Original Article

Access this article online

Quick Response Code:

Website: www.jehp.net

DOI: 10.4103/jehp.jehp_1011_21

High school basic life support training: Is the trainer's experience of cardiopulmonary resuscitation in the actual setting important? A randomized control trial

Ali Sanati, Ali Ansari Jaberi[1], Tayebeh Negahban Bonabi[2]

Department of Medical Surgical Nursing, School of Nursing and Midwifery, Student Research Committee, Rafsanjan University of Medical Sciences, Rafsanjan, Kerman Province, Iran, [1]Department of Psychiatric and Mental Health Nursing, Social Determinants of Health Research Center, School of Nursing and Midwifery, Rafsanjan University of Medical Sciences, Rafsanjan, Kerman Province, Iran, [2]Department of Community Health Nursing, Social Determinants of Health Research Center, School of Nursing and Midwifery, Rafsanjan University of Medical Science, Rafsanjan, Kerman Province, Iran

Address for correspondence:
Dr. Tayebeh Negahban Bonabi, Midwifery, Parastar Street, Rafsanjan, Kerman Province, Iran.
E-mail: negahbant@yahoo.com

Received: 10-07-2021
Accepted: 27-08-2021
Published: 11-06-2022

Abstract:

BACKGROUND: Although basic life support (BLS) has been taught in school by a variety of professionals, it is still unclear that, whether the instructor's previous cardiopulmonary resuscitation (CPR) experience is an important factor. This study aimed to compare the effect of BLS training, based on trainer experience in actual situations, on knowledge and skills of secondary high school students.

MATERIALS AND METHODS: In this randomized controlled trial, 150 high school students were selected based on the inclusion criteria and then assigned into two groups, (76 in Group A), and (74 in Group B) randomly. Both groups were trained according to adult BLS: 2020 American Heart Association guidelines on mannequins in three 60 min in-person training sessions. The knowledge and skill scores were measured for both groups before, immediately, and 1 month after intervention by a questionnaire. Data were analyzed by the SPSS software version 22, using Chi-square, Mann–Whitney U, repeated-measure ANOVA tests, and statistically modeling at a significance level of 0.05.

RESULTS: There were no significant differences between groups regarding demographic characteristics. The knowledge and skill scores in both groups increased significantly compared to baseline immediately and 1 month after the intervention (P = 0.001). However, there was no significant difference in knowledge scores between groups (P = 0.076(. However, at the immediacy and 1 month after the intervention, the skill score in "Group A" was significantly higher than the "Group B" (P = 0.001).

CONCLUSIONS: The trainer's experience of CPR in the actual setting in the transfer of BLS knowledge is not important, but it improved Student's BSL skill acquisition score.

Keywords:

Basic cardiac life support, cardiopulmonary resuscitation, knowledge, motor skill, training

Introduction

Out-of-hospital cardiac arrest (OHCA) is the leading cause of death worldwide and is defined as the loss of mechanical function of the heart along, with the absence of systemic circulation, in outside a hospital setting. The exact out-of-hospital cardiac burden for public health is unknown, because, a significant number of cases occur in the absence of emergency medical services (EMS).[1] According to the autopsy results, 74.8% of sudden cardiac death were due to ischemic heart disease. The Cardiac Registry to Enhance Survival in 2019 reported that, the incidence of EMS for

How to cite this article: Sanati A, Jaberi AA, Bonabi TN. High school basic life support training: Is the trainer's experience of cardiopulmonary resuscitation in the actual setting important? A randomized control trial. J Edu Health Promot 2022;11:165.

OHCA at any age was 76.5 per 100,000 population, and the survival rate after receiving cardiac arrest treatments by out-of-hospital EMS was 10.6%.[2]

After a cardiac arrest, when the EMS staff arrives, which can be after 8–12 min or more, the brain has already begun to die. Therefore, there is a time frame for cardiopulmonary resuscitation (CPR) by nonprofessionals present at the scene[3] and in most cases, CPR performed by nonprofessionals fills the time gap of the presence of EMS staff.[4]

