

The Effect of Cardiopulmonary Resuscitation Training on Knowledge Level: A Repeated Cross-Sectional Evaluation by Sex

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Abstract

Aim: The aim of this study was to evaluate the effect of Cardiopulmonary Resuscitation (CPR) training on the knowledge levels of male and female participants and to compare knowledge levels before and after the training.

Materials and Methods: In this repeated cross-sectional study, the knowledge levels of individuals who participated in examinations before and after CPR training were evaluated. The CPR training was implemented as a structured 6-hour theoretical education program in accordance with current international guidelines. Although the individuals who participated in the pre-training and post-training assessments were drawn from the same population, analyses were conducted using independent samples because individual-level matching was not possible. Knowledge level was measured using a knowledge assessment form consisting of 31 questions and total knowledge scores were calculated. Appropriate parametric and non-parametric statistical tests were applied according to data distribution and correct and incorrect response rates were compared using the chi-square test.

Results: After the six-hour CPR training, no significant change was observed in the total knowledge scores of male participants ($p>0.05$). In contrast, post-training knowledge scores increased significantly among female participants and across all participants ($p<0.001$). The effect of training on knowledge level was determined to be of moderate magnitude for female participants and for the overall group.

Conclusion: CPR training significantly increased knowledge levels among female participants and across all participants. The findings indicate that the effectiveness of CPR training may differ by sex.

Keywords: Cardiopulmonary Resuscitation; Education; Knowledge Level; Sex;

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Repeated Cross-Sectional Study

Introduction

Cardiopulmonary Resuscitation (CPR) is a fundamental emergency intervention aimed at restoring circulation and respiration in individuals who develop sudden cardiac arrest and has life-saving effects when applied correctly and in a timely manner. One of the most important determinants of survival in cardiac arrest cases is the early and effective application of CPR at the scene [1]. Therefore, international guidelines emphasize that CPR is an indispensable component of basic life support and report that having adequate knowledge and skills among practitioners directly affects patient outcomes [1,2]. The effective implementation of CPR depends not only on the presence of theoretical knowledge but also on the proper internalization of this knowledge and

its application in accordance with current guidelines. In this context, structured CPR training programs are of critical importance for both healthcare professionals and community-based groups. In the literature, numerous studies have demonstrated that CPR training programs tailored to different target groups significantly increase participants' knowledge levels and correct response rates [3,4].

Studies conducted among school-aged individuals, university students and healthcare professionals have shown that theoretical and practical CPR trainings result in marked increases in post-training knowledge scores [5-12]. However, the magnitude of post-training knowledge gain may vary depending on several factors, including training method, prior experience and individual characteristics [13-17].

Among demographic variables, sex is considered an important factor that may influence educational outcomes. Some studies have reported that male and female participants may differ in their learning processes and in their responses to educational programs [7]. However, studies examining the effect of CPR training on knowledge level by sex, particularly in designs where individual matching is not possible, remain limited.

In situations where individual-level matching cannot be performed, pre-training and post-training measurements must be treated as independent samples, making the use of appropriate statistical methods essential. Such repeated cross-sectional designs are widely used to evaluate the overall effect of training, particularly in large-scale educational programs [8].

In this study, it was aimed to evaluate the effect of cardiopulmonary resuscitation training on the knowledge levels of male and female participants, to compare pre-training and post-training knowledge levels using independent samples and to determine the overall effect of training on all participants.

Materials and Methods

This study was conducted as a repeated cross-sectional research to evaluate the effect of Cardiopulmonary Resuscitation (CPR) training on knowledge level. Accordingly, the study represents a non-randomized educational intervention and was reported in accordance with the TREND guidelines.

A repeated cross-sectional design was preferred due to the absence of individual identifiers, which precluded matched pre- and post-training analyses.

Although the individuals who participated in the pre-training and post-training assessments were selected from the same population, measurements were treated as independent samples because individual-level matching was not possible.

The study population consisted of individuals who participated in the CPR training program. Participants who took part in the pre-training and post-training assessments were included in the study on a voluntary basis. No individual identifiers such as names or identification numbers were collected; only sex information and responses to the questionnaire items were recorded. Therefore, pre-training and post-training data could not be matched at the individual level. Male and female participants were evaluated as separate groups and all participants were also analyzed collectively. Participants who completed the knowledge assessment questionnaire before or after the CPR training were included in the study, whereas incomplete questionnaires were excluded from the analysis.

Data were collected using a structured knowledge assessment form consisting of 31 questions covering CPR-related topics. The questionnaire was developed in accordance with current CPR guidelines and the literature and included questions related to basic life support, the definition of cardiac arrest, chest compression practices and resuscitation steps [1,2]. Each correct answer was scored as 1 point and total knowledge scores were calculated to range between 0 and 31. The CPR training was structured in accordance with current international guidelines and implemented as a total of 6 hours of theoretical education. The training covered the definition of cardiac arrest, basic life support steps, chest compression techniques and the fundamental principles of CPR. The training content was prepared in line with the basic life support principles recommended by the European Resuscitation Council (ERC) and the American Heart Association (AHA) guidelines [1,2].

