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Effects of Simulation Based Learning in Psychiatry on Self-efficacy, Problem Solving Ability, and Knowledge of Nursing Students: A Systematic Review and Meta-analysis

Young-Ran Yeun*, Hye-Young Kim**

*Professor, Dept. of Nursing, Kangwon National University, Samcheok, Korea
**Professor, Dept. of Dental Hygiene, Kangwon National University, Samcheok, Korea

[Abstract]

The aim was to evaluate the effects of simulation based learning in psychiatry on self-efficacy, problem solving ability, and knowledge of nursing students. PubMed, Cochrane Library, Embase, CINAHL, KISS, RISS, and ScienceOn were searched until July 2023. A systematic review and meta-analysis was conducted of 22 studies (20 reports), with a total of 1,414 nursing students. Overall, simulation based learning in psychiatry appeared to have beneficial effects on self-efficacy (ES = 0.65, $p < 0.001$, I^2=71%), problem solving ability (ES = 0.15, $p < 0.001$, I^2=27%), and knowledge (ES = 0.45, $p = 0.003$, I^2=84%). These results demonstrate that, if integrated appropriately, a simulation educational approach can be used as an active learning methodology in psychiatric academic settings.

▸ **Key words**: Nursing, Students, Simulation, Psychiatry, Meta-analysis

[요 약]

이 연구의 목적은 정신과 시뮬레이션 기반 학습이 간호학생의 자기 효능감, 문제 해결 능력 및 지식에 미치는 영향을 평가하는 것이다. 2023년 7월까지 PubMed, Cochrane Library, Embase, CINAHL, KISS, RISS, ScienceOn을 검색하였다. 총 1,414명의 간호대학생을 대상으로 한 22개 연구(20개 보고서)에 대해 체계적 문헌고찰과 메타분석을 실시하였다. 전반적으로 정신분야에서 시뮬레이션 기반 학습은 자기 효능감(ES = 0.65, $p < 0.001$, I^2=71%), 문제 해결 능력(ES = 0.15, $p < 0.001$, I^2=27%), 지식(ES = 0.45, $p = 0.003$, I^2=84%)에 유익한 영향을 미치는 것으로 나타났다. 이러한 결과는 시뮬레이션 교육 접근법이 적절히 통합될 경우 정신간호학 교육 환경에서 능동적인 학습 방법론으로 사용될 수 있음을 보여준다.

▸ **주제어**: 간호, 학생, 시뮬레이션, 정신과, 메타분석

• First Author: Young-Ran Yeun, Corresponding Author: Hye-Young Kim
*Young-Ran Yeun (yeunyr@kangwon.ac.kr), Dept. of Nursing, Kangwon National University
**Hye-Young Kim (khy0606@kangwon.ac.kr), Dept. of Dental Hygiene, Kangwon National University
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I. Introduction

Clinical practice plays an important role in the education of nursing students. Through clinical practice, students can deepen their understanding of nursing principles and practical meaning by applying the concepts and skills learned in theoretical education to actual patient care[1]. Clinical practice also provides opportunities for students to think critically and develop clinical reasoning skills. Students encounter various patient cases in clinical practice, assess patient conditions, identify priorities, and learn how to implement an appropriate nursing process based on evidence[2].

However, due to the strengthening of patients' rights and safety issues, the clinical practice of nursing students is being conducted in increasingly restricted environments. Unlike the past, students are mainly participating in observation-centered practice rather than performing direct nursing[3]. In particular, psychiatric nursing practice is subject to more restrictions than other clinical practice subjects due to the clinical characteristics of nursing subjects and special treatment environments. Face-to-face practice with patients with clear psychiatric symptoms should consider the patient's risk of self-harm[4]. In addition, most of the nursing students do not have experience with mentally disabled subjects, so they are easily exposed to negative emotions such as fear and anxiety about practice, which causes a sense of helplessness in practice and is reported to reduce self-efficacy[5, 6]. Self-efficacy is the self-belief and confidence required applying the learned contents to practice, and acts as an important factor in connecting newly learned knowledge to action[7]. Nursing students with high self-efficacy work more actively to achieve their goals and cope more positively with setbacks than students with low self-efficacy[8]. Additionally, self-efficacy is closely related to satisfaction with clinical practice[9]. Self-efficacy is not a fixed concept, but can change in the future and can be promoted and improved through education[10].

Simulation training in psychiatry is gradually expanding as a way to supplement these limitations of clinical practice. Simulation training in psychiatry provides a safe and controlled environment in which nursing students can practice and apply their knowledge, skills, and critical thinking skills[11]. This allows students to engage in realistic scenarios that mimic the difficulties and complexities they may face in mental health nursing practice[12]. In addition, simulation training allows nursing students to encounter a wide range of mental health conditions and patient cases that may be limited in real clinical environments. Students may encounter scenarios related to psychiatric emergencies, behavioral disorders, mood disorders, and substance abuse[13]. Furthermore, simulation provides a safe environment for nursing students to learn from their mistakes without compromising patient safety[14]. In simulation, students can identify and manage potential errors, practice self-reflection, and receive constructive feedback from instructors or peers[15]. This feedback-driven approach helps develop continuous learning, self-improvement, and professional attitudes toward patient safety and quality care[16].

