[Research Paper]

동영상 자가 학습 후 음악과 메트로놈 실습 간의 성인 마네킹 가슴압박 비교

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Comparison of Adult Manikin Chest Compression between Music and Metronome Practice after Video Self-Instruction

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요 약

이 연구는 동영상 자가 학습 후 음악과 메트로놈 실습에 따른 마네킹 가슴압박 성적의 차이와 심폐소생술 자가평가 점수에 대한 분석을 통해 가슴압박 훈련을 개선하기 위해 실시했다. 64명의 참여자들은 50 min의 비대면 자가 학습과 25 min의 가슴압박 심폐소생술을 실습했다. 음악 훈련군 32명은 비지스의 스테이브 얼라이브 노래의 분당 103회에 맞춰 가슴압박 심폐소생술을 훈련했고 메트로놈 훈련군 32명은 분당 100회에 맞춰 가슴압박 심폐소생술을 훈련했다. 훈련 직후에 참여자들은 레어달 스킬리포터 마네킹을 대상으로 가슴압박을 150회 실시했고 연구자들은 출력 결과 64건을 수집했으며 실습 전후의 질문조사를 통해 의향, 지식, 술기, 태도에 대한 자가평가점수를 128건을 수집했다. 음악과 메트로놈 훈련에 따른 마네킹 가슴압박 성적의 차이는 없었다. 두 가지 훈련 방법은 미국심장협회의 가슴압박 지침과 부합하거나 유사한 성적을 나타냈다. 따라서 기존의 메트로놈 훈련 방법처럼 음악을 활용하여 일반인 가슴압박 심폐소생술 훈련에 활용할 수 있으나 가슴압박 깊이를 지침에 맞도록 유지하는 방법에 대한 보완 연구가 필요하며 인공호흡은 다른 교정 장비를 활용한 방법으로 훈련해야 한다.

ABSTRACT

The study was conducted to improve chest compression training by analyzing manikin-assessed scores on chest compression and self-assessed scores on cardiopulmonary resuscitation (CPR) based on music and metronome training after video self-instruction (VSI). The 64 participants had undertaken 50 min of VSI and practiced 25 min of compression-only (C-O) CPR. Thirty-two participants of the music (the Bee Gees' Stayin' Alive) training group practiced C-O CPR 103 times a min, while 32 participants of the metronome training group practiced C-O CPR at 100 times a min. Immediately after the training, participants performed 150 chest compressions on Resusci Anne SkillReporter; researchers collected 64 printouts, and 128 self-assessed scores on willingness, knowledge, performance, and attitude through pre and post-training questionnaires. There was no difference in the manikin-assessed scores between the music and metronome training groups. The two training methods were consistent with or similar to the compression guidelines. Therefore, C-O CPR training can be imparted by utilizing music as well as the existing metronome training method; however, supplementary research on how to maintain compression depth is needed, and ventilation training should be provided using other feedback devices.

Keywords : Training, Cardiopulmonary resuscitation (CPR), Knowledge, Performance, Attitude

1. Introduction

The American heart association (AHA) guidelines have simplified basic cardiopulmonary resuscitation (CPR) by primarily focusing on ensuring the quality and quantity of chest

compressions. To this end, the guidelines emphasize compression-only (C-O) CPR and minimizing hands-off time. Chest compressions are deeper and quicker, and the guidelines emphasize that the rescuer must not lean against the patient to ensure completed recoil following chest compression⁽¹⁾. The guidelines are

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focused on increasing the chances of survival of the patient who had a cardiac arrest by helping layperson to easily learn the skills so as to promote basic CPR and increase cerebral blood flow. Applying effective chest compression training to layperson would enhance the survival of out-of-hospital cardiac arrest (OHCA) patients.

Voice advisory manikin enhanced the accuracy of chest compression depth⁽²⁾, and audio feedback manikin increased the accuracy of compression rate⁽³⁾. Feedback/prompt devices have improved CPR retention⁽⁴⁾, and CPR training utilizing verbal/audio-prompts feedback led to equal improvements^(5,6). Training using real-time audiovisual feedback manikin increased the implementation of CPR for in-hospital cardiac arrest patients⁽⁷⁾. In comparing 30 min video self-instruction (VSI) with 30 min face-to-face education, face-to-face education showed better results in CPR skills and willingness to perform CPR⁽⁸⁾. VSI through repeated viewing of CPR videos affected positively not only CPR knowledge but also performance and attitude⁽⁹⁾. Although face-to-face training is effective, the effects of VSI have been confirmed in repeated learning conditions using video.

