ORIGINAL RESEARCH

The Impact of Simulated Education and Training on Undergraduate Students' Disaster Evacuation Competencies

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Background: The occurrence of disasters in the world is natural, but we must learn how to deal with their occurrence and mitigate their impact on people and property. It is important to understand how to behave during hospital disasters and properly evacuate the affected areas. Simulation-based education and training are effective ways to increase knowledge, skills, awareness, and experience in the event of an internal hospital disaster.

Aim: To evaluate the effectiveness of simulated education and training in enhancing undergraduate nursing students' disaster evacuation knowledge, skills, and preparedness.

Methods: The study utilized a quasi-experimental, single-group pre-and post-test design to assess the impact of simulation training on emergency and disaster preparedness among nursing students. It was conducted in the Simulation Nursing Laboratories at the College of Applied Medical Sciences, Taif University. The sample consisted of 119 undergraduate nursing students, including 60 male students and 59 female students. The Evacuation Disaster Simulation Questionnaire (EDSQ) was used to assess the knowledge and skills of the nursing students. The items cover three key subcategories: time, process, and transportation.

Results: The results showed that the mean score of the time in the pre-test group was 1.24±1.49, while it increased to 3.74±1.92 in the post-test. In the Process, the mean before the test is 2.23±1.05 and increased to 3.13±1.17 after the test. Lastly, in transportation, the mean score of the pre-test group was 3.26±1.41, but in the post-test group, the mean score on the scale rose to 4.13±1.28. This indicated an increase in students' understanding and awareness after the lecture and simulation training with a highly significant improvement (P=0.000). The highest mean score regarding evacuation disaster simulation competencies performance and total scores at pre- and post-educational intervention (Time (3.73), Process (3.13), and Transportation (4.12). Moreover, total scores (39.66) for the study group post-intervention program with a highly significant improvement (P= 0.000).

Conclusion: We can see the effectiveness and impact of education through simulation on students, indicating an increase in students' knowledge, understanding, and awareness after the lecture and simulation training.

Keywords: hospital disasters, simulation education, evacuation simulation, evacuation disaster, nursing students

Introduction

In recent years, the significance of education and training in disaster preparedness and response has been crucial, especially in nursing. Simulation-based training is an innovative approach to enhance preparedness among undergraduate nursing students, focusing on disaster evacuation scenarios.[1] Disasters are natural global occurrences causing severe system defects that affect people, the economy, the environment, society, and the community, exceeding resources' ability to handle them, and causing damage to people and property.[2]

Education and training in disaster preparedness are vital because they equip healthcare professionals with the necessary skills, knowledge, and readiness to respond effectively during crises. Disasters often occur unexpectedly, causing chaos and overwhelming healthcare systems, so proper training ensures that staff can manage emergencies

efficiently and minimize harm to patients. In nursing, the significance of education and training is even more pronounced compared to other disciplines for several reasons; frontline role in patient care, holistic care, critical decision-making, patient advocacy and communication, and coordination of care.[2] In comparison to other healthcare professionals, nurses are deeply involved in every stage of patient care, from initial contact to recovery. Their hands-on role, combined with their ability to adapt quickly in dynamic situations, makes disaster preparedness education particularly crucial in nursing.

Over the years, the world has faced many kinds of disasters in the 21st century for instance, the 11 September 2001 attack in the US, the Katherine and Rita hurricane in 2003 in Washington DC, tsunami floods in 2011, a crane machine falling in the holy mosque in Makkah in 2015, novel coronavirus in 2019 and the last disasters the world faced is an earthquake in Turkey and Syria 2023. All of these factors affect many sectors, especially the healthcare sector. It is important to underscore the disaster preparedness and response in hospitals following the events of September 11, 2001, and the devastation caused by Hurricanes Katrina and Rita.[3–5]

Hospitals are vulnerable to various disasters that can disrupt services and expose both workers and patients to potential harm.[6–8] These environments contain numerous hazards, such as medical gases, chemicals, radiation, and electricity, all of which pose risks if proper safety measures are not in place. For instance, a fire at Mercy Hospital in Melbourne on December 3, 2003, caused significant service disruptions and led to the temporary closure of some wards.[9] Internal disasters, such as building collapses, often result from external factors like earthquakes, floods, hurricanes, or man-made events.[10]

In response to such threats, the Kingdom of Saudi Arabia has established a dedicated Emergencies and Disasters Department to manage crises, spurred by incidents such as terrorist attacks, floods, and pilgrim stampedes. The health sector is particularly vulnerable during these events, making emergency preparedness in hospitals essential for effective crisis management. A notable example occurred in 2015, when a fire at Jizan General Hospital resulted in 25 fatalities and 123 injuries, necessitating an evacuation based on evidence-based emergency practices.[11]

