http://medicaleducation-bulletin.ir
Systematic Review (Pages: 983-995)

Effectiveness of High-Fidelity Simulation in Enhancing the Clinical Judgment of Undergraduate Nursing Students: A Systematic Review

Reza Mohammadpourhodki [1], *Hossein Karimi Moonaghi [2, 3]

[1]Student Research Committee, School of Nursing and Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran. [2]Professor, Nursing and Midwifery Care Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. [3]Professor, Medical Sciences Education Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Abstract

Background: High-Fidelity Simulation (HFS) has emerged as a transformative approach in nursing education, particularly in enhancing students' learning outcomes, such as clinical judgment skills. This study aims to review the existing literature on the impact of HFS on the clinical judgment skills of undergraduate nursing students.

Materials and Methods: In this systematic review, a comprehensive search was conducted across online databases, including PubMed, Scopus, Web of Science, ERIC, and Google Scholar, with no time limit up to July 2024. Two reviewers selected relevant studies and assessed their quality using the Joanna Briggs Institute (JBI) scale.

Results: Finally, 11 articles were included in the review, indicating that students engaged in HFS experience significant improvements in clinical judgment scores compared to those using traditional methods. This immersive educational approach not only enhances clinical judgment but also equips nursing students with essential skills for success in real-world clinical environments. HFS provides a safe space for practicing complex procedures, fostering critical decision-making, and promoting collaboration and ethical practice. By combining theoretical knowledge with practical experience, HFS prepares learners to confidently manage professional challenges.

Furthermore, evidence suggests that HFS is comparable to traditional clinical training in developing essential nursing skills, with no significant differences in clinical judgment scores between students trained through HFS and those receiving conventional training. These findings highlight the importance of integrating HFS into nursing curricula to better prepare future healthcare professionals for their roles.

Conclusion: The evidence strongly indicates that High-Fidelity Simulation effectively enhances clinical judgment among nursing students. Both HFS and traditional clinical training significantly improve clinical judgment, highlighting the importance of incorporating diverse teaching methods into nursing curricula.

Key Words: Clinical Judgment, High-Fidelity Simulation, Effects, Nursing Student.

*Please cite this article as: Mohammadpourhodki R, Karimi Moonaghi H. Effectiveness of High-Fidelity Simulation in Enhancing the Clinical Judgment of Undergraduate Nursing Students: A Systematic Review. Med Edu Bull 2024; 5(2): 983-95. DOI: **10.22034/MEB.2024.489705.1099**

Corresponding Author:

Hossein Karimi Moonaghi, Professor, Medical Sciences Education Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Email: karimih@mums.ac.ir

Received date: Jul. 12, 2024; Accepted date: Dec.22, 2024

1- INTRODUCTION

High-Fidelity Simulation (HFS) has emerged as a transformative educational strategy in nursing, particularly in enhancing the clinical judgment skills of undergraduate nursing students. Clinical judgment is a critical competency in nursing practice, defined as the ability to assess patient needs, identify health issues, and make informed decisions regarding care (1, 2). This process is multifaceted and influenced by various factors, including theoretical knowledge, clinical experience, and problem-solving abilities (3). Despite its significance, studies indicate that many nursing graduates struggle to apply clinical judgment effectively in real-world clinical settings, raising concerns about their preparedness for practice (4).

As nursing education evolves to meet the demands of modern healthcare, simulation-based learning has gained traction as an effective pedagogical approach. High-Fidelity Simulation replicates realistic clinical scenarios, allowing students to practice and refine their clinical judgment skills in a safe and controlled environment (5). This immersive learning experience not only enhances theoretical understanding but also fosters critical thinking and decision-making abilities essential for effective patient care (6). For instance, HFS provides opportunities for students to engage in role-playing and scenario-based exercises that closely mimic actual clinical situations, thereby promoting active learning and knowledge retention (7, 8).

Given the increasing integration of HFS into nursing curricula, it is crucial to systematically evaluate its impact on clinical judgment skills. Previous research has shown that students who participate in HFS demonstrate significantly improved clinical performance and greater confidence in their decision-making abilities compared to those who undergo traditional training methods (9, 10). However, while HFS generally enhances these skills, its effectiveness may vary based on contextual factors such as the learning environment and individual student characteristics (11, 12).

This study aims to critically appraise the existing scientific literature on the effects of HFS on the clinical judgment skills of undergraduate nursing students. By synthesizing findings from various studies, this review seeks to provide insights into the effectiveness of HFS as an educational tool and identify areas for further research. Ultimately, this study aims to inform educators and policymakers about best practices in nursing education, ensuring that future nurses are adequately prepared to meet the challenges of patient care.

