Original Article

Teaching Hands-Only CPR (HOCPR) skills to 8th-grade students in urban Bengaluru: Development of a comprehensive Hands-Only CPR programme for high school students

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Submitted: 23-Jul-2021
Revised: 09-Feb-2022
Accepted: 09-Feb-2022
Published: 24-Feb-2022

Access this article online

Website: www.ijaweb.org

DOI: 10.4103/ija.ija_685_21

Quick response code

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ABSTRACT

Background and Aims: Out-of-hospital cardiac arrest is one of the leading causes of death in India. Only 1.3% of these arrests receive bystander cardiopulmonary resuscitation (CPR). Bystander CPR increases a victim's chances of survival; training school children in Hands-Only CPR (HOCPR) is a proven method of increasing bystander CPR rates. Heart Rescue India is an international project working to improve care for cardiovascular diseases, and as a part of it, a ten module Cardiovascular disease (CVD) educational programme, including HOCPR training, was conducted in ten schools in 2017–18. The objective of our study was to assess the effectiveness of HOCPR training for 8th-grade high school students. **Methods:** Four hundred fourteen of the 530 enroled students from ten schools of Bengaluru participated in the study. The participants attended a one-hour didactic session about the recognition of cardiac arrest and HOCPR in three simple steps. Subsequently, students received hands-on training for HOCPR. The sessions included pre- and post-assessment of knowledge and skills. The results were statistically analysed using paired t-test and the McNemar test. **Results:** The mean overall pre-assessment score for knowledge was 62.07 ± 28.38%, and the post-assessment score was 72.42 ± 26.58% ($P < 0.001$). In addition, there was a statistically significant improvement in the post-training scores for HOCPR in all three parameters, namely compressions per minute, depth and chest recoil. **Conclusion:** The study demonstrated a simple yet effective HOCPR programme for high school children.

Key words: Cardiopulmonary resuscitation, out-of-hospital cardiac arrest, schools, teaching

INTRODUCTION

A recent study called the Cardiac Arrest Resuscitation Outcome has indicated that in approximately 56.5% of the witnessed out-of-hospital cardiac arrest (OHCA) events, about 92.5% occur at home, but a mere 1.3% receive bystander cardiopulmonary resuscitation (CPR).[1]

According to the American Heart Association (AHA), close to 90% of out-of-hospital cardiac arrest victims do not survive. Hands-Only CPR (HOCPR) can be a simple yet effective way for a bystander, upon acting immediately, to significantly increase the chances of survival for a cardiac arrest victim.[2]

How to cite this article: Ramesh AC, Hariprasad KV, Abhishek KB, Murthy MR, Edison M, Hoek TL. Teaching Hands-Only CPR (HOCPR) skills to 8th-grade students in urban Bengaluru: Development of a comprehensive Hands-Only CPR programme for high school students. Indian J Anaesth 2022;66:140-5.

OHCA is one of the leading causes of death in India owing in part to poor bystander CPR rates and delayed emergency response. One of the main reasons for low rates of bystander CPR is a lack of awareness and training.[3]

Heart Rescue India (HRI) is an international programme working with healthcare and community partners in Bengaluru to improve the access and quality of acute cardiovascular disease (CVD) care. It is imperative that for our country, we need the majority of our population to be trained in bystander HOCPR to balance the shortage of emergency medical services.[4]

A key aspect of the HRI programme is training 8th-grade school children by providing them with knowledge and skills of HOCPR. Studies largely relying on verbal autopsy and extrapolating the data to national mortality figures roughly estimate that about seven lakh sudden cardiac death cases occur in India annually.[5] CPR is a difficult psychomotor skill that is challenging to teach to the lay public.[6] Moreover, school HOCPR training requires different educational approaches and pedagogical principles depending on the age group. Additionally, lack of funds, poor infrastructure and a full existing curriculum are perhaps the reasons that this essential training is not given to children in most countries.[7]

Rates of bystander CPR are unacceptably low in our country; perhaps training school children will help to increase the percentage of the population trained in CPR. International organisations also recommend that HOCPR training should be a standard part of the school curriculum. Taking cognisance of this, the National Council of Educational Research and Training has included CPR in the class IX curriculum.[8]

Resuscitation skills are complex psychomotor skills that need to be performed in a specified sequence within a limited time frame. Hence, to make it easier for the 8th-grade children to learn this psychomotor skill, we simplified it by restricting it to HOCPR training. The aim of our study was to design an effective, measurable and comprehensive HOCPR training for high school children. Our primary objective was to impart knowledge and skills of HOCPR to school children and our secondary objective was to assess the effectiveness of a HOCPR training module in 8th-grade high school students.

