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ORIGINAL RESEARCH

Application of Automated External Defibrillators Among the Public: A Cross-Sectional Study of Knowledge, Attitude, Practice, and Barriers of Use in Saudi Arabia

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Background: The likelihood of survival of an out-of-hospital cardiac arrest quadruples with the rapid application of basic life support (BLS). The public's ability to perform cardiopulmonary resuscitation (CPR) and use automated external defibrillators (AEDs) is extremely important. This study aimed to assess the public knowledge, attitudes, and practices (KAP) of utilizing AEDs and to understand barriers to AED application.

Methods: We conducted a cross-sectional study from March 1–30, 2022. An electronic questionnaire was constructed and validated to measure the KAP for public AED utilization and its barriers.

Results: Of the 406 participants, 244 (60.10%) were males. Male respondents had 17% less knowledge and poorer attitude towards using an AED as compared to female respondents. Knowledge and attitudes on using AEDs were low (70.7%) among Saudi nationals compared to those of foreign nationals. Those who were BLS/CPR trained had a 2.5 times greater understanding and willingness to use AEDs in public than those who were not. Barriers to AEDs in CPR/BLS-trained participants were: (1) accidentally hurting the victim (14.3%), (2) duty as a bystander to just call the ambulance and wait for help (12.1%), (3) never taught what to do ($n = 41$, 18.4%), (4) did not want to be scolded if performed wrong (3.1%), and (5) never witnessed such a situation (51.6%).

Conclusion: There is a strong association between knowledge of and willingness to use AEDs in emergency situations among the public. Misconceptions about AEDs hinder their use. This calls for urgent training programs through accessible technology to reach the public.

Keywords: automated external defibrillator, AED, public, cardiac arrest

Introduction

Out-of-hospital cardiac arrest (OHCA) is a crucial health problem associated with the high incidence and mortality of cardiovascular disease.[1,2] The prehospital management of such cases is ineffective as it is usually applied late, although

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scientific evidence shows that early basic cardiopulmonary resuscitation (CPR) performed by bystanders can enhance the patient survival rate up to four times.[3–5] Meanwhile, the early basic life support (BLS) procedure is vital to improving the prognosis of OHCA, including immediate defibrillation, if available, as it forms part of the third link in the patient sequence of survival.[6–8]

Initial defibrillation and public access to automated external defibrillators (AEDs) have been shown to increase survival rates by two-thirds.[9–11] When carried out in the first 3–5 minutes after the collapse, survival rates of up to 50–70% have been reported, provided that the previous steps (ie, recognition of cardiac arrest [CA], activation of the emergency system, and start of CPR have been correctly executed.[12–14] Incidentally, for every minute in which defibrillation is postponed, survival decreases by 7–10%.[2,15] Currently, there are many centers that train for BLS and heart savor courses all over the country. AEDs also available for public use in airports, the two holy mosques and in all mass gatherings events.

The present study aimed to evaluate the use of AEDs by the public and assess their knowledge, attitude (willingness to use AED), practice (KAP), and barriers of use during OHCA cases. Ultimately, we aimed to develop recommendations for future generations and to provide instructions in using the device to save as many lives as possible.

Methods

Study Design, Setting and Population

A cross-sectional study using a web-based survey was conducted among adults aged >18 years, currently living in Saudi Arabia. We prepared a structured questionnaire comprising 21 multiple-choice questions. The first part of the questionnaire included demographic data of the participants. The second part (questions 8 to 21) tests the knowledge of AED used and inquire about the reasons for not using the AED. It was tested in a pilot study with 20 participants and reviewed by five experienced emergency physicians. The survey was posted on March 1, 2022, and closed on March 30, 2022. The sample size was calculated using a margin of error of 2.5%, confidence interval (CI) of 95%, 50% response distribution, and six million individuals from www.Rasoft.com, resulting in an approximate population of 385 target participants. The online survey was conveniently distributed to 700 participants in Riyadh through social media channels. Data were collected using an anonymous electronic structured questionnaire. The questionnaire was designed to collect KAP information concerning use of AED devices during emergency situations as well as the participants' demographics, including age, sex, nationality, occupation, and level of education.

