Effect of Simulation on Knowledge of Advanced Cardiac Life Support, Knowledge Retention, and Confidence of Nursing Students in Jordan

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ABSTRACT

This study examined the effect of simulation on nursing students’ knowledge of advanced cardiac life support (ACLS), knowledge retention, and confidence in applying ACLS skills. An experimental, randomized controlled (pretest–posttest) design was used. The experimental group (n = 40) attended an ACLS simulation scenario, a 4-hour PowerPoint presentation, and demonstration on a static manikin, whereas the control group (n = 42) attended the PowerPoint presentation and a demonstration only. A paired t test indicated that posttest mean knowledge of ACLS and confidence was higher in both groups. The experimental group showed higher knowledge of ACLS and higher confidence in applying ACLS, compared with the control group. Traditional training involving PowerPoint presentation and demonstration on a static manikin is an effective teaching strategy; however, simulation is significantly more effective than traditional training in helping to improve nursing students’ knowledge acquisition, knowledge retention, and confidence about ACLS. [J Nurs Educ. 2013(x):xxx-xxx.]

Simulation emerges as an important step in nursing education for enhancing learning (Comer, 2005), improving patient safety and clinical practice, and teaching resuscitation and clinical judgment skills (Henneman & Cunningham, 2005). Simulation is recognized as an important method of instruction in nursing programs worldwide, as well as in Jordan. In Jordan, there are 15 nursing programs that offer a variety of undergraduate and graduate degrees, and the Jordanian High Accreditations Commission emphasizes that simulation laboratories should be an important element in these programs (Akhu-Zaheya, Gharaibeh, & Alostaz, 2013). One of the standards set is that the use of simulation for students’ learning should be approximately 20% of the total learning processes (Akhu-Zaheya et al., 2013).

The World Health Organization (WHO) has provided standards for nursing education and recommends the use of simulation (WHO, 2009). Simulation is a necessary technique in nursing education because it helps students to apply clinical skills while keeping patients safe (Decker, Sportsman, Puetz, & Billings, 2008) and offers students the opportunity to practice clinical skills until they become proficient in performing certain tasks (Medley & Horne, 2005).

Simulation is an effective tool used to integrate realistic clinical situations in a safe environment, which allows nursing students to develop cognitive and psychomotor skills (Parker & Myrick, 2009). Despite an increasing number of nursing education programs that use simulation, there is a lack of research investigating its effect on nursing students’ learning in Jordan.

In Jordan, because of the large demand for clinical placements and a reduced number of clinical instructors, opportunities for nursing students to participate in patient care and work in clinical situations have also decreased. Hospitals in Jordan are crowded with medical and nursing students, which may affect the quality of education. Therefore, use of simulation is needed to overcome the gap created by these conditions. The purpose of this study was to examine the effect of simulation on nursing students’ knowledge in providing advanced cardiac life support (ACLS), knowledge retention, and confidence in applying ACLS activities. Given the need to develop and use simulation to support students’ learning for practice, this research is
tended to contribute to the development of existing knowledge on the effect of simulation on knowledge among nursing students in Jordan.

**LITERATURE REVIEW**

Many factors have contributed to the development of simulation as a teaching and learning strategy. These factors include the shortage of clinical placements, an increasing number of different health care professions (Wilford & Doyle, 2006), and advances in health care technology (Yaeger et al., 2004). Simulation is important because it allows the application and integration of knowledge, skills, and critical thinking (Bruce et al., 2009; Long, 2005). Also, simulation helps students to function in a scene that is close to clinical situations and provides them with the chance to reflect and practice in a safe setting (Serpian, Brown, Gavilanes, & Driggers, 2004).

