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To Evaluate Quality of Cardiopulmonary Resuscitation (CPR) Performed At Scene and During Transport After Out-of-Hospital Cardiac Arrest: A Crossover Trial

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Abstract— Background: **High-quality cardiopulmonary resuscitation (CPR) is essential to improve survival rates in out-of-hospital cardiac arrest. Previous research suggests that the quality of CPR may decline during ambulance transport.**

Aims: **To evaluate the quality of CPR performed at the scene and during transport after out-of-hospital cardiac arrest.**

Methods: **A randomised, controlled, crossover trial was conducted to compare the performance of CPR on a manikin, both at the scene and in a moving ambulance. CPR quality was measured using a QCPR system, capturing parameters including compression depth, rate, recoil, and ventilation sufficiency. Participants alternated between the two scenarios after a one-hour recovery period.**

Results: **18 participants were enrolled, with a mean score for CPR quality of 52.94% in the ambulance and 53.25% at the scene. A t-test revealed no statistically significant difference (t(34) = -0.033, p = 0.97) in scores; furthermore, we observed no statistically significant differences in relation to the following parameters: flow fraction, cycles performed, total number of compressions, compression score, percentage of compressions performed with proper release, percentage of compressions performed with adequate depth, total number of ventilations, and ventilation score (p>0.05).**

Conclusion: **The quality of CPR provided at the scene and in the ambulance is comparable, suggesting that competent CPR providers can deliver high-quality care in both settings.**

***Index Terms*—** **Cardiopulmonary Resuscitation; Emergency Medical Services; Manikins; Out-of-Hospital Cardiac Arrest; Patient Transport; Quality of Health Care; Randomized Controlled Trial.**

I. INTRODUCTION

Throughout the world, out-of-hospital cardiac arrest (OHCA) is a significant public health concern, with outcomes differing significantly from one region to another [1]. Sudden cardiac arrest (SCA) is a leading cause of death, with an annual worldwide incidence of 55 per 100,000 adults, which is equal to 356,000 per year [2,3]. One important survival factor following cardiac arrest is the quality of cardiopulmonary resuscitation (CPR) [4,5]; prior research has shown that high-quality CPR can improve the survival rate in out-of-hospital cardiac arrest [6]. High-quality CPR is defined as a chest compression fraction (CCF) of at least 80%, a compression rate of 100-120/min, and a compression depth of at least 2 inches [7].

The quality of CPR in cardiac arrest patients may be affected by the location (at the scene of out-of-hospital cardiac arrest vs. in the ambulance vs. in the ED) [8]. Previous studies have shown that patients transported to the hospital following OHAC with ongoing CPR have a lower survival rate [8], while investigations on manikins showed that the quality of CPR in moving vehicles was reduced [9]. Hence, the American Heart Association

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(AHA) guidelines recommend optimising onsite care to achieve Return of spontaneous circulation (ROSC), as approximately 2 in 5 OHCA patients who achieved prehospital ROSC survive hospital discharge. For those patients who have not reached ROSC in the field, outcomes are poor, and resuscitation of these patients is a challenge for emergency medical services (EMS). Whether these patients would benefit more from continued CPR on the scene or CPR in the ambulance during transport is controversial and remains an area of study [10]. Yet, there is evidence from prior research that high-quality CPR can be achieved even during transport [13]. Furthermore, a previous study showed that mechanical CPR has higher quality outcomes than manual CPR during ambulance transport [12,13].

At present, it is unclear at what point in the resuscitation process the decision should be made to transfer a patient with ongoing CPR. Emergency medical services ought to consider the risk of transporting a patient with ongoing CPR in a moving vehicle, during which vehicle displacement may reduce the quality of CPR and the outcome, in comparison with achieving ROSC had CPR been prolonged on the scene [14]. In our study, we aimed to evaluate the quality of CPR performed at the scene and during transport after out-of-hospital cardiac arrest.