Accordingly, various studies are being conducted to identify the effects of simulation training in psychiatry, but studies systematically examining the effects are insufficient. Therefore, this study aims to present basic data for evidence-based nursing education by systematically reviewing and analyzing the effects of simulation training in psychiatry applied to nursing students on self-efficacy, problem solving ability, and learning satisfaction.

II. Preliminaries

Simulation in the medical field began in the 1960s when it was used in CPR training. Overseas, it began to be incorporated into student education

in the medical field from the mid-1980s, and domestic nursing education began in the 2010s[17]. In 2020s, as non-face-to-face classes and online practice increased due to COVID-19, it became mandatory for each subject.

The types of simulations used in psychiatric nursing education can be classified into standardized patients(SP), voice simulation(VS), web-based simulation, simulator with voice function, karate mannequin, video clip, etc.[18]. SP simulation was used to communicate with patients with schizophrenia, bipolar disorder, anxiety disorder, major depressive disorder, and manic episode, which are common diseases in psychiatry[19]. Research results showed that nursing students had opportunities to learn by forming trusting relationships and engaging in therapeutic communication with standardized patients rather than actual patients[20].

The VS consisted of performing the presented tasks while listening to voices recorded on tapes, CDs, and MP3s using headsets or earphones. The content of auditory hallucinations delivered through audio was selected as experienced by actual psychiatric patients and recorded by psychiatric clinical nurses, instructors, or the general public. Students performed tasks such as solving math problems, reading books, doing puzzles, and answering interviews while listening to various auditory hallucinations, including self-blaming, negative, and aggressive content[21]. Students stated that they were unable to concentrate while hearing auditory hallucinations and experienced emotional symptoms such as anxiety, restlessness, and physical symptoms such as palpitations, sweating, headaches, and abdominal pain[22]. Through this, it was reported that understanding of psychiatric patients experiencing abnormal symptoms increased, stigma regarding the disease decreased, and the ability to empathize with patients improved[23].

Simulations using simulators or mannequins made situations closer to reality, showing that students reached the learning goals of using therapeutic communication skills and applying core nursing skills[24]. To date, education on the use of simulators in psychiatric nursing has accounted for a small percentage compared to other subjects, but if we consider writing a script in advance and implementing it in advance so that the simulator responds to the student's nursing activities, we can expand its utilization[25].

Simulation using video clips allows the patient to discover problems and apply appropriate nursing interventions by watching videos repeatedly[26], and it can be seen that learning the nursing process based on critical thinking is possible[27].

As described above, the simulation used in psychiatric nursing is structured to reach the learning goal, and it can be seen that it is an educational method that can develop nurses' core competencies to perform their work when they become nurses.

III. Methods

1. Eligibility criteria

Data selection was carried out according to the guidelines of systematic literature review and meta-analysis presented in Preferred Reporting Items for Systematic Reviews and Meta-Analyses(PRISMA). The data selection criteria, PICO-SD(Participants, Intervention, Comparisons, Outcomes, Study Design), are as follows. Participants(P) are nursing students, and Intervention(I) is a simulation training developed for the management of patients with mental disorders such as schizophrenia, depression, bipolar, substance use disorders, anxiety disorders, and adjustment disorders. Simulations included role-play, SP, low/high fidelity simulation, virtual reality(VR), and VS used for educational purposes. Comparisons(C) is the group that received no intervention or another comparative intervention. Outcomes(O) are self-efficacy, problem solving

ability, and knowledge. During the preliminary simulation search, it was found that experimental studies were limited, so the study design(SD) included randomized controlled trials(RCT) as well as non-randomized controlled trials(non-RCT)and single-group pre/post studies that could confirm the effect of the intervention. Qualitative studies, descriptive surveys, meta-analyses, and longitudinal studies were excluded. In addition, studies published only as abstracts, studies for which full texts were not available, and studies with insufficient information necessary to calculate the effect size were excluded.

2. Literature search

The data search targeted articles published in the database by July 2023. The search engines that were used for the study were CINAHL, Cochrane library, Embase, Pubmed, Korean Information Service System(KISS), Research Information Service System(RISS), and ScienceOn.

The keywords that were used for the search were (nursing student*) AND (simulation* OR VR OR fidelity OR standardized patient* OR role-play OR voice OR manikin) AND (psychiatr* OR mental OR Psycho* OR schizophrenia OR depression OR bipolar OR substance use OR anxiety OR adjustment OR addiction* OR agitation OR delirium OR violence OR suicid*) AND (self-efficacy OR problem solving OR knowledge*) AND (single group OR one group OR experimental OR quasi-experimental OR controlled OR comparison* OR comparator* OR group* OR clinical trial* OR RCT OR random* OR allocation* OR placebo* OR single blind* OR double blind*). The search was restricted to data published in either Korean or English. Each researcher independently reviewed all the studies included in the analysis to ensure the integrity of the data collection and selection process. If there were disagreements among the researchers, they reevaluated the criteria for selecting and excluding data until a consensus was reached.

