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Effectiveness of VR applications and 360° VR videos in BLS training compared to task trainers: A randomized simulation trial

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Abstract

Background: Effective basic life support (BLS) training of rescuers plays a vital role in improving outcomes after cardiac arrest. While traditional training relies on task-trainers for practical skill development, technological advancements, particularly in areas like virtual reality, are introducing diversified and potentially engaging educational alternatives.This study aims to assess the effectiveness of BLS training delivered through 360° VR video and a VR application, in comparison with conventional task-trainer-based education.

Methods: Participants were randomly allocated to conventional (task-trainer) or VR groups after theoretical BLS training. In the subsequent phase, the conventional group engaged in hands-on practice using a task trainer, whereas the VR group first viewed 360° VR instructional videos and then performed practical training with the VR-CPR application.One month post-training, both groups were assessed with a realistic and fully immersive simulation manikin for BLS performance, CPR quality, AED use, and procedure times.

Results: Thirty-three participants were enrolled (task trainer:16, VR:17) in the study. There was no significant difference in overall performance scores between the groups (VR: 14.9±2.2 vs. task trainer: 14.7±3.2, p=0.842). The mean chest compression depth was 3.9±1.2 cm in the conventional group and 4.5±1.2 cm in the VR group, with no significant difference (p=0.296). The mean chest compression rate was 109.4±16.9 compressions/min in the conventional group and 125.5±17.8 compressions/min in the VR group. The chest compression fraction was 75.3%±5.7 in the conventional group and 73.3%±6.2 in the VR group.

Conclusions: This study demonstrated that VR-based BLS training was effective as traditional approaches in BLS education.

Introduction

Cardiac arrest is defined as the sudden cessation of cardiac and pulmonary functions (1). Cardiopulmonary resuscitation (CPR) is an emergency, life-saving intervention performed in cases of cardiac arrest. It is well established that the prompt initiation of CPR significantly reduces mortality associated with cardiac arrest (2–5). Therefore, basic life support (BLS) training, which plays a critical role in promoting early and effective intervention and thereby reducing mortality in cardiac arrest cases, is of great importance.

BLS training is generally conducted using task trainers, and frequent, repeated practice is required to reinforce knowledge (1, 3). In stress-inducing scenarios such as CPR, regular reinforcement of fundamental principles is critically important for achieving optimal skill levels. Furthermore, BLS training is a core component of the curriculum and is a mandatory training for all healthcare professionals (3).

In modern medical education, emergency medicine training is predominantly delivered through physical simulator–based methods. Nevertheless, the high costs, time requirements, and organisational challenges associated with such face-to-face training may restrict both the accessibility and frequency of BLS instruction (1, 6). Accordingly, the development of alternative approaches that minimise resource utilisation and enhance the efficiency of training processes could represent a valuable contribution (7, 8).

In recent years, the use of virtual reality (VR) and augmented reality (AR) has increased rapidly, and these methods are considered highly effective for CPR training. Several studies in this field also support the effectiveness of these approaches (3, 9, 10).

Virtual reality (VR) technology immerses users in a realistic, interactive, three-dimensional environment via headset devices. With advances that have made VR and AR systems increasingly portable and accessible, these technologies serve as particularly well-suited educational tools for repetitive procedures and skill-based learning (11, 12) (13). VR-based training further provides advantages by being easily organised, adaptable to both individual and team-based practice, and allowing learners to gain clinical experience without jeopardising patient safety (1, 6, 14, 15).

This study aims to assess the effectiveness of basic life support (BLS) training delivered through VR headsets in comparison with traditional task-trainer–based training.

Methods

Study design and setting

This study was conducted as a prospective, two-arm, randomized controlled simulation trial among 33 fifth-year medical students at the School of Medicine, …….. University. It was carried out at the Medical Education and Training Simulation Centre of the same institution after obtaining ethical approval (No. 2023/189).

Participants

Inclusion criteria consisted of being a fifth-year medical student and currently undertaking an emergency medicine rotation at the time of the study. Exclusion criteria included a known history of epilepsy or inability to complete the intervention due to adverse effects. Written informed consent was obtained from all participants prior to enrollment. Participants were recruited in March 2024, the training interventions were delivered in the same month, and the follow-up OSCE assessments were conducted in April 2024.

