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Effect of simulation modules on Jordanian nursing student knowledge and confidence in performing critical care skills: A randomized controlled trial

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ABSTRACT

Background: Simulation is known to have a significant effect as a teaching strategy in nursing education. However, no studies have been conducted to examine the effect of simulation on nursing students' knowledge and confidence in performing critical care skills in Jordan.

Purpose: This study aimed to test the effect of simulation on university nursing students' knowledge and confidence in performing critical care skills for patients with cardiac, respiratory and neurological health problems.

Method: A randomized controlled (pre-test-post-test) design was implemented. The experimental group (n = 38) attended 9 simulation scenarios, theoretical lectures and clinical training in hospital about cardiac, respiratory and neurological health problems, while the control group (n = 38) attended only the theoretical lectures and clinical training in hospital. Knowledge and confidence were measured using knowledge exam and self-confidence scale respectively.

Results: A paired *t*-test indicated that mean knowledge and confidence regarding implementing critical care skills were significantly higher $P < 0.001$ in the post-test than that in the pre-test, in both the experimental and the control group. However, independent *t* test revealed that the students in the experimental group scored significantly higher $P < 0.001$ than control group in both knowledge and confidence regarding performing critical care skills.

Conclusion: Theoretical and clinical training is valuable teaching strategies that help enhance knowledge and confidence in applying critical care skills. However, adding simulation has a more significant effect than theoretical and clinical training in improving nursing students' knowledge and confidence in performing critical care nursing skills. Author strongly recommended considering simulation as alternative effective educational approach for clinical training especially during COVID-pandemic.

1. Introduction

There are different educational techniques and strategies that were applied and examined to improve nursing education. These approaches include computer-based education and simulation. Simulation is defined as "the use of well developed devices that have a control on a simulated patient, which can react accurately to procedures made by the simulation user" (Gaba, 2007). Simulation helps provide researchers with a controlled environment that mimic reality and perform lots of activities safely (Weldon, Korkiakangas, & Kneebone, 2019). The World Health Organization, 2009 has published principle standards for nursing education. In line with these principles, the use of high facility simulation is highly recommended in nursing school program. Jordan is with no exception, the Jordanian High Accreditations Commission determines that simulation is an essential component of different nursing programs in Jordanian Universities (Tawalbeh, 2017).

Simulation is effective nursing education approach that provides the appropriate setting for clinical training (Kim, Park, & Shin, 2016). It provides the students with the knowledge, skills and confidence in applying different procedures like advanced cardiac life support (ACLS) (Tawalbeh & Tubaishat, 2013), Electrocardiogram (ECG) analysis (Tubaishat & Tawalbeh, 2015) and cardiopulmonary physical examination (Tawalbeh, 2017) and the emergency responces (Karakuş, Duran, Yavuz, Altintop, & Çalişkan, 2014). Simulation is an efficient mean used to incorporate realistic clinical training in a controlled environment and help students to expand their cognitive and psychomotor skills (Motola, Devine, Chung, Sullivan, & Issenberg, 2013). In Jordan, there are many Jordanian nursing schools that integrated simulation as a teaching strategy in nursing curriculum. Therefore, it is important to conduct research that examines the effect of simulation on nursing student knowledge and confidence.

In Jordan, there are many university nursing programs that provide

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undergraduate and graduate degree, while not all of them apply simulation as a basic strategy in nursing education in an effective and appropriate way. In addition, Jordanian High Accreditations Commission asserted that simulation application in nursing education and training should not exceed 20% of students training (Tawalbeh & Tubaishat, 2013). This will highlight the need for more research studies that indicate the importance of simulation in nursing education as a fundamental teaching strategy.

In Jordan, there are many challenges for nursing education including, the large number of students enrolled in the classroom, the high demand for clinical settings, low number of clinical instructors, and the decreased opportunities for nursing students' to take part in providing comprehensive patient care. In addition, Jordanian hospitals received a large number of medical and nursing students with limited training opportunities that might affect the quality of education. Furthermore, COVID-19 pandemic affect the availability of clinical settings for medical and nursing students for the purpose of clinical training. Accordingly, the use simulation may help overcome the gap formed by the preceding situations. Moreover, given the importance to apply simulation to enhance students' learning and training, this research is planned to add to the existing limited understanding on the effect of simulation on students' knowledge and confidence in Jordan. Therefore, this study aimed to test the effect of simulation on nursing students' knowledge and confidence in providing critical care for patients with cardiac, respiratory and neurological health problems.