3. Data extraction

Data were extracted using an excel format configured according to the characteristics of the study. The main data extracted were title, author, year, study design, sample size, age, gender, type of simulation, clinical topic, intervention, outcome measurement, etc. Outcome indicators for eligible studies were independently extracted and data extraction forms were completed by two review authors. In case of disagreement, a consensus was obtained through discussion.

4. Data analysis

Statistical analysis of the effect size and homogeneity of the intervention program was conducted using RevMan 5.3 programs from the Cochrane Library. For effect size calculation, Standard Mean Difference(SMD) was used to standardize the results of each paper as a single unit. To evaluate the statistical homogeneity of the effect size, Higgins' I^2 test was used. As a result of the I^2 test, heterogeneity was judged to be low if the effect size was less than 25%, heterogeneity was considered moderate if the effect size was 50%, and high heterogeneity if the effect size was 75% or more[28]. A fixed effect model was used for merging effect sizes with confirmed homogeneity, and effect sizes were calculated with a random effect model when heterogeneity was confirmed. The statistical significance of the effect size was determined by the overall effect test and 95% confidence interval(CI), and the significance level was less than 5%. As for the effect size, based on the interpretation criteria of Cohen[29], an effect size of ES = 0.20 ~ 0.49 indicates a small effect, ES = 0.50 ~ 0.79 indicates a medium effect, and ES = 0.80 or more indicates a large effect. In the case of two intervention groups in one report, each was analyzed by dividing them into individual studies based on the previous study[30]. In the subgroup analysis, the effect of the moderating effect by intervention type, individual/group, duration, and total time was evaluated to confirm the difference

between the main variables affecting the effect size. The publication bias of the retrieved studies was tested using a funnel plot.

5. Risk of bias assessment

Among the studies included in the analysis of this study, there were no RCT, so the Risk of Bias Assessment Tool for Non-randomized Studies 2.0(RoBANS 2.0) was extracted as a risk of bias assessment tool. ROBANS 2.0 evaluates the eight items of participant comparability, participant selection, confounding variables, exposure measurement, blinding of outcome evaluation, outcome evaluation, incomplete outcome data, and selective outcome reporting as low risk, unclear, and high risk. Risk of bias assessments were performed independently by two review authors, and discrepancies were discussed to obtain concordant results.

IV. Results

1. Literature selection

A total of 586 articles were retrieved from the database. After excluding 119 duplicate searches, 164 articles were screened by reviewing the titles and abstracts of 467 articles. After reviewing the original text according to the selection and exclusion criteria, 20 reports were finally selected, and a meta-analysis was conducted on 22 studies(Figure 1). Giordano et al.[31] evaluated the effect of VR and SP, respectively, so they were divided into Giordano 2020 A and Giordano 2020 B during the meta-analysis. In addition, Sahin-Bayindir and Buzlu[32] also confirmed the effects of SP and high fidelity simulation, respectively, so they were divided into Sahin-Bayindir 2022 A and Sahin-Bayindir B for analysis. The entire process of selecting literature was independently conducted by two researchers, and in case of disagreement, the final paper was selected through discussion.

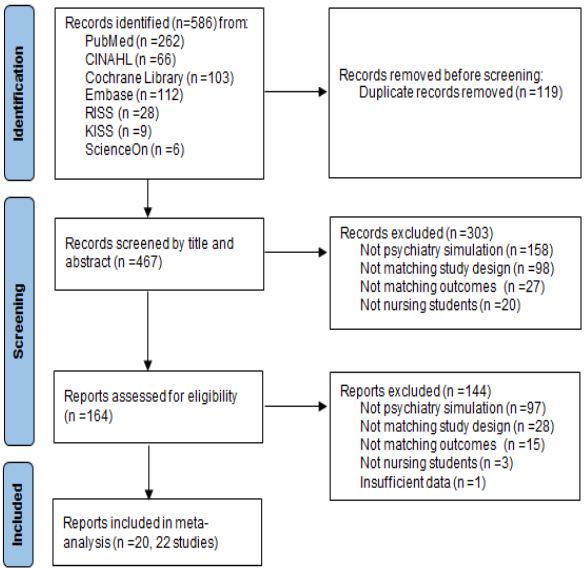


Fig. 1. Flow Diagram of Study Selection

2. Characteristics of the included studies

The characteristics of the 22 studies included in the meta-analysis are shown in Table 1. The study design consisted of 15 single-group pre/posttest studies(68.2%) and 7 non-RCT(31.8%), and there were no RCT. All of the papers were published after 2012, and the total number of participants was 1,414. There were 9 studies(40.9%) for 4th graders and 8 studies(36.4%) for 3rd graders. As for the type of simulation, 16 studies(72.7%) used SP, and VR was used in 4 studies(18.2%). Clinical topics included depressive disorder in 12 studies(54.5%), schizophrenia in 11 studies(50.0%), and alcohol use disorder in 5 studies(22.7%). As for the number of students per group, 8 studies(36.4%) were individually applied, and 4 to 5(18.2%) were the most in group-applied studies. As for the duration of training, 1 day was the most with 7 studie (31.8%), followed by 2 weeks with 3 studies(13.6%), and 1 semester with 3 studies(13.6%). Total training time varied from 1 hour to 90 hours.

