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Effects of Simulation-Based Education in Nursing Care for Stroke Patients

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Abstract: ***This study was conducted to examine the effects of simulation-based education (SBE) on nursing students' clinical performance, knowledge, and learner satisfaction in nursing care for stroke patients. The randomized controlled study involved 61 students who were enrolled in a geriatric nursing education course for a major at S university. Students in the simulation group received stroke patient care training by using a high-fidelity simulator, while those in the control group participated only in lectures. Collected data were analyzed using Chi-square, t-test, and independent t-test with the SPSS 24.0 for Windows program. The experimental group which had SIM-PBL showed significantly higher knowledge (t = 16.152, p< .001), learner satisfaction (t =7.358, p<.001), and clinical performance ability (t = 5.252, p <.001) for stroke patient care, compared with the control group. The results suggest that SIM-PBL is an effective teaching method to increase knowledge and clinical performance ability for nursing students. Therefore, it is necessary to develop simulation-based educational programs for clinical practicum, while further study is needed to determine the effects of diverse debriefing methods on student learning findings.***

Keywords: simulation-based learning, clinical performance, learner satisfaction, stroke patient, nursing education

1. Introduction

With an aging population, there has been a rise in the prevalence of chronic diseases. Stroke is the primary cause of mortality in Korea [1], and the second leading cause of death worldwide [2]. In addition, many patients remain in a disabled condition after suffering a stroke [3]. Consequently, the family and healthcare providers play a major role in ensuring the well-being of these patients [4]. Nurses, in particular, along with the patients' families, take part in the recovery process. Therefore, there is a need to gain a more in-depth knowledge and understanding of the nursing care provided to a stroke patient [5]. Moreover, it is vital to make the information assessable to nursing students who are working with stroke patients in order to help improve patient care.

However, nursing students's experience with patient care has been reduced due to rapid changes in the clinical environment, patient safety problems, and ethical concerns [6]. Currently, simulation education is widely being used as a learning method in many universities as part of healthcare learning [7]. Simulation-based education (SBE) is a useful pedagogical strategy that offers nursing students a chance to transfer theory to practice in an integrated learning environment, and provides an excellent opportunity to practice skills by applying the knowledge gained through lectures [8]. Research shows many advantages of simulation for learners in the increase of clinical skills when used within the subjects of education for students in simulation-based education programs [9]. Simulation education offers clinical practice chances and supports to student practice while increasing knowledge and practice skills in a clinical environment-like settings where there is no fear of harming patients, thereby, curtailing error and anxiety [10].
Several research studies in nursing have examined the effects of simulation-based educational programs [11-13]. However, there is limited knowledge of simulation education for stroke patients. This study aims to determine the effects of simulation-based nursing education on the clinical performance, knowledge, and satisfaction of nursing students.

2. Literature Review

Simulation is a technique, not engineering, to replace or reinforce real-life experience with guided experience, often immersive in nature that arouses or describes substantial aspects of the real world in a fully interactive fashion [14]. Modern simulation use in nursing education has its roots in the military, aviation, and medical simulation training and education [15]. Simulation-based education can bridge the gap between lecture and practicum using an innovative teaching method. [16]. Simulation-based education in nursing defines plenty of activities using patient simulators, including devices, trained persons, life-like virtual environments, and role-playing, not just handling manikins [17]. For advanced undergraduate students, technical skills' simulation can help adjust knowledge to simulated practice through role-play of the nursing decision-making process, or perceptions and interventions of various patient care [18-19]. In this manner, students can participate in a "real" clinical situation, which tests not only their clinical performance ability but also improves their communication skills [20]. Simulation education could improve students' thinking, clinical confidence, decision-making abilities, knowledge, and communication skills while providing an interactive, participatory learning environment by reinforcing knowledge and clinical skill performance [21-24]. Bogossian [18] reported that simulation education could positively impact a high level of knowledge and clinical performance, while Kim [21] highlighted the benefits of self-efficacy among nursing students. Literature review studies commonly reported strong student satisfaction with simulation education [22-23], as well as improved confidence levels [24-25]. Yuan et al. [26] reported mixed results on confidence and competence

improvement. Based on previous studies, there is a need to develop simulation-based educational program for stroke patient care. This study would be useful to develop further interventional strategies and simulation design for nursing students in stroke care nursing curriculum.

