Effectiveness of simulation−based learning regarding management of post−COVID complications in terms of knowledge, clinical decision−making ability, and self−efficacy among nursing students: A quasi−experimental study

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ABSTRACT

Objective: To assess the effectiveness of simulation-based learning regarding the management of post-COVID complications in terms of knowledge, clinical decision-making ability, and self-efficacy among nursing students.

Methods: This was a quasi-experimental study conducted among 115 2nd-year nursing students. The participants were selected by a simple random sampling technique. The participants were divided into an experimental (n=56) and a comparison group (n=59) by a random table method. Data were analyzed using descriptive and inferential statistics with SPSS version 20.

Results: There were significant differences in mean post-test knowledge scores (P=0.03) and mean post-test self-efficacy scores (P=0.001) between the experimental and the comparison groups while the difference in mean post-test clinical decision-making ability scores between the two groups was non-significant (P=0.07). A positive correlation was found between knowledge and clinical decision-making ability in pre-test (P=0.03) and in post-test (P<0.001) and a non-significant correlation was found between pre-test knowledge and self-efficacy score (P=0.52) among the experimental group.

Conclusions: Simulation-based learning regarding the management of post-COVID complications is effective among nursing students. Simulation labs should be established in health care settings where simulation training can be provided for updating the knowledge, clinical decision-making ability, and self-efficacy of nursing personnel during program installment and continuous nursing education.

KEYWORDS: Simulation; Knowledge; Clinical decision making ability; Self-efficacy; Post-COVID complications

Significance

The present study highlighted that simulation-based learning regarding the management of post-COVID complications was an effective intervention that has a significant role in developing clinical decision-making ability and self-efficacy among students. Simulation-directed learning should be included in the curriculum of healthcare professionals to enhance their knowledge and skills in clinical settings.

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1. Introduction

The first case of a series of acute respiratory diseases caused by COVID-19 was reported in India on January 31, 2021[1]. As of July 22, 2022, around 1 million COVID-19-positive cases with 10 621 deaths were reported in Haryana[2]. The majority of COVID-19 patients got recovered within 2-3 weeks of the onset of the disease, but 10%-20% of the patients experienced a variety of aftereffects either following the initial recovery or due to worsening underlying health conditions. The scenario surrounding the COVID-19 pandemic causes strong public reactions and raises a wide range of concerns, which in turn results in many mental health problems such as stress, anxiety, and emotional instability. These mild and long-term effects are collectively known as post-COVID-19 conditions[3,4]. In 2020, a group of scientists discovered that COVID-19 symptoms can fluctuate over time and persist for several weeks following the development of the disease. These symptoms are common among people between the age of 18-49 and can disturb the individuals' quality of life[5]. About 20% of the COVID-19 survivors reported experiencing chest pain[5] and 30% of people reported myocardial damage[6]. Respiratory sequelae such as shortness of breath, coughing, chest pain, hemothorax, pneumothorax, and pneumonia are mostly seen in COVID-19 patients[7]. Among all of these respiratory symptoms, the most common and ongoing one is dyspnea. It occurs in 42%-66% of patients after acute COVID-19 infection[8]. Dermatological sequelae such as maculopapular rashes, black fungus, or yellow fungus fungal infections were also reported among people with a history of COVID-19 infection[9].

The results demonstrated the necessity for nursing education and health organizations to concentrate on equipping students with necessary information so that students engage in proper preventive behaviors. The planning of COVID-19 educational activities and raising awareness of the health dangers posed by this disease must take into account the knowledge, perception, and preventative behavior of student nurses in light of contemporary crises[10]. Insufficient knowledge and inadequate skills of long COVID among non-specialist nurses may cause negative consequences when attending to patients[11]. Self-confidence plays a significant role in determining how quickly, appropriately, safely, and accurately a nurse responds to emergencies and takes care of patients who are severely ill. Higher self-confidence among nurses is associated with a greater ability in generating safe and effective therapies, wise decision-making, and better patient care. To increase their self-efficacy and interaction with COVID-19 patients, nursing educators, and administrators should develop and put into practice additional strategies, such as continuing education and training, organizational support, compensational payment, and availability of protective measures[12]. Stenseth *et al.* reported that there is a requirement of promoting intervention programs in detection and prevention of infectious disease[13].