Studies have reported a significant effect of simulation on knowledge of ACLS (Hoffmann, O'Donnell, & Kim, 2007; Kim & Jang, 2011). Ackermann (2009) examined the effect of simulation on the acquisition and retention of cardiopulmonary resuscitation (CPR) knowledge using a quasi-experimental design. In that study, 69 junior-level baccalaureate nursing students from a small liberal arts college in the northeastern United States participated in the acquisition phase, and 49 students participated in the retention phase. The results showed that simulation had a statistically significant effect on knowledge acquisition and knowledge retention of CPR. Furthermore, Rodgers, Securro, and Pauley (2009) examined the effects of high-fidelity simulation on education outcomes in an ACLS course. A purposeful sample of 34 participants was enrolled in one of two ACLS classes. Their results indicated that high-fidelity simulation was statistically significantly more effective than low-fidelity simulation in improving knowledge and skills related to ACLS. Kim and Jang (2011) examined the effect of simulation on knowledge of ACLS, clinical performance ability, and problem-solving processes using a pretest–posttest experimental design. Fifty nurses were assigned to either the experimental or control group. Their results indicated that the experimental group had significantly greater knowledge and clinical performance ability for cardiopulmonary emergency care, compared with the control group.

In a randomized controlled trial, Steadman et al. (2006) examined the effects of simulation on acute care assessment, including ACLS, and management skills among 31 medical students. The results revealed that simulation had a significant effect on acute assessment and management skills and was superior to problem-based learning in enhancing these skills. Other studies have measured self-confidence, with some reporting significant findings. Cioffi, Purcal, and Arundell (2005) and Goldenberg, Andrusyszyn, and Iwasiw (2005) found improved confidence after students participated in simulation scenarios. Conversely, a study by Brannan, White, and Bezanson (2008) did not find improved self-confidence for students who participated in simulation, compared with students who attended lectures.

The only study evaluated in the current literature review that examined the effect of simulation on knowledge of cardiac life support among 121 university nursing students (Akhu-Zaheya et al., 2013). Their results showed no significant differences in knowledge scores between the experimental and control groups. However, their design, sample, setting, data collection method, procedure, study variables, and the instruments used differed from those used in the current study. Therefore, it is important to examine the effect of simulation on knowledge of ACLS and confidence in applying ACLS activities using a well-controlled experimental design.

**METHOD**

**Design**

An experimental, randomized controlled design was used. A pretest–posttest experiment was used to examine the effect of simulation on students’ knowledge in the provision of ACLS and their confidence in applying ACLS activities. The students were randomly selected and then randomly allocated to either the experimental or control group. The experimental group took part in a simulation scenario relating to ACLS, a 4-hour PowerPoint® presentation, and demonstration on a static manikin, whereas the control group attended only the presentation and demonstration on a static manikin.

**Sample and Sampling Technique**

A simple random sampling technique was used to recruit the nursing students who participated in this study. A list containing all the students in the school of nursing was obtained from the admissions and registration department, and, subsequently, a sample of nursing students was randomly selected using a computer-generated list. The selected students were then randomly assigned to either the experimental or control group. The inclusion criteria for the participants in the current study were (a) that the students did not attend any course regarding critical care at a university and (b) that he or she agreed to participate.

The sample size was calculated using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). A medium effect size (0.50) was required for the purpose of this study. The sample size was determined according to the power level, which was 0.80, and the use of the conventional alpha = 0.05 two-tailed criterion of the significance. On this basis, 70 students were required. To overcome the problem of participants’ attrition, an additional 30 students were recruited, for a total of 100 students in the final sample. The 100 randomly selected students were randomly assigned to either the experimental or control group (50 students in each group).

**Setting**

This study was conducted in the school of nursing in one of the Jordanian government’s universities that offers bachelor and master’s degrees in different specialties. The school of nursing offers a bachelor degree in nursing. The baccalaureate nursing program is of 4 years’ duration, requiring 132 credit hours. The program is accredited at both the national and international levels. Classes are taught in English, and textbooks are similar to those used in universities in the United States. Three departments are in the school of nursing—Adult Health, Community
Health, and Maternal and Child Health. The school of nursing contains many classrooms that are equipped with computers for PowerPoint presentations. Also, nine laboratory rooms are equipped with the essential equipment (e.g., dressing sets, tuning fork, Snellen eye chart) used to enhance the clinical skills of students. In addition, there are two simulation laboratory rooms equipped with adult and pediatric manikins, computers, cardiac monitors, and other essential equipment.

