ORIGINAL RESEARCH ARTICLE

Enhancing cardiopulmonary resuscitation training for the community with foam pillows: A promising approach

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Abstract

This study evaluates the efficacy of foam pillows as instructional aides to achieve accurate compression depth and chest recoil during CPR training. A descriptive study design was employed. The study involved 30 respondents with no experience with CPR. We enrolled 30 respondents aged 17 to 25 through open recruitment via WhatsApp and Instagram. Foam pillows (45 cm x 60 cm) with compression markers served as instructional tools. The study utilized Laerdal's Little Anne QCPR CPR mannequins and the QCPR application on an iPad Air 2 . After 1 minute of hands-only CPR on a foam pillow, all respondents continue to perform in Little Anne QCPR mannequin. The findings of this study show that the correct compression depth was performed by 28 respondents (93%) and the correct chest recoil by 30 respondents (100%). Foam pillows promise to enhance community-based CPR training by promoting precision in compression depth and chest recoil. *(Afr J Reprod Health 2024; 28 [10s]: 160-167).*

Keywords: Cardiopulmonary resuscitation, chest recoil, CPR training, resuscitation education

Résumé

Cette étude évalue l'efficacité des oreillers en mousse comme aides pédagogiques pour obtenir une profondeur de compression et un recul thoracique précis pendant la formation en RCR. Un plan d'étude descriptif a été utilisé. L'étude a porté sur 30 répondants n'ayant aucune expérience en matière de RCR. Nous avons recruté 30 répondants âgés de 17 à 25 ans grâce à un recrutement ouvert via WhatsApp et Instagram. Des oreillers en mousse (45 cm x 60 cm) avec des marqueurs de compression ont servi d'outils pédagogiques. L'étude a utilisé les mannequins Little Anne QCPR CPR de Laerdal et l'application QCPR sur un iPad Air 2. Après 1 minute de RCR avec les mains seules sur un oreiller en mousse, tous les répondants continuent d'effectuer leur exercice sur le mannequin Little Anne QCPR. Les résultats de cette étude montrent que la profondeur de compression correcte a été réalisée par 28 répondants (93 %) et le recul thoracique correct par 30 répondants (100 %). Les oreillers en mousse promettent d'améliorer la formation communautaire en RCR en favorisant la précision de la profondeur de compression et du recul thoracique. *(Afr J Reprod Health 2024; 28 [10s]: 160-167).*

Mots-clés: Réanimation cardio-pulmonaire, recul thoracique, formation en RCR, éducation à la réanimation

Introduction

Out of Hospital Cardiac Arrest (OHCA) is a prevalent issue on a global scale, characterized by a significantly poor chance of survival. According to data provided by the American Heart Association (AHA), the annual incidence of out-of-hospital cardiac arrests is around 3.8 million cases, with a survival rate that varies between 8% and 12%[1]. Sudden cardiac arrest also occurs in sport event with an incidence rate of 0.75 in every 100,000 athletes[2]. Based on findings derived from the Pan Asian Resuscitation Outcome Study (PAROS), it has been reported that over a span of three years within the Asia Pacific region, encompassing Indonesia, a total of 60,000 incidents of cardiac arrests transpired outside of hospital premises[3]. In the year 2014, heart disease ranked second in terms of mortality in Indonesia, following stroke, accounting for 12.9% of the overall causes of death. Nevertheless, according to the 2018 Basic Health Research, heart disease exhibited the highest incidence among all conditions diagnosed by medical professionals, with a mortality rate of 1.5%[4,5].

The American Heart Association (AHA) emphasizes the essential contribution of the community in managing cases of out-of-hospital cardiac arrest (OHCA) within the survival chain. The primary basis for preserving life in out-of-hospital cardiac arrest (OHCA) scenarios is this interconnected sequence comprising six key components. The community has a crucial role in the initial and subsequent components of this process, which include the early identification of cardiac arrest symptoms, prompt communication with emergency medical services (EMS), and timely administration of cardiopulmonary resuscitation (CPR)[6]. The need of active community involvement cannot be overstated, as the window of opportunity for optimal treatment of cardiac arrest is limited, typically lasting only 3 to 5 minutes. Given the limited ability of ambulance crews to promptly get at the location, the involvement of the community plays a crucial role in enhancing survival rates during time-sensitive situations necessitating swift and suitable medical intervention[7].

