

The effectiveness of end-of-life care simulation in undergraduate nursing education: A randomized controlled trial

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ABSTRACT

Background: Nursing students have limited opportunities to experience end-of-life care, so it is difficult for them to learn how to deliver it empirically. The use of simulations with standardized patients may be a way to provide realistic experience of end-of-life care for nursing students.

Objectives: The aim of this study was to evaluate the effectiveness of end-of-life care simulations with standardized patients in improving the knowledge, skill performance and self-confidence of undergraduate nursing students.

Design: Randomized controlled study.

Setting: Japanese university nursing school.

Participants: Thirty-eight students in the third year of the Bachelor's degree in nursing (simulation group = 20, control group = 18).

Methods: After randomization to a simulation or control group, participants in the simulation group participated in an end-of-life care simulation with standardized patients. The primary outcome of a change in the knowledge score was assessed using a knowledge questionnaire, skill performance by completing Objective Structured Clinical Evaluations, and self-confidence related to end-of-life care by self-reported questionnaires.

Results: The simulation group improved significantly in knowledge, skill performance in physical assessment and psychological care, and self-confidence related to end-of-life care. The results of the two-way analysis of variance showed a significant interaction between groups and time ($p = 0.000$). Analysis of the simple main effect showed a significant difference ($p = 0.000$) between groups after the end-of-life care simulation and a significant difference ($p = 0.000$) over time in the simulation group. There were large effects on knowledge improvement ($\eta^2 = 0.372$), physical assessment ($\eta^2 = 0.619$), psychological care skill performance ($\eta^2 = 0.588$), and self-confidence in both physical assessment ($\eta^2 = 0.410$) and psychological care ($\eta^2 = 0.722$).

Conclusions: End-of-life care simulation with standardized patients would be an effective strategy to train nursing students, who have limited opportunities to experience end-of-life care.

1. Introduction

Nurses spend more time with patients at the end-of-life (EOL) than any other health care professionals (Foley and Gband, 2003; Wallace et al., 2009). They play an important role in caring for these patients and their family caregivers. EOL nursing has been highlighted as an

essential part of Japanese undergraduate nursing programs over the past decade (Japan Ministry of Health, Labour and Welfare, 2007). However, EOL care is complex and requires flexible and prudent management. It is therefore difficult for nursing students to learn how to deliver it empirically, because they have limited opportunities to experience it. Undergraduate education in this area is considered

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inadequate (Lippe and Becker, 2015).

A high level of competency is expected in clinical practice, including in EOL care, and nursing colleges around the world have issued guidance on EOL care provision (see, for example, American Association of Colleges of Nursing, 2016, 2017). In Japan, practical training in EOL care has to date far mainly taken the form of case study examination or role-playing with fellow students in the classroom, but it is now recommended that nursing students learn to care for patients at the EOL by practicing with SPs (Japanese Ministry of Education, Culture, Sports, Science and Technology, 2011), as a way to supplement lack of clinical experience (Japanese Ministry of Health, Labour and Welfare, 2011).

Simulation-based healthcare and nursing education has a relatively short history in Japan (Abe, 2016), but allows students to practice problem-solving, critical thinking and other skills under low stress circumstances (Hawkins et al., 2008; Jeffries, 2005). Bremner et al. (2006) reported that nursing students felt that simulations using a human patient simulator provided active learning and increased their confidence. Several studies of EOL care simulation for undergraduate nursing students have shown that it is an effective educational strategy (Fabro et al., 2014; Moreland et al., 2012; Smith-Stoner, 2009). When simulation is conjunction with direct patient care with SPs, nursing students can experience EOL care under realistic clinical situations. Previous studies have also shown that simulation with SPs helps undergraduate nursing students to learn about communication skills and health assessments (Andrea and Kotowski, 2017; Lin et al., 2013), both of which are important components of EOL care. Simulation with SPs could therefore be useful in teaching the knowledge and skills required for EOL care.

