Out of Hospital Cardiac Arrest (OHCA): Experience of a Bystander CPR Training Program in Karachi, Pakistan

Uzma Rahim Khan (✉ uzma.khan@aku.edu)

Aga Khan University

Umerdad Khudadad

Aga Khan University

Noor Baig

Aga Khan University

Fareed Ahmed

Aga Khan University

Ahmed Raheem

Aga Khan University

Butool Hisam

Harvard T.H. Chan School of Public Health

Nadeem Ullah Khan

Aga Khan University

Marcus Ong Eng Hock

Singapore General Hospital

Junaid Abdul Razzak

Weill Cornell Medical College

Research Article

Keywords: Bystander, CPR, Training, Retention, Pakistan, Out of the Hospital Cardiac Arrest

Posted Date: December 21st, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-1176497/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: Nearly 90% of out-of-hospital cardiac arrest (OHCA) patients are witnessed, yet only 2.3% received bystander CPR (cardiopulmonary resuscitation) in Pakistan. This study aimed to determine retention of knowledge and skills of Hands-Only CPR among community participants in early recognition of OHCA and initiation of CPR in Karachi, Pakistan.

Methods: The pre and post-tests were conducted among participants from diverse non-health-related backgrounds from July 2018 to October 2019. Participants were tested for knowledge and skills of CPR before training (pre-test), immediately after training (post-test), and six months after training (retention test). All the participants received CPR training through video and scenario-based demonstration using manikins. Post-training CPR skills of the participants were assessed using a pre-defined performance checklist. The evaluator read out numerous case scenarios to the participants, such as drowning, poisoning, and road traffic injuries, etc., and then asked them to perform the critical steps of CPR identified in the scenario on manikins. The primary outcome was the mean difference in the knowledge score and skills of the participants related to the recognition of OHCA and initiation of CPR.

Results: The pre and post-tests were completed by 722 participants, whereas the retention test after 6 months was completed by 358 participants. The mean knowledge score related to the recognition of OHCA, and initiation of CPR improved significantly ($p < 0.001$) from pre-test (47.2/100, ± 13.2) to post-test (69.9/100, ± 12). The mean CPR knowledge after six months (retention) reduced slightly from (69.9/100, ± 12) to (64.8/100, ± 9.3). The CPR skill retention for various components (correct placement of the heel of hands, complete chest recoil, check for scene safety, check for a response, and activate emergency response system) slightly deteriorated from 79% in the post-test to 72% in re-test. However, participants performed slightly better on achieving an adequate rate of chest compressions from 73.7% in post-test to 75.5% in re-test.

Conclusion: Community members with non-health backgrounds can learn and retain CPR skills, allowing them to be effective bystander CPR providers in OHCA situations. We recommend training the mass population in Pakistan regarding CPR to increase the survival rate from OHCA.

Background

Out of Hospital Cardiac Arrest (OHCA) is a major global health concern and one of the leading causes of death worldwide. In developing countries, it accounts for 10% of mortality (1-4). Globally, it is estimated that on average, less than 10% of all patients with OHCA will survive (5).

Successful resuscitation efforts depend on the 'chain of survival', which includes immediate recognition of cardiac arrest and activation of the emergency response system, early bystander cardiopulmonary resuscitation (CPR) with an emphasis on chest compressions, rapid defibrillation, basic and advanced emergency medical services, and integrated post-cardiac arrest care (6). However, one of the main

barriers in the initiation of the chain of survival is the identification of cardiac arrest and lack of adequate knowledge of life-saving skills such as CPR faced by bystanders (7, 8).

In the United States, Resuscitation Outcomes Consortium Registry (ROC), survival rates were significantly higher (43.6%) if layperson-initiated CPR occurred. In the Cardiac Arrest Registry to Enhance Survival (CARES) in the US, automated external defibrillator (AED) use and bystander CPR explained as much as 50.4% of survival variation across 132 counties (9, 10). In developing countries, where there is a lack of knowledge about bystander CPR, the survival rates are dismal. Studies from developing countries have shown varying survival from as low as 0 % in Mexico to 2 % in Islamabad, Pakistan, and 11 % in Karachi, Pakistan (11-13).

Improving the knowledge and skills of bystander CPR has been recognized as a proven way to increase the survival rate in OHCA victims (14). The Pan-Asian Resuscitation Outcomes Study (PAROS) represents a concerted effort in prehospital emergency care research to document cardiac arrest mortality and ascertain possible outcomes of bystander CPR (15). With regards to bystander CPR, it is important to recognize that bystander means the population at large, from non-healthcare-related fields. Within Pakistan, numerous studies have affirmed the need for bystander CPR training. One study by Mawani et al. found that amongst a cohort of patients brought to an Emergency Department due to OHCA, most of the patients (92.9 %) had witnessed cardiac arrest out of which only a small percentage (2.3 %) received bystander CPR (16). Another study by Khursheed et al found that Pakistan had a higher burden of dead on arrival (DOA) patients than other similar resource settings (about 1 to 2 per 1,000 visits) and one of the causes they cited was lack of bystander CPR and prehospital care (17).

