Original Article :

Knowledge, attitudes, and awareness of cardiopulmonary resuscitation among medical students in Riyadh, Saudi Arabia

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Abstract

Background and Aims:
Cardiopulmonary resuscitation (CPR) delivers artificial ventilation and circulation to sustain life until advanced cardiac life support is available and normal cardiopulmonary function is reestablished. CPR has proven to be a vital lifesaving tool. Anyone can learn CPR and use it to help people experiencing medical emergencies like heart attacks, drowning, or electric shock. This can significantly reduce the number of deaths. This study aimed to assess the knowledge, attitudes, and awareness of cardiopulmonary resuscitation among medical students in Riyadh, Saudi Arabia.

Methods:
This was a cross-sectional study conducted among medical students in Riyadh, Kingdom of Saudi Arabia, calculated sample size was 196 participants, using an anonymous online survey that was posted on social networking sites. Information was gathered on participants' knowledge, attitudes, and awareness regarding cardiopulmonary resuscitation (CPR). Knowledge regarding CPR was measured using a 16-point scale, on which the participants were rated as having little, some, or Fair/Fair level of knowledge. Data analysis was conducted using the Statistical Package for Social Science, with a significant level of $p < 0.05$.

Results:
Of the 203 medical students, 62.1% were males and 41.4% were between 21 and 23 years old. 55.2% were confident in giving cardiopulmonary massage in the event of cardiac arrest. The majority had moderate knowledge of CPR (54.2%), while 28.1% had poor knowledge. Factors associated with increased knowledge included increasing age, higher academic year level, knowledge on how to perform cardiac massage, attendance at BLS training, and awareness of the location of an automated external defibrillator (AED) or pacemaker.

Conclusion:
Lack of CPR knowledge was found among medical students, particularly in younger students in their junior years. Attending BLS training and developing CPR skills can improve their confidence. Further research into larger sample sizes could offer more insight into this issue.

Keywords:
Cardiopulmonary resuscitation, sudden death, knowledge, medical student

Introduction:

Cardiopulmonary resuscitation (CPR) is a vital emergency intervention during cardiac arrest, performed to maintain systemic perfusion and oxygenation to vital organs until spontaneous cardiac rhythm is re-established. This technique utilizes rhythmic chest compressions to mimic cardiac output and rescue breaths to preserve arterial oxygen saturation[1]. CPR has proven to be a vital lifesaving tool. It is no longer limited to healthcare workers. Anyone can learn CPR and use it to help people experiencing medical emergencies like heart attacks, drowning, or electric shock. This can significantly reduce the number of deaths and injuries. One-fifth of deaths around the world are caused by sudden cardiac death (SCD). Out-of-hospital sudden cardiac death is the primary cause of death globally, accounting for approximately 19.8 million deaths in 2022 (About 32% of all global deaths)[2].

Emergency treatment for cardiac arrest involves a set of basic lifesaving techniques (BLS). These techniques include recognizing signs of heart disease, performing CPR, and using a defibrillator. By learning these skills, anyone can help reduce the high death rate from cardiac arrest[3]. The efficacy of BLS is significantly enhanced when initiated by lay rescuers prior to the arrival of professional emergency services. This participation is best driven by educating the public and improving their attitudes toward applying CPR[4].

A study in Vienna found that many people lacked knowledge and awareness about basic life support (BLS) and automated external defibrillators (AEDs)[5]. In Saudi Arabia, a study conducted among university students in the Northern Region revealed limited knowledge of CPR[6>]. Training rates exhibit significant geographic variation; for instance, data from Arizona indicates a higher prevalence of BLS proficiency in urban centers (63.2%) compared to rural regions (55.4%)[4]. Previous studies have shown that the media plays a crucial role in raising awareness about CPR[7]. This highlights the potential of the media to spread information about these interventions. Hence, this study was conducted to assess the level of knowledge, attitudes, and practices regarding CPR among medical students in Riyadh, Saudi Arabia.

Methodology:

Design:

Cross-sectional study design by an online anonymous survey answered by medical students in Riyadh, Saudi Arabia. The survey is based on the essential principles and knowledge that a medical student should know about cardiopulmonary resuscitation. All questions are provided

with (I do not know the answer) to rule out any false insertions by individuals and further increase the reliability and validity of results. The survey is as direct as possible to ease the survey and rule out any blank or incorrect answers.