Randomization and allocation concealment

Participants were randomly allocated to either the conventional group (task trainer) or the VR group. Randomization was conducted using the random module in the Python programming language, applying simple randomization with a 1:1 allocation ratio. Due to the odd total sample size (n = 33), this resulted in groups of 16 and 17 participants. The allocation sequence was generated by an independent researcher who was not involved in participant enrollment or outcome assessment. Participants and trainers were aware of group assignment (no participant blinding was possible due to the different training modalities). However, the examiner scoring the OSCE outcomes was blinded to participants' group allocation. The sample size was limited by the number of available students during the study period. No changes to the trial protocol or methods were made after trial commencement.

Interventions

In the first stage of the study, both groups received a 45-minute theoretical lecture based on ERC BLS guidelines, delivered face-to-face through a PowerPoint® presentation(16). Subsequently, the conventional group underwent skills training using a task trainer. At the same time, the VR group watched a BLS training video recorded with a 360° camera (Insta 360 X3) in 5.7K resolution, presented via VR headset (Meta-Oculus Quest 2). This was followed by hands-on training using VR headsets with the VR-CPR Simulator® (AATE VR®) application. The training materials employed in both groups are presented in the Supplemental File.

Data collection and measurements

One month after the training sessions, participants underwent an OSCE assessment using a realistic and fully immersive simulation manikin (Gaumard®/Hal 3201®) with which they had no prior experience. The assessment was performed using a 20-point performance scale developed according to the ERC BLS guidelines and established by the consensus of three emergency medicine specialists. In addition, AED use was evaluated separately with a 5-point performance scale. Each step was rated dichotomously, with 1 point assigned for correct performance and 0 points assigned if the step was omitted or performed incorrectly.Video recordings were obtained during the evaluation, and data were collected and analyzed using both the manikin software and the video recordings. All evaluations were performed by a single emergency medicine specialist who was blinded to the participants' group assignments. The study flow diagram is presented in Fig. 1. The parameters and cut-off values used in the study were as follows: pulse and breathing assessment ≤ 10 seconds, chest compression rate 100–120 compressions/min, chest compression depth 5–6 cm, chest compression fraction (CCF) ≥ 80% and ≥ 60% (evaluated separately). AED use parameters included turning on the device, correct placement of pads, analyzing the rhythm, ensuring safety, and delivering a shock.

Outcomes

The primary outcome was the total BLS performance score assessed at the first month using an OSCE on a a realistic and fully immersive manikin. Secondary outcomes included CPR quality metrics (compression depth, rate, and CCF), AED use score, and procedure times.

OSCE scenario

The scenario patient was a 35-year-old male with no comorbidities who was a smoker. The scenario began with the facilitator, acting as a relative, stating, "*Help, my brother has collapsed!*" after which the participant entered the room. Initially, the patient presented with respiratory arrest while maintaining a palpable pulse. After two minutes, the patient progressed to cardiac arrest. Participants were evaluated based on their ability to recognise these conditions and intervene appropriately.

Statistical analysis

Statistical analyzes were performed using SPSS version 22.0. The normality of the data distribution was assessed with the Shapiro–Wilk test. Differences between two independent groups were analyzed using the independent-samples t-test or the Mann–Whitney U test. Categorical variables were evaluated with the Pearson chi-square test or Fisher's exact chi-square test. A p-value of < 0.05 was considered statistically

significant. Data visualization was conducted using Python (version 3.11). The pandas and numpy libraries were used for data handling, and figures were generated with the matplotlib library.

Results

A total of 33 participants were included in the study, with 16 in the task-trainer group and 17 in the VR group (Figure 1). No participants met the exclusion criteria. Of the participants, 53% were female and 47% were male. The mean age of participants in the task-trainer group was 23 ± 1.1 years, while in the VR group it was 23±0.6 years. Demographic characteristics of the participants and their previous CPR training experience are presented in detail in Table 1.

Figure 1. CONSORT flow diagram

Comparison of BLS overall scores and AED use scores between the task trainer and VR groups revealed no statistically significant differences (p=0.842 and p=0.143, respectively) (Table 2) (Figure 2).

The performance of the task trainer and VR groups in performing BLS steps was compared, and parameters critical for high-quality CPR, such as chest compression rate, depth, correct hand position, allowance for full chest recoil, and AED use, were evaluated. Detailed findings for parameters are presented in Table 3 and Figure 2.