Data Collection Procedure

When permission to conduct the study was obtained from the university’s ethical scientific research committee, the primary researcher (L.I.T.) randomly selected 100 nursing students, using the computer-generated list, and then 50 students were randomly assigned to each of the experimental and control groups. A pretest on ACLS and confidence in applying ACLS activities was administered to both groups on the first day of the study. On the second day, the nursing students in both groups attended a 4-hour PowerPoint presentation on the subject of ACLS and a demonstration on a static manikin. The reason for providing the total sample with this traditional training method was to standardize the students’ knowledge of ACLS.

On the third day, the experimental group took part in a simulation scenario regarding ACLS, which lasted approximately 30 minutes. At this time, the control group did not receive this intervention. On day 7, a posttest that involved a written examination on ACLS and a confidence scale survey was provided for both groups.

The posttest for the experimental group was conducted in the simulation laboratory by the primary researcher, whereas it was administered in class for the control group. Students who completed the pretest did not know their group assignments; however, the researcher knew the groups in which they were assigned. Students were made aware of their group assignment prior to implementing the education. A code number was given to each student in both groups to mask their participation and keep their data confidential. A second posttest was completed 3 months after the pretest to examine knowledge retention. The study protocol and data collection points are clarified in the Figure.

Simulation Scenarios

The simulation session was implemented in the simulation laboratory of the school of nursing and included a demonstration with illustration from the primary researcher about ACLS. A high-fidelity simulator (METI®, version 6), with simulator features including blood pressure, palpable pulse, electrocardiogram monitoring, chest expansion, and simulator voice, was used.

Forty-nine of 50 students in the experimental group were involved in the simulation experience and were divided into seven groups of seven for the purpose of the demonstration. The scenario lasted approximately 30 minutes, and a debriefing
session, which lasted approximately 10 minutes, was held after each scenario. The purpose of this session was to discuss and highlight certain issues that occurred during the scenario. The primary researcher used a scenario about cardiac arrest, which was created by an ACLS-certified expert and uploaded by a METI engineer. The scenario was about a patient with acute myocardial infarction who suddenly collapses and has a cardiac arrest.

The scenario was pilot tested by the primary researcher with 10 students for its relevancy, applicability and duration. The scenario was easy to apply and was easily understood by the students, and no problems were encountered during its application. The 10 students were not included in the final sample. The simulation scenario was supervised by an ACLS-certified expert. The role of this expert was to monitor the students and to provide directions for the use of the simulator. In addition, an engineer was responsible for the maintenance of the METI equipment, for uploading the scenario, and for attending the scenario to manage any technical problems that might occur during the simulation.

Educational Program Content

The content of the educational lecture and simulation scenario focused on ACLS. The educational lecture covered the advanced skills used to manage patients in cardiac arrest. The laboratory setting was used for the purpose of the demonstration and application of the simulation scenarios. The content of the educational lecture was from a critical care nursing textbook (Morton & Fontaine, 2009), and the information was pilot tested by a panel of experts from clinical and academic backgrounds.

Instrument

A structured questionnaire was used to collect data to achieve the objectives of the study. The questionnaire provided a brief statement concerning the purpose of the study, included informed consent, and was followed by three parts of the tool, all of which were administered before and after the intervention and 3 months after the pretest. Part one was designed to collect demographic data and consisted of a checklist and gap-filling questions concerning variables such as age, gender, and grade point average (GPA). The second part was the ACLS examination, containing 20 multiple choice questions. The questions were drawn from different sources, such as relevant literature, textbooks, and the Internet.

Face validity was performed by four ACLS experts, who indicated that the tool was valid. Also, content validity was conducted by another four other experts—two experts in ACLS and two individuals with doctorate degrees in nursing. The content validity index was 0.87, and the results revealed that the tool was valid. Items were tested for internal consistency in the current study, and the result revealed that Cronbach’s alpha reliability was 0.80.

The third part was the emergency response confidence tool (Arnold et al., 2009), which consisted of 17 items designed to evaluate individual participants’ confidence in reacting to an emergency situation. Items were selected on the basis of basic life support and ACLS skills in CPR. The participants rated their confidence on a scale from 0% to 100% (100% = most confident) for each item. The test–retest reliability was 0.87, indicating a high correlation between the two times the tool was administered, and Cronbach’s alpha was 0.92, which indicated high internal consistency of the items (Arnold et al., 2009). Items were tested for internal consistency, and Cronbach’s alpha was 0.85 for reliability in the current study.

