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Posted Date: 17 March 2026

doi: 10.20944/preprints202603.1271.v1

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 doi:10.20944/preprints202603.1271.v1

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Preparing Nursing Students for Obstetric Emergencies: Impact of High-Fidelity Simulation on Knowledge, Confidence and Learning

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Abstract

Background: Emergency obstetric situations require rapid clinical decision-making, technical competence, and emotional preparedness to ensure safe and compassionate care for both mother and newborn. However, nursing students often have limited opportunities to experience such high-risk, low-frequency events during clinical placements. Simulation-based education has emerged as an effective strategy to prepare future nurses for caring in emergency contexts, allowing them to develop both technical and non-technical skills in a safe learning environment. This study aimed to evaluate the impact of a high-fidelity obstetric emergency simulation program on nursing students' knowledge, perceived safety, and learning experience. **Methods:** A mixed-methods design was employed, combining a quasi-experimental pretest–posttest assessment without a control group and qualitative analysis of open-ended reflections. Eighty-two third-year nursing students participated in two simulation sessions addressing obstetric emergencies such as breech birth, shoulder dystocia, out-of-hospital delivery, eclampsia, postpartum hemorrhage, and maternal cardiac arrest. Data were collected using validated instruments measuring knowledge, perceived safety, and satisfaction and self-confidence in learning, and were analyzed using Wilcoxon signed-rank tests and thematic analysis. **Results:** Significant improvements were observed in students' knowledge of complex obstetric maneuvers and in their perceived safety when managing emergency situations ($p < .001$, $r > .40$). Participants reported high levels of satisfaction and confidence in learning. Qualitative findings highlighted increased emotional preparedness, improved clinical reasoning, and recognition of the importance of teamwork and reflective debriefing in emergency care contexts. **Conclusions:** High-fidelity simulation is an effective educational strategy for preparing nursing students to provide safe and confident care in obstetric emergencies. Integrating simulation into nursing curricula can strengthen both technical competence and the emotional readiness required for caring in urgent and high-pressure clinical situations.

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1. Introduction

Obstetric care is a critical area of clinical practice, where swift and accurate decision-making can have life-or-death consequences for both mother and newborn[1,2]. Situations such as abnormal fetal presentations, shoulder dystocia, out-of-hospital births, or severe obstetric emergencies; including eclampsia, postpartum hemorrhage, or cardiopulmonary arrest; require professionals with comprehensive training, capable of combining theoretical knowledge, technical skills, and the confidence to act under pressure[1,2].

Nurses play a central role in emergency obstetric care, as they are frequently responsible for the early recognition of complications, the coordination of multidisciplinary responses, and the continuous support of women and their families during critical moments[3,4]. Providing effective care in these contexts requires not only clinical knowledge and technical competence, but also emotional preparedness, communication skills, and the ability to work collaboratively under pressure. These relational and human dimensions of care are particularly relevant in emergency settings, where patients and families may experience fear, vulnerability, and uncertainty[5,6].

One major challenge in obstetric education is the low incidence of critical obstetric events in real clinical settings, which makes it difficult for students to gain meaningful hands-on experience. Furthermore, the emotionally demanding nature of obstetric emergencies can increase student anxiety and impair decision-making, potentially compromising patient safety[3].

In response to these limitations, clinical simulation has emerged as an innovative and effective pedagogical strategy in healthcare education[1,7,8]. Simulation enables the recreation of high-fidelity scenarios that allow for repeated practice, real-time decision-making, and reflective learning in a safe and controlled environment[1,7]. In obstetrics, this includes practice with complex maneuvers such as the Bracht, Woods, or Zavanelli techniques, as well as management of severe emergencies like postpartum hemorrhage or eclampsia, all without risk to actual patients[8]. Evidence suggests that simulation-based training improves not only knowledge and technical skills, but also emotional readiness, self-confidence, and perceived safety[9–12]. From an educational perspective, student perceptions are essential to evaluate the effectiveness of simulation. Tools like the Student Satisfaction and Self-Confidence in Learning Scale (SCLS) have demonstrated validity and reliability for assessing learning experiences in simulated environments[13,14]. Additionally, recent studies highlight that structured prebriefings, supportive debriefings, and realistic scenarios enhance motivation, engagement, and learning retention[15,16].

