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COMBINING HIGH-FIDELITY SIMULATION AND STANDARDIZED PATIENT SIMULATION AS A HYBRID TEACHING STRATEGY: EFFECTS ON NURSING STUDENTS' ANXIETY, KNOWLEDGE, AND SKILLS

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ABSTRACT

Objective: *The aim of this study was to determine the effects of high-fidelity simulation and hybrid methods on the anxiety levels, knowledge, and skills of nursing students providing postoperative care to patients with cervical spinal trauma.*

Material and Method: *This quasi-experimental, prospective, controlled study included 48 senior nursing students, who were divided into three groups (control, simulation, and hybrid). Study data were collected using the State–Trait Anxiety Inventory, knowledge forms, and skill assessment forms. Data were analyzed using the paired t-tests, two-factor MANOVA, and one-way ANOVA.*

Results: *The results indicated significant improvements in trait anxiety and knowledge scores before and after training, as well as after the simulation application ($p<0.05$), for both the simulation and hybrid groups. Changes in state anxiety ($F=22.365$, $p<0.001$), trait anxiety ($F=4.637$, $p=0.014$), and knowledge scores ($F=78.371$, $p<0.001$) were significant independent of group, and within-group analyses showed that both groups benefited from the intervention. Additionally, the hybrid group achieved higher mean practice scores than the simulation group after the simulation application ($t=-2.84$, $p=0.008$).*

Conclusion: *Although the study found all simulation methods effective in improving knowledge, the hybrid simulation method was more effective in improving skills. Hybrid simulation methods involving standardized patients should be considered a particularly effective teaching approach in surgical nursing education to prepare nursing students for their future professional practice.*

Keywords: *Students, nursing, high fidelity simulation, patient simulation, postoperative care*

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YÜKSEK GERÇEKLİKLİ SİMÜLASYON VE STANDART HASTA SİMÜLASYONUNUN BİR HİBRİT ÖĞRETİM STRATEJİSİ OLARAK BİRLEŞTİRİLMESİ: HEMŞİRELİK ÖĞRENCİLERİNİN KAYGI, BİLGİ VE BECERİLERİ ÜZERİNE ETKİSİ

ÖZET

Amaç: Bu çalışmada servikal spinal travmalı hastaların postoperatif bakımında yüksek gerçeklikli simülasyon ve hibrit simülasyon yöntemlerinin hemşirelik öğrencilerinin anksiyete, bilgi ve becerileri üzerine etkisini belirlemek amaçlanmıştır.

Materyal ve Metot: Yarı deneysel prospektif kontrollü olarak yapılan bu çalışmada 48 hemşirelik son sınıf öğrencisi kontrol, simulasyon ve hibrit olmak üzere üç gruba ayrılmıştır. Çalışma verileri durumluk ve süreklik kaygı envanteri, bilgi ve beceri formları kullanılarak toplanmıştır. Veriler eşleştirilmiş T testi, iki faktörlü MANOVA ve tek yönlü ANOVA kullanılarak analiz edilmiştir.

Bulgular: Sonuçlar, hem simülasyon hem de hibrit gruplarda eğitim öncesi ve sonrası ile simülasyon uygulamasından sonra süreklilik kaygısı ve bilgi puanlarının anlamlı düzeyde düzeldiğini göstermiştir (p<0,05). Durumluk kaygı (F=22,365, p<0,001), süreklilik kaygı (F=4,637, p=0,014) ve bilgi puanlarındaki (F=78,371, p<0,001) değişimler gruplardan bağımsız olarak anlamlı bulunmuş, grup içi analizler ise her iki grubun da müdahaleden fayda sağladığını ortaya koymuştur. Ayrıca, hibrit grubun simülasyon uygulaması sonrası ortalama uygulama puanı, simülasyon grubuna göre daha yüksek bulunmuştur (t=-2,84, p=0,008).

Sonuç: Çalışmada tüm simülasyon yöntemlerinin bilgiyi artırmada etkili olduğu bulunmasına rağmen becerileri geliştirmede hibrit simülasyon daha etkili bulunmuştur. Hemşirelik öğrencilerini gelecekteki mesleki yaşamlarına hazırlamak amacıyla cerrahi hemşireliği eğitiminde özellikle standart hasta içeren hibrit simülasyon yöntemleri etkili bir öğretim yaklaşımı olarak değerlendirilmelidir.

