Educational Effect of Practical Examination on Basic Cardiopulmonary Resuscitation Self-Learning

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KEYWORDS

Self-Instruction, via internet, Willingness, Knowledge, Performance

ABSTRACT

Simplification of basic cardiopulmonary resuscitation (CPR) enables easy production of videos for training, and non-face-to-face training can be provided via internet. The participants of this study were 89 university students who took basic CPR class in 2020. We utilized teaching materials that is a 50-minute teaching material for standard adult CPR, comprised of a 25-minute power point slide show and a 25-minute video. All participants completed self-learning via Google Classroom (Alphabet Inc., Mountain View, USA). The participants took compression-only (C-O) practical examination consisting of 180 chest compressions after 5-minute C-O CPR using Resusci Anne SkillReporter (Laerdal Medical, Stavanger, Norway). The collected data were analyzed at an α=.05 using the SPSS 20.0 for Windows (IBM Inc, New York, USA). Changes in willingness, knowledge, performance, and attitude toward CPR before and after the practical exam were analyzed using t-tests. Willingness to perform CPR increased from 1.78 to 2.02, showing a statistically significant change (p=.040). The knowledge score increased from 3.12 to 3.56 and performance score increased from 2.87 to 3.36. The attitude score increased from 3.39 to 3.69, and all these changes were statistically significant (p<.001; p<.001; p<.001). The practical exam on self-learning of basic CPR was effective on improving willingness, knowledge, performance, and attitudes of non-healthcare providers.

1. Introduction

According to the American Heart Association (AHA) guidelines, chest compression pauses should be minimized in basic cardiopulmonary resuscitation (CPR) by enhancing the quality and quantity of chest compressions. This is known as compression-only (C-O) CPR, where chest compressions are deeper and quicker, and the guidelines emphasize that the rescuer must not lean against the patient to ensure a completed recoil following chest compressions (Kleinman et al., 2015). Particularly, the goal is to simplify the procedure primarily focused on chest compressions such that laypersons can easily acquire the skills, which would promote education on basic CPR and increase cerebral blood flow and thus increase the patient's chances of survival. Furthermore, this simplified procedure omits artificial ventilation for easier training, omission of artificial ventilation has become an important component in CPR training for non-healthcare providers in the context of the COVID-19 pandemic to prevent the spread of infection.

In CPR training for non-healthcare providers during an epidemic, non-face-to-face training should be increased, and face-to-face training should be minimized or eliminated completely. According to the AHA guidelines, assessment is one of the Emergency Cardiovascular Care Educational Concepts (Bhanji et al., 2010). Face-to-face training could be minimized by implementing a simple assessment during which the instructor examines the students' level of competence achieved through non-face-to-face training and provides feedback about areas that need to be strengthened.

As the practical examination is anticipated to complement some shortcomings of non-face-to-face training, this study aimed to investigate the educational effects of practical examination on CPR self-learning. We assumed that practical examination would improve self-assessed scores of CPR attitude, knowledge, performance, and willingness.

2. Literature Review

Infection-free training circumstances have been established. Simplification of basic CPR enables easy production of videos for training, and non-face-to-face training can be provided via internet. There is also evidence that basic CPR self-instruction can partially replace the conventional face-to-face training. While it was a comparison with an untrained control group, a five-minute video-based self-instruction was effective on basic CPR performance and attitude to attempt basic CPR (Bobrow et al., 2011; Einspruch et al., 2007), and when compared to a control group that received a single session of conventional face-to-face training, repeated self-instruction using a video clip on a mobile phone was

continuously effective on basic CPR performance, confidence, and willingness to attempt basic CPR (Ahn, 2011). In a study that compared self-instruction using a 30-minute video and 30-minute face-to-face training, face-to-face training had superior effects on basic CPR performance and attitude in attempting basic CPR (Uhm & Kim, 2016). While face-to-face training was effective under the conditions of the same duration of training, video-based self-instruction was effective under the conditions of repeated learning using a video clip.

3. Methodology

The participants of this study were university students who took basic CPR class in 2020, and an informed consent was obtained from the participants. Eighty-nine students agreed to participate in the study, and the participants had the freedom to withdraw their consent at any point during or after the class without any repercussions. We utilized teaching materials developed based on the 2015 AHA guidelines for layperson adult CPR for non-face-to-face training (Kleinman et al., 2015). This is a 50-minute teaching material for standard adult CPR, comprised of a 25-minute PowerPoint slide show and a 25-minute video.

Data Collection

The participants of this study were students of 00 university who took basic CPR class in 2020, and an informed consent was obtained from the participants. Eighty-nine students agreed to participate in the study, and the participants had the freedom to withdraw their consent at any point during or after the class without any repercussions. We utilized teaching materials developed based on the 2015 AHA guidelines for layperson adult CPR for non-face-to-face training. This is a 50-minute teaching material for standard adult CPR, comprised of a 25-minute PowerPoint slide show and a 25-minute video.