METHODS

This study was conducted in the academic year of 2017–18 after approval from the institutional ethics review board. Five hundred thirty students were enroled from ten Bengaluru urban schools, both government and private. Out of these, 414 students participated in the study. The CVD training programme consisted of ten modules, of which 3–6 were on HOCPR training. After the completion of the CVD programme in 2018, other modules were completed in 2019, and analysis was done in 2020.

The training was done on the campuses of each of the ten participant schools by AHA accredited emergency medicine doctors along with nurses and paramedics. Age, height, weight and body mass index (BMI) of participants were recorded at the start of the training. The training programme started with an evaluation form of eight multiple-choice questions based on HOCPR knowledge for pre-assessment, followed by the recording of pre-training HOCPR skill parameters.

Subsequently, a 1-hour didactic session, video presentation and practical demonstration were done followed by a hands-on demonstration and training of HOCPR using Laerdal® "QCPR" mannequin based on a 3-step approach [Figure 1]. The training ended with a recording of post-assessment scores of knowledge and post-training HOCPR skill scores. The "QCPR" mobile application gathers real-time data from the mannequin by Bluetooth. In addition to this, the application provides real-time feedback to the user about CPR quality which is proven to enhance training.[9] The required parameters were measured before and after training by the mannequin and shown in the application. This includes the HOCPR score, which is a score representing the overall performance of skill given by the QCPR application based on parameters including rate, depth and recoil.

RESULTS

Data were entered into a Microsoft Excel datasheet and analysed using International Business Machines

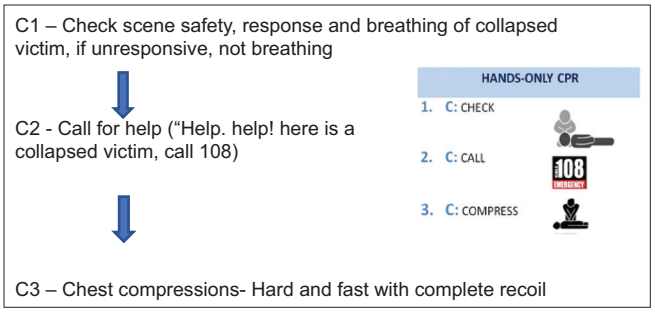

Figure 1: Training protocol

Statistical Package for the Social Sciences (IBM SPSS) Statistics software for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). Categorical data was gathered and analysed as frequencies and proportions. In addition, mean ± standard deviation was used for continuous data. Paired t-test was the test of significance for paired data such as before and after training. A *P* value of < 0.05 was considered statistically significant.

A majority of the subjects were in the age group 14 years (74.6%), followed by 15 years (19.3%), 13 years (3.9%) and 16 years (2.2%). Of them, 54.8% were male and 45.2% female [Table 1]. The mean height of the subjects was 158.46 ± 8.51 cm, mean weight was 48.93 ± 10.92 kg and the mean BMI was 19.46 ± 4.07 kg/m^2. The present study showed that there is no significant correlation between pre- and post-assessment HOCPR scores with parameters such as age, height, weight and BMI of participants [Table 2].

The mean pre- and post-training knowledge scores were 62.07 ± 28.38% and 72.42 ± 26.58% respectively, and the increase noted was statistically significant. With regard to skills training, the mean pre-training (C/M) compression per minute score was 92.66 ± 29.44 and the post-training compression per minute score was 113.26 ± 13.97, and the difference was statistically significant. Similarly, a statistically significant increase was noted in mean average compressions per minute (A/C), with an increase from 42.17 ± 19.93 in pre-training to 63.15 ± 60.60 post-training.

In continuation, we determined that in the parameters of depth and recoil too, there was a statistically significant increase [Table 3]. With regard to the overall HOCPR score, the pre- and post-training values were 62.13 ± 28.40 and 72.64 ± 26.35 respectively, and the difference was statistically significant. Therefore, consistently, in all of the above parameters pertaining to knowledge and skill domains, it was found that there was a statistically significant increase in our post-training values in comparison to pre-training values.