3. Effects of simulation based learning in psychiatry

Twelve studies(54.5%) conducted simulation based learning to improve self-efficacy. The effect size was medium at 0.65(95% CI = 0.41 to 0.89, p<0.001), and

Table 1. Characteristics of Included Studies

First author and year	Study design	Participants				Interventions				Outcome measured
		Grade	Mean age	Female (%)	No. (eN, cN)	Type	Clinical topic	No. of students/ group	Duration, total intervention time	
Evans 2015	Single-group	2	19-50	NR	256	VS	A/H	1	1 day, NR	Knowledge
Gaylle 2019	Non-RCT	4	NR	NR	65 (32,32)	SP	SPR, MDD, AUD, BPD	1	2 weeks, NR	Knowledge
Giordano 2020 A	Single group	4	21.1	93.5	31	HFS, SP	ORON	6 ~ 7	1 day, 1hour	Knowledge
Giordano 2020 B	Single group	4	21.1	94.7	19	VR	ORON	1	1 day, 1 hour	Knowledge
Han 2021	Single group	3	23.1	80.5	40	VR	SPR, MDD, BPD, SUD, AD, AjD	3	10 days, 90 hour	SE
Kameg 2013	Single group	2 ~ 4	NR	91.5	35	SP, Rp	AUD, Trauma, PPD	3 ~ 5	4 days , 8 hour	Knowledge
Kameg 2021	Single group	2	20.12	87.3	102	SP	MDD, BPD, PD	5 ~ 6	1 day, 3 hour	Knowledge
Kang 2021	Non-RCT	3	23.7	75.6	46 (23, 23)	SP	SPR	1	1 day, 2 hour	SE
Kim, MJ 2022	Single group	3	22.6	93.9	49	SP	SPR, MDD, AUD, AD, NCD	4 ~ 5	6 weeks, 30 hour	SE
Kim, NS 2022	Single group	4	23.3	85	186	SP	SPR, MDD	4 ~ 5	6 weeks, 8 hour	SE, PS
Koch 2017	Non-RCT	4	20~59	81	59 (30, 29)	SP	MDD, Psychosis	NR	1 semester, NR	SE
Kunst 2017	Single group	4	NR	NR	44	HFS	Self-harm, agitation, PAWS	≥ 15	1 day, 4~5 hour	PS, knowledge
Lee 2021	Non-RCT	4	22.3	90.1	63 (31, 32)	VR	MDD	NR	1 week, 45 hour	SE, PS, knowledge
Moon 2022	Single group	3	24.4	92.6	27	SP	SPR, MDD, AUD, AD, NCD	4 ~ 5	12 weeks, 30 hour	SE, PS
Park 2012	Non-RCT	4	20~26	93.2	44 (23, 21)	SP	MDD	5 ~ 6	2 weeks, 5 hour	SE
Park 2018	Single group	3	22	93.4	61	SP	SPR	4 ~ 5	10 weeks, 20 hour	SE
Park 2021	Single group	3	NR	NR	31	VR	MDD, AUD	3	10 days, 90 hour	SE, PS
Sahin-Bayindir 2022 A	Single group	NR	20.6	85.7	42	SP	SPR, MDD	1	1 semester, NR	Knowledge
Sahin-Bayindir 2022 B	Single group	NR	20.8	78.9	40	HFS, SP	SPR, MDD	1	1 semester, NR	Knowledge
Seo 2020	Non-RCT	3	20~26	96.2	64 (31, 33)	SP	SPR	6 ~ 7	1 day, 7 hour	SE, knowledge
Speeney 2018	Single group	4	19~24	90.4	52	SP	SPR	1	7 1/2 weeks, NR	Knowledge
Yang 2022	Non-RCT	3	NR	85.3	58 (29, 29)	SP	Psychosis, A/H	1	2 weeks, 100 minutes	SE, knowledge

AD =anxiety disorder, AjD = Adjustment disorder, AUD = alcohol use disorder, A/H = auditory hallucination, BPD =bipolar disorder, HFS = high fidelity simulation, MDD = major depressive disorder, NCD = neurocognitive disorder, NR = not reported, ORON = opioid related overdose and naloxone, PAWS = post-acute ,PD = panic disorder, PPD = postpartum depression, PS = problem solving, Rp = role-paly, SE = self efficacy, SP = standardized patient, SPR = schizophrenia, SUD = substance use disorder, VR = virtual reality, VS = voice simulation

heterogeneity was moderate(I^2=71%)(Figure 2).

In the subgroup analysis, SP simulation showed a larger effect size than VR simulation, and the effect size was larger when applied to groups rather than individually. Additionally, the effect size was largest in the group with intervention duration of 6 to 8 weeks and in the group with a total intervention time of 20 to 45 hours(Table2). There was some publication bias on the funnel plot(Figure 3).