II. MATERIALS AND METHODS

Study Design

This randomised crossover manikin study compares the quality of cardiopulmonary resuscitation (CPR) performed at the scene with that performed during transport. The study was conducted in a tertiary hospital in Saudi Arabia, and employed a Little Anne CPR manikin as a simulated arrested patient.

Study Population

The study participants were healthcare providers from the study hospital, including nurses, emergency medicine residents and paramedics with CPR training and basic life support (BLS) certification. A total of 18 individuals were selected: 13 males and 5 females, over the age of 18 years. Participants were invited via WhatsApp messages and in-person invitations during hospital shifts. Pregnant women, individuals who were hesitant to participate, and those who had medical illnesses with physical limitations that could hinder their ability to perform adequate CPR were excluded from the study. All participants provided informed consent before enrolling in the study.

Study Setting

The study participants underwent two sessions with the same scenario, manikin, and duration, but in different environments (on the scene and in the ambulance). At the beginning of the study, they were blinded with regard to the environment in which they would begin.

The authors conducted the recruitment, enrolment, and randomisation processes. Due to the inherent characteristics of the manikin-based CPR simulation, it was impossible to completely blind the participants and those conducting the interventions. The participants were aware of the simulated environment, and complete concealment was impracticable due to the dissimilar settings of a hospital and an ambulance.

To reduce the effect of awareness-induced biases in the participants, thorough measures were taken to ensure that instructions and procedures were consistent across both scenarios. Moreover, during the study, the assessment team tasked with gathering and analysing data remained blinded regarding the initial intervention allocations of the participants. This methodology aimed to reduce observer bias and preserve the integrity of the crossover RCT structure, thereby enabling a rigorous comparison of CPR performance among participants in both on-the-scene and ambulance conditions.

The Little Anne CPR manikin was selected as a simulated arrested patient as this manikin is designed to closely resemble the anatomy of an adult, enabling trainees to practice CPR techniques using accurate anatomical landmarks with effective training feedback from the manikin, such as a chest raise after correct ventilations. Moreover, it is linked to the QCPR mobile application which provides feedback and guidance on the quality of CPR performed on the manikin. The Little Anne CPR manikin was fitted with advanced sensors that captured and documented real-time data related to chest compression depth, rate, recoil, and ventilation parameters.

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The manikin was positioned on a standard hospital bed during the on-scene session. For the ambulance session, it was secured to the ambulance bed. To simulate the scenario, the ambulance was driven at a speed comparable to that typically used during patient transport. The driver, with prior experience in patient transport, ensured a realistic and near-authentic simulation. A bag-valve mask was used for ventilation during CPR compressions, with a chest compression-to-ventilation ratio of 30:2 for both groups.

On the Scene Session

During the on-scene phase, participants performed the CPR session in the Emergency Department of the study hospital for five minutes, within a controlled environment simulating a conventional resuscitation chamber. They followed standardised protocols for an on-scene cardiac arrest scenario.

Rest Period

Participants were granted a one-hour rest period between the first and second sessions, to avoid any potential effects of fatigue. During this designated time, participants were permitted to relax in a comfortable setting without engaging in any form of physical activity.

Ambulance Session

The participants were transferred to the ambulance simulation and instructed to perform CPR for five minutes, on the same Little Anne manikin, during the simulated ambulance transport. CPR was conducted on the ambulance bed. The simulation vehicle was outfitted with motion technology to accurately reproduce the practical complexities and ever-changing circumstances of ambulance transport.

Environmental Controls

Strict control measures were implemented in the on-scene environment to ensure uniformity and a standardised resuscitation setting throughout all sessions. To accurately simulate the interior of a real ambulance, the vehicle was configured in a such a way as to emphasise motion dynamics.

Simulation Configuration and Data Collection

Compression parameters were collected through the QCPR application, a mobile application designed to provide feedback and direction on the quality of CPR performance. It connects with sensors fitted to CPR training manikins to assess different CPR elements such as compression depth, rate, recoil, and ventilation, enhancing the effectiveness of CPR training by providing immediate, objective feedback on technique.

