The effect of simulation training on paramedical personnel knowledge and performance in basic life support in a developing country

L'effet de la formation par simulation sur les connaissances et les performances du personnel paramédical en matière de réanimation cardio-pulmonaire de base dans un pays en développement

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Abstract

Introduction: Basic life support is important for increasing patient survival after a cardiac arrest. However, it was demonstrated that healthcare professionals lacked certain knowledge and skills in basic life support. This study aimed to evaluate the effectiveness of a low-fidelity simulation training session in improving paramedical personnel knowledge and performance in Basic life support.

Methods: A cross-sectional quasi-experimental single-group pre-post intervention study was conducted at the Internal Security Forces Hospital in Tunisia in January 2024. All paramedical personnel providing direct patient care were included. The training program involved a theoretical course and a simulation training session. Participants filled out pre-tests and post-tests before and after the theoretical course. A practical simulation test with a skill assessment sheet occurred after the basic life support simulation training session.

Results: Fifty-five paramedical personnel participated in the study. Participants' mean age was 39.7±10.3 years and 72.7% of the participants were women. Most participants were nurses (50.9%). Comparing the pre-test (M=1.73, SD= 0.7) with the post-test scores (M=2.77, SD=1.02,) showed a significant improvement in basic life support knowledge after the theoretical course (p< 10-6). After the basic life support simulation training session, a significant improvement in the practical test score (M=4.04, SD= 0.7) compared to the post-test score was observed (p< 10-6).

Conclusions: Simulation training has a positive effect on improving paramedical personnel's knowledge and performance. To enhance their knowledge and practice in cardiopulmonary resuscitation, a basic life support training program is recommended for all paramedical personnel.

Keywords: Basic cardiac life support, Cardiopulmonary resuscitation, Simulation training, Paramedical

Résumé

Introduction : La réanimation cardio-pulmonaire de base est importante pour augmenter le taux de survie des patients après un arrêt cardiaque. Cependant, il a été démontré que les professionnels de santé manquaient de certaines connaissances et compétences en matière de réanimation cardio-pulmonaire de base. Cette étude visait à évaluer l'efficacité d'une session de formation par simulation basse fidélité pour améliorer les connaissances et les performances du personnel paramédical en matière de réanimation cardio-pulmonaire de base.

Méthodes : Une étude transversale quasi-expérimentale à groupe unique avant-après l'intervention a été menée à l'hôpital des forces de sécurité intérieure en Tunisie en janvier 2024. Tout le personnel paramédical fournissant des soins directs aux patients a été inclus. Le programme de formation comprenait un cours théorique et une session de formation par simulation. Les participants ont rempli des pré-tests et des post-tests avant et après le cours théorique. Un test pratique par simulation avec fiche d'évaluation des compétences a eu lieu après la session de formation par simulation.

Résultats : Cinquante-cinq personnel paramédical ont participé à l'étude. L'âge moyen des participants était de 39,7±10,3 ans, et 72,7% des participants étaient des femmes. La plupart des participants étaient des infirmières (50,9%). La comparaison des résultats du pré-test (M=1,73, SD= 0,7) et du post-test (M=2,77, SD=1,02) a montré une amélioration significative des connaissances en matière de réanimation après le cours théorique (p< 10-6). Après de la session de formation par simulation, une amélioration significative du score de l'examen pratique (M=4,04, SD= 0,7) par rapport au score du post-test a été observée (p< 10-6).

Conclusions : La formation par simulation a un effet positif sur l'amélioration des connaissances et des performances du personnel paramédical. Pour améliorer leurs connaissances et leur pratique de la réanimation cardio-pulmonaire, un programme de formation est recommandé pour l'ensemble du personnel paramédical.

Mots clés: Soins de base en réanimation cardiorespiratoire, Réanimation cardiopulmonaire, Formation par simulation, Soins paramédicaux

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What is known?

- Basic life support training is necessary for cardiopulmonary resuscitation improvement.

- It was demonstrated that healthcare professionals lacked certain knowledge and skills in basic life support.

What this article adds

- There is a lack of knowledge of basic life support in paramedical personnel.

- Simulation-based training improves knowledge and skills in basic life support of paramedical personnel.

- Basic life support simulation training must be systematic and continuous for all paramedical personnel.

