The Open Nursing Journal

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RESEARCH ARTICLE

Pediatric Basic Life Support among Nursing Students in Jordan: Stimulation-Based Education

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Abstract:

Background:

In the context of seeking to reduce the neonatal mortality rate (NMR) in Jordan, there is a need to use simulation to teach and train nursing students in pediatric basic life support (PBLS) skills. This study aims to measure the preservation of PBLS knowledge and determine whether active observation of an immersive simulation using a simple checklist would improve PBLS skills.

Methods:

A single group pretest-posttest approach design was applied in the Jordan University of Science and Technology (JUST) pediatric simulation lab for 108 nursing students.

Results:

The result of the paired samples t-test showed that there was a statistically significant increase in PBLS knowledge between pretest and post-test. The result of the paired samples t-test in the group showed that there was a statistically significant enhancement in PBLS skills between pretest and post-test. PBLS skills at pretest were poor (M = 4.31, SD = 1.12). It was reported that place of residence is a significant predictor of knowledge in PBLS ($p < .05$).

Conclusion:

The results of this study showed that a simulation-based PBLS course positively impacted knowledge and skills in pediatric BLS. The findings also suggest that policymakers should establish continued professional development BLS training programs for healthcare providers, especially nurses, which can be provided at low cost in most of the settings around the country.

Keywords: BLS, Pediatric, CPR, Knowledge, NMR, PBLS.

Article History	Received: March 24, 2022	Revised: April 28, 2022	Accepted: June 14, 2022

1. INTRODUCTION

Globally, huge efforts have been made to save children's lives. Fortunately, the children's death decreased from 12.6 million in 1991 to 5.3 million in 2018. The major causes of death were anomalies and non-infectious diseases related to cardiac and respiratory systems. In Jordan, the number of neonate deaths was 10.6 per 10000 in 2016 [1, 2]. However, Western countries, such as the United States, have a much lower number of deaths ranging from 2.05–3.1 per 1000 live births. This suggests that Jordan needs to invest in its future nurses by focusing on teaching them how to apply basic life support interventions in a pediatric setting, which could reduce the number of deaths in the neonatal period (WHO).

Many scholars who have conducted research on the use of simulation in clinical practice recommend that undergraduate nursing education should employ a simulation-based curriculum for clinical reasoning development and knowledge acquisition [3, 4]. Therefore, in the context of seeking to reduce the NMR in Jordan, there is a need to use simulation to teach and train nursing students in pediatric basic life support (BLS) skills. Indeed, it seems crucial to undergo simulation-based learning in these skills, as this teaching method is already increasingly being utilized in the nursing curriculum. According to Motola and Devine [4], the simulation-based learning method includes purposeful responsibilities, allowing students to practice various skills without risking actual

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patients. Also, based on the confidence levels and contentment feedback of nursing students, it has been reported that they enjoy simulation as a method of teaching and learning [3, 5, 6]. However, thus far, self-reported measures and subjective evaluations have been predominantly used to evaluate learning outcomes, leading to concerns about the effectiveness of learning based on simulation [7]. Over the past decade, modalities of nursing education based on simulation learning have had policy and realistic precursors. This entails recognizing that scenarios based on simulations can assist students in learning and making them ready for the clinical setting [8].

Simulation provides opportunities for repeated practice, particularly in managing rare conditions [3, 9], minimizing the required time to attain competency. Besides, according to Larue *et al*. [10] and Ricketts *et al*. [11], learning based on simulation is regarded as a credible alternative to several hours of clinical training in pre-registration nursing units in both the United States and the United Kingdom. Additionally, the limited places available for international clinical placements have accelerated the increase in simulation-based learning courses [11]. In the past five years, there has also been an escalation in research on and around the issue of simulation-based learning in nursing, and the literature in this area has increased significantly.

Thus, it is now beneficial to reevaluate the recent developments in simulation research and analyze the efficiency of this increasingly favored teaching and learning modality. Since there is no one objective measure that can be applied to this type of learning method, existing studies on simulation have based their reviews on different outcomes, such as improving knowledge, developing skills, and increasing levels of confidence. A systematic evaluation of nursing simulation by Lapkin *et al*. [8] revealed a positive learning impact in respect of acquiring knowledge and clinical understanding. However, a methodical evaluation of 23 studies published between 2003 and 2007 showed that limited studies had objectively reviewed the outcomes of simulation teaching [12]. One of the outcomes emerging as a nursing care topic is PBLS training, and nurses need to practice these skills to be competent and effective.