It is important to reach out to a diverse spectrum of the population and provide them with life-saving knowledge and skills to reduce the burden of OHCA mortality. However, the baseline knowledge of a population is equally important in assessing the impact of life-saving interventions including CPR training. Previous studies have tested knowledge, skills, and attitude of CPR amongst medical practitioners including doctors, dentists, and medical students (18-22). On the contrary, knowledge, and skills regarding CPR from non-healthcare-related fields have not been much explored in the context of Pakistan. Within Pakistan, studies have focused mostly on healthcare professionals, not on the need to train members of the general population in performing by-standing CPR. (19, 23) . Encouragingly, a few studies have shown that members of the general population may be receptive to receiving such training. For example, in 2011, a study showed that school children aged 11-15 years were able to grasp the skills of CPR and even had retention of knowledge till 3 months post-training (24). Poor retention of CPR knowledge and skills is a major contributing factor to the low rescue rate of OHCA. Various CPR training modalities, including video and scenario-based training methods, have been shown to improve CPR performance and skill retention (25, 26). However, the long-term retention of CPR knowledge and skills is essential in the context of LMICs considering the limitations of physical and human resources for CPR training.

Aim of the Study

The aim of this study was to determine the retention of knowledge and skills of Hands-Only CPR training among community participants in early recognition of OHCA and initiation of CPR in Karachi, Pakistan.

Methods

Study setting and participants

We conducted a pre and post-test study from July 2018 to October 2019 after obtaining approval from the ethical review committee of the Aga Khan University (AKU). We recruited 722 participants that included teachers, students (>13 years), ambulance drivers, traffic police officers, patrolmen, and military officers.

We arranged a group of 25-30 participants for one-time CPR training sessions. The arrangement of participants was made through appointment, either via phone or email to the participant's primary organization. The training was conducted based on the availability of the participants during the study period. The training was carried out at the participant's primary organization and the emergency department of the AKU. Written informed consent was obtained from all the participants before enrolment in the study. The confidentiality of the participants was maintained throughout the study and anonymity was ensured by using unique identification numbers for each participant.

Baseline Knowledge Assessment

All the participants underwent a pre-test 14-item CPR knowledge questionnaire which took them 25-30 minutes to complete. The questions were read out loud to the participants in the Urdu language. In addition, guidance was provided to the participants who were unable to comprehend the questions.

Training

Each group of 25-30 participants received a well-designed 2-hour CPR training based on the American Heart Association (AHA) guidelines. First, the trainer shared information related to CPR in the Urdu language. Second, a video-based CPR demonstration was displayed to participants followed by a live translation for each step of CPR demonstrated in the video. Third, we asked all the participants to demonstrate the steps of CPR independently on the manikins. In addition, we provided scenario-based training to the participants to help them reflect on true situations and enhance their understanding. Moreover, the trainers provided continuous feedback to the participants regarding CPR techniques. All the assessment questionnaires and checklists were completed anonymously. Furthermore, we conducted a post-training evaluation to improve the training experience for participants in the succeeding pieces of training.

Instrument and Assessment

Knowledge assessment questionnaires and skill checklists were developed with the help of a literature review (27-29) related to CPR training and expert opinion from emergency physicians. The knowledge assessment questionnaire was comprised of questions related to demographics, CPR knowledge, attitude, and practice such as “what do you think CPR means, what are the signs of sudden heart arrest, what are the critical components of high-quality CPR, have you received CPR training and what concerns may prevent you from performing CPR if needed (Refer to Additional File 1 for detailed information on the questionnaire). In addition, CPR performance checklists had three distinctive criteria to assess the participant’s performance that included a participant’s ability to initiate CPR, perform high-quality CPR and discontinue CPR when needed (Refer to Additional File 2 for detailed information on the checklist).

We administered a knowledge assessment questionnaire (Post-test I) to the participants post-training to assess the end-line knowledge. In addition, a similar knowledge questionnaire (Post-test II) was given to the participants after six months of the initial training to assess their knowledge retention. However, the number of participants dropped to half of the baseline sample size (n=358) at the time of knowledge retention assessment. The reduction in sample size was primarily due to military postings that change quarterly.

We assessed the CPR skills of the participants through a pre-defined performance checklist. The evaluator verbally read out different case scenarios to the participants on drowning, poisoning and road traffic crashes, etc., and asked the participants to perform the critical steps of CPR identified in the scenario on manikins. The participants had three opportunities to identify and perform the steps of CPR correctly in the given scenario.