2. Literature review

Simulation is an important learning and teaching strategy in nursing (Tawalbeh, 2017) and medical education (So, Phoon, George, & Tony, 2019). Simulation has been found to improve clinical competence in medical education and patient safety which help reduce health care costs (Asche, et al, 2018; Escudero, Silva & Corvetto, 2019). Also, simulation is useful as an effective stategy for nursing education for different reason; it controls over the tasks provided to students in which it can be started with easier tasks then proceed to more difficult one. Simulation has the opportunity to provide support and guidance; and prevent unsafe and unsafe situations (So et al., 2019).

There are different studies indicated the significant effect of simulation on knowledge and confidence (Tawalbeh, 2017; Tubaishat, & Tawalbeh, 2015; Tawalbeh & Tubaishat, 2013) among nursing student. Cardoza & Hood (2012) examined the effect of simulation on undergraduate s students 'self -efficacy in providing family centered care. A convenience sample of 52 senior baccalaureate nursing students participated in the study. Results indicated that simulation improved student's knowledge and performance skills after simulation scenario application. Simulation was examined as a learning strategy and compared with problem-based learning and standardized patients in the study conducted by Smithburger, Kane-Gill, Ruby & Seybert (2012). Prospective, randomized, crossover study was applied and students were exposed to 3 seizure disorder cases. Results showed that simulation strategy was statistically superior to problem-based strategy and standardized patients.

Bowling and Underwood (2016) examined the effect of midlevel-fidelity simulation versus low-fidelity simulation on nursing students' knowledge, self-confidence, and skill performance. A quasi-experimental study was applied to determine the effects of midlevel-fidelity simulation (n = 37) versus low-fidelity simulation (n = 37) among nursing students. The outcome variables were measured using mini-objective structured clinical examination. Results indicated that there was a significant difference for both groups in knowledge and skill performance without any significant difference between the groups. In addition, Zapoko, Ferranto, Blasiman, & Shelestak, 2018 conducted a descriptive study to assess student perception of best educational practices in simulation and to determine their satisfaction and self-confidence in simulation. A convenience sample of 199 junior and senior nursing students participated in the study and completed the student satisfaction and self-confidence in learning scale and educational practices questionnaire. Result showed that students were satisfied with simulation experience, and felt confident in their performance, and felt that simulations were based on good educational practices and were important for nursing education. However, Herron, Powers, Mullen and Burkhart (2019) conducted a quazi-experimental study among 165 nursing students to assess the effect of vedio-simulation on student's satisfaction, self-confidence and knowledge. Results showed that there was no significant difference between the group who recived vedio-simulation compared to the group who received written case-study.

There are different studies conducted in Jordan about the effect of simulation in nursing education (Tawalbeh, 2017; Tubaishat, & Tawalbeh, 2015; Tawalbeh & Tubaishat, 2013)

Randomized controlled trial design was used and results showed that simulation is significantly better than traditional lab training and lectures in applying physical exam skills (Tawalbeh, 2017), improving knowledge and confidence about ACLS (Tawalbeh & Tubaishat, 2013) and enhancing nursing students knowledge about cardiac arrhythmia (Tubaishat, & Tawalbeh, 2015). However, the aims, data collection procedure, tools, variables, and population to whom the findings will be generalized are different from the present study. In addition, no study has been conducted in Jordan to examine the effect of simulation on nursing students' knowledge and confidence in the area of critical care nursing that include all of the following aspects in the same study: cardiac, respiratory and neurological aspects. Therefore, it is important to examine the effect of simulation on knowledge of and confidence in applying critical care skills using a well-controlled experimental design.

3. Method

3.1. Design

A randomized controlled design was used for the study to examine the addition of simulation modules to theoretical lectures and hospital experience versus theoretical lectures and hospital experience alone on student's knowledge and confidence in performing critical care skills. The students were randomly selected and then randomly distributed either to experimental or control group. The experimental group received the lectures in the classroom, clinical course in the hospital, in addition to the simulation scenarios regarding cardiac, respiratory and neurological systems. On the other hand, the control group attended lectures and clinical training in hospital about cardiac, respiratory and neurological system without simulation scenarios.

3.2. Sample and sampling technique

Randomization was achieved using simple random sampling technique to recruit the nursing students who agreed to participate in the current study. A record including all nursing students in the Faculty of Nursing who registered for the critical care course was obtained from the admission and registration unit. After that, a random sample of nursing students (N = 76) was selected using a computer generating record. Then, the participating students were randomly distributed to either the experimental (n = 38) or control group (n = 38). Nursing students who were eligible to register in the critical care course at the faculty of nursing in the university were included in the study.