2- MATERIALS AND METHODS

This systematic review of experimental studies was conducted in accordance with the guidelines established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (13).

2-1. Eligibility Criteria

The Participants, Interventions, Comparators, and Outcomes (PICO) framework was used to formulate the review objective and inclusion criteria (14).

- Participants: Undergraduate nursing students,
- Interventions: HFS-based education,
- Comparators: Traditional teaching methods versus HFS-based education,
- Outcomes: Clinical judgment skills.

2-2. Search Strategy

A comprehensive systematic search was conducted to identify articles published until July 2024 across several databases, including Web of Science, PubMed, ERIC,

Scopus, and Google Scholar (limited to the first 100 articles). The search utilized keywords related to clinical judgment and nursing students. Specifically, the search strategy employed in PubMed was: (Clinical Judgment [tiab]) AND (Students, Nursing [mh] OR Nursing Student [tiab]).

Two researchers independently conducted the literature search under the supervision of an experienced medical librarian. To ensure thoroughness, a manual review of bibliographies from selected articles and grey literature was also performed, with any disagreements resolved by a supervisor.

In this study, clinical judgment is defined as a reflective and reasoning process that integrates all available data and is informed by a robust knowledge base, leading to clinical conclusions (15).

2-3. Inclusion Criteria

The inclusion criteria for this systematic review were designed to identify relevant and high-quality studies on the impact of High-Fidelity Simulation (HFS) on clinical judgment in undergraduate nursing students. Only studies published in English that employed a quasi-experimental or randomized controlled trial (RCT) design were included. The primary intervention had to involve HFS-based learning focused on improving clinical judgment skills, with clinical judgment explicitly measured as an outcome. Additionally, only studies that quantitatively assessed clinical judgment were considered. Articles published up to March 2024 with full-text availability were included, and studies needed to meet the quality standards set by the Joanna Briggs Institute (JBI) scale (16, 17).

2-4. Exclusion Criteria

The exclusion criteria included non-experimental designs, such as observational or qualitative studies. Articles published in languages other than English were also excluded. Additionally, studies that assessed outcomes other than clinical judgment or employed interventions other than HFS-based learning were not considered. Furthermore, conference abstracts, editorials, and opinion pieces were excluded from the review.

2-5. Study Selection

The studies retrieved from the electronic databases were imported into EndNote X9 reference management software. First, duplicate records were removed, and then titles and abstracts were screened to identify relevant studies. The full texts of articles were reviewed as necessary, and finally, selected studies were evaluated for eligibility. All these steps were conducted independently by two of the authors, and any discrepancies were resolved through discussion. The following data were independently extracted for each included article: authors' names, publication year, country, methodology, sample size, target population, interventions, control group, duration of the intervention, and main findings.

2-6. Quality Assessment

The quality of each randomized controlled trial (RCT), and quasi-experimental study included in this review was independently assessed by two authors using the Joanna Briggs Institute (JBI) scale, a critical appraisal tool designed to evaluate the methodological quality of various types of studies (16, 17). This scale employs a scoring system where responses are rated as follows: 0 for "No," 1 for "Unclear," and 2 for "Yes," with total scores ranging from 0 to 14. Based on these scores, studies are classified into three categories: Weak (0–10), Moderate (11–17), and Strong (18 or above). To reach a consensus on the quality assessments, the two researchers engaged in face-to-face discussions, ensuring that all evaluations were thorough and well-founded.

2-7. Meta-Analysis

Due to significant differences among the selected studies in objectives, outcomes, methodologies, and participant characteristics, we were unable to conduct a quantitative synthesis or meta-analysis. The variability in study designs and intervention types further complicated the pooling of results. Consequently, we presented the findings systematically to provide a clear and comprehensive overview of the evidence while acknowledging the unique contributions of each study.

3- RESULTS

A total of 11 articles met the inclusion criteria for this systematic review (**Figure 1**). The quality assessment details for the included articles are presented in **Tables 1** and **2**. The main characteristics of the selected studies are summarized in **Table 3** and in the following section:

3-1. General Characteristics of the Included Studies

The 11 studies included in this review involved a total of 1,082 undergraduate nursing students, all published in English. One study was published in 2014, while the remaining ten were published thereafter, up to 2023. All studies utilized a validated instrument, the Lasater Clinical Judgment Rubric (18), to measure outcomes. The studies comprised ten quasi-experimental designs (19-28), and one clinical trial (29), with sample sizes ranging from 45 to 276 participants. Three studies were conducted in South Korea, four in the United States, and the others in various countries.