Simulation education is considered critical in teaching knowledge and skills in cardiopulmonary resuscitation (CPR) and PBLS [13, 14]. Both CPR and PBLS are considered life-saving skills in the case of cardiac arrest, and the ineffective use of these skills by nurses may result in death or poor quality of life outcomes [15 - 17]. The American Heart Association has proposed using simulation, response devices, simulators, and online learning courses as PBLS learning and teaching resources since 2015 [18, 19]. Research has revealed that practicing on manikins under the instruction of a supervisor is the most effective training modality [18 - 20]. Moreover, satisfactory outcomes have been attained by conducting training courses based on PBLS simulation, for which simulators have been specially configured for a professional purpose rather than just for entertainment [18, 20, 21]. Given the reported success of the simulation-based approach, this study aims to measure the preservation of PBLS knowledge and determine whether active observation of an immersive simulation using a simple checklist would improve third- and fourth-year nursing students' subsequent performance of PBLS skills.

2. MATERIALS AND METHODS

A single group pretest-posttest design was used to evaluate the efficacy of using simulation by focusing on teaching them how to apply basic life support interventions in a pediatric setting

Third- or fourth-year nursing students in pediatric BLS were instructed. The study was conducted in the Department of Nursing simulation lab and the Consultation Center at Jordan University of Science and Technology (JUST) in Northern Jordan.

2.1. Sample and Sampling Method

Convenience sampling was used to recruit nursing students in their third year of learning who were registered on child health courses in the Nursing Department at JUST. Based on the literature and using a power of .8, a significance level of $\alpha = .5$ and a moderate effect size of .25, it was determined that the sample size required for the study was approximately 100 nursing students. G*Power 3.1 software version 9.2 was used for the calculation. This number was increased by an additional 10% to consider non-responses. Hence, the total sample size was 110 nursing students.

2.2. Criteria for Eligibility

To be eligible for the study, participants had to be third- and fourth-year nursing students enrolled in theory and clinical child health nursing courses and ready to participate at the start of the study. Students who were sick or absent during the learning intervention were excluded from participating in the research.

2.3. Ethical Consideration

Permission to conduct the research was sought and obtained from the Institutional Review Board (IRB # 531/2020) and the Dean of Research at JUST. A complete explanation of the purpose, methods, benefits, and importance of the study was provided to potential respondents. The respondents indicated their willingness to participate by completing an informed consent form, which they filled in after receiving and understanding a clear explanation of the rights and duties of the investigator and the respondents. The Helsinki Declaration has been followed for involving human subjects in the study. To maintain confidentiality, a coding technique was used to identify the participants instead of using their real names. Participant confidentiality was also ensured by anonymizing the data collected via the questionnaire instrument. Furthermore, all the completed questionnaires were held in a secure location that could only be accessed by the researcher.

2.4. Instrument

2.4.1. PBLS Knowledge Questionnaire

A tool, named the PBLS Knowledge Questionnaire, was developed specifically for this research and was based on the relevant literature. It is a two-part questionnaire that contains 18 questions related to BLS. The knowledge part of the questionnaire consists of 13 multiple-choice questions. The instrument includes questions, such as (1) "Have you ever been asked to save a life?" and (2) "Based on your knowledge, what is the right position to place hands while performing chest compressions?" The respondents mark one of the four options (A, B, C, or D) that they think is the correct answer. A right answer is given 1 point, and a wrong answer is given 0 points. Hence, the score can range from 0 to 13, and a higher score indicates a higher knowledge of pediatric BLS.

2.4.2. PBLS Skills Questionnaire

The skills part of the questionnaire consists of five statements about pediatric BLS. The respondents are asked to mark whether the statement is correct or incorrect. If the respondent marks the statement correctly, 1 point is awarded; otherwise, 0. Hence, the score can range from 0 to 5, and a higher score indicates a greater level of PBLS skills. The reliability of the instrument was tested and achieved a Cronbach's alpha of 0.75.

2.5. Data Collection

After receiving ethical approval from the IRB at JUST and the Dean of Research, the researcher wrote an official letter to both the Dean of the Nursing Department and the Chairperson of the Consultation Center for applying to the educational PBLS program. Prior to the study, informed consent was received from every respondent who agreed to participate in the research. Before the participants completed the questionnaire, the researcher was available to answer any questions they might have regarding the questionnaire.