Researchers believe that, resuscitation by nonprofessionals can improve the desired outcomes of the nervous system.[5] Results of a systematic review showed that, lay person basic life support (BLS) skills training can lead to ensure timely implementation of life-saving measures.[6] One promising strategy to increase the number of educated people in the community is to implement CPR training in schools. In this regard, the American Heart Association (AHA) has declared CPR training mandatory in schools.[7] Evidences showed that, BLS training for students leads to increased bystander's CPR.[8,9] The World Health Organization has also supported, the CPR training in schools.[10]

Although CPR has been taught in school by a variety of professional groups, researchers believe that, there is no standard method of implement this[11] and there is limited knowledge about the main challenges of BLS training among high school students.[12,13] Hence, the answer to the following question is still unclear that, whether the instructor's previous experience of performing CPR in the actual situations is an important factor? Due to the limited evidence in this regards, this study aimed to compare the effect of CPR training, based on trainer experience in actual situations, on knowledge and skills of secondary high school students.

Materials and Methods

Study design and setting

This double-blind, randomized controlled trial was performed from October 2020 to November 2020; aimed at comparing the effect of BLS training, based on trainer experience in actual situations, on knowledge and skills of secondary high school students in Neyriz in Fars province, Iran.

Study participants and sampling

Evidence shows that, BLS training could be successfully implemented in a wide range of students. While, older children are more successful in testing,[14] based on this, high school students were considered in this study. The study population included all high school students in Neyriz, who were studying in public, nonprofit and vocational secondary high schools, and the research samples include all students of different years of secondary high school who want to be in the study and met the inclusion criteria. The inclusion criteria were: Official membership in the population of secondary high school students in Neyriz, informed and written consent to participate in the study, no history of receiving a parallel education from similar classes or workshops and having the physical ability appropriate to the training course, the exclusion criteria were: Withdrawing from the study, student dropout and absence from training classes for at least one session.

Due to the COVID-19 pandemic and the restrictions on students' attendance at schools, sampling was initially done through convenience sampling method. So that, the schools were selected that, they were part-time and the principals and the parents of the students were allowed to start the study. At first one class was selected from the schools by random lottery method. Eligible students in the selected classes were divided into two groups, based on the previous grade point average, equally. It should be noted that in Iran, girls "and boys" schools are separated. Each group of students was assigned to an instructor through a lottery method. One group trained by an instructor who was a prehospital EMS nurse and has CPR experience in a real-situation (Group A), and another group trained by a nurse who was a Red Crescent employee and has no real-situation CPR experience (Group B). Both of the instructors were male, certified, and in terms of age, CPR teaching experience, and communication and verbal skills were almost the same. Because the male students were more available and volunteer than girls, the number of boys in the two groups was higher.

Sample size based on previous studies was considered to be 150 (76 in Group A and 74 in Group B), according to the following formula with a standard deviation 3.91 and the effect size of the knowledge score at the confidence level of 95% and power for 90%.

$$n = 2\,(z_{1-\alpha/2} + z_{1-\beta})\,\sigma^2/d^2$$

Data collection tool and technique

The data collection tool consisted of two parts: The first part included a demographic characteristic: (age, gender, field of study, degree, and total grade point average). The second part included a researcher-made questionnaire to assess students' CPR knowledge and skills, which was designed based on the Adult Basic Life Support: 2020 AHA Guidelines for CPR and Emergency Cardiovascular Care.[15] The knowledge assessment tool included 20 four-answer choice questions about the concept of cardiac arrest and BSL components. Students' CPR skills assessment tool was designed in two parts:

A "Self-report Questionnaire" and the "Practical Skills Assessment Checklist." The "Self-report" section of the skills assessment consists of 10 scenarios that, measure students' readiness for response to cardiac arrest and BLS performance in a four-answer choice question. The "Practical Skills Assessment Checklist," with a cardiac arrest scenario, assessed students' performance in 10 areas with 45 items, including: "Personal Protection," "Scene Safety," "Patient Response," "Recovery Position," "Ask for Emergency Help," "Respiratory Assessment," "Pulse Assessment," "Positioning the Patient," "Principles of Chest Compression," and "Airway Administration." Each correct answer choice or action gained one point and each incorrect answer or action loses one point. The range of knowledge score was 0–20 and for skill score was 0–55.