There have been quasi-experimental studies of training nursing students using EOL care simulations (Fluharty et al., 2012; Moreland et al., 2012) and the End-Of-Life Nursing Education Consortium program (Kopla et al., 2016), but all these used high-fidelity mannequins. However, a meta-analysis assessing the effects of simulation training using SPs (Pok-Ja Oh et al., 2015) reported that only four studies were randomized controlled trials and none covered EOL care. Studies involving EOL care simulation with SPs include teaching spiritual care to nursing students (Fink et al., 2014) and comparing stress in students participating in EOL care simulations with a high-fidelity mannequin, SPs, and active learning (Allen, 2018). However, there are no published reports of randomized controlled trials to evaluate the educational effectiveness of EOL care simulations using SPs. The aim of this study was therefore to perform a randomized controlled trial to evaluate the effectiveness of an EOL care simulation with SPs in improving knowledge, skill performance and self-confidence of undergraduate nursing students.

2. Methods

2.1. Study design

This randomized controlled trial evaluated the efficacy of an EOL care simulation program for undergraduate nursing students using pre- and post-tests. Randomization was conducted by three researchers. Students interested in participating in this study were assigned to a simulation or control group using the permuted block method of randomization for a block size of two. The group allocations were not revealed to the participants to prevent bias. The control group followed the usual nursing curriculum (one class on palliative care and four classes involving case study discussion of patients at the EOL stage). The simulation group completed the EOL care simulation as an additional course. This study conformed with the CONSORT guidelines (Schulz et al., 2010).

2.2. Participants and setting

Participants were recruited from a national university located in the

Chubu region of Japan through a poster inviting students to participate in the study. The poster was placed on a bulletin board at the university for 3 months. Eligible students were undergraduate nursing students who (1) had achieved all adult nursing lectures content, (2) agreed to participate in the study, and (3) signed a consent form after receiving a detailed explanation of the study.

2.3. Hypothesis

The hypothesis generated for this study was that the nursing students who participated in the EOL care simulation would have increased knowledge, skill performance, and self-confidence related to EOL care than the control group.

2.4. Intervention

We developed an EOL care simulation program for this study. We designed a scenario that featured a patient with rectal cancer metastases to bone, and experiencing total pain. To enhance the reality of the simulation, we used SPs who were well-trained in medical education. They were trained at least three times to enable them to realistically emulate a patient at the EOL stage suffering from physical and psychological pain. The SPs were given details of the scenario approximately 2 months before the EOL care simulation and also received two 1-hour training sessions. In the first session, the researchers explained the detailed history of the patient in the simulation. In the second and third sessions, the SPs were given the opportunity to ask questions and clarify how to act. The training concluded with a rehearsal in front of four researchers, who confirmed that the performance was effective. The validity of the EOL care simulation scenario had been established previously (Tamaki et al., 2017) but was verified by two certified cancer nursing specialists. The contents of the program are shown in Table 1. The goals of the program were that students should be able to: 1) observe and evaluate patients at the EOL stage and assess their physical and psychological pain; and 2) decide on and provide care that would make EOL patients comfortable. These goals are in line with the goals for the undergraduate nursing curriculum set by the Japan Ministry of Education, Culture, Sports, Science and Technology (2011).

Data were collected from March 2016 to March 2017. Each group consisted of four or five students. The scenario started with a briefing of approximately 10 min, followed by an explanation of the two goals of the EOL care simulation and case introduction. After the briefing, the first student started the 5-minute initial simulation session. After the first session, a 7-minute debriefing session was conducted by two members of faculty, both of whom were registered nurses with more than 5 years' clinical experience including EOL care. In the debriefing session, students commented on what they had done, and faculty members added comments to supplement or strengthen their knowledge. Using the information gained from the debriefing, the next student performed the second simulation session. Four or five students in turn had alternate simulation and debriefing sessions. Overall, the EOL care simulation lasted about 80 min.