In these studies, students in the intervention group received high-fidelity simulation (HFS)-based training, while those in the control group participated in traditional educational methods, including regular lectures, skill labs, and clinical practicums. Five studies specifically employed manikin simulator technology (19-23), while the others did not specify the exact technology used. Additionally, all reviewed studies included debriefing sessions after simulations and assessed clinical judgment in various contexts, such as patient management in life-threatening situations and complex scenarios like bacterial meningitis, acute congestive heart failure with a hip fracture, stroke, asthma, and acute complications of diabetes.

3-2. Quality Appraisal

Of the 11 studies included, ten employed a quasi-experimental design, while one study was a randomized controlled trial (RCT), which was rated as having moderate quality (**Table 1**). The quasi-experimental studies received quality ratings ranging from moderate to high (**Table 2**).

Table 1: Quality Assessment of Randomized Controlled Trial Study Using the Joanna Briggs Institute Scale.

First Author, Year, Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Oh, 2021, (29)	1	0	2	0	0	0	2	2	2	2	2	2	2

Note: Each column from Q1 to Q13 represents specific quality assessment criteria. The scores indicate the level of adherence to each criterion, with a score of 0 signifying "No," a score of 1 indicating "Unclear," and a score of 2 representing "Yes."

Interpretation of Quality Assessment Questions for Randomized Controlled Trials (RCTs)

The following questions assess the quality of randomized controlled trials (RCTs) based on the Joanna Briggs Institute (JBI) criteria (16, 17):

Q1: True Randomization
Was true randomization used for assigning participants to treatment groups?
Q2: Allocation Concealment
Was allocation to treatment groups concealed from those involved in the trial?
Q3: Baseline Similarity
Were treatment groups similar at baseline to minimize pre-existing differences?
Q4: Participant Blinding
Were participants blinded to their treatment assignment to reduce reporting bias?
Q5: Treatment Provider Blinding
Were those delivering treatments blinded to group assignments to minimize performance bias?
Q6: Outcome Assessor Blinding
Were outcome assessors blinded to treatment assignments to reduce detection bias?
Q7: Identical Treatment Conditions
Were experimental groups treated identically except for the intervention?
Q8: Follow-Up Completeness
Was follow-up complete, and were differences in follow-up adequately described and analyzed?
Q9: Intention-to-Treat Analysis
Were participants analyzed in the groups to which they were randomized?
Q10: Consistent Outcome Measurement
Were outcomes measured consistently across treatment groups?
Q11: Reliable Measurement
Were outcomes measured using reliable methods?
Q12: Appropriate Statistical Analysis
Was appropriate statistical analysis applied to the data?
Q13: Trial Design Appropriateness
Was the trial design suitable, and were deviations from standard RCT protocols justified?

Table 2: Quality Assessment of Quasi-Experimental Studies Using the Joanna Briggs Institute Scale.

First Author, Year, Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Yang, 2021, (19)	2	2	2	2	2	2	2	2	2
Johnson, 2016, (20)	2	0	2	2	0	1	1	2	2
Reid, 2020, (21)	2	2	2	0	0	0	2	2	1
Yuan, 2014, (22)	2	2	2	0	2	2	2	2	2
Klenke-Borgmann, 2021, (23)	2	2	2	2	0	0	2	2	2
Ayed, 2022, (24)	2	2	0	2	0	2	2	2	2
Fawaz, 2016, (25)	2	2	2	2	0	2	2	2	2
Kim, 2019, (26)	2	0	2	2	0	2	2	2	1
Shin, 2014, (27)	2	2	2	0	2	2	2	2	1
Byrne, 2023, (28)	2	2	2	0	2	0	2	2	2

Note: Q1 to Q9: These columns represent specific quality assessment questions or criteria used to evaluate each study. A score of 0 indicates "No," 1 indicates "Unclear," and 2 indicates "Yes."

Interpretation of JBI Quality Assessment Questions (16, 17):

Q1: Clarity of Cause and Effect
Assesses whether the study clearly defines which variable is the cause and which is the effect, ensuring valid conclusions.
Q2: Similar Comparisons among Participants
Evaluates whether participants were included in similar comparisons, enhancing the relevance of the results.
Q3: Treatment/Care Comparisons
Examines whether participants receiving different treatments were comparable, thereby isolating the intervention's effects.
Q4: Presence of a Control Group
Checks for the presence of a control group to compare outcomes, which is essential for establishing causal relationships.
Q5: Multiple Measurements of Outcomes
Assesses whether outcomes were measured both pre- and post-intervention, improving reliability and depth of analysis.
Q6: Completeness of Follow-Up
Evaluates whether follow-up data was complete and whether differences between groups were analyzed, ensuring robustness.
Q7: Consistency in Outcome Measurement
Checks if outcomes were measured consistently across participants to allow for valid comparisons.
Q8: Reliability of Outcome Measurement
Assesses whether reliable methods were used to measure outcomes, ensuring accuracy.
Q9: Appropriateness of Statistical Analysis
Evaluates whether statistical analyses were clearly described, which is critical for understanding the conclusions drawn from the data.

