ORIGINAL RESEARCH

Effects of high-fidelity simulation on self-efficacy in undergraduate nursing education regarding family systems care and early palliative care

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Received: May 1, 2023 **Accepted:** July 11, 2023 **Online Published:** July 25, 2023
DOI: 10.5430/jnep.v13n12p1 **URL:** https://doi.org/10.5430/jnep.v13n12p1

ABSTRACT

Objective: Family systems care and palliative care are main topics in nursing education and practice. Self-efficacy of undergraduate nursing students is strengthened by high-fidelity simulation. The aim of this study was to explore the effects of high-fidelity simulation on the self-efficacy of undergraduate nursing students regarding family systems care and early palliative care in an adult setting.

Methods: A quasi-experimental study design with repeated measures was conducted. Self-Efficacy was measured using the Family Nursing Practice Scale (FNPS) and the Self-Efficacy-Subscale of the Bonner Palliativwissenstest (BPW) before the start of the theoretical family systems care and palliative care courses (t1), after completion of the courses (t2), immediately after high-fidelity simulation (t3) and 3 months after high-fidelity simulation (t4). A linear mixed model was performed to evaluate the difference of self-efficacy between the times of measurement.

Results: A total of 46 undergraduate nursing students participated in the study. There were statistically significant differences regarding the FNPS between t1 and t3 (p = .0019) as well as t1 and t4 (p = .0198), and regarding the BPW between t1 and t3 ($p \leq$ .0001), t1 and t4 (p = .0012), as well as t2 and t3 (p = .0112). Between the other times of measurement, no statistically significant differences were found.

Conclusions: High-fidelity simulation in combination with traditional learning methods can have a short- and long-term effect on undergraduate nursing students' self-efficacy regarding family systems care and early palliative care in hospitalized adult patients.

Key Words: High-fidelity simulation, Self-efficacy, Family systems care, Family-centered care, Palliative care, Nursing education

1. INTRODUCTION

Family systems care and palliative care are important topics in nursing practice and education. According to Shajani and Snell,[1] in family systems care, families are defined as a system of people who are emotionally in touch with each other and support one another. Families are empowered in their self-management regarding health and illness. Palliative care aims to improve the quality of life in terminally ill patients and their families. Physical, psychosocial, and spiritual signs and symptoms are treated by health professionals who are part of an interprofessional palliative care team. Nurses are key players in the palliative care team.[2] Palliative care

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consists of the following five phases describing the clinical situation of patients and their families: (Phase 1) stable (signs and symptoms controlled, plan of care established), (Phase 2) unstable (not anticipated increase of signs or symptoms, urgent change in treatment required), (Phase 3) deteriorating (patient's functional status declining, distress of family caregivers worsening, periodic review of the care plan), (Phase 4) terminal (death likely within days) (Phase 5) bereavement – post death support of the family.[3] Therefore, palliative care needs an approach using family systems to deliver optimal care to patients and their families.[4]

Professional knowledge and skills are required for the delivery of high-quality nursing in family systems care and palliative care. A key component for nursing students to apply nursing knowledge, practical skills and abilities acquired during their education in the practical setting is self-efficacy.[5] Self-efficacy is defined as the belief in one's own ability to manage challenging situations. It can be gained by four sources: Own experiences of success, observation of positive experience in peers (vicarious experience), verbal encouragement from others in a conversation, or perception of one's feelings.[6] Studies show that realistic training of nursing practice during the education can improve nursing students' self-efficacy.[7–9] One of the possible learning methods to apply this is high-fidelity simulation.