In-hospital evacuation in healthcare requires training and practice, as disasters can occur suddenly without a plan, posing risks to patients and staff. An example is the 2004 earthquake in Northern California led to the evacuation of eight acute care hospitals.[12] Healthcare facilities, particularly hospitals, rely heavily on nurses for effective evacuation planning and training. They play a crucial role in evacuations, and their training should prioritize their readiness.[13,14] However, there needs to be more formal training for nurses and simulations of reality, which can hinder their ability to respond appropriately in a disaster.[15–18]

Recent developments in the health sector have led to a renewed interest in formal education in universities, particularly in disaster nursing education development.[5] There are differences in the effect of education on students by using traditional and novel methods in education. On one hand, traditional education is the old style of education and has less effect in the nursing field currently, while the innovative teaching method shows the effectiveness of interactive learning.[19]

In the nursing field, Simulation-based education has become an integral component of nursing curricula, offering students a safe and controlled environment to develop and refine their clinical skills and decision-making abilities. When applied to disaster preparedness, simulations provide a valuable platform for students to experience realistic scenarios, thereby bridging the gap between theoretical knowledge and practical application. By immersing students in simulated disaster evacuation exercises, educators can effectively cultivate competencies essential for effective disaster response, such as critical thinking, teamwork, communication, and adaptability.[20]

Also, simulation is considered a new way of training according to evidence-based practice and core competencies. The use of simulation in the evacuation plan during a crowded emergency and disaster situation to measure the effectiveness of education through simulation to improve and increase students' understanding and awareness of evacuation plans in emergency and disaster situations is a useful technique.[21] In Saudi Arabia Disaster nursing is relatively new and the evidence indicates that the nurses in hospitals lack knowledge and skills and are not fully prepared for disasters.[18,22,23] They need to be involved in special disaster courses after graduation to increase their awareness and knowledge.

Evacuation during a disaster is one of the areas of interest in universities to train students about.[24] Therefore, despite there are many studies have been made in this field on hospital nurses, the evidence is lacking around nursing students.

Also, simulating evacuation plans can improve quality levels and educational outcomes during emergencies and disasters. Furthermore, based on our literature review, one of the most identified challenges is the lack of formal education and training for evacuation disaster workers and their lack of reality simulations that could lead them to behave appropriately in the event of a disaster, a lack of core competencies and disaster preparedness in nursing curricula.[15,16,18,22,25,26] Additionally, no studies on simulated disaster evacuation for undergraduate students have been published in Saudi Arabia.

Contribution of the Study and Flow of the Study

The study proceeds methodically, starting with an overview of the significance of disaster preparedness, followed by a thorough methodology outlining the educational intervention and quasi-experimental design, results demonstrating the statistical gains in evacuation skills, and a discussion of the implications for nursing practice and education.

This study emphasizes how important simulation-based learning is for improving undergraduate nursing students' disaster evacuation competencies. The study shows how simulation can improve students' knowledge, readiness, and performance in emergencies by filling a major vacuum in formal disaster education in Saudi Arabia's nursing curricula. Highlighting their function in developing resilient healthcare workers, advances knowledge of creative teaching approaches in disaster management. Significantly, this study clarified and helped to understand the impact of using simulations on nursing students and how the students will behave in emergencies and disasters occurring in hospital departments. Also, the level of quality and accuracy of the work has been increased, and new competencies have been created that will help improve students' understanding and awareness during an evacuation during a disaster. In addition, they contributed to knowing the importance and requirements of education and learning through simulation among undergraduate students and promoting the use of new learning methods in universities to increase the efficiency of the result.

Additionally, this paper will discuss the implications of these findings for nursing education and practice and propose recommendations for optimizing the use of simulation-based training in enhancing disaster preparedness among undergraduate nursing students. Through this comprehensive analysis, we aim to contribute to the ongoing discourse surrounding the role of education and training in bolstering nursing resilience and readiness in the face of disasters.

This study aims to evaluate the effectiveness of simulated education and training in enhancing undergraduate nursing students' disaster evacuation knowledge, skills, and preparedness. Furthermore, this study showed a statistical relationship between the impact of education and training through the simulation of disaster evacuation competency and increasing knowledge, understanding, and awareness of undergraduate nursing students at Taif University, KSA.

Material and Methods

Hypotheses of the Study

1. Undergraduate nursing students' knowledge about disaster evacuation will have improved after education and training through the simulation.
2. Undergraduate nursing students' performance in disaster evacuation will have improved after education and training through the simulation.
3. Pre- and post-educational and training interventions will have a significant difference in knowledge and performance in disaster evacuation among undergraduate nursing students.

Design, Setting, and Participants of the Study

 -The study utilized a quasi-experimental, single-group pre-and post-test design to assess the impact of simulation training on emergency and disaster among nursing students.

- The setting was the College of Applied Medical Sciences at Taif University in the Simulation Nursing Laboratories.

