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The effect of simulation experience on Saudi nursing students' advance cardiac life support knowledge

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A B S T R A C T

Background: Simulation has been used widely in medical education. Little is known about its uses in nursing field.
Objective: This study was conducted to examine the effect of simulation-based learning experiences on the acquisition of knowledge regarding Advance Cardiac Life Support (ACLS).
Methods: A quasi-experimental design with pre and post-test was used.
Setting.
We targeted students in one university in the City of Madinah, which is located to the west of Riyadh, the Capital of the Kingdom of Saudi Arabia.
Participants: The target population was Saudi student nurses, and a convenience sample of 123 nursing students from the College of nursing within one of Government University.
Results: The test results showed that there were statistically significant differences between the mean scores of pre-test and post-test, indicating that simulation has an effect on increasing the ACLS knowledge of nursing students.
Conclusion: We assume that simulation experience can positively influence students' knowledge acquisition.

1. Introduction

Nursing educators worldwide, especially those involved in the critical care area, are interested in assessing their students' knowledge and confidence in completing the Advance Cardiac Life Support (ACLS) training, which credentials critical care expertise (Aqel & Ahmad, 2014; Arnold, Johnson, Tucker, Chesak, & Dierkhising, 2011; Everett-Thomas et al., 2016; La Cerra et al., 2019; Tawalbeh & Tubaishat, 2014; Warren, Luctkar-Flude, Godfrey, & Lukewich, 2016). Prompt response in treating cardiac arrest is a necessary skill that nursing students should master since rapid recognition and treatment of cardiac arrest doubles survival rates for victims (Association, 2019).

Several approaches to ACLS training and mastery of skills have been used by nursing educators. One promising method is the use of a simulated manikin and more specifically high fidelity simulation (HFS) (Everett-Thomas et al., 2016; La Cerra et al., 2019; Unver et al., 2017; Warren et al., 2016). The use of simulation gained popularity when its benefits were recognized: patient safety is preserved; errors are reduced; and lack of clinical staff or real patients does not hinder education. (Everett-Thomas et al., 2016; Omer, 2016; Tawalbeh & Tubaishat, 2014; Warren et al., 2016).

In addition to the above benefits, simulation can offer students the opportunity to practice a rare and critical event in an organized environment. Moreover, students are allowed to repeatedly practice the same procedure until they have mastered the required competency. Further, students can start and end practice sessions at their own pace (Akhu-Zaheya, Gharaibeh, & Alostaz, 2013).

Reviewing the literature revealed that simulation has a positive impact on knowledge acquisition and skills mastering (Akhu-Zaheya et al., 2013; Aqel & Ahmad, 2014; Everett-Thomas et al., 2016; La Cerra et al., 2019; Mohamed, Gonzales, & El Azazey, 2016) and on students' self-efficacy (Omer, 2016; Tawalbeh & Tubaishat, 2014; Vincent, Sheriff, & Mellott, 2015). In Saudi Arabia, at the time of this study, three published nursing studies were documenting the effect of simulation on knowledge acquisition and skills training were identified. The first study, a quasi-experimental design, by ALFozan, El Sayed, and Habib (2015) was carried out on 66 nursing students, to assess students' perception, satisfaction, and learning outcomes after a simulation-based maternity course. The study found that using simulation was helpful and practical, enhanced critical thinking, built self-confidence, and improved knowledge.

The second study conducted by Omer (2016) used a correlational study of 117 female student nurses. The study objective was to explore the perception of nursing students on their satisfaction and self-

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confidence after clinical simulation experiences. The results of the study revealed nursing students were satisfied with clinical simulation experiences; and simulation contributed to improving their knowledge, self-confidence, teamwork, and recognition of patient deterioration events (Omer, 2016).

The third study, using a pretest and a posttest design, involved 68 nursing students, and aimed to examine the effect of simulation-based practice on attitude, confidence and learning outcomes among nursing students. Study findings demonstrated improvement among students in their confidence, decision-making skills, and recognition and prediction of changes in patients' conditions. Regarding students' knowledge, the majority reported they developed better critical thinking and had a better education experience in learning assessment skills (Mohamed et al., 2016).