Simulation as a teaching tool is becoming more and more common in nursing school and a variety of simulators are used. The use of the simulation enables students to practice and correct their errors in conditions similar to clinical settings with little to no risk to patients[14]. The development of evidence-based clinical simulation scenarios and guidelines for nurses is an important step in redesigning nursing education[15]. Therefore, the present study was conducted to assess the effectiveness of simulation-based learning regarding the management of post-COVID complications in terms of knowledge, clinical decision-making ability, and self-efficacy among nursing students.

2. Patients and methods

2.1. Study setting and design

A quantitative research approach was applied in the study. This quasi-experimental (non-equivalent control group pre-test post-test design) study was conducted from February 2021 to March 2022 among 120 2nd-year nursing students at Clinical Skill and Simulation Center, College of Nursing, Maharishi Markandeshwar (Deemed to be University).

2.2. Ethical approval

Formal administrative approval for conducting the study was obtained from the institutional ethical committee of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana (IEC no. 2140). Permission was obtained from concerned authority for conducting the pilot study and the final study. The participants were explained about the research and its purpose. Informed consent was obtained from the students before participation and they were assured the confidentiality of the response.

2.3. Inclusion and exclusion criteria

As per the study protocol and clinical exposure, only 2nd-year nursing students were enrolled. The students available at the time of data collection and willing to participate in the research were included in the study and those who were absent at the time of intervention (simulation-based learning) and at the time of post-test were excluded from the study. The students, who have not completed the learning program, were also excluded from the study.

2.4. Data collection

Conventional teaching on COVID-19 related topics was already conducted by subject teacher. Conventional teaching and the intervention taught similar COVID-19 related contents but the teaching strategies and methods (case scenario, objective structured clinical examination, and structured teaching program) were

different. After 15 days of conventional teaching, data collection was started. The pre-test data of all studied subjects was collected on day 1 and on day 2, the students were divided into an experimental group (n=60) and a comparison group (n=60) by a random table method. Before intervention, one simulation-based video made by a researcher on simulation-based learning regarding the orientation of the management of post-COVID pneumonia and chronic fatigue syndrome was shown to the experimental group. After that, 3 simulation-based scenarios were run for two days. One simulation scenario was on the management of post-COVID pneumonia and chronic fatigue syndrome. The second simulation scenario was related to the management of post-COVID mucormycosis and post-COVID diabetes and the third simulation scenario was regarding the management of post-COVID myocardial infarction (MI). Simulation-based learning was conducted in groups with 12 nursing students in each group from the experimental arm. The content for simulation-based learning included: concept, classifications, etiology, risk factors, signs and symptoms, management of the patient with post-COVID complications. The intervention was given to the experimental group and no intervention was given to the comparison group. On day 15, post-tests of both the experimental and comparison group were conducted. But at the time of post-test, five students (four students in the experimental group and

one student in the comparison group) were absent. Therefore, the analysis was done on 115 nursing students (56 nursing students in the experimental group and 59 in the comparison group). The procedure for data collection in the pilot study and final study was the same (Figure 1).

