

EFFECTIVENESS OF HANDS-ONLY CARDIOPULMONARY RESUSCITATION TRAINING ON KNOWLEDGE AND PRACTICE AMONG UNDERGRADUATE STUDENTS IN SELECTED COLLEGES, BENGALURU: A QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Aim: To evaluate the effectiveness of a structured Hands-Only Cardiopulmonary Resuscitation (CPR) training programme on knowledge and practical skills among undergraduate students and to assess retention of these outcomes one month after training.

Background: Early initiation of bystander CPR is a critical determinant of survival following out-of-hospital cardiac arrest. Despite recommendations promoting Hands-Only CPR for laypersons, many undergraduate students lack the knowledge and practical competence required to respond effectively during cardiac emergencies. Educational interventions targeting this population may strengthen community preparedness and improve emergency response.

Design: A quasi-experimental one-group pre-test and post-test study.

Methods: One hundred undergraduate students from selected non-healthcare colleges in Bengaluru, India, were recruited using convenience sampling. Baseline knowledge was assessed using a structured questionnaire. Participants then received a structured Hands-Only CPR training programme comprising lectures, audiovisual instruction, instructor demonstration, return demonstrations and supervised mannequin-based practice. Knowledge was reassessed one month after training, while practical skills were evaluated immediately after training and again one month later using a standardized observational checklist. Data were analysed using descriptive statistics, paired tests and Chi-square tests.

Results: Mean knowledge scores increased significantly from 5.65 ± 1.11 at baseline to 8.73 ± 0.98 one month after training ($t = -66.31$, $p < 0.001$). Practical performance was high immediately after training, with 96% of participants demonstrating good competency; however, this declined at one month, with only 42% maintaining good performance ($t = 15.99$, $p < 0.001$). No significant associations were found between knowledge or practice scores and socio-demographic variables.

Conclusions: Structured Hands-Only CPR training significantly improved undergraduate students' knowledge and practical skills. Although knowledge was retained after one-month, practical skills declined, indicating the need for periodic refresher training to maintain CPR competency among laypersons.

KEYWORDS: Hands-only CPR; Cardiopulmonary resuscitation; Undergraduate students; Bystander CPR; Simulation-based learning; Knowledge; Skills; Cardiac arrest.

INTRODUCTION

Sudden cardiac arrest (SCA) is a major global public health emergency and one of the leading causes of preventable mortality worldwide. According to the World Health Organization (WHO), Cardiovascular diseases account for approximately 17.9 million deaths annually, representing nearly 32% of all global deaths, with a substantial proportion resulting from sudden cardiac arrest (OHCA) depends on the rapid recognition of cardiac arrest, immediate activation of emergency medical services, early initiation of cardiopulmonary resuscitation (CPR) and timely defibrillation. Each minute of delay in initiating CPR reduces the probability of survival by approximately 7-10%, emphasizing the critical importance of immediate bystander intervention. [2]

Hands-Only Cardiopulmonary Resuscitation (Hands-Only CPR), consisting of continuous chest compressions without rescue breaths is recommended by the American Heart Association (AHA) for untrained lay rescuers witnessing an adult with sudden cardiac arrest. [3] Compared with conventional CPR, Hands-Only CPR is easier to learn, requires fewer technical skills, minimizes hesitation related to mouth-to-mouth ventilation and has been shown to improve the likelihood of bystander intervention. Consequently, international organizations advocate

widespread community education in Hands-Only CPR to strengthen the chain of survival and improve outcomes following out-of-hospital cardiac arrest. [3,4]

Despite these recommendations, bystander CPR rates remain low in many low- and middle-income countries, including India. Limited public awareness, inadequate CPR training, fear of causing harm, lack of confidence and insufficient exposure to emergency preparedness programmes continues to hinder timely initiation of CPR during cardiac emergencies. [5] In India, organized CPR training among the general population remains limited and many victims of sudden cardiac arrest do not receive immediate bystander assistance before the arrival of emergency medical services. These gaps highlight the urgent need for community-based educational initiatives to improve CPR knowledge and practical competency among laypersons. [6]