In our study, among males, the pre-training C/M score was 90.47 ± 30.11 and after training, it increased to 111.98 ± 14.39; the difference was statistically significant [Table 4]. Similarly, there was an increase in the mean average A/C, depth, recoil and overall CPR score after training compared to before training among males. Overall male HOCPR score before training was 58.57 ± 27.10% and it increased to 89.57 ± 8.26% after training whereas, among female participants, a significant increase was noted in the

Table 1: Age and gender distribution

	Count (*n*=414)	%
Age in years		
13	16	3.9%
14	309	74.6%
15	80	19.3%
16	9	2.2%
Gender		
Male	227	54.8%
Female	187	45.2%

*P<0.05 - statistically significant

Table 2: Correlation between Age, Height, Weight and BMI with Overall CPR score

	Pre-Assessment Overall CPR score	Post-Assessment Overall CPR score
Age		
Pearson Correlation	0.044	0.050
P	0.367	0.310
Height in cm		
Pearson Correlation	-0.042	0.047
P	0.390	0.337
Weight in kg		
Pearson Correlation	0.060	0.036
P	0.225	0.464
BMI kg/m^2		
Pearson Correlation	0.095	0.017
P	0.054	0.726

BMI: Body mass index, CPR: Cardiopulmonary resuscitation

Table 3: Comparison of pre- and post-assessment parameters of knowledge and skill

	Mean	SD	Median	*P*
Knowledge Assessment				
Written HOCPR Knowledge Assessment score				
Pre Score %	62.07	28.38	66	<0.001*
Post Score %	72.42	26.58	83	
HOCPR Skill Assessment				
Compression per minute				
Pre Score	92.66	29.44	100	<0.001*
Post Score	113.26	13.97	115	
Average compression per minute				
Pre Score	42.17	19.93	36	<0.001*
Post Score	63.15	60.60	56	
Depth				
Pre Score	54.02	22.20	56	<0.001*
Post Score	69.41	14.83	68	
Recoil				
Pre Score	60.12	24.05	64	<0.001*
Post Score	78.94	14.37	80	
Overall HOCPR score				
Pre Score	62.13	28.40	66	<0.001*
Post Score	72.64	26.35	83	

*P<0.05 - statistically significant. HOCPR: Hands-only cardiopulmonary resuscitation, SD: Standard deviation

pre-training mean C/M score from 95.33 ± 28.46 to 114.82 ± 13.30 after training. Similarly, there was an increase in mean A/C, depth, recoil and HOCPR scores after training compared to before training among females [Table 5]. Overall HOCPR score before training was 57.48 ± 27.72% and it increased to 88.26 ± 7.71% after training.

DISCUSSION

This study demonstrated that the HOCPR score was much higher post-training when compared to pre-training. This statistically significant improvement of scoring post-training was seen in all domains of compressions, depth of compression and chest recoil during HOCPR. These results are comparable to the study conducted by Kristin M *et al*. in Costa Rica, wherein, it was found that mean HOCPR scores for high school students in the post-test were significantly higher in comparison to their pre-test scores. In addition, in the same study, the post-test scores were 93% in comparison to the pre-test score of 41%, which included questions of the affective domain such as the study subject's increase in comfort level with HOCPR.[3]

In another study conducted by Li H *et al.*,[10] the CPR score regarding the depth of compression, rate of compression and ratio of compression increased from 7.58% to 72.94%, 8.18% to 72.57%, and 28.89% to 76.55%, respectively and the differences were found to be statistically significant. A study performed in Northern Ireland by Connolly *et al*.[11] found that children instructed in CPR showed a significant increase in the level of knowledge following the training session. While their level of knowledge decreased over a period of six months, it remained significantly higher than that of a comparable group of children who had never been trained.Further, in a study done by Kuvaki B and Özbilgin Ş in Turkey, it was demonstrated that appropriate CPR training can be delivered by a simple two-hour session.[12] In addition to this existing data, the current study clearly demonstrated that children are good recipients of HOCPR training. In most high-income nations, deaths from sudden cardiac arrest have been drastically reduced by the performance of HOCPR by the nearest bystander of the victims.[13,14]