There were 5 studies(22.7%) that investigated the effect on problem solving ability. The effect size was 0.15(95% CI = 0.07 to 0.23, p<0.001), and the heterogeneity was low(I^2=27%)(Figure2). Due to the low heterogeneity, subgroup analysis was not performed. There was no publication bias(Figure3).

There were 13 studies(59.1%) that looked at knowledge. The effect size was 0.45(95% CI = 0.16 to 0.74, p = 0.003), and heterogeneity was

high(I^2=84%)(Figure2). In the subgroup analysis, VS simulation showed the largest effect size, and SP simulation showed a larger effect size than VR simulation. The individual intervention showed a larger effect size than the group, and the largest effect size was found in the intervention duration of 6 to 8 weeks. A statistically significant effect size appeared only when the total intervention time was 4 hours or more(Table2). There was no publication bias(Figure 3).

4. Risk of bias assessment

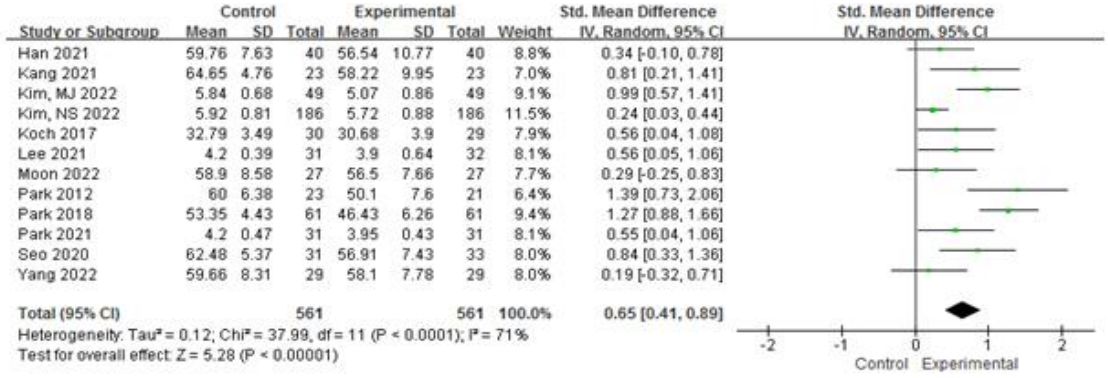
The results of the risk of bias assessment are shown in Figure 4. In the comparison possibility of participants, 20 studies(90.9%) had a low risk of bias because the two groups were homogeneous or the participants were the same before and after intervention. There were 2 studies(9.1%) evaluated by unclear because it was not clear whether confounding variables were identified in the confounding variables area. In blinding of the outcome assessments, there were 11 studies(50.0%) without mention of the rater, and there were 3 studies(20.0%) with a high risk of bias because the researcher conducted the evaluation himself. In the incomplete outcome data, one study(4.5%) was evaluated as having a high risk of bias due to the high dropout rate of the participants. In all other domains, the risk of bias was low.

V. Discussion

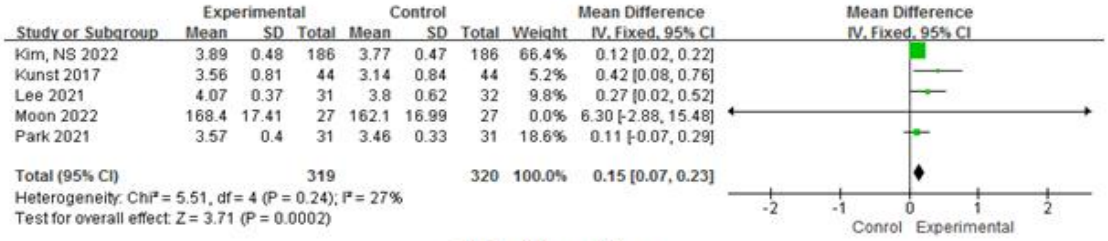
This evidence-based study aims to explore the effects of simulation based learning in the field of mental health nursing on self-efficacy, problem-solving ability, and knowledge among nursing students. The study also aims to identify the main components that significantly influence the effect size of the simulation training.

As a result of this study, simulation based learning in psychiatry showed a medium effect size in enhancing self-efficacy in nursing students. This is a similar result to a previous study that verified the effectiveness of simulation learning using SP for nursing students in other fields. Oh et al.[33] conducted a meta-analysis of 18 controlled trials applied to all fields of nursing and reported that simulation-based learning using SP had a moderately significant effect on improving self-efficacy. Yun et al.[34] also emphasized that Situation, Background, Assessment, and Recommendation (SBAR)-based simulation training had positive results in improving learning self-efficacy in a systematic review of 12 papers conducted in nursing education. In addition, Oliveira Silva et al.[35] also support the results of this study by saying in a methodological report on simulation intervention that mannequins, standardized patients, and virtual simulators contribute to improving students' confidence. Students with a high level of self-efficacy are more likely to approach challenging situations with confidence and thus demonstrate their competence in clinical practice[36]. In addition, the possibility of participating in effective communication, forming a therapeutic relationship with the patient and actively participating in treatment increases[37]. Therefore, developing and fostering self-efficacy in nursing education can contribute to quality nursing provision and better patient outcomes.