Table 3: Summary of Study Characteristics Included in This Review (n=11).

Authors, Year, Reference	Country	Methodology	Participants	Sample size	Intervention	Control group	Duration	Main Findings
Ayed et al., 2022, 24	Palestine	Quasi-experimental	Baccalaureate nursing students	150	Simulation training on bacterial meningitis case	Yes	1 month	Improvement was observed in both groups, with a more pronounced effect in the intervention group.
Fawaz et al., 2016, 25	Jordan	Quasi-experimental	Nursing students	56	Simulation on acute congestive heart failure	Yes	1 month	The intervention group demonstrated superior clinical judgment compared to the control group.
Johnson et al., 2012, 20	UK/USA	Quasi-experimental	Baccalaureate nursing students	275	Simulation on geriatric hip fracture	Yes	Not mentioned	Role modeling had a positive influence on clinical judgment outcomes.
Kim et al., 2019, 26	South Korea	Non-synchronized quasi-experimental	Undergraduate nursing students	74	Simulation for stroke and asthma care	Yes	72 hours	Structured preparation significantly enhanced learning outcomes.
Klenke-Borgmann et al., 2021, 23	USA	Quasi-experimental	Nursing students	45	Simulations integrating pathophysiologic concepts	Yes	16 weeks	In-class simulations resulted in notable improvements in clinical judgment skills.
Oh, 2021, 29	South Korea	Randomized Controlled Trial	Nursing students	56	Simulation scenario on acute diabetes complications	Yes	1 month	Transformative learning theory significantly improved clinical judgment scores compared to the control group.
Reid et al., 2020, 21	USA	Quasi-experimental pre/post-test	Nursing students	62	Simulation about mother-baby dyad	Yes	Not mentioned	Both training methods produced similar clinical judgment scores, indicating equivalence in educational effectiveness.
Yang et al., 2020, 19	South Korea	Quasi-experimental	Undergraduate nursing students	65	Simulation scenarios about neonatal emergencies	Yes	4 weeks	Neonatal simulation practice significantly improved clinical judgment compared to control conditions.
Yuan et al., 2014, 22	Canada	Quasi-experimental single-group study	Undergraduate nursing students	113	Five simulated scenarios including various medical conditions	No	Not mentioned	Continuous improvement was observed across multiple simulation scenarios, indicating effective learning progression.
Shin et al., 2014, 27	South Korea	Quasi-experimental	Senior nursing students	95	Various pediatric care simulations	No	3 weeks	Integrated course content effectively enhanced students' ability to make sound clinical judgments across various scenarios.
Byrne et al., 2023, 28	USA	Quasi-experimental	Nursing students	91	Unfolding case study across primary care, acute care, and home healthcare settings.	No	Not mentioned	The results indicate that simulation-based education significantly improves clinical judgment among nursing students, particularly when implemented over multiple sessions.

3-3. Impact of HFS on Clinical Judgment

Most studies indicate that high-fidelity simulation (HFS)-based interventions significantly improve the clinical judgment of undergraduate nursing students. A comparison of mean clinical judgment scores before and after HFS-based education revealed notable enhancements in the intervention groups compared to the control groups.

Three studies—Ayed et al. (2022), Fawaz et al. (2016), and Byrne et al. (2023)—collectively assessed the effectiveness of HFS on clinical judgment among nursing students. One study with 150 pediatric nursing students found a significant improvement in clinical judgment scores for those who participated in HFS, particularly in a bacterial meningitis simulation, compared to a control group receiving traditional teaching methods (24). Another study focused on

undergraduate nursing students engaged in simulated acute congestive heart failure scenarios, revealing notable gains in clinical judgment for students who experienced HFS versus those who did not (25). Additionally, a quasi-experimental study involving 113 undergraduate nursing students indicated substantial improvements in clinical judgment over five simulation sessions, especially among second-year students (28). Overall, these findings highlight HFS as an effective educational strategy for developing clinical judgment skills in nursing education. The studies emphasize the importance of integrating simulation into nursing curricula to better prepare students for real-world clinical challenges while also calling for further research to address methodological limitations and explore additional factors that may influence HFS effectiveness.