Sample:

The target population of the study was medical students in Riyadh. Inclusion criteria were male and female undergraduate medical students in Riyadh, Saudi Arabia, who were 18 years or older for ethical reasons. Exclusion criteria were medical students outside Riyadh and respondents under the age of 18. The sample size was calculated by using a specific sample size equation for a cross-sectional study: $n = Z^2 (1-\alpha) p (1-p) / d^2$, by using a margin of error of 7% and confidence level of 95%, the required sample size was 196 participants.

Data collection:

The survey was posted online on diverse social media platforms. A message was attached to the survey stating that the use of an individual's results in the research implied their consent, also, the survey included a completion message at the end. The study protocol was reviewed and approved by Imam Muhmmad Ibn Saud, College of Medicine Ethics Committee.

Questionnaire:

A previously validated questionnaire with established English versions was adopted from a study conducted in Jordan[4]. The questionnaire was developed using Google Form and was based on the most recent American Heart Association (AHA) guidelines.

First, we assessed the socio-demographic characteristics of medical students, which include age, gender, academic year, and marital status. Second, we assessed the attitude and practice toward sudden death, which includes prior witness of a sudden death, action to be taken if a sudden death occurred, knowledge of CPR, attendance to CPR training, knowledge of any type of BLS, and knowledge about the location of the Automated External Defibrillator or Pacemaker.

Lastly, we assessed the CPR knowledge of the medical students. The Cardiopulmonary resuscitation knowledge was assessed using a 16-item questionnaire, with correct answers coded as 1 and incorrect answers coded as 0. The total knowledge score has been calculated by adding all 16 items. Scores ranging from 0 to 16 points have been generated. The higher the score, the higher the knowledge of CPR. By using 50% and 75% as cutoff points to determine the level of knowledge, students were considered to have poor knowledge if their score was below 50%, moderate knowledge if their score was between 50% and 75%,

and good knowledge levels if their score was above 75%[8].

Statistical analysis:

Descriptive statistics were summarized as frequencies and percentages for all categorical variables, while mean and standard deviation were given for all continuous variables. The knowledge score has been compared with socio-demographic characteristics and attitudes toward sudden death using the Mann-Whitney Z-test. A normality test was performed using the Kolmogorov-Smirnov test. Based on the plot, the knowledge score follows the non-distribution; therefore, a non-parametric test was applied. A significant test was set at a $p<0.05$ level. All statistical data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26 (Armonk, NY: IBM Corp, USA).

Results:

This study enrolled 203 medical students. Table 1 presents the socio-demographic characteristics of the participants. 41.4% were between 21 and 23 years old.

Table 1: Socio-demographic characteristics of the medical students (n=203).

Study variables	N (%)
Age group	
18 – 20 years	59 (29.1%)
21 – 23 years	84 (41.4%)
>23 years	60 (29.6%)
Gender	
Male	126 (62.1%)
Female	77 (37.9%)
Academic year	
Preparatory	15 (07.4%)
1st year	22 (10.8%)
2nd year	28 (13.8%)
3rd year	41 (20.2%)
4th year	24 (11.8%)
5th year	73 (36.0%)

The majority were male (62.1%), and 36% were in the fifth year of study. Additionally, 96.6% were single. Regarding the assessment of attitude and practice toward sudden death (Table 2), only 7.9% had ever witnessed a stranger having a sudden death attack.

Table 2: Assessment of attitude and practice toward sudden death (n=203).