- The sample consisted of students from the nursing department of the College of Applied Medical Sciences with the following;

Inclusion Criteria

Male and female students at Taif University, College of Applied Medical Science, Faculty of Nursing, specifically from the fourth-year degree in the nursing department. They can read and write English also, who has the desire and voluntary consent to participate in the study, where students who completed the pre-test and post-test were included.

Exclusion Criteria

Students from majors other than nursing were excluded, as students from levels other than the fourth year, and students who did not complete the pre-test or post-test.

Sample Size

The total number of nursing students was 130, and according to the Epi website (Open-Source Statistics for Public Health) was utilized to determine the necessary sample size to assess the intervention's efficacy, using the formula (Sample size $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$, the study sample was 98 with a precision level of 5% and a confidence level of 95%. The sample before the test was n=130, and the sample tested after the exclusion criterion was n=119, with a turnover rate of 7% to 8%. The equation solutions were presented using the Fleiss method.[27]

Data Collection

Instrument: The Evacuation Disaster Simulation Questionnaire (EDSQ)

The Evacuation Disaster Simulation Questionnaire (EDSQ) was developed by the investigator to assess the knowledge and skills of nursing students in evacuating hospital departments during an internal disaster, both before and after the educational and training intervention (Supplementary figure 1).

The EDSQ consists of two parts:

1. **Part 1: Demographic and Historical Data**
   This section collects information about the participant's background, such as gender, and any previous training or experience related to disaster management. This data helps in understanding the characteristics of the study sample and identifying any factors that could influence the results.
2. **Part 2: Competency Questionnaire**
   his section contains 11 items designed to evaluate the student's knowledge and skills regarding evacuation plans and procedures during emergency and disaster situations. The items cover three key subcategories":

Time: Evaluate the participant's understanding of the appropriate timeframes for responding to an evacuation order.
Process: Assesses knowledge about the correct procedures to follow during an evacuation, including prioritizing patients and coordinating with team members.
Transportation: Tests knowledge on the safe and efficient transportation of patients during an evacuation.

Each of the 11 items is scored as correct and incorrect (5 and 0, in the same order) regarding knowledge while the total scores of participants graded a five-point Likert scale with 1, 2, 3, 4, and 5 as, excellent, very good, good, pass, and fail, respectively. This scoring system allows for a detailed evaluation of students' knowledge levels before and after the intervention, providing insight into the effectiveness of the simulation-based education and training.

Validity and Reliability

Content Validity Assessment

To ensure the content validity of the Evacuation Disaster Simulation Questionnaire (EDSQ), a structured review process was conducted with a panel of seven experts. This panel included professors and assistant professors from the university's nursing faculty with expertise in disaster management and nursing education. The content validity process

involved the following steps:

1. *Initial Review of Instrument Items*:
- The panel members individually reviewed each item of the EDSQ, assessing whether the questions were clear, relevant, and comprehensive enough to measure the intended aspects of disaster evacuation knowledge and skills.
- They evaluated whether the items adequately covered the three subcategories: time, process, and transportation, which are critical components of evacuation competency.
- The panel also assessed whether the demographic questions and competency items were appropriately structured to collect the necessary data without any bias.

2. *Feedback and Suggestions*:
- After their individual review, the panel members provided feedback and suggestions. They considered aspects such as the clarity of language, the relevance of each item to the study objectives, and the overall structure of the questionnaire.
- The feedback process ensured that the instrument items were both representative and aligned with the goals of the study. However, the panel concluded that no changes were necessary, as the items were deemed clear and relevant.

3. *Content Validity Index (CVI)*:

- To quantify content validity, the panel members rated each item using a four-point scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant).
- The ratings were then used to calculate the Content Validity Index (CVI) for each item and for the entire questionnaire.
- The item-level CVI (I-CVI) was calculated by dividing the number of panel members who rated an item as "3" or "4" by the total number of panel members. Items with an I-CVI of 0.80 higher are generally considered to have good content validity. This confirmed that the EDSQ had strong content validity and was appropriate for assessing the study's objectives.

Reliability Analysis

After validating the content, the reliability of the EDSQ was tested among 10 nursing students using a test-retest method, with assessments two weeks apart. Following this, Cronbach's alpha was calculated using SPSS, yielding a value of 0.84. This indicates a high level of internal consistency also, demonstrating that the instrument ensured that the EDSQ was both a valid and reliable tool for assessing the knowledge and skills of nursing students in disaster evacuation scenarios.

Ethical Considerations

A Human Ethics Certificate of Approval (44–002) was obtained from the Taif University Human Research Ethics Committee on 21/08/2022 (HAO-02-T-105) before data collection. Participants, specifically nursing students, provided informed consent before the intervention. The study, including its risks and benefits, was explained by the principal investigator and/or co-investigator. Participation was voluntary and confidential, with no associated costs or payments. Participants used unique codes to access the online questionnaire. To ensure anonymity, consent was signed by the research assistant students after the principal and fellow researchers left the room.