This application provides real-time data which is collected and analysed by the investigators to compare performance between on-scene and in-transport CPR.

Sample Size

The sample size for our study was determined using the Sample Size Calculator for Crossover Design, made available to us by the Biostatistics Center at Harvard University (http://hedwig.mgh.harvard.edu/sample_size/js/js_crossover_quant.html). 18 participants were required to detect a 10-unit difference, with 80% power and a 0.25 significance level. This calculation assumes a standard deviation of 10 for the response variable among participants, with the standard deviation of the difference remaining undefined [15].

The selected sample size provides sufficient statistical power to identify the hypothesised difference, considering the participants' variability and the intended level of statistical significance.

The collected data was transferred to an Excel spreadsheet, and SPSS software was used for all processing of the exported, coded Excel data.

Table of variables

Continuous data is presented as mean or median if not normally distributed. Nominal data is given as a percentage. Qualitative data is provided as mean and standard deviation if it is normally distributed, or median and range if it is not normally distributed. For comparison between different groups, a t- test was used. All tests were 2-sided at a p-value of 0.05.

III. RESULTS

18 participants were enrolled in our study, all of whom participated in both arms. The number of females was 5 (28%). The mean score for quality of CPR was 52.94% in the ambulance versus 53.25% on the scene. We used a t-test to evaluate the quality of CPR in the ambulance versus on the scene. The findings were not statistically significant; [M = 0.52, SD = 0.26, (95% CI 0.40 to 0.66)]

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and [M = 0.53, SD = 0.25, (95% CI 0.41 to 0.66)]; t (34) = -0.033, p = 0.97.

The flow fraction for CPR performed in the ambulance was 55.94%, versus 55.6% on the scene; thus, it did not differ significantly between the two settings; [M=0.56, SD=0.09, (95% CI 0.511 to 0.61)] and [M=0.56, SD=0.10, (95% CI 0.50 to 0.60)]; t (34) =0.10, p=0.92.

A comparison of the other CPR parameters is illustrated in Table 1. The statistical analysis of CPR parameters is illustrated in Table 2.

Influence of gender on effectiveness of CPR

We investigated the influence of gender on several CPR parameters, as illustrated in Table 3. We noted that females performed less efficient CPR than males; this was evident upon investigating the flow fraction, compression score and ventilation score. However, the number of cycles performed, total number of compressions provided, and total number of compressions with good release and good depth did not differ by gender (p>0.05).

IV. DISCUSSION

According to our data, the percentage of participants delivering high-quality CPR varied from 52.94% in the ambulance to 53.25% on the scene. Prior research suggests that the quality of CPR provided in the ambulance setting is comparable to that offered on-scene, which challenges the belief that chest compressions during transport are less effective [6,9]. Nonetheless, our results are consistent with one research study that shows no variation in the quality of chest compressions (CC), including the mean CC rate, mean CC depth, and mean CC fraction in the ambulance compared versus on the scene [4].

Gender disparities in many aspects of healthcare have been well-documented, including differences in treatment outcomes and access to medical care. These variations extend to the realm of CPR, as proven by a study emphasising the varying efficiency of male versus female CPR [16]. In our study, women performed less effective CPR than men; this is consistent with findings from other studies. This was apparent in the ventilation score, compression score, and flow fraction. Many studies have shown that men and women provide different OHCA care, which, in the raw data, results in a poorer prognosis for women [17,18]. Our findings appear to corroborate this. It is important to note that gender disparities in CPR effectiveness may have various underlying factors, including differences in physical strength and training opportunities.