2.5. Outcome measures

The effects of the EOL care simulation were evaluated by assessing students' knowledge, skill performance and self-confidence on EOL care.

The primary outcome was a change in the knowledge score. A knowledge questionnaire was prepared using the questions on EOL care from the national nursing examination in Japan. This ensured that the knowledge questionnaire had the same validity as the national examination. The questionnaire consisted of 10 multiple-choice questions with a score range of 0–10 points.

To evaluate skill performance, both groups completed the Objective Structured Clinical Evaluation (OSCE). This consisted of two stations, a

Table 1
Contents of the EOL care simulation program.

Main program (80 min)	
1. Pre-learning	Participants were given instructional materials that had been used in past lectures, and tests were administered. Contents: Definitions of pain, pain assessment, pharmacological therapies for pain, side effects of opioid-like medications, side-effect management
2. Briefing (10 min)	Case introduction, explanation of the program goals. Goals 1) Ability to observe, evaluate, and carry out physical and psychological pain assessment of patients at the end-of-life. 2) Ability to consider palliative care for patients at the end-of-life, and provide some aspects of that care. Case introduction Explanation of patient histories, vital signs, and brief description of physician orders.
3. Simulation (Simulation session: 5 min + 7 min debriefing) × five times	First student Simulation: Vital signs measurement and observation. Debriefing: Helping the student recognize and understand the following: specify the area of pain; how to assess the patient's pain with a numeric rating scale; the influence of pain on vital signs; the necessity of observing the side-effects of opioid analgesics. Second student Simulation: Observation and assessment of pain and side-effects of opioid analgesics. Debriefing: Helping the student recognize when the patient needs a rescue dose. Third student Simulation: Response to the patient's barriers to pain relief. Debriefing: Importance of providing information effectively. Attentive listening and identifying patients' misconceptions. Fourth student Simulation: Listening to the patient's concerns. Providing the patient with accurate information. Response to the patient's psychological distress. Debriefing: Helping the student recognize the total pain. Essentials of communication at the end-of-life. Effective therapeutic communication to bring out the patient's feelings using naming, understanding, respecting, supporting, and exploring (Kurihara, 2015) Last student Simulation: Demonstrate effective therapeutic communication techniques. Debriefing: Discussion of nursing care plans for the patient.
4. Summary (10 min)	

physical assessment examination station (OSCE 1), and a psychological care examination station (OSCE 2). These were used to evaluate students' skill performance in caring for patients at the EOL stage. OSCE 1 consisted of four items including symptom assessment, narcotic analgesic management and evaluation of pain; scores ranged from 0 to 8. OSCE 2 consisted of eight items including the acceptance of and listening to psychological suffering and a supportive attitude towards patients in the EOL stage; scores ranged from 0 to 15. There were two members of faculty at each OSCE station. The students were given 3 min to read the case and a further 5 min to complete the OSCE. Upon completion, they left the OSCE station. The two members of faculty separately scored the students' performance and then agreed a score. Self-confidence related to EOL care was assessed using self-reported questionnaires with responses on a five-point Likert-type scale. The questionnaire contained just two items, asking students to rate their self-confidence in 1) conducting physical assessment and 2) providing psychological care for patients at the EOL, with answer options being 1 = not at all confident, 2 = not very confident, 3 = neutral, 4 = confident, and 5 = highly confident. The instrument was created for this study by researchers, so no prior psychometric information was available.

Relevant characteristics were collected from all participants at baseline, including age, sex, and prior exposure to caring for patients at the EOL or taking opioid analgesics.

2.6. Sample size

There has been no similar previous randomized controlled trial to examine the educational effects of EOL care simulation for nursing students. An appropriate sample size was therefore calculated from a previous quasi-experimental study that evaluated the impact of simulation on nursing students' knowledge related to EOL care, in which the mean difference in knowledge after simulation was 1.2 (standard deviation = 1.12) points higher (Fluharty et al., 2012). The parameters were $\alpha = 0.05$ and $\beta = 0.8$. Assuming a 20% dropout rate, the required sample size was estimated as 18 students per group, giving a total sample of 36 students. Participants were recruited on a voluntary basis, and the number of participants was restricted.