Pilot Study

Furthermore, an initial pilot study was conducted with (10%) participants of the nursing students The pilot study evaluated the study instruments' readability, applicability, and time demand as well as their viability. The study results remained unchanged after the pilot study's findings were integrated.

Procedures

The researchers started collecting data from the nursing students who met the inclusion criteria after receiving legal authorization. ***The study was carried out through interviewing, implementation, and evaluation.***

Interviewing

-Interviewing starts in the first academic semester the period from August to November 2023 in the college simulation nursing laboratory. The educational and training program, its goal, the intervention, and the period of intervention requirements were all explained to nursing student participants.

Data were collected on two days, with male students on the first day and female students on the second day. They all followed the same process for collecting the data over two days.

- A pre-test was conducted for the participants to assess their knowledge in 20 minutes. The lecture and simulation will be carried out for two hours.

Implementation (The Explanation for the Simulation Procedures)

A scenario was developed by the researcher and presented to the students using a projector. The scenario described a situation where:

"In a tertiary care hospital with three floors and a capacity of 150 beds, a fire broke out in one of the wards on the third floor due to an electrical short circuit. The fire quickly spread throughout the ward, and smoke began to fill the other wards on the same floor. A staff member notified the hospital's operations manager, who then ordered an evacuation as directed by the commander's coordinator". The simulation lab board ([Supplementary Figure 2](#)) was prepared to represent the area to be evacuated. The layout included an inpatient department with three rooms, each containing three beds, a Medium-Intensive Care Unit (MICU) with two beds, a diagnostic room, a storage room, and a nursing station, as well as two emergency exits.

Students were divided into two groups over two days—male students on the first day and female students on the second. Each day was split into two sessions: the first session from 8:00 a.m. to 12:00 p.m., and the second from 12:00 p.m. to 4:00 p.m. Upon arrival, students registered and received cards with a unique code. They were then directed to the lecture hall.

Participants were introduced to the project and the procedures to be followed by the researcher. They were instructed to enter the code they received during registration to complete an online pre-test, which assessed their knowledge before the training began. Following the pre-test, a lecture was conducted on hospital evacuation procedures and the appropriate response during emergencies and disasters requiring evacuation. The students were then divided into small groups of five to conduct a practical simulation of the evacuation process, based on the scenario provided.)Evidence about the program intervention)).

Evaluation

Finally, the students underwent a post-test using the same code as in the pre-test to measure their understanding, awareness, and acquired knowledge of the impact of the evacuation disaster simulation project.

Data Analysis

Data were analyzed using SPSS version 29 statistical analysis software. The mean and standard deviation (SD) were calculated for each of the questions. Group statistics were extracted from the data in three groups: time, process, and transport. Correlation descriptive analyses were performed. Descriptive analysis and paired-sample *t*-test analysis were performed to identify the differences that occur at a P-value = 0.05 and were statistically significant.

Result

The study is correlation comparative, descriptive in which 119 undergraduate nursing students were included in the pre-test and post-test groups, 60 male students were included, and 59 female students. Revealed an almost equal

**Table 1** The Distribution of Participants' Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	60	50.4	50.4	50.4
Female	59	49.6	49.6	49.6
Total	119	100,0	100,0	100,0

representation of both genders in the study sample, with a slightly higher representation of the males compared to females in the total sample (50.4% compared to 49.6% respectively). As shown in the Table 1

More than half of the participants have been not exposed to evacuation disaster management education at the university while less than half of them declared that they have received evacuation disaster management training at their university as shown in Figures 1 and 2.

Table 2 describes the number and percentage of participants who answered correctly and incorrectly each question of the evacuation disaster simulation knowledge questionnaire in both the pre-test and post-test groups. It can be clearly seen that in the pre-test the highest proportion is in question 9 (characteristics of collection points?) by (77.3%), that the students have a certain knowledge about the special features of collection points, while in the post-test the first question (Moving people and assets temporarily to safer places before, during, or after the occurrence of a hazardous event to protect them. This is a definition of?) by (89.9%), scores highest with an increase of (27.7%) in the post-test over the pre-test (62.2%) which means to improve students' knowledge.

