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Investigation of the Effect of Using a Metronome or Song on the Lay Rescuers' Quality of Chest Compressions

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Abstract: This study aimed to determine the quality of chest compressions performed by lay rescuers assisted by a healthcare worker over the telephone and investigate the effect of metronome use or the Stayin' Alive song on the quality of these chest compressions. This study was conducted prospectively at the emergency department of a tertiary hospital. The lay rescuers were assisted by an emergency medicine specialist over the telephone to perform chest compressions using the CPR Lilly PRO+ simulator. Three groups were formed, and the same participants performed three cycles of chest compressions over the telephone for two minutes: first without any external stimulus (Group 1), then using a metronome as an external stimulus (Group 2), and finally by listening to the Stayin' Alive song as another external stimulus (Group 3). The obtained data were analyzed with IBM SPSS v. 23.0. There was no statistically significant difference between the three groups in terms of the target number of chest compressions ($p=0.404$). However, the compression depth and chest compression fraction statistically significantly differed between the groups ($p<0.05$). If lay rescuers who have not received basic life support training in Turkey are assisted by healthcare workers over the telephone, they can achieve a sufficient number of chest compressions. However, considering the inadequate compression depth, chest compressions applied by lay rescuers with telephone assistance do not seem to be effective in our country. ©2023 NTMS.

Keywords: Metronome; Chest Compressions; Emergency Medicine; Stayin' Alive Song; Resuscitation.

1. Introduction

One of the most important factors affecting the return of spontaneous circulation in out-of-hospital cardiac arrests (OHCA) is early and effective chest compressions (CCs) [1]. However, in OHCA cases, bystanders are often hesitant to intervene with patients. In a previous study, it was shown that cardiopulmonary resuscitation (CPR) in patients with OHCA was performed by non-healthcare professionals or emergency rescue service personnel at a rate of approximately 49/100.000 in the European Union [2]. In order to increase these rates, many training programs are organized, during which methods for high-quality CCs are also practiced. One of the methods to achieve an appropriate number of CCs is the use of a metronome [3, 4]. This is an instrument that makes beats at regular intervals to provide a stable rhythm. When performing CCs, the operator's synchronization with the metronome makes it easier to reach the target number of compressions [5].

In the literature, there are also studies examining CCs accompanied by songs to achieve the targeted number of CCs [6-8]. The oldest and best-known song that has

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been the subject of many studies on reaching the target number of CCs is "Stayin' Alive" by the Bee Gees [8]. Various researchers have attempted to achieve the targeted number of CCs during CPR using the metronome, Stayin' Alive, and other songs [9-11]. However, to the best of our knowledge, in Turkey, no study has been conducted to investigate the harmony of lay rescuers with this song when performing CCs. Therefore, this study aimed to determine the quality of CCs performed by lay rescuers assisted by a healthcare worker over the telephone prior to the CPR process and compare the use of a metronome and the Stayin' Alive song in terms of their effects on the quality of these CCs.

2. Material and Methods

2.1. Study Design and Participant Selection

This study was conducted prospectively at a tertiary emergency department after obtaining approval from the local ethics committee (meeting no:10, decision no:18). The study was performed in accordance with the tenets of the Declaration of Helsinki. G∗Power 3.1 (Heinlich-Heine Universität, Düsseldorf, Germany) was used to determine the sample size [12]. The sample size was calculated at the 95% confidence interval, 80% power, α 0.05 error, and 0.39 effect size. Assuming a 10% loss, the number of participants required for the study was found to be 94.

As lay rescuers, volunteer non-healthcare professionals aged >18 years who had not received basic life support (BLS) or advanced cardiac life support (ACLS) training, had no speech or hearing problems, were able to understand and speak Turkish, and had no contraindications to performing CCs (upper extremity amputation-injury, history of ischemic heart disease, third trimester pregnancy, etc.) were included in the study. Excluded from the sample were those who had previously received BLS or ACLS training, healthcare professionals, and individuals who could not perform CCs for any reason.

2.2. Study Interventions

A temporary information station was set up to reach the participants by telephone. Before moving on to the area where CCs would be performed, the participants were informed about the study scenario, in which they would talk to an emergency medicine specialist with more than five years' professional experience and encounter a simulator simulating a patient with no pulse. They were asked to phone once they entered the simulation area to talk to the healthcare worker. It was explained that all the necessary information would be given during this telephone call and that there would be no further conversation.

