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ORIGINAL RESEARCH

Effect of Simulation-Based Education of Adult BLS-CPR on Nursing Students' Skills and Knowledge Acquisition

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Purpose: Cardiopulmonary arrest is a life-threatening condition where initiating and performing effective cardiopulmonary resuscitation (CPR) is extremely connected to patient outcome. Therefore, acquisition of knowledge and skills related to basic life support is very important for nursing students as future workers. In this study, we aimed to assess the effect of a simulation-based education of adult basic life support cardiopulmonary resuscitation (BLS-CPR) on the acquisition of knowledge and skills among nursing students.

Subjects and methods: This study used a post-test nonequivalent control group quasi-experimental design. It was conducted in the medicine faculty's clinical simulation center among second-year nursing students, enrolled in public and private institutes of nursing education in Sousse, Tunisia, during the 2022/2023 academic year. In this study, convenience sampling was used to recruit 240 nursing students who were assigned using the simple random allocation into two groups. The students designated as the control group (n = 130) received two hours of the conventional BLS education lecture. And the intervention group (n = 110) received the same lecture with added structured simulation-based education of adult BLS-CPR. Adult Basic Life Support Knowledge Questionnaire and Adult Basic Life Support Observation Checklist were used to assess Students' knowledge and practices acquisition in both groups. The data were analyzed using descriptive and inferential statistical techniques in SPSS 26.

Results: The mean post-test BLS-CPR's knowledge and skills scores were higher in the intervention group compared to the control group. In addition, students from the public institute showed a higher score in both control and intervention groups with significant p values, respectively, for the BLS-CPR Knowledge score (<0.001; 0.039) and the BLS-CPR Skills score (<0.001; <0.0001).

Conclusion: Simulation-based adult BLS-CPR education is an effective method that improves nursing students' skills and knowledge acquisition.

Keywords: simulation, adult BLS-CPR, acquisition, knowledge, skills, nursing student

Introduction

Intra-hospital cardiac arrest requires immediate and appropriate intervention. It is a frequent event and represents a major public health problem with a significant mortality rate.[1] Indeed, the survival rate decreases by 10% per minute in the absence of adequate support. Therefore, the survival prognosis is linked to the initial care's speed and quality.[2]

The fact that nurses are often the first responders to an in-hospital cardiac arrest, nursing students, as future nurses, are required to initiate and perform effective cardiopulmonary resuscitation (CPR) when beginning their nursing careers.[3–5]

However, many nursing researchers reported that, in spite of good knowledge base, nursing students were not skillful in clinical settings.[6] And several previous studies have shown that nursing students' level of knowledge on basic life support needs to be improved.[7–9] And due to an ineffective initial training, the quality of CPR practices among nurses and nursing students was deficient which leads to poor retention of CPR knowledge and skills.[10,11]

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In the same context, according to the European Resuscitation Council, taking into account the regular education in technical skills is an essential factor in CPR, and lack of education leads to inappropriate CPR performance and poor clinical outcomes for patients with cardiac arrest.[12]

So, as the CPR education program of nursing students is very important and crucial to optimize patients' survival,[13] introduction of structured resuscitation program in the undergraduate curriculum is needed and efforts should be made to determine an appropriate and efficient course design.[14]

Thus, nursing educational institutions have the responsibility, and they are invited to provide nursing students with good quality learning of CPR' principles through well-developed basic life support programs.

Therefore, to improve the quality of CPR education, nursing students should be educated with the most appropriate and recent knowledge regarding resuscitation in order to ensure transferability, and put in practice this theoretical knowledge.[15]

Hence, with an objective of bridging the gap between theory and practice, educators have faced this challenge by using different educational methods and innovative teaching techniques including simulations.[16]

The latter, being defined as a representation of real-life occurrences, allows students to develop the skills they will need when critical situations occur in reality and to apply knowledge in a safe and controlled environment.[17]

Those findings have been further supported by several researchers who highlighted the importance given to clinical simulation which allows students to make connections between theory and practice and provides them with valuable opportunity to improve their skills and increase retention of knowledge in education.[18–20]

In addition, previous studies demonstrated that nursing students participating in a simulation program are more likely to safely perform CPR and have higher self-confidence in the presence of a real patient.[21]

Based on this background, the aim of this study is to evaluate the impact of simulation-based training among Tunisian nursing students, in both public and private institutes of nursing education, on the acquisition of knowledge and practices of adult basic life support cardiopulmonary resuscitation (BLS-CPR).