The inclusion criteria in the current study were (a) nursing student enrolled in the baccalaureate nursing program in the faculty of nursing at the selected University (b) nursing students who registered in critical care course for the first time at the faculty of nursing in the university (c) nursing students agreed to participate

The sample size was determined based on the parameter of the G* power software (Faul, Erdfelder, Lang & Buchner, 2007). The power level which is 0.80, medium effect size for independent *t* test 0.50 and

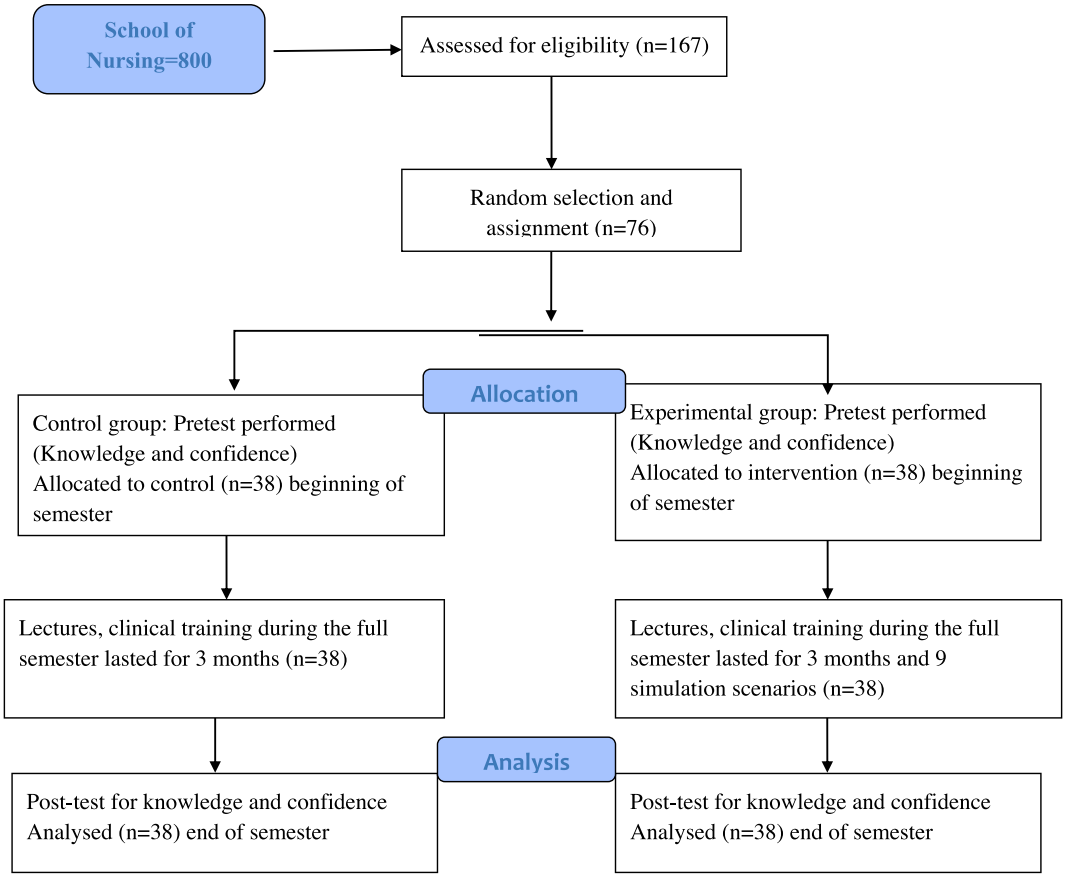

Fig. 1. Schematic diagram indicates the study procedure and data collection process. This figure indicates the sampling technique in which a random sample of 76 students was chosen and then the students were assigned randomly to experimental (n = 38) and control group (n = 38). A pre-test and post-test was performed to measure knowledge and confidence for both groups. The experimental group received lectures, clinical training during the full semester lasted for 3 months and 9 simulation scenarios. While the control group received only lectures, clinical training during full semester lasted for 3 months.

the use of conventional $\acute{\alpha} = 0.05$ two tailed criterion of the significance were used in sample calculation. Seventy-six students were recruited and they were equally distributed to have 38 students in the experimental and the control group.

3.3. Setting

This study was conducted in School of Nursing in Al-al-Bayt University which offer bachelor and masters degrees in Nursing. A master degree in critical care nursing is available in both thesis and comprehensive tracks. The baccalaureate nursing degree is a 4-year program necessitates 134 credit hours. Both programs are accredited at the national and international level. English is the language of teaching and examination, and text books are the same to those utilized in the United States and many Europe Universities. Adult health, community health and maternal and child health are the departments presented in the School of Nursing. This school has many teaching-rooms which are prepared with computers for power point presentations. There are many laboratory rooms with only two for simulation. These simulation laboratories are operational with adult and pediatric manikins, computesr, cardiac monitors, truma kit and other important equipments.