2.5. Research tools

The tools that were originally developed by the researchers and used for the data collection. There were selected variables (6 items), a structured knowledge questionnaire (30 items), a structured clinical decision-making ability questionnaire (25 items), and an objective structured clinical examination checklist (41 items). The tools were validated by nine experts from the nursing department, medical department, and simulation lab. The content validity of the tools was assessed and found that the selected variable (scale-level content validity index (SCVI): 0.95; item-level content validity index (ICVI): 0.71-1), structured knowledge questionnaire (SCVI: 0.94; ICVI: 0.71-1), structured clinical decision-making ability questionnaire (SCVI: 0.93; ICVI: 0.71-1) and objective structured clinical examination questionnaire for self-efficacy (SCVI: 0.93; ICVI: 0.71-1) and tools were found to be reliable.
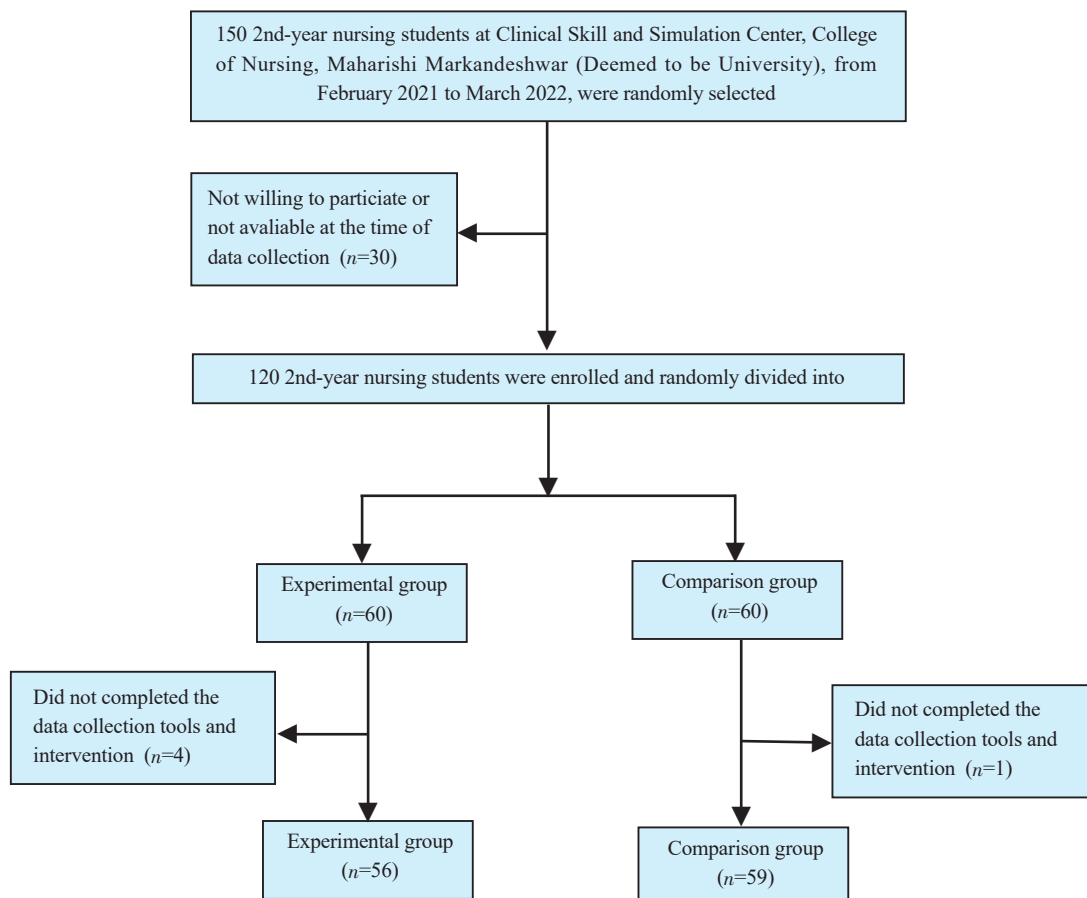

Figure 1. The study flowchart.

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2.6. Statistical analysis

Data analysis was done by using both descriptive and inferential statistics *i.e.* frequency, mean, median, standard deviation, chi-square, *t*-test, Mann-Whitney *U* test, Wilcoxon test, and Pearson correlation test. SPSS 20.00 software was used for data analysis. Kolmogorov-Smirnov test was used to check the normality of data distribution and it was found that pre-test self-efficacy score was not normally distributed, so the non-parametric test was applied to assess self-efficacy between the experimental and the comparison groups. $P<0.05$ was considered significant.

