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The effect of high-fidelity simulation on nursing students' self-confidence and stress levels during patient intervention: a randomized controlled trial

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Abstract

Background High-fidelity simulation provides a safe and effective learning environment in nursing education, supporting the development of clinical competence and patient safety. This randomized controlled trial aimed to examine the effect of high-fidelity simulation on nursing students' self-confidence and perceived stress levels during patient care interventions.

Methods The study included 38 senior nursing students who completed a pretest consisting of the Student Identification Form, the Self-Confidence in Intervening with Patients Scale, and the Perceived Stress Scale. The experimental group participated in a simulated shock scenario using high-fidelity simulation, while the control group received routine theoretical instruction. Posttests were administered to both groups two weeks after the intervention. The data obtained in the study were statistically analyzed using SPSS (Statistical Package for the Social Sciences) version 25.0 for Windows. The study adhered to the CONSORT 2010 guidelines.

Results No statistically significant differences were found between the experimental and control groups in posttest total scores of self-confidence or perceived stress ($p > 0.05$). However, within-group analysis indicated significant improvements in the experimental group's self-confidence total score and in the subdimensions of clinical practice and psychological support ($p < 0.05$). These improvements demonstrate that students' clinical performance during patient care interventions is supported.

Conclusion High-fidelity simulation training significantly enhanced nursing students' self-confidence during patient care interventions, whereas perceived stress levels did not differ significantly within or between groups. These findings support the integration of high-fidelity simulation into nursing curricula to enhance students' clinical preparedness. Further studies with larger and diverse samples are recommended to strengthen the evidence base.

Clinical trial number "https://ClinicalTrials.gov "; ClinicalTrials.gov Identifier: NCT06454786 [Registration date 2024/06/06].

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Keywords High-fidelity simulation, Simulation-based education, Nursing education, Self-confidence, Perceived stress, Patient care, Randomized controlled trial

Background

Nursing is a profession that requires the acquisition of cognitive, psychomotor, and attitudinal competencies; therefore, integrating innovative approaches into nursing education is essential [1]. Simulation-based training allows students to manage nursing processes in scenarios that replicate patient conditions using high-fidelity simulators. These scenarios are designed to foster the development of knowledge, skills, and attitudes necessary for clinical decision-making, emergency interventions, and critical thinking [2].

Simulation practices, particularly those implemented in skills training, bridge the gap between theory and practice, enhance psychomotor skills, develop therapeutic communication, and improve decision-making and critical thinking abilities [1–3]. Students benefit from a safe learning environment in which they can collaborate with educators and peers without fear of harming patients [3, 4]. Simulation training may also help reduce stress and anxiety associated with lack of clinical experience [3, 5, 6], while rehearsing and practicing skills before real patient encounters can increase competence and self-confidence [3, 5, 7].

Shock is a critical condition in which cells cannot maintain normal function, potentially leading to organ damage or death [8]. Managing shock requires nurses to make rapid decisions and perform effective interventions [1, 2, 9]. Simulation-based training has been shown to enhance students' ability to manage shock by providing a realistic clinical environment in which they can practice monitoring, treatment, communication, and organizational skills [10].

Enhancing nursing students' patient intervention skills and strengthening their ability to cope with stress are essential for clinical competence and professional proficiency. High levels of self-confidence are fundamental for effective patient care, which is critical for patient safety and satisfaction [4]. Recent evidence from a systematic review and meta-analysis further supports the effectiveness of high-fidelity simulation in improving nursing students' self-confidence, clinical competence, and stress management skills [11]. Simulation-based education provides experiential learning opportunities that can improve students' self-confidence and stress-coping skills in clinical settings [3, 12, 13]. This study aimed to determine the effect of high-fidelity simulation training on nursing students' self-confidence and stress levels during patient interventions.

Methods

Study design

A randomized controlled trial was conducted with nursing students at Istanbul Kent University in Istanbul, Turkey.

Study setting

The study was conducted in a laboratory environment using a high-fidelity simulator between April and May 2024. The simulation laboratory was designed to closely replicate real clinical settings and was equipped with standard hospital equipment to enhance realism.