In addition, the lowest percentage for question 6 (In the gradual evacuation, how many hours does it take to prepare for the hospital evacuation?) increases from (15%) in the pre-test to fourfold (69.7%) percent in the post-test. While in the post-test the fourth question (In the event of a fire evacuation, do you know how many levels for the evacuation we have?) is the lowest at 44.5% and slightly up from the pre-test by 10.9%. Moreover, the fifth and eighth questions (One of the evacuation techniques that takes about 1–2 hours to prepare is? After the patients are evacuated from the hospital,
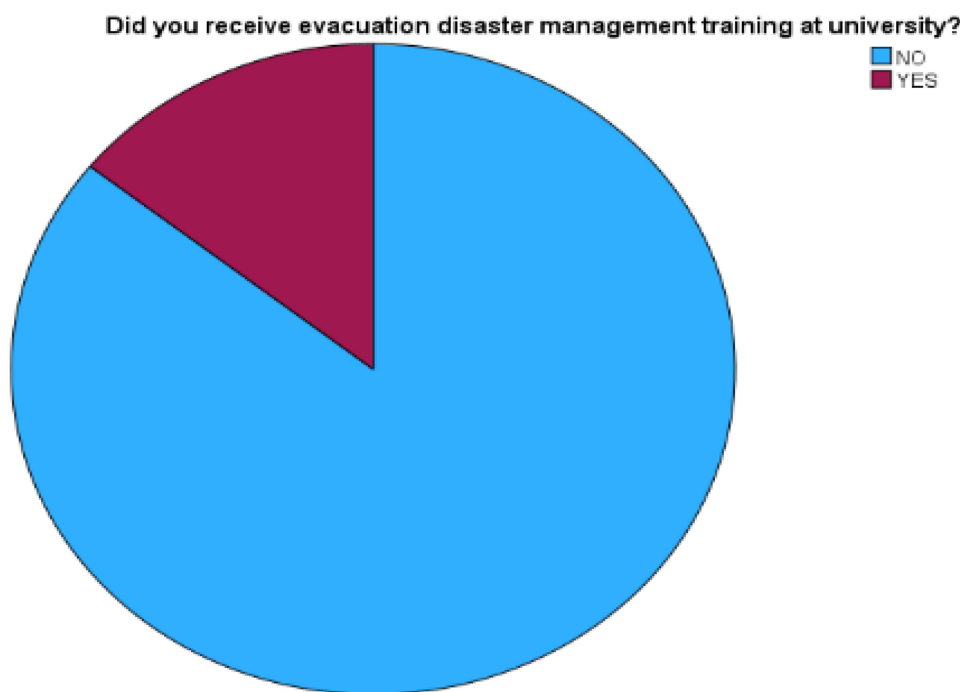
Figure 1 Exposure to evacuation disaster management training at participant university.
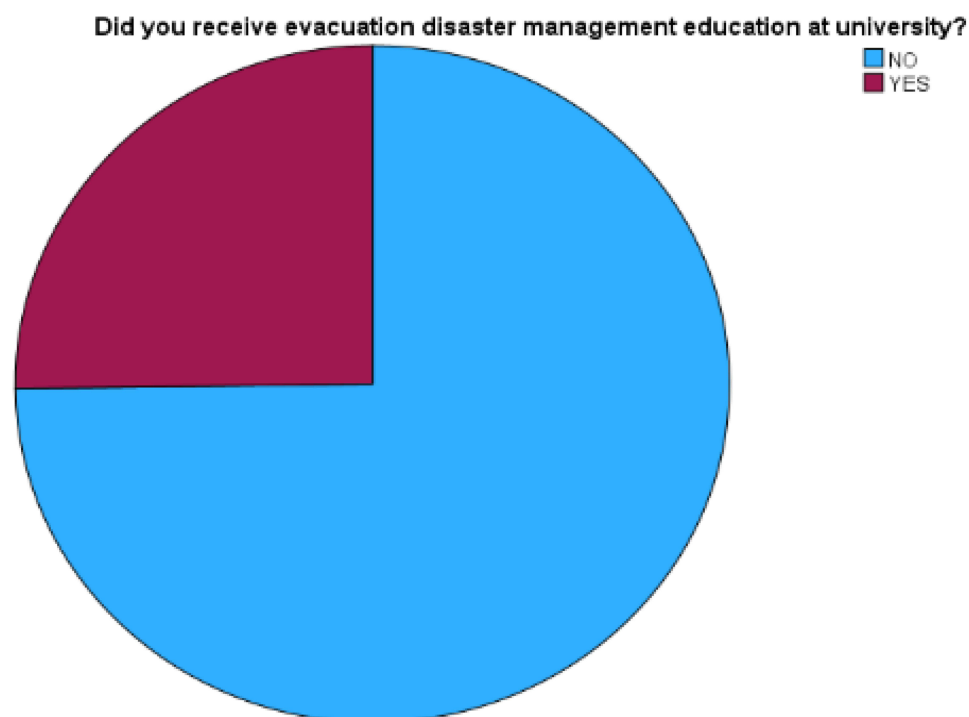
Figure 2 Exposure to evacuation disaster management education at participant university.

where should they be kept?) showed a significant improvement in knowledge and awareness of the Double post-test to pre-test times (34.5% had risen to 79.8% and 42.0% had risen to 81.0%).