2.7. Data collection procedures

All participants were asked to complete baseline questionnaires covering demographic information, knowledge and self-confidence. Each student was also scheduled to undertake the OSCE to measure their baseline skill performance (pre-test). All participants in both groups undertook the post-tests a week after the simulation group had completed the EOL care simulation (post-test). The questionnaires and OSCE for post-test were similar to the pre-tests. The participants also completed a feedback form after the program.

2.8. Statistical analysis

Statistical analyses used R studio version 0.98.953 software. Pre-test baseline characteristics for the simulation and control groups were examined using *t*-tests and χ^2 tests. The paired *t*-test was used to compare the mean differences in knowledge and skill performance based on the OSCE within groups. The Wilcoxon signed rank test was used to compare the pre-test and post-test self-confidence scores within groups.

Two-way repeated measures analysis of variance (ANOVA) was used to compare differences between the groups for changes in knowledge, skill performance and self-confidence scores. The effects of the EOL care simulation were tested by examining the interaction effect, using partial eta-squared (η^2) values as a measure of group-by-time effect size. The strength of eta-squared values was interpreted as 0.01 being a small effect, 0.06 a moderate effect, and 0.14 a large effect (Cohen, 2012). A difference was considered significant when the *p*-value was less than 0.05.

2.9. Ethical considerations

Approval for this study was given by the Research Ethics Review Board, Graduate school of medicine, Mie university (approval no, 1557) before data collection and recruitment, and the study was registered in the Clinical Trials Registry Platform – UMIN (000021183) record. The participants were given a detailed explanation of the study, and informed that no academic credit would be given for participating. Students allocated to the control group who wanted to experience the EOL care simulation were offered the same program after all data collection had been completed. Written informed consent was obtained from all participants.

3. Results

3.1. Samples and characteristics of participants

Fig. 1 shows that 49 students were enrolled in the study. After the randomization, nine students were excluded (five from the control group and four from the simulation group) because they could not attend on the day of baseline measurements. After the baseline measurements, two participants in the control group withdrew from the

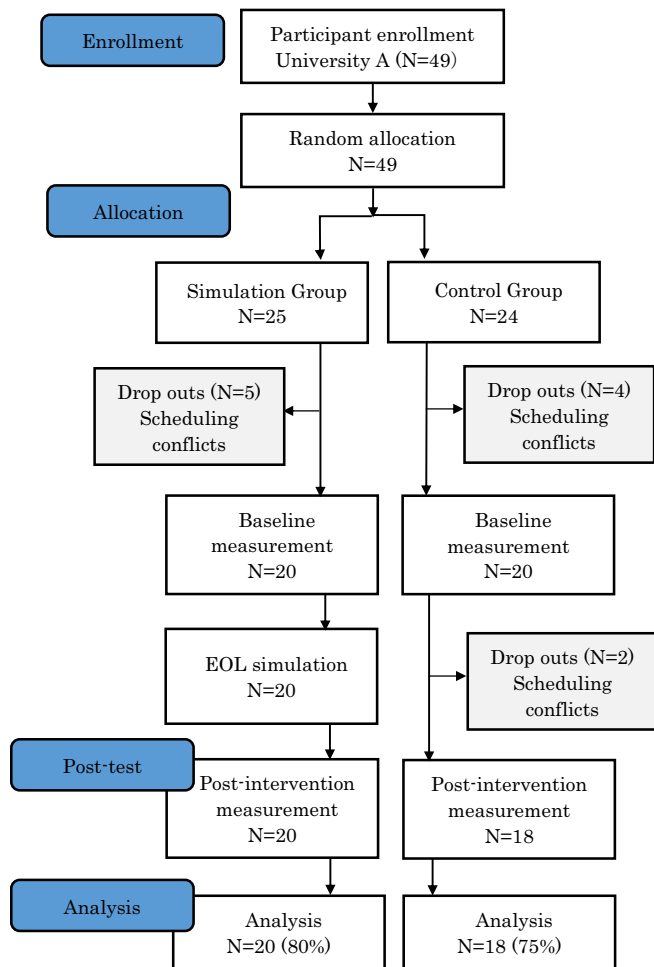


Fig. 1. Flow diagram of the participants of this study.