The chest compression rate was significantly higher in the VR group (125.5 ± 17.8/min) compared to the task trainer group (109.4 ± 16.9/min); however, it exceeded the recommended target range (p = 0.012). The mean chest compression depth was 4.5 ± 1.2 cm in the VR group and 3.9 ± 1.2 cm in the task trainer group; this difference was not statistically significant (p=0.127). The chest compression fraction was calculated as 75.3% ± 5.7 in the task trainer and 73.3% ± 6.2 in the VR group, with no significant difference (p=0.350) (Figure 2).

Figure 2. Comparison of BLS and AED performance metrics between task trainer and VR training modalities

The proportion of participants performing chest compressions within the target rate range was 50% in the conventional group and 29% in the VR group (p = 0.394). The proportion achieving the target depth was 53% in the VR group and 31% in the conventional group (p = 0.296). When the target chest compression fraction was set at ≥80%, the achievement rates were low in both groups, with 19% in the conventional group and 18% in the VR group, showing no significant difference (p = 1.000). When the target was set at ≥60%, all participants in the conventional group and 94.1% of those in the VR group achieved the goal. The time to complete each step of the scenario was analyzed from video recordings and compared between the task trainer and VR groups. Detailed data for these parameters are presented in Table 4.

No adverse events or side effects were observed in either group, and no participant discontinued the training due to discomfort.

Discussion

Improving the quality and frequency of BLS training for both lay rescuers and healthcare professionals will enhance CPR quality and thereby contribute to increased survival rates. Therefore, numerous studies have been conducted to make CPR training more accessible, rapid, and efficient (17–20). In this context, the use of innovative technologies such as VR in addition to traditional methods offers important potential for making BLS training more effective, accessible, and efficient(7, 8, 21).

In this study, BLS training was provided through a 360° VR video and a VR application, and the effects of this method on related competencies were assessed. To the best of our knowledge, this is the first study to employ both a 360° VR video and application, with a comprehensive analysis of all BLS steps conducted on a realistic and fully immersive manikin. While a few previous studies have utilised VR applications and 360° videos, these primarily focused on participants' self-efficacy, satisfaction, and knowledge without performing a detailed assessment of individual skills and procedural steps(21, 22).

Studies in the literature have shown that training delivered through VR headsets is at least as effective as traditional methods such as task trainers (18, 23, 24). Consistent with the literature, our study also demonstrated that BLS training provided with VR video and VR application was as successful as conventional methods.

In a study conducted by Semeraro et al. in 2019, no significant differences were found between participants trained with VR headsets and those trained on a conventional manikin (Resusci Anne®) in terms of chest compression rate and depth (9). In another study by Nas et al., only 16% of the participants had previously received CPR training, and it was reported that performance scores were higher in those who received face-to-face training compared with those trained with VR (17). In our study, however, almost all participants had previously received CPR training during their first year of medical school. Therefore, applying a similar protocol to individuals without prior CPR training might yield different results.

In our study, 94% of the participants in the VR group reported that they had never used a VR headset before. The fact that participants had limited VR experience and used the headset for the first time during this study may have contributed to making the data obtained more objective. However, it remains unclear whether more frequent use of VR devices and increased experience would further enhance the outcomes.

In the present study, comparison of total BLS performance scores revealed no statistically significant differences between the VR and conventional groups. Likewise, analysis of AED performance scores demonstrated no significant intergroup differences. Consistent with our findings, Castillo et al. and Hubail et al. also reported no significant differences in skill-based performance or overall evaluation scores (18, 24). Collectively, these results suggest alignment of our study with the existing literature and reinforce the notion that VR-based BLS training is at least as effective as traditional approaches.

When overall performance scores were analyzed by gender, no differences were observed between males and females in the conventional group. In contrast, male participants in the VR group were found to be more successful. This may be attributed to the cultural characteristics of the sample, where male individuals may have a greater tendency to use technological devices (24). However, some studies in the literature have reported no gender differences, indicating that this finding of our study differs from previous reports (16, 22).

In our study, BLS training was evaluated according to guideline-based steps, and no significant differences were found between the two groups for any parameter. Similarly, Castillo et al. (2023) reported no differences in chest compression depth, rate, hand position, recoil allowance, or compression ratios following training, consistent with our findings. That study also found no differences in EMS activation or correct AED pad placement between groups (17). Although no statistically significant difference was observed between the groups regarding compression rate, the mean rate in the VR group was noted to exceed the recommended target range. This finding may be considered the most unfavorable outcome related to the VR group in our study.