Data collection began with the participants filling in a pre-knowledge test comprising the 13 multiple-choice questions in the knowledge part of the PBLS Questionnaire. The learning intervention to inculcate knowledge centered on PBLS was executed in the center of simulation and the JUST consultation center. The learning intervention consisted of two components: (1) a 3-hour PowerPoint-based lecture together with a video demonstration of the necessary skills and (2) a 2–3-hour display of skills using high-fidelity simulation manikin and mock scenarios.

The respondents then participated in the first learning intervention component, i.e., the 3-hour course lecture on BLS. The content of this component covered the key PBLS concepts and included a simulated instance that was used to link theoretical knowledge to practice. The course concentrated on identifying very sick children, primary life support, the survival chain, managing choking children, and managing cardiac arrhythmias. After completing the first component of the intervention, each student was asked to demonstrate their skills in conducting CPR in children in simulation scenarios (component two of the learning intervention). This demonstration component lasted for 3 hours in total. This part of the intervention was anonymized because the results were compiled for the group, not individually. The participants were then asked to complete a post-knowledge test that contained the same multiple-choice questions in the pretest they had tackled at the beginning of the study intervention. They were also asked to fill in a satisfaction questionnaire taken from the American Heart Association to gauge the satisfaction of the participants with the training they had received on pediatric BLS.

3. RESULTS

3.1. Demographic Characteristics

A total of 108 nursing students participated in the study. The age of the students ranged from 21 to 28 years (M = 20.8, SD = 3.5). The sample consisted of 66 female and 42 male students (61.1% *vs*. 38.9%). All the students were in their third year or fourth year of study and were all unmarried (Table **1**).

Table 1. Frequency distribution of socio-demographic characteristics of participants (*n*= 108).

Variable	Frequency	Percentage
Gender		
Female	66	61.1
Male	42	38.9
Level of Education		
Third year	93	86.1
Fourth-year	15	13.9
Age	M=20.74	SD=1.13
Father Education		
Primary school	41	38.0
Secondary school	11	10.2
Diploma	13	12.0
Baccalaureus	34	31.5
Master	5	4.6
PhD	4	3.7
Mother education		

(Table 1) contd.....

Variable	Frequency	Percentage
Primary school	40	37.0
Secondary school	7	6.5
Diploma	16	14.8
Baccalaureus	41	38.0
Master	3	2.8
PhD	1	.9
Have a Laptop or a Computer		
Have a laptop	79	73.1
Have a computer	10	9.3
Have both	19	17.6
Income	M=897	SD=9.34
Specialty Area		
Jordan	95	88
Others	13	12
Area of Living		
Urban	50	46.3
Rural	58	53.7
Prior Experience with BLS		
No	102	94.4
Yes	6	5.6
GPA	M=3.24	Sd=2.34

3.2. Knowledge of PBLS Posttest

The nursing student's post-test PBLS knowledge was good (M = 10.37, SD = 2.5) that ranged from zero to 12. The questions that were answered correctly by nearly all of the participants were: "Which of the following signs are true if something is blocking the baby's airway?" (103, 95.4%), "If you are alone, you should start CPR at a compressions-to-breaths ratio of 30:1" (N = 104, 96.3%), and "If you are not alone, switch who is giving CPR every time" (N = 97, 89.8%). The questions that were answered wrongly post-training were, "What is the best place to try to find a pulse in a child? (N = 3, 2.8%) and "Can you use an adult AED on an infant?" (N = 54, 50.0%) (Table **2**).

3.3. Difference in PBLS Knowledge in Pretest and Posttest

The result of the paired samples t-test showed that there was a statistically significant increase in PBLS knowledge between pretest and post-test. The PBLS knowledge at pretest was poor (M = 7.27, SD = 2.34), which was significantly lower than that achieved after the learning intervention (M = 9.7, t = -5.25, df = 108, p < 0.001), with a Cohen's effect size of D = 0.803).

3.4. Difference in PBLS Skills in Pretest and Posttest

The result of the paired samples t-test in the group showed that there was a statistically significant enhancement in PBLS skills between pretest and post-test. PBLS skills at pretest were poor (M = 4.31, SD = 1.12), which was significantly lower than after the intervention in the skill score (M = 10.37, t = -13.2, df = 59, p < 0.001), with a Cohen's effect size of D = 0.703.