High-fidelity simulation is a well explored learning approach in nursing education using realistic computerized patient manikins with effects on different learning outcomes, e.g. knowledge, critical thinking, clinical judgement, performance and competence in nursing practice.[10–15] Self-efficacy of nursing students can also be strengthened using this learning method.[16–20] There are two phases of high-fidelity simulation, the performance with the manikin followed by the debriefing, where the performance is reflected.[21] High-fidelity simulation is based on three theoretical backgrounds. Primarily, this learning method contains all four sources of self-efficacy mentioned by Bandura.[6] Furthermore, high-fidelity simulation follows the steps of experiential learning during the performance in the scenario (concrete experience, active experimentation), the peers observing the scenario (reflective observation) and the debriefing (abstraction/conceptualization).[22] Finally, the transformative learning theory[23,24] is also included, as it's authentic learning where students can critically self-reflect themselves and their own subjective theories after the experience and can try to find new solutions to solve a problem. High-fidelity simulation shows statistically significant positive effects on the learning outcomes of nursing students. However, it's very resource intensive, especially with large student cohorts.[25] Therefore, nursing educators must evaluate the effect of high-fidelity simulation and continuously improve this learning method.[26] The four-level-model by Kirkpatrick Partners[27] is an organizational tool that can be used for the evaluation and categorization of the outcome criteria in nursing education training. In this framework the learning outcomes are classified into the levels reaction, learning, behavior, and results (impact on patient outcomes).

There are several studies describing the use of high-fidelity simulation for the training of family systems care, where the computerized manikin is used for the patient and an actress for the family member.[16,28,29] Moreland et al.[17] explored the effect of high-fidelity simulation on the self-efficacy of undergraduate nursing students in an end-of-life situation (Phase 4, terminal phase of palliative care). The results showed a significant improvement of students' self-efficacy. The only study exploring the use of high-fidelity simulation for the education of family systems care and palliative care of undergraduate nursing students was implemented in a geriatric nursing setting focusing on the primary outcome "attitude towards dying",[30] and, equally to the study of Moreland et al.,[17] in the fourth, terminal phase of palliative care.[3]

The procedure of the high-fidelity simulation is often not described clearly in the studies; therefore, the methodological approach can't always be compared. Various studies apply quasi-experimental designs, describe small sample sizes and do not use validated questionnaires.[11,13,15,31] It is unknown how the effects of high-fidelity simulation on the self-efficacy of undergraduate nursing students regarding family systems care and palliative care are in hospitalized adult patients in the second, instable phase of early palliative care,[3] where the patients functional status has not massively declined and they're not dying immediately.

The purpose of this study was to explore the effect of high-fidelity simulation on the self-efficacy of undergraduate nursing students regarding family systems care and palliative care in hospitalized adult patients in the early, instable phase of palliative care. The research question was: What effects does high-fidelity simulation in combination with traditional learning methods have on the self-efficacy of undergraduate nursing students regarding family systems care and early palliative care in hospitalized adult patients immediately after and 3 months after the high-fidelity simulation-intervention?

2. METHODS

A quasi-experimental, repeated measures design was conducted. The study population were fourth semester Bachelor of Science in nursing students from a university of applied sciences in Switzerland. Inclusion criteria were the comple-

tion of the theoretical courses in family systems care and palliative care (see Figure 1). Full sampling of the 2022 cohort (n = 92) was intended.

2.1 Data collection

Data was collected from June 2022 until October 2022 using REDCap®, a web-based software to assess and manage the research data.[32] It was stored on a server belonging to the university to be conform with the guidelines of good clinical practice. Demographic data (age, gender, and pre-education) was assessed. Self-efficacy regarding family systems care was measured with the German version of the Family Nursing Practice Scale (FNPS), rated on a 5-point Likert-type scale with 1 = high self-efficacy and 5 = low self-efficacy.[33] The FNPS German versions' structural validity was assessed by an exploratory factor analysis (factor loadings > .50 except two items [.45; .42]). The internal consistency was determined using Cronbach's alpha (.84). The construct validity is given (t = -4.915, p = .000).[33] For this study, items 1-10 were used. Items 11-13 were omitted, as they are open questions. We adapted the items linguistically to gender-responsiveness. To assess self-efficacy regarding palliative care, 13 of the 15 questions of the Self-Efficacy-Subscale of the Bonner Palliativwissenstest (BPW) were used, rated on a 4-point Likert-type scale with 1 = low self-efficacy and 4 = high self-efficacy.[34] Cronbach's alpha of the Self-Efficacy-Subscale of the Bonner Palliativwissenstest was measured at .84.[34] Furthermore, two items concerning nursing topics not covered in the theoretical courses and the high-fidelity scenario were excluded. We adapted the instrument linguistically for the Swiss setting and to gender-responsiveness. These adaptions were approved by the first author of the BPW-validation study. Total mean scores were computed for both instruments.