To determine the content validity of the tool, both qualitative and quantitative methods were used. In the qualitative part, the tool was provided to 11 professors and specialists in the field of nursing and CPR. The Waltz and Basel validity approach[16] was used to determine the quantitative content validity index (CVI), which relates to the relevance, simplicity, and clarity of the items. The final version of the questionnaire includes: 20 four-four-choice questions for measuring knowledge, 10 four-choice scenario-based questions for measuring self-report skills, and 45 item of a scenario for skill assessment checklists. The CVI for skill checklist was calculated 1, for self-report Skills questions were 0.909 and CVI for knowledge questions was 0.959. The CVI scores of all items were greater than 9. Therefore, they were accepted. It should be noted that, some items in terms of writing and some options in terms of the order of appearance were corrected with the opinion of professors.

After approving the proposal and obtaining the code of ethics with REC number: IR.RUMS.REC.1398.210 from research council of Rafsanjan University of Medical Sciences and also presenting an introduction letter to the Shiraz University of Medical Sciences and then education department of Neyriz, sampling was performed. After allocation the samples into two groups, students' knowledge and skills were first measured as a pretest. Then, BLS training was performed in two groups on separate days at schools.

The educational content for both groups was based on Adult Basic Life Support: 2020 AHA Guidelines for CPR and Emergency Cardiovascular Care, and the training was performed on mannequins in three consecutive sessions, out of school time. The first two sessions on the first 2 consecutive days were for teaching cardiac arrest, BLS principals, questioning, and course discussions. The third session was held on the 3rd day to practice and repeat the skill. The average duration of the training sessions was 60 min. Finally, 1 day and 1 month after the completing the course, students' knowledge and skills were examined by the researcher colleague who was an EMS nurse and had experience of BLS teaching at schools.

To avoid bias in how to answer questions and how to evaluate and grade, students and the examiner were blind to the main objectives of the study and trainer's experiences. In this way, the students and the nurse who conducted the tests, did not aware about the purpose of the research and how to allocate the samples in the study groups. All three stages of the test were performed at the school where the students were trained.

Ethical consideration

In order to observe the ethics in the research, the proposal was approved by the research council of Rafsanjan University of Medical Sciences and the code of ethics was obtained from the research committee of this university (code of ethics: IR.RUMS.REC.1398.210). Furthermore, before starting work, the necessary permission was obtained from the provincial education department to conduct the study. After attending the schools, students were informed that their participation or nonparticipation in the training course would have no effect on their school education program, and their participation in the training course is completely voluntary.

Data were analyzed using SPSS software version 22 (IBM Company Armonk, NY, USA), by Kolmogorov–Smirnov statistical tests (to determine the normality of quantitative data distribution), Chi-square statistical tests (to compare ratios), Mann–Whitney *U*-test (to compare the means in between groups), the repeated measure ANOVA and statistical modeling were used to compare time by time, the mean of knowledge and skill score in repeated measurements between and among the studied groups. A significance level of 0.05 was considered.

Results

In the current study, a total of 159 high school students were assessed. About, 9 students were excluded due to noncompliance with exclusion criteria. The sampling details were explained in consort flow diagram [Figure 1].

The data from 150 secondary high school students were analyzed (76 in Group A and 74 in Group B). The results of Kolmogorov–Smirnov showed that, with the exception of age, and the mean scores of the previous year, all of the quantitative variables distributed normally. The data analysis results showed that, the mean and standard

deviation of the age of the samples was 16.21 ± 0.945 with a minimum of 15 and a maximum of 18 years. The gender of 44 (29.3%) were female and 106 (76.7%) were male. In terms of the field of study, 20 (13.3%) were studied in natural sciences course, the course of 31 (20.7%) were mathematics, 44 (29.3%) were humanistic, and 55 (36.7%) were studying in the field of "technical and professional." No statistically significant difference was observed between the study groups regarding age, gender the mean scores of the previous year, and the field of study [Table 1].