Methods

Study Design and Setting

The current study used a quasi-experimental design with post-test and control group. It was conducted in the medicine faculty's clinical simulation center and in both public and private institutes of nursing education in Sousse, Tunisia, which are currently conducting nursing programs at all levels of education.

This survey was carried out during the second semester of the 2022/2023 academic year after the approval of the study protocol by the ethics committee of the faculty of medicine –Sousse, Tunisia – (on date 13/01/2023 - Ref: CEFMS 208/2023).

Research Population and Sampling

In the second year, nursing students learn critical care courses, in which there is a session about CPR. Using a random method (draw), students were classified as intervention and control groups by an individual who was not aware of the purpose of the study.

The intervention group's students received a conventional education method combined with simulation-based education of adult basic life support cardiopulmonary resuscitation (BLS-CPR). For the control group's students, they gained only conventional education method about CPR.

A convenience sample of all second-year nursing students, enrolled in public (4 groups) and private (6 groups) institutes of nursing education in Sousse, Tunisia, during the 2022/2023 academic year, ***who have consented to participate*** were included in the study and nursing students who were not available at the time of data collection were excluded from the study.

The number of the sample was calculated according to Cohen equation (1988) (Statistical Power Analysis for the Behavioral Sciences - Jacob Cohen - Google Books, n.d).

$$n = \frac{Z^2 XPXQ}{D^2}$$

Where: *n: Calculated sample size, Z: the z-value for the selected level of confidence = 1.96 P: Estimated prevalence in the population: 50%, Q: (1-P) = 50%, D: the maximum acceptable error (precision level) = 0.05.*

The calculation resulted in sample size of 64 students in each group. This number was increased by an additional 20% to consider non-responses. Hence, the total sample size required for each group was 77 nursing students.

Finally, 240 students participated in this study, 130 were designated as the control group and the rest (n=110) as the intervention group.

Inclusion Criteria

In order to be sure that the results to be obtained are due to the effect of the educational intervention, the participants were chosen according to the following inclusion criteria:

- Second-year nursing students in public and private institutes of nursing education agree to participate in the study.
- Students with no previous experience of CPR and who have no Basic Life Support (BLS) certificate.

Assessment Tools

1. Adult BLS-CPR Knowledge Questionnaire: This questionnaire was designed from the questionnaire developed by the ERC' experts, questions that are not related to CPR have been removed because the focuses of this study are on adult CPR only. This modified form included 30 true/false questions about knowledge and practices on adult basic life support. It examined mainly the recognition of a person in cardiopulmonary arrest, calling for help, chest compression in terms of number and depth, essential airway management (insufflations) and the use of the Automated External Defibrillator (AED). Correct answers were rated 1 point, and incorrect answers were rated 0 points. The minimum score that can be obtained from the questionnaire was 0, the maximum score was 30. Higher knowledge questionnaire scores indicated better knowledge about adult basic life support.

The content validity of this modified questionnaire was evaluated and confirmed by the panel of experts composed of 2 BLS instructors, ERC trainer, resuscitation doctor and clinical simulation trainer. Cronbach's alpha was determined to establish the reliability of this questionnaire, and it was 0.84.

2. Adult BLS-CPR Observation Checklist: For educational (non-certificatory) purposes, the BLS-CPR assessment form developed by ERC's experts was used, and it was filled out by Tunisian instructors certified by the ERC. This checklist included 13 steps related to BLS-CPR practices and has 2 types of response categories (acquired or not acquired). The response "Acquired" receives 1 point and "Not Acquired" receives 0 points. The minimum score is 0, and the maximum score is 13. Higher scores indicate better skills about BLS-CPR practices. The reliability coefficient of this Observation Checklist was found 0.84.

Educational Intervention: Simulation-Based Education of Adult BLS-CPR

Training program regarding adult BLS-CPR was developed for the intervention groups' nursing students based on 2021 ERC guidelines, and it was structured to enhance knowledge and practices regarding adult BLS-CPR. To make the students aware, the teaching method adopted was to apply the four-stage (stepwise) approach deployed by the ERC trainers in each BLS course session. The original four stages are described in details below and were applied according to the needs of the BLS course participants.

- *Stage 1*: The instructor demonstrates the skill, without explanation, at normal speed and without interruption.
- *Stage 2*: The instructor demonstrates the skill again, this time adding a description of what is being done and why.
- *Stage 3*: The instructor performs the skill again, this time with a candidate, or candidates guiding the instructor.
- *Stage 4*: The candidates demonstrate the complete skill, with or without a commentary on what they are doing.