Undergraduate students represent an ideal population for Hands-Only CPR education. They are physically capable of performing effective chest compressions, frequently participate in community activities and have the potential to act as first responders during emergencies occurring in educational institutions, workplace, public places and homes. Furthermore, students can disseminate lifesaving knowledge to family members and the wider community, thereby multiplying the public health impact of CPR training programmes. [7]

Previous studies have consistently demonstrated the effectiveness of structured CPR education in improving knowledge and practical skills among non-healthcare students. Karathan et al. reported significant improvements in CPR knowledge, confidence and willingness to perform bystander CPR among university students following structured training. [8] Mathew et al. similarly demonstrated that simulation-based Hands-Only CPR education significantly improved knowledge and psychomotor performance among Indian college students. [9] However, several published investigations have shown that although immediate learning outcomes are favorable practical CPR skills decline substantially over time without regular reinforcement. Schmid et al. and Bray et al. reported significant deterioration in CPR psychomotor performance during follow-up assessments, emphasizing the importance of periodic refresher training to maintain competency. [10,11]

In Bengaluru, undergraduate students from non-healthcare disciplines generally receive limited formal instruction in basic life support despite their potential role as community first responders. Assessing the effectiveness of structured Hands-Only CPR education and evaluating short-term retention of knowledge and practical skills are essential for developing evidence-based educational strategies and determining appropriate refresher training intervals. Therefore, the present study was undertaken to evaluate the effectiveness of a structured Hands-Only Cardiopulmonary Resuscitation (CPR) training programme on knowledge and practical skills among undergraduate students in selected colleges in Bengaluru.

MATERIALS AND METHODS

Design

A quantitative study employing a quasi-experimental one-group pre-test and post-test design was conducted to evaluate the effectiveness of a structured Hands-Only Cardiopulmonary Resuscitation (CPR) training programme on undergraduate students' knowledge and practical skills. Knowledge was assessed before the intervention (pre-test) and one month after the training programme (post-test). Practical skills were evaluated immediately after training and reassessed one month later to determine skill retention.

Setting and Participants

The study was conducted in selected non-healthcare undergraduate colleges in Bengaluru, Karnataka, India, between March and April 2026. Undergraduate students aged 17-25 years who were enrolled in non-healthcare academic programmes and were willing to participate were considered eligible for inclusion.

Students were included if they were available throughout the study period and provided written informed consent. Students who had received certified Basic Life Support (BLS) or Hands-Only CPR training within the previous six months, were absent during the intervention or follow-up assessment or declined participation were excluded.

Sample size and sampling

A sample of 100 undergraduate students was recruited using a non-probability convenience sampling technique. The sample size was estimated using findings from a previous quasi-experimental study and was considered adequate to detect significant differences between pre- and post-intervention outcomes while maintaining sufficient statistical power.

Educational Intervention

Following baseline assessment, participants attended a structured Hands-Only CPR training programme conducted by the principal investigator. The intervention was based on current American Heart Association (AHA) recommendations for Hands-Only CPR.

The programme lasted approximately 60-90 minutes and included:

- ☐ Interactive lecture on sudden cardiac arrest and Hands-Only CPR
- ☐ PowerPoint-assisted teaching
- ☐ Audio-visual demonstration of Hands-Only CPR
- ☐ Live instructor demonstration
- ☐ Return demonstration by each participant
- ☐ Supervised hands-on practice using adult CPR mannequins

- ☐ Immediate feedback and correction of CPR techniques

The educational programme emphasized early recognition of cardiac arrest, activation of emergency medical services, correct hand placement, recommended compression depth and rate, complete chest recoil and uninterrupted chest compressions.

Data Collection Instruments

Three instruments were used for data collection.