3.4. Data collection procedure

The permission to conduct the study was obtained from the ethical and research committee at the faculty of nursing at one of the Jordanian Universities. The primary investigator applied the random selection to have 76 nursing students whom were randomly assigned to either experimental or control group. A written examination measuring knowledge in critical care nursing and confidence in providing care for critically ill patients was conducted for the control and the experimental group. A code number was provided for each student in the whole sample to cover their participation and keep their data confidential.

The control and the experimental group received the assigned lectures in the school of nursing and the clinical training in the selected hospitals over the whole semester that lasted over three months. However, the experimental group received the simulation scenarios about cardiac, respiratory and neurological health problems. These scenarios include many cardiac, respiratory and neurological case scenarios. Power point presentation and classroom discussion are used in the lectures to provide the students with the information. The reason for providing the total sample with theoretical and clinical training in hospital was to standardize the students' knowledge about critical care nursing. The educational lecture was carried out by the same educator two times each week and lasted approximately 1.5 h for each. The clinical training was conducted for the experimental and the control group over two days per week over three months in hospitals that offered critical care for patients with cardiac, respiratory and neurological health problems.

The simulation scenarios lasted approximately two hours for each scenario for the experimental group. The simulation session that was implemented in the laboratory room in the faculty of nursing included actual demonstration with illustration from the primary researcher about cardiac, respiratory and neurological case scenarios. After that, the 38 students involved in the simulation experience were divided into 3 groups, 12–13 students per group for the purpose of demonstration. The primary researcher used the same scenarios for each group. The

scenarios were pilot tested by the primary researcher in 10 students for their relevancy, applicability and duration before the actual data collection started. Those 10 students were not included in the final sample size. The scenarios were about chest pain management in myocardial infarction, open heart surgery, shortness of breathing management in different respiratory problems like acute respiratory failure, pulmonary embolism and acute respiratory distress syndrome, stroke management, head injuries, and elevated intracranial pressure (ICP) management.

A high-fidelity simulator (METI version 6) was used with simulator features including ventilation, hemodynamic monitoring, electrocardiogram analysis, medication administration, and chest tube. There were three scenarios for each system including cardiac, respiratory and neurological systmes. Each scenario lasted two hours for each group. Twenty-minutes for debriefing session was conducted after each scenario. The debriefing session included questions and feedback from the students regarding each scenario. A total of 18 h simulation was provided for each group in the experimental group. The primary investigator explained each scenario for the group with actual demonstartion for the required critical care nursing skills. Afterthat, each student was asked to practice and demonstrate the required scenario and skills and was closely monitered by the investigator. The scenarios assessed both critical thinking and hands-on skills for the students. These scenarios were implemented in the first two weeks before student's clinical training in the hospital. The experimental and the control group completed the posttest (knowledge exam and confidense scale) at the end of the semester. The data collection duration lasted for three months from September to December 2019. The study protocol and data collection points are clarified in Fig. 1.

3.5. The educational program content

The educational lecture and simulation scenarios covered different topics regarding cardiac, respiratory and neurological diseases. The educational lecture focused on the process of decision making in providing critical care of patients with cardiac, respiratory and neurological diseases. The content of the educational lecture was drawn from a critical care nursing textbook (Morton & Fontaine, 2018). The course aims to: integrate specific theoretical knowledge from nursing and other health care disciplines to provide nursing intervention for patients experiencing critical health disturbances, analyze research results and it's implication in the area of critical care that relate to current practice, and reflect on legal and ethical issues related to critical care nursing. This course covered different topics that are included cardiac anatomy and physiology, hemodynamic monitoring, dysrhythmias and the 12-lead ECG, acute myocardial infarction (AMI), open heart surgery, respiratory system anatomy and physiology, acute respiratory failure (ARF) & acute respiratory distress syndrome (ARDS), pnemuothorax, hemothorax, chest tube, pulmonary embolism, pulmonary edema, mechanical ventilator and O2 therapy, neurological systems anatomy and physiology, acute head injury, stroke, ICP monitoring and management.

3.6. Instrument

A structured questionnaire was used to gather the appropriate data based on the objectives of the study. The questionnaire is begun with a brief statement addressing the purposes of the study and the informed consent. The first part of the tool is the demographic data that consisted of a checklist and gap filling questions addressing variables such as age, gender and grade point average (GPA), academic level, monthly income and participating in workshop about critical care nursing. The second part was the critical care nursing exam that containing 40 multiple choice questions that measured knowledge about cardiac, respiratory and neurological diseases. This exam was designed specifically for the current study. One mark was given to the correct answe and 0 for the false the total score ranged from 0 to 40 with higher score indicating a higher knowledge. The questions were drawn from different sources, such as relevant literature, text books, and internet resources. Face validity was applied by three experts' physicians who are working in intensive care unit (ICU) and showed that the tool was valid. The content validity was employed by other two experts' physicians in ICU and two PhD holders in nursing science. The content validity index (CVI) was 0.89 and the results indicated that the tool measure what is supposed to measure. The Cronbach's alpha in the current study was 0.90 and indicated high internal consistency reliability.