CPR plays a critical role in the management of cardiac arrest, which is a life-threatening condition requiring immediate intervention. Although manual CPR has been the standard approach for many years, recent studies have explored the use of mechanical CPR devices as an alternative. These devices, such as active compression-decompression CPR, offer automated and consistent compressions, improving the quality and effectiveness of compressions during resuscitation efforts. While manual CPR requires active physical exertion by healthcare providers, mechanical CPR devices can deliver consistent compressions without fatigue. Machines have been demonstrated to follow the criteria and recommendations of organisations such as the European Resuscitation Council more closely than manual CPR, especially when administered during transfer on a stretcher [12]. However, a prior systematic review found insufficient information to support or refute the use of mechanical CPR equipment in cases of OHCA and when assessing factors such as compression depth, rate, recoil, hand position, and ventilation volume [19]. One study that contrasted the effectiveness of QCPR and conventional CPR training found that both techniques were equally effective when used on QCPR and conventional manikins [20].

V. LIMITATIONS

Our study had some limitations that are important to address. We analysed a manikin model, rather than real patients, which may not accurately reflect real-life situations. Additionally, the unequal gender distribution may impact the results, as the number of males participants was higher than that of females (13 vs. 5, respectively). Moreover, while we used the QCPR app to assess CPR quality both on the scene and in the ambulance, its effectiveness in a moving vehicle may be influenced by factors such as motion or external disturbances, potentially affecting the accuracy of the assessment.

VI. RECOMMENDATIONS

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As a recommendation, we suggest incorporating the use of the QCPR application to assess CPR quality both at the scene and in the ambulance. This tool has the potential to significantly enhance the quality of CPR, particularly during transport in a moving ambulance, thereby increasing the likelihood of high-quality CPR during patient transport. Furthermore, we recommend exploring the benefits of mechanical CPR, which may prove to be an effective method for maintaining high-quality CPR over prolonged periods, especially in cases of out-of-hospital cardiac arrest (OHCA) occurring in rural areas where access to timely advanced care may be limited.

VII. CONCLUSION

In the field of resuscitation, the assessment and improvement of CPR quality are crucial to increasing survival rates and improving patient outcomes. Several studies have examined the quality of CPR in different resuscitation locations, such as on the scene and in the ambulance. The results of our study show that the average quality of CPR is comparable between these two locations. This finding suggests that competent providers can deliver excellent care regardless of the setting in which they perform CPR.

VIII. REFERENCES

1. Kiguchi T, Okubo M, Nishiyama C, Maconochie I, Ong MEH, Kern KB, Wyckoff MH, McNally B, Christensen EF, Tjelmeland I, Herlitz J, Perkins GD, Booth S, Finn J, Shahidah N, Shin SD, Bobrow BJ, Morrison LJ, Salo A, Baldi E, Burkart R, Lin CH, Jouven X, Soar J, Nolan JP, Iwami T. Out-of-hospital cardiac arrest across the world: First report from the International Liaison Committee on Resuscitation (ILCOR). *Resuscitation*. 2020 Jul;152:39-49. doi:10.1016/j.resuscitation.2020.02.044. Epub 2020 Apr 6. PMID: 32272235.
2. Yan S, Gan Y, Jiang N, Wang R, Chen Y, Luo Z, Zong Q, Chen S, Lv C. The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care*. 2020 Feb 22;24(1):61. doi: 10.1186/s13054-020-2773-2.PMID: 32087741; PMCID: PMC7036236.
3. Lee J, Lee W, Lee YJ, Sim H, Lee WK. Effectiveness of bystander cardiopulmonary resuscitation in improving the survival and neurologiccal recovery of patients with out-of-hospital cardiac arrest: A nationwide patient cohort study. *PLoS One*. 2020 Dec 16;15(12):e0243757. doi: 10.1371/journal.pone.0243757. PMID: 33326454; PMCID: PMC7744051.
4. Roosa JR, Vadeboncoeur TF, Dommer PB, Pan- chal AR, Venuti M, Smith G, Silver A, Mullins M, Spaite D, Bobrow BJ. CPR variability during ground ambulance transport of patients in cardiac arrest. *Resuscitation.* 2013 May;84(5):592-5. doi: 10.1016/j.resuscitation.2012.07.042. Epub 2012 Nov 21. PMID: 23178870.
5. Wallace SK, Abella BS, Becker LB. Quantifying the effect of cardiopulmonary resuscitation quality on cardiac arrest outcome: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes*. 2013 Mar 1;6(2):148-56. doi: 10.1161/CIRCOUTCOMES.111.000041. Epub 2013 Mar 12. PMID: 23481533.
6. Abella BS. High-quality cardiopulmonary resuscitation: current and future directions. *Curr Opin Crit Care.* 2016 Jun;22(3):218-24. doi: 10.1097/MCC.0000000000000296. PMID: 27054627.
7. American Heart Association. 2020 American Heart Association Guidelines for Cardiopulmonary- nary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020 Oct 20;142(16_suppl_2):S337-S357. doi: 10.1161/CIR.0000000000000916.
8. Kurz MC, Dante SA, Puckett BJ. Estimating the impact of off-balancing forces upon cardiopulmonary resuscitation during ambulance transport. Resuscitation. 2012 Sep;83(9):1085- doi: 10.1016/j.resuscitation.2012.01.033. Epub 2012 Feb 1. PMID: 22306258
9. Kim JA, Vogel D, Guimond G, Hostler D, Wang HE, Menegazzi JJ. A randomised, controlled comparison of cardiopulmonary resuscitation performed on the floor and on a moving ambulance stretcher. Prekops Emerg Care. 2006 Jan- Mar;10(1):68-70. doi: 10.1080/10903120500373108.PMID: 16418093.

