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. In this study, we conducted a comparison of adult manikin chest compression between music and metronome practice after video self-instruction. 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
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-min. 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 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.
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 layperson and healthcare providers reported that feedback/promp 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. 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. However, further studies are needed to examine ways to help maintain appropriate compression depths, and artificial ventilation must be trained using other equipment.

Acknowledgment

This research was supported by 2020 Eulji university University Innovation Support Project grant funded.

References

1. M. E. Kleinman, E. E. Brennan, Z. D. Goldberger, R. A. Swor, M. Terry, B. J. Bobrow, R. J. Gazmuri, A. H. Travers et al., “Adult Life Support and Cardiopulmonary Resuscitation Quality. In: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care”, Circulation, Vol. 132, pp. S414-S435 (2015). https://doi.org/10.1161/CIR.0000000000000259.

2. M. Leary and B. S. Abella, “The Challenge of CPR Quality: Improvement in the Real World”, Resuscitation, Vol. 77, No. 1, pp. 1-3 (2008). https://doi.org/10.1016/j.resuscitation.2008.02.005.

3. T. H. Uhm, T. Y. Moon and J. H. Kim, “Comparison of Adult CPR Skill Scores: Real-time Visual Feedback Manikin Anne Skillreporter vs. Non-feedback Manikin (Actar 911 Squadron)”, The Korean Society of the Journal of Emergency Medical Technology, Vol. 15, No. 2, pp. 101-108 (2011). https://doi.org/10.14408/KJEMS.2011.15.2.101.

4. J. Yeung, R. Meeks, D. Edelson, F. Gao, J. Soar and G. D. Perkins, “The Use of CPR feedback/prompt Devices During Training and CPR Performance: A Systematic Review”, Resuscitation, Vol. 80, No. 2, pp. 743-751 (2009). https://doi.org/10.1016/j.resuscitation.2009.04.012.

5. L. Wik, H. Myklebust, B. H. Auestad and P. A. Steen, “Twelve-month Retention of CPR Skills with Automatic Correcting Verbal Feedback”, Resuscitation, Vol. 66, No. 1, pp. 27-30 (2005). https://doi.org/10.1016/j.resuscitation.2004.12.022.

6. W. C. Chiang, W. J. Chen, S. Y. Chen, P. C. I. Ko, C. H. Lin, M. S. Tsai, W. T. Chang, S. C. Chen et al., “Better Adherence to the Guidelines during Cardiopulmonary Resuscitation Through the Provision of Audio-prompts”, Resuscitation, Vol. 64, No. 3, pp. 297-301 (2005). https://doi.org/10.1016/j.resuscitation.2004.09.010.

7. T. H. Uhm and J. H. Kim, “Comparison of Willingness to Perform Cardiopulmonary Resuscitation between Video Self-instruction and Conventional Method”, Indian Journal of Science & Technology, Vol. 9, pp. 1-6 (2016). https://doi.org/10.17485/ijst/2016/v9i6/103230.

8. T. H. Uhm and J. H. Kim, “Effectiveness of 5, 10, 15 min Video Self-Instruction in Cardiopulmonary Resuscitation Training”, Research Journal of Pharmacy and Technology, Vol. 11, No. 2, pp. 649-651 (2018). https://doi.org/10.5958/0974-360X.2018.00121.X.

9. B. S. Abella, D. P. Edelson, S. Kim, E. Retzer, H. Myklebust, A. M. Barry, N. O’Hearn, T. L. V. Hock et al., “CPR Quality Improvement during In-hospital Cardiac Arrest using a Real-time Audiovisual Feedback System”, Resuscitation, Vol. 73, No. 1, pp. 54-61 (2006). https://doi.org/10.1016/j.resuscitation.2006.10.027.

10. J. W. Hafner, A. C. Jou, H. Wang, B. B. Bleess and S. K. Tham, “Death before Disco: The Effectiveness of a Musical Metronome in Layperson Cardiopulmonary Resuscitation Training”, The Journal of Emergency Medicine, Vol. 48, No. 1, pp. 43-52 (2014). https://doi.org/10.1016/j.jemermed.2014.07.048.