study because of scheduling conflicts. The remaining 38 students (77.6%) (20 in the simulation group and 18 in the control group) completed the study.

There were no significant differences between the two groups in assessed characteristics or prior exposure to caring for patients either at the EOL or taking opioid analgesics (Table 2).

3.2. Main outcomes

Table 3 shows the mean scores for knowledge, skill performance and self-confidence related to EOL care at baseline and post-test. The

Table 2
Baseline characteristics in the intervention group and the control group.

	Simulation group N = 20	Control group N = 18	P-value
Age (SD)	21.3 (0.62)	21.0 (0)	0.19 ^a
Sex			
Male	0 (0%)	1 (5%)	0.47 ^b
Female	20 (100%)	17 (95%)	
Prior experience: EOL patients			
Yes	3 (15%)	1 (5%)	0.61 ^b
Never	17 (85%)	17 (95%)	
Prior experience: opioid analgesic			
Yes	2 (10%)	6 (33%)	0.12 ^b
Never	18 (90%)	12 (67%)	

EOL: end-of-life; SD: standard deviation.

^a t-test of independence.

^b Fisher's exact test.

results support our hypothesis that the EOL care simulation would increase nursing students' knowledge, skill performance, and self-confidence in providing EOL care.

3.3. Knowledge of EOL care

At baseline, there was no significant difference in mean score for knowledge related to EOL care between the simulation group and the control group. In the post-test, the mean knowledge score had significantly increased for the simulation group ($p = 0.000$) but not the control group ($p = 0.604$).

The results of the two-way ANOVA on knowledge related to EOL care score showed a significant interaction between groups and time. Analysis of simple main effect test results showed a significant difference between the groups in the post-test ($p = 0.000$) and a significant difference over time in the simulation group ($p = 0.000$). The estimated effect size was large ($\eta^2 = 0.372$).

3.4. Skill performance of EOL care

At baseline, there was no significant difference in mean score for physical assessment between the simulation group and the control group. The mean physical assessment score of the simulation group had significantly increased ($p = 0.000$) at the post-test, but the control group showed no significant difference over time ($p = 0.055$). The mean score for psychological care was also significantly greater ($p = 0.000$) at the post-test in the simulation group but not in the control group ($p = 0.785$).

The results of the two-way ANOVA for both physical assessment and psychological care showed a significant interaction between groups and time. Analysis of the simple main effect test results showed a significant difference between groups post-test ($p = 0.000$) and a significant difference ($p = 0.000$) over time in the simulation group. The estimated effect size was large for improvements in both physical assessment ($\eta^2 = 0.619$) and psychological care ($\eta^2 = 0.588$).

3.5. Self-confidence in EOL care

There was no statistically significant difference in baseline scores for self-confidence in physical assessment between the simulation and control groups. The mean self-confidence score in the post-test had increased significantly for the simulation group ($p = 0.000$), but not the control group ($p = 1.00$). The mean post-test self-confidence score for psychological care was also significantly greater in the simulation group ($p = 0.000$), but not in the control group ($p = 0.727$).

The results of the two-way ANOVA on self-confidence in both physical assessment and psychological care showed a significant interaction between groups and time. Analysis of simple main effect test results showed a significant difference ($p = 0.000$) for both physical assessment and psychological care between the groups post-test and over time in the simulation group. The estimated effect size was large for both physical assessment ($\eta^2 = 0.410$) and psychological care ($\eta^2 = 0.722$).