Population and sample

The study population consisted of senior nursing students enrolled in the undergraduate nursing program. The inclusion criteria were being a senior nursing student and volunteering to participate. The exclusion criteria were students who did not agree to participate or who submitted incomplete questionnaires during data collection.

To determine the required sample size, a power analysis was performed using the G*Power 3.1 software. In a similar study conducted by Uslu [14], the effect size for the variable *Confidence in Intervening with Patients* was reported as 0.868. Based on this effect size (0.868), with a significance level of 0.05 and a desired power exceeding 95%, it was estimated that 16 participants per group (32 in total) would be required ($df = 15$; $t = 1.753$). Considering possible data loss and to ensure sufficient statistical power, the study aimed to include 19 participants in each group, for a total of 38 participants. Given that the effect size used in the power analysis represents a large effect, the study may have limited sensitivity to detect smaller effects.

Randomization and masking

Thirty-eight senior nursing students were randomly assigned to the experimental group ($n = 19$) or control group ($n = 19$) using a simple randomization method generated by a statistician via computer software. Group assignments were implemented by an independent individual who was not involved in participant recruitment, data collection, intervention delivery, or outcome assessment, ensuring no influence on group allocation. As a methodological strength, the statistician who conducted the data analysis was blinded to group allocation, thereby reducing potential analysis bias (Fig. 1).