The third part is self-confidence scale which is a Likert-type scale (Hicks, 2006) consisting of 12 items was developed to measure confidence. The answer for each item ranges from 1 (not at all confident) to 5 (very confident). The total score ranged from 12 to 60 with higher score representing greater self-confidence. The items in the tool assessed the accuracy of identifying a change in circumstances of patients with frequent critical care problems; carrying out essential physical assessments for patients with frequent critical care problems; recognizing basic nursing intervention for of patients with frequent critical care problems; and evaluating the efficiency of interventions for patients with frequent critical care problems. Permission to utilize the self-confidence tool was gained from the tool's owner. After that, two PhD holder in nursing science and two knowledgeable personnel in both Arabic and English language translated the tool. Translation and back translation were performed. No main inconsistency between the original and the translated tool was presented. The translated tool was evaluated to assess cultural appropriateness by another Jordanian expert in ICU. The scale's Cronbach's alphas in the previous studies were 0 0.93 for pretest and 0 0.96 for posttest, which indicated high internal consistency reliability. The Cronbach's alpha in the current study for the Arabic version of the self-confidence scale was 0.91 and indicated high internal consistency reliability.

Face validity was performed for the Arabic version and the results indicated that the tool measured what is intended to measure. The CVI was 0.88, and the results showed that the tool was valid. Pilot testing was applied for the whole questionnaire using 15 nursing students who met the inclusion criteria and were not included in the final sample size. Results showed that there were no problems the administration, coding and scoring of the questionnaire. The time desired to fill the questionnaire was about 70 min.

3.7. Ethical Issues

The current study was approved by the ethical research committee of the faculty of nursing in one of the Jordanian Universities. All participants who agreed to participate in the study provided informed consent before the data collection started. The students were assured that their participation was completely voluntary and their responses were highly confidential. A code number was provided for each participant to protect their confidentiality. All filled questionnaires were maintained in a secured cabinet to keep the collected data private and confidential. The participants had the right to withdraw from the study at any time without penalty. There were no physical, psychological, social or economical harm or risk affected the participants.

3.8. Data analysis

The Statistical Package of Social Science (SPSS) Version 23 was used to analyze the data (SPSS, Inc., Chicago, IL, USA). Descriptive statistics including mean (M) and standard deviation (SD) were used to describe the sample's characteristics, the level of knowledge and confidence level. An independent *t*-test was utilized to determine if there was any statistically significant difference in knowledge and confidence between the experimental and the control group at the pre-test level and post-test. To examine the difference between the mean pre-test and post-test scores of knowledge and confidence for the experimental and control group, a paired *t*-test was applied. In addition, to assess the

homogeneity between the groups, independent *t*-test and Chi-square were used to assess any statistically significant difference between experimental and control group in terms of age, GPA, monthly income, gender, participation in workshops at pretest level. Significance was set at $p \leq 0.05$

4. Results

4.1. Sample characteristics

Seventy-six students were randomly assigned either to the experimental or control group, so that there were 38 students in each group at pretest. The mean age for the students was 20.24 (standard deviation, SD = 0.54). Forty-six females and 30 males participated in the study. The mean GPA for the whole sample was 74.97 (SD = 3.12) and the mean monthly income was 917.10 Jordanian Dinar (JOD), (SD = 132.80). Chi-square showed that there was no statistically significant difference between the experimental and the control group in terms of gender (X^2 (1) = 0.22, P = 0.64) and participation in critical care workshop (X^2 (1) = 0.85, P = 0.35). In addition, independent *t*-test revealed that there was no statistically significant difference between the groups in terms of age t(74) = -0.83, P = 0.40, GPA t (74) = −1.17, P = 0.24, monthly income t(74) = 0.86, P = 0.39, pre-test knowledge t(74) = −0.40, P = 0.68 and pre-test confidence t (74) = -0.91, P = 0.36. The result of Chi-square and independent *t* test indicated that the two groups were homogeneous as indicated in Table 1. This indicated that no significant difference between the two groups at baseline in terms of demographics and other all related variables.

An independent *t*-test indicated that there was a statistically significant difference t(74) = 7.66, *P < 0.001* between the control group (M = 23.84, SD = 2.18) and the experimental group (M = 29.81, SD = 4.27) regarding knowledge about critical care nursing at post-test. Moreover, independent *t*-test indicated that there was a statistically significant difference t (74) = 12.30, *P < 0.001* between the control group (M = 23.00, SD = 3.33) and the experimental group (M = 35.76, SD = 5.45) regarding confidence in applying critical care skills at post-test as showen in Table 2.