Several studies revealed the importance of this topic, and pointed out the necessity for more studies to discover the effectiveness of simulation in enhancing student learning and increased awareness about simulation learning (Everett-Thomas et al., 2016; Warren et al., 2016). There has been a lack of such studies in Saudi Arabia. Therefore, this current study was conducted to examine the effect of high-fidelity ACLS simulation training on knowledge acquisition of Saudi nursing students.

2. Method

2.1. Study design

A quasi-experimental design was used in this study. A pretest-posttest experiment was employed to examine the effect of simulation experience on student's ACLS knowledge.

2.2. Setting

This study was conducted in the College of Nursing (CoN) at Taibah University in the City of Madinah in the Kingdom of Saudi Arabia. Al-Madinah is located about 800 km to the west of Riyadh, the capital. Taibah University is a government university which offers a bachelor's degree in nursing on two campuses, one for Male students and one for Female students. CoN offered the bachelor's degree on both campuses with a plan to offer a master's degree in nursing soon. There are four departments in the CoN: Medical-surgical health; Community health; Maternal and Child health; and Administration and Psychiatric health department. The college encompasses 13 laboratory rooms equipped with essential equipment to enhance the clinical skills of nursing students. Moreover, these labs are fitted with simulation devices that have adult and pediatric manikins, computers, cardiac monitors and other essential equipment.

2.3. Participants

A convenience sampling technique was used to recruit nursing students to participate in this study. Students included in this study were: (a) sixth and/or eighth level nursing students enrolled in Taibah University, (b) had not attended any course regarding critical care at the university, (c) agreed to participate.

The sample size was calculated using G* power software (Faul, Erdfelder, Lang, & Buchner, 2007). A medium-effect size needed for the current work is 0.50. The sample size was decided based on the power level of 0.80 and the use of conventional $\acute{\alpha} = 0.05$ criterion of the significance. According to that 70 students will be enough to address the research objectives and question. However, because it was the end of the semester and some students were participating in clinical rotations, more than 70 participants were recruited to avoid attrition problems; therefore 123 students participated.

2.4. Data collection

After receiving ethical approval for this study from the research and ethics committee at CoN at Taibah University, the study began. Students at the sixth and eighth levels were invited to participate by the research team via a flyer and announcement boards on both campuses during the second semester of the 2018/'19 academic year, specifically from January to May 2019. Students were divided into six groups to facilitate the learning process and to control the number of participants; where three groups for male students, and three for the female students. Each group received a pretest exam that measured their knowledge of the ACLS, and then received two hours' training using a simulator and facilitator on the lab. After the two hours students completed a posttest questionnaire, which were the same questions asked on the pretest but in a different order.

Training was based on simulation scenarios already uploaded on the computer and was accompanied by an illustration and debriefing by one of the research team, who served as a facilitator for the learning process. Content scenarios focused on different cardiac arrest situations, the causes, and the interventions required, employing ACLS skills. Lecture content derived from different resources, such as critical care nursing textbooks, American Heart Association (AHA) website and available resources. The educational package was pilot tested by a panel of experts from clinical and academic backgrounds. Necessary adjustments were made to the teaching and assessment methods used. Simulation training and demonstrations took three hours.

2.5. Instrument

A structured questionnaire was used to collect the data. The questionnaire commenced with a brief statement about the study purpose and informed consent and was divided into two parts. Part one asked for demographic data on age, gender, academic level, and Grade Point Average (GPA). The second part was ACLS written exam, with 20 questions and multiple-choice answers. The questions derived from AHA guidelines on ACLS knowledge, critical care academic textbooks, internet resources, and ACLS algorithms.

The panel of experts consisted of three doctoral-prepared nurses who specialize in critical care nursing. They assessed the knowledge test for clarity, wording, scientific content and any other issues. The test was prepared and delivered in English to the students since English is widely used and understood by nursing students.

2.6. Ethical consideration

The study method and protocol were reviewed and approved by the research and ethics committee of CoN at Taibah University. Students were asked to indicate their willingness to participate by ticking a box on the consent form, considered as a proof of consent. Participation in this study was entirely voluntary. Students were assured their responses were confidential and that after the study was completed all data would be properly disposed of.