Figure 1 shows the four times of measurement of FNPS and BPW, before the theoretical courses of family systems care and palliative care (t1), immediately after the courses (t2), immediately after high-fidelity simulation (t3) and 3 months after high-fidelity simulation (t4).

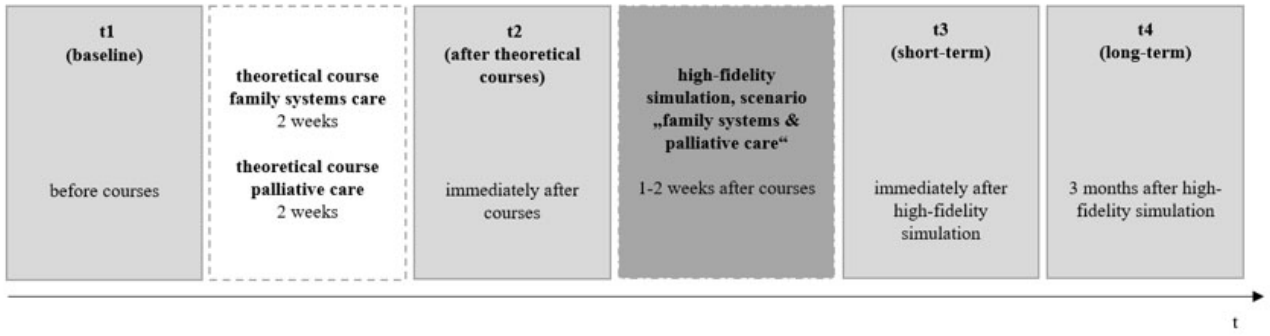

Figure 1. Study design with times of measurement

2.2 Intervention

The high-fidelity simulation used in this study was developed and conducted following the International Nursing Association for Clinical Simulation and Learning (INACSL) Healthcare Simulation Standards of Best Practice.[35] The simulation scenario describes a 41-year-old palliative patient (simulation manikin "Nursing Anne™" from Laerdal, spoken by a professional, standardized actress) and her family caregiver (second professional, standardized actress). The patient was in the second, instable phase of palliative care and hospitalized on a medical ward. The students had to manage the physical, psychosocial, and spiritual aspects of an acute, unexpected symptom exacerbation. The scenario was developed in 2017, evaluated and adapted several times by former students and the simulation team. All simulation team members were lecturers with formal training in high-fidelity simulation and debriefing. They had 3-5 years of simulation experience in the role of debriefer and/or operator. All interventions were conducted by the same simulation team members (2 constant pairs of debriefers, 1 operator) and the same 2 actresses.

Groups of 5-6 students participated in two high-fidelity simulation sessions, which lasted 1.25 hours each (pre-briefing 15 minutes, briefing 10 minutes, scenario 10 minutes, debriefing 40 minutes, break between the two simulation sessions). 2 students were involved in the active nursing role during the first, 2 others during the second simulation session. The first and second session of the high-fidelity simulation differed from each other due to the psychosocial reaction of the simulation manikin and the family caregiver. 1-2 students participated in the role of observer for both sessions and took notes of the peer-performance during the scenario. The video-assisted debriefing rounds were conducted immediately after the scenario using a written debriefing checklist. It addressed

aspects of holistic symptom management, communication with the patient/family caregiver as a system, and teamwork of the students involved in the scenario. The focus was not only on areas for improvement in students' performance, but also on success factors, which contributed to a professional management of the situation. The two actresses were actively involved in the debriefing to share the patient/family caregiver experience during the scenario. The observers participated in the debriefing upon request of the debriefers. To keep the simulation scenario confidential, students who had participated in the intervention were asked not to share their knowledge of the scenario with others.

