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ORIGINAL ARTICLE

The Impact of Downbeat Fit-CPR Music on Compression Rate During Cardiopulmonary Resuscitation by Undergraduate Students: A Randomised Controlled Trial

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ABSTRAK

Metronom muzik merupakan salah satu kaedah untuk membantu orang awam melakukan penekanan dada pada kadar yang optimum. Kajian ini menilai pengaruh muzik Fit-resusitasi kardiopulmonari (CPR) dengan rentak turun yang inovatif berbanding tanpa muzik dalam membimbing orang awam melakukan CPR berkualiti tinggi. Satu kajian percubaan terkawal secara rawak telah dijalankan dalam kalangan pelajar sarjana muda bukan perubatan di Lembah Klang, dengan membandingkan kumpulan muzik Fit-CPR (intervensi) dengan latihan CPR piawai (kawalan). Kumpulan intervensi menerima latihan CPR tanpa bantuan pernafasan selama 90 minit, yang merangkumi kuliah, tayangan video dan tiga pusingan latihan CPR bersama fasilitator sambil mendengar muzik. Kumpulan kawalan menjalani latihan yang sama tanpa muzik. Hasil utama kajian merangkumi komponen berkaitan penekanan dada (kadar, kedalaman serta pulangan dada) dan komponen bukan berkaitan penekanan dada (keselamatan, tindak balas, bantuan, pemeriksaan pernafasan dan penempatan tangan). Seramai 53 pelajar terlibat dengan 27 orang (50.9%) dalam kumpulan intervensi dan 26 orang (49.1%) dalam kumpulan kawalan. Kedua-dua kumpulan menunjukkan peningkatan prestasi CPR yang signifikan selepas latihan ($p < 0.001$). Kumpulan intervensi menunjukkan prestasi lebih baik berbanding kumpulan kawalan dalam komponen penekanan dan bukan penekanan dada ($p = 0.008$, $p = 0.031$). Terdapat hubungan signifikan antara intervensi dan kadar penekanan dada ($p < 0.001$), di mana 96.3% peserta dalam kumpulan intervensi mencapai kadar yang disarankan berbanding 53.8% dalam kumpulan kawalan. Walau bagaimanapun, tiada hubungan signifikan ditemui bagi kedalaman penekanan dada atau pulangan dada ($p = 1.000$, $p = 0.498$). Kajian ini menunjukkan bahawa muzik Fit-CPR membantu orang awam mengekalkan kadar penekanan dada yang disarankan oleh Persatuan Jantung Amerika, sekaligus berpotensi menjadi alat bantuan latihan CPR yang berkesan.

Kata kunci: *Latihan; metronom muzik; orang awam; pendidikan; resusitasi kardiopulmonari; sarjana muda*

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ABSTRACT

A musical metronome is one method to assist the public in performing optimal chest compressions. This study evaluated the influence of innovative downbeat Fit-cardiopulmonary resuscitation (CPR) music versus no music on guiding laypersons to perform high-quality CPR. A randomised controlled trial was conducted among non-medical undergraduate students in Klang Valley, comparing a Fit-CPR music group (intervention) to standard CPR training (control). The intervention group received 90 minutes of hands-only CPR training, including a lecture, video presentation and three rounds of CPR practice with facilitators while listening to music. The control group underwent the same training without music. Primary outcomes included chest compression-associated components (rate, depth, recoil) and non-compression components (safety, response, help, breathing check, hand placement). A total of 53 students participated, with 27 (50.9%) in the intervention and 26 (49.1%) in the control group. Both groups showed significant improvement post-training ($p < 0.001$). The intervention group outperformed the control in compression and non-compression components ($p = 0.008$, $p = 0.031$). A significant association was found between the intervention and compression rate ($p < 0.001$), with 96.3% achieving the target rate compared to 53.8% in the control. However, no significant association was found for compression depth or recoil ($p = 1.000$, $p = 0.498$). This study demonstrates that Fit-CPR music helps laypersons to sustain the American Heart Association-recommended chest compression rate, highlighting its potential as an effective CPR training aid.

