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RESEARCH ARTICLE

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Impact of high-fidelity simulation exposure of nursing students with their objective structured clinical examination: A quasi-experimental study

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Abstract

Aim: The study aimed to establish the impact of high-fidelity simulation (HFS) in the objective structured clinical examination (OSCE) of nursing students enrolled in four undergraduate courses (medical-surgical, critical-care, maternal-health and paediatric nursing).

Design: This quasi-experimental research study was performed during the midterm and final OSCEs of nursing students at the institution, and their OSCE performance was assessed.

Methods: The students were divided into two: those who were exposed to HFS in addition to their clinical training and the other group who underwent clinical training without HFS exposure.

Results: The combined mean midterm and final OSCE results of the group of nursing students with HFS exposure and those without HFS exposure were 92.58 and 82.66, respectively, with a mean between-group difference of 9.92% ($p < .01$). Our findings reveal that the HFS exposure in addition to clinical training enhanced the students' OSCE performance.

KEYWORDS
clinical decision-making, clinical judgement, clinical reasoning, nursing education, simulation training

1 | INTRODUCTION

Learning comprises of continuous internalization, observation and application. Particularly, nursing students are expected to possess thorough knowledge and expertise in clinical procedures, along with appropriate attitude, competence and confidence to deal with different scenarios in a healthcare setting. Thus, exposing undergraduate nursing students to an integrated curriculum with simulation-based learning is pivotal to their overall learning and performance.

The Society for Healthcare Simulation defines high-fidelity simulation (HFS) as "simulation experiences that are extremely realistic and provide a high level of interactivity and realism for the learner and can apply to any mode or method of simulation (e.g., human, manikin, task trainer or virtual reality)." Therefore, HFS is being employed in nursing education. It allows learners to practice and apply their skills in a realistic, risk-free environment, while fostering independent clinical decision-making and improving their understanding of the effect of critical nursing actions on the patients' condition.

Therefore, it has gained recent prominence in nursing education and is used to enhance the performance of undergraduate nursing students.

In healthcare education simulations, fidelity refers to the degree of realism replicated by a simulation, or in other words, the similarity between a simulation and its real-life counterpart. In nursing education, the fidelity of an integrated simulation experience is expected to vary for each type of learner (Moran et al., 2018). Typically, HFS contains additional features that imitate real-life environments. For example, when observing clinical settings, a high degree of complexity in human interactions was noted. HFSs of nursing-patient communication are designed to resemble the said complicated interactions (Al-Ghareeb & Cooper, 2016). Studies related to simulation fidelity are still being conducted to determine the best interests of nursing students and the outcomes of simulation-based learning processes. Vincent et al. (2015) noted that additional studies are needed in order to determine whether psychomotor clinical practices can be enhanced through HFS. An integrative review conducted by Cant and Cooper (2017) found that nursing students practicing clinical care are able to improve their knowledge base, critical thinking skills and self-confidence through the utilization of HFS. However, Doolen et al. (2016) noted that nursing simulation results are assessed by various inconsistent metrics across simulations; thus, validity and reliability of these evaluation methods are questionable.

It has been reported that throughout the duration of clinical practice training, nursing students tend to retain and recall the learning outcomes from their experiences with simulation-based training (Hustad et al., 2019) and this methodology is an effective strategy for and solution to the current lack of facilities for the clinical placement of nursing students (Jeffries, 2020). Other studies also posit that the combination of HFS and traditional clinical experiences is a more effective educational strategy (Curl et al., 2016). However, another previous study stated that more studies are needed to determine the benefits of simulation for the improvements in assessment and management skills in clinical practice (Cooper, 2015).

High-fidelity simulation can bridge the gap between theoretical knowledge and nursing practice, and improve safety and quality of patient care in baccalaureate nursing education (Zhu et al., 2020). The result of an integrative literature review highlighted that students valued experiences of simulation where there was a high degree of realism. But despite the identified benefits of HFS, transferability of skills was not assured, as there were incompatibilities identified between the simulated and clinical settings (Bowen-Withington et al., 2020). Furthermore, another literature review recommends evaluating outcomes of HFS, suggests the need for a more comprehensive measurement of clinical competence that extends evaluation to clinical practice outcomes (Hanshaw & Dickerson, 2020).

Objective structured clinical examinations (OSCEs) are frequently conducted in simulation-based assessments as a summative evaluation of students' clinical competence (Arrogante et al., 2021; Harden & Gleeson, 1979). OSCE and clinical simulation methodology enable bridging the gap between theory and practice, due to their practical efficiency (Hope et al., 2011; Lisko & O'Dell, 2010; Ricketts, 2011; Shin et al., 2015). Furthermore, simulation-based learning approaches present effective learning strategies for nurses to progress in terms of their curriculum (Lee et al., 2019).