3. Results

3.1. Baseline characteristics of study population

Table 1 shows that except for the sex, there was no significant difference in COVID-19 history, any family member infected with COVID-19, caring a patient with post-COVID in the outpatient department, previous cumulative scores, and clinical evaluation marks in medical surgical nursing. Thus, the nursing students in both the experimental and comparison groups were homogenous at baseline and comparable.

3.2. Effectiveness of simulation−based learning on knowledge, clinical decision−making ability, and self−efficacy regarding management of post−COVID complications during post−test

The mean post-test knowledge score (13.67±4.16 *vs.* 12.10±3.53, t=2.19, P=0.03), clinical decision-making ability score (12.26±6.36 *vs.* 10.38±4.51, t=1.86, P=0.07), and self-efficacy score (77.96 *vs.*

39.05, U=534, P=0.001) were higher in the experimental group than in the comparison group.

3.3. Correlation between knowledge, clinical decision−making ability, and self−efficacy among nursing students in the experimental group regarding management of post−COVID complications

The findings showed that there was a statistically moderate positive significant correlation between pre-test knowledge and clinical decision-making ability (r=0.28, P=0.03) and a highly positive significant correlation between post-test knowledge and clinical decision-making ability (r=0.57, P<0.001) in the experimental group. There was a non-significant correlation between pre-test knowledge and self-efficacy score (r=−0.08, P=0.52) and a mild positive significant correlation between post-test knowledge and self-efficacy score.

4. Discussion

In the present study, the simulation-based learning provided a simulated scene of the medicine ward and emergency area. Several studies reported the administration of simulation-based learning program regarding the management of COVID-19 and its complications. There were very few studies on post-COVID complications as it is a current health care issue. In the present study, the majority of nursing students (75%) in the experimental group and 96.66% of the nursing students in the comparison group were females. These findings were consistent with those of the study by García-Esquinas *et al.*[16] as well as the study by Zhang *et al.*[15]. The majority of nursing students (96.66%) in the experimental group

Table 1. Baseline characteristics of the study population (n=115).

Variables	Experimental group (n=56)	Comparison group (n=59)	χ^2	P
Sex				
Male	14 (25.0%)	2 (3.4%)	11.20	<0.001
Female	42 (75.0%)	57 (96.6%)	-	-
COVID history				
Yes	1 (1.8%)	1 (1.7%)	<0.05	0.970
No	55 (98.2%)	58 (98.3%)	-	-
Family member infected with COVID				
Yes	2 (3.6%)	2 (3.4%)	0.00	0.950
No	54 (96.4%)	57 (96.6%)	-	-
Have you ever attended a patient with post−COVID in outpatient department				
Yes	2 (3.6%)	0 (0%)	2.14	0.14
No	54 (96.4%)	59 (100%)	-	-
Previous cumulative session scores among the 2nd−year nursing students				
0-112	10 (17.9%)	8 (13.5%)	0.41	0.81
113-124	3 (5.3%)	3 (5.1%)	-	-
125-337	43 (76.8%)	48 (81.4%)	-	-
Clinical evaluation marks in medical surgical nursing				
0-25	38 (67.9%)	30 (50.8%)	2.68	0.10
26-50	18 (32.1%)	29 (49.2%)	-	-

and all nursing students (100%) in the comparison group had never attended a post-COVID patient in an outpatient department as the students were in online-study mode and did not gain experience to caring the post-COVID patients. The findings of the study were consistent with the findings of the study by Zhang *et al.*[15]. In the present study, the mean post-test knowledge score (13.67±4.16) (*P*<0.001) of nursing students was higher than the mean pre-test knowledge score (10.39±4.67) in experimental group. These findings were consistent with the study by Kabi *et al.*[14] and Zhang *et al.*[15]. In the present study, the researchers integrated typical cases of post-COVID complications that were run through three simulation scenarios of five complications (post-COVID mucormycosis, pneumonia, chronic fatigue syndrome, diabetes, and MI). The post-test knowledge score showed that the highest modified gain was found among nursing students in the area of post-COVID mucormycosis (27.82%) after intervention and the lowest modified gain was found in post-COVID diabetes (8.95%) in the experimental group. As post-COVID mucormycosis incidence rate was rapidly rising in patients with COVID-19 after the second wave thus was mostly highlighted[15]. Whereas in the comparison group, the highest modified gain of nursing students was in the area of post-COVID mucormycosis (−1.92%) and the lowest modified gain was in the area of post-COVID pneumonia (14.50%). As the students already learn about the topic through conventional teaching and may get the knowledge from other sources as this was the current health issue.