The Bee Gees' Stayin' Alive (Broadcast Music Inc., Nashville, USA) retained chest compression performance for five weeks and improved trainees' competence and confidence⁽¹⁰⁾, and training using a metronome also enhanced chest compression performance^(11,12). These training programs utilized a manikin, and they contributed to improving basic CPR and the CPR implementation rate in the hospital. As shown here, training is administered using manikins with various performance specifications, however because low-fidelity manikins are useful for group training for laypersons, training techniques that can replace various features must be employed. Although metronomes are generally used and music is also used, music can be utilized more widely if there are no differences in their effectiveness. Because training with guidance from a popular song has been shown to prevent deterioration of chest compression rate over time⁽¹³⁻¹⁵⁾.

In this study, we analyzed the differences in the manikin chest compression scores and CPR self-assessed scores between hands-on training using music and metronome following a video-based self-learning and anticipated that training using music would improve chest compression as would training using a metronome.

2. Methods

2.1 Sample Design

The participants of this study were second- and third-year

students of 00 University who have taken a basic CPR class, and an informed consent was obtained from the students. Sixty-four 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 disadvantages. We developed teaching materials based on the 2015 AHA guidelines for layperson adult CPR⁽¹⁾. This teaching material for standard adult CPR consisted of 50 min, with 25 min of a PowerPoint slide show and 25 min of video. The contents included the order, application, and precautions for layperson adult CPR, however it did not contain education to promote willingness to perform CPR. All participants completed an online 50 min video self-instruction (VSI) via Google Classroom (Alphabet Inc., Mountain View, USA) until April 23, 2020. We divided the participants into two groups (music and metronome) with 32 students in each group via stratified sampling on sex. Two assistant instructors were assigned to each group to help with the hands-on practice. The participants were assigned one Actar 911 Squadron (Non-feedback mannequin, Vital signs, New jersey, USA) to practice C-O CPR for 25-m. The duration of the entire session was 75 min, consisting of 50 min of online VSI and 25 min of offline C-O CPR practice.

2.2 Analysis Method

Thirty-two participants in the music training group practiced C-O CPR at a rate of 103 beats/min while listening to the Bee Gees' Stayin' Alive (Broadcast Music Inc., Nashville, USA). Thirty-two participants in the metronome training group practiced C-O CPR at a rate of 100 beats/min. Immediately after the training, the participants performed 150 chest compressions using Resusci Anne SkillReporter (Laerdal Medical, Stavanger, Norway) for a skill assessment, and 64 manikin-assessed scores were collected. Further, we collected 128 self-assessed scores for willingness, knowledge, performance, and attitude as well as participants' demographic factors and previous CPR training toward CPR via pre and post questionnaires.

The collected data were analyzed using the SPSS 20.0 for Windows (IBM Inc, New York, USA) at an $\alpha=.05$ (two-tailed). The study was designed as a randomized controlled trial. The differences in C-O CPR scores for compression depth, compression rate, incorrect pressure point, incomplete recoil, and compression correctness between the music and metronome groups were analyzed with independent t-tests, and the self-assessed scores before and after the assessment between the music and metronome groups were compared with analysis of covariance (ANOVA).

3. Results

Table 1 shows that 64 participants were enrolled, and the mean age of the participants was 21.6 years. There were 24 male (37.5%) and 40 female (62.5%) students. Thirty-three students had previous basic CPR training (51.2%), with a greater number of students with prior training in the metronome group ($n = 18$).