To examine the changes of the knowledge and skill scores during consecutive measurement times (time effect), among the study groups over the time (group effect), and knowledge score changes over time taking into account the effect of groups (interaction between time

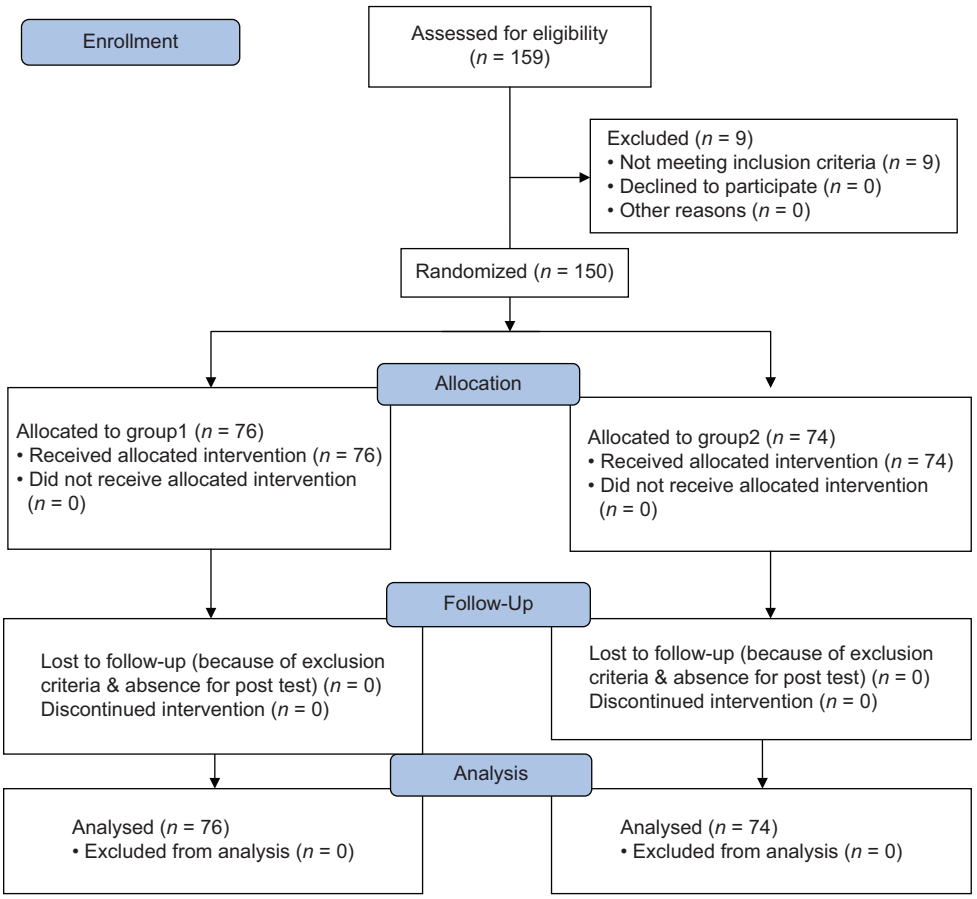

Figure 1: CONSORT 2010 flow diagram

Table 1: Comparison of the demographic characteristics across the studied groups

Variables	Group A (*n*=76), *n* (%)	Group B (*n*=74), *n* (%)	*P*
Gender*			
Male	54 (71.1)	52 (70.3)	0.916
Female	22 (29.9)	22 (29.7)	
Grade			
Tenth	30 (39.5)	30 (40.5)	0.990
Eleventh	19 (25)	18 (24.3)	
Twelfth	26 (35.1)	27 (35.5)	
Field of study*			
Natural sciences	10 (13.2)	10 (13.5)	0.999
Mathematics	16 (21.1)	15 (20.3)	
Humanistic	22 (28.9)	22 (26.7)	
Technical and professional	28 (36.8)	27 (36.5)	
Mean scores of the previous year**, median (quartile range)	18±0.02	18±0.5	0.751
Age**, median (quartile range)	15±0	17±0	0.574

*Chi-square test, **Mann–Whitney *U*

and group), the repeated measure ANOVA was used. The results of Mauchly's Sphericity test showed that, the correlation coefficients of the consecutive measurements were significantly different ($P < 0.0001$). Hence, the correlation equation precondition was not accepted. Therefore, Greenhouse-Geisser correction coefficient was used to report *P* values.

The results of multivariate test for knowledge score showed that, the effect of interaction between time and group ($P = 0.082$), the effect of time ($P = 0.001$) is statistically significant, which means that the comparison of the mean scores of knowledge within the groups is statistically different. However, the results of between subject effect test of the group effect (the intergroup comparison) did not show a statistically significant difference ($P = 0.076$).

The results of multivariate test for skill score showed that, the effect of time and group ($P = 0.001$), and also the effect of interaction between time and group ($P = 0.001$), was statistically significant [Table 2 and Figure 2], so to examine the interaction between time and group in detail, statistical modelling was used.