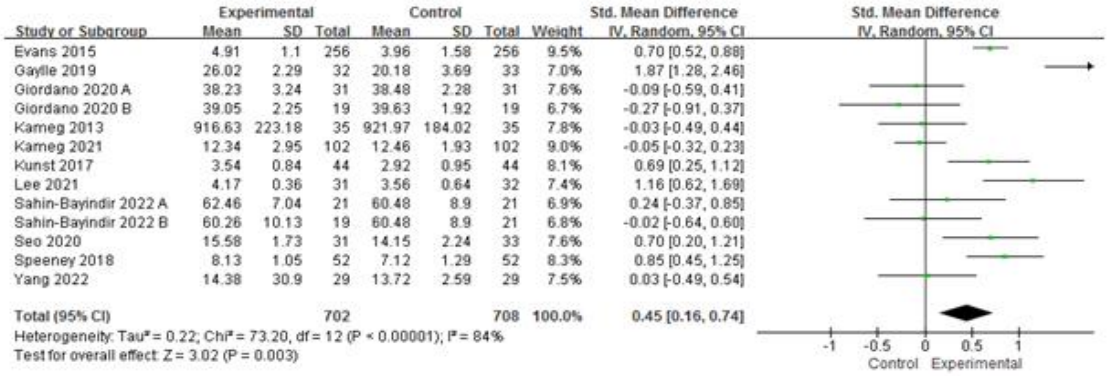
Simulation based learning also had a statistically significant effect on improving students' psychiatric problem-solving ability. Lee and Oh[38], who conducted a meta-analysis of 26 controlled clinical trials, reported that high-fidelity patient simulation(HFPS) had a large effect size on the problem-solving ability of nursing students, supporting the results of this study. Mulyadi et al.[39] also stated that simulation technology-based learning not only improves nursing students' problem-solving abilities, but also provides an opportunity to bridge the gap between theory and clinical practice. Meanwhile, Arslan et al.[40], who



A. Self-efficacy

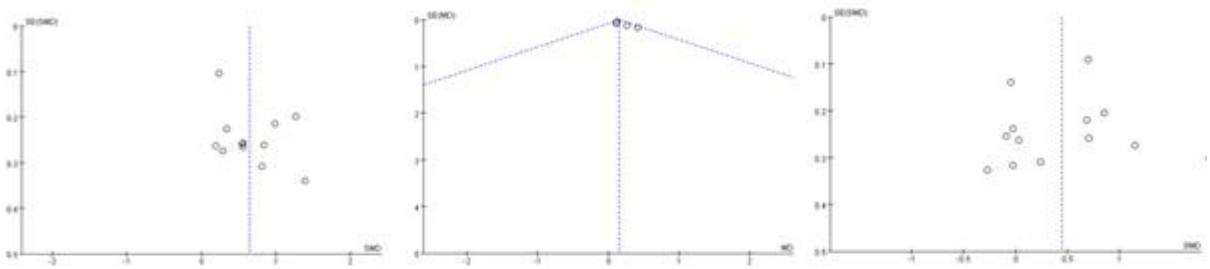


B. Problem solving



C. Knowledge

Fig. 2. Forest Plot of the Effects of Simulation Training in Psychiatry



A. Self-efficacy B. Problem solving C. Knowledge

Fig. 3. Funnel Plot of the Effects of Simulation Training in Psychiatry

Table 2. Subgroup Meta-analysis of Self-efficacy and Knowledge

Categories		Self-efficacy				Knowledge			
		ES	95% CI	N	I^2 (%)	ES	95% CI	N	I^2 (%)
Type	SP	0.71	0.40, 1.03	9	78	0.59	0.05, 1.13	6	88
	VR	0.47	0.19, 0.75	3	0	0.45	-0.95, 1.85	2	91
	HFS	-	-	-	-	0.69	0.25, 1.12	1	-
	VS	-	-	-	-	0.70	0.52, 0.88	1	-
	Combined	-	-	-	-	-0.05	-0.35, 0.25	3	0
Individual /group	Individual	0.48	-0.13, 1.09	2	57	1.02	0.81, 1.22	7	87
	Group	0.72	0.38, 1.05	8	80	0.57	0.37, 0.76	6	40
Duration	1 day	0.59	-0.15, 1.32	2	0	0.26	-0.08, 0.60	7	83
	1 ~ 2 weeks	0.56	0.22, 0.91	5	55	1.01	-0.04, 2.06	3	91
	6 ~ 8 weeks	0.83	0.44, 1.22	2	90	0.85	0.45, 1.25	1	-
	≥ 10 weeks	0.73	0.12, 1.34	3	79	0.11	-0.32, 0.55	2	0
Total time	≤ 3 hours	0.48	-0.13, 1.09	2	57	-0.22	-0.78, 0.34	4	0
	4 ~ 8 hours	0.77	0.09, 1.45	3	86	0.72	0.37, 1.07	3	14
	20 ~ 45 hours	0.96	0.57, 1.35	3	58	0.61	0.35, 0.87	1	-
	≥ 90 hours	0.43	0.10, 0.76	2	0	-	-	-	-