Evaluator

A mixed group of evaluators that included emergency faculty, master trainers, medical interns, and emergency medicine residents independently assessed the CPR skills of the participants via a checklist. The evaluators are BLS certified and had completed prior CPR training. All of them were trained to use the checklist and rate the performance of participants objectively. Moreover, these evaluators were not involved in the analysis of the study.

Outcome measure

The primary outcome was the mean difference in score on knowledge and skills of the participants related to the recognition of OHCA and initiation of CPR.

Statistical Analysis

All data were entered and analysed using the Statistical Package for Social Sciences (SPSS) version 21(30). The answers for each question in the knowledge questionnaire were scored as true, false, or don't know. Analysis was performed by scoring 1 for a correct response and 0 for an incorrect response. The total score was converted into a percentage, ranging from 0 to 100 percent. Each domain score was also analysed by summing the scores of correct answers and converted into a scale of 0 to 100. Zero indicates the lowest level of knowledge, whilst 100 indicates the highest level. The mean knowledge score was calculated for each domain. Non-parametric tests were used since the data obtained were not normally distributed. The Wilcoxon Signed-rank test was used to compare the difference between the tests and retest results. A p-value of less than 0.001 was considered significant.

Results

Demographics of the Study Participants

The pre and post-tests were completed by 722 participants, whereas the re-test was completed by 358 participants. Table 1 shows the demographic characteristics of the participants. Most of the participants were male (n=567, 78.5%) and had matric/O-level education (n=341, 47.2%). The majority of the participants (n=404, 56%) were in the age group of 25-44 years. In addition, a considerable percentage of the participants (n=271, 59.6%) had no training in CPR before pre-testing.

Knowledge of CPR at Pre, Post, and Re-tests

On the pre-test, a question related to the understanding that survival is high when CPR is done immediately received the highest number of correct responses (n=666, 94.2%%). Other questions on which participants scored high in the pre-test included the understanding that CPR is an emergency procedure that is attempted to restart the heart that has stopped beating (n=633, 90%%) and understanding that CPR is generally continued until the person regains consciousness or is declared dead (n=629, 89.2%). Table 2 shows the frequency of correct responses against knowledge assessment questions at pre-test, post-test, and re-test. The retention of CPR knowledge related to the rate of chest compression reduced from n=223, 31.9% to n=276, 77.1% followed by force that must be applied during chest compressions (from n=448, 62% to n=172, 48%) and switching roles when performing two-rescuer CPR (from n=630, 87.3% to 188, 52.5%). However, more than 90% of the participants had knowledge retention for the questions that had binary (Yes/No) responses; questions number 10 to 14.

Mean CPR Knowledge Score

The mean percentage of the knowledge score at pre-test was 48.38 (± 13.1) which increased to 70.6 (± 11.9) at post-test and decreased to 63.9 (± 10.8) at re-test using a sample of 358 participants. This was statistically significant ($p < 0.001$). The percentage difference in the knowledge gain was 22.6% from pre-test to post-test. Figure 1 shows the mean percentage of the knowledge score at pre, post, and re-test

levels using a sample of 358 and 722 participants. A similar significant difference ($p < 0.001$) was seen in the mean percentage of the knowledge score at pre, post, and re-test with the sample of 722 participants.

CPR Skill Performance and Retention

The CPR skills of the participants were assessed post-training and after six months. Figure 2 shows the percentage of the participants who performed CPR skills correctly at the first attempt at post-test and re-test. Majority of the participants were able to perform skills correctly regarding checking for the scene safety ($n=574$, 79.6%), checking for response ($n=582$, 80.7%), calling for help ($n=76.1\%$), and activating emergency response system ($n=493$, 68.4%). Furthermore, 79.8% ($n=576$,) of the participants were able to place their heels of hands appropriately while performing CPR whereas, 73.7% ($n=532$) had an adequate rate of chest compressions. The retention of CPR skills slightly deteriorated for placing the heel of hands correctly from 79.8% to 73%, allowing complete chest recoil from 77.4% to 69.4%, and checking for scene safety from 79.6% to 74.4%. However, participants performed slightly better on achieving an adequate rate of chest compressions from 73.7% in post-test to 75.5% in re-test.

Generalized Estimating Equation Regression for Sociodemographic Factors

The Generalized Estimating Equation (GEE) analysis revealed that gender and prior CPR training were found to be strongly associated with improved CPR knowledge scores. However, the increase in CPR knowledge scores overtime did not vary significantly by age groups and education status of the participants. Table 5 shows that the regression coefficients for the GEE model relating CPR knowledge score to sociodemographic characteristics. The females scored on an average of 7.35 points (95% CI: 5.57, 9.14) higher than males. In addition, participants who had prior CPR training scored on an average of 3.64 points (95% CI: 2.21, 5.09) higher than those who had not.