For decades, OSCEs have been integrated into programmes for nursing students and medical practitioners. OSCEs are used to assess nursing and medical students in preparation for clinical practice and to identify areas that need to be improved (Baid, 2011; Harden & Gleeson, 1979; Kelly et al., 2016; Rushforth, 2007; Selim et al., 2012). Moreover, OSCE is a strategic method to assess the clinical proficiency of a nursing student by assessing their performance in addressing a variety of simulated circumstances. The OSCE format uses simulations with diversified levels to develop fidelity and promote realistic assessment opportunities and settings. These HFSs are crucial to assess critical thinking and technical skills. The OSCE assesses six skill areas and includes two simulations as part of the student's evaluation of their competency. Longitudinal feedback from faculty and students suggests an increase in the use of the OSCE format during simulation-based examinations. This practice had been transformed into an assessment tool promoting eight simultaneous simulations (Brown et al., 2010).

In general, OSCEs present several skill stations – usually eight to ten, with five to eight minutes minimum required per station for examination. Students rotate between each station to assess distinct proficiencies and clinical and professional expertise (Harden & Gleeson, 1979). Rating scales or checklists are used by observing assessors to determine the students' understanding of mandatory competencies (Harden, 1988). To efficiently assess students' preparation from their comprehensive training, OSCEs must evaluate multiple aspects of nursing care in addition to technical capabilities. In particular, OSCEs must evaluate the non-cognitive aspects of nursing practice (Kelly et al., 2016; McWilliam & Botwinski, 2010).

Therefore, the effects of simulation-based learning on clinical practice should be further examined. In this study, we aimed to compare the OSCE results between the two groups of nursing students enrolled to four undergraduate courses (medical-surgical, critical-care, maternal-health and paediatric nursing) who underwent clinical training with or without HFS.

2 | METHOD

This study employed a quasi-experimental research design to compare the OSCE results of the student groups with and without exposure to HFS. Structured OSCEs are a reliable medium to evaluate the impact of HFS as it measures and validates the student's ability to obtain and interpret data, solve patient problems according to the given scenario, conduct patient teaching, exercise communication skills and handle unpredictable patient behaviour during the course of nursing care. According to Zhu et al. (2015) the use of HFS creates an innovative method for practical teaching in nursing, while substantially advancing teaching and training; moreover, OSCEs are a reliable medium to evaluate students' performance of specific skills in a simulation (Lopreiato, 2016). The students were divided into two

TABLE 1 HFS sessions and duration of pre-briefing, scenario and debriefing

Sessions	Scenarios	Duration		
		Pre-briefing	Scenario	Debriefing
Adult Health Nursing				
1	Managing Diabetic Patient Manifesting Hypoglycemia	20–30 min	8–10 min	20–35 min
2	Myocardial Infarction: ECG Placement and Interpretation	20–30 min	12–15 min	20–40 min
3	Perioperative Nursing Care	20–30 min	8–10 min	20–35 min
Critical Care Nursing				
1	Hemorrhagic Shock: Blood Transfusion Administration and Reaction	20–30 min	8–10 min	20–35 min
2	Pulses VT: CPR and Defibrillation	20–30 min	10–15 min	20–40 min
3	Splenic Rupture with Pneumothorax: Chest Tube	20–30 min	8–10 min	20–35 min
4	Tension Pneumothorax: Needle Decompression	20–30 min	8–10 min	20–35 min
5	Burns and Spinal Shock Management	20–30 min	8–10 min	20–35 min
6	Intubation and Mechanical Ventilation	20–30 min	8–10 min	20–35 min

groups with and without HFS exposure. Since the study used total population sampling to all the students enrolled in the four courses, the groups were categorized according to the course, topics relationship and for the continuity of the scenario used during the simulation sessions such as women's health and child health nursing were grouped together since they are related and adult health 1 and critical care nursing accordingly. The students were exposed multiple times to HFS during their midterm and final period, and two OSCEs were conducted to ensure consistent and accurate results. The students were assessed by two trained raters in every station during the OSCEs using a rating scale. Prior to the midterm and final OSCE, a pilot test was conducted to ensure that the rating scale was appropriate to assess the students. Items of the rating scale covered all the important steps of the procedure, all indicators of the checklist were well-defined, and a global rating scale was used for the raters to provide a holistic judgement on the students' performance.

