian AA, Panchal AR, et al. Part 1: executive summary: 2020 American heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2020;142(16_suppl_2):S337–S357. doi:10.1161/cir.0000000000000918
36. Awadalla NJ, Humayed RSA, Mahfouz AA. Experience of basic life support among king khalid university health profession students, Southwestern Saudi Arabia. *Int J Environ Res Public Heal*. 2020;17(13):4822. doi:10.3390/ijerph17134822
37. Jarrah S, Judeh M, AbuRuz ME. Evaluation of public awareness, knowledge and attitudes towards basic life support: a cross-sectional study. *BMC Emerg Med*. 2018;18(1):37. doi:10.1186/s12873-018-0190-5
38. Association AH. Cardiopulmonary resuscitation: statement by the Ad Hoc committee on cardiopulmonary resuscitation of the division of medical sciences, national academy of sciences—national research council. *JAMA*. 1966;198(4):372–379. doi:10.1001/jama.1966.03110170084023
39. Wheeler C. Pre-hospital emergency skills for medical students. *Emerg Med J*. 2015;32(12):1001. doi:10.1136/emermed-2015-205372.52
40. Chandra RR, Kilari SK, Uppalapati SL, Bathula AK, Mopuri MK, Katragadda S. Introduction of basic life support in medical curriculum - is this the need of an hour? *J Evol Méd Dent Sci*. 2019;8(39):2982–2985. doi:10.14260/jemds/2019/648
41. Nagashima K, Takahata O, Fujimoto K, Suzuki A, Iwasaki H. Investigation on nurses' knowledge of and experience in cardiopulmonary resuscitation and on nurses' knowledge of the guidelines for cardiopulmonary resuscitation and emergency cardiovascular care established in 2000–results of a survey at Asahikawa Medical College Hospital (second report). *Masui Jpn J Anesthesiol*. 2003;52(4):427–430.
42. Price CSG, Bell SF, Janes SEJ, Ardagh M. Cardio-pulmonary resuscitation training, knowledge and attitudes of newly-qualified doctors in New Zealand in 2003. *Resuscitation*. 2006;68(2):295–299. doi:10.1016/j.resuscitation.2005.07.002
43. Jensen ML, Hesselfeldt R, Rasmussen MB, et al. Newly graduated doctors' competence in managing cardiopulmonary arrests assessed using a standardized Advanced Life Support (ALS) assessment. *Resuscitation*. 2008;77(1):63–68. doi:10.1016/j.resuscitation.2007.10.022
44. Srinivas H, Kotekar N, Rao S. A survey of basic life support awareness among final year undergraduate medical, dental, and nursing students. *Int J Heal Allied Sci*. 2014;3(2):91. doi:10.4103/2278-344x.132692
45. Mansuri FA, Al-Zalabani AH, Zalat MM, Qabshawi RI. Road safety and road traffic accidents in Saudi Arabia. A systematic review of existing evidence. *Saudi Méd J*. 2015;36(4):418–424. doi:10.15537/smj.2015.4.10003
46. Barrimah I, Midhet F, Sharaf F. Epidemiology of road traffic injuries in Qassim Region, Saudi Arabia: consistency of police and health data. *Int J Heal Sci*. 2012;6(1):31–42. doi:10.12816/0005971
47. Saquib SA, Al-Harthi HM, Khoshhal AA, et al. Knowledge and attitude about basic life support and emergency medical services amongst healthcare interns in university hospitals: a cross-sectional study. *Emerg Med Int*. 2019;2019:9342892. doi:10.1155/2019/9342892
48. Mk K, Amberkar MB, Sa S, Bhat PM, Bansal S. Clinical awareness of do's and don'ts of cardiopulmonary resuscitation among university medical students-a questionnaire study. *J Clin Diagn Res*. 2014;8(7):MC08–11. doi:10.7860/jcdr/2014/8541.4567
49. Tsegaye W, Knowledge TM. Attitude and practice of cardiopulmonary resuscitation and associated factors in Ethiopian university medical students. *J Gen Pr*. 2016;2015(04). doi:10.4172/2329-9126.1000206