Statistical Analysis

Descriptive statistics, such as the mean and standard deviation (SD), were computed for quantitative variables, and frequencies and percentages were calculated for categorical variables. Differences in means were evaluated using the *t*-test. The differences in KAP scores with respect to individual covariates were evaluated using the Mann–Whitney U and Kruskal–Wallis tests. Binary logistic regression was used to compute odds ratios with 95% confidence intervals (CIs) and to assess the presence and degree of association between the dependent and independent variables. Variables with a p-value <0.05 in the bi-variable analysis were used for multivariate analysis. Spearman correlation was used to assess the association between knowledge and attitude. All tests were two-sided, and statistical significance was set at a p-value < 0.05. All statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL, USA).

Results

A total of 406 individuals with a median age of 32.64 years responded in the online survey. The average age of participants who received and did not receive BLS/CPR training was 33.88±10.97 and 31.13±10.97, respectively. Overall, 244 (60.10%) were males and 162 (39.90%) were females (Table 1). Among male and female respondents, 139 (62%) and 84 (37.7%) had CPR/BLS training, respectively.

Moreover, 296 (72.90%) were Saudi nationals and 110 (27.10%) were of a foreign nationality. A total of 165 (55.74%) Saudi nationals and 58 (52.72%) foreign nationals were trained for CPR/BLS.

Our study included 117 students, 146 employees, 81 health workers, and 62 non-workers. Fifty-three students (45.2%) and 72 (49.3%) employees had training on CPR/BLS while only three health workers (3.7%) were not trained for CPR/BLS. Among non-workers, 42 (67.7%) were not trained and 20 (32.2%) were trained for CPR/BLS.

Table 1 Participants' Sociodemographic Details

Characteristics	Number of Respondents			P-value
	All N(%)	Had CPR/BLS Training N(%)	No CPR/BLS Training N(%)	
Age - mean, S.D.	32.64 (11.28)	33.88 (10.97)	31.13 (11.50)	**0.014***
Sex – *f (%)*				
Male	244 (60.1)	139 (62.3)	105 (57.4)	0.311
Female	162 (39.9)	84 (37.7)	78 (42.6)	
Nationality – *f (%)*				
Saudi	296 (72.9)	165 (74)	131 (7.6)	0.588
Non-Saudi	110 (27.1)	58 (26)	52 (28.4)	
Occupation - *f (%)*				
Student	117 (28.8)	53 (23.8)	64 (35)	**0.017***
Employee	146 (36)	72 (32.3)	74 (40.4)	
Healthcare worker	81 (20)	78 (35)	03 (1.6)	
Non-worker	62 (15.3)	20 (9)	42 (23)	
Level of education - *f (%)*				
Elementary	10 (2.5)	3 (1.3)	7 (3.8)	**0.000***
Secondary	98 (24.1)	39 (17.5)	59 (32.2)	
University	231 (56.9)	137 (61.4)	94 (51.4)	
Higher education	67 (16.5)	44 (19.7)	23 (12.6)	

Notes: * p <0.05, considered statistically significant).
Abbreviations: BLS, basic life support; CPR, cardiopulmonary resuscitation.

Additionally, Table 1 shows the educational attainment of the respondents, of whom, 10 (2.5%) had an elementary level education, 98 (24.1%) had a secondary level education, 231 (56.9%) had university-level qualifications, and 67 (16.5%) had higher education. Among the participants who received training on CPR, 3 (1.3%), 39 (17.5%), 137 (61.4%), and 44 (19.7) had elementary, secondary, university, and higher levels of education, respectively.

Among the respondents untrained on CPR/BLS, 7 (3.8%) had elementary education, 59 (32.2%) had secondary level, 94 (51.4%) had university level, and 23 (12.6%) had higher education. The relationship between CPR attitude and knowledge.