Anahtar kelimeler: Öğrenciler, hemşirelik, yüksek gerçeklikli simülasyon, hasta simülasyonu, postoperatif bakım

INTRODUCTION

Clinical competence is a core component of nursing education, requiring the integration of knowledge and practical skills. Simulation methods offer some specific benefits to students, including transferring theoretical knowledge to the clinical environment, performing repeated exercises without risk, reducing anxiety during clinical practice training, working individually or as a team, and improving problem-solving and decision-making skills.[1,2]

On the other hand, while simulation provides the opportunity to perform procedures without the possibility of harming the real patient, it may also interfere with the learning process and cause anxiety in students for several reasons, such as working on a mannequin, being under observation, being alone in the environment, worrying about criticism from the instructor, time constraints, and being video-recorded.[2,3] In addition, the level of realism influences students anxiety levels depending on the difficulty of the procedure and can lead to low-performance scores.[4,5] Working as an inexperienced primary nurse and not achieving the expected results can also cause anxiety.[6,7] The literature indicates that the use of standardized patients in simulations positively affects anxiety levels, with few reports of high stress or high anxiety scenarios when standartised patients are used. [8-9]

Although nursing students encounter cardiopulmonary arrest, trauma or intensive care patients during their training, they do not feel confident in acquiring sufficient knowledge and skills to care for such patients holistically.[10,11] It is important that these students develop skills in providing care for critically ill patients through simulation methods.[12,13] Patients who have sustained spinal trauma can be considered critically ill, and nursing students are usually involved in interventions related to severe emergencies such as spinal trauma only as observers.[14-15] Graduated nurses are expected to manage appropriate nursing interventions in many areas when dealing with spinal cord injuries, including performing neurological examinations, positioning the patient appropriately, maintaining body temperature, assisting with elimination, and preventing complications.[16] Currently, there are a limited number of studies in the literature regarding the management of patients with spinal trauma.[17-20]

Objectives

This prospective quasi-experimental controlled study aimed to determine the effects of scenario-based simulation and hybrid methods, identified as high fidelity, on the anxiety, knowledge and skills of students providing postoperative care to patients with cervical spinal trauma.

Hypotheses

To meet the study objectives, the author(s) proposed the following hypotheses:

H1: There is a difference between the anxiety levels of the nursing students trained with the hybrid method and the anxiety levels of the other groups.

H2: There is a difference between the knowledge levels of the nursing students trained with the hybrid method and the knowledge levels of the other groups.

H3: There is a difference between the patient care skills of the nursing students trained with the hybrid method and the patient care skills of the other groups.

MATERIAL and METHOD

Design

This study was conducted using an investigative methodology, employing the simulation environment as an experimental model. As such, the participants can identify problems related to patient safety, test new technology and protocols, and increase their knowledge, skills and experience in a healthy environment without harming patients, enabling them to go on to use what they learn safely in clinical practice.[21] The intensive care environment was simulated using the hybrid simulation method, which combines a standardized patient with high-fidelity simulation, allowing students to directly observe features such as vital signs and respiratory sounds.

Settings

Study Preparation, Scenario, and Implementation

Environment Preparation: The study was conducted in the nursing simulation laboratory that depicted an intensive care environment. Both the standardized patient and the mannequin were dressed and made up in the same way. A wearable injection pad was placed on the standardized patient. While training with the hybrid group, at the first stage of the study, the mannequin was placed alongside the standardized patient but behind a screen that separated them to prevent the student from having visual contact with the mannequin. When the standardized patient left the laboratory at the end of the first stage, the screen was removed and the student continued the scenario with the mannequin.

Scenario Roles: The roles required in the scenario were played by three people (doctor, surgical nurse and a member of staff from intensive care). The application phase was recorded and these recordings were used in the debriefing session. The standardized patient had been instructed about the simulation application by the Department of Medical Education and Informatics at Hacettepe University and was not known to the students. In the simulator group, the mannequin was voiced by a team member unknown to the student, and in the hybrid group by the standardized patient. The team member received the necessary training before the study.