During the simulation, once the telephone call was made, the emergency medicine specialist gave the participants a standard instruction on how to perform CCs: "depress the thorax 5-6 (2-2.4 inch) cm deep from the midpoint of the thorax at a rate of 100-120 per minute"[1]. With the phone left on speaker mode, the participants were asked to perform two minutes of CCs without any external stimulus. After a 15-minute rest, the simulation was repeated by giving the same instruction, which was, this time, followed by the use of a metronome (103 beats/min) without the participants' knowledge. After the participants performed CCs accompanied by the metronome for two minutes, they rested for 15 minutes, and the same procedure was repeated using the Stayin' Alive song by the Bee Gees as the external stimulus (103 beats/min).

2.3. Data Collection

The simulator used was CPR Lilly PRO+(3B Scientific GmbH Ludwig-Erhard-Straße 20. 20459 Hamburg. Germany), which was available in our clinic. This new high-quality CPR training manikin from 3B Scientific allows practitioners to measure, monitor, and analyze CPR performance. CPR Lilly PRO+ helps measure practitioner performance by connecting with the free CPR Lilly App on the tablet to which it is connected (Lenovo Tab M10 TB-X306F 4GB + 64GB 10.1" IPS Tablet ZA7W0007TR) to track CPR performance and provide objective feedback on high-quality CPR training practice. In the test mode of the CPR Lilly application, the number of CCs performed by the practitioner during CPR, the mean depth of CCs, chest recoil, correct or incorrect hand positions, and chest compression fraction (CCF) can be measured. We formed three study groups and obtained data on the telephone-assisted CCs performed by each practitioner over two minutes first without an external stimulus (Group 1, n=94), then using the metronome as an external stimulus (Group 2, n=94), and lastly using the Stayin' Alive song as an external stimulus (Group 3, n=94). We also recorded the age, sex, and educational status of the participants.

2.4. Statistical Analysis

Statistical analyses were performed using IBM SPSS v. 23.0 (IBM Corp., Armonk, NY, USA) software. The Shapiro-Wilk test was used to check the normality of data distribution. Categorical variables were expressed as frequency and percentage, and continuous variables as median and interquartile range. The Friedman test and Cochran's Q test were used for non-parametric data. Statistical significance was accepted as $p<0.05$.

3. Results

Ninety-four individuals [47 (50%) men] were included in the study. The median age was 25.0 years. When the educational status of the participants was examined, it was determined that 40.4% (n=38) were graduates of secondary schools (Table 1).

Table 2 presents the comparison of the CPR parameters of the participants according to the groups. Accordingly, there was a statistically significant difference between the groups in terms of compression depth and CCF ($p<0.05$) (Figure 1).

Table 1. Characteristics of the participants.

Variables (n = 94)	
Age, median (IQR)	25.0 (20.0-39.3)
Sex, male, n (%)	47 (50)
Education, n (%)	
Primary school	6 (6.4)
Secondary school	38 (40.4)
Associate degree	24 (25.5)
Undergraduate/post-graduate degree	26 (27.7)

IQR: interquartile range.

4. Discussion

In this study, with the over-the-phone instruction of a healthcare worker before CPR, lay rescuers were able to reach a sufficient compression rate (100-120/min) without any stimulus but could not achieve an adequate compression depth (2-2.4 inches). It was observed that the use of an external stimulus (metronome sound or the Stayin' Alive song) did not have an effect on the CCs rate. However, there was a change in compression depth with the use of external stimuli. The depth of compression did not significantly differ between Groups 1 and 2 and Groups 1 and 3. However, the compression depth of Group 3 was statistically significantly higher than that of Group 2. Regardless of the presence of an external stimulus, the pressures applied by the participants did not achieve a sufficient level of depth. Therefore, we consider that CPR assisted by a healthcare worker over the telephone is not applicable for lay rescuers in Turkey.

In OHCA cases, early CCs increase the chance of survival [13]. Therefore, bystanders are often expected to initiate CCs in individuals with OHCA [14]. Researchers have begun to discuss the compression abilities of lay rescuers in OHCA cases. In a study by Plata et al. On this subject, the compression rate of lay rescuers guided by telephone was found to be 82/min [15]. Ecker et al. on the other hand, observed that the lay rescuers applied an average of 74/min compressions per minute without being assisted, while the mean number of compressions increased to 99/min in the group assisted by telephone [16]. In the current study, when the lay rescuers were assisted by telephone, they applied an average of 100/min compressions, which is consistent with the target number of CCs reported in the literature.