Regarding the seventh question (What advice do you need to follow regarding the use of transport for hospital evacuation?). Almost three-quarters of the participants (73.9%) answered the question correctly in the pre-test group, while the percentage in the post-test group went up marginally (79.0%) by (5.1%). Concerning the last question, "What

Table 2 Undergraduate Nursing Students' Knowledge About Disaster Evacuation Disaster Simulation Pre- and Post-Education

Questions		Pre-test		Post-test	
		N	**%**	**N**	**%**
1-Moving people and assets temporarily to safer places before, during, or after the occurrence of a hazardous event to protect them. This is a definition of?	Incorrect	45	37.8	12	10.1
	correct	74	62.2	107	89.9
2- In the event of a fire alarm and evacuation to the hospital, how many types of evacuation do we have?	Incorrect	83	69.7	63	52.9
	correct	36	30.3	56	47.1
3- How will we prioritize the patients in the hospital evacuation?	Incorrect	91	76.5	50	42.0
	correct	28	23.5	69	58.0
4-In the event of a fire evacuation, do you know how many levels for the evacuation we have?	Incorrect	79	66.4	66	55.5
	correct	40	33.6	53	44.5
5- One of the evacuation techniques that takes about 1–2 hours to prepare is?	Incorrect	78	65.5	24	20.2
	correct	41	34.5	95	79.8

(*Continued*)

Table 2 (Continued).

Questions		Pre-test		Post-test	
		N	**%**	**N**	**%**
6- In the gradual evacuation, how many hours does it take to prepare for the hospital evacuation?	Incorrect	101	84.9	36	30.3
	correct	18	15.1	83	69.7
7- What advice do you need to follow regarding the use of transport in hospital evacuation?	Incorrect	31	26.1	25	21.0
	correct	88	73.9	94	79.0
8-After the patients are evacuated from the hospital, where should they be kept?	Incorrect	69	58.0	22	18.5
	correct	50	42.0	97	81.5
9- What characteristics of collection points are?	Incorrect	27	22.7	16	13.4
	correct	92	77.3	103	86.6
10-After hospital evacuation and transfer to another hospital, what should accompany the patient?	Incorrect	39	32.8	20	16.8
	correct	80	67.2	99	83.2
11- What should be closed immediately in case of fire?	Incorrect	32	26.9	31	26.1
	correct	87	73.1	88	73.9
Total	Incorrect	675	51.5	365	27.9
	correct	634	48.5	944	72.1

should be closed immediately in case of fire?", the percentage of the participants who answered the questions correctly remains at the same level increasing only (0.8%) from (73.1%) in the pre-test to (73.9%) in the post-test group.

The overall percentage of students who correctly answered the eleven questions on the evacuation disaster management knowledge assessment questionnaire increased from (48.5%) in the pre-test group to (72.1%) in the post-test group, which is considered a remarkable improvement.

Table 3 summarizes the average scores of undergraduate nursing students on the evacuation disaster simulation knowledge scale in the three competency groups. The results showed that the mean score of the time in the pre-test group was 1.24±1.49, while it increased to 3.74±1.92 in the post-test. In the Process, the mean before the test is 2.23±1.05 and increased to 3.13±1.17 after the test. Lastly, in transportation, the mean score of the pre-test group was 3.26±1.41, but in

Table 3 Comparison of Mean Score of Undergraduate Nursing Students' Knowledge in the Three Subcategories of Evacuation Disaster Simulation

Category	N	Minimum	Maximum	Pre-test		Post-test		P1 value
				Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	
Time	119	0.00	5.00	1.2395	1.48702	3.7395	1.92205	T=10.40, P=0.000**
Transportation	119	0.00	5.00	3.2563	1.41139	4.1282	1.27677	T=7.33, P=0.000**
Process	119	0.00	5.00	2.2269	1.04506	3.1345	1.17115	T=7.43, P=0.000**

Note: Correlation is significant at the 0.01 level (2-tailed). ** a paired *t*-test (P1) = Comparison of each dimension of evacuation disaster simulation knowledge among study groups pre-and post-intervention.

the post-test group, the mean score on the scale rose to 4.13±1.28. This indicated an increase in students' understanding and awareness after the lecture and simulation training with a highly significant improvement (P=0.000).

Table 4. The table revealed the highest mean score regarding evacuation disaster simulation competencies performance and total scores at pre- and post-educational intervention (Time (3.73), Process (3.13), and Transportation (4.12). Moreover, total scores (39.66) for the study group post-intervention program with a highly significant improvement (P= 0.000).

The relationship between post-test scores and student knowledge was examined using Pearson's correlation coefficient. There was an insignificant positive correlation between variables n=119, p<0.05. However, there was a mean positive correlation between two variables r=412, n=119, p=<0.01. as shown in the Table 5.