Table 2 shows the top concerns among respondents with training on CPR/BLS prior to using AEDs. These include (1) accidentally hurting the victim ($n = 32$, 14.3%); (2) duty as a bystander is just to call the ambulance and wait for help to arrive ($n = 27$, 12.1%); (3) never taught what to do ($n = 41$, 18.4%); (4) do not want to be scolded if I do the wrong thing ($n = 7$, 3.1%); and (5) never witnessed such a situation ($n = 115$, 51.6%).

Meanwhile, respondents who were not trained on CPR/BLS expressed the following as their reasons for not using AEDs: (1) accidentally hurting the victim ($n = 39$, 21.3%); (2) duty as a bystander is just to call the ambulance and wait for help to arrive ($n = 42$, 23%); (3) never taught what to do ($n = 73$, 39.9%); (4) do not want to be scolded if I do the wrong thing ($n = 13$, 7.1%); and (5) never witnessed such a situation ($n = 103$, 56.3%).

Table 3 shows the factors influencing the respondents' knowledge and attitude on AED use. As the respondent's age increases, with OR 1.00 (0.97–1.03), knowledge and attitude toward AED utilization both increase by 0.3% (Table 2). Male respondents had a 17% lower knowledge and attitude of AED use (with OR 0.82 [0.46–1.48]) as compared to

Table 2 Barriers of AED Use Among Respondents

Characteristics	Number of Respondents			P-value
	All	Had CPR/BLS Training N=223 (54.9)	No CPR/BLS Training N=183 (45.1)	
Use of AED before	78 (19.2)	76 (34.1)	2 (1.1)	**0.000***
Barriers for not using AED				
i. Scared that I might accidentally hurt the victim	71 (17.5)	32 (14.3)	39 (21.3)	0.066
ii. Duty as a bystander is just to call the ambulance and wait for help to arrive	69 (17)	27 (12.1)	42 (23)	**0.004***
iii. I have never been taught what to do	114 (28.1)	41 (18.4)	73 (39.9)	**0.000***
iv. I do not want to be scolded if I do the wrong thing	20 (4.9)	7 (3.1)	13 (7.1)	0.066
v. Never witnessed such a situation	218 (53.7)	115 (51.6)	103 (56.3)	0.343
I feel confident enough to use an AED				
Strongly Agree	120 (29.6)	88 (39.5)	32 (17.5)	**0.000***
Agree	80 (19.7)	48 (21.5)	32 (17.5)	
Neutral	116 (28.6)	52 (23.3)	64 (35)	
Disagree	55 (13.5)	21 (9.4)	34 (18.6)	
Strongly Disagree	35 (8.6)	14 (6.3)	21 (11.5)	

Notes: * p <0.05, considered statistically significant).
Abbreviations: AED, automated external defibrillator; BLS, basic life support; CPR, cardiopulmonary resuscitation.

Table 3 Factors Influencing Respondents' Knowledge of and Attitude Toward AED Utilization

Variable	Univariable Regression OR (95% CI)	P-value
Age	1.00 (0.97–1.03)	0.869
Sex	0.82 (0.46–1.48)	0.528
Nationality	0.29 (0.15–0.53)	**0.000***
Occupation		
Student	0.09 (0.03–0.25)	**0.000***
Employee	0.11 (0.05–0.23)	**0.000***
Non-worker	0.12 (0.04–0.33)	**0.000***
Healthcare worker	Reference category	
Education		
Elementary	0.84 (0.14–4.90)	0.852
Secondary	0.35 (0.14–0.85)	**0.021***
University	0.62 (0.31–1.21)	0.164
Higher education	Reference category	
BLS training	2.57 (1.42–4.65)	**0.002***

Notes: * p <0.05, considered statistically significant).
Abbreviations: OR, odds ratio; CI, confidence interval; AED, automated external defibrillator; BSL, basic life support.