Appropriately executed bystander CPR can drastically increase survival rates. The AHA has a programme named "CPR Anytime", which trains and increases the confidence of middle and high school students regarding the knowledge and performance of HOCPR.[15] Taking cognisance of this fact, the state of Norway introduced a similar programme as early as 1961.[16] In addition, St. John's ambulance, the British Red Cross, and the British Heart Foundation have campaigned for the inclusion of HOCPR in the school curriculum.[17,18]

Knowledge and psychomotor skills acquired in early childhood are likely to last for a long period of time. Researchers have demonstrated that older children performed and learned better than younger children.[19] Jones and colleagues also opined that the children aged around 13 years were able to understand

Table 4: Chest compression quality comparison among male participants

	Before Training			After Training			*P*
	Mean	SD	Median	Mean	SD	Median	
C/M	90.47	30.11	100.00	111.98	14.39	112.00	<0.001*
A/C	41.33	19.20	35.00	66.20	80.33	56.00	<0.001*
DEPTH	51.88	21.39	56.00	68.28	15.51	66.00	<0.001*
RECOIL	58.56	24.11	60.00	78.65	15.03	80.00	<0.001*
Overall hocpr score	58.57	27.10	61.00	89.57	8.26	89.00	<0.001*

C/M: Compression per minute; A/C: Average compression per minute; HOCPR: Hands-only cardiopulmonary resuscitation, SD: Standard deviation.
*P<0.05 - statistically significant

Table 5: Chest compression quality comparison among female participants

	Before Training			After Training			*P*
	Mean	SD	Median	Mean	SD	Median	
C/M	95.33	28.46	100.00	114.82	13.30	115.00	<0.001*
A/C	43.18	20.80	36.00	59.45	16.99	58.00	<0.001*
DEPTH	56.63	22.94	59.00	70.79	13.88	69.00	<0.001*
RECOIL	62.02	23.91	69.00	79.29	13.57	80.00	<0.001*
Overall hocpr score	57.48	27.72	61.00	88.26	7.71	89.00	<0.001*

C/M: Compressions per minute; A/C: Average compressions per minute; HOCPR: Hands-only cardiopulmonary resuscitation; SD: Standard deviation
*P<0.05 - statistically significant

the procedure better, and even the depth required for chest compression was performed better by older compared to younger children.[20] Notably, Van Aken *et al*.[21] have demonstrated that training of school children of 8th grade in CPR has shown to be effective, and a statement from the ERC and endorsed by the World Health Organization states that children above the age of 12 years should receive this knowledge and be taught the skills of CPR annually. These reports were the basis for us to choose high school students for our study.

A study was found that video-based training is a potent tool for HOCPR training.[22] A recent study concluded that in addition to the inclusion of CPR training in the school curriculum, a periodic revision would prevent knowledge attrition.[23] Therefore, a combination of video and instructor-led training for maximum impact was used in the current study. The challenge of having participants from both government and private schools was overcome by developing a simple training model. In addition, this study model enabled the team of professional instructors to deliver the training at the school campus, allowing for a safe and friendly environment for the children. Nevertheless, this study provides a simple, sustainable and scalable training model for implementation across all schools.

The less-than-ideal level of awareness of CPR among the high school students in our study can be attributed to the lack of structured education programmes regarding lifesaving skills, including CPR, in the current high school education system. However, one limitation of our study is that the quality of compression and fatigue beyond one minute was not assessed in the event of a delay in the arrival of help.

CONCLUSION

To conclude, our study demonstrated a simple yet effective HOCPR programme for high school children. We would add that our training model is effective yet sustainable, and implementation of the same in high schools by skilled professionals will empower students and perhaps the society at large to save lives.

Acknowledgements

This study was conducted in urban Bengaluru as a part of an international project, Heart Rescue India, and our knowledge partner was the University of Illinois at Chicago. We thank all of the following people for their immense contribution and support. Dr. Naresh Shetty-Sr. Professor of Orthopaedics at Ramaiah Medical College, Bangalore. Dr. Bellur S Prabhakar-Professor of Department of Microbiology and Immunology, Associate Dean for Technology Innovation and Training at University of Illinois College of Medicine, Chicago. Ms. Rhea M Begeman-Director of Operations of the UIC Center for Global Health and the UIC Department of Emergency Medicine, University of Illinois College of Medicine, Chicago. Dr. Nayanjeet Chaudhury-senior Global Technical Advisor to Medtronic Foundation. Dr Roopa K P, Dr Harish K S of Department of Emergency Medicine, Ramaiah medical college.