Keywords: Cardiopulmonary resuscitation; education; musical metronome; public; training; undergraduate

INTRODUCTION

Sudden cardiac arrest remains a leading cause of mortality worldwide (Harmon et al. 2011; Xu et al. 2010). Prompt initiation of cardiopulmonary resuscitation (CPR) following a cardiac arrest can significantly improve survival rates (Hasselqvist-Ax et al. 2015). According to the American Heart Association (AHA), CPR should not only begin immediately but should also be performed by a bystander to enhance outcomes. High-quality CPR guidelines emphasise maintaining a compression rate of 100-120 per minute, as survival is closely linked to this parameter (Abella 2013). In this context, the general public plays a vital role in strengthening the chain of survival. Furthermore, CPR training can be effectively delivered to the broader community (Isa et al. 2019; Lenzer 2003).

While there are clear written recommendations for CPR delivery and well-established programmed for CPR skill training, the quality of CPR administered during real cardiac arrest, both in-hospital and out-of-hospital, remains substandard (Abella et al. 2005; Isa et al. 2019; Valenzuela et al. 2005). This is corroborated by research demonstrating that chest compression procedures are frequently performed ineffectively (Kern et al. 2002). Even some medical personnel have been shown to be unable of providing effective chest compression (Saiboon et al. 2007).

Various public initiatives have been introduced to improve CPR outcomes. One approach has been the use of audio feedback, such as a musical metronome, to help maintaining the AHA-recommended chest compression rate. However, the traditional metronome, relying solely on a ticking sound, has been considered less appealing (Hong et al. 2016). Research has explored the use of music as a potential tool to assist the public in maintaining a compression rate of approximately 100 beats per minute (bpm). Songs like *Stayin' Alive* by the Bee Gees (RSO Records) (Matlock et al. 2008) and the nursery tune *Nellie the Elephant* by Mandy Miller (Parlophone Records Limited) (Rawlins et al. 2009) have been studied for this purpose. However, not all songs are suitable for CPR training. In fact, one study found that training with *Nellie the Elephant* was ineffective

in achieving high-quality chest compressions (Rawlins et al. 2009).

Hence, there is a pressing need for an intervention that can assist the public in developing high-quality CPR skills while also increasing their confidence in performing CPR in real-world scenarios. Any steps done to streamline and simplify CPR training might help to increase retention (Moser & Coleman 1992). Thus, a downbeat Fit-CPR music was produced with a beat optimised for CPR training. It was composed in this manner to emphasise the downbeats and goes at a speed of 100 bpm. This tempo can assist in determining the most effective rate of chest compression. Thus, we conducted a study to evaluate the impact of downbeat Fit-CPR music in assisting the public to perform high-quality CPR compared to training without music. We anticipated that participants in the music-assisted group would achieve higher-quality CPR performance than those in the non-music-assisted group.

MATERIALS AND METHODS

Study Design

A prospective randomised interventional study was done to assess the performance of high-quality CPR between a music-assisted group (intervention) utilising an innovative downbeat Fit-CPR song and a non-music-assisted group (control).

Setting

This pre- and post-intervention study was conducted among non-medical undergraduate university students in Klang Valley, Malaysia between 1st February 2020 to 30th September 2020. Ethical approval was obtained from the Universiti Kebangsaan Malaysia (UKM) Medical Research and Ethics Committee (JEP-2020-271) prior to data collection and was performed following the ethical standard of the Helsinki Declaration. All participants received detailed written and verbal information about the study objectives, procedures, potential risks and their rights as participants. Participation was entirely voluntary, and informed consent was obtained from each participant before enrollment. Confidentiality of participant data was maintained throughout the study. All data were anonymised using unique identification codes. Participants were informed of their right to withdraw from the study at any time without penalty or consequences. As the study involved CPR training on manikins without any invasive procedures or real-life patient involvement, it was considered to involve minimal risk. Additionally, all training sessions were conducted under supervision by certified instructors, and necessary precautions were taken to prevent injury or overexertion.