4. Discussion

Our results suggest that the EOL care simulation was effective in increasing nursing students' knowledge, skill performance, and self-confidence related to EOL care, although the improvement was only measured once, and after a short follow-up time. However, nursing students generally cannot experience EOL care through clinical practice, so simulations may provide an alternative way to acquire competency in caring for patients at the EOL as part of basic nursing education. Our findings suggest that using SPs in an EOL care simulation enhanced not only knowledge and skill performance but also the broad scale of nursing students' competencies.

Table 3
EOL care knowledge, skill-performance and self-confidence by group over time.

Measure	Simulation group (N = 20)		Control group (N = 18)		Two-way analysis of valiance			
	Mean (SD)		Mean (SD)		F-value	Time	Groups	Groups × Time
	Baseline	Post-test	Baseline	Post-test				
Knowledge related to EOL care (range: 1–10)	6.15 (1.23)	8.45 (1.36)	6.00 (1.33)	6.17 (1.38)	F-value	23.62	47.64	21.35
					p	0.000	0.000	0.000
					η^2	0.423	0.715	0.372
Skill performance (OSCE score) Physical assessment (range: 0–8)	2.10 (1.45)	5.55 (1.67)	2.94 (1.51)	2.39 (1.38)	F-value	39.99	63.74	58.59
					p	0.000	0.000	0.000
					η^2	0.526	0.770	0.619
Psychological care (range: 0–15)	3.30 (2.15)	11.75 (2.38)	5.78 (3.54)	6.00 (3.40)	F-value	37.12	107.27	51.30
					p	0.000	0.000	0.000
					η^2	0.508	0.850	0.588
Self-confidence about EOL care Physical assessment (range: 1–5)	1.50 (0.69)	2.80 (0.89)	1.39 (0.70)	1.33 (0.59)	F-value	34.61	35.29	24.92
					p	0.000	0.000	0.000
					η^2	0.491	0.650	0.410
Psychological care (range: 1–5)	1.30 (0.47)	2.25 (0.10)	1.67 (0.77)	1.56 (0.62)	F-value	110.42	261.48	93.40
					p	0.000	0.000	0.000
					η^2	0.754	0.932	0.722

Note: Two-way analysis of valiance for p-value; EOL: end of life; OSCE: objective structured clinical evaluation; SD: standard deviation; η^2 : partial eta squared.

Students in the simulation group showed significantly higher knowledge scores than those in the control group after the EOL care simulation. This is consistent with previous studies on EOL care simulation (Fink et al., 2014; Fluharty et al., 2012), and confirm that simulation is an effective tool for knowledge acquisition in the tough, emotional setting of EOL care.

The skill performance scores in the simulation group also increased significantly after the EOL care simulation. These results indicate that the EOL care simulation enabled nursing students to acquire skills by being in realistic situations and interacting with SPs. A previous study reported that SPs are encouraged to give authentic emotional responses, which produces realistic patient care scenarios mimicking those encountered in real-world settings (Luctar-Flude et al., 2012). Students who learned with SPs have previously shown significantly higher scores for clinical judgment, clinical skill performance, and communication skills (Yoo and Yoo, 2003). When interacting with SPs, learners may also practice their health assessment skills (Robinson-Smith et al., 2009). We documented remarkable improvements in psychological care, which is important in EOL care. With a high-fidelity mannequin, there are limits to non-verbal communication and how realistically the condition of EOL patients can be mimicked (Gillan et al., 2014; Laster, 2007). The students in this study were able to experience care that was very realistic through interactions with SPs, who convincingly acted out the physical and psychological pain of EOL patients. This enabled the students to acquire good physical assessment and psychological care skills.