Table 4 Comparison of KAP Scores of AED Use

Characteristics	KAP Mean score	P-value
Sex		
Male	4.58 (2.24)	0.748
Female	4.49 (2.1)	
Nationality		
Saudi	4.38 (2.08)	**0.020***
Non-Saudi	5.01 (2.44)	
Occupation		
Student	3.91 (1.62)	**0.000***
Employee	4.14 (2.12)	
Non-worker	3.94 (1.65)	
Healthcare worker	6.65 (2.18)	
Level of education		
Elementary	3.90 (2.02)	**0.000***
Secondary	3.77 (1.83)	
University	4.58 (2.18)	
Higher education	5.67 (2.31)	
BLS training		
Yes	5.17 (2.45)	**0.000***
No	3.79 (1.55)	

Notes: * p <0.05, considered statistically significant). The Mann–Whitney *U*-test and Kruskal–Wallis test were used to analyze the mean KAP scores of AED use among categorical variables.
Abbreviations: AED, automated external defibrillator; KAP, knowledge, attitudes, and practices.

females. Compared to foreign nationals, Saudi nationals had decreased knowledge and attitudes toward AED utilization by 70.7%. Being a student, employee, or non-worker reduced the odds of knowledge and attitude toward AED utilization by 90.1%, 88.9%, and 87.6%, respectively, when compared to healthcare workers. Compared to participants with higher education, participants with elementary, secondary, and university education had reduced odds of knowledge and attitude toward AED utilization by 15.4%, 64.8%, and 37.8%, respectively. Participants who had BLS training had 2.5 times more knowledge and attitude towards utilizing AED in public when compared to non-BLS trained participants.

There was a statistically significant difference in the mean KAP scores of AED use among nationality, occupation, level of education, and BLS training (p-value <0.05), but not between sexes (p-value >0.05) (Table 4).

Discussion

Proper and basic knowledge on the application of CPR and AEDs are life-saving skills, which are critical for all members of society to possess.[15] The purpose of this study was to assess the attitude, understanding, and awareness of the use of AED among individuals in Saudi Arabia.

The Spearman rank correlation revealed that male respondents had 17% less knowledge and attitude towards using an AED than did female respondents. In a survey among students, there was no significant difference in knowledge scores

between the male and female participants.[16] Additionally, Kanstad and Bjorn[17] reported that female students had a much higher level of dedication than male students. According to research, female students were especially interested in taking BLS classes outside the classroom if they were more widely available.

There was no discernible difference in the age between respondents who received and did not receive training on CPR/BLS. However, the Spearman rank correlation coefficient showed that with an increase in the respondents' age (OR 1.00), their knowledge and attitude on using AEDs increased by 0.3%.

Saudi nationals' knowledge and attitude on using an AED were low at 70.7%, when compared with foreign nationals. Statistics from a public study by Al-Turki and Yousef[18] revealed that Saudi Arabia has a lower proportion of trained individuals than other nations do. This proportion suggests that to bring citizens into compliance with international standards, more attention should be paid to the necessity of training the public in utilizing AEDs and other life-saving techniques.

Our study included working adults, students, health care professionals, and non-workers. The results showed that 54.7% of students, 49.3% of employees, 96.2% of health workers, and only 32.2% of non-workers had training on CPR/BLS. Overall, 54.92% had received BLS/CPR training. According to Jarrah and Samiha,[19] 29% of participants of their study received CPR training in Jordan, which is higher than the percentages reported in Hong Kong (21%)[20] and mainland China (25.6%)[21] and on par with that reported in Ireland 28%[22] and in New Zealand (27%).[23] Other countries have reported higher percentages of trained individuals at 58%, 75%, and 79% for Australia,[24] Poland,[25] and the United States,[26] respectively.