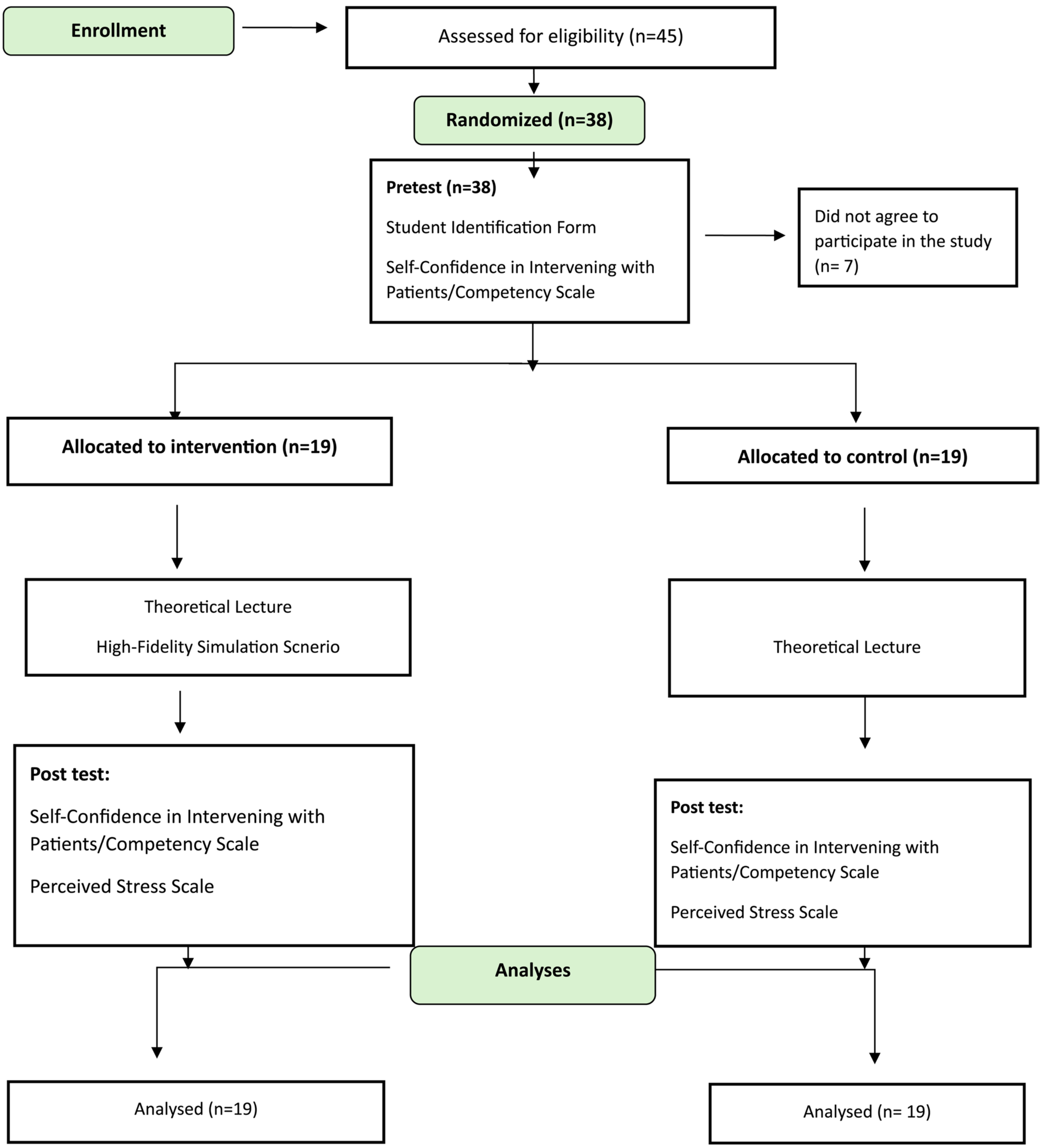

Fig. 1 The CONSORT flow diagram of the study

Instruments

Student identification form

This form included the students' age and gender.

Self-Confidence in Intervening with Patients/Competency Scale

This scale was developed by Terzioğlu, Terzioğlu, and Ünal [15] in 2012 for healthcare professional students with experience in scenario-based simulation education. It consists of 18 items divided into three subdimensions: clinical practice (11 items), psychological support (4 items), and health care system knowledge (3 items). Responses are rated on a five-point Likert scale, with higher scores indicating greater self-confidence in patient intervention. In the original validity and reliability study by Terzioğlu et al. [15], the Cronbach's alpha coefficient was 0.94. In the present study, the Cronbach's alpha was 0.96, indicating excellent internal consistency and representing a methodological strength of the study.

Perceived stress scale (PSS-10)

This 10-item scale, developed by Cohen, Kamarck, and Mermelstein in 1983 [16] and adapted to Turkish by Erci in 2006 [17], is used to measure perceived stress levels. Four items are positively scored and six items negatively scored; higher total scores indicate higher perceived stress. The original study reported Cronbach's alpha of 0.70. Erci's 2006 [17] Turkish adaptation confirmed its validity and reliability for the Turkish population. In the present study, Cronbach's alpha was 0.92.

Table 1 Scenario Preparation and Implementation Plan

Readiness for Learning	**Having Received Training on Shock and Its Types**
Scenario Objectives	1. To establish effective communication
	2. To collaborate effectively with the team.
	3. To assess the patient's current condition (vital signs, Glasgow Coma Scale).
	4. To perform appropriate interventions for hypovolemic shock.
Summary	A 42-year-old patient named A.A is currently in the intensive care unit, diagnosed with mitral valve insufficiency for 4 years and on postoperative day 2. Due to variability in vital signs and persistently low blood pressure, the patient is being monitored continuously in the ICU. The scenario will begin immediately after two nurses on duty hand over their shift to two other nurses under the supervision of the charge nurse. The scenario management is expected to be actively conducted by the two nurses receiving the handover. The duration of the scenario is 10 minutes, and it will conclude when the instructors enter the room at the end of this period.
Roles	1 charge nurse
	2 primary nurses (receiving the handover)
	2 secondary nurses (giving the handover)
	Important Information Regarding Roles: Patient information will be provided to the nurses giving the handover prior to the scenario, and it will be communicated to the entire group that the main interventions are expected from the primary nurses (receiving the handover).
Prebriefing (Preparation)	Reading of Lecture Notes and Relevant Articles on Shock and Its Types, and Nursing Care
Time Scheduling	**Briefing: 10 minutes**
	Scenario: 10 minutes
	Debriefing: 30 minutes
Briefing	**Method: PEARLS**
	Points: Discuss emergency situations requiring urgent intervention such as shock, and their impact on both nurses and patient outcomes.

Outcome measures

The primary outcome of the study was the change in nursing students' self-confidence in performing patient care interventions, measured using the *Self-Confidence in Intervening with Patients Scale*.

The secondary outcome was the change in perceived stress levels, measured using the *Perceived Stress Scale*. Both outcomes were assessed at baseline (pretest) and at posttest, which was conducted two weeks after the intervention.