In the present study, the mean post-test clinical decision-making ability score (10.98±6.70) (*P*=0.001) of nursing students in the experimental group was higher than the mean pre-test clinical decision-making ability score (12.26±6.36). During simulation-based learning, students were assigned their roles individually so they got opportunities to perform on standardized patients where triggering factors were also added and the lacking were discussed in the debriefing, so that students may develop clinical decision-making abilities that reflect in their post-test clinical decision-making ability scores. The findings of the present study were consistent with the study by Ayed *et al.*[17]. In the present study, the mean post-test clinical decision-making ability score (12.26±6.36) in the experimental group was higher than the comparison group (10.38±4.51). But statistically, it was non-significant (*P*=0.07). A possible explanation for this result is that as the clinical postings of the students were going on, they were also learning during their duty. In post-test, the highest modified gain among nursing students was in the area of post-COVID mucormycosis (12.74%) and the lowest modified gain was in post-COVID MI (6.68%) in the experimental group. As the topic of MI was already in their curriculum and their pre-test score in the area of post-COVID MI was already high. Therefore, there was not that much gain in management but the post-COVID mucormycosis was new a topic to them so after the simulation-based learning, this area had the highest modified gain.

The mean post-test self-efficacy score (23.82±3.72) of the experimental group was higher than the mean pre-test self-efficacy score (18.28±3.17) and the calculated *Z*-value (*P*=0.001) was found to be statistically significant at a 0.05 level of significance. It showed that simulation-based learning was effective to enhance the self-efficacy regarding management of post-COVID complications among nursing students within the experimental group. The findings were consistent with another study by Hung *et al.*[18]. Additionally, the present study also revealed that there was a statistically moderate positive significant correlation between pre-test knowledge and clinical decision-making ability (*r*=0.28, *P*=0.03). In contrast to the present findings, a cross-sectional study found that there was no significant correlation between knowledge and practices[19]. Our study found that simulation-based learning was effective in developing competencies among nursing students.

The limitations of the current study are that we have covered only five post-COVID complications due to time constraints. Also, the students' satisfaction regarding the intervention was not assessed by taking feedback. In this study, the sample size was insufficient to make generalized findings.

For future research, the study can be replicated on a large sample of nursing students in selected areas of Haryana for a wider generalization. In addition, a mixed-method study may be conducted to identify barriers to the development of clinical simulation or difficulties that may be encountered. A comparative study can be done to assess the effectiveness of simulation-based learning and other traditional methods of teaching in terms of competency regarding the management of post-COVID complications.

Based on the findings of the present study, it is concluded that simulation-based learning was effective in enhancing the knowledge, and clinical decision-making ability regarding the management of post-COVID complications of nursing students. Today's society demands greater responsibility and increased efficiency and effectiveness from healthcare providers. In the time when we are coexisting with the coronavirus and people are unaware of the treatment regimen, it is required for healthcare providers to receive extensive education and rigorous training to better treat the patient. Healthcare professionals must be confident and knowledgeable so that their patients are safe. Simulation training provides a great hands-on experience for nurses by creating an artificial representation of real-world processes for protecting patients from unnecessary risks. Nursing students are the future nurses that need to be competent but during the COVID pandemic, they hardly get exposure to care of post-COVID patients. Hence, through the use of task trainers, mannequins, virtual reality, and standardized patients, the vital purpose of enhancing knowledge and improving skills is served among nursing students.

Conflict of interest statement

The authors report no conflict of interest.

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Authors' contributions

TM, E, KY and SJ designed and conducted the study. NK conduted data analysis and SP prepared and designed the manuscript, who also acts as the corresponding author of the manuscript.

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