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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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 enrolled 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]
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 enrolled 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
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/m². 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
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 | <0.001* |
| C/M            | 90.47  | 30.11  | 100.00 | 111.98 | 14.39  | 112.00 |     |
| 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 | <0.001* |
| C/M            | 95.33  | 28.46  | 100.00 | 114.82 | 13.30  | 115.00 |     |
| A/C            | 43.18  | 20.80  | 36.00  | 59.45  | 16.99  | 56.00  | <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. Notably, Van Aken et al. 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. A recent study concluded that in addition to the inclusion of CPR training in the school curriculum, a periodic revision would prevent knowledge attrition. 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.

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**Conflicts of interest**

There are no conflicts of interest.

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