In within group comparison, the results of pairwise comparison of skill scores between the three stages showed a statistically significant difference ($P = 0.001$). So that, in both groups, the mean difference and standard error of the skill scores at immediately after the intervention were significantly higher than the pretest and 1 month after the intervention ($P = 0.001$), and the skill scores at 1 month after the intervention were significantly lower than the immediately after the intervention score ($P = 0.001$) [Table 3 and Figure 3].

Table 2: Comparison of mean and standard deviation of skill score across the study groups at three times of measurement

Variables	Mean±SD		*P**
	Group A	Group B	
Before intervention	6.05±1.55	5.80±1.51	*P*=0.001
Immediately after intervention	45.51±2.73	40.94±3.36	
1 month after intervention	39.92±3.54	32.97±4.51	

*Interactive between group and time effect. SD=Standard deviation

In between group comparison, the results of Pairwise comparison of the mean difference and standard error of skill scores showed that, there was no statistically significant difference between the two groups in the pretest scores ($P = 0.128$). However, at the immediately and 1 month after the training, the skill score in the "Group A" was significantly higher than the "Group B" ($P = 0.001$) [Table 4].

Discussion

The results of the present study showed that, although the knowledge score was improved in both groups after the intervention, but the change in knowledge score between two study groups in consecutive measurements was not statistically significant. Students' skill scores improved immediately and 1 month after the intervention. Although the CPR skill score had a significant drop in the third measurement, but, the students who were trained by a previous CPR experienced instructor in real-situations, performed significantly better than others.

In different studies, CPR training for schoolchildren conducted with a variety of professions such as:

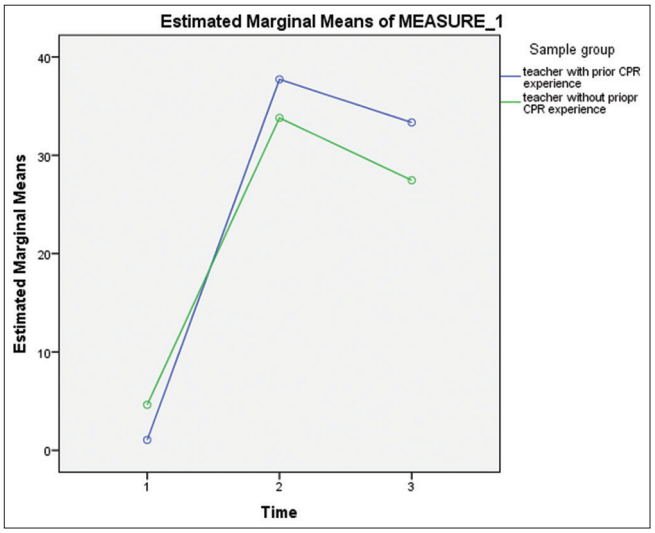

Figure 2: The knowledge scores changes in the study groups in three time measurements

Table 3: Pairwise comparison of mean changes and standard error of skill score both groups

Trial	Group A Mean difference±SE	*P**	Group B Mean difference±SE	*P**
Pretest				
Immediately after intervention	−37.816±0.431	0.001	−34.568±0.437	0.001
1 month after intervention	−31.605±0.482	0.001	−25.189±0.488	0.001
Immediately after intervention				
Pretest	37.816±0.431	0.001	34.568±0.437	0.001
1 month after intervention	6.211±0.356	0.001	9.378±0.360	0.001
1 month after intervention				
Pretest	31.605±0.482	0.001	25.189±0.488	0.001
Immediately after intervention	−6.211±0.356	0.001	−9.378±0.360	0.001

*Adjustment for multiple comparisons: Bonferroni. SE=Standard error

Table 4: Paired comparison of mean changes and standard error of skill score between two groups in three times measurements

Trial	Between groups	Mean difference±SE	*P**
Pretest	Group A	0.396±0.259	0.128
	Group B		
Immediately after intervention	Group A	3.644±0.632	0.001
	Group B		
1 month after intervention	Group A	6.812±0.732	0.001
	Group B		