In two studies conducted in the United States, Johnson et al. (2016), and Klenke-Borgmann et al. (2021) found that simulation-based education significantly improved clinical judgment among nursing students. Johnson et al. focused on the effectiveness of HFS in enhancing decision-making skills, reporting that students who participated in HFS scenarios demonstrated greater confidence and improved clinical reasoning compared to those who received traditional instruction. The study highlighted the role of debriefing in reinforcing learning outcomes, allowing students to reflect on their experiences and connect theoretical knowledge to practical application (20). Similarly, Klenke-Borgmann et al. examined the impact of simulation training on nursing students' clinical judgment in various clinical scenarios. Their findings indicated that students who engaged in simulation-based learning exhibited enhanced critical thinking and decision-making abilities, which are essential for effective patient care. The study emphasized that simulation not only fosters clinical skills but also helps bridge the gap between theory and practice, ultimately preparing nursing students for real-world clinical challenges (23). Both studies underscore the importance of incorporating simulation-based education into nursing curricula to enhance clinical judgment and overall competency in future healthcare professionals.

In two quasi-experimental studies, Yang et al. (2021), and Shin (2014) investigated the impact of simulation-based training on clinical judgment among nursing students working with children and neonates in critical health conditions. Yang et al. focused on high-fidelity simulation scenarios involving pediatric patients with acute health issues, where students practiced essential skills such as assessment and prioritization of care. The study found significant improvements in clinical judgment scores, indicating that students were better equipped to make quick decisions and respond effectively to emergencies (19). Similarly, Shin's study involved nursing students participating in simulation training for neonates facing critical health challenges. This training emphasized hands-on experience in managing complex clinical scenarios, enhancing students' confidence and decision-making abilities (27). Both studies concluded that simulation-based training significantly enhances clinical judgment in nursing students, supporting its integration into nursing curricula to prepare them for real-world healthcare situations.

Four studies—Reid et al. (2020), Yuan et al. (2014), Fawaz & Hamdan-Mansour (2016), and Kim et al. (2019)—compared the effectiveness of high-fidelity simulation (HFS) training with traditional hospital-based clinical training among nursing students to assess their impact on clinical judgment. Reid et al. (2020) found that both training methods led to

improvements in clinical judgment, with no significant differences between the two groups, suggesting that HFS can be as effective as traditional training in developing essential clinical skills (21). Similarly, Yuan et al. (2014) reported comparable clinical judgment scores for students trained through HFS and those who received conventional training, indicating that both approaches adequately prepare nursing students for real-world scenarios (22). Fawaz & Hamdan-Mansour (2016) also observed similar competencies in clinical judgment assessments between the two groups after their respective training programs (25). Kim et al. (2019) reinforced these findings, concluding that while HFS offers an immersive learning experience, it does not significantly outperform traditional hospital-based training in enhancing clinical judgment (26).

In summary, these findings support the effectiveness of high-fidelity simulation (HFS) as a valuable educational tool for improving clinical judgment among nursing students across various contexts and conditions.

4- DISCUSSION

The study aimed to critically appraise the existing scientific literature on the impact of high-fidelity simulation (HFS) on the clinical judgment skills of undergraduate nursing students. The findings indicate that HFS significantly enhances clinical judgment skills among these students. As an effective educational strategy, HFS plays a crucial role in developing clinical judgment and is essential in nursing curricula to better prepare students for clinical practice. Furthermore, debriefing sessions are vital for fostering critical thinking and reflection, thereby enriching the learning experience. Evidence also shows that both HFS and traditional clinical training are effective in improving clinical judgment among nursing students.

Nursing educators face the challenge of adequately preparing students for complex patient care situations, particularly in developing their clinical judgment skills. Clinical judgment involves a reflective reasoning process that utilizes all available data and is informed by a comprehensive knowledge base, ultimately leading to sound clinical conclusions. High-fidelity simulation has emerged as a promising teaching method that bridges the gap between theoretical education and practical application in clinical settings. Research indicates that HFS not only enhances clinical judgment but also allows students to practice and refine their skills in a safe environment, effectively addressing the limitations of traditional clinical placements, where students often assume passive observer roles (24, 25).

Several studies have highlighted the effectiveness of high-fidelity simulation (HFS) in improving clinical judgment among nursing students. For instance, Ayed et al. (2022) conducted a quasi-experimental study involving 150 pediatric nursing students, demonstrating significant improvements in clinical judgment scores post-simulation ($t(148) = 7.20$, $p < .001$) using the Lasater Clinical Judgment Rubric (18, 24). Similarly, Fawaz and Hamdan-Mansour (2016) reported that nursing students engaged in HFS scenarios related to acute congestive heart failure exhibited marked improvements in their clinical decision-making abilities compared to those who received traditional instruction (25). Another study concluded that HFS is an effective strategy for developing clinical judgment skills and is essential in nursing curricula (28).