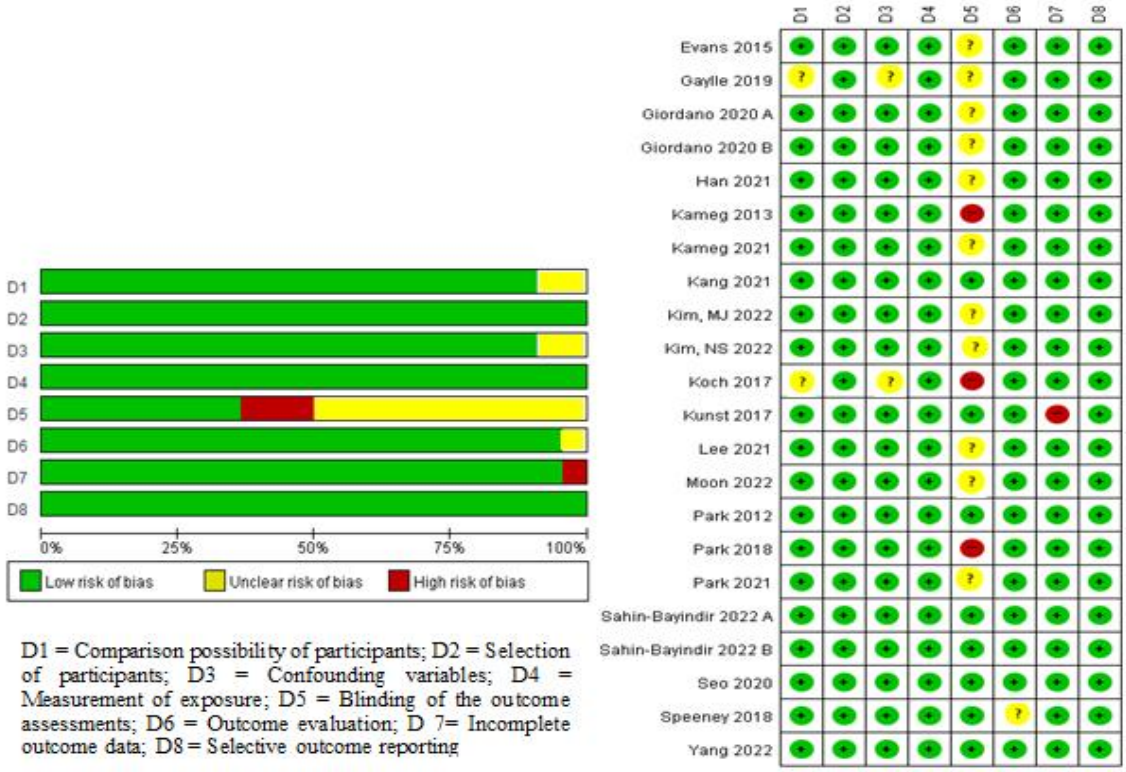


Fig. 4. Assessment of Risk of Bias

conducted a meta-analysis on the effectiveness of simulation-based Peripheral intravenous catheterisation(PIVC) training for nursing students and hospital nurses, reported that compared to the plastic arm training method, the effects of virtual IV training on skills, satisfaction, and anxiety are still unclear. Psychiatric practice involves complex and dynamic situations in which patients may exhibit a variety of symptoms and difficulties. Effective problem-solving skills enable students to identify and understand patients' nursing problems, set nursing goals, and develop appropriate intervention plans[41]. Additionally, psychiatric practice often requires the management of crisis situations such as suicidal thoughts, aggressive behavior, or severe emotional distress. Nursing students should possess problem-solving skills to think quickly, assess risks, and implement

appropriate interventions to ensure patient safety and well-being[42, 43]. The ability to stay calm, analyze the situation, and make an informed decision is very important in these high-stress situations.

Simulation based learning also showed a positive effect on psychiatric knowledge. La Cerra et al.[44] stated in a meta-analysis of 33 papers that simulation based on life-threatening clinical condition scenarios had a medium effect size in improving knowledge of undergraduate and graduate nursing. Li et al.[45], who explored the effects of high-fidelity simulation(HFS) in nursing education, also reported that HFS can more effectively foster nursing students' knowledge, skills, collaboration, and consideration. In addition, Tong[46] confirmed that HFS with prebriefing applied to nursing education was effective in improving nursing students' knowledge, skills, satisfaction, and critical thinking, supporting the results of this study. As in all fields of nursing, in the field of mental health, it is essential to keep up to date with the latest research, evidence-based interventions, and clinical techniques in the field to provide optimal care to patients[47]. Through simulation training, nursing students can obtain the most up-to-date and accurate information about mental health disorders, nursing methods, medications, and interventions. Also, knowledge is not limited to health care providers. Knowledge is also a powerful tool for patients and their families. Psychiatric nurses who actively promote knowledge can empower patients and families by providing accurate information about mental health conditions, treatment options, and self-management strategies[48]. Therefore, experience through simulation can lead to better results by equipping nursing students with the necessary skills and expertise to provide comprehensive and effective nursing care to patients.