Table 4 Comparison of Evacuation Disaster Simulation Competencies Performance and Total Scores at Pre- and Post-Educational Intervention (N=119)

Talent management domains				
	Mean	SD	Min – Max	P1 value
Time				
Pre	1.2395	1.48702	0–5	T=11.40, P=0.000**
Post	3.7395	1.92205	0–5	
Process				
Pre	2.2269	1.04506	0–5	T=7.53, P=0.000**
Post	3.1345	1.17115	0–5	
Transportation				
Pre	3.2563	1.41139	0–5	T=7.33, P=0.000**
Post	4.1282	1.27677	0–5	
Total score of evacuation disaster simulation				
Pre	26.6387	8.80844	5–30	T=13.63, P<0.001**
Post	39.6639	11.06091	20–55	

Note: Correlation is significant at the 0.01 level (2-tailed). ** a paired *t*-test (P1) = Comparison of each dimension of evacuation disaster simulation competencies performance and total scores at pre- and post-educational intervention.

Table 5 Correlation Between Study Variables About Evacuation Disaster Simulation (N. 119)

		Time-post	Process-post	Transportation-post
Time-post	Pearson Correlation	–	0.283**	0.250**
	r	–	0.002	0.006
Process-post	Pearson Correlation	0.283**	–	0.412**
	r	0.002	–	<0.001
Transportation-post	Pearson Correlation	250**	0.412**	–
	r	0.006	<0.001	–

Note: Correlation is significant at the 0.01 level (2-tailed).**.

Table 6 Evacuation Disaster Simulation Competencies Performance for Male and Female Students

Evacuation disaster simulation competencies.	Gender	Pre-test			Post-test		
		Mean	Std. Deviation	Std. Error Mean	Mean	Std. Deviation	Std. Error Mean
Transportation	Male	3.2500	1.45919	0.18838	4.1458	1.37108	0.17701
	Female	3.2627	1.37357	0.17882	4.1102	1.18474	0.15424
Process	Male	2.1167	1.02662	0.13254	3.0000	1.19320	0.15404
	Female	2.3390	1.06042	0.13805	3.2712	1.14215	0.14869
Time	Male	1.0833	1.48200	0.19133	3.5833	1.91817	0.24763
	female	1.3983	1.48782	0.19370	3.8983	1.92931	0.25117

Table 6 shows a notable convergence in mean scores about the performance of male and female students on the pre- and post-test for evacuation disaster simulation competencies.

Discussion

The overall preparedness level in Saudi Arabia for disaster evacuation competencies has seen notable progress in recent years, particularly due to the government's efforts to enhance emergency response capabilities and resilience through its Vision 2030 initiative. So, evaluate the impact of education by simulation on nursing students to know the effectiveness of engaged simulation on education. Assess students' awareness of the evacuation plan in case of a disaster inside the hospital and how they will act in evacuation. What is a necessary mode of evacuation they will use according to the event hazard? Through an online pre-examination Afterward min lecture and simulation on evacuation then an online post-examination. The study was conducted at Taif University's nursing department simulation laboratories which started teaching disaster nursing to students in the last three years.

Because the senior nursing students can volunteer in the hospitals and have internship time, so we need to start by giving them some training about the disasters they face in the hospitals may be exposed to and how they will behave if they face them. Internal disasters that require evacuation are one of the most disasters they can face in hospitals. The rush and lack of knowledge about evacuation plans by the students is a real and major disaster. Teaching undergraduate nurses, the basic principles of disaster will qualify them to volunteer in disaster situations.[14] The Saudi Arabia university system teaches male and female students separately but follows the same curriculum and study plans. Saudi Arabia has made significant strides in improving its disaster preparedness and evacuation competencies, particularly in healthcare settings.

The current study showed that more than half of the participants had no clinical experience. The results agree with, Rostami & Alaghmandan (2023) mention that the majority of study participants reported having no prior experience in the safety/emergency field, and never received any training in this field.[26] Also was like the study by Mızrak, S., and Aslan, R. (2020).[28]

The study shows that there are differences in student scores on evacuation disaster management from the pre-test (48.5%) to the post-test group, (72.1%) due to increased knowledge and understanding, which is considered a remarkable improvement. This result may be related to progress in creative thinking skills and problem-solving skills for students to learn easily for disaster management. The results agree with (Ghezeljeh et al, 2022) who said that the posttest knowledge score was significantly higher in the intervention group.[29] This result is incongruent with (Hu et al, 2022) who stated that the statistical comparison of pre-test and post-test knowledge scores did not reveal significant group differences for short-term improvement ($P \geq 0.05$).[30]

A similar score for performance enhancement was reported in one study conducted in Saudi Arabia. The course consists of a lecture and then simulation training over two days, each group one day. Hence, there is a notable convergence in the performance of male and female students on the pre-and post-test for evacuation disaster simulation

competencies. A similar finding, there was no significant difference between the mean scores of males and females on the pre-test or the post-test.[24] Furthermore, it is important to consider that simulations should include different scenarios Carvalhais et al, (2023).[31]