Nevertheless, several challenges persist. These include the lack of standardized protocols, limited comprehensive outcome assessments, and concerns about the long-term sustainability of simulation-based programs in nursing curricula[1]. Addressing these gaps requires empirical studies that jointly evaluate the effects of simulation on knowledge acquisition, emotional preparedness, and students' subjective learning experience.

Therefore, the aim of this study is to evaluate the impact of an obstetric emergency simulation-based training intervention on nursing students' technical knowledge, perceived safety, and self-reported satisfaction and confidence using the Student Satisfaction and Self-Confidence in Learning Scale (SCLS).

2. Materials and Methods

2.1. Design

This mixed-methods study combined a quasi-experimental pretest–posttest design without a control group and a qualitative phenomenological component. A control group was omitted for

 doi:10.20944/preprints202603.1271.v1

ethical and pedagogical reasons, avoiding the exclusion of students from a potentially beneficial intervention. Methodological rigor was ensured through established criteria for mixed-methods research. The quantitative and qualitative components adhered to TREND [17] and SRQR [18] guidelines, respectively, ensuring transparency and validity[19].

2.2. Study Setting and Sampling

The study took place at a Spanish public university with third-year nursing students enrolled in a Women's Health course (2022–2023). Using purposive non-probability sampling, the required sample size was calculated via G*Power (d = 0.5, α = 0.05, power = 0.95), estimating 54 participants. Considering a 20% attrition rate, 66 students were targeted, and 86 ultimately participated.

2.3. Inclusion and Exclusion Criteria

Eligible participants were actively enrolled in the Women's Health Nursing course, had no prior childbirth experience, and provided informed consent. Students who had passed the continuous assessment or withdrew during the semester were excluded. Repeaters who had not passed this component could participate.

2.4. Study Interventions

The intervention comprised two two-hour high-fidelity simulation sessions. The first covered breech delivery, shoulder dystocia, and out-of-hospital birth; the second addressed emergencies like eclampsia, postpartum hemorrhage, and maternal cardiac arrest. Sessions followed the PEARLS framework [20] and used the "debriefing with good judgment" model [21], aiming to strengthen clinical competence and confidence [7,22].

2.5. Fidelity of Intervention

Simulation fidelity was ensured using high-fidelity birthing mannequins and standardized clinical scenarios. Faculty followed scripted roles and applied the PEARLS model for prebriefing and debriefing to foster psychological safety and reflection. [20,22]. Preparatory meetings aligned facilitators with learning objectives and ensured

2.6. Instruments with Validity and Reliability / Data Source

Data were collected using three instruments: 1) a knowledge questionnaire on obstetric emergencies validated through the Delphi method; 2) the Perceived Safety Scale, adapted to assess confidence in managing obstetric complications; and 3) the Simulation Clinical Learning Scale (SCLS), which has been validated in Spanish and demonstrates high reliability (Cronbach's α > 0.80) [12]. Qualitative data were obtained through open-ended questions exploring participants' learning experiences, emotions, perceived strengths, and areas for

2.7. Data Collection

Data collection occurred in three stages: 1) pre-intervention (knowledge and safety assessments),2) intervention (two simulation sessions), and 3) post-intervention (repeat assessments and SCLS). Students also answered reflective open-ended questions on the simulation experience: What aspects of the simulation did you find most useful for your learning?; What would you improve about the activity or the environment?; How did you feel during the practice?; What have you learned or reinforced through the simulation? All responses were collected anonymously using coded identifiers.

2.8. Data Analysis

 doi:10.20944/preprints202603.1271.v1

A mixed descriptive analysis integrated quantitative and qualitative data. Quantitative analysis used SPSS v.27, with Wilcoxon signed-rank tests for pre–post comparisons due to non-normal distribution [23], and effect sizes calculated using r[24]. SCLS scores were analyzed univariately. Qualitative data underwent inductive thematic analysis via Braun and Clarke's method [25], with dual independent coding to ensure rigor[18].