A subgroup analysis was conducted comparing the effect sizes of SP simulation and VR simulation. The results showed that SP simulation had a larger effect size compared to VR simulation. SP and VR are both valuable tools in education with their own strengths and limitations. Although it is difficult to make definitive statements about the effectiveness of each other, there are certain aspects for which SP simulations are often considered more effective. First, SP simulations involve trained actors or individuals who realistically portray patients, allowing learners to interact with humans representing emotions, body language, and communication nuances. This authenticity can enhance the learning experience by providing a more realistic representation of clinical encounters compared to VR[49]. SP simulations also provide opportunities for learners to develop and practice communication and interpersonal skills such as active listening, empathy, and relationship building[50]. VR simulation may not always capture the subtleties and nuances of human interaction, which can make it difficult for learners to develop these essential skills effectively. Moreover, SP simulations allow educators to modify SP behaviors, reactions, and clinical presentations in real time to tailor the experience to appropriately challenge and engage learners[51]. This adaptability and variability can be more difficult to achieve in VR. However, it should be noted that VR offer unique benefits in training, such as providing an immersive and controlled environment for procedural training, or experiences that are difficult to reproduce with SPs, such as rare medical conditions or high-risk situations[52]. SP simulations and VR simulation each have their own strengths, so combining and complementing approaches depending on learning objectives, available resources, and desired outcomes of training programs can provide a balanced and effective training experience.

In subgroup analysis, group intervention was effective in increasing self-efficacy, and individual intervention was effective in enhancing knowledge. The intervention duration was also considered in

the analysis. The largest effect size was observed in the group that received the intervention for 6 to 8 weeks. Furthermore, a statistically significant effect size appeared only when the total intervention time was 4 hours or more. Intervention method, duration, and total intervention time are important considerations in simulation education because they directly affect the quality of the learning experience[53]. Based on the results of this study, by selecting an appropriate intervention method, designing appropriate intervention duration, and providing sufficient total intervention time, educators can optimize the effectiveness of simulation in psychiatry, strengthen learner participation, and promote meaningful skill acquisition and knowledge application.

The limitations of this study are as follows. First, there is a lack of RCT. By randomly assigning participants to different groups, RCT minimize biases and confounding factors. The absence of RCT in this study reduces the internal validity, limiting the ability to draw strong conclusions about cause and effect relationships. Second, it has a high proportion of single-group pre/post studies. Without a comparison group, it becomes challenging to determine if the observed changes are truly due to the intervention or other factors. Further studies are required to include a control group or to adopt a more robust study design. Third, heterogeneous measurement tools were used. This variation makes it difficult to compare and combine results across studies, hindering the identification of consistent patterns and mediating factors. Developing standardized measurement tools can promote consistency and comparability across studies, facilitating the identification of common mechanisms and effect sizes. Despite several limitations, this study highlights the positive impact of simulation-based learning in psychiatric nursing on self-efficacy, problem-solving ability, and knowledge among nursing students. It provides valuable insights into the optimal intervention formats, duration, and total intervention time required to maximize the benefits of simulation-based learning in this field.

VI. Conclusion

This study conducted a systematic literature review and meta-analysis to explore the effects of simulation-based learning in the field of psychiatric nursing on self-efficacy, problem-solving ability, and knowledge of nursing students. As a result of analyzing 22 studies with a total of 1414 participants, simulation in psychiatry had a moderate effect on self-efficacy and a small effect on problem-solving ability and knowledge. In the subgroup analysis conducted, it was found that the SP simulation yielded a larger effect size compared to the VR simulation. Additionally, group intervention was effective in increasing self-efficacy, and individual intervention was effective in improving knowledge. The study also identified that the most effective duration for the interventions was 6 to 8 weeks. Furthermore, it was noted that a significant effect was observed only when the total intervention time amounted to at least 4 hours. Future studies could consider implementing randomized controlled trials, incorporating control groups, and using standardized measurement tools to enhance internal validity, minimize bias, and improve the generalizability of findings.

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Authors

Young-Ran Yeun received the B.S. degree in Nursing from Sahmyook University in 1993, the M.S. degree in public health form AIIAS in 2008, and the Ph.D. degree in Nursing from the Catholic University, Korea, in 2012. Dr. Yeun joined the faculty of the Department of Nursing at Kangwon National University, Samcheok, Korea, in 2014. She is currently a Professor in the Department of Nursing, Kangwon National University. She is interested in health promotion, psychiatric mental health, and research methods.

Hye-Young Kim received B.S., in industrial engineering at Kyungnam University in 2000. M.S. in preventive dentistry from Kyungpook National University, Korea, in 2002. Ph.D. from Chonnam National University, Korea, in 2006, respectively. Dr. Kim joined the faculty of the Department of Dental Hygiene at Dongeui University, Korea, in 2008. She is currently a professor in the Department of Dental Hygiene, at Kangwon University. She is interested in basic dentistry.