2.1 | Participants

This study enrolled nursing students from each of the four major courses offered by the Fakeeh College for Medical Sciences in the second semester (February 2020–May 2020) that include a laboratory and clinical component. Nursing students in our country are required to complete 134 credit hours from level 1–8 of the 4-year Bachelor of Science in Nursing (BSN) programme. In addition, they are required to complete the 1-year internship with intensive clinical training before they are eligible to graduate, practice and obtain a national nursing licence.

We used total population sampling and thus included all the students enrolled in these four courses. No participant dropped out during the study period. A total of 192 nursing students were recruited from the following courses: maternal-health nursing (50 students; level 6; 3rd year), child health nursing (51 students; level 6; 3rd year), adult health nursing (53 students; level 5; 3rd year) and critical care nursing (38 students; level 7; 4th year). All participants were female and were regular students (started the BSN programme at the institution from first year and continued till internship year; age range, 24–26 years old). The diploma students (graduated from a 2-year nursing diploma course, licensed and practicing as nurse technicians in different hospitals, age range, 27–37 years old) under the bridging programme to BSN were excluded from the study. The students of maternal-health and child-health nursing courses underwent traditional nursing laboratory teaching and clinical training inherent to the course but received no exposure to HFS. These student groups appeared for one midterm and OSCE. For the adult-health nursing students, three sessions were conducted during the midterm and final period each (three HFS exposures and one OSCE in the midterm and finals each). For the critical care nursing students, six sessions were conducted with high-fidelity simulators during the midterm and final period (six HFS exposures and 1 OSCE in the midterm and finals each) along with traditional laboratory teaching and clinical training. All scenarios were applied during the HFS sessions (see Table 1).

2.2 | Data collection procedure

Each HFS session was conducted as follows: (1) students were briefed about the scenario and objectives; (2) students from all courses were grouped during the simulation sessions and each group (four to five members) were allotted some time to comprehend and recall their knowledge, skills and attitudes about the scenario; (3) each group was brought to the simulation lab separately; while the other groups waited in the briefing room, the groups who completed their session were seated in a separate room till the others completed their sessions; (4) a debriefing session was conducted by a trained faculty after all groups completed the sessions using the GAS Debriefing

TABLE 2 Comparison of midterm and final OSCE results per nursing course

		Midterm OSCE results		Final OSCE results		Overall OSCE results	
Group	**Courses**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
With HFS Exposure	Adult Health Nursing	91.51	15.37	90.19	7.78	90.63	10.07
	Critical Care Nursing	89.96	9.29	97.97	1.77	95.30	4.00
Without HFS Exposure	Child Health Nursing	78.37	12.00	83.52	8.71	81.80	8.49
	Maternal Health Nursing	83.19	10.07	83.72	7.54	83.54	6.69

Abbreviations: HFS, High-fidelity simulation; OSCE, Objective structured clinical examinations; SD, Standard deviation.

Model; participants were gathered in the debriefing room to reflect on the recorded video of the sessions and were encouraged to share their thoughts. The facilitators then provided feedback about their performances and highlighted the accurate and incorrect steps executed by the participants. Lastly, participants were tasked with providing a list of actions that they personally thought were efficient and adequate to the success of the simulation sessions.

Before the OSCE, the course coordinators and clinical instructors prepared and reviewed all the objectives and scenarios with the equipment needed in each station. The procedural rubrics used were taken from Mosby's Pocket Guide to Nursing Skills & Procedures for adult health nursing and critical care nursing. For women's health nursing and child health nursing, the procedural checklist was taken from Clinical Skills Manual for Maternal & Child Nursing Care. The OSCE stations were appropriately set-up according to the blueprint. All rubrics used a 4-point Likert-type scale: 3 (*done correctly*), 2 (*done, but incomplete*), 1 (*done incorrectly*) and 0 (*not done*); the indicators used depended on the procedure. Raters and students were instructed about their role and their task in the OSCE, respectively. Raters comprised the nursing faculty members (course coordinators and clinical instructors), while invited preceptors were staff nurses of Dr. Soliman Fakeeh Hospital. Station numbers were assigned to laboratories, and all the required equipment were arranged to avoid confusion. The standardized patients were briefed and oriented about their roles during the examination.