3.5. Multiple Regressions

Using prospective predictive variables, such as age, gender, educational level, mother's education, father's education, residence area and monthly income, multiple regressions were used to predict knowledge and skills in pediatric BLS. Multiple regressions tested revealed that the only other variable that has an impact on knowledge and skills in PBLS is the place of residence (B = 9.59, p = .003). On the other hand, gender, income, and mother's educational level are not significantly associated with knowledge and skills in pediatric BLS (Table **3**).

Table 2. Response to knowledge questionnaire (N=108).

Questions	False		True	
	Count	Row N %	Count	Row N %
1. Which of the following signs are true if something is blocking the baby's airway?	5	4.6%	103	95.4%
2. Coughing is the most effective way to dislodge a blockage	12	11.1%	96	88.9%
3. If an infant is unconscious, how long should you check for a pulse before starting CPR?	19	17.6%	89	82.4%
4. If you are alone, you should start CPR at a compressions-to-breaths ratio of	4	3.7%	104	96.3%
5. If you have additional help, start high-quality CPR at a compressions-to-breaths ratio of	14	13.0%	94	87.0%
6. When performing compressions on an infant, compress the chest by pushing down about how many inches	14	13.0%	94	87.0%
7. You cannot use an adult AED on an infant	54	50.0%	54	50.0%

(Table 2) contd.....

Questions	False		True	
	Count	Row N %	Count	Row N %
8. If you are not alone, switch who is giving CPR every	11	10.2%	97	89.8%
9. How many chest compressions should you deliver in a minute	19	17.6%	89	82.4%
10. The best place to try to find a pulse in a child is	105	97.2%	3	2.8%
11. A shockable rhythm means:	14	13.0%	94	87.0%
12. CPR terminated in (this/these) condition(s)	36	33.3%	72	66.7%
13. The CPR start by	36	33.3%	72	66.7%

Table 3. Predictors of PBLS knowledge and skills (N=108)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.923	3.789		3.938	.000
	Gender	.400	.377	.117	1.061	.292
	Age	-.211	.180	-.138	-1.175	.243
	Years of study	-.583	.575	-.122	-1.013	.314
	Income JD	.000	.000	-.087	-.613	.542
	Mother educational level	-.202	.136	-.170	-1.481	.143
	Father educational level	.019	.134	.018	.145	.885
	Place of Residence	-1.197	.402	-.355	-2.979	.004
	Have a computer or laptop	.038	.230	.018	.163	.871
	GPA	-.138	.438	-.036	-.314	.754
	Number of family members	.091	.110	.091	.826	.412
	Nationality	.127	.282	.064	.450	.654
	Have previous course training	-.446	.740	-.066	-.603	.548

a. Dependent Variable: sums

4. DISCUSSION

All healthcare givers concerned with caring for newborns must have a high level of knowledge and skills in neonatal resuscitation, and there is a wide offering of PBLS in healthcare facilities [18 - 20]. Learning techniques based on simulation have been proposed to have a positive effect on the delivery of PBLS instructions. Nevertheless, only a few studies have been undertaken to assess the impact of the different types of simulation labs on learning outcomes in respect of pediatric BLS [14 - 16]. Moreover, currently, there are no established best practices for the use of the simulation lab in the instruction of PBLS skills. Although researchers support the assumption that simulation improves the participant's critical thinking [22], teaching programs lack efficient integration of knowledge acquisition through simulation [23]. In this study, the participants' PBLS knowledge and skills were assessed before they started the simulation-based learning intervention. The outcomes support the efficiency of simulator use as compared to other methods because it was found that there was a significant difference in knowledge about PBLS after the intervention using a simulation lab for training. However, it should be noted that there is a need for more research to determine the optimal point for post-training assessment. This study revealed that PBLS knowledge levels and skills were low among the respondents in the pretest and post-test. The skills at the attainment stage between teaching and training, knowledge of PBLS and skills increased significantly after the training session. Nevertheless, the participants in the simulation group attained more knowledge and skills than those in the control group. These findings are in agreement with those reported in previous studies [24, 25].

The outcomes of this research show that simulation is an efficient method that enables students to acquire knowledge and skills. The advantages of the simulation-based approach improved the learning outcomes of the third-year nursing students who participated in this study. Therefore, instructors should identify the best way to assimilate simulation into the nursing curriculum. They should exploit suitable simulation instances that are in line with the students' educational level. For the achievement of optimal simulation benefits, various scenarios should be practiced depending on the educational level of the students.