Research procedure

Scenario design

The scenario was developed using Healthcare Simulation Best Practice® Standards [18] and reviewed by two simulation experts. The scenario was piloted prior to the main study to ensure clarity, feasibility, and realism. Feedback obtained during the pilot phase was incorporated into the final scenario by refining scenario flow, adjusting timing, and revising debriefing questions to better align with learning objectives. Materials included lecture notes, scenario cues, shock presentation materials, and PEARLS method questions for debriefing (Table 1) [18, 19].

Pilot study

Five third-year nursing students, who had previously received training on *shock, its types, and nursing care*, but were not part of the study, tested the scenario. Feedback on clarity, learning objectives, timing of pre-briefing (10 min), scenario (10 min), and debriefing (30 min) led to minor adjustments.

Implementation phase

Pretest Student Identification Form, Self-Confidence Scale, and Perceived Stress Scale were administered to all participants.

Theoretical lecture Three 45-minute sessions covered shock, its types, signs and symptoms, treatment, and nursing follow-up [9, 20–22].

High-Fidelity simulation Conducted three days after the lecture. Each session included 4–5 students; all students participated only once. Pre-briefing and debriefing were conducted using the Promoting Excellence and Reflective Learning in Simulation (PEARLS) method. The simulation environment replicated a single-patient Intensive Care Unit (ICU) room. Facilitators provided necessary cues, and students could ask questions during pre-briefing. Scheduling prevented interactions between students who had and had not yet completed the simulation (Table 1).

Posttest All forms were completed by both groups two weeks after the simulation.

Data analysis

The data obtained in the study were statistically analyzed using SPSS (Statistical Package for the Social Sciences) version 25.0 for Windows. Normality was assessed using skewness and kurtosis. Independent samples t-tests compared groups; paired t-tests assessed intra-group differences. Chi-square tests analyzed categorical variables. Significance was set at $p<0.05$. Data analysis was performed by a blinded statistician.

Ethical considerations

The study was conducted according to the Declaration of Helsinki and Good Clinical Practice (GCP) guidelines and approved by the university ethics committee (Approval No: 2024/3). Written informed consent was obtained from all participants. Data were collected anonymously using code numbers, and group identity was revealed only after data analysis. The control group was offered simulation sessions after posttest completion.

Results

The experimental group included 8 males (42.1%) and 11 females (57.9%), while the control group included 10 males (52.6%) and 9 females (47.4%). Chi-square analysis indicated no significant difference in gender distribution between the groups (χ^2 = 0.422, $p=0.373$). The mean age of the experimental group was 23.26 ± 2.05 years, and the mean age of the control group was 24.58 ± 3.45 years, with no statistically significant difference observed between the groups ($t=-1.428$, $p=0.162$) (Table 2).

There was no significant difference between the experimental and control groups in total pretest scores of the Self-Confidence in Intervening with Patients Scale ($p>0.05$). Both groups showed a significant increase in total self-confidence from pretest to posttest. In the experimental group, paired samples t-test results were $t=-3.023$, $p=0.007$, with an effect size of $d=0.693$. In the control group, the results were $t=-2.606$, $p=0.018$, $d=0.598$.

In the clinical practice subdimension, a significant difference was found at pretest, with the control group scoring higher than the experimental group [$t(36)=-2.242$, $p=0.031$]. No significant difference was observed in posttest scores between the groups ($p>0.05$). Both groups showed a significant increase from pretest to posttest; in the experimental group, $t=-3.530$, $p=0.002$, $d=0.810$, and in the control group, $t=-2.574$, $p=0.019$, $d=0.591$.

No significant differences were observed between the experimental and control groups in the psychological support subdimension at pretest or posttest ($p>0.05$). Within the experimental group, psychological support scores significantly increased from pretest to posttest ($t=-2.104$, $p=0.050$, $d=0.483$), whereas the control group showed no significant change ($p>0.05$).

Similarly, no significant differences were found between the groups in the health care system knowledge subdimension at pretest or posttest ($p>0.05$), or in Perceived Stress Scale scores ($p>0.05$) (Table 3).