Participants

Participants were first- and second-year undergraduate students from various non-health-related faculties. Recruitment was conducted through open invitations shared on online student platforms. Students who expressed interest voluntarily registered for the study and were screened based on predefined eligibility criteria. Those who had received formal CPR training within the past two years, or did not complete the study protocol were excluded to minimise potential bias from prior exposure and ensure consistency in training. Selected participants were enrolled and subsequently randomised into two parallel groups: the music-assisted group (intervention) and the non-music-assisted group (control). Randomisation was performed using a computer-generated table of random numbers. To ensure allocation concealment, sequentially numbered, sealed envelopes were prepared by an independent assistant who was not involved in the recruitment or data collection process. Each envelope contained the group assignment and was opened only after the participant's enrollment was confirmed. The researcher assigned participants to their respective groups based on the envelope contents. Figure 1 presented the data collection using the Consolidated Standards of Reporting Trials

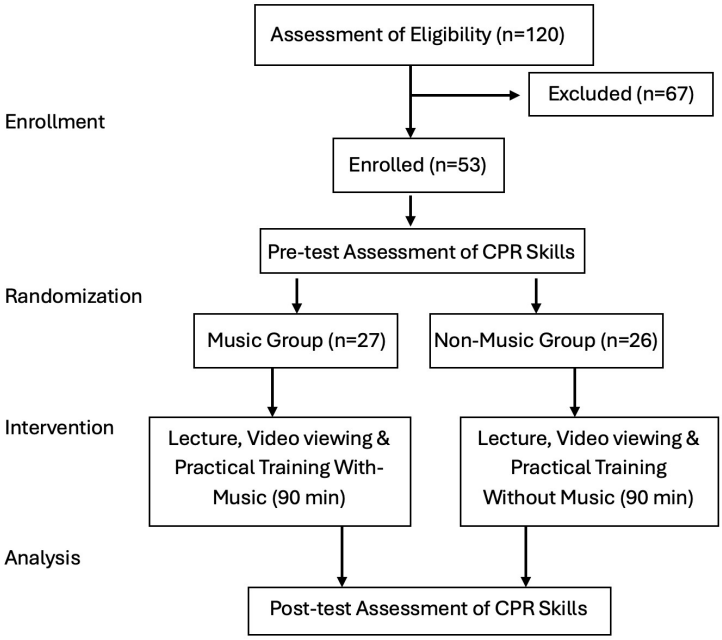

FIGURE 1: Flow diagram of the study protocol. (CPR: Cardiopulmonary resuscitation)

(CONSORT) which assessments conducted both before and immediately after the intervention.

Assessment Tools

The Objective Structured Clinical Examination (OSCE) checklist was used to assess their performance. This checklist had two components: items associated with chest compression (compression rate, depth and recoil), and items not associated with chest compression (scene safety, check for response, calling for help, check for breathing and hand placement). Consent was obtained to use the validated checklist from the author of a previously published study (Isa et al. 2019).

Study Protocol

Upon completion of the baseline assessment of CPR performance for both groups, the participants in the intervention group were assigned to their smaller groups. There were trained for 90 minutes to perform high quality hands-only CPR by two main instructors assisted by group facilitators. The teaching and learning process included a lecture, a video demonstration and three rounds of CPR practice, which included question and answer (Q&A) sessions. Participants were not informed of their individual pre-test performance to avoid influencing their motivation or performance during the training. To guide chest compressions, participants listened to the newly composed and customised downbeat Fit-CPR music which was solely created for CPR training (https://drive.google.com/file/d/1CYz65xOTmdnDfyspU3haIJ9DyAXLq8Kx/view?usp=sharing). The music was an original composition by Dato' Johari Salleh, a professional musician, specifically created for CPR training purposes. The authors hold the copyright for this composition. The music was composed to emphasise strong, consistent downbeats and helping listeners to align chest compressions with the rhythm. Unlike the