Participants obtained both oral and written information regarding the purpose, content and extent of the study. Anonymity was preserved, no names were sought. Each participant was given a code number to protect their confidentiality. Participants were told they had the right to withdraw from the study at any time. No physical, psychological, social or economic harm or risk affected participants since the data collection process primarily relied on a detailed noninvasive questionnaire. Potential benefits from this study were addressed: that the students would increase their knowledge about an essential topic in critical care—ACLS certification.

All collected data was stored in a locked cabinet in the researcher's office, which no one could access. Data was kept in storage for the entirety of the study. After completion and publication, data was disposed of appropriately.

Table 1
Sample demographics.

Variable	Frequency (%)
Age (years) M (SD)	21.6 (1.19)
Gender	
Male (N)	29 (23.6)
Female (N)	94 (76.4)
Grade point average	
Excellent	44 (51.8)
Very good	27 (31.8)
Good	13 (15.3)
Poor	1 (1.2)
Academic Level	
Sixth level	72 (58.5)
Eighth level	51 (41.5)
Pretest for knowledge M (SD)	7.9 (3.19)

2.7. Data analysis

Statistical Package for the Social Science (SPSS) Version 17 was used to analyze the data (SPSS, Inc., Chicago, IL, USA). Descriptive statistics were used to describe sample characteristics. Paired *t*-test was used to examine whether there were statistically significant differences between the pretest and posttest scores of ACLS knowledge. The Independent *t*-test and One-way ANOVA test were used to further analyze posttest scores.

3. Result

Participants' ages ranged from 20 to 27, with a mean of 21.6 (SD = 1.19) (Table 1). The majority of participants were female students (n = 94, 76.4%); and 29 were male students (23.6%). A total number of 44 students (51.8%) have an excellent GPA; one student (1.2%) had a poor GPA. Less than two-thirds of students were in the sixth level, equivalent to a third-year college student in other countries. More than one-third were in the eighth level—a senior level equal to a fourth-year college student. The ACLS knowledge score was poor at the pretest; the mean score was 7.9 (SD = 3.19), out of 20 (maximum score).

Of the 123 students at the pretest phase, 71 (57.7%) completed the study. A paired *t*-test indicated the mean score of ACLS knowledge at the posttest was significantly higher than at the pretest ($t(70) = -10.81$, $p < 0.001$). As mentioned previously, the pretest mean score for ACLS knowledge was 7.9. It increased significantly at the posttest to 14.8 (SD = 3.42) (Table 2). Results demonstrated students' knowledge was significantly improved after using ACLS simulation as a method of teaching.

Further analysis of posttest scores showed the followings results (Table 3). The independent *t*-test showed no significant differences in ACLS knowledge posttest scores, when the age ($t(70) = -0.46$, $p = 0.65$) and gender ($t(70) = 3.16$, $p = 0.61$) of students was noted. The one-way ANOVA test also revealed no significant differences between the posttest score and the GPA of students ($F(3, 70) = 2.24$, $p = 0.12$). The only factor affecting this posttest score was the academic level; where independent *t*-test results demonstrated that students from the eighth level had higher ACLS knowledge scores after the posttest, compared to their counterparts at the sixth level ($t(70) = -2.66$, $p = 0.01$).

Table 2
ACLS knowledge score differences between the pretest (n = 123) and posttest (n = 71).

Variable	Pretest Scores M (SD)	Posttest Scores M (SD)	t (70)	P value
Knowledge of ACLS	7.9 (3.19)	14.8 (3.42)	−10.81	0.001

* $p \leq 0.001$ level (2-tailed).

Table 3
Further analysis for the post-test scores.