Change score analysis (Table 4) revealed that the total Self-Confidence change score was significantly higher in the experimental group ($M=13.474$) than in the control group ($M=2.368$; $t=2.441$, $p=0.024$). The Clinical Practice change score also favored the experimental group ($t=2.787$, $p=0.011$), indicating a positive impact of the simulation intervention on clinical skills. Although the Psychological Support change score was higher in the experimental group ($M=2.474$), the difference did not reach statistical significance ($t=1.898$, $p=0.071$). No significant differences were found in Health Care System Knowledge change scores ($t=1.251$, $p=0.219$) or Perceived Stress change scores ($t=1.350$, $p=0.185$). These results indicate that high-fidelity simulation effectively enhanced overall self-confidence and clinical practice skills, while psychological support, system knowledge, and perceived stress were not significantly affected (Table 4). The significant increase in total self-confidence observed in the experimental group was also supported by a moderate effect size, indicating a meaningful impact of the high-fidelity simulation intervention.

Discussion

This study demonstrated that simulation-based training improved nursing students' self-confidence in patient intervention, clinical practice, and, to some extent,

Table 2 Descriptive characteristics

		Experimental Group		Control Group		p
		n	%	*n*	%	
Gender	Male	8	%42,1	10	%52,6	X^2=0,422 $p=0,373$
	Female	11	%57,9	9	%47,4	
		Mean	**SD**	**Mean**	**SD**	**t/p**
Age		**23,263**	**2,051**	**24,579**	**3,453**	**−1,428/0,162**

Chi-Square Analysis; Independent Samples T-Test

Table 3 Comparison of pretest and posttest scores of the Self-Confidence in patient intervention scale and the perceived stress scale in experimental and control groups

Measurements	Experimental Group		Control Group		t[a]	*p*
	Mean	SD	Mean	SD		
Total Pretest Score of the Self-Confidence in Patient Intervention Scale	64,105	16,865	72,421	7,328	−1,971	0,056
Total Post test Score of the Self-Confidence in Patient Intervention Scale	77,579	10,543	74,790	7,976	0,920	0,364
t[b]	−3,023		−2,606			
p	**0,007**		**0,018**			
Clinical Practice Subdimension Pretest	37,579	10,063	43,421	5,263	−2,242	**0,031**
Clinical Practice Subdimension Posttest	46,947	6,778	45,158	4,705	0,945	0,352
t[b]	−3,530		−2,574			
p	**0,002**		**0,019**			
Psychological Support Subdimension Pretest	15,000	4,320	16,947	2,483	−1,703	0,097
sychological Support Subdimension Posttest	17,474	2,412	17,053	1,929	0,594	0,556
t[b]	−2,104		−0,252			
p	**0,050**		0,804			
Health Care System Knowledge Subdimension Pretest	11,526	3,289	12,053	1,353	−0,645	0,523
Health Care System Knowledge Subdimension Posttest	13,158	1,740	12,579	1,742	1,025	0,312
t[b]	−1,996		−1,564			
p	0,061		0,135			
Perceived Stress Scale Pretest	33,263	5,506	35,158	3,760	−1,239	0,223
Perceived Stress Scale Posttest	35,211	5,084	35,263	3,478	−0,037	0,971
t[b]	−1,649		−0,154			
p	0,116		0,879			

[a]Independent Samples T–Test

[b]Paired Samples T–Test

SD Standard Deviation

Table 4 Comparison of score changes in Self-Confidence in patient intervention scale and the perceived stress scale between experimental and control groups

Measurements	Experimental Group (*n* = 19)		Control Group (*n* = 19)		t[b]	*p*
	Mean	SD	Mean	SD		
Total Score Change in the Self-Confidence in Patient Intervention Scale	13.474	19.429	2.368	3.961	2.441	0.024
Score Change in the Clinical Practice Subdimension	9.368	11.567	1.737	2.941	2.787	0.011
Score Change in the Psychological Support Subdimension	2.474	5.125	0.105	1.823	1.898	0.071
Score Change in the Health Care System Knowledge Subdimension	1.632	3.562	0.526	1.467	1.251	0.219
Score Change in the Perceived Stress Scale	1.947	5.148	0.105	2.979	1.350	0.185