The collective knowledge and talents of the community play a crucial role in enhancing the likelihood of survival for individuals who suffer from cardiac arrest in non-hospital settings. According to a study conducted by Tay *et a*l. (2019), the implementation of a Basic Life Support (BLS) training intervention in the community resulted in a 4% increase in the rate of Return of Spontaneous Circulation (ROSC) among patients who had experienced cardiac arrest. This finding was reported in a subsequent publication by Tay *et a*l. (2020). Enhancing community engagement in the practice of cardiopulmonary resuscitation (CPR) can be achieved through the implementation of instructional training programs[8].

Cardiopulmonary resuscitation (CPR) training is administered in several settings, including educational institutions, occupational environments, and communal recreational facilities. In university settings, learning using simulation methods may have significant impact on students level of ability and confidence in achieving CPR competency. However, in the general public, this method is difficult to apply because it requires time and more advanced equipment[9]. Numerous scientific studies have demonstrated the efficacy of online and blended learning methodologies in the context of cardiopulmonary resuscitation (CPR) training. According to a study conducted by Cason and Stiller[10], it was found that all respondents successfully completed the skills assessments. Moreover, the individuals enrolled in online courses had superior performance compared to those enrolled in traditional courses. This observation implies the effectiveness of online courses and their capacity for wider distribution[10].

A recent investigation conducted by Ali *et al*. (2021) and Lactona & Suryanto (2021) has demonstrated that the use of blended learning, which integrates video-based instruction with in-person lectures facilitated via online platforms, has been found to effectively augment the knowledge and proficiency of nursing students in cardiopulmonary resuscitation (CPR)[11,12]. In contrast, traditional in-person CPR training shown proficiency in specific areas, particularly in the initiation of chest compressions. Conversely, alternative approaches such as hybrid and online-only training exhibited superiority in multiple aspects, rendering them viable alternatives for widespread public training[11,12]. The utilization of online resources and video records has been shown to facilitate the retention and enhancement of students' CPR abilities, providing them with the chance to engage in repetitive learning and receive comprehensive feedback. The results of this study support the inclusion of home-based learning through the use of video or interactive CD in CPR education. This approach is cost-effective and easily accessible, making it a viable option for reaching a larger and more diverse population[13].

The utilization of mannequins is shown to have a notable impact on the improvement of respondents' practical skills, thereby providing them with the necessary hands-on experience required for proficiently executing high-quality CPR. Although the influence on respondents' theoretical knowledge levels may be constrained, the compulsory integration of mannequin-based training in Basic Life Support (BLS) programs has the capacity to generate significant advantages, perhaps leading to a decrease in patient death rates[14].

Numerous studies have undertaken endeavors to offer alternative forms of media, such as the use of non-industrial handcrafted mannequins. This study aims to assess the efficacy of utilizing a foam pillow as a tool for imparting tactile feedback to those undergoing CPR instruction, specifically in

relation to chest compression depth and recoil. The inclusion of compression depth and chest recoil is crucial in the execution of effective cardiopulmonary resuscitation (CPR). It has a significant influence on the likelihood of survival for those experiencing cardiac arrest.

Methods

Design

This research is a descriptive study to examine the ability of a foam pillow as a teaching media for hands-only CPR in training the accuracy of compression depth and chest recoil. The variables measured in this study include compression depth and chest recoil when hands-on CPR was performed, measured via the laerdal QCPR application connected to a mannequin.

Sample

The respondents in this research comprised a sample of 30 individuals between the ages of 17 and 25 who had not previously experiences in any cardiopulmonary resuscitation (CPR) training. The respondents in this study were recruited through an open recruitment process, which involved broadcasting messages on WhatsApp and posting recruitment posters on Instagram.

Instrument

The research instrument utilized in this study was a foam pillow with dimensions of 45 cm x 60 cm, which has been appropriately marked to indicate its compression levels. Additional equipment utilized included the Laerdal brand CPR mannequin, that is the Little Anne QCPR model, in conjunction with the QCPR application integrated on the iPad Air 2 device. The present application pertains to the standard utilization of the Laerdal Little Anne QCPR mannequin, which serves the purpose of assessing the efficacy of High-Quality Cardiopulmonary Resuscitation (CPR) by measuring various parameters such as chest compression depth and recoil.