E-mail: Mayakhaled1996@gmail.com

10. Schmidbauer S, Yates EJ, Andréll C, Bergström D, Olson H, Perkins GD, Friberg H. Outcomes and interventions in patients transported to hospi-tal with ongoing CPR after out-of-hospi-tal cardi-ac arrest - An observational study. Re-susc Plus. 2021 Oct 16;8:100170. doi: 10.1016/j.re- splu.2021.100170. PMID: 34901895; PMCID: PMC8640866.
11. Cheskes S, Byers A, Zhan C, Verbeek PR, Ko D, Drennan IR, Buick JE, Brooks SC, Lin S, Taher A, Morrison LJ; Rescu Epistry Investiga-tors. CPR quality during out-of-hospital cardiac arrest transport. Resuscitation. 2017 May;114:34-39. doi: 10.1016/j.resuscita-tion.2017.02.016. Epub 2017 Feb 24. PMID: 28242210.
12. Sunde K, Wik L, Steen PA. Quality of mechani-cal, manual standard and active compression-decompression CPR on the arrest site and dur-ing transport in a manikin model. Resuscitation. 1997 Jun;34(3):235-42. doi: 10.1016/s0300-9572(96)01087-8. PMID: 9178384.
13. Perkins GD, Lall R, Quinn T, Deakin CD, Cooke MW, Horton J, Lamb SE, Slowther AM, Wool-lard M, Carson A, Smyth M, Whitfield R, Wil-liams A, Pocock H, Black JJ, Wright J, Han K, Gates S; PARAMEDIC trial collaborators. Me-chanical versus manual chest compression for out-of-hospital cardiac arrest (PARA-MEDIC): a pragmatic, cluster randomised con-trolled trial. Lancet. 2015 Mar 14;385(9972):947-55. doi: 10.1016/S0140-6736(14)61886-9. Epub 2014 Nov 16. PMID: 25467566.
14. Manoukian MAC, Rose JS, Brown SK, Wynia EH, Julie IM, Mumma BE. Development of a model to measure the effect of off-balancing vec-tors on the delivery of high-quality CPR in a moving vehicle. Am J Emerg Med. 2022 Nov;61:158-162.doi: 0.1016/j.ajem.2022.08.059. Epub 2022 Sep 6. PMID: 36137329.
15. Ødegaard S, Olasveengen T, Steen PA, Kramer-Johansen J. The effect of transport on quality of cardiopulmonary resuscitation in out-of-hospi-tal cardiac arrest. Resuscitation. 2009 Aug;80(8):843-8. doi: 10.1016/j.resuscita-tion.2009.03.032. Epub 2009 May 27. PMID: 19477573.
16. Lindner TW, Sunde K, Løfstad R. Gender dif-differences in bystander CPR and outcomes in out-of-hospital cardiac arrest. J Am Heart As-soc. 2020 Nov 17;9(22):e035794. doi: 10.1161/JAHA.124.035794.
17. Blom MT, Oving I, Berdowski J, van Valken-goed IGM, Bardai A, Tan HL. Women have lower chances than men to be resuscitated and survive out-of-hospital cardiac arrest. Eur Heart J. 2019 Dec 14;40(47):3824-3834. doi: 10.1093/eurheartj/ehz297. PMID: 31112998; PMCID: PMC6911168.
18. Malta Hansen C, Kragholm K, Dupre ME, Pear-son DA, Tyson C, Monk L, Rea TD, Starks MA, Nelson D, Jollis JG, McNally B, Corbett CM, Granger CB. Association of bystander and first-responder efforts and outcomes according to sex: Results from the North Carolina HeartRes-cue Statewide Quality Improvement Initiative. J Am Heart Assoc. 2018 Sep 18;7(18):e009873. doi: 10.1161/JAHA.118.009873. PMID: 30371210; PMCID: PMC6222952.
19. Labuschagne MJ, Arbee A, de Klerk C, de Vries E, de Waal T, Jhetam T, Piest B, Prins J, Uys S, van Wyk R, van Rooyen C. A comparison of the effectiveness of QCPR and conventional CPR training in final-year medical students at a South African university. Afr J Emerg Med. 2022 Jun;12(2):106-111.doi: 10.1016/j.afjem.2022.02.001. Epub 2022 Feb 27. PMID: 35251921; PMCID: PMC8885445.
20. Ong ME, Mackey KE, Zhang ZC, Tanaka H, Ma MH, Swor R, Shin SD. Mechanical CPR de-vices compared to manual CPR during out-of-hospital cardiac arrest and ambulance transport: a system-atic review. Scand J Trauma Resusc Emerg Med. 2012 Jun 18;20:39. doi: 10.1186/1757-7241-20-39. PMID: 22709917; PMCID: PMC3416709.