2.3 Statistical analysis

We computed mean scores for the 10 FNPS items and the 13 BPW items, respectively. Descriptive statistical methods were applied. We fitted a linear mixed model (LMM) to the mean FNPS score and the mean BPW score, respectively, with timepoint as independent variable and subject as random intercept. In contrast to classical repeated measures ANOVA, LMM can handle individual missing timepoints.[36]

Prior power analysis showed that with n = 46, four timepoints, a power of 0.8, a significance level of 0.05, and with assuming a subject autocorrelation of 0.5, the minimum detectable effect size is 0.17 (Cohen's f) for the global time effect, corresponding to a small to medium effect size.

Residual analysis was performed to check model assumptions. Global tests of time effect, pairwise contrasts with 95% confidence intervals with tukey adjustment and model-based predictions for each timepoint were computed from the fitted models. The statistical analysis was conducted with the statistical software R version 4.2.1, using the lme4 and the emmeans package. Results are presented as numbers (n)/percentages (%), as means/standard deviations (SD), as estimated means/standard errors, and as estimates, 95% confidence interval (CI) and *p*-values, respectively.

2.4 Ethical considerations

According to the Cantonal Ethical Committee Kanton Zürich, Switzerland, and the Research Committee for Scientific and Ethical Questions (RCSEQ) of the Private University for Health Sciences and Health Technology (UMIT), Hall in Tyrol, Austria, ethical approval was not necessary for this research study, as it does not fall within the scope of the Swiss Human Research Act. The participating students received oral and written information about the study and gave their written informed consent using REDCap® software.

3. Results

A total of 46 undergraduate nursing students participated in the study (response rate 42.32%). Participants' age ranged from 20-37 years (mean = 23.2, SD = 3.45). 78.3% (n=36) identified as female, 19.6% (n = 9) as male and 2.2% (n = 1) as divers. 52.2% (n = 24) had graduated from high school while 47.8% (n = 22) had an additional 3 years of vocational training in health care ("Fachfrau/-mann Gesundheit").

Table 1 illustrates the number of participants, mean, and standard deviation at the different times of measurement for the FNPS-/BPW-instruments.

Table 1. Development of number of participants, mean and standard deviation (SD) for FNPS and BPW

Time of measurement	FNPS			BPW		
	n	Mean	SD	n	Mean	SD
t1	46	2.57	.59	45	2.88	.46
t2	44	2.33	.65	43	2.96	.40
t3	41	2.08	.69	41	3.14	.38
t4	37	2.14	.80	37	3.10	.37

Note. FNPS: Self-efficacy 1 = high; 5 = low; BPW: Self-efficacy 1 = low; 4 = high

3.1 Development of predicted FNPS-Mean

Residual analysis showed no evidence against model assumptions. The global test of time effect on FNPS-mean showed a statistic of F(3,122.85) = 5.22 with a *p*-value of .002. Model-based predictions for the FNPS score are shown in figure 2 (t1 estimated marginal mean [emmean] = 2.57, standard error [SE] = .10; t2 emmean = 2.33, SE = .10; t3 emmean = 2.09, SE = .11; t4 emmean = 2.18, SE = .11).

3.2 Development of predicted BPW-Mean

Residual analysis showed no evidence against model assumptions. The global test of time effect on BPW-mean showed a statistic of F(3,119.83) = 9.33 with a *p*-value of .0001. Model-based predictions for the BPW score are shown in figure 3 (t1 emmean = 2.88, SE = .06; t2 emmean = 2.97, SE = .06; t3 emmean = 3.13, SE = .06; t4 emmean = 3.08, SE = .06).

3.3 Contrasts of times of measurement for FNPS and BPW

Table 2 illustrates the contrasts of times of measurement for FNPS and BPW. Regarding FNPS, there are statistically significant contrasts between t1 (before courses) and t3 (immediately after high-fidelity simulation) ($p = .0019$) and between t1 (before courses) and t4 (3 months after high-fidelity simulation) ($p = .0198$). Regarding BPW, there are statistically significant contrasts between t1 (before courses) and t3 (immediately after high-fidelity simulation) ($p \leq .0001$), t1 (before courses) and t4 (3 months after high-fidelity simulation) ($p = .0012$) as well as t2 (after courses) and t3 (after high fidelity simulation) ($p = .0112$). No statistically significant differences were found between the other times of measurement.