Table 2 shows that there were no statistically significant differences in the five chest compression scores between the two groups. While compression depth did not meet the cutoff, at 47.3 mm in the music group and 49.1 mm in the metronome group, the metronome group was close to the target. Compression rates were in compliance with the criteria, at 115.4 per min in the music group and 110.1 per min in the metronome group. Number of compressions for 5 cycles

Table 1. Participants' Characteristics

N = 64(%)			
Participants		Training	
		Music*	Metronome**
Group	64 (100.0)	32 (50.0)	32 (50.0)
Age, M (SD)	21.6 (1.7)	21.4 (1.7)	21.7 (1.8)
Sex			
Male	24 (37.5)	12 (37.5)	12 (37.5)
Female	40 (62.5)	20 (62.5)	20 (62.5)
Previous CPR Training			
Yes	33 (51.2)	15 (46.9)	18 (56.3)
No	31 (48.8)	17 (53.1)	14 (43.7)

M: Mean, SD: Standard deviation,

CPR: Cardiopulmonary resuscitation

*Music: Stayin' Alive, **Metronome: 100 / min

Table 2. Comparison of Chest Compression Scores between Music and Metronome Training

Manikin-Assessed Score	M (SD)		<i>t</i>	<i>p</i>
	Music	Metronome		
Average Compression Depth (50-60 mm)	47.3 (8.9)	49.1 (7.6)	-0.750	.405
Average Compression Rate (100-120 / min)	115.4 (13.9)	110.1 (7.8)	1.882	.087
Total Compression (150 #)	158.1 (18.5)	151.8 (10.8)	4.765	.456
Correct Compression (100%)	43.3 (37.2)	54.5 (35.5)	-1.935	.370
Incomplete Recoil (0 #)	10.2 (24.8)	6.4 (15.5)	2.132	.054

M: Mean, SD: Standard deviation, #: Number

exceeded the criterion, at 158.1 in the music group and 151.8 in the metronome group, however the metronome group was close to the target. The percentage of participants with accurate pressure point was 43.3% in the music group and 54.5% in the metronome group, showing relatively better results in the metronome group. Number of incomplete recoil was 10.2 in the music group and 6.4 in the metronome group, showing relatively better results in the metronome group.

Table 3 shows a comparison of self-assessed scores before and after the training between the two groups. The willingness score (Number of relevant responses in 7 items on willingness) increased from 2.9 to 3.4 in the music group and from 3.0 to 3.3 in the metronome group, however there were no statistically significant differences between the groups. The knowledge score increased from 2.7 to 3.2 in the music group and from 2.9 to 3.3 in the metronome group, however there were no statistically significant differences between the groups. The performance score increased from 2.6 to 3.3 in the music group and from 2.7 to 3.4 in the metronome group, however there were no statistically significant differences between the groups. The attitude score increased from 2.7 to 3.3 in the music group and from 2.8 to 3.2 in the metronome group, however there were no statistically significant differences between the groups.

Table 3. Comparison of Self-Assessed Scores between Training Group and Pre & Post Training

Self-Assessed score		M (SD)		<i>F</i>	<i>p</i>
		Music	Metronome		
CPR Willingness*	Pre	2.9 (1.9)	3.0 (1.9)	4.023	.068
	Post	3.4 (2.0)	3.3 (2.4)		
Knowledge**	Pre	2.7 (0.9)	2.9 (0.8)	5.679	.057
	Post	3.2 (0.8)	3.3 (0.7)		
Performance**	Pre	2.6 (0.8)	2.7 (0.9)	6.605	.054
	Post	3.3 (0.8)	3.4 (0.9)		
Attitude**	Pre	2.7 (0.7)	2.8 (0.8)	4.771	.061
	Post	3.3 (1.1)	3.2 (1.4)		

M: Mean, SD: Standard deviation, CPR: Cardiopulmonary resuscitation

*Number of willingness variables: 0-7 (Prevention of brain damage progression; confidence in ability to perform correct compression; understanding of the damage caused by compression; Confidence in the Provider's own physical ability; low probability of infection; Ability to overcome the patient's appearance; Awareness of exemption from liability)

**Likert Scale: 0-5 (1, Not at all; 2, Not really; 3, Undecided; 4, Somewhat; 5, Very much)

4. Discussion

Manikin compression scores and CPR self-assessment scores were analyzed for the music and metronome groups, and there were no differences in the scores between the two groups. In this study, compression scores were compared because both training methods are not appropriate for learning artificial ventilation. This is in line with the AHA guidelines, which emphasize chest compression in layperson CPR, and is also an economical option. A systematic review on laypersons and healthcare providers reported that feedback/prompt devices are effective in the learning, retention, and performance of chest compression and artificial ventilation⁽⁴⁾, however manikins with such features are costly and difficult to transport, which limits their use for layperson training. Study results that using a metronome on the provider's cell phone in a CPR scenario led to satisfactory chest compressions, though implementation was delayed, however artificial ventilation was inadequate sheds light on the limitations of these two training methods⁽¹⁰⁾.