Statistical testing proceeded under the independent samples assumption given the inability to perform individual-level matching. Continuous variables underwent normality assessment via the Shapiro-Wilk test [9]. A normal distribution was observed in the pre- and post-training total knowledge scores of male participants, prompting the use of an independent samples t-test. For female participants and the combined sample, where the normality criteria were not fulfilled, the Mann-Whitney U test was administered [10,11]. Finally, effect sizes were computed using Cohen's d and r coefficients to suit the independent design.

The chi-square test was used to compare correct and incorrect response rates before and after training [12]. Statistical significance was accepted as $p < 0.05$ for all analyses. Statistical analyses were conducted using IBM SPSS Statistics software.

Ethical Approval

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee (Approval No: 852-852-10, Date: September 25, 2025). The study was conducted on a voluntary basis and written or verbal informed consent was obtained from the participants. No identifying information was collected during the survey and the data were analyzed anonymously. The study was conducted in accordance with the principles of the Declaration of Helsinki [13].

Results

In this study, the knowledge levels of individuals who participated in examinations before and after Cardiopulmonary Resuscitation (CPR) training were evaluated. Although pre-training and post-training participants were selected from the same population, analyses were conducted using independent samples because individual-level matching was not possible. Knowledge level was measured using a 31-item knowledge assessment form and total knowledge scores were calculated. Analyses were performed separately for male and female participants and also for all participants combined. A total of 108 participants were evaluated in both the pre-training and post-training assessments. Because the total knowledge scores of male participants before and after training were normally distributed, comparisons were performed using an independent samples t-test. The analysis revealed no statistically significant difference between pre-training and post-training total knowledge scores ($p > 0.05$). The Cohen's d value calculated for male participants was 0.06, indicating that the effect of training on knowledge level was negligible. The comparison of pre-training and post-training total knowledge scores among male participants is presented in Table 1. Because total knowledge scores did not show a normal distribution among female participants, pre-training and post-training scores were compared using the Mann-Whitney U test. Post-training total knowledge scores were found to be significantly higher than pre-training scores ($p < 0.001$). The effect size calculated for female participants was $r = 0.51$, indicating that the training had a moderate-to-high effect on knowledge level. The comparison of pre-training and post-training total knowledge scores among female participants is presented in Table 2.

When all participants were evaluated together, pre-training and post-training total knowledge scores were compared using the Mann-Whitney U test and post-training scores were found to be significantly higher ($p < 0.001$). The effect size calculated for this group was $r = 0.34$, indicating that the training had a moderate effect on overall knowledge level. The comparison of pre-training and post-training total knowledge scores among all participants is presented in Table 3.

Correct and incorrect response rates of male participants before and after training were compared using the chi-square test and no significant difference was found between the two periods ($p > 0.05$). The comparison of male participants before and after training is presented in Table 4. In contrast, a significant increase in correct response rates was observed in the post-training period among female participants and across all participants ($p < 0.001$). The comparison of female participants before and after training is presented in Table 5.

Table 6 presents the distribution of correct and incorrect responses given by all participants before and after the training period. In the pre-training period, a total of 1979 correct and 1771 incorrect responses were recorded, whereas in the post-training period, 1712 correct and 1528 incorrect responses were identified. The chi-square analysis conducted to compare correct-incorrect response distributions between the pre-training and post-training periods revealed that the difference between the two periods was statistically significant ($\chi^2 = 61.88$; $p < 0.001$). This finding indicates that the response distribution among all participants changed significantly after CPR training and that the training had a statistically significant effect on knowledge level.

Period	n	Mean ± SD		
Pre-training	28	15.32 ± 2.63		
Post-training	28	15.50 ± 3.10		
Test	t	sd	p	Effect Size (Cohen's d)
Independent samples t-test	-0,44	52,48	0,665	0,06

Table 1: Comparison of total knowledge scores before and after training among male participants. Total knowledge scores were calculated based on 31 questions. Pre-training and post-training scores among male participants were compared using an independent samples t-test. Cohen's d values were calculated for independent samples.

Period	n	Median (Min-Max)		
Pre-training	80	14 (3-21)		
Post-training	80	18 (12-25)		
Test	U	p	Effect Size (r)	
Mann-Whitney U	1310,5	<0,001	0,51	

Table 2: Comparison of total knowledge scores before and after training among female participants. Because total knowledge scores among female participants did not follow a normal distribution, the Mann-Whitney U test was used. Effect size r was calculated using the Z value obtained from the Mann-Whitney U test.

Period	n	Median (Min-Max)		
Pre-training	108	14		
Post-training	108	17		
Test	U	p	Effect Size (r)	
Mann-Whitney U	3520,0	<0,001	0,34	

Table 3: Comparison of total knowledge scores before and after training among all participants. For all participants, pre-training and post-training total knowledge scores were evaluated as independent samples.