Intervention

All respondents were given a simulation carried out by one instructor regarding chest compression only

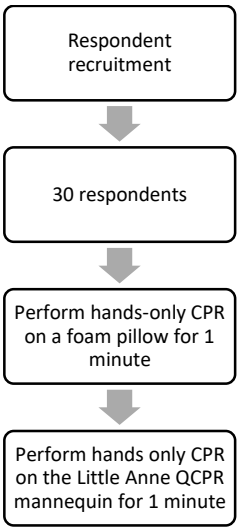

Figure 2: Recruitment process

Figure 3: Foam pillow

cardiopulmonary resuscitation (C) - CPR) and hand placement on a foam pillow. Each respondent was instructed to perform chest compression only cardiopulmonary resuscitation (CO - CPR) on a foam pillow for a duration of one minute. Following a one-minute session of conducting CO - CPR on a foam pillow, each respondent proceeded to engage in a one-minute practical application of CO - CPR on a Laerdal Littleanne mannequin. Measurements of chest depth and recoil were conducted during the execution of hands-on cardiopulmonary resuscitation (CPR) on the mannequin by the respondent. The measurements were conducted using the QCPR program that was loaded on the iPad Air 2 tablet and connected wirelessly to the Laerdal Littleanne mannequin.

Data collected

The chest depth and recoil measures obtained from the QCPR application were subsequently categorized into correct and incorrect groups. Compression depth was considered accurate if it reached at least 5 cm, while chest recoil was deemed accurate if the chest wall returned to its initial position before being compressed. These measurements were conducted using the Laerdal Little Anne Mannequine equipped with depth, rate, and chest recoil sensors. The depth and recoil measurements of the mannequine were visualized through the QCPR application, which is connected to the mannequine via Bluetooth. The Laerdal Little Anne mannequin uses two indicators to measure depth accuracy during chest compressions. One is a depth sensor read in the QCPR application, and the other is a mechanical "click" sound that is heard when compressions reach a depth of 5 cm. Compression depth accuracy testing was conducted by performing 60 chest compressions in one minute guided by a metronome. Accuracy was assessed by counting the number of "click" sounds produced during chest compressions (observed by two observers), and the results were compared with the numbers displayed in the QCPR application. The chest recoil accuracy test was carried out by 60 compressions per minute guided by a metronome, which was calculated manually by two observers by observing the perfect return movement of the chest wall after each compression is performed; the results were then compared with the readings in the QCPR application. In the QCPR application used in this study, 100% accuracy was obtained for chest depth and recoil.

Respondents were classified as having achieved the appropriate compression depth if their compression depth percentage within a one-minute timeframe was 76% or higher. Similarly, in relation to chest recoil, it was reported that respondents were deemed to have executed chest recoil accurately if they were able to achieve flawless recoil in 76% or more of chest compressions during a duration of one minute. The benchmark value of 76% utilized for establishing the boundaries of depth and recoil accuracy was derived from the BLS examination checklist for healthcare providers, as prescribed by the American Heart Association (AHA).

Data analysis

After obtaining the percentage of hands-only CPR compressions and depths from the QCPR application, we classified them into correct and incorrect categories. The classification of depth and recoil of compression accuracy was based on the percentage benchmarks established by the American Heart Association (AHA). The benchmark value of 76% utilized for establishing the boundaries of depth and recoil accuracy was derived from the BLS examination checklist for healthcare providers.

Based on the value of 76% above, the depth and chest recoil in hands-only CPR carried out by respondents were divided into two categories: appropriate and inappropriate. Furthermore, the number of respondents who fall into both categories is reported as numbers and percentages.

Research ethics

The present study adheres to the research ethics guidelines established by the Health Research Ethics Committee of the Faculty of Medicine at Lambung Mangkurat University. The process of obtaining ethical clearance for research or medical studies involves the submission of relevant documentation to the Institutional Review Board (IRB) of the Faculty of Medicine at Lambung Mangkurat University. This step ensures that the research adheres to ethical guidelines and principles. The ethical appropriateness of this research was confirmed through the issuance of letter 564/KEPK-FK ULM/EC/XII/2022.

Results

Age

The mean of respondents's age 19,93 years, with a standard deviation of 1.639. The reported minimum age was seventeen, while the maximum age was twenty-three. Controlling potential age-related confounding factors in the study can be facilitated by the respondents' very homogeneous age distribution, as indicated by the low standard deviation and limited age range.