ISSN 1925-4040 E-ISSN 1925-4059

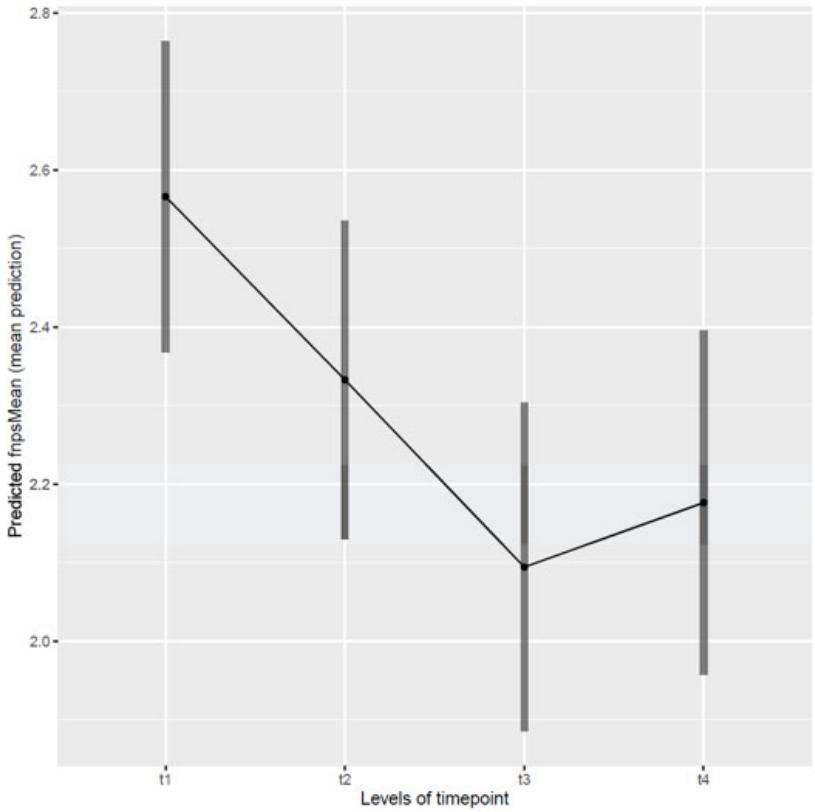

Figure 2. Development of predicted FNPS-Mean (Linear Mixed Model), point estimates with 95% CI

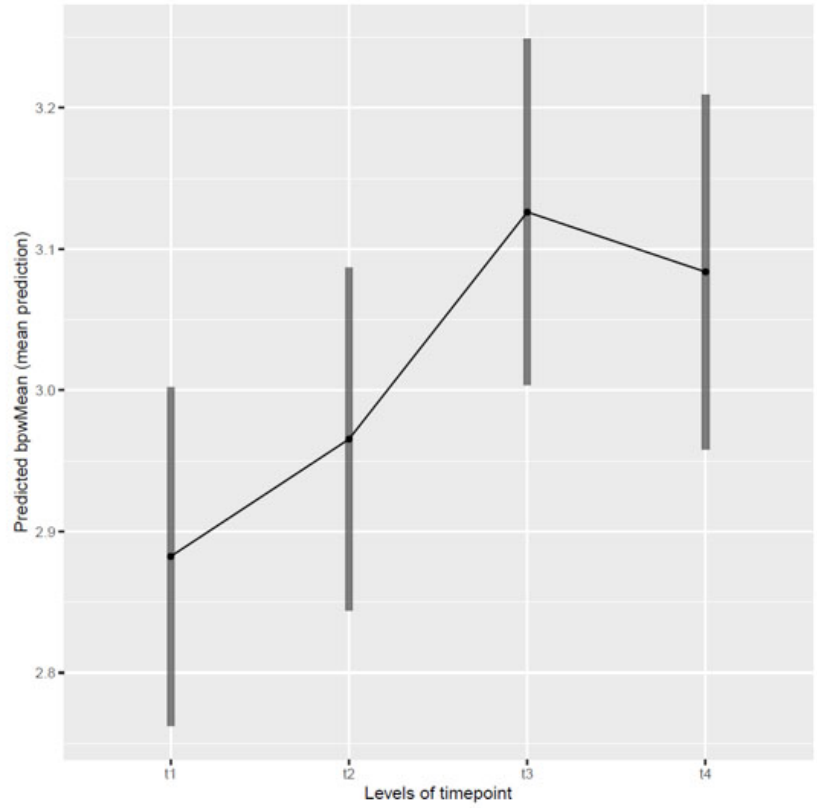

Figure 3. Development of predicted BPW-Mean (Linear Mixed Model), point estimates with 95% CI