A paired *t*-test revealed that mean knowledge (M = 29.81, SD = 4.27) and confidence (M = 35.76, SD = 5.45) regarding critical care skills at the post-test was significantly higher than that at the pre-test for knowledge (M = 11.42, SD = 2.61) and for confidence (M = 5.78, SD = 1.86) for experimental group. In addition, a paired *t*-test revealed that mean knowledge (M = 23.84, SD = 2.18) and confidence (M = 23.00, SD = 3.33) regarding critical care skills at the post-test was significantly higher than that at the pre-test for knowledge (M = 11.15, SD = 3.00) and for confidence (M = 5.36, SD = 2.14) for control group. In conclusion, students' knowledge and confidence in performing critical care nursing significantly enhanced after the application of either theoretical or clinical training in the control group, or simulation in the experimental group. However, as indicated in Table 3, results showed that student knowledge and confidence in performing critical care skills was significantly greater in the simulation module group compared to theoretical and clinical experiences alone.

Table 1
Sample characteristics at baseline and the pre-test of knowledge and confidence for the experimental and the control group (n = 76).

Variable	Experimental group n = 38	Control group n = 38	P value
Age (years) M (SD)	20.36 (0.54)	20.47 (0.55)	0.40
Gender			
Male (N)	16	14	0.64
Female (N)	22	24	
Monthly income JOD	930.26 (135.83)	903.94 (130.16)	0.39
Grade point average M (SD)	74.55 (3.06)	75.39 (3.16)	0.24
Pretest for knowledge M (SD)	11.42 (2.61)	11.15 (3.00)	0.68
Pretest for confidence M (SD)	5.78 (1.86)	5.36 (2.14)	0.36

M = Mean, SD = Standard Deviation, JOD = Jordanian Dinar.
* P ≤ 0.05 level (2-tailed).

Table 2
Independent *t* test to examine the difference in knowledge and confidence mean in the post-test between the experimental (n = 38) and control group (n = 38).

Variable	Experimental group n = 38 M (SD)	Control group n = 38 M (SD)	t (74)	P value
Knowledge	29.81 (4.27)	23.84 (2.18)	7.66	< 0.001
Confidence	35.76 (5.45)	23.00 (3.33)	12.30	< 0.001

M = Mean, SD = Standard Deviation.
* P ≤ 0.001 level (2-tailed).

Table 3
Paired *t* test to examine the difference in knowledge and confidence mean between the pretest and post-test for both the experimental (n = 38) and control group (n = 38).

Variable	Experimental group			Control group		
	M (SD) pretest	M (SD) posttest	t (74)	M (SD) pretest	M (SD) posttest	t (74)
Knowledge	11.42 (2.61)	29.81 (4.27)	< 0.001	11.15 (3.00)	23.84 (2.18)	< 0.001
Confidence	5.78 (1.86)	35.76 (5.45)	< 0.001	5.36 (2.14)	23.00 (3.33)	< 0.001

M = Mean, SD = Standard Deviation.
*P ≤ 0.001 level (2-tailed).

5. Discussion

The aim of the current study was to test the effect of simulation on nursing students' knowledge and confidence in performing critical care skills for patients with cardiac, respiratory and neurological health problems. Results revealed that the knowledge and confidence in the experimental group significantly enhanced compared to the control group. This finding is congruent with the findings of other research studies which asserted that simulation a significant effect on knowledge, confidence of ACLS and clinical critical skills (Tawalbeh, 2017; Tawalbeh & Tubaishat, 2013; Tubaishat, & Tawalbeh, 2015). Also, this indicated in the results of Park, Conway & McMillan (2016). in which simulation support knowledge gaining and critical thinking skills among nursing students while they are performing critical care like cardiopulmonary resuscitation.

The significant impact of simulation on knowledge and confidence in providing critical care in the experimental group may be clarified as the following. The key difference in the experimental group's education, that incorporated simulation, was the availability of a team of learners who work together as they have done in actual situations in an environment similar to a real clinical setting. Also, equipments that were utilized in real clinical areas in hospitals like cardiac monitors, direct current shock device are available in simulation lab with the simulated patients. These help nursing students to monitor physiological changes and responses that may appear on the patients in clinical settings.