Discussion

This study determined the retention of CPR knowledge and skills after hands-only bystander CPR training among non-healthcare professionals in Pakistan. The mean CPR knowledge score of the participants improved substantially after CPR training. In addition, the participants were able to retain considerable knowledge and skills of CPR after six months of the initial training. We found out that gender, and prior CPR training were strongly associated with an increase in the CPR knowledge scores.

CPR knowledge and skill retention were tested after six months of the initial training. This duration reflects findings from previous literature which suggests that skill retention is usually till six months (31). In addition, assessment criteria used to determine the retention knowledge and skills based on the sequence of events and demonstration may influence the retention rates. Evidence suggests that retention of theoretical CPR knowledge is higher than skills performance (32). CPR knowledge and skills

might decline over time, and there is no one preferred approach for re-training. A mix of training methods may provide opportunities to bystanders to refresh skills, supporting the retention of CPR knowledge over time. Previous studies have highlighted that 'low dosage, high frequency' refresher training, in which participants undergo brief but frequent CPR training sessions, improves the quality and retention of skills significantly (33, 34). In contrast to our findings on demographics that prior training and gender associated with CPR knowledge and skills, a study from Europe showed that age and education affected the acquisition and retention of CPR knowledge and skills (35). Healthcare systems that integrate CPR training into civic, work, or school activities offer a useful and effective means to assure retention (36).

The ability to perform effective CPR is critical and a lifesaving skill for bystanders in line with the pre-hospital emergency care system. Previous studies have confirmed that learning bystander CPR can improve OHCA outcomes (37, 38). This study revealed that a combination of video and instruction-based CPR training is an effective method to improve the knowledge and skills of bystanders which is widely used in other contexts (39, 40) and had similar positive effects. However, implementing effective training methods to increase bystander CPR knowledge may improve resuscitation in high-risk groups (41, 42). In a Swedish longitudinal study, efforts to provide conventional training significantly increased the number of individuals with CPR training and nearly doubled the proportion receiving bystander CPR from 31 to 55 percent in two decades (43). In addition, previous research indicates that training targeted populations, such as neighbourhoods with poor bystander CPR rates, may be an effective strategy to increase bystander CPR rates and OHCA outcomes (44).

Bystander CPR is the first and foremost component in the chain of survival following cardiac arrest (45). Based on the chain of survival that focuses on an integrated continuum of care; Pakistan lacks access to automated external defibrillators, a robust prehospital emergency care system, and health care facilities capable of both continuing resuscitative efforts and providing integrated and intensive post-resuscitative care and rehabilitation (46-48). Even though, bystander CPR has gained widespread recognition as a life-saving skill; implementation of bystander CPR training and public access to it is generally limited in LMICs. However, in Pakistan, healthcare professionals have inadequate knowledge of CPR (49, 50). There are several major concerns that bystanders may have regarding their readiness to perform CPR in Pakistan, including making a mistake when performing CPR or unintentionally injuring the patient, being concerned about legal consequences, and hesitating to perform CPR on the opposite gender which is consistent with the previous findings (51). In addition, the reluctance to perform CPR on women is linked with fears of inappropriate touching and allegations of sexual assault (52). This again underlines the importance of CPR training particularly with regards to bystander receptivity.

In this study, skill assessment was primarily done by master trainers. These are healthcare professionals who are BLS certified and have received prior CPR training. They are qualified to teach and evaluate laypersons who can act as providers in a community setting. Master trainers represent a sustainable model of community CPR training, leading to the 'Train the Trainer' models (53). A pragmatic example of this within Pakistan is the Pakistan LifeSavers Program (PLSP) with the mission of training 10 million laypersons in 10 years (54).

Limitations of the Study

This study has various limitations. For one, it could not capture all participants for a refresher training session and so comparison of post-test and re-test results may depict a less than the accurate picture but is still consistent in terms of reasonable depreciation of skills after a considerable period. Also, there was a lack of participation from rural settings where access to care in case of emergencies is limited and where the need for such training would be greater. In addition, we were unable to evaluate the quality of the educational skills of trainers due to the time constraints of the instructors.

Future studies could focus on assessing baseline knowledge amongst participants from a variety of backgrounds and residential settings, both urban and rural areas. In addition, different methods of training delivery can be evaluated, particularly, video-based learning for refresher training and assessment of CPR skill retention.

Conclusion

The implementation of video-based CPR demonstration and scenario-based training model improves the long-term retention amongst bystanders which could potentially lead to improved survival outcomes in the OHCA. To this end, the public should be continually encouraged to acquire CPR skills. The public health system needs to identify simple and cost-effective strategies to improve the retention of CPR knowledge and skills. Advocacy initiatives such as public service messages, corporate and institutional programs, and government incentives may help to achieve these aims. This could set a precedent for health policies and officials to investigate training at a mass level as bystander CPR is a sustainable and effective tool for reducing mortality from cardiac arrest.