In order to provide a more effective training, the instructors who animated this training workshop have been specialized, certified, from the ERC, and experienced in basic life support training.

The time duration for the training program was 1 hour and for demonstration the time duration was 2 hours.

Procedure

In both groups, the conventional adult BLS-CPR course was conducted using Power-Point presentations, it lasted two hours for each group at both the public and the private institutes of nursing education. Then, data collection was obtained only from the students of control groups (knowledge and practices assessment).

For the intervention groups, in addition to receiving conventional education, students benefited from practical training in the medicine faculty's clinical simulation center where clinical skills were taught on CPR mannequins. This training program regarding adult BLS-CPR was provided by instructors who were certified and experienced in basic life support training. After that, the nursing students were divided into small groups consisting of six students per group where post-test knowledge regarding BLS was carried out for all the groups. In order to assess nursing practices, using the same scenarios, the students practiced the BLS in two-member groups under the supervision of the instructor at the medicine faculty's clinical simulation center who filled out the Adult Basic Life Support Observation Checklist. The students continued to practice various BLS roles, including heart compression, artificial respiration, and the use of AED. Each student practiced BLS steps for 5 minutes and a total of 10 minutes in each group.

Data Collection

- Data collection was conducted in the institution's lecture hall for control group's students and in the medicine faculty's clinical simulation center for the intervention group's students.
- Before the questionnaire was administered, the researcher briefed all participants regarding the expectation of the study and that their participation was voluntary and it will not in any way affect their learning performance. They were also informed that their anonymity in answering the questionnaires will be maintained by the researchers. The participants then signed informed consent forms to participate in the study.
- Practices were assessed on CPR adult manikin, through observation checklist that contains 13 steps of procedure. Knowledge was assessed by a structured knowledge questionnaire comprised 30 true/false questions.
- Data was obtained immediately after the course for the control group's students and for intervention group's students it was gained just after the training program.

Data Analysis

The data were analyzed according to the objectives of the study using both descriptive and inferential statistics. Calculation was carried out with the help of the Statistical Package for Social Science (SPSS version 26) Program.

For qualitative variables, frequencies and percentages were calculated, as well as means and standard deviations for the quantitative variables.

The Student "t" test was used for the comparison of means, and the comparison of frequencies was carried out with the Pearson chi-square test. For all statistical tests, the significance level p was set at 0.05.

Ethical Considerations

In order to ensure compliance with ethical rules, to conduct the research:

- Ethical committee permission was obtained from the ethics committee of the faculty of medicine –Sousse, Tunisia – (on date 13/01/2023 - Ref: CEFMS 208/2023).
- Institutional permissions were granted from the institute of nursing education's administrations and the simulation center's director.
- The researchers explained the aim and procedures of the current research to the students. They gave written informed consent and their confidentiality was guaranteed.
- *To ensure fairness between students, as soon as data collection has already been carried out, participants in the control group received the same clinical simulation training.*

Results

Table 1 shows that the mean post-test BLS-CPR knowledge score was higher in the intervention group (mean = 19.7±2.7) compared to the control group (mean = 17.6±2.9). In addition, the BLS-CPR skills mean post-test score was 5.9 ± 2.5 in the control group versus 9.5±1.5 in the intervention group. There were statistically significant differences between the level of BLS-CPR nursing students' knowledge and skills in the two study groups (p<0.001).

According to Table 2, there were statistically significant differences depending on the nature of students' institutes (public and private) in the two study groups. Students from the public institute had a higher score in both control and intervention groups with significant p values, respectively, for the BLS-CPR Knowledge score (<0.001; 0.039) and the BLS-CPR Skills score (<0.001; <0.0001).

Referring to Table 3, the comparison of the correct answers shows similarities between the answers of the students in both control and intervention groups. Statistically, significant differences were noted only for 9 out of 30 questions which are questions with the following numbers: 3, 12, 13, 17, 18, 20, 24, 25, 30.

Results in Table 4 *show that a* significant difference between the control and the intervention groups affected 8/13 of the skills which are as follows:

- Check response (p=0.004)
- Assess breathing (p<0.001)
- Chest compressions (p<0.001)
- Rescue breaths (p<0.001)
- Compression: ventilation ratio (p=0.001)
- Activate the AED (p<0.001)
- Deliver shock (p<0.001)
- CPR (p<0.001)

Table 1 Comparison of Adult BLS-CPR's Knowledge and Skills Scores Between Students in the Control and the Intervention Groups

	Control Group		Intervention Group		p
	Mean	SD	Mean	SD	
BLS-CPR Knowledge score	17,6	2,9	19,7	2,7	<0.001
BLS-CPR Skills score	5.9	2.5	9.5	1.5	<0.001

Note: The significance level p was set at 0.05.