Previous studies have found that the timing of the debriefing is an important element of simulations (Neill and Wotton, 2011). Generally, debriefing often occurs after the simulation has ended, when participants have moved out of the clinical environment (Jeffries, 2012). We chose to provide debriefing “in-scenario”, and conducted in the simulation setting. Holding a debriefing for each session “in-scenario” supplemented the students’ knowledge through immediate feedback. In the next session, students could then put this learning into practice. This may have helped them to organize and structure their knowledge and skills, improving learning.

Self-confidence scores in both physical assessment and psychological care significantly increased in the simulation group after participating in the EOL care simulation. This suggests that students believed that they had improved their knowledge and skills in EOL care. The results of a qualitative analysis of feedback from students participating in this program (Inumaru et al., 2018), provided categories on

“acquisition of knowledge relating to EOL care”, “acquisition of knowledge relating to communication”, and “affirmative view of self in relation to nursing”, which suggest that acquisition of knowledge leads to a more affirmative view of nursing ability, which in turn leads to increased self-confidence. Belief in improvement in psychological care skills, which are often perceived as difficult, led to increased self-confidence.

EOL care simulations using SPs can therefore contribute to the acquisition of physical assessment capabilities, such as pain management. They may also provide opportunities to learn about therapeutic communication and other psychological care skills, which are important aspects of EOL care.

Finally, we only measured the benefits of participating in the EOL care simulation as a whole. A previous study showed that observers of a simulation also had significant score changes after the event (Fluharty et al., 2012; Kaplan et al., 2012). This suggests that the observation role in our EOL care simulation could be as important as the active roles, and this may make simulations an even more practical tool for wider implementation.

4.1. Limitations of this study

This study had several limitations. The participants were recruited from just one university. Including other universities with different student populations would help to generalize the results. Second, all participants chose to register for this program, suggesting that they were highly motivated or interested in EOL care. Caution should therefore be exercised when generalizing the results to other nursing students.

Using a self-reported instrument to measure self-confidence may also have affected the results. A previous study indicated that young, inexperienced nurses were over-confident about their clinical judgment (Miragilia and Asselin, 2015). A future study is needed to evaluate self-confidence more objectively. And the reliability and validity of the self-confidence measurement tool had not been established. Establishing its reliability and validity in the further study would be helpful.

The use of a similar knowledge test and the OSCE to collect pre-test and post-test data could have created testing effects that would threaten internal validity of the pre–post comparison part of this study. However, students were not given any information about what was scored in the OSCE, and both the simulation group and the control group were tested in the same way, so it should be possible to compare

the two groups.

Additionally, the Hawthorne effect (that having faculty members observe the performance of students may influence behavior) may also have affected the results.

Finally, as previously noted, the outcomes were measured 1 week after completion of the EOL care simulation program because of time limitations. It is hoped that using the simulation contributes to the significant changes, but longer and repeated follow-ups might have resulted in different findings, and future studies may wish to consider this option. However, the long-term effects of nursing education have seldom been evaluated, which is a challenge for future nursing education across all areas.

5. Conclusions

Nursing students in the simulation group showed significant improvements in knowledge, physical assessment skills, psychological care skills, and self-confidence related to EOL care. The experience of cooperating with SPs, which is unlike a classroom case study discussion or role-playing with classmates, provided undergraduate nursing students with opportunities to experience provision of realistic and practical EOL care. An EOL care simulation that incorporates interactions with SPs may therefore be an effective and useful educational approach for supplementing opportunities for nursing students to care for actual patients at the EOL stage. The EOL care simulation enhanced the integration of didactic content into a clinical setting and helped students to learn about EOL care in a way that may encourage them to apply their learning to future clinical practice. An EOL care simulation is therefore an effective way to provide all students with similar learning experiences to meet expected learning objectives.

Contribution

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Conflicts of Interest

The authors declare no conflict of interest.

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Ethical Approval

The Research Ethics Review Board, Graduate school of medicine, Mie University (approval no. 1557) approved this study. And the study was registered in the Clinical Trials Registry Platform - UMIN (000021183) record.

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