Abbreviations

CPR: Cardiopulmonary Resuscitation

OHCA: Out of Hospital Cardiac Arrest

ROC: Resuscitation Outcomes Consortium Registry

CARES: Cardiac Arrest Registry to Enhance Survival

AED: Automated External Defibrillator

LMICs: Low-and-middle Income Countries

AKU: Aga Khan University

AHA: American Heart Association

GEE: Generalized Estimating Equation

Declarations

Ethics approval and consent to participate

The study was approved by the ethical review committee of the Aga Khan University in Karachi, Pakistan (reference number: 2020-0608-14608). Written informed consent was obtained from all the participants at the beginning of study. The confidentiality of the respondents was maintained throughout the study and anonymity was ensured by using unique identification numbers for each participant.

Consent for publication

Not Applicable

Availability of data and materials

The data is stored in the repository of the Aga Khan University. The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research was supported by the Singapore Clinical Research Institute (SCRI). The content is solely the responsibility of the authors and do not represent the views of SCRI.

Authors' contributions

URK, NB, FA and NK directly contributed in proposal development. URK, UK and BH contributed in research paper planning and manuscript development. RA analyzed and interpreted data. JR and MOEH critically reviewed the paper and contributed to ensure that it is aligned with the current global perspective on the subject. All authors have read and approved the final manuscript.

Acknowledgements

The authors wish to thank the trainers who assisted in the training of the participants: Nazir Najeeb, Osama Zahid, Shahid, Aqeel Mehdi, Mustehsan, Hasnain, Noman, Mahreen Solanki, Safia Awan, Murtaza, Zubair, Mariam, Fatima and Hira.

References

1. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. *Jama*. 2008;300(12):1423-31.
2. Lund-Kordahl I, Olasveengen TM, Lorem T, Samdal M, Wik L, Sunde K. Improving outcome after out-of-hospital cardiac arrest by strengthening weak links of the local Chain of Survival; quality of advanced life support and post-resuscitation care. *Resuscitation*. 2010;81(4):422-6.
3. Rao BH, Sastry B, Chugh SS, Kalavakolanu S, Christopher J, Shangula D, et al. Contribution of sudden cardiac death to total mortality in India—a population based study. *International journal of cardiology*. 2012;154(2):163-7.
4. Noc M, Fajadet J, Lassen JF, Kala P, MacCarthy P, Olivecrona GK, et al. Invasive coronary treatment strategies for out-of-hospital cardiac arrest: a consensus statement from the European association for percutaneous cardiovascular interventions (EAPCI)/stent for life (SFL) groups. *EuroIntervention*. 2014;10(1):31-7.
5. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. *Resuscitation*. 2010;81(11):1479-87.
6. Berg DD, Bobrow BJ, Berg RA. Key components of a community response to out-of-hospital cardiac arrest. *Nature Reviews Cardiology*. 2019;16(7):407-16.
7. Ong MEH, Perkins GD, Cariou A. Out-of-hospital cardiac arrest: prehospital management. *The Lancet*. 2018;391(10124):980-8.
8. Perkins GD, Jacobs IG, Nadkarni VM, Berg RA, Bhanji F, Biarent D, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update of the utstein resuscitation registry templates for out-of-hospital cardiac arrest: a statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. *Circulation*. 2015;132(13):1286-300.
9. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation*. 2018.
10. Beck B, Bray J, Cameron P, Smith K, Walker T, Grantham H, et al. Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: results from the Aus-ROC Epistry. *Resuscitation*. 2018;126:49-57.