*Adjustment for multiple comparisons: Bonferroni. SE=Standard error

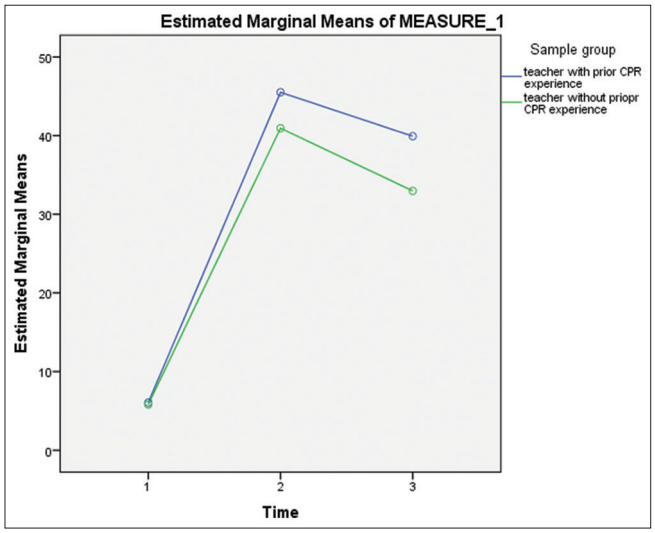

Figure 3: The skill scores changes in the study groups in three time measurements

Teachers,[17,18] doctors,[19] nurses,[20] emergency personnel,[21] medical students,[22] certified BLS instructors,[23] lifesavers,[24] and student's self-regulated.[25,26] However, there is a perception that, teachers with their professional competencies such as teaching skills can provide their students BLS skills in a sustainable manner.[27] However, teachers are skeptical of performing this role properly.[28] Therefore, researchers have considered the presence of medical professionals as mentors in this field necessary.[29]

Despite the importance of the issue, limited studies have been conducted to answer the question of among the health system specialists who is more qualified for teaching BSL in schools. Researchers have paid so far, less attention to the role of the previous CPR experiences of BSL trainers in actual situations. In some studies, the instructor's previous experience teaching CPR has been cited and contradictory results have been reported. In some studies, researchers concluded that, having previous teaching experience of instructors for BSL is not an important factor and trained trainers enabled high school students to respond to OHCA to increase overall bystander CPR rates.[12,30,31] Researchers also found that there was no advantage between medical students, physical education student teachers and registered nurses in CPR training in schools.[30] In another study, focusing on peer-to-peer education, the researchers showed that the high school peer education model could be an effective way to teach BLS in schools due to a lack of funding and trained educators.[32] However, some researchers have stated that, doctors with experience working in emergency medicine, may act as consultants in BSL projects in schools to improve the quality of training[18] or they may act as trainers for the trainers.[29] In some other studies, researchers have emphasized on the role of education methods in BLS training, including role-playing models,[33] electronic and traditional methods.[34] In addition, in other researches, scenario-based and problem-oriented methods have been mentioned as effective methods.[35,36]

Limitation and recommendation

This study, for the first time, considered the role of trainers' previous real time CPR experiences in the transfer of CPR knowledge and skills and showed its importance in the quality of the BSL skills transferring. Despite the fact that, in this study the researchers tried to obtain accurate results by carefully designing and controlling confounding factors, we were faced with the closure and partial closure of schools due to the COVID-19 epidemic and as a result of limited access to students, there was a possibility of choice bias. But we tried to select an equal number of students from each school and each class for both study groups. On the other hand, in this study, due to the lack of access to smart mannequins, the quality of chest pressure was not evaluated and compared. Therefore, it is recommended to repeat the study with smart mannequins.

Conclusions

The results of this study showed that, having the experience of CPR in the real situation of trainers is not important in transferring BLS knowledge. However, it plays an important role in improving students' practical skills and to be efficient to empower high school students to response for OHCA as a first responders. The results of this study can be useful in selecting appropriate trainers for teaching social skills in schools as well as in policies to manage OHCA cases.

Acknowledgment

This article follows the master's thesis on medical surgical nursing. The authors of this study acknowledge the Deputy Assistant Professor of Research and Technology of Rafsanjan University of Medical Sciences for his financial support in the research project, as well as all students and their families who cooperated in the implementation of this study.

Financial support and sponsorship

The research and Technology of Rafsanjan University of Medical Sciences supported financially the research project.

Conflicts of interest

There are no conflicts of interest.