The level of PBLS knowledge and skills among the participants differed significantly pre and post-test. In the post-test, the participants exhibited more knowledge retention and improved skills compared to their results in the pretest. This finding is similar to those reported in previous studies that evaluated the retaining of PBLS knowledge and skills [26]. However, Smith *et al*. [27] determined that nursing students who had completed PBLS training on a static manikin showed a reduction of approximately 37% in their skills and knowledge within a 3-month period and a 42% decline within 12 months. However, a higher proportion (85%) of the intervention category retained these skills 3 months after learning. This outcome highlighted the efficiency of simulation training compared to low fidelity simulation training.

In this study, the participants fell into a narrow age range

(20–28 years). This may have been one of the reasons for their generally low level of cognitive knowledge, skills and self-efficacy before their participation in the modified PBLS training. As 90% of the participants failed the PBLS knowledge questionnaire, the findings of this study support the assumption that nursing students lack PBLS cognitive knowledge. This outcome is similar to a prior study in which it was found that 94% of the participants did not pass the test before attending the training [28]. According to Passali *et al*. [29], recent research has reported that medical experts have poor PBLS knowledge and skills.

It was found that the modified PBLS training in this research was valid. This training course significantly increased the pass rate in the standard test for knowledge and skills from 10% before training to 100% after the training. Furthermore, the post-test scores for PBLS knowledge and skills were quite a lot better compared to the pretest scores. The internal validity of the PBLS course and questionnaire could explain this outcome because it was expressly tailored to improve knowledge and skills of PBLS competence.

The course content of the learning intervention applied in this study covered the key PBLS knowledge and skill concepts and included a simulated instance used to link theoretical knowledge to practice. Thus, the PBLS course positively impacted the performance of the students in relation to their PBLS cognitive knowledge and skills. A study [28, 30] contends that simulation is a practical approach for PBLS knowledge and skill training and can boost retention and enhance the comfort of students in terms of performing PBLS [31]. Other previous studies among nursing students concluded that after the teaching simulation, there was an increase in the students' knowledge and an enhancement in their skills [30, 32]. Moreover, the results of this study were similar to previous studies demonstrating that training on PBLS should occur in hospital settings and guidelines based on evidence [33], which boosted beneficial outcomes. The findings of this study suggest that the most critical impact of using a PBLS simulator was on the satisfaction of the students with teaching and their confidence to conduct neonatal resuscitation.

4.1. Implications for Education and Practice

The findings of this study regarding the effect of simulation-based PBLS education provide nursing instructors in universities and nursing colleges with strong evidence that supports the inclusion of this topic in educational programs for nursing students and supports the training of students in this topic using both the lecture-based and simulation-based. Moreover, the findings of this study regarding the effect of the simulation-based PBLS educational course provide healthcare providers with evidence-based information that reflects their clinical practice through the application of competencies (as the provider cannot practice what they do not know), which, in turn, can reduce the suffering of pediatric patients and their families [34]. Finally, the findings also suggest that policymakers should establish continued professional development BLS training programs for healthcare providers, especially nurses, which can be provided at low cost in most of the settings around the country.

4.2. Limitation of the study

The main limitation of this design is that subjects were not chosen randomly, which may impact the generalizability of the study. However, this study recruited all the classroom students. Another limitation of the study is focusing on one setting, but the only setting that had a stimulation lab was the setting of implementing this study.

CONCLUSION

The findings of this study regarding the effect of the simulation-based PBLS educational course provide nursing students with evidence-based information that reflects their clinical practice through the application of competencies. The results of this study showed that a simulation-based PBLS course positively impacted knowledge and skills in pediatric BLS. The findings also suggest that policymakers should establish continued professional development BLS training programs for healthcare providers, especially nurses, which can be provided at low cost in most of the settings around the country. Using a quasi-experimental design or RCT in the next study will improve the external validity of the study.

LIST OF ABBREVIATIONS

PBLS = Pediatric Basic Life Support

JUST = Jordan University of Science and Technology

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board (IRB # 2020/2343).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, [A.K] on special request.

FUNDING

This study was funded Jordan University of Science and Technology (Grant #531/2020).

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The authors would like to thank all the students who participated in the study.

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