Paired Samples T-Test; $t_{(}b_{)}$, *p* Significance, *df* Degrees of Freedom

psychological support skills. Both the experimental and control groups showed increased post-intervention self-confidence scores, suggesting that both theoretical and simulation-based education contribute to skill development. However, the greater increase observed in the simulation group indicates that high-fidelity simulation is a more effective learning method for enhancing self-confidence in patient intervention. These findings align with previous studies, which reported that clinical simulation increases students' confidence in their skills [7, 8, 23–25]. Similar results were reported by Aqtam et al. [26] who found that simulation-based clinical education enhanced self-confidence and satisfaction among clinical students, supporting the relevance of simulation training in comparable educational contexts. Zulkosky et al. [3] and Toqan et al. [27] emphasized that high self-confidence is essential for effective nursing interventions, and simulation-based education promotes this by actively engaging students in clinical decision-making [1, 28, 29].

No significant difference was observed between groups in posttest clinical practice subdimension scores. Nevertheless, both groups demonstrated significant within-group improvements, with the simulation group achieving a posttest level comparable to the control group, despite initially lower pretest scores. This suggests that simulation may be more effective than theoretical education in improving clinical practice competencies. Similar findings have been reported, where simulation supports clinical adaptation and knowledge acquisition, regardless of whether students participate actively or observe [3, 11]. Aqtam et al. [26] similarly reported that simulation-based clinical training supports adaptive learning and skill development among clinical students.

In the psychological support subdimension, no significant differences were found between groups. This may reflect the scenario's focus on clinical shock interventions rather than systematic psychological support. Silva et al. [13] highlighted that integrating psychological support mechanisms into simulation can enhance students' confidence and reduce stress. Future studies should design simulation scenarios that explicitly address psychological aspects of patient care.

No significant differences were observed in health care system knowledge between groups. Previous studies reporting significant improvements often involved comprehensive content, including information systems, patient safety, electronic health records, and multidisciplinary team communication [13, 30, 31]. Therefore, enhancing system knowledge may require multi-session, structured simulation scenarios.

Finally, no significant differences were found in perceived stress levels between groups. Literature on simulation and stress is mixed, with some studies reporting increased stress [32] and others reporting reductions [33]. A meta-analysis by Silva et al. [13] concluded that the effect of simulation on stress remains inconclusive. The lack of change in this study may relate to students' first experience with simulation; repeated sessions could facilitate adaptation and potentially reduce stress.

Limitations

This study was conducted at a single center, which may limit the generalizability of the findings. In addition, all measurements were based on self-reported data, which may introduce subjective bias. Follow-up assessments were not conducted due to time constraints, so the long-term effects of simulation on self-confidence and stress levels remain unknown. Furthermore, both the experimental and control groups received the same theoretical lecture prior to the intervention, which may have contributed to improvements observed in both groups and potentially reduced between-group differences. Although an a priori power analysis was conducted, the relatively small sample size should also be considered a limitation of the study.

Conclusion

This study demonstrated that simulation-based education significantly enhanced nursing students' self-confidence in patient intervention. Although theoretical education also led to some improvement, simulation had a greater effect on self-confidence development. The intervention did not produce significant short-term changes in stress levels, suggesting that repeated simulation sessions may be necessary to impact stress. Future simulation training should incorporate structured scenarios that systematically address psychological support and health care system knowledge to further enhance students' competencies. In addition, future studies should include longitudinal follow-up to assess the long-term retention of self-confidence gained through simulation-based education.

Abbreviations

ICU	Intensive Care Unit
INACSL	International Nursing Association for Clinical Simulation and Learning
PEARLS	Promoting Excellence and Reflective Learning in Simulation

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Authors' contributions

SY, GA, ZA, FSA, AE, ÖK, GO and contributed to conception and design of research. GA, ZA, AE and ÖK contributed to data collection. SY and ZA contributed to formal analysis. SY and ZA drafted the manuscript. GO and GA critically revised the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets generated and analysed during the current study are not publicly available due but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Health Sciences, Istanbul Kent University (2024/3). The research was conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical Practice (GCP). Written and verbal informed consent was obtained from all earthquake survivors prior to their participation in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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