Item	N (%)
Have you ever witnessed a sudden death? If yes, who was he/she?	
Somebody from my family	12 (05.9%)
Somebody from my friends or acquaintances	05 (02.5%)
A stranger	16 (07.9%)
I have not seen this	170 (83.7%)
If somebody from among your family members or friends felt faint (sudden death), what would you do?	
I would begin to give cardiac massage	68 (33.5%)
I would call an ambulance (911)	96 (47.3%)
I would call somebody or call for help	34 (16.7%)
I would just watch and leave	05 (02.5%)
What would you do if you witnessed a stranger feeling faint (sudden death)?	
I would begin to give cardiac massage	46 (22.7%)
I would call an ambulance (911)	131 (64.5%)
I would call somebody or call for help	21 (10.3%)
I would just watch and leave	05 (02.5%)
Do you know how to give cardiopulmonary massage in the case of cardiac arrest and respiratory standstill (namely, sudden death)?	
Yes	112 (55.2%)
No	91 (44.8%)
Have you received any training in this subject? (Basic Life Support training)	
Yes	104 (51.2%)
No	99 (48.8%)
Where did you receive BLS training? (n=107)	
At school	06 (05.8%)
At university	34 (32.7%)
During the driving school	01 (01.0%)
At a Resuscitation Society course	21 (20.2%)
At a course given by the trainers of the Ministry of Health	22 (21.2%)
At a course given by the municipality	03 (02.9%)
At a course given in the workplace	09 (08.7%)
Social media (YouTube, Snapchat, Instagram, Twitter)	06 (05.8%)
Other	02 (01.9%)
If you are confronted with a person whose heart has stopped, which of the Basic Life Support applications can you apply?	
I can open the airway	15 (07.4%)
I can control respiration	03 (01.5%)

I can ventilate/conduct mouth to mouth ventilation (kiss of life)	10 (04.9%)
can give cardiac massage	27 (13.3%)
I can both ventilate and give cardiac massage	**88 (43.3%)**
I don't know	**60 (29.6%)**
Do you have any idea about where an "Automated External Defibrillator" or "Pace-maker" can be found?	
Yes	**97 (47.8%)**
No	**106 (52.2%)**

The most common action to be taken if sudden death occurs within a family member (47.3%) or a stranger (64.5%) was calling an ambulance. More than half (55.2%) knew how to perform CPR in the event of sudden cardiac arrest. The proportion of medical students who received training related to BLS was 51.2%. Of them, 32.7% received it from their university. The most common BLS method to be applied if confronted by sudden death was ventilate and cardiac massage (43.3%). Additionally, nearly half (47.8%) knew where to find the automated external defibrillator or pacemaker.

Regarding the assessment of the knowledge about CPR (Table 3), medical students were aware that the most common signs of sudden cardiac arrest were discontinuation of circulation (85.7%) and loss of consciousness (82.8%).

Table 3: Assessment of the knowledge about cardiopulmonary resuscitation (n=203).

Knowledge items	(%) N
Which of the following may be a sign of sudden cardiac arrest?	
Discontinuation of circulation (the heart sound not being heard or not feeling the pulse) [yes]	(85.7%) 174
Nausea [no]	(83.7%) 170
Loss of consciousness (the individual appearing to have fainted) [yes]	(82.8%) 168
Discontinuation of breathing (respiratory standstill) [yes]	(62.6%) 127
Breathing difficulties [no]	(55.7%) 113
Chest pain [no]	(53.7%) 109
The individual is not moving [yes]	(50.2%) 102
Cyanosis [yes]	(44.3%) 90
Faintness of the skin [yes]	(28.1%) 57
How can the consciousness state of the individual be determined? [Not moving at all]	(32.0%) 65
How can the absence of respiration be determined? [Not having any respiratory movement]	(55.2%) 112
How can the absence of circulation be determined? [Not feeling a pulse in the vessels of the neck]	(64.5%) 131

What do you think "cardiac compression" means? [Apply strong compression to the chest at certain intervals (compress)]	(74.4%) 151
What is the proper rate of cardiac massage/artificial ventilation during cardiac massage? [30/2]	(64.0%) 130
Which area must cardiac massage be applied to? [Middle of the chest]	(60.6%) 123
What must be the rate of the cardiac massage? [At least 100 times per minute]	(50.7%) 103
How much force must be applied during heart massage? [Moderate force, such that the rib cage moves down 5 to 6 cm]	(46.8%) 95
What do you know about the device defined as a "defibrillator" that is used during CPR when necessary? [It is a device to restart a heart that has stopped working.]	(56.2%) 114
Total knowledge score (mean ± SD)	3.07 ± 10.5
Level of knowledge	
Poor	(28.1%) 57
Moderate	(54.2%) 110
Good	(17.7%) 36