Characteristic	Number (%)	ACLS knowledge Mean (SD)	Statistics (t/F)	significance level
Age			0.46	0.65
≤22	40 (83.7)	12.6 (3.39)		
22+	24 (16.3)	13.0 (3.21)		
Gender			3.16	0.61
Male	15 (21.1%)	14.1 (2.64)		
Female	56 (78.9%)	13.2 (3.35)		
Academic Level			−2.66	0.01*
6th level	47 (66.2)	12.1 (3.50)		
8th level	24 (33.8)	14.3 (2.79)		
GPA			2.24	0.12
Good	6 (48.6)	11.7 (2.28)		
Very Good	14 (24.9)	12.0 (3.77)		
Excellent	26 (6.6)	12.5 (2.90)		

* $p \leq 0.05$ level

4. Discussion

This study was conducted to examine if education by simulation impacts the acquisition of related knowledge such as ACLS certification training in nursing students. Our findings demonstrated that after simulation training, knowledge about ACLS was significantly higher in students at the posttest than at the pretest. In our study, simulation influenced students' cognitive ability, which comprises knowledge acquisition. This finding could be interpreted as using a knowledge test before a scenario simulation may strengthen students' cognitive learning as described by the International Nursing Association for Clinical Simulation and Learning (2016). A learning stimulus can make students more aware of both the knowledge they have and the knowledge they lack. To discover one's own lack of knowledge in a test conducted prior to the simulation may increase students' attention during the simulation (Haukedal, Reierson, Hedeman, & Bjork, 2018).

These current research findings are supported by Alshammari, Pasay-an, Indonto, and Gonzales (2018). The latter showed students only retain 10% of what they hear, while they retain up to 75% of the material they have an opportunity to see and practice. Furthermore, several studies were done in different professions including nursing and their results showed simulation has a positive effect on knowledge acquisition (Akhu-Zaheya et al., 2013; ALFozan et al., 2015; Tawalbeh & Tubaishat, 2014). Thus, this study result supports the use of simulation in nursing education. Simulation should be used appropriately and as an educational tool that enhances the quality of nursing learning experience.

However, it is difficult to compare our results with other studies due to methodological differences. Some studies referenced here used a true experimental design, with a control and experimental group. In Solymos, O'Kelly, and Walshe (2015), there was an improvement in knowledge using simulation as compared to lectures. Posttest knowledge and performance scores were significantly higher in students exposed to HFS, compared to students exposed to videos (D'Souza, Venkatesaperumal, Chavez, Parahoo, & Jacob, 2017). Use of HFS technology was proven effective and beneficial to learning acquisition in a non-risk and safe lab environment.

Predictors of the posttest scores showed academic level was the only factor that affected the score; students from the fourth year (eighth level) had higher ACLS knowledge scores at the posttest compared to their counterparts in the third year (sixth level). This could be explained by Rodrigues (2015) concept of chronological effect that points

to better academic performance for older students. Chronological age can impact academic performance in the fourth year (eighth level); however, in our study, pretest scores showed poor knowledge at both levels.

The results of this study highlight the need for simulation to provide a practical risk-free learning environment for nursing students and educators. Simulation is an effective strategy implemented as an undergraduate teaching method. The use of simulation-based learning should be considered to prepare competent nurses to increase the number of nursing students and address a shortage of nursing faculty. It is a given that nurse educators must be well trained in simulation to use it effectively in educating students and staff nurses for better outcomes. It is recommended that nurse managers invest in high fidelity manikin simulation in nurse education; which integrates the cognitive, psychomotor, and affective domains in a non-threatening and safe environment thus ensuring accuracy and competency of skills before the student enters the clinical environment. (King, 2018).

Despite the strength of the study design, a few limitations need to be acknowledged. Analysis indicated 70 participants were enough of a sample; however, the final response rate of 58% is considered low. This was because the study was conducted at the end of the semester and some students were based in hospitals for their practical training and evaluation.

Furthermore, using a sample of students drawn from just one public nursing facility in Saudi is another limitation. Our findings cannot be generalized for students enrolled in other degree programs. Repeating this study with a larger, randomized sample would expand knowledge of the effect of high-fidelity ACLS training simulation on knowledge acquisition of Saudi nursing students.

5. Conclusion

Students' knowledge scores were compared before and after the simulation learning session. Results showed a significant improvement in scores post simulation. Based on these findings, we assume simulation experience can positively influence students' knowledge acquisition. Results of this study support implementation of simulation as a dynamic teaching strategy that helps expand students' knowledge in applying clinical skills.

6. Authors' contributions

IS conceived and designed the study, conducted research, provided research materials, and collected and organized data. **AT** analyzed and interpreted data. **MA** wrote initial and final draft of article and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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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.

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