In the analyzes, the time required to turn on and operate the AED (from picking up the device to delivering the shock) was found to be shorter in the conventional group. We believe this may be because participants in the conventional group had the opportunity to physically handle and use a real AED during training, whereas participants in the VR group learned to operate only a virtual device in a simulated environment. In addition, the fact that the same AED model used in training was also employed during the assessment in the conventional group may have influenced the results. Participants in the conventional group performed CPR by physically applying force on a manikin. In contrast, participants in the VR group received CPR training in a virtual environment without VR–manikin integration. Consequently, we anticipated that motor memory would not form in the VR group, resulting in a lower success rate. However, the proportion of participants reaching the target chest compression depth (5–6 cm) was higher in the VR group (53%) than in the task trainer group (31%), although this difference was not statistically significant. Despite the lack of statistical significance, the higher proportion in the VR group was contrary to our expectations. Castillo et al. (2023) and Hubail et al. (2022) utilised a hybrid approach combining VR devices with physical manikins and reported no significant differences between control and experimental groups regarding chest compression depth or rate (18, 20).

In one study, 88% of participants who received training solely with VR headsets achieved the target chest compression rate, and 65% achieved the target compression depth (19). In contrast, in our study, 29% of participants in the VR group reached the target chest compression rate, and 53% achieved the target depth. While similar results were obtained for compression depth, the proportion achieving the target compression rate was lower in our study. This difference may be due to physical variations among the manikins used to measure compression depth. In our study, when the target chest compression fraction was set at ≥ 80%, the average rate achieved was 18% in both groups. However, when the threshold was set at ≥ 60%, all participants in the conventional group and 94.1% in the VR group reached the target. In both cases, no statistically significant differences were observed between the two groups. In contrast, Nas et al. (2020) reported that chest compression fraction was significantly higher in the group receiving face-to-face training (17). Such differences may be attributable to variations in training protocols, with a hybrid approach integrating VR and manikin practice potentially offering additional benefits

Our study demonstrated that the proportion of participants achieving many of the target values in BLS training remained low. While the outcomes were comparable to those of conventional training methods, the overall number of individuals reaching the desired thresholds was inadequate. These findings highlight the need for BLS training to be repeated and delivered at more frequent intervals. Furthermore, the integration of innovative methods such as VR and AR alongside traditional approaches may enhance training effectiveness. Such combined strategies may strengthen participants' knowledge and skills and facilitate attainment of the desired performance levels.

The use of VR may be an important learning method for BLS training. Immersive virtual reality represents the direction of education in the twenty-first century and holds great promise for maximising learning and motivation. Its suitability for individual use and personal application may enable savings in both time and cost in medical education. Incorporating VR into routine medical training may also provide benefits in terms of workforce and cost. Repeating these trainings frequently and supporting them with innovative methods will contribute in the long term to more individuals achieving competency in BLS.

Limitations

Among the participants included in our study, all members of the conventional group and the majority of the VR group reported having previously received BLS training, which may be considered a factor that could have influenced the results.

Although none of the participants experienced adverse effects that required discontinuation of the training, this method may not be suitable for individuals who cannot comfortably engage with VR devices. The absence of a pretest represents another limitation; although the groups were randomly assigned, we do not know whether there were differences in baseline knowledge and skills prior to training.

Our findings, obtained in a single institution with medical students, may not generalise to other populations, such as non-medical personnel, or to settings using different VR equipment and software. Caution should be used in extending these results to broader contexts. Also, noting that this was a simulation-based outcome (manikin performance) and not patient outcomes is relevant – the translation of improved simulation performance to real-life resuscitation performance remains to be validated.

Conclusion

According to the results of our study, BLS training delivered through VR was found to be as effective as conventional methods. No significant differences were observed in success rates between the two approaches. These findings suggest that VR, as a training method suitable for individual use, can be integrated into medical education.