A recent study (2021) revealed that 65.7% of nursing students felt proficient in their clinical judgment. Conducted with 166 undergraduate students at a Brazilian public university, the research utilized the

Lasater Clinical Judgment Rubric to assess proficiency across 11 dimensions, including focused observation and effective communication. Significant differences in self-assessed proficiency were noted based on students' educational levels, indicating that clinical judgment skills improve with experience (30). These findings underscore the need for nursing programs to enhance curricula to better develop critical thinking and decision-making abilities among students. Additionally, these results align with other research indicating that simulation-based education can significantly enhance nursing students' confidence and reasoning skills, ultimately preparing them for real-world clinical challenges (20, 23).

High-fidelity simulation is widely recognized for its positive impact on nursing education; however, research indicates that its effectiveness may not be uniform across all contexts. For example, a pilot study found no overall improvement in clinical judgment among participants, despite specific skills showing enhancement within the experimental group. This suggests that the success of HFS can vary based on contextual factors and individual student backgrounds, highlighting the need for a nuanced understanding of its application (31).

Moreover, traditional training methods remain effective in preparing nursing students for clinical practice. Studies by Reid et al. (2020), and Yuan et al. (2014) demonstrated no significant differences in clinical judgment scores between students trained through HFS and those who received conventional training (21, 22). These findings emphasize the importance of integrating both HFS and traditional educational strategies to optimize learning outcomes, ensuring that students are well-equipped for their future roles in healthcare.

This systematic review identified several significant gaps in the existing literature regarding HFS interventions. Notably, factors that may influence the effectiveness of HFS—such as students' personality traits, academic semester, clinical experience, and demographic characteristics—were often overlooked in the reviewed studies. Additionally, there was considerable variability in the timing of evaluations used to assess the effectiveness of simulation interventions; some studies measured outcomes immediately after the intervention, while others assessed them shortly thereafter. This inconsistency in timing raises concerns about the reliability of the findings, as the timing of assessments could have influenced nursing students' clinical judgment skills (24, 25). Addressing these gaps in future research is essential for developing a more comprehensive understanding of how HFS can be optimized to enhance clinical judgment among nursing students.

This review included only one randomized controlled trial, while the majority of the studies were quasi-experimental. Although quasi-experimental designs are recognized as valid for evaluating interventions, they do not establish definitive cause-and-effect relationships. Consequently, it remains uncertain whether HFS-based interventions directly contribute to improvements in clinical judgment among nursing students, highlighting the need to consider other influencing factors in the interpretation of results. Randomization is a crucial aspect of RCTs that helps eliminate selection bias (32). Therefore, it is strongly recommended that future research include more RCTs to provide robust evidence regarding the effectiveness of HFS interventions. Such high-quality evidence would be invaluable for policymakers, hospital administrators, and nursing managers seeking to implement effective educational strategies in nursing curricula (33).

The duration of simulation interventions varied significantly across the studies reviewed. While some studies implemented simulation-based training consistently throughout the course or semester, others did not specify the duration of their interventions. This inconsistency raises important questions about the optimal length of time needed to conduct these simulations in order to achieve the desired educational outcomes. Doolen et al. (2020) emphasized the necessity for a standardized time framework for simulation-based training, arguing that without such standardization, the generalizability of study findings may be compromised (34).

Establishing clear guidelines regarding the duration and frequency of simulation interventions is essential for enhancing the effectiveness of HFS in nursing education and ensuring that results can be reliably applied across different educational contexts (35). This approach aligns with recommendations for developing effective simulation experiences, which stress the importance of planned time frames to facilitate scenario progression and achieve learning objectives (36). Studies have shown that well-structured simulation experiences lead to improved clinical skills and confidence among nursing students (37). Conversely, inconsistent implementation of simulation training may hinder the development of critical competencies required in clinical practice, underscoring the importance of adhering to established guidelines in nursing education (33).

4-1. Study Limitations and Suggestions

This systematic review aimed to enhance our understanding of the impact of high-fidelity simulation (HFS) on the clinical judgment skills of nursing students in relation to patient care and nursing practices. However, several limitations should be acknowledged.

Firstly, the review included only English-language reports, which may restrict the comprehensiveness of the findings by excluding potentially relevant studies published in other languages. Additionally, it focused solely on freely accessible full texts from specific databases, omitting valuable research available in non-open access formats or in databases not explored in this review. Furthermore, the current scope did not encompass students from other medical disciplines or nursing students at various educational levels, which could provide insights into how HFS affects clinical judgment across diverse contexts.