Socio-demographic Questionnaire

A structured questionnaire collected information regarding participants' age, gender, course of study, academic year, previous CPR training, source of CPR information, family type and place of residence.

Knowledge Questionnaire

Knowledge regarding Hands-Only CPR was assessed using a structured 13 item multiple-choice questionnaire developed from current American Heart Association guidelines and relevant literature. Each correct response was awarded one mark, whereas incorrect responses received zero marks. Total scores ranged from 0 to 13, with higher scores indicating better knowledge.

Knowledge level was categorized as:

- ☐ Inadequate (0-6)
- ☐ Moderate (7-9)
- ☐ Adequate (10-13)

The internal consistency of the questionnaire was satisfactory (Cronbach's $\alpha = 0.86$).

Practice Assessment

Practice competency was evaluated using an 11-item observational checklist based on American Heart Association recommendations. Participants individually demonstrated Hands-Only CPR on an adult CPR mannequin while being assessed on critical performance components, including scene safety, assessment of responsiveness, activation of emergency medical services, correct hand placement, compression depth, compression rate, body posture, complete chest recoil and continuity of chest compressions.

Each correctly performed step received one mark, resulting in total scores ranging from 0 to 11.

Practice scores were classified as:

- ☐ Poor (0-5)
- ☐ Fair (6-8)
- ☐ Good (9-11)

Inter-rater reliability for the checklist was acceptable ($r = 0.82$).

Validity of the Instruments

Content validity was established through review by experts in Community Health Nursing, Medical-Surgical Nursing, Emergency Nursing and Nursing Education. Their recommendations were incorporated to improve the clarity, relevance and comprehensiveness of the study instruments before data collection.

Data Collection Procedure

Administrative permission was obtained from the participating colleges before commencement of the study. Eligible students were informed about the purpose and procedures of the research and written informed consent was obtained.

Baseline socio-demographic information and knowledge were collected before the educational intervention. Participants then completed the structured Hand-Only CPR training programme.

Practical skills were assessed immediately following completion of the training using the standardized observational checklist.

One month after the intervention, participants completed the same knowledge questionnaire and repeated the practical assessment to evaluate retention of knowledge and CPR skills.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Ramaiah Institute of Nursing Education and Research, Bengaluru, before commencement of the study. Administrative permission was obtained from the participating colleges. Written informed consent was obtained from all participants before enrolment. Participation was voluntary, confidentiality and anonymity were maintained throughout the study and the participants were informed of their right to withdraw from the study at any time without penalty.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics (Version 20). Descriptive statistics, including frequencies, percentages, means and standard deviations were used to summarize participant characteristics and study variables.

Paired t-tests were to compare pre- and post-intervention knowledge scores and immediate versus one-month practice scores. Chi-square tests were performed to examine associations between knowledge and practice scores and selected socio-demographic variables. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 100 undergraduate students completed the study and were included in the final analysis. Participants completed all study assessments, including the baseline knowledge assessment, immediate post-training practical assessment and one-month follow-up evaluation. The findings are presented according to the study objectives.

Participant Characteristics

The demographic characteristics of the participants are summarized in Table 1. Most participants were aged 17-19 years (65%), followed by 20-22 years (28%) and 23-25 years (7%). Females constituted 55% of the sample, while 45% were males. The majority were first-year students (63%), enrolled in Bachelor of Commerce (55%) programmes, belonged to nuclear families (67%) and resided in urban areas (60%). Most participants (79%) had no previous CPR training or exposure before participating in the study.