For the midterm, seven OSCE stations were set, five for nursing procedures and two for written interpretation, each with an equivalency of 10% of students' midterm grade. The average grade was calculated including the midterm OSCE marks of each student. For the final, 10 stations were prepared, eight for nursing procedures and two for written interpretation, each with an equivalency of 20% of students' final grade. The average grade was calculated including the final OSCE marks of each student. The laboratory rooms were prepared; all the equipment needed for the procedure and scenarios were posted outside the OSCE station rooms. The organizer, who acted as a facilitator and timekeeper, ensured that the students were confined to the classroom and were only permitted to leave for taking the laboratory-based examination. Mobile phones and any other kind of technology devices were prohibited inside the classroom. During the OSCE, the students were given one minute to read and analyse the scenario before entering the rooms. When the examinee entered the room, their time of five minutes began. Two students each from the women's health and adult health nursing groups did not finish some of the procedures within the allotted time; the rubric indicator *not done*, which has a score of 0, was applied in these instances. After the OSCE, a debriefing was conducted.

2.3 | Data analysis

The data were collected and analysed from the midterm and final OSCE results. Students were assessed using a procedural rubric that accompanied each scenario, immediately after the simulation sessions had been conducted. At each station, the students were given five minutes to perform the procedure. Two raters were assigned to each of the OSCE stations, except for the written interpretation stations, to evaluate the students' performance separately; however, the same rubric was used.

The midterm and final OSCE results were calculated using Excel 2019 (Microsoft Corp.). The results were encoded and analysed using statistical package Stata 15.1 (StataCorp). The correlation between HFS exposures and OSCE results was evaluated using Pearson correlation coefficient.

2.4 | Ethics

The purpose of the study, including their rights to withdraw, was explained to the participating undergraduate nursing students; written informed consent was given and signed by the participants before the study commenced. Research Ethics Committee approval for this study was obtained from the affiliated Institutional Review Board.

3 | RESULTS

Table 2 shows the OSCE results of undergraduate nursing students in each nursing course. The mean percentage with standard deviation (SD) of the OSCE midterm and final results of nursing students with HFS exposure in adult health nursing was 91.51(15.37) and 90.19 (7.78), respectively, with an overall mean percentage of the OSCE midterm and final results of 90.63 (10.07). The mean percentage of the OSCE midterm and final results of

nursing students with HFS exposure in critical care nursing was 89.96 (9.29) and 97.97 (1.77), respectively, with an overall mean percentage of the OSCE midterm and final results of 95.30 (4.00). However, the mean percentage of the OSCE midterm and final results of nursing students without HFS exposure in child health nursing was 78.37 (12.00) and 83.52 (8.71), respectively, with an overall mean percentage of the OSCE midterm and final results of 81.80 (8.49). Furthermore, the mean percentage of the OSCE midterm and final results of nursing students without HFS exposure in maternal health nursing was 83.19 (10.07) and 83.72 (7.54), respectively, with an overall mean percentage of the OSCE midterm and final results of 83.54 (6.69).

Table 3 shows the mean percentage of the combined OSCE midterm results of the group of nursing students with HFS exposure and those without HFS exposure was 90.86 (13.13) and 80.75 (11.29), respectively, and the mean difference between the groups was 10.11% supported with the *p-value* of less than .01. However, the mean percentage of the combined mean (SD) results of the final OSCE of nursing students with HFS exposure and those without HFS exposure was 93.44 (7.15) and 83.62 (8.11), respectively. Furthermore, the mean difference between the groups of nursing students was 9.82% supported with the *p*-value of less than .01. The overall mean (SD) midterm and final OSCE results of the group of nursing students with HFS exposure and those without HFS exposure were 92.58 (8.40) and 82.66 (7.66), respectively, and the mean difference between the groups of nursing students was 9.92% supported with the *p*-value of less than .01.

4 | DISCUSSION

The current study aimed to compare the OSCE results of two groups of nursing students enrolled to four undergraduate courses (medical-surgical, critical-care, maternal-health and paediatric nursing), who underwent clinical training with or without HFS. Thus, the main purpose of exposing the students to simulation scenarios is to develop clinical reasoning, decision-making and clinical judgement skills. The result of the study provides strong evidence that HFS exposure of nursing students in addition to the traditional nursing laboratory sessions and clinical training produces positive impact in their midterm and final OSCE performance compared to those nursing students without HFS exposure but underwent traditional nursing laboratory sessions and clinical training. The repeated exposure to HFS training offers an advantage and enhances the students' performance in the OSCEs. Furthermore, the need for a standardized and systematized simulation model in nursing education is necessary to achieve the intended learning outcomes of HFSs. Additionally, selecting the best model of debriefing will facilitate learning among all participants and improve their performances in future simulations or in actual healthcare settings.

HFS-based training requires nursing students to apply their theoretical knowledge in a safe environment that simulates the real clinical setting. This learning modality is effective for nursing students to develop high-level skills in decision-making and clinical competency based on their performance in the OSCE after HFS exposure.