The contents included the order, application, and precautions intended for a layperson adult CPR. However, this did not contain educational information on promoting willingness to perform CPR. Therefore, the teaching material did not include contents about the prevention of brain damage progression, confidence in the ability to perform the correct compression, understanding the sequelae of compression, confidence in the provider's own physical ability, low probability of infection, ability to overcome the patient's appearance, and awareness of exemption from liability.

All participants completed self-learning using the 50-minute self-instructional material conducted online for four weeks from April 2 to April 30, 2020 via Google Classroom (Alphabet Inc., Mountain View, USA). After eight weeks, on June 26, the participants took compression-only (C-O) practical examination consisting of 180 chest compressions after 5-minute C-O CPR using Resusci Anne SkillReporter (Laerdal Medical, Stavanger, Norway). The participants were given a 1–2-minute feedback about the test results immediately after the practical exam.

Data Analysis

We collected the participants' self-assessed scores for willingness to perform CPR, knowledge, performance, and attitude as well as their demographic information, previous CPR training, and number of views of the self-learning materials using pre and post questionnaires before and after the practical exam. We also obtained 89 manikin assessed scores using the short print out from the manikin. The collected data were analyzed at an α=.05 (two-tailed) using the SPSS 20.0 for Windows (IBM Inc, New York, USA). Changes in willingness, knowledge, performance, and attitude toward CPR before and after the practical exam for video-based self-learning were analyzed using paired *t*-tests.

4. Results and discussion

The mean age of the participants was 20.2 years, and there were 78 female students (87.6%). The mean number of previous CPR training sessions was 1.2, and 70 (78.7%) participants had previous CPR training. The participants viewed the self-learning video for an average of 1.9 times, with 37 (41.6%) watching the video once and 37 (38.2%) watching the video twice. The detail of 89 participants is summarized in Table 1.

Table 1: Participants' characteristics

Characteristics	N(%)
Age, M(SD)	20.2(2.23)
Gender	
male	11(12.4)
female	78(87.6)
Previous CPR training, M(SD)	1.2(0.41)
Yes.	70(78.7)
No.	19(21.3)
Number of views, M(SD)	1.9(1.04)
1	37(41.6)
2	34(38.2)
3≤	18(20.2)

M: mean, SD: standard deviation, CPR: cardiopulmonary resuscitation.

The manikin-assessed chest compression results were as follows: mean chest compression depth of 43.5 mm, mean compression rate of 119.7 compressions a minute, mean number of compressions of 187.5, compression accuracy of 20.5%, and mean incomplete recoil of 13.1 times. The manikin-assessed scores are summarized in Table 2.

Table 2: Chest compression scores at practical examination

Manikin assessed score (2015 AHA guidelines)	**M(SD)**
Average compression depth (50-60mm)	43.5(7.94)
Average compression rate (100-120/min)	119.7(9.49)
Average compression (#)	187.5(78.43)
Correct compression (%, 5cm+ / total compression)	20.5(28.66)
Incomplete recoil (#)	13.1(36.52)

AHA: American Heart Association, M: mean, SD: standard deviation, #: number.

Regarding willingness to perform CPR, for which students were allowed to choose more than one option, there were 22 more students who expressed willingness to perform CPR after the practical exam. There were 13 more cases with increased confidence in the ability to correctly perform CPR, and 10 more cases who had better understand of the sequelae of chest compressions. However, there were six fewer cases emphasizing on the prevention of brain injury progression, and two fewer cases with the ability to overcome the patient's appearances. Regarding low probability of infection and awareness of exemption from liability, there were only nine cases who expressed understanding of these areas after the practical exam. The willingness to perform cardiopulmonary resuscitation is summarized in Table 3.

Table 3: Willingness to perform cardiopulmonary resuscitation between pre and post practical examination

Multiple response (0-7)		**Case**	**Difference**
Prevention of brain damage progression	pre	59	-6
	post	53	
Confidence in ability to perform correct compression	pre	26	+13
	post	39	
Understanding of the damage caused by compression	pre	25	+10
	post	35	
Confidence in the provider's own physical ability	pre	13	+3
	post	16	
Low probability of infection	pre	4	+1
	post	5	
Ability to overcome the patient's appearance	pre	25	-2
	post	23	
Awareness of exemption from liability	pre	6	+3
	post	9	
Overall	pre	158	+22
	post	180	

In the self-assessed scores after the practical exam, cases indicating willingness to perform CPR increased from 1.78 to 2.02, showing a statistically significant change (p=.040). In addition, the knowledge score (degree of understanding) increased by 0.44 from 3.12 to 3.56 and performance score (degree of physical ability) increased by 0.49 from 2.87 to 3.36. The attitude score (degree of willingness to attempt CPR) increased by 0.3 from 3.39 to 3.69, and all these changes were statistically significant (p<.001; p<.001; p<.001). The self-assessed scores are summarized in Table 4.