Comparing students, employees, and non-workers to healthcare workers, the probability of having knowledge and a positive attitude on using an AED were reduced by 90.1%, 88.9%, and 87.6%, respectively. Compared with higher education participants, those with elementary, secondary, and university education levels had lower probabilities of knowledge and attitude towards using AEDs by 15.4%, 64.8%, and 37.8%, respectively. Compared to those who did not receive BLS/CPR training, those who were trained had a 2.5 times greater understanding of and attitude towards using an AED in public.

According to Chair et al, people with full-time occupations and higher educational degrees were more likely to receive CPR instructions.[19] In case of an emergency, those who said that they had undergone CPR training were more willing to use it at home and in public. Nevertheless, the respondents' overall level of CPR knowledge was low. Research conducted in Nepal in 2012 revealed that medical and paramedical workers had lower average mean scores on their knowledge of resuscitation techniques.[27] These traits lend credence to the notion that CPR training is more likely to increase the likelihood of performing CPR.

The five main issues that our study participants experienced were as follows: 71 respondents (40% had CPR training) were terrified that one of the victims may be inadvertently wounded. Additionally, 69 respondents (39.1% had CPR training) believed that the bystander's sole responsibility was to call the ambulance and wait for help to arrive. Of the 114 passengers who claimed that they had never been instructed on what to do, 35.9% had received CPR training. Twenty respondents (35% had CPR training) feared committing an error. A total of 218 respondents stated that they had never witnessed such a situation; among them, 52.7% were CPR trained. In a study by Jarrah,[19] 23.3% of the overall participants witnessed a sudden cardiac arrest. Nearly half of the participants said that they dialed the emergency line, and the remaining participants said that they asked for assistance, applied chest compressions, and performed mouth-to-mouth breathing. Chest compressions, mouth-to-mouth breathing, and "simply watched and left" received the lowest ratings.

Familiarity with fundamental CPR procedures can increase the likelihood of a patient's survival. The purpose of this study was to ascertain the relationship between the CPR knowledge and skills of emergency medical workers and the general public.

Although having a thorough understanding of CPR was linked to a higher likelihood of performing the tasks correctly, research by Todd[28] revealed that the overall performance remained subpar, which is inconsistent with our study. This sub-standard performance might be caused by the caliber of refresher courses and educational workshops, time between sessions, busy work schedules, lack of motivation or interest in the job, rarity of interactions with medical emergencies, or failure to recognize the value of maintaining CPR knowledge.[29]

Although universities and schools play a significant role in raising awareness, media can reach a wider audience and cover a significant number of individuals. The inclusion of such straightforward training programs by qualified individuals may benefit communities and public health. Clear funding and sources of pertinent school information are required for the successful implementation of CPR training programs in school curricula. Relevant information

should include who can train students in CPR, what proficiency level is necessary, what training materials are needed, where to find the resources, which grades can be trained, how often training should occur, and which curriculum components should be included.[30] Future studies are required to identify the best practices for implementing CPR education.

A planned reaction to cardiac emergencies will lower fatalities in educational settings and guarantee that confusion will not result in a poor or non-existent response.[31] Moreover, Hansen[31] underlined the need for complete explanations of all curriculum topics and the inclusion of hands-on CPR and AED practice. Despite the limitations of the study's sample size, this study offers a comprehensive view of the topic. Additionally, there is a critical need to start monitoring cardiac arrest and raise public understanding of public health measures, such as CPR.

Conclusion

This study shows the importance of AED education in order to increase it's usage. Practical implications are outcomes connected to or implied by putting a plan or scenario into action in the real world. We advise supporting training programs through the media, using accessible and cost-effective technologies, such as social and digital media, to reach the public. National rules such as the Good Samaritan law should also safeguard individuals who assist those in a cardiac arrest or other emergency situations.

Abbreviations

AED, automated external defibrillator; BSL, basic life support; CPR, cardiopulmonary resuscitation; KAP, knowledge, attitudes, and practices.

Data Sharing Statement

The data collected and used in this study are available from the corresponding author upon request.