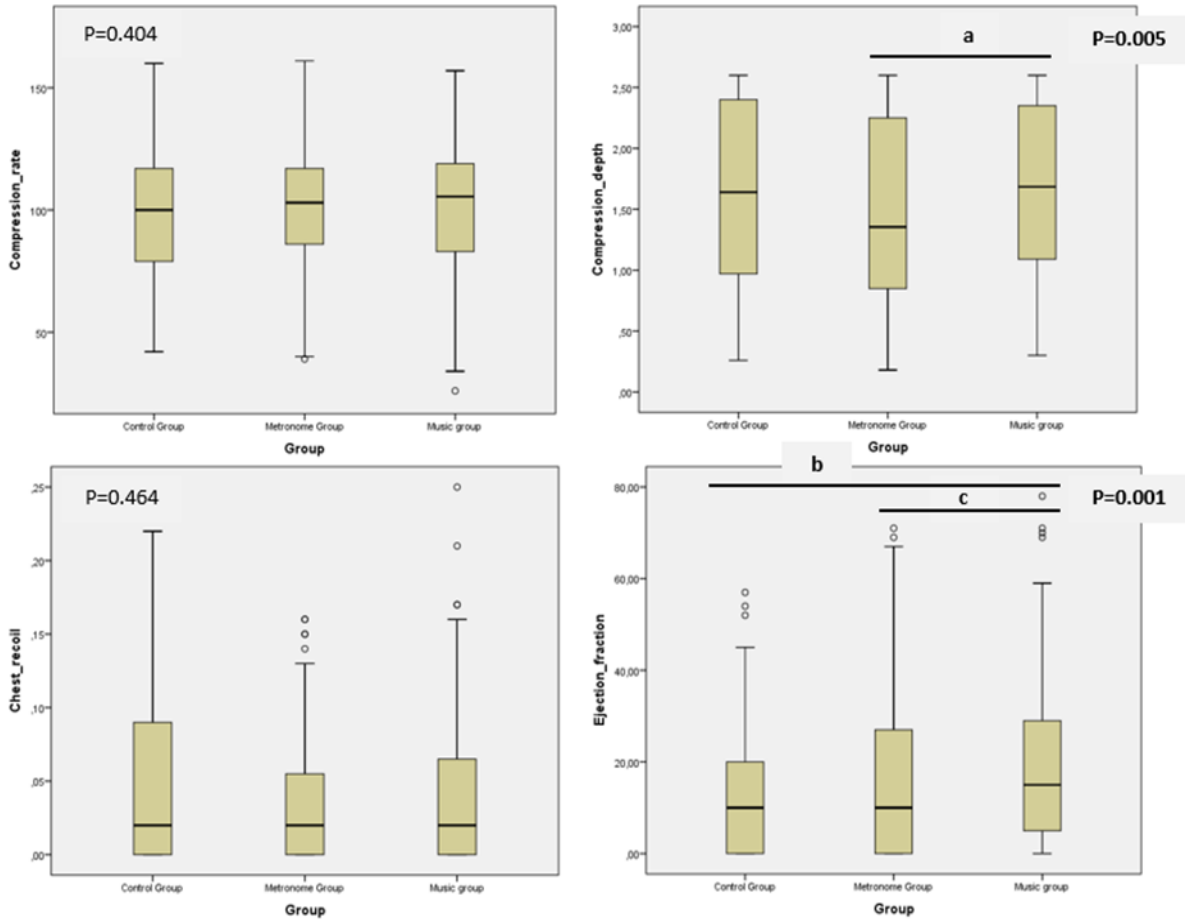

Figure 1: Box plot showing the cardiopulmonary resuscitation parameters by groups. a: 0.004, b: 0.002, c: 0.018.

Table 2: Comparison of the cardiopulmonary resuscitation parameters of the participants according to the study groups.