metronome, the track featured a clear percussive pulse, minimal melodic variation and a repetitive, rhythmic structure to reduce cognitive load and support entrainment with compressions. The music emphasised downbeats and was set to a tempo of 100 and verified using MixMeister bpm Analyser software, a widely used digital audio tool that accurately determines the tempo of audio tracks. This tempo was selected to help participants maintaining the recommended chest compression rate. Participants were informed that the music was intended to help guiding the rhythm and tempo of chest compressions, without being explicitly told that it was part of a study hypothesis or intended to improve performance. During each round of practice, participants performed high-quality CPR on Little Anne QCPR manikins (Laerdal) while the music was played through the hall's speaker system. The manikins were connected to the QCPR Learner and QCPR Training smartphone applications, which provided objective feedback on compression rate, depth and recoil.

The control group, meanwhile, received the same training as the intervention group, including a lecture, a video demonstration and three rounds of instructor-led CPR practice. However, the practical sessions were conducted without any accompanying music. The participants were given instructions to manually perform chest compressions at a pace of 100-120 bpm without music. The duration of instructional and practice time was consistent with that of the intervention group, amounting to a total of 90 minutes.

Assessment was done using the validated OSCE checklist. Five stations were prepared to test their ability to perform high quality CPR. The assessors were blinded from the teaching method that the participants received. Participants were mixed of the intervention and control groups. Each station was allocated 2 minutes for the participants to complete their tasks.

To ensure intervention fidelity across all training sessions, several measures were implemented. First, a standardised lesson plan was developed and followed strictly by all facilitators during each session. A training-of-trainers session with all group facilitators prior to the intervention was done. A checklist was used to verify that all components of the session including the lecture, video demonstration, practice rounds and music playback were consistently delivered. Furthermore, all participants practiced CPR using the same model of manikin (Little Anne QCPR) connected to the QCPR training applications. The apps provided real-time visual feedback during practice, ensuring uniformity in the training experience.

Outcome Measurement

The outcome measure was the participants' ability to perform high-quality hands-only CPR according to the checklist. Two components were measured: those related with compression (rate, depth and recoil) and those that were not associated with compression (scene safety, check response, call for help, checking for breathing and hand placement).

Sample Size

The sample size was determined based on a previous study by Tastan et al. (2017), which reported that 87.2% of participants in the music-assisted group successfully performed high-quality CPR, compared to only 42.1% in the non-music-assisted group. The high-quality CPR was determined by the ability to give 100-120 compressions per minute. The calculation was made using the formula from Fleiss et al. (2013). The total sample size for both groups was 42 participants. Considering the dropout rate of 20% for each group, the total number of samples needed was at least 50 participants (for both group).

Assessors Calibration

The OSCE assessors comprised emergency physicians and instructors qualified in basic life support. To minimise inter-assessor variability, all assessors performed a pre-assessment calibration procedure. The assessors were informed on the study protocol, CPR performance checklist,

and CPR demonstration videos. During the calibration session, assessors reviewed five video recordings depicting both correct and incorrect CPR performances. Additionally, they received training on how to utilise the Little Anne QCPR training programmed. The assessors were then asked to independently score each video using the checklist.

Statistical Analysis

Collected data were analysed using Statistical Package for the Social Science, (SPSS software version 22.0 (IBM Corp., Armonk, NY, USA). Shapiro-Wilk test is used to check for normality of the data ($p > 0.05$). A paired t-test was used to compare the means between the score of pre-teaching evaluation and post-teaching evaluation. Mann Whitney U test was used to compare the median of the overall performance score and their component between the two groups. Pearson Chi square was used to analyse the categorical variables between compression rate and music influences. The same method was used for compression recoil. Fisher's Exact test was used to analyse the categorical variables between compression depth and music influences. The p-value < 0.05 was taken as significant level.

RESULTS

Demographic Characteristics

A total of 58 participants met the inclusion criteria and were selected. However, five participants were subsequently excluded due to prior CPR training that was only disclosed after initial screening. Therefore, the final sample included 53 participants who completed the full research protocol, with 27 (50.9%) allocated to the intervention group and 26 (49.1%) to the control group (Figure 1). All participants were first- and second-year undergraduate students from non-health-related faculties with no formal medical or healthcare training backgrounds. There were no significant demographic differences between these two groups in terms of age, gender or number of CPR courses attended during the past two years ($p > 0.05$) (Table 1).