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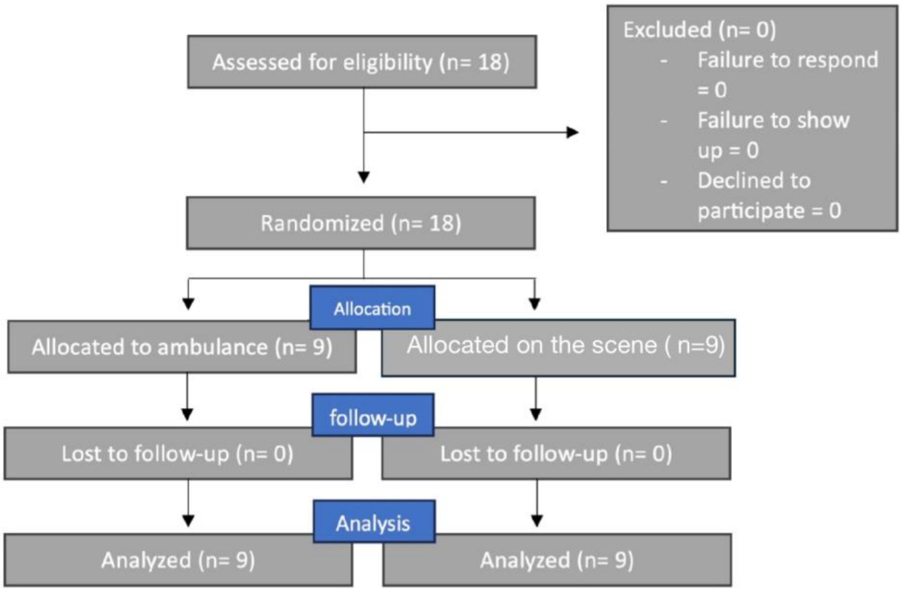

Figure 1. Flow chart of participant selection.