Table 2 Comparison of Adult BLS-CPR's Knowledge and Skills Scores Between Students in the Control and the Intervention Groups According to the Nature of Their Institutes

	Control Group			Intervention Group		
	Public Institute	Private Institute	p	Public Institute	Private Institute	p
BLS-CPR Knowledge score (Mean ± SD)	19.3 ± 2.4	16.9 ± 2.4	<0.001	20 ± 3	18.6 ± 3.2	0.039
BLS-CPR Skills score (Mean ± SD)	8.9±1.9	4.3±2.1	<0.001	9.9±0.8	8.3±0.7	<0.001

Note: The significance level p was set at 0.05.

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Table 3 Comparison of Correct Answers Given to the Adult Basic Life Support Knowledge Questionnaire Between Students in the Control and the Intervention Groups

Questions	Control Group		Intervention Group		p
	n	%	n	%	
1. To check for consciousness, carefully shake the victim's shoulders and ask "are you okay?"	107	82.3	89	80.9	0.780
2. When the victim starts to move, you can stop CPR	100	76.9	83	75.5	0.790
3. Once you have asked a second witness to call 190, you must immediately start with 2 ventilations	76	58.5	83	75.5	**0.006**
4. During the AED analysis, keep yourself safe while looking around to make sure no one is touching the victim.	125	96.2	109	99.1	0.223
5. If your first breath does not lift the chest, you should check your technique before your next attempt	106	81.5	81	73.6	0.141
6. If you are trained in CPR, you must deliver 2 breaths after each sequence of 30 chest compressions	115	88.5	100	90.9	0.536
7. Once the victim is unconscious, the degree to which the head is tilted back no longer matters	111	85.4	89	80.9	0.354
8. As soon as you have checked breathing, you give the witness the following message "call 190, and say that there is an unconscious victim, and that our position is X"	33	25.4	37	33.6	0.161
9. If the witness places the AED pads incorrectly, you should never correct this	110	84.6	84	76.4	0.106
10. It is mandatory that each AED electrode be applied in accordance with the images on the AED	9	6.9	10	9.1	0.535
11. The main reason for looking at the chest between two breaths is to see it collapse when the air comes out.	89	68.5	79	71.8	0.572
12. The reason the fingers are interlaced for chest compressions is to avoid pressure on the ribs	89	68.5	88	80	**0.043**
13. To resume CPR, after a shock for example, you first perform two breaths and then CPR 30/2	55	42.3	72	65.5	**<0.001**
14. To perform high-quality chest compressions, you must release all pressure on the chest, without losing contact between your hands and the victim's chest	97	74.6	88	80	0.323
15. In an unconscious victim, you do not have to listen to breathing for 10 seconds if you hear it after 3 seconds	99	76.2	74	67.3	0.126
16. After the insufflations, you resume CPR by placing the heel of the hand in the center of the thorax, the other hand above the first by interlacing the fingers	108	83.1	96	87.3	0.364
17. If it is impossible to perform rescue breaths, continue CPR by performing only chest compressions	68	52.3	103	93.6	**<0.001**
18. Your first breath was effective but the second was not, you perform one more breath before resuming chest compressions because you know your technique failed the second time	70	53.8	73	66.4	**0.049**
19. To check if a victim is breathing, you listen for breathing sounds, feel the breath against your cheek, and look at the victim's chest to check for movement.	123	94.6	105	95.5	0.766
20. As soon as an AED has arrived, you ask to activate it after the cycle of 30 chest compressions and 2 breaths is completed	27	20.8	54	49.1	**<0.001**
21. Before placing your mouth over the victim's mouth to deliver breaths, you must first inhale deeply	32	24.6	36	32.7	0.165
22. To administer chest compressions, you must depress the chest at least 4 cm	47	36.2	53	48.2	0.060
23. If the AED no longer advises shock, it is reasonable to assume that the victim has regained a heartbeat	46	35.4	37	33.6	0.777
24. The correct hand position for performing chest compressions is in the center of the sternum	40	30.8	16	14.5	**0.003**

(*Continued*)

Table 3 (Continued).