Declarations

Declaration of interests: The authors declare that they have no competing financial, professional or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

Author contributions:

Seyran Sakine Nas: Data curation, Writing- Original draft preparation, Melih Imamoglu: Investigation, Writing- Reviewing and Editing, Data curation, Ebru Turhal: Data curation, Fulya Batmaz: Data curation, Alperen Kasimhan Unluer: Data curation, Abdul Samet Sahin: Investigation, Data Curation, Sinan Pasli: Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Visualization, Supervision, Formal analysis

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Not applicable

Ethical approval

This study was performed in line with the principles of the Declaration of Helsinki. Ethics committee approval for the study was received from the Karadeniz Technical University Scientific Research Ethics Committee (protocol number: 2023/189)

Consent to participate

In this study, participants were informed and included in the study after signing an informed consent form. The informed consent form was reviewed by the Ethics Committee and deemed appropriate.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. If required by the journal's policy, the authors are willing to deposit the de-identified dataset in a public repository for transparency.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1. Demographic characteristics and training background of participants

		Task-trainer	**VR**
		n (%)	
Gender	Male	7 (43)	8 (47)
	Female	9 (57)	9 (53)
		mean ± sd	
Age (years)		23 ± 1,1	23 ± 0.6
Body weight (kg)		71,0 ±13,3	67,9 ± 13,3
Height (m)		1,7 ± 0,1	1,7 ± 0,1
BMI (kg/m^2)		24,2 ± 3,6	23,8 ±3,3
		n (%)	
Previous CPR training status	Yes	16 (100)	16 (94)
	No	0 (0)	1 (6)
Reference guideline for CPR training	According to AHA guidelines 2015	11 (68)	10 (62)
	According to AHA guidelines 2020	5 (32)	6 (38)
Previous VR experience	Yes	0 (0)	1 (6)
	No	16 (100)	16 (94)

Table 2. Comparison of BLS and AED use scores in task trainer and VR groups

Overall scores						
		Group	n	mean±sd*/ median (min-max)**	t*/Z**	p-value
	BLS score*	Task trainer	16	14.7 ± 3.2	-0,201	0,842
		VR	17	14.9 ± 2.2		
	AED use score**	Task trainer	16	5 (0-5)	-1,463	0,143
		VR	17	5 (0-5)		
Overall scores by gender						
		Gender	N	mean±sd*/ median (min-max)**	t*/Z**	p-value
Task trainer group	BLS score *	Male	7	16 ± 3.2	1,464	0,165
		Female	9	13.7 ± 3.2		
	AED use score**	Male	7	4 (0-5)	-1,290	0,197
		Female	9	5 (2-5)		
VR group	BLS score *	Male	8	16 ± 2.1	2,156	0,048
		Female	9	13.9 ± 2		
	AED use score**	Male	8	5 (0-5)	-0,172	0,864
		Female	9	5 (1-5)		

A p-value <0.05 was considered statistically significant

*Independent Sample t-Test, **Mann Whitney U Test

Table 3. Steps for BLS scenario and AED use according to guidelines in task trainer vs VR groups

BLS steps	Performance Status	Task-trainer n (%)	VR n (%)	P-Value
Ensure scene safety**	Performed	4 (25)	1 (6)	0,175
	Not-performed	12 (75)	16 (94)	
Shout for nearby help *	Performed	16 (100)	17 (100)	1,000
	Not-performed	0 (0)	0 (0,0)	
Activate emergency response system / (Call EMS)*	Performed	16 (100)	17 (100)	1,000
	Not-performed	0 (0)	0 (0)	
Check responsiveness**	Performed	16 (100)	16 (94)	1,000
	Not-performed	0 (0)	1 (6)	
Retrieve AED**	Performed	15 (6)	17 (100)	0,485
	Not-performed	1 (94)	0 (0)	
Use AED**	Performed	13 (81)	14 (82)	1.000
	Not-performed	3 (19)	3 (18)	
Assess breathing (no more than 10 sec)**	Performed	15 (94)	17 (100)	0,485
	Not-performed	1 (6)	0 (0)	
Check the pulse**	Performed	15 (94)	17 (100)	0,485
	Not-performed	1 (6)	0 (0)	
Check the pulse within 10 sec*	Performed	9 (56)	7 (41)	0,387
	Not-performed	7 (44)	10 (59)	
Recognize respiratory arrest (*pulse present, no normal breathing*) **	Performed	14 (88)	15 (88)	1,000
	Not-performed	2 (12)	2 (12)	
Provide 1 breath every 6 seconds (10 breaths/min) **	Performed	7 (44)	5 (29)	0,392
	Not-performed	9 (56)	12 (71)	
Reassess pulse/breathing after 2 minutes**	Performed	14 (88)	13 (76)	0,656
	Not-performed	2 (12)	4 (24)	
Recognize cardiac arrest *(no breathing, no pulse)***	Performed	13 (81)	14 (82)	1,000
	Not-performed	3 (14)	3 (18)	
Initiates CPR cycle **	Performed	12 (75)	14(82)	0.688
	Not-performed	4 (25)	3 (18)	
Ensure correct hand placement for chest compressions *	Performed	6 (37)	10 (59)	0,221
	Not-performed	10 (63)	7 (41)	
Deliver chest compressions 5–6 cm deep *	Performed	5 (31)	9 (53)	0,208
	Not-performed	11 (69)	8 (47)	
Allow full chest recoil after each compression **	Performed	12 (75)	14 (82)	0,688
	Not-performed	4 (25)	3 (18)	
Maintains 30:2 compression-to-breath ratio*	Performed	12 (75)	13 (76)	1.000
	Not-performed	4 (25)	4 (24)	
Maintain compression rate of 100–120/min *	Performed	12 (75)	10 (59)	0,325