Table 1. Socio-demographic characteristics of participants (N=100)

Variable	Frequency (%)
Age (17-19 years)	65(65.0)
Age (20-22 years)	28(28.0)
Age (23-25 years)	7 (7.0)
Male	45 (45.0)
Female	55 (55.0)
First year	63 (63.0)
Second year	30 (30.0)
Third year	7 (7.0)
B. Com	55 (55.0)
B.Sc.	45 (45.0)
Nuclear family	67 (67.0)
Joint family	33 (33.0)
Urban residence	40 (40.0)
Rural residence	60(60.0)
Rural residence	40 (40.0)
Previous CPR training - Yes	21(21.0)
Previous CPR training - No	79 (79.0)

Effect of Hands-Only CPR Training on Knowledge

Participants demonstrated a significant improvement in knowledge following the educational intervention. The mean knowledge score increased from 5.65 ± 1.11 before training to 8.73 ± 0.98 at the one-month follow-up. The paired t-test showed that this improvement was statistically significant ($t(99) = -66.31$, $p < 0.001$) (Table 2)

Table 2. Comparison of knowledge scores before training and one month after training (N= 100)

Assessment	Mean $\pm$ SD	t	P
Pre-test	5.65 ± 1.11		

One-month post-test	8.73 ± 0.98	-66.31	<0.001*
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Significant at $p < 0.05$.

Effect of Hands-Only CPR Training on Practical Skills

Immediately after the training programme, 96% of participants demonstrated good practical competency, while 4% achieved fair competency. None of the participants demonstrated poor practical performance.

At the one-month follow-up, practical competency declined. Good competency was observed in 42% of participants, whereas 41% demonstrated fair competency and 17% demonstrated poor competency.

The mean practice score decreased significantly from 9.98 ± 0.72 immediately after training to 8.24 ± 0.75 after one month ($t(99) = 15.99$, $p < 0.001$), indicating a reduction in skill retention over time (Table 3).

Table 3. Comparison of practical skill scores immediately after training and one month after training (N = 100).

Assessment	Mean ± SD	t	p
Immediate post-test	9.98 ± 0.72		
One-month follow-up	8.24 ± 0.75	15.99	<0.001*

Significance at $p < 0.05$.

Association Between Knowledge and Socio-demographic Variables

Chi-square analysis showed no statistically significant association between pre-test knowledge levels and selected socio-demographic variables, including age, gender, academic year, programme of study, residence, family type and previous CPR training (all $p < 0.05$).

Association Between Practical Skills and Socio-demographic Variables

Similarly, no statistically significant association was observed between practical skill scores at the one-month follow-up and any selected socio-demographic variable (all $p < 0.005$), indicating that the effectiveness of the training programme was independent of participants' demographic characteristics.

DISCUSSION.

The present study evaluated the effectiveness of a structured Hands-Only Cardiopulmonary Resuscitation (CPR) training on the knowledge and practical skills of undergraduate students in selected colleges in Bengaluru. The findings demonstrated that the intervention produced significant improvements in both cognitive knowledge and psychomotor performance. Knowledge scores increased significantly one month after training, whereas practical skills, although initially high, declined during the follow-up period, indicating the need for periodic reinforcement to sustain CPR competency.

The mean knowledge score increased significantly from 5.65 ± 1.114 during the pre-test to 8.73 ± 0.983 at the one-month follow-up ($t = -66.308$, $p < 0.001$). These findings indicate that the structured Hands-Only CPR training programme effectively enhanced participants' understanding of sudden cardiac arrest recognition, activation of emergency medical services and correct chest-compression techniques. Similar findings were reported by Karuthan et al. (2019) [3], who demonstrated significant improvements in CPR knowledge, confidence and willingness to perform bystander CPR among Malaysian university students following structured training. Likewise, Mathew et al. (2020) [5] observed a significant increase in CPR knowledge among Indian college students following a structured educational programme, concluding that simulation-assisted instruction is highly effective for improving theoretical understanding of basic life-support principles. These consistent findings suggest that structured CPR education is an effective strategy for improving emergency preparedness among undergraduate students regardless of geographical setting.