While compression rates in both the music and metronome groups were within the target recommended in the guidelines, compression depth did not meet the target. This is consistent with prior findings that a metronome helps maintain the compression rate, however does not assist in maintaining the compression depth⁽¹²⁾, calling for further attention to maintain an appropriate compression depth in music and metronome training. Based on the results of a study that divided nursing students into the music group and no music group and observed that the music group had better compression rates-although no follow-up was performed in the said study-⁽¹⁶⁾ and results of a study that divided laypersons into the metronome and no metronome groups and reported that the metronome group continuously had better compression scores immediately after the training and 6 weeks later⁽¹⁰⁾, these two training methods are speculated to have comparable effects on the retention of compression performance. Moreover, a study that reported that healthcare providers who had been trained with CPR using popular music felt as if their performance and confidence were boosted⁽¹⁷⁾, and although statistically insignificant, this is similar to the partial improvements after training⁽¹⁰⁾. Although these results were self-assessed scores and thus are limited, they indicate the training was effective, as confidence is an important factor in a cardiac arrest situation. However, the fact that there were no statistically significant changes after the training suggests that the 25 min face-to-face compression training had little contribution to learning, however the cause cannot be determined in the present study.

The educational effects of non-face-to-face basic CPR training have already been substantiated to an extent, so in the present study, we were able to analyze the differences in the outcomes between two different hands-on training methods following non-face-to-face education utilizing PowerPoint slides and video. While it was a comparison with an untrained control group, a five-min VSI was effective on basic CPR performance and attitude to attempt basic CPR^(18,19). Further, a study that aimed to investigate the effects of the duration of VSI on basic CPR performance and attitude in college students instructed the 5 min VSI group to watch the video once, 10 min VSI group to watch the video twice, and 15 min VSI group to watch the video 3 times, and their results confirmed that repeated viewing was educationally effective. When the changes of their self-assessed scores were compared before and after the VSI, the 5 min group showed statistically significant changes in performance score, while the 10 min group showed statistically significant changes in the knowledge and performance scores. The 15 min group showed statistically significant changes in the knowledge, performance, and attitude scores. In a study that compared 30 min of VSI and 30 min of face-to-face learning, the latter was more effective in improving CPR performance and willingness⁽⁷⁾. Thus, we designed our program to consist of 50 min of non-face-to-face self-learning and 25 min face-to-face chest compression practice. However, the lack of statistically significant results after face-to-face training in contrast to previous findings should be further examined in subsequent studies.

Accuracy of artificial ventilation (Number of artificial ventilations with 500-800 ml per second out of total number of artificial ventilations given) increased with increasing learning duration, with statistically significant differences among the three groups, specifically between the 5 min and 15 min VSI groups and between the 10 min and 15 min VSI groups⁽⁷⁾. According to the said study, even if high-fidelity manikins that are used in advanced life support (ALS) training cannot be used in basic CPR training, a simple feedback device could be used to increase the learning effects and increase the training interval. Even a simple manikin feedback device is effective for hands-on training and can be utilized as an objective assessment parameter. With correction using a light, metronome, or music, the trainee's performance would naturally be improved. Audio devices are helpful for learning the compression rate, while visual devices help learn compression depth and recoil. Ultimately, manikin feedback can contribute to enhancing the quality of basic CPR at the scene. To increase the return of spontaneous circulation (ROSC) with OHCA patients, continuous basic CPR education

programs are needed along with effective training⁽²⁰⁾. It is also necessary to study the effect of music and metronome practice after VSI on CPR retention.

5. Conclusions

There were no differences in the manikin-assessed compression scores between the music and metronome groups. The two training methods were either in line with the compression guidelines or produced scores close to the guidelines. In addition, there were no differences in self-assessed performance, knowledge, attitude, and willingness scores between the music and metronome groups. Thus, music would be a viable alternative to metronome for C-O training. Although it did not confirm the effectiveness of non-face-to-face education, the training methods were in line with or were close to the compression guidelines, so non-face-to-face training would be an option for basic CPR training. However, further studies are needed to examine ways to help maintain appropriate compression depths, and artificial ventilation must be trained using other equipment.

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