CPR Performance

Pre-test results indicated that the control group performed better overall CPR (3.08 ± 1.38 vs. 2.37 ± 1.08; $p < 0.001$). However, both groups showed significant increment at post-test, with the intervention group scored higher than the control group 8.30 ± 0.54 and 7.58 ± 0.81, respectively. When the pre- and post-test scores of two groups

TABLE 1: The demographic data of the participants

	Fit-CPR Music n = 27 n (%)	**Non-music n = 26 n (%)**	**p-value***
Gender			
Male	13 (48)	12 (46)	0.884
Female	14 (52)	14 (54)	
Previous CPR training within 2 years			
Yes	0 (0)	0 (0)	
No	27 (100)	26 (100)	
Background medical illness			
Yes	0 (0)	0 (0)	
No	27 (100)	26 (100)	

*Chi-square test

were compared, there was a significant difference between them ($p < 0.001$) (Table 2).

High-Quality CPR

The intervention group's median score for high-quality CPR components (rate, depth and recoil) was 2.0 ± 1.0 with a mean rank of 32.00, whereas the control group scored 2.0 ± 1.0 with a mean rank of 28.12. There were statistically significant differences between the two groups ($p = 0.008$) (Table 3). Meanwhile, for scores of non-compression related components, the differences also showed statistically significant ($p = 0.031$) between intervention and control groups with median score of 6.0 ± 0.0 and 6.0 ± 1.0 with mean rank of 25.85 and 28.19, respectively (Table 3).

High-Quality CPR Components

Additional analyses of the sub-components of high-quality CPR were conducted. It had been classified as adequate or inadequate, as shown in Table 4. For compression rate, it was determined that there was a significant correlation between intervention and compression rate ($p < 0.001$), with 96.3% of individuals in the intervention group achieving an appropriate rate, compared to 53.8% in the control group. Despite the fact that there was no significant correlation between compression depth and musical influences after intervention ($p > 0.99$), the majority of participants 88.9% in the intervention group and 88.5% in the control group were able to compress to an appropriate depth (Table 4). Similarly, the chest recoil exhibited no significant association with

TABLE 2: Comparison mean scores on overall performance of pre and post intervention between music assisted group and non-music assisted group

	Fit-CPR Music n = 27 Mean (SD)	Non-music n = 26 Mean (SD)
Pre-test	2.37 (1.08)	3.08 (1.38)
Post-test	8.30 (0.54)	7.58 (0.81)
p-value*	<0.001	<0.001

SD: Standard deviation
* It showed the within group comparisons of the total score at pre and post intervention

TABLE 3: Comparison median scores on overall and components (compression vs non-compression) of CPR performance between music assisted group and non-music assisted group

	Fit-CPR music n = 27		Non-Music n = 26		p-value*
	Median (IQR)	Mean rank	Median (IQR)	Mean rank	
Overall performance	8.0 (1.0)	33.96	8.0 (1.0)	19.77	<0.001
Compression related[a]	2.0 (1.0)	32.00	2.0 (1.0)	21.81	0.008
Non-compression related[b]	6.0 (0.0)	30.04	6.0 (1.0)	23.85	0.031

IQR: Interquartile range.
[a]Performance score for component associated with compression (rate, depth, recoil)
[b]Performance score for component not associated with compression (scene safety, call for help, breathing assessment, hand placement)
* Mann Whitney U Test

TABLE 4: Performance associated with compression (rate, depth & recoil) scores between music assisted group and non-music assisted group

	Fit-CPR music n = 27		Non-Music n = 26		p-value
	n	%	n	%	
Compression rate (bpm)					
Adequate (100-120)	26	96.3	14	53.8	<0.001[a]
Inadequate (<100 and>120)	1	3.7	12	46.2	
Compression depth (cm)					
Adequate (5)	24	88.9	23	88.5	1.000[b]
Inadequate (<5)	3	11.1	3	11.5	
Compression recoil					
Adequate	16	59.3	13	50.0	0.498[a]
Inadequate	11	40.7	13	50.0	

bpm: beat per minute.
[a]Pearson Chi-Square; [b]Fisher's Exact Test

musical effects (p = 0.498). The intervention group achieved a score of 59.3 percent, whereas the control group achieved a score of 50% (Table 4).