Participant Preparation: A theoretical lecture, which included spinal cord anatomy, spinal traumas, and nursing care for patients undergoing spinal surgery, was delivered to the participating students for 60 minutes after the pretests. The educational materials used were prepared by the researchers. After the lecture, the student was informed that they would be working alone as an ICU nurse during the simulation practice. Having been given a brief description of the simulation content, the student was introduced to the laboratory environment for about five minutes. Following the briefing, the simulation practice began. The student was alone during the simulation practice but could communicate with the attendant team members when necessary.

Scenario: Nursing care following spinal trauma surgery is a challenging and complex process. As nursing students are among the healthcare professionals who most frequently encounter trauma patients and are expected to develop essential competencies in spinal trauma care, postoperative spinal trauma care was chosen as the simulation scenario for this study. The scenario was developed by the authors; the first author holds a SIM Educator certificate. Expert opinion regarding the scenario was obtained from a surgical nursing specialist. The preliminary application of the scenario was conducted with two students from each group. The patient had undergone surgery following a spinal trauma and was quadriplegic. The student was expected to take the patient's history, perform a physical examination, and provide postoperative care. The scenario was used in both the simulation practice and hybrid simulation groups. It comprised three phases: recording patient history and performing a physical examination (Scene I), nursing interventions (Scene II), and spinal shock (Scene III). In the spinal

shock phase, the scenario ended when the patient's condition deteriorated. The simulated practice lasted approximately 30 minutes for the simulation group and 40 minutes for the hybrid group. In the hybrid group, the standardized patient was taken out of the laboratory because the simulation continued with the mannequin after the first phase. The interior design of the laboratory was modified according to the second stage. After the scenario ended, the student attended a debriefing with the first author that lasted approximately 30 minutes, and the gather, analyse, summarize (GAS) method was used. The students in the control group did not attend simulation practice, and post-tests were administered after the lecture (Figure 1).

Participants and Study Size

The study population consisted of 140 senior students who had taken the surgical diseases course. The study sample comprised 48 senior nursing students who voluntarily agreed to participate. The students were divided into three groups using a simple random sampling lottery method conducted by the second author, and all were blinded. The students who received the theoretical lecture formed the control group (CG), those who underwent scenario-based simulated practice formed the simulation group (SG), and those who underwent scenario-based simulation practice using a standardized patient formed the hybrid group (HG). The study was conducted between December 2016 and May 2017. As no studies were found in the literature addressing the care of patients with spinal trauma using hybrid and simulation-based methods, a pilot study was first conducted. Based on its findings, the main study was conducted with 16 students in each group (n=48 in total). The type I error (α) was assumed to be 0.05 (5%), and the type II error (β) was assumed to be 0.20 (20%), corresponding to a statistical power of 80%. The statistical power of the study (G*Power Version 3.1.9.3) was calculated as 81.2% with a 5% margin of error and an effect size of 0.333 for state anxiety. For trait anxiety, the statistical power was 86.8%, with an effect size of 0.375

Data Collection Forms

Demographic Data Form

This nine-item questionnaire included questions about the participant's age, gender, previous training in spinal trauma, and whether the student had prior experience caring for a patient with spinal trauma.

Table 1. The average anxiety scale and knowledge scores of the groups

	Groups	Pre- Training	Post-Training	*p***	Post-Simulation Application	*p****
		Mean ±SD	Mean ±SD		Mean ±SD	
State Anxiety	Control	39.31±3.45	40.53±3.99		-	0.160
	Simulation	39.93±4.28	38.56±3.68	0.540	43.56±4,06	0.545
	Hybrid	39.00±3,25	37.25±3,89		42.33±3,79	0.135
Trait Anxiety	Control	46,18±2,80	47,75±3,43		-	<0.001
	Simulation	45.31±5.22[a]	45.37±5.14[a,b]	0.046	44.43±5.83[b]	0.014
	Hybrid	45.87±3.98	48.06±3.43[b]		46.18±3.41[b]	0.014
Test Score	Control	44.19±10.17	73.21±16.59		-	<0.001
	Simulation	47.76±8.13[a,b]	69.64±12.09[a]	0.473	72.32±11.62[b]	<0.001
	Hybrid	48.21±13.42[a,b]	74.55±11.94[a]		75.89±9.35[b]	<0.001