11. Fraga-Sastrias JM, Asensio-Lafuente E, Martinez R, Barcenas IA, Prieto-Sagredo J, Castillo L, et al. Out-of-hospital cardiac arrest: first documented experience in a Mexican urban setting. *Prehospital and disaster medicine*. 2009;24(2):121-5.
12. Ishtiaq O, Iqbal M, Zubair M, Qayyum R, Adil M. Outcome of cardiopulmonary resuscitation-predictors of survival. *J Coll Physicians Surg Pak*. 2008;18(1):3-7.
13. Rehmani R, Baqir SM, Amanullah S. Return of spontaneous circulation and survival at hospital discharge in patients with out-of-hospital and emergency department cardiac arrests in a tertiary care centre. *Journal of Pakistan Medical Association*. 2007;57(6):278.
14. Shams A, Raad M, Chams N, Chams S, Bachir R, El Sayed MJ. Community involvement in out of hospital cardiac arrest: A cross-sectional study assessing cardiopulmonary resuscitation awareness and barriers among the Lebanese youth. *Medicine*. 2016;95(43).
15. Doctor NE, Ahmad NSB, Pek PP, Yap S, Ong MEH. The Pan-Asian Resuscitation Outcomes Study (PAROS) clinical research network: what, where, why and how. *Singapore medical journal*. 2017;58(7):456.
16. Mawani M, Kadir MM, Azam I, Mehmood A, McNally B, Stevens K, et al. Epidemiology and outcomes of out-of-hospital cardiac arrest in a developing country-a multicenter cohort study. *BMC emergency medicine*. 2016;16(1):28.
17. Khursheed M, Bhatti JA, Parukh F, Feroze A, Naeem SS, Khawaja H, et al. Dead on arrival in a low-income country: results from a multicenter study in Pakistan. *BMC emergency medicine*. 2015;15(2):S8.
18. Alkandari SA, Alyahya L, Abdulwahab M. Cardiopulmonary resuscitation knowledge and attitude among general dentists in Kuwait. *World journal of emergency medicine*. 2017;8(1):19.
19. Majid A, Jamali M, Ashrafi MM, Haq ZU, Irfan R, Rehan A, et al. Knowledge and attitude towards cardiopulmonary resuscitation among doctors of a tertiary care hospital in Karachi. *Cureus*. 2019;11(3).
20. Olajumoke T, Afolayan J, Raji S, Adekunle M. Cardiopulmonary resuscitation-knowledge, attitude & practices in Osun State, Nigeria. *Journal of the West African College of Surgeons*. 2012;2(2):23.
21. Roshana S, Batajoo K, Piryani R, Sharma M. Basic life support: knowledge and attitude of medical/paramedical professionals. *World journal of emergency medicine*. 2012;3(2):141.
22. Oteir AO, Almhdawi KA, Kanaan SF, Alwidyan MT, Williams B. Cardiopulmonary resuscitation level of knowledge among allied health university students in Jordan: a cross-sectional study. *BMJ open*. 2019;9(11).
23. Irfan B, Zahid I, Khan MS, Khan OAA, Zaidi S, Awan S, et al. Current state of knowledge of basic life support in health professionals of the largest city in Pakistan: a cross-sectional study. *BMC health services research*. 2019;19(1):865.
24. Naqvi S, Siddiqi R, Hussain SA, Batool H, Arshad H. School children training for basic life support. *J Coll Physicians Surg Pak*. 2011;21(10):611-5.

25. Baldi E, Cornara S, Contri E, Epis F, Fina D, Zelaschi B, et al. Real-time visual feedback during training improves laypersons' CPR quality: a randomized controlled manikin study. *Canadian Journal of Emergency Medicine*. 2017;19(6):480-7.
26. Xu Y, Li J, Wu Y, Yue P, Wu F, Xu Y. An audio-visual review model enhanced one-year retention of cardiopulmonary resuscitation skills and knowledge: A randomized controlled trial. *International Journal of Nursing Studies*. 2020;102:103451.
27. Berthelot S, Plourde M, Bertrand I, Bourassa A, Couture M-M, Berger-Pelletier É, et al. Push hard, push fast: quasi-experimental study on the capacity of elementary schoolchildren to perform cardiopulmonary resuscitation. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2013;21(1):41.
28. Panchal AR, Meziab O, Stolz U, Anderson W, Bartlett M, Spaite DW, et al. The impact of ultra-brief chest compression-only CPR video training on responsiveness, compression rate, and hands-off time interval among bystanders in a shopping mall. *Resuscitation*. 2014;85(9):1287-90.
29. Swor R, Khan I, Domeier R, Honeycutt L, Chu K, Compton S. CPR training and CPR performance: do CPR-trained bystanders perform CPR? *Academic Emergency Medicine*. 2006;13(6):596-601.
30. SPSS I. SPSS version 21.0. IBM SPSS, Chicago, Illinois, USA. 2012.
31. Lim SH, Aw SJ, Cheong MA, Chew J, Ler AC, Yong LP, et al. A randomised control trial to compare retention rates of two cardiopulmonary resuscitation instruction methods in the novice. *Resuscitation*. 2016;103:82-7.
32. Brown TB, Dias JA, Saini D, Shah RC, Cofield SS, Terndrup TE, et al. Relationship between knowledge of cardiopulmonary resuscitation guidelines and performance. *Resuscitation*. 2006;69(2):253-61.
33. Sutton RM, Niles D, Meaney PA, Aplenc R, French B, Abella BS, et al. Low-dose, high-frequency CPR training improves skill retention of in-hospital pediatric providers. *Pediatrics*. 2011;128(1):e145-e51.
34. Cheng A, Nadkarni VM, Mancini MB, Hunt EA, Sinz EH, Merchant RM, et al. Resuscitation education science: educational strategies to improve outcomes from cardiac arrest: a scientific statement from the American Heart Association. *Circulation*. 2018;138(6):e82-e122.
35. Papalexopoulou K, Chalkias A, Dontas I, Pliatsika P, Giannakakos C, Papapanagiotou P, et al. Education and age affect skill acquisition and retention in lay rescuers after a European Resuscitation Council CPR/AED course. *Heart & Lung*. 2014;43(1):66-71.
36. Halm M, Crespo C. Acquisition and retention of resuscitation knowledge and skills: what's practice have to do with it? *American Journal of Critical Care*. 2018;27(6):513-7.
37. Takei Y, Kamikura T, Nishi T, Maeda T, Sakagami S, Kubo M, et al. Recruitments of trained citizen volunteering for conventional cardiopulmonary resuscitation are necessary to improve the outcome after out-of-hospital cardiac arrests in remote time-distance area: A nationwide population-based study. *Resuscitation*. 2016;105:100-8.
38. Park YM, Shin SD, Lee YJ, Song KJ, Ro YS, Ahn KO. Cardiopulmonary resuscitation by trained responders versus lay persons and outcomes of out-of-hospital cardiac arrest: A community observational study. *Resuscitation*. 2017;118:55-62.