References

1. Myat A, Song KJ, Rea T. Out-of-hospital cardiac arrest: Current concepts. Lancet 2018;391:970-9.
2. Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW, *et al.* Heart disease and stroke statistics – 2021 update: A report from the American Heart Association. Circulation 2021;143:e254-743.
3. Wissenberg M, Lippert FK, Folke F, Weeke P, Hansen CM, Christensen EF, *et al.* Association of national initiatives to improve cardiac arrest management with rates of bystander intervention and patient survival after out-of-hospital cardiac arrest. JAMA 2013;310:1377-84.
4. Böttiger BW, Van Aken H. Training children in cardiopulmonary resuscitation worldwide. Lancet 2015;385:2353.
5. Shimamoto T, Kiyohara K, Matsuyama T, Kitamura T, Kiguchi T, Nishiyama C, *et al.* Impact of bystander cardiopulmonary resuscitation and dispatcher assistance on survival after out-of-hospital cardiac arrest among adult patients by location of arrest. Int Heart J 2020;61:46-53.
6. Cave DM, Aufderheide TP, Beeson J, Ellison A, Gregory A, Hazinski MF, *et al.* Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: A science advisory from the American Heart Association. Circulation 2011;123:691-706.
7. Neumar RW, Eigel B, Callaway CW, Estes NA 3rd, Jollis JG, Kleinman ME, *et al.* American Heart Association response to the 2015 institute of medicine report on strategies to improve cardiac arrest survival. Circulation 2015;132:1049-70.
8. Abelairas-Gómez C, Schroeder DC, Carballo-Fazanes A, Böttiger BW, López-García S, Martínez-Isasi S, *et al.* KIDS SAVE LIVES in schools: Cross-sectional survey of schoolteachers. Eur J Pediatr 2021;180:2213-21.
9. Haskins B, Nehme Z, Ball J, Mahony E, Parker Stebbing L, Cameron P, *et al*. Comparison of out of hospital cardiac arrests occurring in schools and other public locations: A 12 year retrospective study. Prehosp Emerg Care 2022;26:179-88.
10. Böttiger BW, Van Aken H. Kids save lives – Training school children in cardiopulmonary resuscitation worldwide is now endorsed by the World Health Organization (WHO). Resuscitation 2015;94:A5-7.
11. Brown LE, Lynes C, Carroll T, Halperin H. CPR instruction in U.S. high schools: What is the state in the nation? J Am Coll Cardiol 2017;70:2688-95.
12. Aaberg AM, Larsen CE, Rasmussen BS, Hansen CM, Larsen JM. Basic life support knowledge, self-reported skills and fears in Danish high school students and effect of a single 45-min training session run by junior doctors; a prospective cohort study. Scand J Trauma Resusc Emerg Med 2014;22:24.
13. Rajagopalan B, Shen WK, Patton K, Kutyifa V, Di Biase L, Al Ahmad A, *et al*. Surviving sudden cardiac arrest – Successes, challenges, and opportunities. J Interv Card Electrophysiol 2021; 28 April:1-5.
14. Plant N, Taylor K. How best to teach CPR to schoolchildren: A systematic review. Resuscitation 2013;84:415-21.
15. Merchant RM, Topjian AA, Panchal AR, Cheng A, Aziz K, Berg KM, *et al.* Part 1: Executive summary: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2020;142:S337-57.
16. Waltz CF, Bausell RB. Nursing Research: Design, Statistics, and Computer Analysis. Philadelphia: FA Davis Company; 1981.
17. Chamdawala H, Meltzer JA, Shankar V, Elachi D, Jarzynka SM, Nixon AF. Cardiopulmonary resuscitation skill training and retention in teens (CPR START): A randomized control trial in high school students. Resusc Plus 2021;5:100079.
18. Böttiger BW, Lockey A, Georgiou M, Greif R, Monsieurs KG, Mpotos N, *et al.* KIDS SAVE LIVES: ERC Position statement on schoolteachers' education and qualification in resuscitation. Resuscitation 2020;151:87-90.
19. Wang MF, Wu YK, Chien CY, Tsai LH, Chen CB, Seak CJ, *et al.* Learning effectiveness assessment between primary school students and adults in basic life support education. Emerg Med Int 2021;2021:5579402.