3. Method

3.1 Study design and participants

The study was a randomized controlled trial involving 4th year nursing students at S University located in the Chungcheongbuk-do province of South Korea. Students who had completed the lecture aspect of Geriatric Nursing Care but not the clinical part of the course were enrolled in the integrated simulation practice course. The subjects were selected from nursing students who (a) were enrolled in the Integrated Simulation Practice course for geriatric care, (b) understood the purpose and method of the research, and (c) signed informed written consent. The sample size was calculated using G-power 3.1. Based on the calculation of the two-tailed t-test, significance level (α) = 0.05, statistical power (1-β) = 0.80, and effect size (d) = 0.8, a sample size of 26 per group was deemed appropriate. For this research, 30 students were placed in the experimental group, and 31 students in the control group, which met the sample size requirement. All the subjects participated in the research in its entirety.

3.2 Measuring tools

To evaluate clinical performance, the study examined the fundamental nursing textbook [27] and core nursing skill content. The measurement tool has 49 questions in three categories related to stroke patient care, including 17 based on urinary dysfunction, 15 on airway aspiration, and 17 on physical assessment. Each item was measured using a 3-point Likert scale, with zero (0) indicating not performed, one (1) meaning partially performed, and two (2) indicating performed completely. The score ranged from 0 to 98, wherein a higher score was linked to the higher confidence of clinical performance. Cronbach's alpha was 0.95 in this study.

The measurement tool of knowledge was initially developed based on the Adult Health Nursing textbook [28]. However, this tool was revised and modified for this study after consulting with two professors of adult nursing and one professor of geriatric nursing courses. This tool consisted of 20 items. The correct answer was scored as one (1) point, and the incorrect answer was scored as zero (0). The lowest possible score was 0, and the highest was 20, corresponding to higher knowledge. To determine the reliability of this measurement tool, the items were divided into odd and even numbers, and then the correlation coefficient between each correct answer was calculated using the Spearman-brown formula. The reliability of the knowledge measurement tool was Cronbach's alpha= 0.62.

To measure learner satisfaction, the questionnaire originally developed by Yoo et al. [29] was revised and modified after consulting with two professors, teaching Fundamentals of Nursing and Adult Health Nursing, respectively. The measurement tool consisted of 20 items, which included the learner's attitude towards a method of learning, learner satisfaction, appropriateness of the content of the study, learning achievement, and the relevance of the evaluation of learning. Each item was measured using a 5-point Likert scale ranging from one (1): strongly disagree to five (5): strongly agree. The learner satisfaction score ranges from a minimum of 20 to a maximum of 100, with a higher score denoting higher satisfaction. The reliability of the learner satisfaction tool was Cronbach's alpha = 0.952.

3.3 Study Process

Development of simulation-based education

An educational needs assessment was conducted among 4th year nursing students who were enrolled in the integrated simulation training course. The results showed that the needs for stroke patient care were higher than three (3) points (of 5) among these students. Based on the needs assessment results, the nursing faculty developed a simulation scenario and objectives for stroke patient care.

The faculty identified high educational needs for caring for patients with ineffective airway clearance, neurological assessment, urinary dysfunction, and skincare. The draft of the simulation scenario was developed after reviewing the contents of the Adult Health and Geriatric Nursing Care textbooks [27-28]. The scenario was then reviewed by two experienced registered nurses on the neurosurgical unit, and the final scenario was synthesized based on their feedback. The educational pamphlet provided to the students included simulation topics, practice and patient overviews, evaluation items, supplies for the simulation, and an introduction to the simulation room environment.

A 49-item evaluation tool, which included 17 items related to the assessment of urinary difficulty and simple catheterization, 15 to airway aspiration, and 17 to the physical assessment of stroke patients, was used to evaluate the students' performance. Each item had a score of zero (0): not performed at all, one (1): partially performed, and two (2): performed all. The lowest score is 0 points, and the highest score is 98, which means the higher the score, the better the clinical performance of nursing students in stroke care.