This Assesses Students' Performance, Understanding, and Awareness in Three Main Areas: Time, Process, and Transportation During a Disaster

Regarding time: Time is important during in-hospital evacuation, as we know, time is the first enemy in emergencies, especially when evacuation is to be immediate to save patients and staff. For this, the commander in the hospital gives the order with exactly the time it takes to evacuate the affected area. A good communication between the commander in the hospital and the other disciplines will help evacuate effectively. Manpower is needed to reach the goal on time. The incident command system at the hospital is responsible for contacting everyone involved in the evacuation process.[32,33] In addition, hospital nurses should know the proper chain of command who to communicate with, and how to communicate effectively in the event of a disaster.[6,34]

According to this study, the process of evacuation has a significant correlation at the 0.01 level (2-tailed) with the time during the evacuation by (0.283**). All employees know their roles and responsibilities and know how to behave well and how we prioritize patients during evacuation to facilitate the process. Three points should be kept in mind when a disaster strikes: Do not Panic, Keep Calm, and Take Action. To make the right decision and effectively assist in the evacuation process. For instance, keep calm and make rational decisions. This can only be achieved in one way: by providing information about the risks, by understanding the dangers, and by providing instructions on what to do in the event of a fire.[35,36]

Moreover, transport during an in-hospital evacuation is significantly related to the time and process at the 0.01 level (2-tailed) during the evacuation by (0.250**and.412** respectively). A sufficient amount of transportation equipment will facilitate the process and meet the needs of the patients. In addition, all internal departments of the hospital have enough resources and equipment to be utilized in the event of a disaster. Any lack of transportation can affect the evacuation time and process. All employees are trained in handling all modes of transport. Response to evacuation disasters depends on several non-clinical medical organizations, eg External services such as transport equipment.[37,38] During transport, all employees know where the patient-safe collection points with unique properties are in the hospital. The system suggests sensible and realistic assembly points and shelters, and the routing algorithm provides optimal routes for evacuation purposes.[39] With the transport of the patients to the assembly point, the patients are provided with the necessary information for aftercare and to track them after the end of the emergency.

Lastly, our study findings indicated an increase in students' understanding and awareness of evacuation disaster simulation knowledge and performance after the lecture and simulation training with a highly significant improvement (P=0.000). Studies supporting these findings as the following; Alim et al (2020) found that disaster simulation training significantly improved nursing students' knowledge and preparedness. Practical exercises like simulations were shown to enhance student's understanding of complex situations and improve their disaster response readiness.[40] Labrague et al (2018) observed a notable improvement in disaster preparedness knowledge among nursing students following simulation-based education. They highlighted that simulations enable students to apply theoretical concepts in realistic scenarios, leading to better knowledge retention.[41]

Smith et al (2019) reported that combining lectures with hands-on disaster simulations boosted self-confidence and knowledge retention among nursing students. The study emphasized that interactive simulations help students better grasp critical evacuation procedures.[42] On the other hand contrary with Farra et al (2015) questioned the long-term retention of knowledge gained through simulation training. While they found significant immediate improvement, they noted that this knowledge could decline over time without ongoing reinforcement.[43]

Conclusion and Recommendation

The study demonstrates the effectiveness and impact of education through simulation on students, showing a significant increase in their knowledge, understanding, awareness, and performance following lectures and simulation training. This suggests that dedicated simulation-based education can better prepare nursing graduates to handle disaster situations effectively. By engaging in simulation training, students are more motivated to learn, which enhances their effectiveness and efficiency in managing disasters.

To build on these findings, it is recommended that:

1. Disaster evacuation training should be a focus area in universities, and integrating disaster simulation into nursing curricula is suggested and conducting periodic refresher sessions.
2. Efforts should be made to improve the quality of education and outcomes during emergencies and disaster situations.
3. Future studies should include larger, more diverse samples with a control group to further evaluate the effectiveness of simulation training on emergency evacuation competence among nursing students across different settings.

The Implication of Our Result for Future Practice

The results of simulated education and training on undergraduate students' competencies in disaster evacuation suggest significant improvements in their ability to respond effectively in emergencies. For future practice, this implies that integrating simulation-based training into nursing curricula can enhance students' practical skills, confidence, and preparedness for real-life disaster scenarios. This approach can lead to better patient outcomes and more efficient evacuation procedures, ultimately contributing to overall healthcare system resilience and safety. Implementing such training programs across various institutions and settings can standardize and elevate the competency levels of future healthcare professionals.

Limitation

This study has one limitation that should be considered. The study was conducted at Taif University in KSA, so the researcher recommended conducting the study at more than one university to generalize the results.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Consent for Images Published

Students who participated in Supplementary Figures 3 and 4 have provided their informed consent for the images to be published.

Disclosure

The authors declare no conflicts of interest in this work.

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