Permission to use the emergency response confidence tool was obtained from the tool’s developer. Subsequently, a panel of two doctorally prepared nurses and two individuals who were competent in both the Arabic and English languages translated the tool. One of the doctoral nurses and one of the other individuals translated the tool from English into Arabic; the other two performed the back translation. No major discrepancy between the original and the translated tool was found. The translated versions were reviewed by another Jordanian faculty member for proper language use and cultural appropriateness. Face validity was performed for the Arabic version, and the results indicated that the tool was valid. Also, content validity was conducted by another two doctorally prepared nurses. The content validity index was 0.89, indicating the tool measured what it was intended to measure. The entire questionnaire was pilot tested on 20 students who met the inclusion criteria. No problems were detected during the questionnaire’s administration, coding, and scoring. The time needed to complete the questionnaire was 45 minutes.

Ethical Issues

The study method and protocol was reviewed and approved by the ethical scientific research committee of the school of nursing in one Jordanian university. Written informed consent was obtained from all participants who agreed to participate in the study. The participants received both oral and written information about the purpose, content, and extent of the study. Students’ participation was completely voluntary, and they were assured their responses were confidential. Confidentiality of participants was protected by providing a code number for each participant at the stage of data collection and analysis. In addition, the collected questionnaires were kept in a locked cabinet to keep the participants’ information private and confidential. After the study was completed, all questionnaires were destroyed.

The participants were informed that they had the right not to participate and could withdraw from the study at any time. They were also told that demographic data and information regarding their knowledge of ACLS and confidence would be collected three times—once before and twice after the intervention. In addition, the procedure of the data collection process was explained to all participants and information regarding the estimated time and number of contacts with participants was provided. The participants were not subject to any physical, psychological, social, or economical harm or risk, as the data collection process primarily relied on a descriptive, noninvasive questionnaire.

Data Analysis

The SPSS®, version 17, software was used to analyze the data. Descriptive statistics were used to describe the sample’s
characteristics. An independent t test was used to examine whether any statistically significant differences existed between the experimental and control groups at the pretest level to assess the degree of homogeneity between the study participants. In addition, the independent t test was used to examine whether statistically significant differences existed between the experimental and control groups in knowledge of ACLS and confidence in applying ACLS activities. A paired t test was used to assess whether statistically significant differences existed between the mean pretest and posttest scores of knowledge and confidence for both groups.

RESULTS

One hundred students (56 women and 44 men) were randomly assigned either to the control or experimental group, so that there were 50 students in each group at baseline. The participants’ mean age was 20.42 years (SD = 0.98 years), and the mean GPA for the whole sample was 67.9 (SD = 5.42). An independent sample t test showed no statistically significant differences between groups in age, GPA, pretest knowledge, and confidence, indicating that the two groups were homogeneous (Table 1). Of the 100 students at baseline, 82 (82%) completed the study. Of those, 42 (51.2%) were in the control group, and 40 (48.8%) were in the experimental group.

An independent t test showed a statistically significant difference (t(80) = –6.96, p < 0.001) between the experimental group (M = 12.92, SD = 3.02) and the control group (M = 7.88, SD = 3.50) regarding ACLS knowledge. In addition, the results indicated a statistically significant difference (t(80) = –21.28, p < 0.001) between the experimental group (M = 74.38, SD = 11.55) and the control group (M = 32.85, SD = 18.16) regarding confidence in applying ACLS activities (Table 2). Furthermore, an independent t test showed a statistically significant difference (t(80) = –5.36, p < 0.001) between the experimental group (M = 12.00, SD = 2.90) and the control group (M = 7.30, SD = 3.09) regarding ACLS knowledge in the retention phase (Table 2).

A paired t test indicated that mean ACLS knowledge and confidence at the posttest phase was significantly higher than at pretest for both the experimental and control groups. That is, students’ knowledge and confidence significantly improved after the application of either traditional training in the control group or simulation in the experimental group. However, as shown in Table 2, an independent t test indicated that simulation is significantly more effective than traditional training in improving knowledge of ACLS and students’ confidence.