Introduction

Cardiac arrest is a major health problem responsible for 15–20% of all deaths and is associated with poor survival rates (1). Several studies showed that the cardiac arrest survival rate decreases by 5–10% for each minute of cardiac arrest without cardiopulmonary resuscitation (CPR), which is an integral component of basic life support (BLS) (2). BLS plays a key role in increasing patient survival after a cardiac arrest. Adult BLS includes immediate recognition of sudden cardiac arrest and activation of the emergency response system, early cardiopulmonary resuscitation, and rapid defibrillation with an automated external defibrillator (AED) (3).

However, it was demonstrated that healthcare professionals are not delivering high-quality resuscitation skills in cardiac arrest, with delayed defibrillation, which is associated with lower survival rates (4). In another study, the authors showed that nurses and doctors lacked certain knowledge of BLS and advanced life support guidelines. They highlighted the fact that resuscitation training had a positive effect on CPR theoretical knowledge (5). Therefore, BLS training is necessary for CPR effects improvement. The 2015 American Heart Association Guidelines recommend that all healthcare providers should be trained in BLS (3). BLS training remains a crucial part of paramedical personnel' education. Several BLS training tools including online courses (6), low and high-fidelity simulation (7–10) were evaluated in CPR skills learning in continuing education.

Various sources confirm that clinical simulation is an essential learning means for paramedical personnel (11–13). The simulation improves the learner's competence, ability, and confidence levels in performing tasks. A direct correlation between survival rates and the increased number of BLS simulation training was demonstrated (14). Many studies showed the usefulness of high-fidelity simulation in resuscitation training. Using low-fidelity simulation for paramedical personnel's BLS training is a relatively new approach to continuing medical education in a developing country such as Tunisia, which has been evaluated in a few studies (10). The present study aimed to investigate the effectiveness of a low-fidelity simulation training session in improving the knowledge of paramedical personnel in BLS, and to evaluate their performance in cardiopulmonary resuscitation.

Methods

Design and setting

A cross-sectional quasi-experimental single-group pre-post intervention study was conducted at the Internal Security Forces Hospital in Tunisia in January 2024.

Sampling

All paramedical personnel working at the participating hospital and providing direct patient care were included in the study.

Training program

The BLS training program was a one-day program involving a theoretical course and a practical session. The 30-minute theoretical course was carried out for all participants and was consistent with the 2022 American Heart Association guidelines on BLS (15).

All participants had a low-fidelity simulation training session on BLS after the theoretical course. It consisted of twenty minutes of BLS practice across four stations of adult CPR and an AED.

The low-fidelity mannequin was a standard plastic mannequin for BLS (Little Anne QCPR (Quality cardiopulmonary resuscitation, Laerdal) that allows chest compression. The course instructors were doctors' specialists in CPR and certified in BLS.

The low-fidelity scenario was: You are in the mall shopping when you notice someone nearby yelling for help. A man in his sixties has collapsed to the ground.

Measurement instruments

A questionnaire collecting sociodemographic and educational variables, including age, gender, current work hospital, and previous participation in BLS training, was distributed to participants at the beginning of the training.

A pre-test containing six multiple-choice questions designed according to the 2020 American Heart Association guidelines on BLS was filled in by participants to evaluate baseline knowledge regarding BLS. The questions included items regarding; recognition of a sudden cardiorespiratory arrest, chain of survival, CPR sequence, chest compression technique, indication, and correct steps to operate an AED. To guarantee anonymity, each participant coded the pre and post-test with the same anonymous identifier.

After the theoretical course was completed, a post-test with the same questions as the pre-test was distributed to the participants to assess the theoretical knowledge acquisition.

A score of one point was given for each correct answer and for any wrong or non-response answer a score of

zero was assigned. The overall score for the pre and post-test was from zero to six points; a higher score revealed more knowledge about BLS.

To assess changes in technical skills in cardiopulmonary resuscitation, and evaluate the low-fidelity simulation training session, all participants took a BLS practical simulation test conducted by an expert in clinical simulation. The practical test took place after the BLS simulation training session.

A skill assessment sheet divided into six items for critical CPR steps according to the BLS skills checklist of the "European Resuscitation Council" was used. Each item was noted as "zero" for "Not yet competent", and one point for "Excellent with independent practice". The total score was obtained by summing the six items with a maximum score of six.

Data analysis

A database was created with the collected information. SPSS software version 24 was used for the statistical analysis. A descriptive analysis of the continuous variables was carried out, expressed as means, standard deviations, and percentages. Wilcoxon signed-rank test was used to compare the pre and post-test scores to determine if there was a significant difference between the two tests. The Chi-Square test of independence was used to compare frequencies. The threshold of statistical significance for the T-tests was set at $p < 0.05$.