Based on the aforementioned statistics, it can be observed that the mean age of the respondents is 19.93 years, which falls within the adolescent age

Table 1: Distribution of depth and recoil

Variables	Accuracy	Frequency	Percentage
Depth	Right	28	93 %
	Wrong	2	7 %
Recoil	Right	30	100 %
	Wrong	0	0 %

range. During this stage of development, individuals exhibit accelerated learning capabilities, proficient physical aptitudes, and a strong inclination to apply acquired knowledge.

Gender

The proportion of male and female respondents in this study was relatively the same, with 13 male respondents (43,3 %) and 17 female respondents (56,7 %).

Depth and chest recoil

Most respondents (93%) succeeded in achieving the correct compression depth, and all respondents (100%) succeeded in performing chest recoil correctly. This success rate of above 90% shows that the training method used can be considered for teaching CPR techniques. A significant proportion of the respondents, specifically 93%, demonstrated adherence to the recommended standards by correctly executing chest compressions at a depth within the stated range of 5 - 6 cm, complies with high-quality CPR standards the American Heart Association (AHA) sets. Nonetheless, a notable proportion of respondents, specifically 7%, indicated that there was a requirement to rectify the depth of their chest compressions.

Additionally, The percentage of respondents who achieved appropriate chest recoil according to AHA guidelines reached 100%. the research indicates that respondents trained with foam pillows demonstrated proper execution of chest recoil by allowing sufficient time for the chest to fully rebound to its initial position subsequent to compression. The aforementioned substantial percentage indicates that foam pillows have the capacity to elicit a favourable rebound impact on individuals participating in research studies.

Discussion

In out-of-hospital cardiac arrest (OHCA), the community can act as lay rescuers and perform hands-only CPR while waiting for the medical team to arrive. When bystanders perform CPR on victims suffering out-of-hospital cardiac arrest (OHCA), they mostly concentrate on performing chest compressions, often known as hands-only CPR. A maximum chest recoil of 5–6 cm, together with a compression rate of 100–120 per minute and complete chest recoil, are characteristics of effective chest compressions[15]. One of the challenges in training the community is the high cost of mannequins for CPR training and their limited availability. Therefore, there is a need to search for alternative media that can be used to train CPR on a mass scale at a low cost. For example, foam pillow. The affordability, simplicity in design, and accessibility of materials of this training medium make it an ideal tool for CPR training. Its use can provide a practical and realistic training experience for individuals. Foam pillows are objects that are easily available in every home in Indonesia. With the availability of media to practice at home, people will have ample opportunities to learn CPR both classically and in online classes.

In this study, we focused on evaluating the effectiveness of a foam pillow in training respondents on the aspects of compression depth accuracy and chest recoil. The importance of maintaining adequate chest recoil and compression depth in CPR instruction is underscored by research outcomes. Emphasizing chest recoil in training enhances learners' understanding, leading to improved compression quality. The interplay between compression depth, recoil, and their impact on compression and recoil velocities highlights the need for training methods that prioritize these aspects. Understanding these correlations can enhance CPR practices in training and real-life situations, ultimately improving outcomes for cardiac arrest victims[16].

As a training medium, a foam pillow must be able to meet the skill targets intended in CPR training. The foam pillow should enable respondents to achieve the standards of High-Quality CPR for lay rescuers. High-Quality CPR consists of variables including a minimum compression depth of 5 cm, a rate of 100-120 compressions per minute, complete chest recoil, interruptions not exceeding 10 seconds, and changing rescuers every 2 minutes at most. Based on our result, the foam pillow specifically can be used to train respondents to perform

compressions with a minimum depth of 5 cm and complete chest recoil. Other variables can be achieved through synergistic methods with the training implementation (e.g., using a metronome for rate training).

Additional research findings suggest that a significant emphasis on attaining sufficient depth during training can lead to efficient acquisition of the suggested compression depth standards for adult CPR, which are commonly established at approximately 5-6 centimetres. The aforementioned emphasis guarantees that individuals within the community possess the necessary competencies to administer CPR of exceptional quality. Furthermore, it is imperative for individuals to respond to emergencies with confidence by emphasizing the importance of chest recoil and ensuring the maintenance of appropriate compression depth. The implementation of these essential components of cardiopulmonary resuscitation (CPR) can greatly enhance the likelihood of survival for those experiencing cardiac arrest. This underscores the vital importance of receiving adequate CPR training in order to save lives within the community[17].