**DISCUSSION**

The purpose of this study was to examine the effect of simulation on nursing students’ knowledge in the provision of ACLS, knowledge retention, and students’ confidence in applying ACLS activities using an experimental design. The results indicated that the knowledge and confidence of students in the experimental group improved significantly in the first posttest, compared with the control group. This finding is consistent with the findings of other studies that showed that simulation has a positive effect on enhancing learning, confidence, and competency in clinical skills (Alinier, Hunt, & Gordon, 2004; Feingold, Calaluce, & Kallen, 2004; Goldenberg, et al., 2005; Mole & McLaffery, 2004) and encourages knowledge acquisition and critical thinking for nursing students learning CPR (Ackermann, 2009; Bruce et al., 2009; Kim & Jang, 2011; Long, 2005).

The significant effects of simulation on knowledge of ACLS in the experimental group may be attributed to many factors. The main difference in the experimental group’s training, which included simulation, was the presence of a realistic patient environment compared with the traditional training of the control group. It involved the use of monitors that displayed physiological changes and a simulated patient in which the student monitored responses to ACLS skills application. The simulation environment stimulates visual, auditory, and tangible learning methods and elicits different, more engaged responses from students, compared with the superficial responses obtained from traditional lectures in the classroom (Steadman et al., 2006). Schoening, Sittner, and Todd (2006) emphasized the importance of simulation as an effective means of providing a realistic and practical environment. In addition, the simulation scenario in the current study was followed by debriefing sessions that clarified students’ mistakes, helping to improve knowledge of ACLS. This is consistent with the study by Cantrell (2008), who concluded that debriefing helps students to decompess and integrate the experience into their knowledge base. The debriefing session may offer the opportunity for valuable reflective learn-

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental Group (n = 50)</th>
<th>Control Group (n = 50)</th>
<th>p Value*</th>
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</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>20.60 (0.78)</td>
<td>20.2 (1.00)</td>
<td>0.20</td>
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<tr>
<td>Gender</td>
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<tr>
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<td>21</td>
<td></td>
</tr>
<tr>
<td>Female (No.)</td>
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<td>29</td>
<td></td>
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<tr>
<td>Grade point average</td>
<td>68.16 (5.31)</td>
<td>67.64 (5.56)</td>
<td>0.63</td>
</tr>
<tr>
<td>Pretest for knowledge</td>
<td>5.01 (1.78)</td>
<td>4.59 (1.86)</td>
<td>0.46</td>
</tr>
<tr>
<td>Pretest for confidence</td>
<td>11.01 (5.86)</td>
<td>10.50 (4.96)</td>
<td>0.21</td>
</tr>
</tbody>
</table>

* p < 0.05 (2 tailed).
EFFECT OF SIMULATION

The sample was limited to baccalaureate nursing students in one Jordanian university. It is recommended that this study be replicated on a larger scale to investigate whether the significant findings can be sustained among a larger, heterogeneous sample. In the current study, retention of ACLS knowledge was examined at 3 months after the intervention. It is recommended that retention of ACLS knowledge also be examined beyond 3 months. It is also suggested that a study including many nursing education sites with various nursing programs would offer insight into learning outcomes in a more generalized sample.

The findings of the current study have direct implications for nursing, as simulation provides a practical safe environment for nursing students and educators. Simulation is an effective teaching strategy that can be adopted as an undergraduate teaching method. Future research should be conducted to examine the sociodemographic characteristics of students and to identify which students benefit the most so that more simulation time can be assigned to them. Future research to evaluate other learning outcomes using simulation is recommended. Simulation can be used for a variety of emergency scenarios, to practice skills, and to teach various concepts in nursing.

More research is recommended to further examine the effect of simulation on nurses and to assess different learning outcomes to provide more evidence that simulation would be valuable for staff development (Ackermann, Kenny, & Walker, 2007). Simulation may also be considered by individuals outside of nursing because ACLS training is offered for other health care professionals as well. The findings of these studies can enrich nurses' knowledge also be examined into learning outcomes in a heterogeneous sample. In the current study, retention of ACLS knowledge was examined at 3 months after the intervention. It is recommended that retention of ACLS knowledge also be examined beyond 3 months. It is also suggested that a study including many nursing education sites with various nursing programs would offer insight into learning outcomes in a more generalized sample.

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