DISCUSSION

This study incorporated downbeat music into CPR training and demonstrated a significant improvement in overall performance among participants in the intervention group, who achieved higher-quality CPR compared to the control group. Moreover, those in the intervention group were more successful in maintaining the recommended chest compression rate, as outlined by the AHA guidelines, while performing CPR to the rhythm of downbeat music.

These findings align with previous research showing that the general public often struggles to perform effective chest compressions (Tastan et al. 2017). Even among medical practitioners, studies have found that many fail to maintain adequate compression rates, with the majority performing at less than 80 compressions per minute during hospital resuscitations (Abella et al. 2005). Evidence suggests that slower compression rates can compromise blood flow to vital organs, reducing the chances of survival (Beattie et al. 1991; Cipani et al. 2019). However, by integrating structured and engaging training methods, CPR education can become more accessible, improving skill acquisition and retention among the general public (International Liaison Committee on Resuscitation 2005).

It is important to note that in the pre-test, the control group demonstrated a significantly higher baseline performance in overall CPR scores compared to the intervention group. This unexpected difference may reflect variability in prior informal exposure, learning aptitude or initial comfort with simulation-based assessment, despite participants reporting no formal CPR training within the last two years. To account for this, the post-test comparisons focused on the magnitude of improvement in performance, not just absolute post-test scores. Notably, both groups showed statistically significant improvements following the training session, suggesting the overall effectiveness of the CPR education provided. However, the intervention group demonstrated a greater increase in performance, especially in maintaining an optimal chest compression rate, supporting the potential utility of downbeat music as an

enhancement tool in CPR training.

Multiple strategies are available to assist learners keeping up with chest compression rates. The metronome-based audio feedback system is one example. However, despite it is being simple to use and generally accessible to the public, metronomes are not commonly used, and they might be difficult to use in some settings due to background noise. Furthermore, as reported in a recent study, the impact of incorporating music is more successful than using metronomes alone (Bottiroli et all. 2014). In this study, downbeat music was utilised as a technique to help students perform and maintain proper compression rates. Downbeat stands out because it has the strongest beat and it is the easiest for people to perceive. It makes it simpler for them to keep up with the beat and match their pace of compression. This downbeat, custom-composed music was produced specifically for mass CPR training. In addition to the simplicity of the music, the tempo contains 100 downbeat per minute, which provides encouragement and can increase the participants' memories (International Liaison Committee on Resuscitation 2005), thus guiding them to achieve the optimal chest compression rate. Moreover, our downbeat music can aid those who suffer from tone-deaf. About 4-5% of the population have difficulty in perceiving tune and rhythm (Kalmus & Fry 1980; Peretz & Vuvan 2017). Besides that, while conducting the research, we discovered that when listening to music through a speaker, the downbeat sound, which was a critical component of the musical beat and influenced the rate of compression, could be heard clearly compared to when listening through individual earphones; thus, the intervention group's teaching and assessment sessions were conducted using a common speaker.

We further subdivided the total performance score into two components: chest compression-related (rate, depth, and recoil) and non-compression-related (scene safety, check for response, call for help, check for breathing and hand placement). This study discovered that practicing CPR while listening to downbeat music improved both non-compression and compression related outcomes in the intervention group compared to the control group. In comparison to other studies, the results were consistent with those research conducted by Tastan et al. (2017) on the effects of music on the proper performance of the rate and depth of chest compression for nursing students. The results indicated a significant difference in chest compression rate between the intervention and control groups, leading them to conclude that a musical piece helps students to remember the ideal chest compression rhythm easily, thereby assisting them in performing chest compression at optimal rates.