*: The same superscript letters show significant differences within measure (p<0.05)
**: The paired t-test was performed
***: Two-way analysis of variance was used in repeated measurements
SD: Standard deviation

Table 2. Two-factor MANOVA results of anxiety scales and knowledge scores

Scales and knowledge scores	Source	Sum of squares	Degrees of freedom	*Mean Square*	F	*p*
State Anxiety	Group	24.445	1	24.445	0.878	0.357
	Time	397.348	2	198.674	22.365	<0.001
	Group*time	0.014	2	0.007	0.001	0.999
Trait Anxiety	Group	47.163	1	47.163	0.883	0.355
	Time	44.839	2	22.419	4.637	0.014
	Group*time	23.678	2	11.839	2.449	0.095
Test Score	Group	212.585	1	212.585	1.029	0.318
	Time	13517.219	2	6758.610	78.371	<0.001
	Group*time	83.971	2	41.986	0.487	0.617

Table 3. Mean simulation practice scores of students

Practices	Simulation Group (n:16)	Hybrid Group (n:16)	Statistical Evaluation
	Mean ±SD	Mean ±SD	
History Taking	55.72±18.43	58.85±14.74	t=-0.53
			p=0.600
Physical examination	52.88±14.56	64.42±15.35	t=-2.18
			p=0.370
Nursing Interventions	55.32±8.38	65.97±9.77	t=-3.30
			p=0.020
Spinal shock	61.45±16.35	64.58±8.33	t=-0.68
			p=0.500
Total	54.58±7.68	61.81±6.62	t=-2.84
			p=0.008

SD: Standard deviation

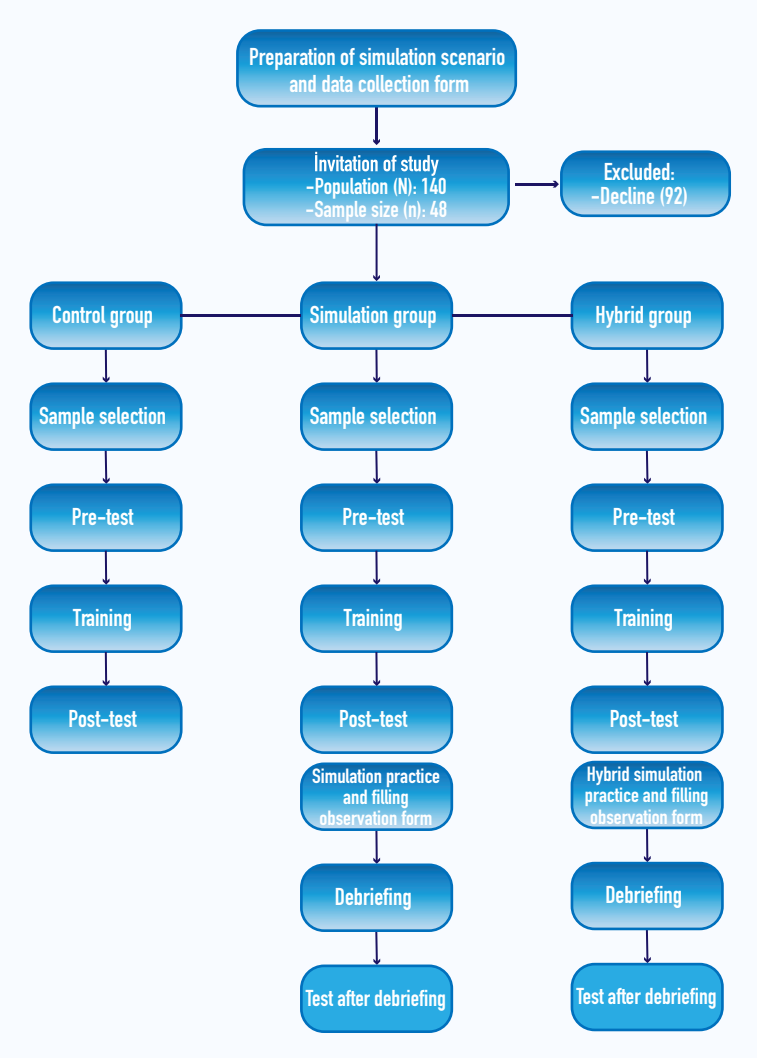

Figure 1. Study flowcart (Among the 140 students invited, 48 agreed to participate and 92 declined; group allocation was performed by lottery.)