Variables	Group 1	Group 2	Group 3	P value	Post hoc
Compression rate, median (IQR)	100.0 (78.8-117.0)	103.0 (85.8-117.5)	105.5 (82.8-119.0)	0.404[a]	
Compression depth, median (IQR)	1.64 (0.97-2.41)	1.36 (0.85-2.26)	1.69 (1.08-2.36)	0.005[a]	Group 1 vs. 2: 0.160 Group 1 vs. 3: 0.606 Group 2 vs. 3: 0.004
Chest recoil, median (IQR)	0.03 (0-0.10)	0.02 (0-0.06)	0.04 (0-0.08)	0.464[a]	
CCF, median (IQR)	10.0 (0-20.0)	10.0 (0-27.3)	15.0 (5.0-29.0)	0.001[a]	Group 1 vs. 2: 0.871 Group 1 vs. 3: 0.002 Group 2 vs. 3: 0.018
Hand position, accurate, n (%)	43 (45.7)	38 (40.4)	44 (46.8)	0.412[b]	

Group 1: no external stimulus, Group 2: metronome, Group 3: Stayin' Alive song, IQR: interquartile range, CCF: chest compression fraction. [a] Friedman test, [b] Cochran's Q test.

In the literature, there are also studies in which verbal motivation, metronome use, and songs that can match the compression rhythm have been used to keep the number of CCs performed by lay rescuers within an effective range [17-19]. In some of these studies, it was observed that the use of a metronome or a song did not affect the average number of compressions per minute [11, 20]. Similarly, we determined that the use of a metronome or the Stayin' Alive song did not significantly affect the number of compressions per minute.

Concerning the depth of compressions performed by lay rescuers, Plata et al. determined the mean compression depth of the participants assisted by telephone to be 55 mm (2.16 inches). The authors noted that this compression depth was within the optimum range [17]. However, another study showed that telephone-assisted lay rescuers applied less pressure (1.6 inches) than necessary, and this was not adequate [21]. In our study, the lay rescuers assisted by telephone without an external stimulus could not obtain sufficient compression depth. Although the compressions accompanied by the Stayin' Alive were deeper than those performed without any external stimulus, the participants were still not able to achieve sufficient compression depth.

While performing effective CCs, the hands must be placed on the anterior chest wall appropriately. In the literature, lay rescuers assisted by video applications have been reported to be more successful in positioning their hands appropriately compared to those who were unassisted or only assisted by telephone [15, 22]. In our study, although the participants were assisted by telephone at all times, the highest rate of accurate hand positioning was 46.8%, regardless of the presence of an external stimulus. This confirms the necessity of including visual descriptors through video calls and drone assistance in BLS, as recommended by the relevant section of the European Resuscitation Council Guidelines 2021 [23].

An effective CCF can be achieved by applying CCs uninterruptedly at the right place and speed and with sufficient compression depth. For a good-quality CCs, it is recommended that the CCF value be 60% [24]. In our study, although the participants reached the appropriate number of CCs in all three cases, the CCF values were below this requirement due to the insufficient CCs depth and inaccurate hand positioning during CPR. However, CCF increased up to 15% in Group 3, probably in parallel to the increase in CCs depth. Despite this, the participants were still not able to achieve optimal CCF.

5. Conclusions

If lay rescuers who have not received basic life support training in Turkey are assisted by healthcare workers over the phone, they can perform a sufficient number of CCs. However, they cannot achieve optimal compression depth. In addition, the rate of accurate hand positioning during CPR is not high when only telephone guidance is provided. Therefore, it can be concluded that CCs applied by lay rescuers with telephone assistance do not seem to be effective in Turkey. Further studies should be conducted in which rescuers are assisted by visual methods. Based on the results of such studies, BLS training should be organized for lay rescuers.

Limitations of the Study

This study had certain limitations. First, it was carried out using a manikin. When faced with a real person who requires CCs, the reactions and practices of lay rescuers with no BLS training may change. Second, the participants were not informed that external stimuli would be applied during two sets of CPR simulations. Therefore, they may have focused only on the voice of the healthcare worker speaking on the phone. Another limitation can be considered as an English song being chosen as an external stimulus in Group 3, which may have created difficulties in adapting to a song that was not in the native language of the participants.

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Conflict of Interests

The authors declare no conflict of interest.

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Author Contributions

None.

Ethical Approval

Ethical approval was obtained from the Atatürk University, Faculty of Medicine clinical research ethics committee (Number: 10/18, Date: 19/12/2022).

Data sharing statement

Data and statistical analysis plan will be shared if requested.

Consent to participate

Consent was obtained from all patients for the use of data under ethical conditions.

Informed Statement

Written informed consent was obtained from all of the participants..

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