Questions	Control Group		Intervention Group		p
	n	%	n	%	
25. Even though it is a fully automatic AED, you must press the shock button when the AED advises shock	22	16.8	33	30	**0.016**
26. Breathing air for 1 second as in normal breathing, while watching the chest rise is the right way to achieve effective breaths	95	79.1	91	82.7	0.074
27. You can stop CPR when you hear the paramedics coming	93	71.5	89	80.9	0.091
28. The maximum frequency of chest compressions does not matter as long as it is above 100 per minute	72	55.4	70	63.6	0.195
29. It is not necessary to begin CPR if an unconscious victim is breathing loudly and slowly but you hear the breathing within the first seven seconds	62	47.7	46	41.8	0.362
30. As soon as the AED is activated, you place the first electrode on the left side of the victim, just below the collarbone	35	26.9	44	40	**0.032**

Notes: *The significance level p was set at 0.05Significant difference between groups have been highlighted with bold style.

Table 4 Comparison of Answers Given to the Adult BLS-CPR Observation Checklist Between Students in the Control and the Intervention Groups

skills	The Candidate	Control Group		Intervention Group		p
		Achieved (n, %)	Not achieved (n, %)	Achieved (n, %)	Not achieved (n, %)	
Check response	Demonstrates gently shaking and shouting to establish responsiveness	62 (48.4)	68 (51.6)	74 (67)	36 (33)	**0.004**
Assess breathing	Demonstrates head tilt and chin lift	32 (25)	98 (75)	75 (67.9)	35 (32.1)	**<0.001**
Assess breathing	Demonstrates look, listen and feel for normal breathing for no more than 10 sec (does not count aloud)	66 (51.6)	64 (48.4)	60 (54.1)	50 (45.9)	0.693
Call emergency services (Get help)	Describes how to phone for emergency services: 112, unresponsive and non-breathing victim, AED	89 (69.5)	41 (30.5)	76 (68.8)	34 (31.2)	0.904
Chest compressions	Demonstrates effective chest compressions; rate 100–120/min, depth 5–6 cm; hand position: centre of the chest. Minimises interruptions in chest compressions	29 (22.7)	101 (77.3)	81 (73.4)	29 (26.6)	**<0.001**
Rescue breaths	Demonstrates rescue breaths sufficient to cause the chest to rise and fall	18 (14.1)	112 (85.9)	64 (57.8)	46 (42.2)	**<0.001**
Compression: ventilation ratio	Demonstrates ratio of 30 compressions to 2 ventilations	64 (50)	66 (50)	81 (73.4)	29 (26.6)	**0.001**
Activate AED	Switch the AED on or, if a helper is present, ask him/her to do it	49 (38.3)	81 (61.7)	73 (66.1)	37 (33.9)	**<0.001**

(*Continued*)

Table 4 (Continued).

skills	The Candidate	Control Group		Intervention Group		p
		Achieved (n, %)	Not achieved (n, %)	Achieved (n, %)	Not achieved (n, %)	
Attach pads	Demonstrates attaching pads in correct position	74 (57.8)	56 (42.2)	77 (69.7)	33 (30.3)	0.058
Stand clear	Allows rhythm analysis whilst making sure that nobody touches the victim (including visual sweep and verbal instruction)	79 (61.7)	51 (38.3)	76 (68.8)	34 (31.2)	0.254
Deliver shock	Demonstrates rapid and safe delivery of a shock (including visual sweep and verbal instruction to stand clear)	39 (30.5)	91 (69.5)	69 (62.4)	41 (37.6)	**<0.001**
Follow AED instructions	Demonstrates listening to and executing AED instructions	55 (43)	75 (57)	58 (52.3)	52 (47.7)	0.152
CPR	Minimises interruptions in chest compressions and demonstrates correct sequence in ratio of 30 compressions to 2 ventilations	42 (32.8)	88 (67.2)	71 (64.2)	39 (35.8)	**<0.001**

Notes: *The significance level p was set at 0.05. Significant difference between groups have been highlighted with bold style.

Discussion

The main interest of the different resuscitation education methods is to offer students a solid basis for the improvement of their knowledge, psychomotor skills and self-efficacy necessary to successfully resuscitate a victim of cardiopulmonary arrest. In the present study, we aimed to evaluate the effects of a simulation-based education of adult basic life support cardiopulmonary resuscitation (BLS-CPR) on the acquisition of knowledge and practices among nursing students. Such information can help educators choose the most suitable teaching method to optimize student progress. Therefore, it appears necessary to develop a learning module that helps enhance both cognitive and psychomotor nursing skills.