39. Paglino M, Contri E, Baggiani M, Tonani M, Costantini G, Bonomo MC, et al. A video-based training to effectively teach CPR with long-term retention: the ScuolaSalvaVita.it ("SchoolSavesLives.it") project. *Intern Emerg Med*. 2019;14(2):275-9.
40. Del Rios M, Han J, Cano A, Ramirez V, Morales G, Campbell TL, et al. Pay It Forward: High School Video-based Instruction Can Disseminate CPR Knowledge in Priority Neighborhoods. *West J Emerg Med*. 2018;19(2):423-9.
41. Kappus RM, McCullough G. The feasibility of a novel method of bystander CPR training: A pilot study. *Am J Emerg Med*. 2020;38(3):594-7.
42. Nas J, Thannhauser J, Vart P, van Geuns RJ, Muijsers HEC, Mol JQ, et al. Effect of Face-to-Face vs Virtual Reality Training on Cardiopulmonary Resuscitation Quality: A Randomized Clinical Trial. *JAMA Cardiol*. 2020;5(3):328-35.
43. Strömsöe A, Andersson B, Ekström L, Herlitz J, Axelsson Å, Göransson K, et al. Education in cardiopulmonary resuscitation in Sweden and its clinical consequences. *Resuscitation*. 2010;81(2):211-6.
44. Bergamo C, Bui QM, Gonzales L, Hinchey P, Sasson C, Cabanas JG. TAKE10: A community approach to teaching compression-only CPR to high-risk zip codes. *Resuscitation*. 2016;102:75-9.
45. Hansen CM, Kragholm K, Pearson DA, Tyson C, Monk L, Myers B, et al. Association of bystander and first-responder intervention with survival after out-of-hospital cardiac arrest in North Carolina, 2010-2013. *Jama*. 2015;314(3):255-64.
46. Zia N, Shahzad H, Baqir S, Shaukat S, Ahmad H, Robinson C, et al. Ambulance use in Pakistan: an analysis of surveillance data from emergency departments in Pakistan. *BMC Emerg Med*. 2015;15 Suppl 2(Suppl 2):S9.
47. Razzak JA, Baqir SM, Khan UR, Heller D, Bhatti J, Hyder AA. Emergency and trauma care in Pakistan: a cross-sectional study of healthcare levels. *Emerg Med J*. 2015;32(3):207-13.
48. Mawani M, Azam I, Kadir MM, Samad Z, Razzak JA. Estimation of the burden of out-of-hospital traumatic cardiac arrest in Karachi, Pakistan, using a cross-sectional capture-recapture analysis. *Int J Emerg Med*. 2020;13(1):26.
49. Majid A, Jamali M, Ashrafi MM, Ul Haq Z, Irfan R, Rehan A, et al. Knowledge and Attitude Towards Cardiopulmonary Resuscitation Among Doctors of a Tertiary Care Hospital in Karachi. *Cureus*. 2019;11(3):e4182.
50. Iqbal A, Nisar I, Arshad I, Butt UI, Umar M, Ayyaz M, et al. Cardiopulmonary resuscitation: Knowledge and Attitude of doctors from Lahore. *Ann Med Surg (Lond)*. 2021;69:102600.
51. Becker TK, Gul SS, Cohen SA, Maciel CB, Baron-Lee J, Murphy TW, et al. Public perception towards bystander cardiopulmonary resuscitation. *Emerg Med J*. 2019;36(11):660-5.
52. Perman SM, Shelton SK, Knoepke C, Rappaport K, Matlock DD, Adelgais K, et al. Public Perceptions on Why Women Receive Less Bystander Cardiopulmonary Resuscitation Than Men in Out-of-Hospital Cardiac Arrest. *Circulation*. 2019;139(8):1060-8.

53. Pearce J, Mann MK, Jones C, Van Buschbach S, Olff M, Bisson JI. The most effective way of delivering a train-the-trainers program: a systematic review. Journal of Continuing Education in the Health Professions. 2012;32(3):215-26.