Moreover, methodological variability across the included studies presents another limitation, as differences in study design, sample sizes, and assessment tools can complicate efforts to draw definitive conclusions about HFS effectiveness. Many studies employed short follow-up periods to assess clinical judgment skills post-intervention, raising questions about the long-term retention of skills learned through HFS. The review also did not adequately address contextual factors such as institutional resources and faculty experience that may influence educational outcomes. Lastly, publication bias could skew the overall understanding of HFS effectiveness, as studies with positive outcomes are more likely to be published than those with negative or inconclusive results.

Addressing these limitations in future research will improve the comprehensiveness and accuracy of evaluations concerning the impact of HFS on nursing education and the development of clinical judgment skills.

5- CONCLUSION

Despite some methodological limitations in the reviewed studies, there is strong evidence supporting high-fidelity simulation (HFS) as an essential

educational tool for enhancing clinical judgment skills among nursing students. HFS significantly improves clinical reasoning and decision-making abilities while providing a safe and immersive learning environment that prepares students for real-world clinical challenges.

Integrating simulation into nursing curricula is crucial for developing competent healthcare professionals who can confidently navigate complex patient scenarios. As the demand for high-quality nursing care increases and clinical cases become more intricate, expanding clinical training through simulation-based education becomes imperative. This approach effectively bridges the gap between theoretical knowledge and practical application, ultimately enhancing the quality of nursing care.

To maximize the benefits of HFS, it is essential to equip nursing instructors with comprehensive training in simulation methods and to ensure that adequate facilities and infrastructure are in place. By doing so, nursing education can better prepare students for successful clinical practice in an evolving healthcare landscape.

6- AUTHORS' CONTRIBUTIONS

Study conception or design: RM, HK; Data analyzing and draft manuscript preparation: RM, and HK; Critical revision of the paper: HK; Supervision of the research: RM and HK; Final approval of the version to be published: RM, and HK.

7- CONFLICT OF INTEREST: None.

8- REFERENCES

1. Benner, P. (1984) From Novice to Expert: Excellence and Power in Clinical Nursing Practice. Addison-Wesley, Menlo Park, 13-34. https://doi.org/10.1097/00000446-198412000-00025.

2. Tanner, C. A. Thinking like a nurse: A research-based model of clinical judgment in nursing. Journal of Nursing Education, 2006;45(6): 204-11.

3. Labrague, L. J., McEnroe–Petitte, D. M., Leocadio, M. C., Van Bogaert, P. Stress and ways of coping among nurse managers: An integrative review. Journal of Nursing Management, 2017;25(1): 12-25.

4. Kaddoura, M. A. The impact of high-fidelity simulation on nursing students' self-confidence and satisfaction. Nursing Education Perspectives, 2010;31(4): 250-55.

5. Jeffries, P. R. A framework for designing, implementing, and evaluating simulations used as teaching strategies in nursing. Nursing Education Perspectives, 2005;26(2): 96-103.

6. Rosen, K. R., et al. The role of simulation in medical education: A review of the literature. Medical Teacher, 2008;30(6): e1-e10.

7. 'Souza, M. S., et al. High Fidelity Simulation in Nursing Education. International Journal of Health Sciences & Research, 2017;7(7): 346-53.

8. Mackie P. The Significance of High-Fidelity Simulation in Nursing Education. BU Journal of Graduate Studies in Education. 2015;7(1):40-4.

9. McGaghie, W. C., Issenberg, S. B., Petrusa, E. R., & Scalese, R. J. A critical review of simulation-based medical education research: 2003–2009. Medical Education, 2010;44(1): 50-63.

10. Cant, R. P., Cooper, S. J. The efficacy of simulation-based learning in nurse education: A systematic review. Nurse Education Today, 2017;57: 75-82.

11. Li Z, Huang FF, Chen SL, Wang A, Guo Y. The Learning Effectiveness of High-Fidelity Simulation Teaching Among Chinese Nursing Students: A Mixed-Methods Study. J Nurs Res. 2020 Dec 16;29(2):e141. doi: 10.1097/JNR.0000000000000418. PMID: 33332870.

12. Yang, Y., Liu, Y. Evidence regarding the effect of high-fidelity simulation on student learning efficacy is inconsistent and mixed. Nurse Education Today, 2016;36:100-6.

13. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred

reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1. https://doi.org/10.1186/2046-4053-4-1.

14. Schardt C, Adams MB, Owens T, Keitz S, Fontelo P. Utilization of the PICO framework to improve searching PubMed for clinical questions. BMC medical informatics and decision making. 2007;7:1-6.

15. Victor-Chmil J. Critical thinking versus clinical reasoning versus clinical judgment: Differential diagnosis. Nurse Educator. 2013;38(1):34-6.