Table 4: Self-assessed scores between pre and post practical examination

Self-assessed score (1-5) *		**M(SD)**	***t***	***p***
Willingness	pre	1.78(0.889)	-2.08	.040
	post	2.02(1.390)		
Knowledge	pre	3.12(0.654)	-5.72	<.001
	post	3.56(0.722)		
Performance	pre	2.87(0.741)	-5.64	<.001
	post	3.36(0.742)		
Attitude	pre	3.39(0.820)	-4.41	<.001
	post	3.69(0.732)		

M: mean, SD: standard deviation.

*Likert scale: 1, not at all; 2, not really; 3, undecided; 4, somewhat; 5, very much.

Our participants were young college undergraduates, and a substantial number of the participants had prior CPR training and completed two sessions of video-based learning within a month. Hence, their knowledge, performance, and attitude toward CPR were adequate even before the practical exam. The improvements after the practical exam seem to be attributable to the fact that the students were given a summary of their weaknesses and strength immediately after the practical exam. Therefore, feedback is effective when key issues are conveyed immediately. The fact that voice advisory manikin enhanced the accuracy of chest compression depth and audio feedback manikin increased the accuracy of the compression rate are in line with the previous findings that immediate feedback helped improve the quality of chest compressions (Leary et al., 2008; Uhm et al., 2011; Yeung et al., 2014; Mpotos et al., 2013; Sarma et al., 2017). Hence, the concept that trainings utilizing real-time audiovisual feedback manikin increased the application of CPR to patients with cardiac arrest in the hospital suggest that immediate feedback improved attitude (Abella et al., 2005).

Because low-fidelity manikins are widely used in basic CPR training for a layperson, it is necessary to implement the above methods of practical exams that can provide immediate feedback. Appropriate feedback extends CPR retention and can lengthen training intervals (Chiang et al., 2005; Wik et al., 2005); moreover, training using popular songs helped retain chest compression performance for 5 weeks and improved students' competence and confidence. Therefore, music should be utilized in video-based trainings (Hafner et al., 2012; Tastan et al., 2017).

New guidelines published amid the COVID-19 pandemic state that a practical exam can be an excellent means to address the shortcomings of non-face-to-face learning while minimizing infection risk (Edelson et al., 2020). With non-face-to-face training, according to the 2015 AHA guidelines (Kleinman et al., 2015), the mean compression rate met the cutoff, however the mean compression depth, compression frequency, and mean incomplete recoil did not. In particular, the low compression accuracy that resulted from frequent light compressions highlights the need to improve the push hard compression area, which is emphasized by the guidelines, in non-face-to-face training. The group that only watched the 5-minute video once showed improved performance score, while the group that watched the video twice showed improved knowledge and performance scores. The group that watched the video three times showed improved knowledge, performance, and attitude scores and demonstrated manikin chest compression competence close to that targeted in the guideline's willingness (Uhm & Kim, 2018). This result shows that repeated learning influences performance competence and highlights the need to repeat video-learning. However, there were no statistically significant differences, which is speculated to be due to the lack of hands-on practice and thus can be addressed

by the implementation of a practical exam.

While willingness to perform CPR was improved overall, prevention of brain injury progression and ability to overcome patient's appearances were slightly reduced, with a slight increase in the low probability of infection and awareness of exemption from liability. This shows that although the shortcomings of non-face-to-face training were partially addressed with a practical exam, limitations are still present. In a comparison of willingness to perform CPR between video self-instruction and the conventional method, the former group demonstrated reduced willingness while the latter group showed increased willingness (Uhm & Kim, 2016), and it is speculated that providing feedback through a practical exam following the video-based learning would have reduced this gap.

This study demonstrated the effectiveness of the practical examination on the same group after 50 minutes of video self-study and five minutes of manikin practice, the study on medical students showed excellent performance after two weeks in the experimental group with 3.5 hours of hospital resuscitation training and 30 minutes of skill test compared to the control group with four hours of hospital resuscitation training (Kromann et al., 2009). In other words, it has educational effects through training and skill tests, and skill tests can reduce practice to some extent. Although it will be difficult to completely replace practice, it is expected that skill test will be able to reduce practice to some extent.

5. Conclusion and future scope

The practical exam including feedback on self-learning of basic CPR was effective on improving willingness, knowledge, performance, and attitudes of non-healthcare providers. Further promoting non-face-to-face basic CPR training would enable a more affordable layperson basic CPR training. Assessment, which is one of the Emergency Cardiovascular Care Educational Concepts outlined in the AHA guidelines, should be utilized more widely as a means of feedback not only in the conventional training but also in the non-face-to-face training.

However, as this study analyzed the educational effects by collecting students' responses before and after the practical exam, other methods should be utilized to measure changes in willingness, knowledge, performance, and attitude, and case-control studies should also be conducted for comparative analysis.

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