Ethics Approval and Consent to Participate

Informed consent was obtained from all participants. The KAP survey forms were sent anonymously and did not include any identifiers or personal information about the participants. Procedures were performed in accordance with the ethical standards of this committee and with the Helsinki Declaration. IRB approval was obtained from Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia (No: 22 - 0251).

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The authors declare that they have no conflict of interest.

References

1. Olasveengen TM, Semeraro F, Ristagno G, et al. European resuscitation council guidelines 2021: basic life support. *Resuscitation*. 2021;161:98–114. doi:10.1016/j.resuscitation.2021.02.009
2. Merchant RM, Topjian AA, Panchal AR, et al. Adult basic and advanced life support, pediatric basic and advanced life support, neonatal life support, resuscitation education science, and systems of care writing groups (2020)(16_suppl_2) Part 1: executive summary: 2020 American heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2020;142:S337–S357. doi:10.1161/CIR.0000000000000918
3. Kiyohara K, Sado J, Kitamura T, et al. Public-access automated external defibrillation and bystander-initiated cardiopulmonary resuscitation in schools: a nationwide investigation in Japan. *Europace*. 2019;21:451–458. doi:10.1093/europace/euy261
4. Sasson C, Rogers MAM, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes*. 2010;3:63–81. doi:10.1161/CIRCOUTCOMES.109.889576
5. Holmberg M, Holmberg S, Herlitz J. Effect of bystander cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients in Sweden. *Resuscitation*. 2000;47:59–70. doi:10.1016/s0300-9572(00)00199-4