The foam pillow, as a CPR training tool, offers lower resistance compared to standard mannequins and actual human chests. Consequently, it is essential to emphasize instructions that the desired compression depth should be a minimum of 5 cm. In cases where respondents are unable to estimate depth, they should be instructed to compress as deeply as possible.

Due to its affordability and widespread availability, the foam pillow has the potential to be utilized as a learning tool for CPR training at home. It can be combined with teaching methods that can reach respondents in their homes, such as online learning. Several studies have shown that online learning can improve both the skills and confidence of individuals in performing CPR. Birkun (2020) suggests that online CPR training can significantly increase the willingness of non-medically trained individuals to perform CPR in emergency situations. These findings indicate that online training is effective in imparting essential knowledge and boosting individuals' confidence to act appropriately in critical circumstances[18]. Additionally, Jiang (2020) conducted a study on the impact of online CPR training on individuals' self-assurance in administering CPR. The results suggest that online CPR training has the potential to enhance individuals' confidence in performing CPR, which is crucial for improving preparedness during a cardiac emergency[19]. Chong *et al*. (2023) also emphasize the potential of online CPR courses in expanding the reach of CPR training to a larger population[20]. In CPR training, the utilization of mannequins facilitates the opportunity for individuals to engage in practical, real-life scenarios, hence fostering a genuine learning experience in the acquisition of fundamental skills[14].

The utilization of hand-made mannequins, such as foam pillows, proves to be highly advantageous for CPR training in economically challenged communities. Research conducted by Nakagawa *et al*. (2021) demonstrates promising outcomes with hand-made mannequins in CPR training. Their study revealed that a 40-minute training session with hand-made mannequins achieved a teaching success rate of 89.4% across all CPR components, encompassing scene safety, assessment, hand placement, and high-quality CPR[21]. The use of foam pillows for this training refers to the concept of low-fidelity simulation. This concept emphasizes training using media that cannot provide feedback on the indicators being trained (for example, chest depth and recoil). The focus of low-fidelity simulation is on training the psychomotor skills of the training respondents[22]. Research on the use of low-fidelity media for teaching CPR in the community has been explored in recent studies by Nehra *et al*. (2017), Piscopi *et al*. (2018), and Ohle *et al*. (2021)[23–25]. Nehra *et a*l. compared the effectiveness of hands-only CPR training using a modified foam pillow with a plastic bottle made from PET to a traditional mannequin. Both groups showed proficiency in compression depth after training. However, the pillow group demonstrated higher accuracy in chest recoil, with 45 out of 50 respondents (90%) achieving correct compression depth and 38 out of 50 respondents (76%) demonstrating proper chest recoil[23–25]. On the other hand, Ohle *et al*. (2021) developed a CPR training method using toilet paper. Their study found that a higher percentage of respondents trained with toilet paper achieved correct compression depth compared to the mannequin group, with 61 out of 64 respondents (95.3%) successfully performing chest compressions at the correct depth. However, the toilet paper group had lower success rates in

achieving proper chest recoil, with 38 out of 64 respondents (59.4%) demonstrating correct chest recoil[24]. It has been demonstrated that foam pillows are valuable for teaching chest depth and recoil during CPR. The foam pillow's soft yet sturdy design, and the respondent can practice applying the right amount of pressure to reach the perfect depth of chest compression. Furthermore, during compression workouts, the foam pillow quickly assumes its normal shape as pressure is released, making it a useful model for training chest recoil. As a result, the foam pillow teaches respondents the correct release of pressure after compressions, which is essential for effective CPR, as well as the understanding and practice of optimum compression depth.

Conclusion

Foam Pillow demonstrate promising potential for enhancing chest depth and recoil during CPR training in home.

Contribution of authors

Abdurahman Wahid: Conceptualized and designed the study
M. Atoillah Isfandiari: Academic advisor
Bernadetta Germia Aridamayanti: Edited the paper
Shofy Aristia Wardani, Mahadani, Nida Islah Salsabila, Muhammad Syarif and Achmad Rifky Wiguna: Collected data
Maulidah: Analyzed Data.

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