To verify the proper working of the simulation scenario for stroke patient care, a pilot study was conducted using the same scenario on 4th year nursing students at S University in J city who had experiences in SBE. Each team was limited to three students to promote student participation in a simulation activity as a team. The focus of the clinical skill performance was moved from the original plan of indwelling catheter placement to simple catheterization for patients with urinary difficulties due to time constraints. This change was also based on the nursing faculty's recommendation to focus more on the assessment considering the importance of accurate assessment of stroke patients. The clinical performance was evaluated on the airway aspiration, not tracheostomy care as initially planned, while the physical assessment skill performance focused on the decubitus ulcer.

Simulation-Based Nursing Education for Stroke Patients

In the first week, orientation and educational materials were provided to the students, and a survey was conducted using questionnaires before the simulation activity. The post-simulation survey was performed after the five-week simulation training. Simulation-based nursing education was provided from the second to fourth weeks. During the second week, the SBE focused on the assessment of the urinary difficulty of stroke patients and simple catheterization, which was followed by a debriefing. SBE focusing on stroke patients' airway aspiration and a debriefing were provided in the third week, while in the fourth week, SBE focusing on the physical assessment of the stroke patient and debriefing were provided. To meet the objectives of SBE, each group was given one hour for self-study, and there was a discussion on stroke patient care before the simulation activity.

The experimental group was divided into five groups of three (3) students who participated in 10-15 minutes of simulation activity for assessment of urinary dysfunction and simple catheterization, tracheal aspiration, and physical assessment of stroke patients in the simulation room with a one-way mirror. The control group had received education on the care for stroke patients by using the static manikin in the skill laboratory. Providing this SBE only to the experimental group may be considered unethical. Therefore, two weeks after the completion of the research, the same SBE was provided to students who were in the control group in order to offer them the same educational opportunity. Pre-tests were conducted in both the experimental and control groups immediately after starting the orientation class. In the third week of class, a two-hour mock simulation was provided to the control group that included a mini-lecture pertaining to information about rules during the skills practice time. After that, the students were offered two hours of individual study time before the class. The students in the control group were asked to practice techniques individually at the designated time, and then to submit the contents of individual learning at the time of evaluation of the simulation exercise.

Only the experimental group had received one hour of team-based learning strategy prior to the study. The experimental group, two groups of 15 students each, shared their knowledge for two hours as a team-based learning strategy. These 15 students were further divided into five groups of three students each to provide enough time for every student to practice skills or techniques several times at a designated time. The students were then asked to submit the contents of the learning at the time of evaluation of the simulation exercise.

Simulation Evaluation

The evaluation of the simulation exercise consisted of learning prior to the simulation, during the simulation exercise, and debriefing. When providing orientation, the students did not receive any information about which group, experimental or control, they belonged to. The simulation exercise started after obtaining an informed consent that included a confidentiality agreement pertaining not to share information related to the simulation activity and protect the privacy of the participants. When implementing the SBE, first, a conventional simulation activity was carried out with one class starting with the didactic portion of the course. In the experimental group, prior to starting the simulation-based clinical education, an additional one hour was added to the orientation class to include information about the application of the team-based learning method. Both the experimental and control groups were divided into two sets of 15 samples and provided either team-based learning or individual learning method. After that, each group was divided into five (5) teams of three students each by random drawing during the class of the simulation-based clinical practice before the running of the simulation scenario. Then, the small groups of three students were assigned their roles as nurse one, nurse two, and a family member by the randomized drawing. The evaluation of the experimental and control groups was performed on a team-basis using an evaluation checklist. The researchers evaluated the students' clinical performance after reviewing the recordings of the simulation activity. Nursing simulation-based clinical practice for stroke patients was conducted for a total of 245 minutes, which consisted of 10 minutes for the introduction and preparation time for each team (10 minutes x 5), 15 minutes of the team-based simulation evaluation for each team (15 minutes x 5 team), and 20 minutes of preparation and implementation of debriefing for each team (20 minutes x 5 team). However, the actual total debriefing period for this study was 120 minutes.