Only 32% knew how to determine the individual's consciousness state, and 55.2% knew how to determine the absence of respiration. Those who knew how to determine the absence of circulation were 64.5%. Medical students who were aware of the correct meaning of "cardiac compression" were 74.4%. Nearly two-thirds (64%) recognized the proper rate of cardiac massage/artificial ventilation during cardiac arrest, while those who were able to identify the correct area to have cardiac massage were 50.4%. Students who knew how much force must be applied during heart massage were 46.8%, and those who knew the device "defibrillator" were 56.2%. Based on the above knowledge items, the overall mean knowledge score was 10.5 (SD 3.07), with poor, moderate, and good knowledge levels constituting 28.1%, 54.2%, and 17.7%, respectively.

Exploring the association between the knowledge score among the socio-demographic characteristics and the attitude and practice of the medical students toward sudden death showed that knowledge scores were significantly associated with older age groups ($Z=6.782$; $p<0.001$), senior students ($Z=7.099$; $p<0.001$), those who knew how to give CPR massage ($Z=7.103$; $p<0.001$), received BLS training ($Z=6.739$; $p<0.001$), and knew the location of automated external defibrillator or pacemaker ($Z=6.134$; $p<0.001$). No significant differences were observed in knowledge scores related to gender and having ever witnessed a sudden death ($p > 0.05$) (Table 4)

Table 4: Association between the knowledge score and the socio-demographic characteristics and the attitude and practice of the medical students regarding sudden death (n=203).

Factor	Knowledge Score (16) Mean ± SD	Z-test	P-value §
Age group			
≤22 years	9.22 ± 2.76	6.783	<0.001 **
>22 years	12.1 ± 2.68		
Gender			
Male	10.5 ± 2.94	0.074	0.941
Female	10.5 ± 3.29		
Academic year			
Junior students (prep – 3d year)	9.07 ± 2.79	7.099	<0.001 **
Senior students (4th – 5th year)	12.1 ± 2.54		
Have you ever witnessed a sudden death?			
Yes	10.2 ± 3.41	0.400	0.689
No	10.6 ± 3.01		
Do you know how to give cardiopulmonary massage in the case of cardiac arrest and respiratory standstill (namely, sudden death)?			
Yes	11.9 ± 2.72	7.103	<0.001 **
No	8.85 ± 2.64		
Have you received any training in this subject? (Basic Life Support training)			
Yes	11.8 ± 2.78	6.739	<0.001 **
No	9.03 ± 2.69		
Do you have any idea about where an "Automated External Defibrillator" or "Pacemaker" can be found?			
Yes	11.9 ± 2.77	6.134	<0.001 **
No	9.28 ± 2.82		

§ P-value has been calculated using Mann-Whitney Z-test.
**** Significant at p<0.05 level.**

Discussion:

This study examines the knowledge, attitudes, and awareness of cardiopulmonary resuscitation among medical students in Riyadh, Saudi Arabia. The findings of this study could be a great contribution to literature, given the importance of CPR skills in saving lives. The findings consistently support the need for ongoing assessment and improvement of CPR training to ensure that medical students are well-prepared to respond effectively in emergency situations.

Knowledge of CPR

The knowledge of medical students regarding CPR was inadequate. According to our results, nearly 30% were regarded as having poor knowledge levels, while only about 18% were considered to be good (mean score: 10.5 out of 18 points). This is consistent with the study of Machino et al. (2022). Twenty-two percent of respondents reported having knowledge of the CPR procedure in the context of the COVID-19 pandemic[9]. Corroborating these reports, Dinberu & Yemane (2024) identified 97 individuals (61%) who scored below 75%, indicating poor knowledge, while 13 participants (8.2%) demonstrated good knowledge by achieving scores above 75%[8]. However, Alshammari et al. (2023) showed better knowledge ratings among surveyed medical students. Only 10.9 percent of individuals reported a poor knowledge score, while the majority of participants (54 percent) indicated a moderate level of knowledge[10]. These differences stemmed from variations in population characteristics, regional and cultural contexts, research methodologies, timing, educational interventions, and the focus of assessment. It is important to consider these factors when comparing results across different studies. The gaps in knowledge are evident in our results, underscoring the need for improvement. Enhancing the knowledge of medical students in CPR is essential for cultivating proficient and confident healthcare professionals. Hence, universities should ensure that medical students possess the essential knowledge and skills required to perform CPR confidently during medical emergencies.