Table 2. Contrasts of times of measurement for FNPS and BPW

Contrast times of measurement	FNPS			BPW		
	Estimate	95% CI	*p*-value	Estimate	95% CI	*p*-value
t2 – t1	-.23	-.56; .09	.2500	.08	-.05; .21	.3508
t3 – t1	-.47	-.81; -.14	.0019	.24	.11; .38	<.0001
t3 – t2	-.24	-.58; .01	.2567	.16	.03; .29	.0112
t4 – t1	-.39	-.73; -.05	.0198	.20	.06; .34	.0012
t4 – t2	-.16	-.50; .19	.6445	.12	-.02; .26	.1193
t4 – t3	.08	-.27; .43	.9295	-.04	-.18; .1	.8563

Note. t1 = before courses, t2 = immediately after courses, t3 = immediately after high-fidelity simulation, t4 = 3 months after high-fidelity simulation

4. Discussion

This study illustrates statistically significant differences in undergraduate nursing students' self-efficacy regarding family systems care (FNPS) and palliative care (BPW) between t1 (before courses) and t3 (immediately after high-fidelity simulation) as well as between t1 (before courses) and t4 (3 months after high-fidelity simulation). These results suggest that the combination of theoretical courses with traditional learning methods and high-fidelity simulation has a short-term and a long-term effect on students' self-efficacy regarding family systems care and palliative care. The main distinction between FNPS and BPW according to the level of statistical significance is the contrast between time of measurement t2 (immediately after courses) and t3 (immediately after high-fidelity simulation), where only the BPW shows statistical significance. This indicates that the high-fidelity simulation seems to be more effective in influencing the self-efficacy regarding palliative care than family systems care. A reason for this could be the didactic structure of the course "family systems care": There were mandatory communication skills trainings with standardized actors included so that the students had the possibility to practice family systems communication. As communication is a key component in family systems care, this training possibility could have led to smaller differences concerning self-efficacy regarding family systems care immediately after high-fidelity simulation (t3). In the palliative care course, there was only one voluntary communication training. Furthermore, palliative care consists of different aspects of holistic symptom management[2] which students could apply during the high-fidelity simulation, but not during the course. Moreover, high-fidelity simulation offers the students the possibility to learn through experiences and self-reflecting,[23,24] not only by listening.

For both FNPS und BPW there is a light decrease in self-efficacy between t3 (immediately after high-fidelity simulation) and t4 (3 months after high-fidelity simulation). This could be caused by the fact that students were in their clinical placement during the assessment of t4. They could have recognized the difference of their self-efficacy during simulation at university and in the reality of nursing practice. Lots of nursing students are affected by anxiety during their clinical placements due to their high sense of responsibility, fear of making mistakes or their interaction with patients.[37] Furthermore, the subjective theories of students[38] and their sense of self-efficacy could have clashed with the reality experienced in nursing practice by observing colleagues not applying key components of family systems care and palliative care. These experiences would have been the opposite of the first two sources of self-efficacy (own experiences of success, observation of positive experience in peers).[6]

Our results are consistent with systematic reviews regarding short-term effect on self-efficacy,[7,13] with Moreland et al.[17] focused on self-efficacy in the fourth, terminal phase of palliative care[3] and without integration of a family member in the scenario, with Weiler et al.[20] concerning a scenario of postpartum hemorrhage, with Sharour[19] in an oncological setting, and with Ruiz-Fernandez et al.[18] who evaluated three home visit-scenarios. Compared to Weiler et al.[20] we did not distinguish between the different student roles in the scenario because of the small sample size. The learning outcome concerning self-efficacy of students in the observer/documenter role seems to be the same as those of the students in the role of the first nurse in the scenario.[20] The study of Bates et al.[39] revealed no significant differences between the different student roles in high-fidelity simulation.