Knowledge Form

This 14-item questionnaire form included multiple-choice questions about the characteristics of spinal trauma, motor examination, and appropriate nursing care of patients with spinal trauma. In the scoring of the items, correct responses to the questions were given '1' point, and incorrect responses or unanswered questions scored 0. A total score was calculated after this rating and evaluated out of 100 points.

State-Trait Anxiety Inventory (STAI)

The STAI developed by Spielberger, Gorsuch, and Lushene, and the Turkish version of was evaluated by Oner and Le Compte for validity and reliability.[22] The STAI contains two subscales (state anxiety and trait anxiety) composed of 40 items. This scale was developed to evaluate how the respondent feels at a given time or under a given condition, while the Trait Anxiety Scale evaluates how the respondent feels, independent of the state and condition of an individual. A higher score indicates a high, and a lower score a low, level of anxiety. The range of total scores for each scale is 20–80 points. Cronbach's alpha varied between 0.88 and 0.94 for the state anxiety scale and between 0.87 and 0.88 for the trait anxiety scale of the study.

Simulation Practice Observer Form

This form included items on communication with the patient, physical examination, and nursing interventions related to the care of a postoperative patient with cervical spinal trauma. It was completed during simulated and hybrid practice by two separate observers located in the control room behind a one-way mirror. The students had no visual contact with the observers. Inter-observer consistency ranged from 0.921 to 0.922. Practices performed by the students during simulation training were rated as '1', while partially completed or uncompleted tasks were rated as '0'. Scores for each section and the overall total were evaluated out of 100.

Statistical Analysis

The data were analysed using SPSS 20.0 (IBM, NY, USA). Descriptive statistics (mean, median and standard deviation) were used in the data analysis. Normal distribution was checked using the Shapiro–Wilk test. For comparison between the groups, as the groups were distributed normally, a variance paired t-test, a two-factor MANOVA, and a one-way ANOVA test were used for repeated measurements. A p-value less than 0.05 was considered statistically significant

Institutional Review Board Approval

An application for ethical approval was submitted to the Hacettepe University Non-Interventional Trials Ethics Committee, and the study was approved at the committee meeting held on 27 May 2015 (Decision No: GO 15/276-03). Written permission was obtained from the administrators of the nursing departments at the same university. Before initiating the study, written informed consent was obtained from the students and standardized patients.

RESULTS

A total of 48 senior students participated in the study, with a mean age of 23.52±5.14 years (min–max: 22–58); of these, 46 (95.8%) were female, and seven had previous experience caring for a patient with spinal trauma. There was no difference in the trait anxiety score in the CG, but there was a significant difference between the SG and HG (p<0.005), which was due to the HG.

When the students' average trait anxiety scores were analysed, there was a statistically significant difference between the mean values of each group for the pre-test, post-test, and post-simulation scores (p<0.05). This significant difference was based on the mean post-test and post-simulation scores. The mean scores of the groups for the pre-test, post-test, and post-simulation scenarios were statistically significant (p<0.001) and resulted from the post-test and post-simulation mean scores (Table 1, and Figure 2).

When the two-factor MANOVA results for the STAI scale and knowledge scores were analysed, it was found that changes in students' state anxiety (F=22.365, p<0.001), trait anxiety (F=4.637, p=0.014), and knowledge scores (F=78.371, p<0.001) were independent of the groups. The inter-group and group–time interactions were not statistically significant. However, significant changes in STAI and knowledge scores were observed over time within the groups (Table 2).

In Table 3, a statistically significant difference was found between the nursing interventions and the total mean simulation practice scores in the SG and HG (p<0.05), attributed to higher mean scores in the HG. No statistically significant difference was observed between the two groups in the mean scores for patient history recording, physical examination, and spinal shock sections (p>0.05).