The Ethics Committee of the Internal Forces Security Hospital in Tunisia approved this study.

Results

Participants characteristics

Fifty-five paramedical personnel participated in the study. Participants' ages ranged from 24 to 57 years with a mean age of 39.7±10.3 years. Women accounted for 72.7% of the participants. Among participants, 28 (50.9%) were nurses, 11 (20%) were anesthetic technicians, seven (12.7%) were surgical instrument technicians, five (10.9%) were physiotherapists and three (5.4%) were laboratory technicians (figure 1).

About half of the participants (52.7%) attended theoretical courses on CPR during their academic studies and 23.6% received CPR training in the hospital. Only 29% of participants provided CPR for a cardiac arrest during their professional activity and 32.7% have already used an AED.

Pre-test and post-test scoring results

Participants had low pre-test scores (M=1.73, SD= 0.7, range = 0-3.6). Only three participants (5.45%) passed the pre-test (≥50% of correct answers).

A statistically significant improvement in BLS cognitive knowledge was observed in the post-test (M=2.77, SD=1.02, range=0.6 to 4.8) (p< 10-6) (figure 2).

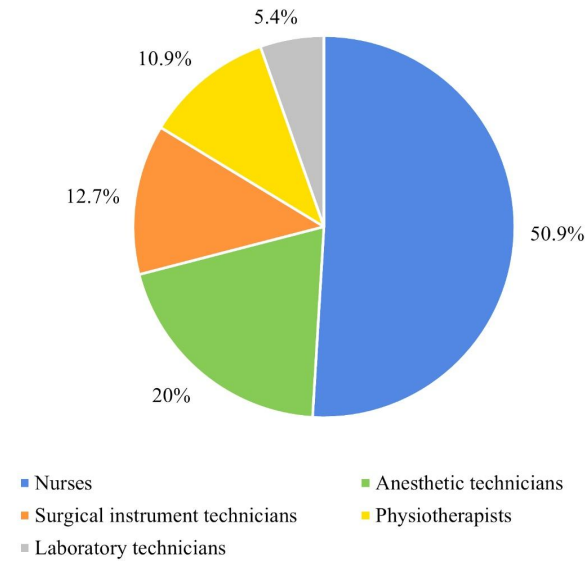

Figure 1. Paramedical personnel categories

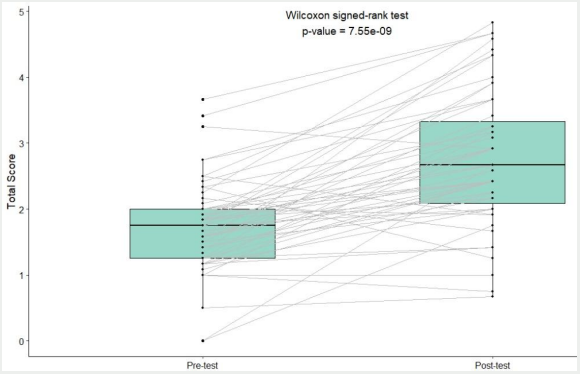

Figure 2. Comparison of pre and post-test scores

Nineteen participants (34.54%) passed the post-test (≥50% of correct answers) (< 10-6) (figure 3).

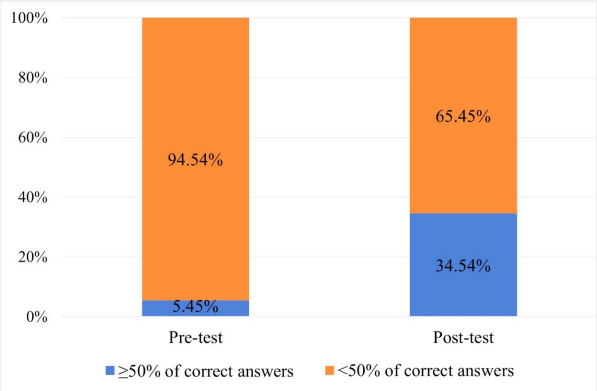

Figure 3. Comparison of percentage of more than 50% of correct answers in pre and post-test

There was no difference between participants who had prior theoretical courses on CPR and those who did not have it in pre-test score (with courses: 1.79±0.74), without courses: 1.66±0.67, p=0.51) and post-test score (with courses: 2.85±1.04), without courses: 2.62±0.97, p=0.52).

The mean score in the BLS practical simulation test was 4.04 (SD= 0.7, range = 0.5-6). Almost all the participants (98%) passed the BLS simulation practical test (BLS practical simulation test score ≥ 3 points). There was a statistically significant improvement in the BLS practical simulation test score compared to the post-test score (p< 10-6) (table 1).