For future high-fidelity simulation research Hanshaw and Dickerson[13] recommended in their systematic review the focus on the retention of learning through simulation over time. For the outcome of self-efficacy this was done by Takhdat et al.[40] with a high-fidelity simulation scenario of a cardiopulmonary resuscitation compared to case-based learning over a period of 4 weeks. The authors reported a statistically significant difference in favor of the high-fidelity simulation group. This supports our findings of statistically significant results for the long-term-period of 12 weeks after

high-fidelity-simulation.

As the response rate was low, it was not possible to conduct a randomized controlled trial with a control group, which was originally planned. A reason for the low response rate could be the low motivation of the students to attend the high-fidelity simulation[41] caused by anxiety to expose oneself during a high-fidelity simulation.[42] Furthermore, the study was conducted during the semester and the students had to invest extra-time to participate in it.

In this study, a combination of a high-fidelity simulation manikin and standardized actors were used. In the literature, there are different simulation-based approaches to teach nursing students family systems care and palliative care with poorly applied evaluation methods and a lack of standardization.[43] Often, standardized actors play the role of patients instead of high-fidelity simulation manikins. This could be because communication and caring are key components of family systems care and palliative care. In nursing education practice, communication and caring are better known to be trained by standardized actors, community volunteers or lecturers. High-fidelity simulation can also be powerful to optimize the communication skills[44] and caring competencies[31] of undergraduate nursing students. The results of Basak et al.[45] showed higher student satisfaction and self-confidence in learning using high-fidelity simulation than with other simulation approaches. A combination of high-fidelity simulation manikin and standardized actor is also recommended by Fitzgerald and Ward[29] as an effective teaching strategy to connect the theory of family systems care with nursing practice. They emphasize the possibility of the standardized actors to give feedback to the students, as we did in our high-fidelity simulation.

Limitations

There are several study limitations: The maximum study population was predetermined as we could only include students enrolled in the current semester of the university. As mentioned above, due to the fact we could not conduct a randomized controlled trial, there was no control group. This means, that this study cannot compare high-fidelity simulation to the traditional learning methods. The sample size was not representative of the population, because only voluntary, motivated students participated from a single university. BPW has been validated in one study[34] and not all items have been used. FNPS and BPW are both self-administered tools. The accuracy and validity of self-reports can be contested.[46] There could also be responses to match social desirability. Students had time to fill in the forms for the time of measurement t1during a lesson.

Compared to Kirkpatrick Partners[27] organizational tool for the evaluation and categorization of the outcome criteria, our study reveals results from level 2, learning, of 4 levels. It's unknown if nursing students apply their family systems care and palliative care competence in practice for improving patient and family outcomes. Further educational research is required concerning level 3, changes in behavior, and level 4, impact on patient outcomes.

5. Conclusion

High-fidelity simulation in undergraduate nursing education is an important pillar of the curriculum, as it can have – in combination with traditional learning methods – positive short- and long-term effects on nursing students' self-efficacy regarding family systems care and early palliative care. The implementation of high-fidelity simulation regarding family systems care and palliative care in nursing curricula is recommended.

This study has revealed results concerning the effects of high-fidelity simulation on the self-efficacy of undergraduate nursing students regarding the training of family systems care in hospitalized adult patients and in the second, instable phase of palliative care, which were both missing in the current research. More research regarding other learning outcomes and using a study design with higher quality is needed.

Acknowledgements

The authors thank the participating students, Barbara Preusse-Bleuler for her support regarding family systems care during the development of the scenario, the lecturers for the theoretical courses of "Family Systems Care" and "Palliative Care", the simulation team at the Zurich University of Applied Sciences, Institute of Nursing, and the actresses for their help with the intervention, David Pfister for the permission to use the adapted version of BPW, and Martha Pryce for the proofreading of the article.

Conflicts of Interest Disclosure

The authors declare that there are no conflicts of interest.

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