Period	Correct	Incorrect
Pre-training	582	558
Post-training	429	411
Test	χ^2	p
Chi-square	0,17	0,68

Table 4: Correct-incorrect response rates before and after training among male participants.

Period	Correct	Incorrect
Pre-training	1397	1213
Post-training	1285	1115
Test	χ^2	p
Chi-square	78,96	<0,001

Table 5: Correct-incorrect response rates before and after training among female participants.

Period	Correct	Incorrect
Pre-training	1979	1771
Post-training	1712	1528
Test	χ^2	p
Chi-square	61,88	<0,001

Table 6: Correct-incorrect response rates before and after training among all participants.

Discussion

In this study, the effect of Cardiopulmonary Resuscitation (CPR) training on knowledge level was evaluated using a repeated cross-sectional design. The use of independent sample analyses due to the inability to perform individual-level matching between pre-training and post-training measurements allowed for the assessment of the overall effect of training. The findings demonstrated that CPR training significantly increased total knowledge scores and correct response rates among female participants and across all participants, whereas no significant change was observed among male participants. This suggests that training effectiveness may vary depending on participant characteristics.

The significant increase in post-training knowledge scores and correct response rates among female participants is consistent with previous studies reporting the positive effects of CPR training on knowledge acquisition [14,18]. It has previously been shown that structured training programs increase knowledge level and confidence related to training [14,18]. The moderate effect size calculated for female participants in this study supports that the training effect was not only statistically significant but also educationally meaningful.

In contrast, no significant differences were observed in pre-training and post-training knowledge scores or correct response rates among male participants. The negligible effect size calculated for male participants suggests that the practical effect of training in this group may be limited. In the literature, limited post-training improvement in groups with high baseline knowledge levels has been attributed to a “ceiling effect” [17]. Additionally, learning motivation, engagement in training and individual learning styles may differ by sex [15].

When all participants were evaluated together, the significant increase in post-training knowledge scores and correct response rates indicates that CPR training was effective in improving overall knowledge level. The moderate effect size observed in this group supports the practical and educational significance of the training and is consistent with the findings of similar studies [16,17].

Scholarly attention has increasingly shifted toward sex-based variations in CPR training efficacy. Prior research highlights that educational responses can differ significantly between male and female cohorts, pointing to a clear need for sex-sensitive curricula [16,20]. Additionally, because mainstream instructional media and simulation hardware are historically calibrated to male anatomy, they may inadvertently alter the learning trajectory for female participants. These findings may have practical implications for the design of CPR training programs, suggesting that sex-sensitive educational strategies could improve training effectiveness.

Limitations

This study has several limitations. First, analyses were conducted using independent samples due to the inability to match individuals who participated in the pre-training and post-training assessments. This limits the ability to monitor individual-level changes resulting from the training.

Second, only knowledge level was evaluated in the study and practical skills and performance measurements were not included. However, the literature emphasizes that CPR success is related not only to theoretical knowledge but also to the quality of practical performance. Future studies incorporating practical skill assessments and longitudinal follow-up may provide a more comprehensive evaluation of CPR training effectiveness.

Although priori power analysis was not performed due to the observational nature of the study, post-hoc power calculations were considered to aid interpretation of the findings. Based on the observed effect size (Cohen's $d = 0.06$) and sample size in the male subgroup, the statistical power was low, suggesting that the absence of a significant difference may be partly attributable to limited power in this subgroup. In contrast, the observed effect sizes and sample sizes for female participants and for the overall group indicated sufficient statistical power to detect meaningful differences.

In addition, the relatively low number of male participants may have limited statistical power in this subgroup and should be considered as a possible reason for the absence of a significant post-training difference among male participants. The single-center design of the study and the voluntary nature of the sample may also limit the generalizability of the findings.

Despite these limitations, the study provides important data by demonstrating the overall effect of CPR training on knowledge level and by evaluating sex-based differences.

Conclusion

In conclusion, the findings of this study demonstrate that CPR training significantly and educationally improves knowledge levels among female participants and across all participants, whereas a similar effect could not be demonstrated among male participants. These findings indicate that sex-sensitive approaches and different educational strategies should be considered in the planning of CPR training programs. Despite the positive effect of CPR training on overall knowledge level, the absence of a significant change among male participants highlights the need to re-evaluate training content and instructional methods. In particular, the adoption of sex-sensitive educational approaches, increasing the emphasis on practical training and planning periodic refresher courses may enhance training effectiveness. Future studies are recommended to employ designs that allow individual-level matching and include practical skill assessments to more comprehensively evaluate the effect of CPR training.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Statement

The study protocol was approved by the Uşak University Non-Interventional Clinical Research Ethics Committee (Approval date: 25.09.2025; Approval No:852-852-10).

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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