Financial support and sponsorship

This study was supported by The Medtronic foundation.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Krishna CK, Showkat HI, Taktani M, Khatri V. Out of hospital cardiac arrest resuscitation outcome in North India - CARO study. World J Emerg Med 2017;8:200-5.
2. Ewy GA. Cardiocerebral resuscitation: The new cardiopulmonary resuscitation. Circulation 2005;111:2134-42.
3. 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.
4. Garg R, Ahmed SM, Kapoor MC, Mishra BB, Rao SC, Kalandoor MV, *et al*. Basic cardiopulmonary life support (BCLS) for cardiopulmonary resuscitation by trained paramedics and medics outside the hospital. Indian J Anaesth 2017;61:874-82.
5. Rao BH. Global burden of sudden cardiac death and insights from India. Indian Heart J 2014;66(Suppl 1):S18-23.
6. Reder S, Cummings P, Ouan L. Comparison of three instructional methods for teaching CPR and use of AED to high school students. Resuscitation 2006;69:443-53.
7. Lafferty C, Larsen P, Galletly D. Resuscitation teaching in New Zealand schools. N Z Med J 2003;116:U582.
8. Senapaty H. Learning outcomes at the secondary stage. In: Uppal S, editor. Learning Outcomes for Health and Physical Education. New Delhi: National Council of Educational Research and Training; 2019. p. 83-8.
9. Yeung J, Meeks R, Edelson D, Gao F, Soar J, Perkins GD. The use of CPR feedback/prompt devices during training and CPR Performance: A systematic review. Resuscitation 2009;80:743–51.
10. Li H, Shen X, Xuc X, Wang Y, Chu L, Zhao J, *et al*. Bystander cardiopulmonary resuscitation training in primary and secondary school children in China and the impact of neighbourhood socioeconomic status. A prospective controlled trial. Medicine 2018;97:e12673.
11. Connolly M, Toner P, Connolly D, McCluskey DR. The 'ABC for life' programme - Teaching basic life support in schools. Resuscitation 2007;72:270-9.
12. Kuvaki B, Özbilgin S. School children save lives. Turk J Anaesthesiol Reanim 2018;46:170-5.
13. Iwami T, Kitamura T, Kiyohara K, Kawamura T. Dissemination

of chest compression-only cardiopulmonary resuscitation and survival after out-of-hospital cardiac arrest. Circulation 2015;132:415–22.
14. Zorzi A, Gasparetto N, Stella F, Bortoluzzi A, Cacciavillani L, Basso C. Surviving out-of-hospital cardiac arrest: Just a matter of defibrillators? J Cardiovasc Med 2014;15:616–23.
15. Potts J, Lynch B. The American Heart Association CPR anytime program: The potential impact of highly accessible training in cardiopulmonary resuscitation. J Cardiopulm Rehabil 2006;26:346-54.
16. Lind B. Teaching mouth-to-mouth resuscitation in primary schools. Acta Anaesthesiol Scand 2007;51:1044–50.
17. Colquhoun M. Learning CPR at school -Everyone should do it. Resuscitation 2012;83:543–4.
18. 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. Circulation 2011;123:691–706.
19. Van Kerschaver E, Delooz HH, Moens GF. The effectiveness of repeated cardiopulmonary resuscitation training in a school population. Resuscitation 1989;17:211-22.
20. Jones I, Whitfield R, Colquhoun M, Chamberlain D, Vetter N, Newcombe R. At what age can school children provide effective chest compressions? An observational study from the Heartstart UK schools training programme. BMJ 2007;334:1201-03.
21. Van Aken H, Hessler M, Brinkrolf P, Bohn A, Böttiger BW, Gottschalk A. Resuscitation training for schoolchildren worldwide: Kids save lives. Anesth Analg 2017;124:1354–6.
22. Ali S, Athar M, Ahmed SM. A randomised controlled comparison of video versus instructor-based compression only life support training. Indian J Anaesth 2019;63:188-93.
23. Dhansura T, Ghurye N, Khurana A, Kudalkar S, Upadhyay Y. The understanding and recall of school children in Mumbai in compression only life support cardiopulmonary resuscitation. Indian J Anaesth 2020;64:501-6.