Table 1. CPR parameters in the ambulance versus on the scene.

Parameter	**In the ambulance (mean)**	**On the scene (mean)**
Cycles performed	30.33 (SD 5.8)	31.55 (SD 2.89)
Total number of compressions	336 (SD 57.3)	315.61 (SD 38.66)
Compression score	0.64 (SD 0.33)	0.73 (SD 0.27)
Percentage of compressions with good release	92%	90%
Percentage of compressions with good depth	71.6%	83.4%
Total number of ventilations	20.44 (SD 6.63)	19 (SD 2.99)
Ventilation score	0.84 (SD 0.13)	0.92 (SD 0.09)
Percentage of ventilations with good volume	1	1
Percentage of ventilations with too-high volume	0	0

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Table 2. Statistical analysis of CPR parameters.

Parameters	**(Mean (SD**	**Statistical test**	**p-value**
Cycles performed	M=30.33 (5.80), M=31.55 ((2.89	t(34)=-0.79	0.42=*p*
Total number of compressions	M=336.11 (57.30), M=315.61 ((38.66	t(34)=1.25	*p=0.22*
Compression score	(M=0.64 (0.33), M=0.73 (0.27	t(34)=-0.89	*p=0.37*
Percentage of compression done with good release	M=0.922 (0.16), M=0.90 ((0.14	t(34)=0.42	*p=0.67*
Percentage of compression done with good depth	(M=0.72 (0.38), M=0.83 (0.07	t(34)=-1.02	*p=0.31*
Total number of ventilations	(M=20.4 (6.63), M=19 (2.99	t(34)=0.84	*p=0.41*
Ventilation score	(M=0.84 (0.13), M=0.91 (0.09	t(34)=-1.99	*p=0.054*

Table 3. CPR variables of male versus female participants.

Parameters	**Male**	**Female**	**Statistical test**	**p-value**
Overall CPR	M= 0.58, SD=0.22, 95%CI 0.49 to 0.67	M=0.39, SD=0.28, 95%CI 0.19 to 0.59	t (34) =2.05	p=0.04
Flow fraction	M=0.58, SD=0.07, 95% CI=0.55 to 0.61	M=0.49, SD=0.13, 95% CI= 0.40 to 0.59	t (34) =2.53	p=0.01
Cycles performed	M=31.46, SD=3.61, 95% CI= 24.97 to 30	M=29.6, SD=6.47, 95% CI=24.97 to 34.22	t (34) =1.10	*p=0.28*
Total number of compressions	M=329.81, SD=44.6, 95% CI=311.79 to 347.82	M=315.6, SD=61.30, 95% CI=271.74 to 359.45	t (34) =0.77	*p=0.45*
Compression score	M=0.76, SD=0.24, 95%CI=0.66 to 0.86	M=0.49, SD=0.36, 95%CI=0.23 to 0.75	t (34) =2.65	*p=0.01*
Percentage of compression done with good release	M=0.88, SD=0.17, 95%CI=0.82 to 0.95	M=0.96, SD=0.07, 95%CI= 0.92 to 1.02	t (34) =-1.43	*p=0.16*
Percentage of compression done with good depth	M=0.83, SD=0.31, 95%CI=0.71 to 0.96	M=0.63, SD=0.41, 95%CI= 0.34 to 0.92	t (34) =1.58	*p=0.12*
Total number of ventilations	M=20.5, SD=5.44, 95%CI=18.26 to 22.66	M=17.8, SD=3.74, 95%CI=15.13 to 20.47	t (34) =1.42	P=0.17
Ventilation score	M=0.91, SD=0.10, 95%CI= 0.87 to 0.96	M=0.78, SD=0.12, 95%CI= 0.70 to 0.87	t (34) =3.14	P=0.003