3.3 Data Collection

Data were collected from September 12-December 7, 2014. The preliminary survey was obtained after the orientation using a self-reported checklist of knowledge and clinical performance of stroke patients. The clinical performance was evaluated on a team-basis by the researcher immediately after the SBE by reviewing the video recordings of the simulation exercise repeatedly.

3.4 Ethical Consideration

To protect the study subjects, ethical considerations were strictly followed. The study subjects in both the control and experimental groups were informed about the purpose and process of the research, assured anonymity, and told that the data would only be used for the purpose of the study during the general orientation in the first week. The subjects were also informed that they could withdraw at any time of the study process without any penalty or disadvantage related to course grades. Students were also told that the class and the clinical performance evaluation would be done by others who were not the course faculty. In the second week, during the pre-briefing, signed informed consents and demographics surveys were obtained from the students who volunteered to participate in the study.

3.5 Data Analysis

The collected data was analyzed using the SPSS/WIN 25.0 program. The general characteristics of the subjects were analyzed using real numbers, percentages, means, and standard deviations. To test the homogeneity of demographic characteristics and dependent variables between the experimental and control groups, χ^2 test and t-test were used. An independent t-test was used to analyze the differences between the experimental and the control groups' knowledge, clinical performance, and learner satisfaction. The reliability

of the measurement tool was tested using Cronbach's α coefficient.

4. Results and Discussion

4.1 Results

General Characteristics and Homogeneity Test

Of the 61 participants, 77% (n = 47) were female, and 23% (n =14) were male, and their ages ranged from 20 to 25, with a mean age of 22.30 (2.1). The demographic characteristics of both groups are presented in Table 1. There were no statistically significant differences between the experimental and control groups in academic achievement using grade point average (GPA; t = 259, p = 0.795), and major satisfaction level (t = 0.763, p = 0.448). Also, there were no statistically significant differences between the groups on mean pre-knowledge scores (t = 0.739, p= 0.448). Therefore, the groups are considered homogeneous.

Mean Differences in Dependent Variables

The mean differences between the two groups' clinical performance, knowledge, and satisfaction are presented in Table 2. After the intervention, the mean of clinical performance was higher in the experimental group (75.52) than in the control group (53.19),which was a statistically significant difference between the two groups (t= 5.252, p= 0.000). The mean of knowledge improvement was higher in the experimental group (18.02) than in the control group (15.41), which was a statistically significant difference between the two groups (t= 16.152, p= 0.000)The difference in the mean scores for learner satisfaction (t=7.358, p=0.001) was statistically significantly different between the groups.

Table 1: Homogeneity test for general characteristics

Variables	Exp.(n=30) M (SD)	Con. (n=31) M (SD)	t/χ^2	p
Age	22.63(2.7)	22.31(1.5)	0.574	0.567
Male	5(16.7)	9(29.0)	1.318	0.251
Female	25 (83.3)	22(71.0)		
GPA	3.28(0.38)	3.25(0.51)	0.259	0.795
Major Satisfaction	3.45(0.08)	3.47(0.12)	0.763	0.448
Knowledge	9.78(1.08)	9.87(1.02)	0.334	0.739

Table 2: Difference between the two groups

Variables	Exp.(n=30) M(SD)	Con.(n=31) M(SD)	t	p
Clinical performance	75.52(15.89)	53.19(17.26)	5.252	0
- Nelaton catheterization	25.91(5.91)	18.57(6.98)	4.425	0
- Endotracheal suction	24.38(4.61)	17.19(5.68)	5.418	0
- Physical assessment	25.24(6.53)	17.43(5.59)	5.024	0
Knowledge	18.02(0.25)	15.41(0.85)	16.152	0
Learner Satisfaction	3.78(0.15)	3.58(0.02)	7.358	0

4.2 Discussion

Simulation-based education offers practical experience to prepare students for nursing in real clinical settings [26]. It has been shown that high-fidelity simulation education increases satisfaction, knowledge, and clinical performance [21-26]. The purpose of this study was to explore the effects of SBE on knowledge, clinical performance, and satisfaction. The study results indicated that while both high-fidelity simulator and traditional teaching method improve knowledge and clinical performance, the high-fidelity simulator method was found to be significantly more effective than the traditional teaching method in increasing students' knowledge and clinical performance levels. This finding verifies the review of relevant literature, showing that SBE is an effective education method that enhances participants' knowledge [30-33].