Our findings point to the advantageous effect of adding structured simulation-based BLS-CPR training to a traditional classroom lecture format on students' skills and knowledge acquisition. However, the results of this study demonstrated that in the intervention group compared with the control group, the knowledge and skills scores were increased after the intervention *with the respective averages of 19.7± 2.7 and 9.5± 1.5*. In same line of this finding, multiple previous researches among nursing students stated that, after the simulation-based educational intervention, there was an increase in the nursing student's knowledge and an improvement in their skills for BLS steps.[22–24]

Particularly, in the present study, simulation-based adult BLS–CPR training was found to be effective in the development of resuscitation skills among nursing students. Hence, statistical significant difference between the two groups affecting almost 3/4 of the skills for BLS–CPR steps (8/13) was found. This finding was in agreement with the literature where Hsin-Hsin Lin showed in his study that the simulation-based approach significantly impacts nursing students' self-efficacy and performance qualifications.[25] In addition, the available research reported that following BLS training, nursing students had increased skills related to BLS practices.[26]

In terms of the students' CPR knowledge acquisition, while the results clearly demonstrate a positive training effect, the findings would seem to be a little discouraging. In fact, the responses of the students in the intervention group show that there was a statistically significant difference affecting only 1/4 of all items (9/30).

The high increase in the knowledge and practices scores revealed in this study may be due to the measures undertaken at the time of the intervention. In fact, the Adult BLS–CPR training was conducted with small groups and by using specific teaching methods. On this subject, it was reported that the use of valid methods in accordance with international guidelines and providing BLS training for groups in appropriate size are very important for the success of theoretical and practical training and have a more positive effect on nursing students' BLS practice skills.[27]

On the other hand, based on our results, the gain in knowledge and skills affected more specifically students who were part of the public institute of nursing education *with significant p values respectively for the BLS-CPR Knowledge score (<0.001; 0.039) and the BLS-CPR Skills score (<0.001; <0.0001)*.

This can be explained by the fact that in our state, the selection of students in public institutes is done on a more relevant and rigorous basis. Subsequently, admission scores to such institutes are higher than those required by private institutes, which assumes and leads to believe that students in the public sector are better than students in the private sector.

Finally, the advantages of the simulation-based adult BLS-CPR approach improved the learning outcomes of the second-year nursing students who participated in this study. Therefore, instructors should identify the best way to assimilate simulation into the nursing curriculum.

Strengths of the Study

The Main Strengths of This Study Figures as Below

1. In order to prevent any bias, the educational intervention was provided for all the groups by the same instructor who was experienced, specialized and certified for providing basic life support training.
2. The study was conducted among students enrolled in two different nursing education institutes, and randomized technique was used in the construction of the intervention group.
3. For more effective training, the sample was divided into small groups and the instructor used the up-to-date guideline instruction for the education of Basic Life Support steps.

Limitations of the Study

This study has several factors that may affect the method in which the study was conducted and influence the generalizability of our findings. For instance:

1. BLS-CPR's practices and knowledge retention were not assessed in the current study.
2. The number of participants was limited by the number of students enrolled in the course; hence, the results may differ with a larger group and random assignment that would be more predictive in changes after simulation because of the simulation and not by chance.
3. Prior to the study, students' knowledge and practices were not assessed to determine comparability of the groups which is potentially a threat to external validity.

Conclusion

The findings of this study support the value of the use of simulation as a key educational tool and provide a stepping point for understanding how it may affect the students' knowledge and practices. However, in light of our findings, adding a one-time simulation-based adult BLS-CPR sessions to traditional lecture classes is an effective instructional pedagogy to increase nursing students' cognitive ability and skills before graduation.

Moreover, as the goal *of health sciences education programs is to impart the knowledge, skills, and attitudes necessary for preparing students to become competent healthcare professionals particularly* in the event of a cardiac related emergency *such as cardiac arrest*, there is still a need for a continued focus on CPR education among nursing students after finishing their education. Therefore, we suggest follow-ups to evaluate how recently graduated nurses demonstrate their nursing skills in a real clinical setting.

Ethical Approval

Ethical committee approval was obtained from the ethics committee of the faculty of medicine –Sousse, Tunisia – (on date 13/01/2023 - Ref: CEFMS 208/2023).

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Disclosure

The authors declare no conflicts of interest in this work.

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