Significant factor of knowledge

Older age groups and senior medical students were identified as significant predictors of increased knowledge. Contributing factors to these effects include greater exposure and experience in clinical settings among senior medical students compared to their junior counterparts, more comprehensive and advanced education, repeated hands-on practice, increased confidence, a stronger sense of responsibility, and the structure of medical curricula that introduces advanced emergency procedures in later years. Additionally, involvement in peer teaching and mentoring further reinforces their understanding of the material, making them more skilled than their counterparts. These findings are strikingly similar to those of Almutairi et al. (2023). Both age and academic year level were also recognized as significant factors for the level of awareness and knowledge about CPR[11]. However, Alnajjar et al. (2020) and Srinivasan et al. (2021) reported that female students had better knowledge levels than their male counterparts[12,13]. This finding

did not align with our results, as we found no significant differences in knowledge between males and females ($p > 0.05$). On the other hand, our study outperforms the findings of Alghamdi et al. (2021) and Alshehri et al. (2023). Both studies reported no differences in CPR knowledge across all demographic variables[6,14]. These differences could be due to the variations in study populations, contexts, methodologies, operational definitions, and temporal influences. Consideration of these factors is necessary when interpreting and comparing the findings of various studies.

Details of knowledge

Despite most medical students being aware of the signs of sudden cardiac arrest, including discontinuation of circulation and breathing, and loss of consciousness, fewer students were aware that pallor of the skin and cyanosis were also signs. Further, medical students are not confident enough to recognize the consciousness state of the individual who has suffered a sudden cardiac arrest, and nearly half were aware of the force that must be applied during cardiac massage. In contrast, the majority were shown to have confidence in determining the absence of circulation and respiration, as well as the proper rate of cardiac massage/artificial ventilation during cardiac massage. These results suggested that there is still room for improvement in terms of knowledge. These findings align with the study by AlShehri et al. (2023), in which only less than half of the respondents correctly identified the appropriate situations in which CPR should be administered. Only 40.4% were able to accurately state the first step to be taken in a CPR scenario, while just 22.9% demonstrated awareness of the correct sequence of actions involved in performing CPR. Notably, a mere 8.9% were familiar with the correct compression-to-ventilation ratio for adults during CPR[14]. Corroborating these reports, Alnajjar et al. (2020) documented a lack of understanding among university students regarding the basic facts of CPR, particularly in terms of the actions to be taken during sudden cardiac arrest[12].

Attitude toward CPR

The attitude of medical students regarding CPR achieved a satisfactory rating. More than half were able to attend BLS training, mostly through their university or Ministry of Health programs, and this attendance significantly improved their knowledge of CPR ($p < 0.001$). The most obvious reason for this effect is that attending BLS enhances both theoretical understanding and practical application of CPR, thereby significantly improving an individual's ability to respond effectively in

life-threatening emergencies. Our results seem to have the upper hand compared to several studies, as most of them documented a negative attitude toward BLS training[3,15,16]. However, a conflicting report by Alsharari et al. (2018) revealed that, despite most students desiring more CPR training to enhance their skills, 49% still showed a lack of awareness about medical emergencies, thereby suggesting that CPR training should be a mandatory requirement for graduation at all universities[6].

Practice of CPR

Over half were confident to perform CPR in case of sudden cardiac arrest. Furthermore, most of them were willing to perform cardiac massage on a stranger (i.e., a person who has poor personal hygiene at the bus stop), or a family member, or a friend. This confidence in performing CPR was also identified as a significant predictor of increased knowledge ($p < 0.001$). This finding is consistent with the study by Alshehri et al. (2023), which reported that 53.9% of participants performed CPR when confronted with a situation that necessitated it. Furthermore, regarding the participants' willingness to perform CPR on various individuals, the majority expressed their readiness to administer CPR whenever necessary[14]. Contradicting these reports, various papers showed poor practices in performing CPR in the time of sudden cardiac arrest[15,16,17]. Contributing factors for these variations include differences in guidelines, geography, healthcare resources, study design, interpretation of evidence, and ethical or legal contexts. This underscores the importance of critically appraising the context and methodology of each publication when comparing CPR practices.