The distribution of knowledge categories further supports the effectiveness of the intervention. Before training, most participants demonstrated inadequate knowledge, whereas one month after training, the majority achieved adequate knowledge and none remained in the inadequate category. This substantial shift indicates that the educational intervention not only improved average knowledge scores but also enabled participants to attain clinically meaningful competency in Hands-Only CPR among non-healthcare students and laypersons, supporting the inclusion of CPR education within undergraduate curricula. Sayre et al. (2008) [2, 15] emphasized the effectiveness and importance of Hands-Only CPR for immediate bystander response during cardiac arrest.

Practical competency improved remarkably immediately after the intervention. Nearly all participants (96%) demonstrated good-quality Hands-Only CPR performance following completion of the training programme, reflecting the effectiveness of mannequin-based simulation and supervised return demonstrations. The mean practice score of 9.98 ± 0.724 immediately after training indicates that participants successfully acquired essential psychomotor skills, including correct hand placement, compression depth, compression rate, complete chest recoil and appropriate body posture. These findings are consistent with those of Urban et al. (2013) [4, 12], who reported that structured CPR education improved knowledge and willingness to perform Hands-Only CPR among laypersons. Similarly, Ramesh et al. (2022) [6, 13] demonstrated that structured Hands-Only CPR training

substantially enhanced practical competency among non-medical college students in India, emphasizing the importance of repeated demonstration and supervised practice.

Despite the excellent immediate post-training performance, practical skills declined significantly at the one-month follow-up, with the mean score decreasing to 8.24 ± 0.754 ($t = 15.989$, $p < 0.001$). Although most participants retained moderate competency, the reduction in performance indicates deterioration of psychomotor skills over time. This finding is consistent with Schmid et al. (2018) [8], who reported progressive decline in CPR performance following training despite satisfactory knowledge retention. Similarly, Bray et al. (2017) [7, 14] demonstrated that CPR skills and awareness can decline without continued training and emphasized the importance of repeated practice and refresher training. Kim et al. (2017) [9] also examined retention of CPR skills following Hands-Only and conventional CPR training, supporting the need for periodic retraining to maintain psychomotor competency. The decline observed in the present study reinforces the importance of periodic retraining and competency assessment rather than relying on a single educational session.

The present study found no statistically significant association between knowledge or practical skill scores and selected socio-demographic variables, including age, gender, academic year, programme of study, family type, place of residence and previous CPR exposure. These findings suggest that the educational intervention was equally effective across different demographic groups. Similar observations were reported by Urban et al. (2013) [4, 12], who found that demographic characteristics had minimal influence on knowledge and willingness to perform Hands-Only CPR among laypersons. The uniformly low baseline knowledge observed in the present study further indicates that undergraduate students, irrespective of their background, require formal CPR education to develop essential lifesaving competencies.

The findings have important implications for nursing education and public health. Undergraduate students constitute a large and socially active population who may witness sudden cardiac arrest in educational institutions, workplaces, public transport, sports facilities and community settings. Equipping this population with Hands-Only CPR skills can substantially increase the number of competent bystanders capable of initiating early resuscitation before emergency medical services arrive, thereby improving the likelihood of survival and favourable neurological outcomes following out-of-hospital cardiac arrest. Berdowski et al. (2010) [1] highlighted the considerable global burden of out-of-hospital cardiac arrest and the importance of improving survival through early intervention. Similarly, Sayre et al. (2008) [2, 15] emphasized the importance of Hands-Only CPR for increasing the likelihood of immediate bystander intervention. Therefore, incorporating structured Hands-Only CPR training into undergraduate curricula represents an important strategy for strengthening community emergency preparedness and improving survival from cardiac arrest.

Several limitations should be considered when interpreting the findings. The study employed a quasi-experimental one-group design without a control group, limiting comparisons with alternative educational approaches. Participants were recruited using convenience sampling from selected colleges in Bengaluru, which may limit the generalisability of the findings. Furthermore, participants were evaluated only one month after training, preventing assessment of long-term competency. Further research should include multicentre randomized controlled trials, larger and more diverse samples, objective feedback-enabled CPR manikins and follow-up assessments extending to six or twelve months. Comparative evaluation of conventional teaching, e-learning, virtual simulation and other training strategies is also recommended to identify the most effective approaches for maintaining long-term CPR competency.