6. Atwood C, Eisenberg MS, Herlitz J, Rea TD. Incidence of EMS-treated out-of-hospital cardiac arrest in Europe. *Resuscitation*. 2005;67:75–80. doi:10.1016/j.resuscitation.2005.03.021
7. Soto-Araujo L, Costa-Parcero M, López-Campos M, Sánchez-Santos L, Iglesias-Vázquez JA, Rodríguez-Núñez A. Chronobiology of out-of-hospital cardiac arrest in Galicia with semi-automatic external defibrillators. *Semergen*. 2015;41:131–138. doi:10.1016/j.semerg.2014.05.002
8. Berdowski J, Berg RA, Tijssen JGP, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. *Resuscitation*. 2010;81:1479–1487. doi:10.1016/j.resuscitation.2010.08.006
9. Murugiah K, Chen SI, Dharmarajan K, et al. Most important outcomes research papers on cardiac arrest and cardiopulmonary resuscitation. *Circ Cardiovasc Qual Outcomes*. 2014;7:335–345. doi:10.1161/CIRCOUTCOMES.114.000957
10. Nielsen AM, Folke F, Lippert FK, Rasmussen LS. Use and benefits of public access defibrillation in a nation-wide network. *Resuscitation*. 2013;84:430–434. doi:10.1016/j.resuscitation.2012.11.008
11. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, Hiraide A; Implementation Working Group for the All-Japan Utstein Registry of the Fire and Disaster Management Agency. Nationwide public-access defibrillation in Japan. *N Engl J Med*. 2010;362:994–1004. doi:10.1056/NEJMoa0906644
12. Perkins GD, Lockey AS, de Belder MA, Moore F, Weissberg P, Gray H; Community Resuscitation Group. National initiatives to improve outcomes from out-of-hospital cardiac arrest in England. *Emerg Med J*. 2016;33:448–451. doi:10.1136/emermed-2015-204847
13. Kumar S, Chow C, Jan S. *Rapid Literature Review on Public Access to Defibrillation*. Newtown: The George Institute for Global Health; 2017.
14. Ibrahim WH; Ibrahim WH. Recent advances and controversies in adult cardiopulmonary resuscitation. *Postgrad Med J*. 2007;83:649–654. doi:10.1136/pgmj.2007.057133
15. Benjamin EJ, Muntner P, Alonso A, et al.; American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics-2019 update: a report from the American heart association. *Circulation*. 2019;139:e56–e528. doi:10.1161/CIR.0000000000000659
16. Parnell MM, Pearson J, Galletly DC, Larsen PD. Knowledge of and attitudes towards resuscitation in New Zealand high-school students. *Emerg Med J*. 2006;23:899–902. doi:10.1136/emj.2006.041160
17. Kanstad BK, Nilsen SA, Fredriksen K. CPR knowledge and attitude to performing bystander CPR among secondary school students in Norway. *Resuscitation*. 2011;82:1053–1059. doi:10.1016/j.resuscitation.2011.03.033
18. Al-Turki YA, Al-Fraih YS, Jalaly JB, et al. Knowledge and attitudes towards cardiopulmonary resuscitation among university students in Riyadh, Saudi Arabia. *Saudi Med J*. 2008;29:1306–1309.
19. 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;18:37. doi:10.1186/s12873-018-0190-5
20. Chair SY, Hung MS, Lui JC, Lee DT, Shiu IY, Choi KC. Public knowledge and attitudes towards cardiopulmonary resuscitation in Hong Kong: telephone survey. *Hong Kong Med J*. 2014;20:126–133. doi:10.12809/hkmj134076
21. Chen M, Wang Y, Li X, et al. Public knowledge and attitudes towards bystander cardiopulmonary resuscitation in China. *BioMed Res Int*. 2017;2017:3250485. doi:10.1155/2017/3250485
22. Jennings S, Hara TO, Cavanagh B, Bennett K. A national survey of prevalence of cardiopulmonary resuscitation training and knowledge of the emergency number in Ireland. *Resuscitation*. 2009;80(325048542):1039–1042. doi:10.1016/j.resuscitation.2009.05.023
23. Larsen P, Pearson J, Galletly D. Knowledge and attitudes towards cardiopulmonary resuscitation in the community. *N Z Med J*. 2004;117:U870.
24. Celenza T, Gennat HC, O'Brien D, Jacobs IG, Lynch DM, Jelinek GA. Community competence in cardiopulmonary resuscitation. *Resuscitation*. 2002;55:157–165. doi:10.1016/s0300-9572(02)00201-0
25. Rasmus A, Czekajlo MS. A national survey of the Polish population's cardiopulmonary resuscitation knowledge. *Eur J Emerg Med*. 2000;7:39–43. doi:10.1097/00063110-200003000-00008
26. Sipsma K, Stubbs BA, Plorde M. Training rates and willingness to perform CPR in King County, Washington: a community survey. *Resuscitation*. 2011;82:564–567. doi:10.1016/j.resuscitation.2010.12.007
27. Roshana S, Kh B, Rm P, Mw S. S. Basic life support: knowledge and attitude of medical/paramedical professionals. *World J Emerg Med*. 2012;3:141–145. doi:10.5847/wjem.j.issn.1920-8642.2012.02.011
28. Brown TB, Dias JA, Saini D, et al. Relationship between knowledge of cardiopulmonary resuscitation guidelines and performance. *Resuscitation*. 2006;69:253–261. doi:10.1016/j.resuscitation.2005.08.019
29. Aroor AR, Saya RP, Attar NR, Saya GK, Ravinanthanan M. Awareness about basic life support and emergency medical services and its associated factors among students in a tertiary care hospital in South India. *J Emerg Trauma Shock*. 2014;7:166–169. doi:10.4103/0974-2700.136857
30. Malta Hansen C, Zinckernagel L, Ersbøll AK, et al. Cardiopulmonary resuscitation training in schools following 8 years of mandating legislation in Denmark: a nationwide survey. *J Am Heart Assoc*. 2017;6:e004128. doi:10.1161/JAHA.116.004128
31. Rose K, Martin Goble M, Berger S, et al. Cardiac emergency response planning for schools: a policy statement. *NASN Sch Nurse*. 2016;31:263–270. doi:10.1177/1942602X16655839