	Not-performed	4 (25)	7 (41)	
Deliver guideline-appropriate rescue breath**	Performed	15 (94)	17 (100)	1.000
	Not-performed	1 (6)	0 (0)	
AED use steps				
Switch on AED	Performed	15 (100)	16 (100)	1,000
	Not-performed	0 (0)	0 (0)	
Place AED pads correctly **	Performed	14 (7)	15 (94)	1,000
	Not-performed	1 (93)	1 (6)	
Allow AED to analyze rhythm **	Performed	15 (100)	15 (94)	1,000
	Not-performed	0 (0)	1 (6)	
Ensure no one touches the patient during analysis/shock **	Performed	10 (67)	15 (94)	0,083
	Not-performed	5 (33)	1 (6)	
Deliver shock (press shock button if indicated) **	Performed	14 (7)	15 (94)	1,000
	Not-performed	1 (93)	1 (6)	

A p-value <0.05 was considered statistically significant

*Pearson Chi-Square Test, **Fisher's Precise Chi-Square Test

Table 4. Time intervals and success rates in achieving guideline targets for task trainer and VR groups

	Group	N	mean±sd* / median (min-max)**	t*/Z**	p-value
Total scenario duration (sec)*	Task trainer	16	331.3±44.3	0,798	0,431
	VR	17	319.5±40.6		
Time from scenario start to check patient responsiveness (sec)**	Task trainer	13	7,7 (5-20)	-1,083	0,279
	VR	15	6,1 (4-17)		
Time from scenario start to EMS call (sec)*	Task trainer	16	13.1±5.3	2,109	0,047
	VR	17	10.1±2.4		
First assessment of pulse/breathing (from scenario start) (sec)*	Task trainer	16	17.8±6.7	0,369	0,716
	VR	17	17.1±3.1		
Pulse/breathing assessment duration (sec)*	Task trainer	16	12.8±8.9	0,821	0,421
	VR	17	10.7±4.2		
Time to give first rescue breath (sec)*	Task trainer	14	32.8±13	0,963	0,344
	VR	15	29.1±6.7		
Interval between two rescue breaths (sec)	Task trainer	14	6,5 (5-13)	-1,093	0,275
	VR	15	6,0 (4-10)		
Time from scenario start to request AED (sec)**	Task trainer	16	16,1 (9-190)	-1,693	0,090
	VR	17	13,3 (10-22)		
Time from AED power-on to deliver shock (sec)**	Task trainer	14	65 (58-97)	-2,45	0,014
	VR	15	80 (63-125)		
Reassessment of pulse/breathing duration (sec)	Task trainer	12	4 (2-8)	-1,821	0,069
	VR	8	5,9 (4-22)		
Duration of 5 CPR cycles (sec)*	Task trainer	16	109.2±8.3	-0,41	0,685
	VR	17	110.9±15.1		
Total chest compression duration for 5 cycles (sec)*	Task trainer	16	82.3±9.8	0,371	0,713
	VR	17	81±10.5		
Chest compression fraction (%) *	Task trainer	16	75.3±5.7	0,949	0,350
	VR	17	73.3±6.2		
Chest compression depth (cm)*	Task trainer	16	3.9±1.2	-1,570	0,127
	VR	17	4.5±1.2		
Chest compression rate (beats/min) *	Task trainer	16	109.4±16.9	-2,671	0,012
	VR	17	125.5±17.8		
A p-value <0.05 was considered statistically significant					
*Independent Sample t-Test, **Mann Whitney U Test*					