The National League for Nursing also suggested the incorporation of simulation, with a clear connection to students' learning accomplishments, into the nursing curriculum (Jeffries, 2016). Bridging the gap between theory and practice, such as making independent clinical decisions and understanding the effect of actions on patients' condition in a safe controlled environment, can be resolved using simulation as a teaching modality in nursing (Wall et al., 2014). Students who were exposed to simulation sessions were deemed more capable of applying theoretical knowledge to skill performance assessment (Bevan et al., 2015). Simulation is an effective strategy for and solution to the current lack of facilities for the clinical placement of nursing students. It offers evidence-based, experiential learning opportunities that nurture students' critical thinking and clinical reasoning (Jeffries, 2020). Additionally, prior studies confirm that students' development of knowledge, clinical reasoning skills and competence in caring for patient and families in a complicated

TABLE 3 Comparison of combined midterm and final OSCE results

OSCE results	Group	Mean	SD	Mean difference	*p*-Value
Midterm	With HFS Exposure	90.86	13.13	10.11	<.01
	Without HFS Exposure	80.75	11.29		
Final	With HFS Exposure	93.44	7.15	9.82	<.01
	Without HFS Exposure	83.62	8.11		
Overall	With HFS Exposure	92.58	8.40	9.92	<.01
	Without HFS Exposure	82.66	7.66		

Abbreviations: HFS, High-fidelity simulation; OSCE, Objective structured clinical examinations; SD, Standard deviation.

healthcare environment is aided by simulation (Aebersold, 2018; Jeffries, 2012; Kiernan, 2018).

A randomized controlled trial conducted by Guerrero et al. (2021) reported that repeated HFS exposure improves nursing interns' clinical performance, which can help boost their competency. Therefore, supplemental HFS, in addition to the traditional pure hands-on training, can expand nurses' clinical competence. While the literature supports the use of HFS to enhance patient safety, most evidence is specific to undergraduate nursing students (Bliss & Aitken, 2017; O'Rourke et al., 2021).

A study by Lee and Oh (2015) suggested that simulation brings development in problem-solving skills, critical thinking and clinical reasoning and expertise among nursing students. An HFS was reviewed by Doolen et al. (2016) within the undergraduate nursing education system. It was identified that there are varieties in the design and assessment strategy in each simulation result. Additionally, a meta-analysis by Shin et al. (2015) compared the simulation education within a controlled group that is unable to engage in simulation. Through this comparison, researchers found that simulations have a huge impact when it comes to achieving the required psychomotor skills during HFS.

Moreover, OSCE offers educators with an opportunity to provide constructive feedback, according to the results of students' performance, following the simulated scenarios, based on the checklist. By the OSCE, the clinical skills of the nursing students can be assessed in a real-life simulated clinical environment (Harden & Gleeson, 1979; Mitchell et al., 2009; Oermann et al., 2016; Ryall et al., 2016). Therefore, simulation-based assessments (1) evaluate the real performance of the students in a situation that is comparable to real-life clinical practice, (2) evaluate multidisciplinary professional skills and (3) present standard clinical scenarios compared to other traditional assessment methods, such as written or oral tests (Cant & Cooper, 2010; Chernikova et al., 2020; Kim et al., 2016).

4.1 | Limitations

The findings of this study indicate the impact of HFS to the nursing student's performance in the OSCEs. However, the study was conducted with a small number of participants, and it was only conducted in one setting/location. Moreover, the participants were only limited to female students, since the particular nursing programme only accepts females as part of cultural practice and government policy of the country. Additionally, the use of the procedural rubrics was a limitation, as they were adopted from course-appropriate reference books but not tested for reliability.

Future longitudinal studies should be conducted with a multicenter design with multiple number of participants to facilitate incorporation of simulation-based training in nursing education and develop students' clinical competency and enable practice readiness. Intensive training of faculty members in the simulation sessions would be necessary for nursing students, including structured assessment of their clinical performance and competency.

5 | CONCLUSION

This study provides evidence of the influence of HFS exposure to evaluate students' performance in the midterm and final OSCEs. Our study findings reveal that simulation exposure enhanced students' OSCE performance through the appropriate use of clinical reasoning, decision-making and judgement, while dealing with the provided scenarios. Thus, exposing students to HFS boosted their learning retention and improved their practical skills in performing nursing procedures that can be applied in the real world.

ETHICAL APPROVAL

The purpose of the study was explained to the participants, who agreed to participate before the study commenced. Ethical approval for this study was obtained from Fakeeh College for Medical Sciences Institutional Review Board (Approval No. 285/IRB). Furthermore, informed consent has been obtained from all participants.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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