Overall, the present study provides evidence that structured Hands-Only CPR training is an effective educational intervention for improving knowledge and practical skills among undergraduate students. However, the observed decline in psychomotor performance highlights that one-time training is insufficient to maintain competency. Regular simulation-based refresher programmes and integration of Hands-Only CPR education into undergraduate curricula are likely to improve long-term skill retention, increase the number of competent bystanders and contribute to better survival outcomes following sudden cardiac arrest. Bray et al. (2017) [7, 14], Schmid et al. (2018) [8] and Kim et al. (2017) [9] support the importance of continued training and periodic reinforcement for maintaining CPR competency.

Strengths and Limitations

This study has several strengths. It evaluated both cognitive and psychomotor learning outcomes, providing a comprehensive assessment of the effectiveness of Hands-Only CPR training. The inclusion of a one-month follow-up enabled evaluation of short-term retention of knowledge and practical skills. Furthermore, the intervention employed a structured educational approach incorporating lectures, demonstrations, audiovisual materials and mannequin-based simulation.

However, certain limitations should be acknowledged. The study used a convenience sampling technique and was conducted in selected colleges within a single geographical area, which may limit the generalizability of the findings. The absence of a control group restricts comparison with alternative educational methods. In addition, practical skill retention was assessed only one month after training; therefore, long-term retention could not be determined. Future studies should employ randomized controlled designs, larger multicenter samples and extended follow-up periods to evaluate the sustainability of CPR competency over time.

Overall, the findings demonstrate that structured Hands-Only CPR training is an effective educational intervention for undergraduate students. While significant improvements were observed in both knowledge and practical

competency, the decline in skill retention underscores the importance of ongoing practice and periodic refresher training to maintain CPR proficiency.

CONCLUSION

Structured Hands-Only Cardiopulmonary Resuscitation (CPR) training significantly improved undergraduate students' knowledge and practical skills in responding to sudden cardiac arrest. Knowledge remained significantly higher one month after the intervention, demonstrating satisfactory short-term retention of theoretical concepts. Although practical competency was high immediately after training, a significant decline in psychomotor performance was observed during the one-month follow-up, highlighting the need for periodic refresher training to maintain CPR proficiency.

These findings support the integration of structured Hands-Only CPR training into undergraduate education, particularly for students from non-healthcare disciplines. Incoming simulation based training and regular competency assessments may improve community emergency preparedness by increasing the number of individuals capable of providing timely and effective bystander CPR. Future studies should evaluate the long-term effectiveness of refresher training using randomized controlled designs and extended follow-up periods.

Clinical Implications

The finding of this study demonstrate that structured Hands-Only CPR education can improve emergency preparedness among undergraduate students. Integrating CPR training into undergraduate curricula may increase the number of competent bystanders capable of initiating lifesaving interventions before the arrival of emergency medical services. Regular simulation-based refresher programmes should be considered to maintain psychomotor competency and ensure sustained readiness to respond to cardiac emergencies.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethics Committee of Ramaiah Institute of Nursing Education and Research, Bengaluru, India, before commencement of the study.

Approval Number: EC-25/136-PG-RINER

Written informed consent was obtained from all participants prior to enrolment. Participation was voluntary, confidentiality and anonymity were maintained throughout the study in accordance with institutional ethical guidelines and the principles of the Declaration of Helsinki.

Data availability statement.

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

CREDIT Author Contributions.

Nikhil A.M: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing- Original Draft.

Ms. Arul Shanthi: Supervision, Methodology, Validation, Writing – Review and Editing.

All authors reviewed and approved the final version of the manuscript.

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