Another explanation for the significant effect of simulation in the experimental group is the availability of safe environment. The safe environment that presented in the simulation labs help nursing students to perform effectively and confidently better than the stressful area in hospital like critical care settings. This is supported by the idea that

learners like nursing students need to feel safe and secure in order to express themselves. Simulation labs have a perfect environment for nursing students without fear of harming patients (So et al., 2019). This could explain that student who works in a safe environment like simulation labs have a confident to apply critical care skills better than critical care areas in hospitals

In the current study, 20 min of debriefing sessions followed each simulation scenario. This is also may help improve knowledge and confidence among students in experimental group. This is supported by Ostovar et al. (2018) who indicated the positive and the significant effect of debriefing session that would improve significant and effective learning experiences. In addition,

Nursing students received timely feedback during the simulation sessions. So et al. (2019) indicated that feedback to learner is the most significant part to make sure that students received effective learning.

Moreover, high fidelity simulation may help improve knowledge and confidence among nursing students. The degree to which the scenario in the simulation lab portrays the reality and draws the students into the situation may affect the ability and the confidence in applying the skills (Kiernan, 2018). Well planned scenarios taking in consideration all variables that have an effect on learners' awareness of realism may help students engage in the simulation effectively Motola et al. (2013). Furthermore as reported in previous studies (Tawalbeh, 2017) simulation labs motivates auditory, visual and tangible learning techniques. This may help elicit more correct responses from the students that are superior to the superficial responses obtained from traditional ways of learning (Alanazi, Nicholson, & Thomas, 2017).

The addition of simulation to the experimental group help improve knowledge and confidence in applying critical care skills since simulation is considered a powerful form of enactive, direct and purposeful experiences. Simulation is often followed by a debriefing sessions to facilitate reflection, conceptualization and learning process. In addition, it is considered that more concrete and active experiences like using simulation have a higher retention for students and can possibly improve learning skills in the future (So et al., 2019).

The results of the present study revealed that simulation significantly improved confidence in applying critical care nursing practices. This is congruent with the results of other research studies (Bowling & Underwood, 2016) in which simulation improved confidence in applying different clinical skills. Simulation improves student's abilities to apply nursing skills by reinforcing basic skills, help them to work in a safe environment and provide direct feedback (Dearmon et al., 2012).

The control group received the traditional lectures and clinical training in the hospital. The result indicated that this approach is effective in improving knowledge and confidence. However, simulation was superior to traditional training in improving knowledge and confidence in critical care nursing. This is may be due to that the student in the control group who received the traditional training has limited opportunity to apply clinical skills in an overcrowded environment. In addition, there is inadequate supervision and reflective learning due to shortage of clinical nursing staff in Jordanian universities. To have appropriate competency-based education, there is a need for comprehensive practical experience (Benner, Tanner, & Chelsa, 1996).

6. Limitations, recommendations and implications

The use of convenience sample of nursing students affect the external validity of the results, in which the findings have limited generalizability. The author recommended replicating the study using a larger, heterogeneous sample of nursing students from all over the Jordan. Further research studies are required to examine the effect of simulation on specific critical care nursing skills either in cardiac, respiratory or neourologgical health conditions. Moreover, more studies are recommended to determine the effect of simulation on critical care nurses abilities who work in critical care units. Different research findings supported the significant effect of simulation in nursing practice at national and international level. Also, this study adds to the existing body of knowledge that simulation is efficient method to enhance knowledge and confidence in critical care settings in safe environment for both learners and educators. The findings of this study can be adopted in nursing education since simulation is an effective technique that help enhance knowledge and confidence and should be used as main education strategy in all Jordanian universities. Stakeholders in Jordan should help universities to build and establish well-designed simulation lab that help improve nursing education. In addition, simulation labs are considered as alternative teaching and training strategy especially during the cuyrrent situation of COVID-19 pandemic.

7. Conclusion

The findings of the present asserted that simulation has a significant and positive impact on nursing students' knowledge and confidence in implementing critical care nursing skills. This finding adds to the current body of knowledge that adding simulation is an effective and important teaching strategy to improve performing critical care nursing skills and it should be integrated in nursing education.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Alanazi, A. A., Nicholson, N., & Thomas, S. (2017). The use of simulation training to improve knowledge, skills, and confidence among healthcare students: A systematic review. *Internet Journal of Allied Health Sciences and Practice, 15*(3), 2.

Asche, C. V., Kim, M., Brown, A., Golden, A., Laack, T. A., Rosario, J., ... Okuda, Y. (2018). Communicating value in simulation: cost-benefit analysis and return on investment. *Academic Emergency Medicine, 25*(2), 230–237.

Benner, P., Tanner, C. A., & Chelsa, C. A. (1996). *Expertise in nursing practice: Caring, clinical judgment, and ethics.* New York: Springer.

Bowling, A. M., & Underwood, P. W. (2016). Effect of simulation on knowledge, self-confidence, and skill performance in the USA: A quasi-experimental study. *Nursing & Health Sciences, 18*(3), 292–298.