This study found that majority of participants were better to time their compression rates so that they were neither too fast nor too slow for the proper range when listening to music. However, music has no positive influence on depth or recoil, as no significant correlation was established between them in this study. These findings highlight the limitations of rhythm-based audio cues such as music in improving all components of high-quality CPR. Compression depth and chest recoil are highly dependent on physical factors such as body strength, posture and fatigue, rather than purely rhythmic guidance. Previous research supports this observation. For example, Rawlins et al. (2009) and Chung et al. (2012) reported no significant differences in compression depth when comparing metronome or music-assisted training to standard instruction. One possible explanation is that while rhythmic cues help to synchronise timing, they do not provide real-time feedback on force or pressure, both of which are critical to achieving optimal depth and full recoil. One possible explanation is that while rhythmic cues help to synchronise timing, they do not provide real-time feedback on force or pressure, both critical for achieving optimal depth and full recoil, which may explain why the use of music did not significantly impact participants' performance on chest recoil. Another study also reported the similar finding where lower compression depth has been observed in the metronome-assisted group (Chung et al. 2012).

Though no statistically significant difference was seen, the majority, if not all, of our participants in both research groups were capable of doing appropriate chest compressions. Oh et al. (2008) suggested that the inadequate compression depth was a result of multitasking, as participants had to synchronise their CPR rate with the metronome while performing other CPR steps. CPR is a complex psychomotor skill (Miyadahira 2001). Many have suggested that tempo had a significant influence on the compression depth. If the tempo is too fast, it will result in an inadequate depth and recoil. Therefore, different mechanisms are responsible for these measures and future research is needed to investigate more on those aspects. Ultimately, these results underscore that while music particularly downbeat-driven audio can enhance rhythm consistency, it may need to be combined with other instructional strategies to effectively improve all dimensions of CPR quality. Targeted training, focused feedback and repeated hands-on practice are likely required to enhance compression depth and recoil among laypersons.

The participants in this study were undergraduate students with no medical background and no prior CPR training or hands-on experience in the past two years. These people possess the capacity to effectively depict the community, hence aligning with the findings of prior study (Hafner et al. 2015). Furthermore, we have successfully demonstrated that by employing a strategic approach and leveraging the impact of Fit-CPR music, individuals may acquire CPR skills with a high level of effectiveness. Consequently, by increasing the proportion of community people who possess CPR competence, there is a potential to augment the incidence of bystander CPR.

Finally, while the study demonstrated significant improvements in compression rate among participants trained with downbeat music, several potential confounding factors may have influenced the results. Firstly, despite randomisation, the control group showed slightly better baseline CPR scores compared to the intervention group. Although both groups improved significantly after training, this initial discrepancy could have affected the post-intervention comparisons. Secondly, variations in individual learning styles and musical sensitivity such as participants' ability to perceive rhythm or prior exposure to rhythm-based activities may have contributed to differences in performance.

Limitation

This study has several limitations. First, the participants were exclusively non-medical university students, which may limit the generalisability of the findings to other populations, such as older adults, healthcare professionals or individuals with different educational backgrounds. The homogeneity of the sample in terms of age and academic setting may not reflect the broader community where CPR skills are needed. Future studies should include more diverse populations to better assess the applicability of music-assisted CPR training across different demographic groups. Second, while efforts were made to ensure consistency in OSCE scoring through structured assessor calibration sessions, formal interrater reliability statistics (e.g., Cohen's kappa or intraclass correlation coefficient) were not calculated. The calibration process aimed to align scoring behaviour and reduce variability, but the absence of statistical validation remains a limitation. We recommend future research to incorporate formal interrater reliability assessments to enhance the rigor and reproducibility of evaluation methods.

CONCLUSION

This study demonstrated that the use of downbeat music during CPR training significantly improved participants' ability to achieve the recommended chest compression rate. While no significant improvements were observed in other aspects of CPR performance, the music-assisted approach shows promise as a simple and accessible tool to support rhythm consistency in layperson training. Further research is needed to explore its impact on other elements of CPR quality and its effectiveness in real-life scenarios.

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