20. Martínez Isasi S, García Suárez M, Rodríguez MA, Gómez Salgado J, Fernández N, Méndez Martínez C, *et al*. Basic life support training programme in schools by school nurses: How long and how often to train? Medicine 2021;100:e24819.
21. Schmid KM, García RQ, Fernandez MM, Mould-Millman NK, Lowenstein SR. Teaching hands-only CPR in schools: A program evaluation in San José, Costa Rica. Ann Glob Health 2018;84:612-7.
22. Suwanpairoj C, Wongsombut T, Maisawat K, Torod N, Jaengkrajan A, Sritharo N, *et al.* Outcome of basic life support training among primary school students in Southeast Asia. Clin Exp Emerg Med 2020;7:245-9.
23. Stærk M, Vammen L, Andersen CF, Krogh K, Løfgren B. Basic life support skills can be improved among certified basic life support instructors. Resusc Plus 2021;6:100120.
24. Yeung J, Kovic I, Vidacic M, Skilton E, Higgins D, Melody T, *et al.* The school lifesavers study – A randomised controlled trial comparing the impact of lifesaver only, face-to-face training only, and lifesaver with face-to-face training on CPR knowledge, skills and attitudes in UK school children. Resuscitation 2017;120:138-45.
25. Süss-Havemann C, Kosan J, Seibold T, Dibbern NM, Daubmann A, Kubitz JC, *et al.* Implementation of basic life support training in schools: A randomised controlled trial evaluating self-regulated learning as alternative training concept. BMC Public Health 2020;20:50.
26. Bylow H, Karlsson T, Claesson A, Lepp M, Lindqvist J, Herlitz J. Self-learning training versus instructor-led training for basic life support: A cluster randomised trial. Resuscitation 2019;139:122-32.
27. Tanaka S, Hara T, Tsukigase K, Sagisaka R, Myklebust H, Birkenes T, *et al.* School CPR training by non-CPR teaching experienced teacher: A pilot study of targeting 1000 chest compressions hands-on practice during 50 min of PWW-based QCPR Classroom training. Resuscitation 2018;130:e82-3.
28. Zinckernagel L, Malta Hansen C, Rod MH, Folke F, Torp-Pedersen C, Tjørnhøj-Thomsen T. What are the barriers to implementation of cardiopulmonary resuscitation training in secondary schools? A qualitative study. BMJ Open 2016;6:e010481.
29. Bohn A, Lukas RP, Breckwoldt J, Böttiger BW, Van Aken H. 'Kids save lives': Why schoolchildren should train in cardiopulmonary resuscitation. Curr Opin Crit Care 2015;21:220-5.
30. Cuijpers PJ, Bookelman G, Kicken W, de Vries W, Gorgels AP. Medical students and physical education students as CPR instructors: An appropriate solution to the CPR-instructor shortage in secondary schools? Neth Heart J 2016;24:456-61.
31. Magid KH, Heard D, Sasson C. Addressing gaps in cardiopulmonary resuscitation education: Training middle school students in hands-only cardiopulmonary resuscitation. J Sch Health 2018;88:524-30.
32. Kesici S, Bayrakci Z, Birbilen AZ, Hanalioglu D, Öztürk Z, Teksam Ö, *et al*. Peer education model for basic life support training among high school children: A randomized trial. Prehosp Disaster Med 2021;36,5:1-8.

33. Nasr-Esfahani M, Yazdannik A, Mohamadiriz S. Development of nursing students' performance in advanced cardiopulmonary resuscitation through role-playing learning model. J Educ Health Promot 2019;8:151.
34. Aminizadeh M, Rasouli Ghahfarokhi SM, Pourvakhshoori N, Beyramijam M, Majidi N, Shahabi Rabori MA. Comparing the effects of two different educational methods on clinical skills of emergency intermediate technician: A quasi-experimental research. J Educ Health Promot 2019;8:54.
35. Jafarizadeh H, Moradi Y, Rasouli J, Zeinalzadeh S. The effect of scenario-based and participatory method of cardiopulmonary resuscitation (CPR) training on the knowledge of basic and advanced life support (BLS and ACLS) in emergency medical technicians. Med Legal Update 2020;20:245-9.
36. Karimi N, Saadat-Gharin S, Tol A, Sadeghi R, Yaseri M, Mohebbi B. A problem-based learning health literacy intervention program on improving health-promoting behaviors among girl students. J Educ Health Promot 2019;8:251.