Cardoza, M. P., & Hood, P. A. (2012). Comparative study of baccalaureate nursing student self-efficacy before and after simulation. *CIN. Computers, Informatics, Nursing, 30*(3), 142–147.

Dearmon, V., Graves, R. J., Hayden, S., Mulekar, M. S., Lawrence, S. M., Jones, L., ... Farmer, J. E. (2012). Effectiveness of simulation-based orientation of baccalaureate nursing students preparing for their first clinical experience. *Journal of Nursing Education, 52*(1), 29–38.

Escudero, E., Silva, M., & Corvetto, M. (2019). *Simulation: A Training Resource for Quality Care and Improving Patient Safety.* IntechOpen: In Nursing-New Perspectives.

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral and biomedical sciences. Behavior Research Methods, 39(2), 175-191.

Hicks, F. D. (2006). Clinical decision-making self-confidence scale. National Council of State Boards of Nursing.(2009). The Effect of High-Fidelity Simulation on Nursing Students' Knowledge and Performance: A Pilot Study. Available at: https://www. ncsbn. org/09_SimulationStudy_Vol40_web_ with_cover. pdf (accessed 1 April 2018).

So, H. Y., Chen, P. P., Wong, G. K. C., & Chan, T. T. N. (2019). Simulation in medical education. *Journal of the Royal College of Physicians of Edinburgh. 49*(1), 52–57.

Gaba, D. M. (2007). *The future vision of simulation in health care.* Quality and Safety in Health Carei2–i10.

Karakuş, A., Duran, L., Yavuz, Y., Altintop, L., & Çalişkan, F. (2014). Computer-based simulation training in emergency medicine designed in the light of malpractice cases. *BMC medical education, 14*(1), 155.

Kiernan, L. C. (2018). Evaluating competence and confidence using simulation technology. *Nursing, 48*(10), 45.

Kim, J., Park, J. H., & Shin, S. (2016). Effectiveness of simulation-based nursing education depending on fidelity: A meta-analysis. *BMC Medical Education, 16*(1), 152.

Morton, P., & Fontaine, D. (2018). *Critical Care Nursing: A Holistic Approach* (11th. Ed.). Philadelphia: Lippincott Williams & Wilkins.

Motola, I., Devine, L. A., Chung, H. S., Sullivan, J. E., & Issenberg, S. B. (2013). Simulation in healthcare education: a best evidence practical guide. AMEE Guide No. 82. Medical Teacher, 35(10), e1511-e1530.

Ostovar, S., Allahbakhshian, A., Gholizadeh, L., Dizaji, S. L., Sarbakhsh, P., & Ghahramanian, A. (2018). Comparison of the effects of debriefing methods on

psychomotor skills, self-confidence, and satisfaction in novice nursing students: A quasi-experimental study. *Journal of Advanced Pharmaceutical Technology & Research, 9*(3), 107.

Park, M. Y., Conway, J., & McMillan, M. (2016). Enhancing critical thinking through simulation. *Journal of Problem-Based Learning, 3*(1), 31–40.

Smithburger, P. L., Kane-Gill, S. L., Ruby, C. M., & Seybert, A. L. (2012). Comparing effectiveness of 3 learning strategies: Simulation-based learning, problem-based learning, and standardized patients. *Simulation in Healthcare, 7*(3), 141–146.

Tawalbeh, L. I., & Tubaishat, A. (2013). Effect of simulation on knowledge of advanced cardiac life support, knowledge retention, and confidence of nursing students in Jordan. *Journal of Nursing Education, 53*(1), 38–44.

Tubaishat, A., & Tawalbeh, L. I. (2015). Effect of cardiac arrhythmia simulation on nursing students' knowledge acquisition and retention. *Western Journal of Nursing Research, 37*(9), 1160–1174.

Tawalbeh, L. I. (2017). Effect of simulation on the confidence of university nursing students in applying cardiopulmonary assessment skills: A randomized controlled trial. *Journal of Nursing Research, 25*(4), 289–295.

Weldon, S. M., Korkiakangas, T., & Kneebone, R. (2019). How simulation techniques and approaches can be used to compare, contrast and improve care: an immersive simulation of a three-Michelin star restaurant and a day surgery unit. doi:10.1136/bmjstel-2018-000370.

World Health Organization (2009). Nursing and Midwifery, Human Resources for Health, Global standards for the initial education of professional nurses and midwives. World Health Organization, Department of Human Resources for Health. 2009. http://www.who.int/hrh/nursing_midwifery/en/. Accessed March 11 2018.

Zapko, K. A., Ferranto, M. L. G., Blasiman, R., & Shelestak, D. (2018). Evaluating best educational practices, student satisfaction, and self-confidence in simulation: A descriptive study. *Nurse Education Today, 60*, 28–34.