	Achievement of target values	Task trainer	VR	P-Value
		n (%)	n (%)	
Check pulse/breathing within ≤10 sec Φ	Yes	8 (50)	7 (41)	0,611
	No	8 (50)	10 (59)	

Chest compression fraction ≥80% †	Yes	3 (19)	3 (18)	1,000
	No	13 (81)	14 (82)	
Chest compression depth (5-6 cm) †	Yes	5 (31)	9 (53)	0,296
	No	11 (69)	8 (47)	
Chest compression rate (100–120/min) Φ	Yes	8 (50)	5 (29)	0,394
	No	8 (50)	12 (71)	

A p-value <0.05 was considered statistically significant

Φ:Pearson Chi-Square Test, †:Fisher's Exact Chi-Square Test

Figures

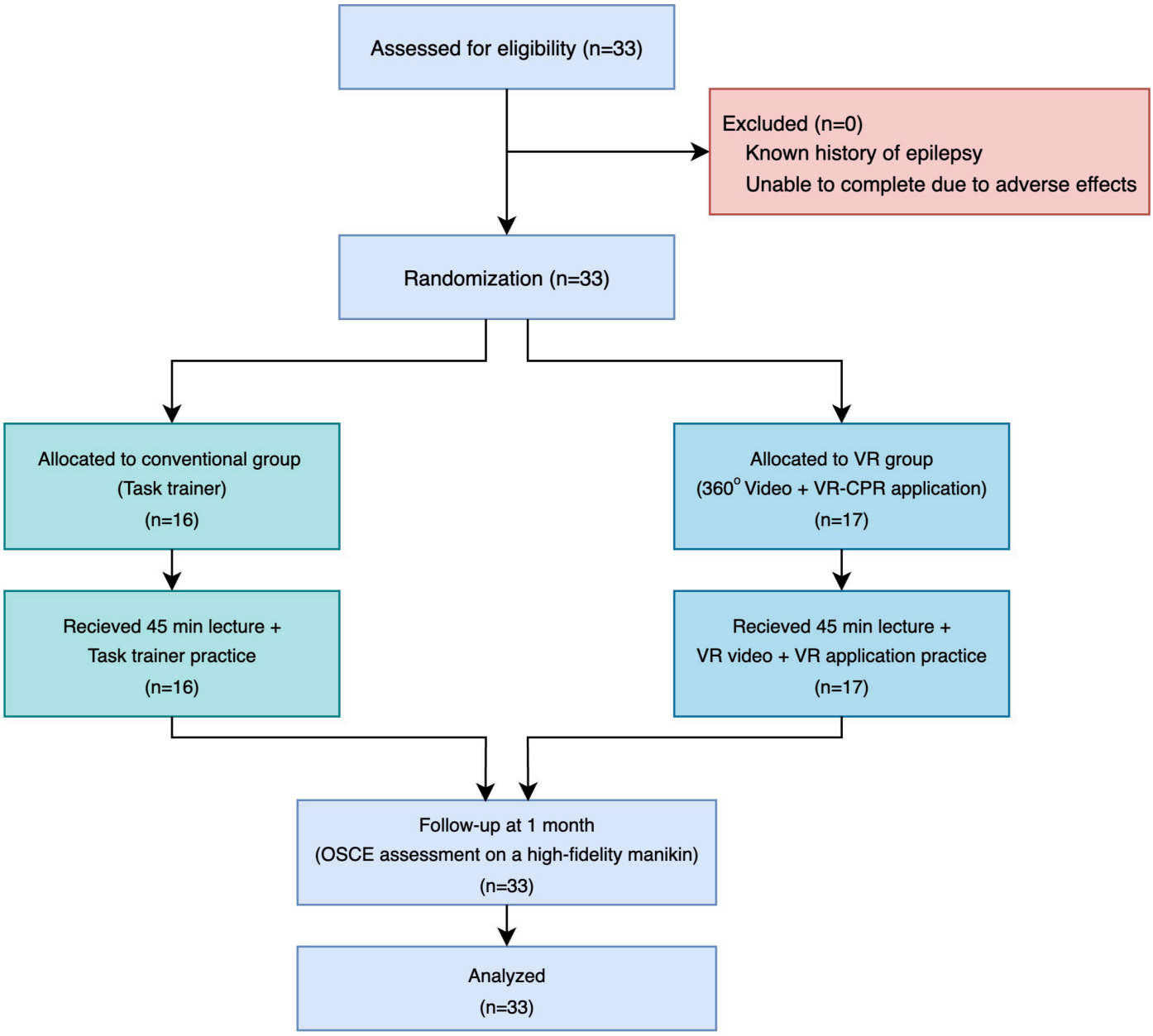


Figure 1

CONSORT flow diagram

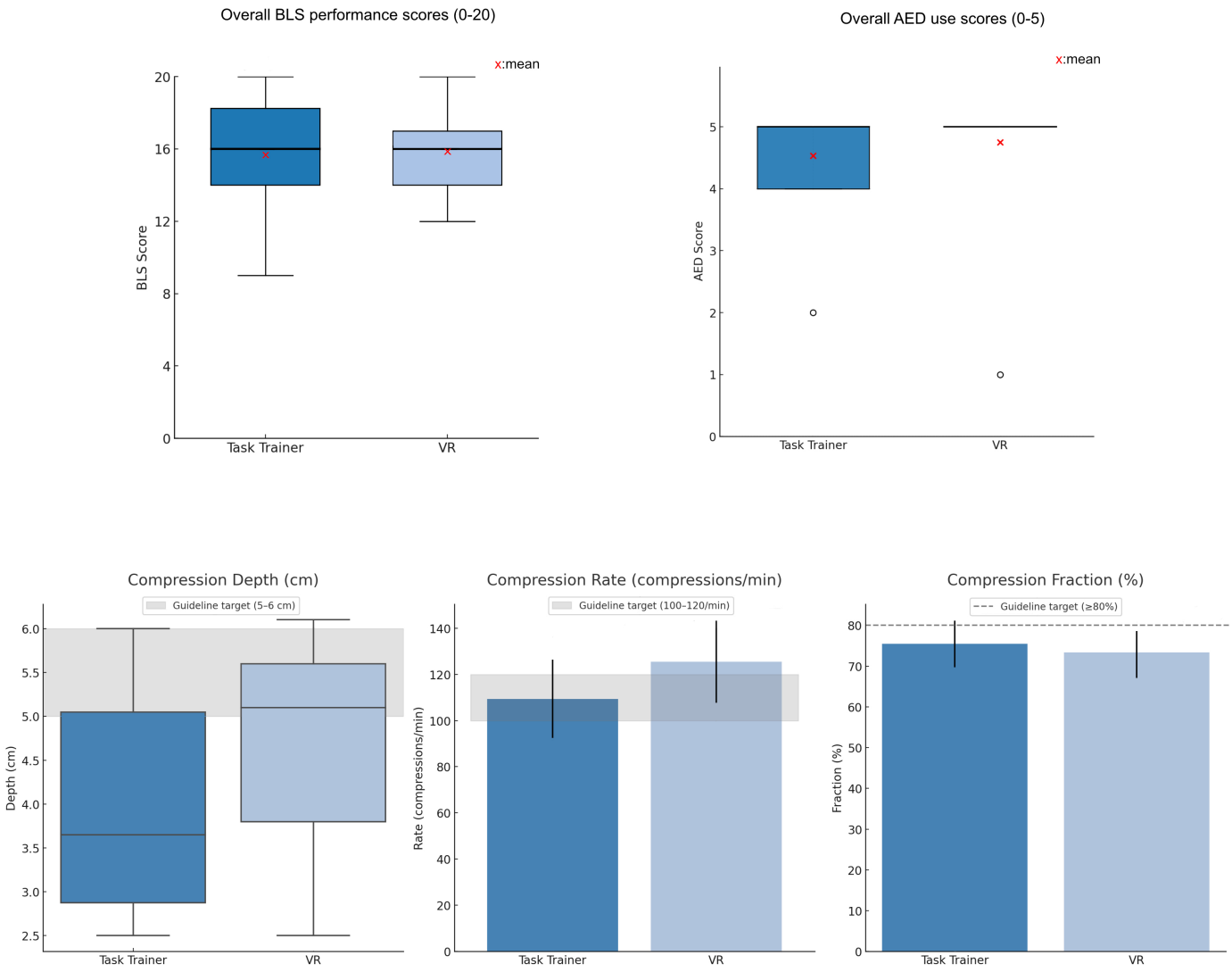


Figure 2

Comparison of BLS and AED performance metrics between task trainer and VR training modalities

Supplementary Files

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- SupplementalFile.docx