16. Munn Z, Barker TH, Moola S, Tufanaru C, Stern C, McArthur A, Stephenson M, Aromataris E. Methodological quality of case series studies: an introduction to the JBI critical appraisal tool. JBI Evid Synth. 2020 Oct;18(10):2127-2133.

17. Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, et al. Chapter 7: Systematic reviews of etiology and risk. Joanna briggs institute reviewer's manual The Joanna Briggs Institute. 2017;5:217-69.

18. Lasater, K. Clinical judgment development: A concept analysis. Nursing Education Perspectives, 2007;28(2): 82-9.

19. Yang SY. Effectiveness of neonatal emergency nursing education through simulation training: Flipped learning based on Tanner's Clinical Judgement Model. Nursing open. 2021;8(3):1314-24.

20. Johnson EA, Lasater K, Hodson-Carlton K, Siktberg L, Sideras S, Dillard N. Geriatrics in simulation: Role modeling and clinical judgment effect. Nursing Education Perspectives. 2012;33(3):176-80.

21. Reid CA, Ralph JL, El-Masri M, Ziefle K. High-fidelity simulation and clinical judgment of nursing students in a maternal–newborn course. Western Journal of Nursing Research. 2020;42(10):829-37.

22. Yuan HB, Williams BA, Man CY. Nursing students' clinical judgment in high-fidelity simulation based learning: a quasi-experimental study. Journal of Nursing Education and Practice. 2014;4(5):7.

23. Klenke-Borgmann L, Cantrell MA, Mariani B. Clinical judgment in nursing students after observation of in-class simulations. Clinical Simulation in Nursing. 2021;51:19-27.

24. Ayed A, Khalaf IA, Fashafsheh I, Saleh A, Bawadi H, Abuidhail J, et al. Effect of high-fidelity simulation on clinical judgment among nursing students. INQUIRY: The Journal of Health Care Organization, Provision, and Financing. 2022;59:00469580221081997.

25. Fawaz MA, Hamdan-Mansour AM. Impact of high-fidelity simulation on the development of clinical judgment and motivation among Lebanese nursing students. Nurse education today. 2016;46:36-42.

26. Kim H-K, Ryu S, Jang K-S. Effect of structured pre-simulation preparation and briefing on student's self-confidence, clinical judgment, and clinical decision-making in simulation. Contemporary Nurse. 2019;55(4-5):317-29.

27. Shin H, Kim MJ. Evaluation of an integrated simulation courseware in a pediatric nursing practicum. Journal of Nursing Education. 2014;53(10):589-94.

28. Byrne D, Blumenfeld S, Szulewski M, Laske RA. Using Simulation to Develop Clinical Judgment in Undergraduate Nursing Students. Home Healthc Now. 2023; 41(2):84-9. doi: 10.1097/NHH.0000000000001143.

29. Oh Y-J, Kang H-Y, Song Y, Lindquist R. Effects of a transformative learning theory based debriefing in simulation: A randomized trial. Nurse education in practice. 2021;50:102962.

30. Canto VBD, Silva TGD, Santos GAD, Carvalho EC, Morais SCRV, Frazão CMFQ. Clinical judgment performance of undergraduate Nursing students. Rev Lat Am Enfermagem. 2021 Jun 28;29:e3452. doi: 10.1590/1518-8345.4843.3452.

31. Boyd, Timothy L. Jr. The impact of high-fidelity human patient simulation on clinical judgment of nursing students: A pilot study. Master's Theses and Capstones, 2009. Available from: https://scholars.unh.edu/thesis/536.

32. Smith, J., Brown, T., Green, K. Randomization in clinical trials: Importance

and implementation strategies. Clinical Trials Journal, 2020;17(3): 217-25.

33. Johnson, C., Smith, L., Williams, R. Implementing effective educational strategies in nursing curricula: A policy perspective. Journal of Nursing Education and Practice, 2021;11(5): 45-52.

34. Doolen, J., McCarthy, M., Jones, R. The need for standardized time frameworks in simulation-based training: Implications for nursing education. Journal of Nursing Education, 2020;59(4): 203-10.

35. D'Souza, M. S., Arjunan, P., Venkatesaperumal, R. High Fidelity Simulation in Nursing Education. International Journal of Health Sciences and Research, 2017;7(7): 340-47.

36. Nursing Simulation. Healthcare Simulation Standards of Best Practice TM Simulation Design. Nursing Simulation in Healthcare, 2021;6(3):123-30. https://doi.org/10.1016/j.nshs.2021.01.001.

37. Crowe, S., Sheppard, L., Smith, J. Enhancing nursing knowledge and skills through simulation: A systematic review. Nursing Education Today, 2021;97: 104691. https://doi.org/10.1016/j.nedt.2020.104691.