Table 1. Comparison between post-test and practical simulation test scores

	N	Mean	SD	range	P-value
Post-test	55	2.77	1.02	0.6 – 4.8	$< 10^{-6}$
Practical simulation test	55	4.04	0.7	0.5 - 6	

Discussion

This study evaluated the effectiveness of a low-fidelity simulation BLS training session in paramedical personnel at a Tunisian university hospital. The results of this study demonstrated a significant improvement in the post-test score compared with the pre-test score after completing the BLS theoretical course. There was a statistically significant improvement in the BLS practical test score after completing a low-fidelity simulation training session compared to the post-test score.

The results of this study demonstrated that organizing simulation-based training sessions in BLS in a low-resource hospital setting increased paramedical personnel knowledge and performance in cardiopulmonary resuscitation.

Our results are consistent with previous studies conducted in nurses. These studies showed a significant effect of the BLS simulation training program on nurses' skills in BLS (7–9,16). The results of a study carried out among licensed nurses employed in government hospitals in Palestine showed that simulation-based BLS training programs had a significant and immediate impact on BLS nurses' skills and performance (7). A similar result was observed in a Jordanian study (9).

Other studies conducted among undergraduate nursing students showed that the simulation training had a significant and immediate impact on BLS knowledge and performance (17,18).

An interesting finding in our study was the significant improvement in paramedical personnel's skills in BLS after the low-fidelity simulation training session, confirming the educational interest in this learning method. The use of clinical simulation in medical and paramedical education is a well-established training modality (19–21). The superiority of simulation-based education to conventional education was proven in the literature (17). Simulation is a learning method that allows different knowledge and skills acquisition in a safe and educationally oriented environment. It was demonstrated that simulation develops simple psycho-motor skills to gain competence with a procedure or technique and increases students' ability to solve problems and develop integrated knowledge.

In BLS training, clinical simulation helps learners to support critical thinking skills, technical and communication skills and improve self-confidence in learning (18,22,23).

In our study, we observed a low pre-test score, and only 5.45% of participants passed the pre-test. This finding is consistent with the study of Partiprajak and all (18), showing that 90% of undergraduate nursing students failed the pre-test before the training course. Another study evaluating the acquisition of cognitive knowledge in CPR in medical and paramedical personnel also reported that only 10% of participants had higher than 70% correct answers in the pre-test (16). The lack of experience in CPR may explain the poor acquisition of cognitive knowledge in the pre-test before the BLS training program. Only 29% of participants provided CPR for a cardiac arrest in real situations.

Another interesting finding in our study is that although about half of the participants attended theoretical courses on CPR during their academic studies, their pre-test scores were insufficient. Furthermore, there was no difference between participants with prior theoretical courses and those who did not have them in pre-test and post-test scores. This finding highlights the fact that BLS cognitive knowledge falls with time. This purpose was supported by the literature (17,18,24) and emphasizes the importance of incorporating BLS training in a continuing professional development program for all healthcare providers.

To the best of our knowledge, no previous studies about paramedical personnel's BLS knowledge were conducted in Tunisia. In the literature, almost all studies on simulation BLS training have been carried out among nurses. Our study included several categories of paramedical professionals, strengthening this study's importance.

Limitations

Among the limitations of the study, we can highlight the limited number of participants included from only one university hospital in Tunisia which restricts the generalization of the results for all Tunisian paramedical personnel.

A second limitation of this study is that its pre and post-tests evaluations were confined to theoretical knowledge, thereby restricting the assessment of the training's impact solely to cognitive gains. This approach neglected to measure improvements in behavioral or applied knowledge, which could have been assessed through scenario-based evaluations. Although a practical simulation test was included, it wasn't directly linked to participants' initial practical skill levels because no pre-training practical evaluation was conducted. Consequently, it's difficult to definitively attribute the observed skill changes to the simulation session alone, or to fully understand how theoretical learning influenced practical performance.

To address these limitations, it would be advisable to conduct multicenter studies with more participants and incorporating both baseline and post-training skills-based assessments in addition to knowledge-based ones.

Conclusions

This study revealed that BLS simulation training sessions are associated with a significant improvement in the knowledge, performance, and skills of Tunisian paramedical personnel on CPR. This finding highlights the importance of including BLS simulation training, which must be systematic and continuous, for all healthcare providers to maintain their knowledge, self-efficacy, and skills and increase their confidence in CPR.

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