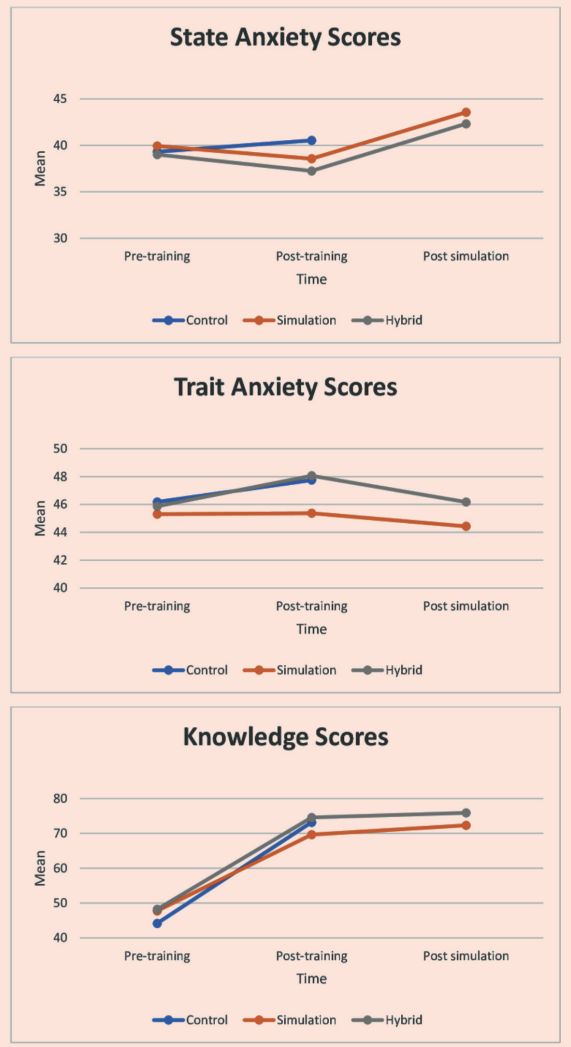

Figure 2. State and trait anxiety, and knowledge group/time graphics

DISCUSSION

The study results showed that the HG had a lower mean state anxiety score. Although this increased after the simulation, there was no statistically significant difference between the groups in state anxiety scores. In a study by Cura et al., it was observed that the stress levels of the group working with the standardized patient increased significantly after the simulation compared to the high-fidelity and partial task groups.[23] Mert Karadas et al., in their study comparing the effects of different simulation methods, found no significant difference in students' state anxiety.[24] The reason students' state anxiety levels were statistically insignificant in this study could be due to the fact that senior nursing students have had various experiences with simulation-based applications during their training, so they perceive the simulation laboratory as a very familiar environment ,and are able to perform well in practice. The hybrid group participants had a greater sense of reality and experience, than the other groups; they felt less lonely and had less difficulty making decisions. It is thought that the state anxiety levels of the hybrid group were lower than those of the other group in the simulation laboratory because of the comfort and confidence they felt when working with a real person. Furthermore, incorporating integrated scenarios within hybrid simulation, designed to foster both psychomotor and non-psychomotor skill development through direct interaction with a human rather than a static mannequin, may be beneficial in managing students' anxiety during challenging cases.

Although all groups showed increased trait anxiety scores post- lectures and decreased scores of post-simulation applications, the average trait anxiety scores increased most in the hybrid group. However, no significant differences were found between the groups. This may be due to the fact that the trait anxiety was usually high in the participants. Studies have shown that after the simulation training, the students' anxiety levels were lower than before training.[25,26] On the contrary, our study identified increased state anxiety levels among students after the simulation. This may be

due to the feeling of being left alone in the laboratory environment, and the challenges posed by the spinal injury setting. This situation was also expressed by some students in the debriefing session. In their study investigating individual and peer group post-simulation stress and anxiety levels, Nakayama et al. found that, after simulation training, the individual group had a significantly higher state anxiety score than the peer group.[27] In another simulation study in which both a standardized patient and a mannequin were used, participants reported experiencing more stress when interacting with the standardized patient.[28] These results are in line with the findings of the present study. In their studies, both Ignacio et al., and Dawson et al., stated that working with standardized patients was stressful.[29,30] Martin-Sanchez et al., found that the anxiety level of students in the simulation study on sepsis, myocardial infarction, polytrauma and anaphylactic shock was higher than in the other scenarios.[31] In the present study, some participants were not interested in the patient's current clinical situation and ignored the standardized patient's complaints to avoid being placed in a difficult situation or being unable to answer their questions. It is thought that managing difficult cases such as spinal trauma scenarios causes anxiety in students some of whom try to overcome this anxiety by ignoring the patient's symptoms. Student anxiety can be related to factors such as being video-recorded during simulation practice, being observed by the simulation team, a lack of simulation experience, and the sense of realism provided by the application.[32] Indeed, some students stated that being observed increased their anxiety levels, and the majority of the students in the HG reported that working with the standardized patient was stressful but they were able to practise more easily despite the decreased realism after the standardized patient simulation was completed. Although simulations with standardized patients increase realism, it is suspected that they can cause stress in students, which should be considered when planning simulation scenarios. In addition, it is thought that group work, rather than individual work, may reduce the anxiety that working alone with a standard patient would cause.