54. Initiative launched to train 10 million youth in lifesaving skills. 2020.

Tables

Table 1

Sociodemographic characteristics of the study participants at pre-test, post-test, and re-test from July 2018 to October 2019

Demographics Characteristics	Pre and Post-test n=722	Re-test n=358
Gender		
Male	567 [78.5%]	285 [79.6%]
Female	155 [21.5%]	73 [20.4%]
Education Status		
Primary school	67[9.3%]	36[10.1%]
Matric/ O-Level	341[47.2%]	166[46.4%]
Intermediate/ A-Level	141[19.5%]	73[20.4%]
Graduation	120[16.6%]	53[14.8%]
Post-graduate	53[7.3%]	30[8.4%]
Age Groups		
<=18 Years	78[10.8%]	39[10.9%]
18-24 Years	107[14.8%]	47[13.1%]
25-44 Years	404[56%]	196[54.7%]
>=45 Years	133[18.4%]	76[21.2%]
Have you received any prior CPR training?		
Yes	184[40.4%]	88[24.6%]
No	271[59.6%]	270[75.4%]
Marital Status		
Single	231[32%]	105[29.3%]
Married	491[68%]	253[70.7%]

Table 2

Comparison of knowledge score of participants at pre, post and retest from July 2018 to October 2019

Correct responses on knowledge attributes	Pre-test	Post-test	Re-test
	n (%)	n (%)	n (%)
N	722	722	358
Knowledge Score	n [%]	n [%]	n [%]
1.What do you think “Cardiopulmonary resuscitation (CPR)” means? know	552 [78.4%]	671 [94%]	331 [92.5%]
2.Which of the following may be a sign of sudden heart arrest?	5 [0.7%]	55 [7.6%]	25 [7%]
3.How can the consciousness state of the individual be determined?	88 [12.2%]	132 [18.3%]	81 [22.8%]
4.How can the absence of respiration be determined?	77 [10.7%]	255 [35.3%]	104 [29%]
5.CPR is performed on which part of chest?	405 [57.7%]	625 [88%]	309 [86.3%]
6.What must be the rate of the chest compressions?	223 [31.9%]	656 [91.9%]	276 [77.1%]
7.How much force must be applied during chest compressions?	132 [19%]	448 [62%]	172 [48%]
8.The critical characteristics of high-quality CPR include which of the following?	34 [4.7%]	140 [19.6%]	52 [14.7%]
9.How often should rescuers switch roles when performing two-rescuer CPR?	192 [27.4%]	630 [87.3%]	188 [52.5%]
10.Cardiopulmonary resuscitation (CPR) is an emergency procedure which is attempted to restart the heart that has stopped beating.	633 [90%]	675 [95.3%]	346 [96.6%]
11.CPR has to be attempted always inside of a hospital and not outside.	574 [81.2%]	664 [93.1%]	341 [95.5%]
12.CPR is generally continued until the person regains consciousness or is declared dead.	629 [89.2%]	686 [96.5%]	340 [95.5%]
13.The survival rate is high when CPR is done immediately.	666 [94.2%]	697 [97.5%]	353 [98.9%]
14.Is CPR effective in saving life of children?	514 [72.6%]	690 [97.2%]	330 [92.4%]

Table 3

Overall impact of sociodemographic characteristics on the CPR knowledge

Factors	β (95% CI)*
Constant	51.52 (48.35, 54.69)
Age Group (in years)	
Up to 18 years (Ref.)	
19 to 24 years	0.55 (-2.08, 3.18)
25 to 44 Years	1.49 (-1.29, 4.27)
45 Years & above	1.46 (-1.66, 4.58)
Gender	
Male (Ref.)	
Female	7.35 (5.57, 9.14)
Education Status	
Primary School (Ref.)	
Matric/o-Level	1.59 (-0.72, 3.90)
Intermediate/A-Level	3.79 (1.25, 6.34)
Graduation	3.73 (1.05, 6.40)
Post-Graduation	5.14 (1.94, 8.33)
Prior CPR training	
No (Ref.)	
Yes	3.65 (2.21, 5.09)

Legends: *Generalized estimation equation model by gaussian method

Figures

Figure 1

Title: Mean percentage of the CPR knowledge score at pre, post and re-test

Legend: The mean percentage score for CPR knowledge was computed at pre-test, post-test, and retest using two different sample sizes. The variability in the sample size is due to the number of participants dropped out after six months of initial training from $n=722$ to $n=358$ when re-test was conducted. The difference in the knowledge score was analysed using Wilcoxon Signed Rank test and the P value of less than 0.001 was considered significant.

Figure 2

Title: Participants CPR skills performance at post and re-test

Legends: The percentage of the participants performed CPR skills correctly at post-test and re-test was computed. The CPR skills assessed are given in y-axis.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AdditionalFile1.docx](#)
- [AdditionalFile2.docx](#)