Awareness of CPR

Most students were not aware of sudden death, as only 16.9% had ever witnessed such an event, while nearly half reported being aware of the location of the AED or pacemaker. Results from our study suggest that witnessing such events and being mindful of the location of AEDs significantly improves knowledge of CPR ($p < 0.001$). Potential reasons for these effects are attributed to the transforms, which CPR from an abstract concept into an absolute and urgent necessity, thereby significantly enhancing both the motivation to learn and the retention of CPR knowledge and skills. Furthermore, calling an ambulance (911) was the most common action to take in such events. This is not comparable with the study of Spinelli et al. (2021). After completing the course, 51.3% of respondents still considered their level of preparation to be inadequate. Nevertheless, the study noted a substantial improvement in the number

of correct responses post-course, especially in scenarios involving absent vital signs, cardiopulmonary resuscitation (CPR) procedures, and the use of a defibrillator[3]. However, Mansour et al. (2019) noted that female students were more aware of the location of chest compressions than their male counterparts ($p < 0.05$)[18], a finding that did not align with our results.

Barriers to performing CPR

Afraid of making mistakes, fear of causing bone fractures, and scared of the punishment associated with legal matters were recognized as the most significant barriers to performing cardiac massage on a friend, relative, or stranger. This finding aligns with the studies by Alnajjar et al. (2020) and Sayed et al. (2023). Both studies documented that the fear of making mistakes was the primary reason for not performing CPR[12,16]. In the instance of sudden cardiac arrest, our respondents indicated that they might perform both ventilation and cardiac massage. This did not align with the study of Mansour et al. (2019). Half of the students reported that, upon witnessing a child suddenly begin to choke, they would perform five cycles of back blows and chest compressions, followed by opening the mouth to remove the foreign body[18]. These differences reflect variations in the populations studied, cultural and legal contexts, methodological approaches, temporal factors, and the specific focus of the research. Key strategies to mitigate the effects of these barriers include expanding public access to CPR training, simplifying instructions, and promoting hands-only techniques to overcome knowledge gaps and reduce fear of disease transmission. A comprehensive, community-wide approach is necessary to overcome these challenges and enhance bystander response in emergencies.

Study limitations

The generalization of this study was subject to some limitations. First, the sample in this study was inadequate (N=203). Inadequate sample sizes can lead to overestimation or underestimation of effects, increasing the risk of drawing incorrect or misleading conclusions from the data. Second, the majority of the medical students were single; hence, pairwise comparisons between single and married individuals are inconclusive and require further investigation. Lastly, this study utilized an objective questionnaire to assess the knowledge of medical students regarding CPR. However, the use of an objective questionnaire may be limited by a lack of depth in responses, potential for misrepresentation, response bias, and oversimplification.

Conclusion

Despite showing a favorable attitude, the

knowledge of medical students regarding cardiopulmonary resuscitation was less than desired. Increasing age, higher academic levels, attendance at BLS training, skills in CPR, and awareness of automated external defibrillators or pacemakers were associated with better knowledge of CPR. Furthermore, fear of making a mistake, worries of causing bone fractures, and the burden of legal issues were identified as detrimental factors in conducting CPR during a sudden attack. Hence, strategies to enhance medical students' knowledge of CPR are necessary for effective patient care and professional development, as well as to increase confidence in performing CPR. Effective strategies include implementing structured training programs (such as BLS and ACLS), utilizing simulation-based learning with hands-on practice, and ensuring regular refresher courses to maintain proficiency. Peer-led and team-based training, objective assessment with feedback, and early integration of CPR into the curriculum further support skill development. Supplementing education with digital tools, encouraging self-directed learning, conducting debriefing sessions, and involving students in research or quality improvement projects also contribute to improved CPR competence. Together, these methods foster greater proficiency and confidence in CPR among medical students.

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