11. P. Paal, I. Pincher, T. Baur, E. Gruber, A. M. Strasak, H. Herff, H. Brugger, V. Wenzel et al., “Mobile Phone-assisted Basic Life Support Augmented with a Metronome”, The Journal of Emergency Medicine, Vol. 43, No. 3, pp. 472-477 (2011). https://doi.org/10.1016/j.jemermed.2011.09.011.

12. T. N. Chung, S. W. Kim, J. S. You, Y. S. Cho, S. P. Chung, I. Park and S. H. Kim, “The Specific Effect of Metronome Guidance on the Quality of One-person Cardiopulmonary Resuscitation and Rescuer Fatigue”, The Journal of Emergency Medicine, Vol. 43, No. 6, pp. 1049-1054 (2012). https://doi.org/10.1016/j.jemermed.2012.01.021.

13. M. Woollard, J. Poposki, B. McWhinnie, L. Rawlins, G. Woollard, J. Poposki, B. McWhinnie, L. Rawlins, G.
Munro and P. O’Meara, “Achy Breaky Makey Wakey Heart? A Randomised Crossover Trial of Musical Prompts”, Emergency Medicine Journal, Vol. 29, pp. 290-294 (2012). https://doi.org/10.1136/emermed-2011-200187.

14. J. H. Oh, S. J. Lee, S. E. Kim, K. J. Lee, J. W. Choe and C. W. Kim, “Effects of Audio Tone Guidance on Performance of CPR in Simulated Cardiac Arrest with an Advanced Airway”, Resuscitation, Vol. 79, pp. 273-277 (2006). https://doi.org/j.resuscitation.2008.06.022.

15. C. K. Hong, S. Y. Hwang, K. Y. Lee, Y. S. Kim, Y. R. Ha and S. O. Park, “Metronome vs. Popular Song: a Comparison of Long-term Retention of Chest Compression Skills after Layperson Training for Cardiopulmonary Resuscitation”, Hong Kong Journal of Emergency Medicine, Vol. 32, No. 3, pp. 145-152 (2016).

16. S. Tastan, H. Ayhan, V. Unver, F. I. Cinar, G. Kose, T. Basak, O. Cinar and E. Iyigun, “The Effects of Music on the Cardiac Resuscitation Education of Nursing Students”, International Emergency Nursing, Vol. 31, pp. 30-35 (2017). https://doi.org/10.1016/j.ienj.2016.06.007.

17. J. W. Hafner, J. L. Sturgell, D. L. Matlock, E. G. Bockewitz and L. T. Barker, “Stayin’ Alive”: A Novel Mental Metronome to Maintain Compression Rates in Simulated Cardiac Arrests”, The Journal of Emergency Medicine, Vol. 43, No. 5, pp. e373-e377 (2012). https://doi.org/10.1016/j.jemermed.2012.01.026.

18. B. J. Bobrow, T. F. Vadeboncoeur, D. W. Spaite, J. Potts, K. Denninghoff, V. Chikani, P. R. Brazil, B. Ramsey et al., “The Effectiveness of Ultrabrief and Brief Educational Videos for Training Lay Responders in Hands-Only Cardiopulmonary Resuscitation: Implications for the Future of Citizen Cardiopulmonary Resuscitation Training”, Circulation: Cardiovascular Quality and Outcomes, Vol. 4, pp. 220-226 (2011). https://doi.org/10.1161/CIRCOUTCOMES.110.959353.

19. E. L. Einspruch, B. Lynch, T. P. Aufrheide, G. Nichol and L. Becker, “Retention of CPR Skills Learned in a Traditional AHA Heartsaver Course Versus 30 min Video Self-training: A Controlled Randomized Study”, Resuscitation, Vol. 74, pp. 476-846 (2007). https://doi.org/10.1016/j.resuscitation.2007.01.030.

20. S. H. Bang, J. H. Kim, G. Y. Kim and S. G. Roh, “A Case Report of ROSC for Out-of Hospital Cardiopulmonary Resuscitation: Based on One Area Heart Saver”, Journal of Korean Institute of Fire Science & Engineering, Vol. 27, No. 4, pp. 61-67 (2013). http://dx.doi.org/10.7731/KIFSE.2013.27.4.61.