Cant and Cooper [33] conducted a 10-study integrative review and found that all the studies demonstrated an improvement in knowledge, and scores in the intervention groups were consistently higher than those in the control group, which did not participate in the SBL. Our findings are consistent with Boling and Hardin-Pierce's study. Conversely, in didactic lectures, the focus is to explain the textbook through the teacher, so that students can passively acquire knowledge. Either SBE or a typical course could improve students' professional knowledge, and the results are acceptable because the students in both the test and comparison groups received 36 hours of teaching.

This finding supports the results of previous studies [30-31], which showed that simulation-based clinical practice improves nursing students' clinical performance. The scenarios used in this study were developed based on actual clinical cases that had high content validity, which was needed in providing high realism of the SBE. In addition, the simulation-based clinical practice promotes efficient learning in improving nursing performance through the integration of the key basic nursing skills practice, role play, problem-based learning. Furthermore, nursing students were allowed to identify and correct errors based on the feedback provided by the experienced simulation instructors in a safe learning environment [35]. Each student was allowed to check his/her strengths and weaknesses based on the instructor's feedback and their reflection of the simulation activity during the debriefing process. Therefore, they were able to improve their performance by the time of post evaluation. In contrast, the control group's core basic nursing skills were lower than that of the experimental group, probably because the students in this group did not have an instructor monitoring during the self-paced skills practice, which lacked adequate repetition of the skills practice, orientation, and feedback by the instructor as well as students' self-reflection. Therefore, in undergraduate nursing SBE, the nursing faculty needs to monitor students' self-paced skills practice and provide their feedback on students' performance and learning outcomes using a structured debriefing method. Future research is needed to identify relationships between these variables.

Overall, the results showed that learner satisfaction was significantly higher in the experimental group than in the control group, which was in line with the systematic review and meta-analysis of the literature that learner satisfaction in SBE was significantly higher than that of traditional clinical education [24], [35]. High learner satisfaction scores may be related to the students' understanding of the learning objectives and the team-based problem-solving approach using a high-fidelity simulator [36]. Students in the experimental group clearly understood the objectives of the

simulation activity through the orientation provided by the instructor, which prepared the students for team-based learning prior to SBE. Through simulations that combine peer role-play and modeling, the students were able to correct their errors by repeatedly practicing mastery skills such as communication and direct patient care in addition to students' self-reflection and instructor feedback. In this study, the patient's mental status was set up as "drowsy" and provided a family member to promote students' communication skills. However, the students revealed that they were not confident in communicating with the patient and family member. This underscores the need for ongoing research on the impact of implementing various simulation scenarios for improving communication skills. Research focusing on the effects of various debriefing methods in SBE is lacking in current nursing literature. Therefore, further studies focusing on the effects of the various debriefing methods are needed.

5. Conclusion

This study was a non-equivalent control group pre-test and post-test design to identify nursing students' clinical performance, knowledge acquisition, and learner satisfaction after implementing simulation-based clinical practice for stroke patient care. The results indicated that SBE incorporating team-based training achieved a higher level of clinical performance, knowledge acquisition, and learner satisfaction among nursing students when providing care for a stroke patient. The results also confirmed that SBE was an essential factor associated with students' high performance when providing stroke patient care and high learner satisfaction. It is recommended that nursing educational institutions should share the SBEs they have developed, especially in stroke patient care, with other schools to prepare better future nursing workforces, which can be cost-effective and time-saving for the nursing faculty so that they need not develop the same scenarios from scratch. Future simulation-based research focusing on the effects of various debriefing methods on student learning outcomes is also recommended.

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