Studies have shown that after training and simulation practice, students' theoretical knowledge and skills improve.[33,34] The present study identified a change in spinal trauma knowledge after the lecture and after the simulation, which was greatest in the CG and HG, respectively. Salemeh et al. used a complex case involving mechanical ventilator training in a high-fidelity simulation study. Although, the case was difficult, it was observed that the knowledge levels of the simulation group increased.[35] Simulation-based learning using the standardized patient method had important effects on the cognitive, affective and psychomotor domains of learning, and the use of standardized patients showed significant positive effects on knowledge acquisition, learning motivation and clinical competence.[36] Although there was no difference between the groups in the present study, the greatest increase in test scores after the simulation was observed in the HG. The time-dependent increase in the students' knowledge scores in the present study is considered attributable to the effectiveness of the theoretical lecture and the transfer of theoretical knowledge gained from training to practice in a realistic simulation environment, thereby strengthening the students' knowledge. The students in the HG had opportunities to transfer their theoretical knowledge in practice.

Simulation-based training aims to develop skills that students are expected use in their professional careers. Fung et al. conducted a study comparing a combined approach using standardized patients and high-fidelity simulators with the use of high-fidelity simulations alone. The results demonstrated that the integrated method significantly improved students' clinical competence.[37] In the present study, participants in the HG were more likely to communicate with the standardized patient and implement interventions requiring physical contact; however, they avoided implementing some interventions because the mannequin was inanimate. This is due to better interaction with the patient through the use of both a standardized patient and a human simulator in the hybrid simulation group, which provides the ability to observe the patients'physical reactions, and the opportunity to perform interventions on the human simulator that cannot be otherwise performed on a standardized patient. Studies have reported that simulation methods improve skills, the transfer of knowledge to clinical practice, confidence, and critical judgement skills.[38,39] Sahin Bayindir et al. utilized standardized patient and hybrid simulation approaches and found that both methods enhanced participants' clinical assessment skills.[40] Central to the nursing profession is the provision of care and the ongoing interaction with patients. Our study demonstrates that students in the standardized patient hybrid group engage in this interaction in a way that closely resembles interaction with actual patients. Hybrid simulation is regarded as an effective learning method for preparing students for interactions with real patients.

CONCLUSION

The present study evaluated the effects of scenario-based simulation and hybrid simulation methods on the anxiety levels, knowledge and skills of students providing postoperative care to patients with cervical spinal injuries. In all three groups, students' knowledge levels increased. In addition, nursing intervention scores and total mean simulation practice scores in the HG were statistically significantly higher. Nursing and medical education is a challenging and stressful process due to the heavy workload and clinical practice requirements. During this process, students encounter complex treatment and care processes, particularly in high-risk clinical settings such as emergency departments and intensive care units. When caring for trauma cases, such as patients with spinal trauma, healthcare professionals must manage their emotions, including anxiety and stress, to provide effective care. To ensure students are well prepared for post-graduation, innovative educational models that combine multiple methods, such as hybrid simulations, are needed to develop their knowledge and skills without risking harm to real patients. We recommend the use of the hybrid simulation method in different scenarios, and for individual or multidisciplinary groups such as physician or paramedic students, related to various surgical nursing interventions on a larger study sample. Instructors should also be trained in the use of new methods, such as hybrid simulation.

Limitations

The most significant limitations of our study are the inability to conduct long-term follow-up after simulation training and the limited sample size.

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*The authors declare that there are no conflicts of interest.

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