2.9. Ethical Considerations

This study was conducted as part of a curricular educational activity within the undergraduate nursing program. The research involved no patients, clinical interventions, or collection of sensitive personal data. All data were collected anonymously using coded identifiers, and participation was voluntary. According to institutional guidelines for educational research involving students and anonymous data, formal approval from a Research Ethics Committee was not required. Nevertheless, the study followed the ethical principles outlined in the Declaration of Helsinki and ensured confidentiality, voluntary participation, and the right to withdraw at any time without academic consequences[26].

3. Results

Of the 86 students enrolled, 82 participated (95.3%), predominantly women (89%), with a mean age of 22.6 years (SD = 5.1). Kolmogorov–Smirnov tests confirmed non-normal distribution ($p < .001$). Median knowledge scores were 4 (IQR = 6) both pre- and post-intervention. Results integrate quantitative and qualitative data to assess changes in knowledge, safety perception, satisfaction, and student experience.

Knowledge significantly improved for breech delivery ($Z = –3.50$, $p < .001$, $r = .39$), Bracht ($Z = –3.80$, $p < .001$, $r = .42$), and Zavanelli maneuvers ($Z = –3.75$, $p < .001$, $r = .41$), all with medium effect sizes. The Woods maneuver showed marginal gains ($p = .051$), while no significant changes were observed for out-of-hospital delivery or umbilical cord management ($p > .05$). No knowledge improvement was found in obstetric emergencies ($p > .05$). These results highlight simulation's effectiveness in reinforcing complex, low-frequency procedures (Figure 1).

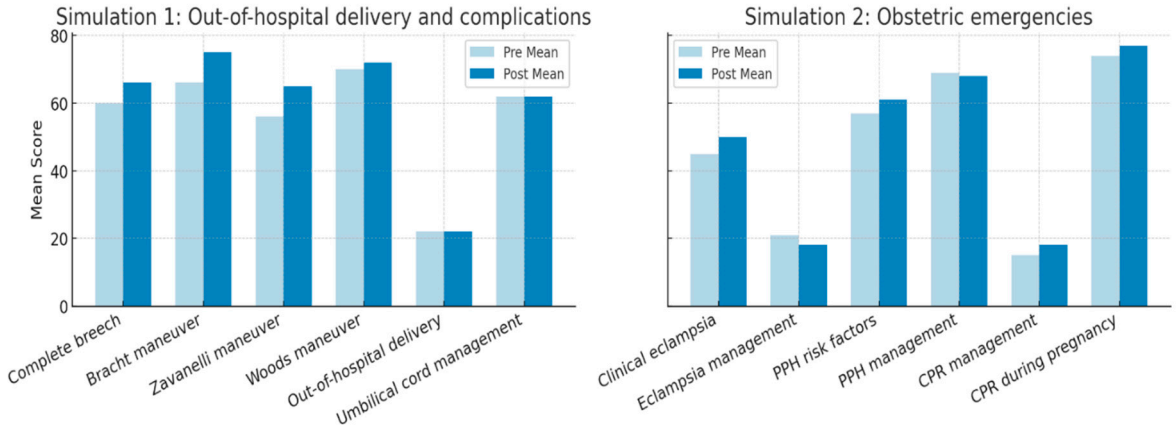

Figure 1. Knowledge acquired – Comparisión of Pre and Post Simulation Scores.

Perceived safety improved significantly across all obstetric scenarios: breech delivery, shoulder dystocia, and out-of-hospital birth ($Z = –4.45$ to $–4.60$, $p < .001$, $r \approx .50$), with large effect sizes and mean gains >2.8 points. Significant increases were also seen in emergencies—eclampsia, postpartum hemorrhage, and maternal resuscitation ($Z = –7.08$ to $–7.58$, $p < .001$, $r = .78–.84$)—highlighting the strong impact of simulation on students' confidence in managing complex situations (Figure 2).

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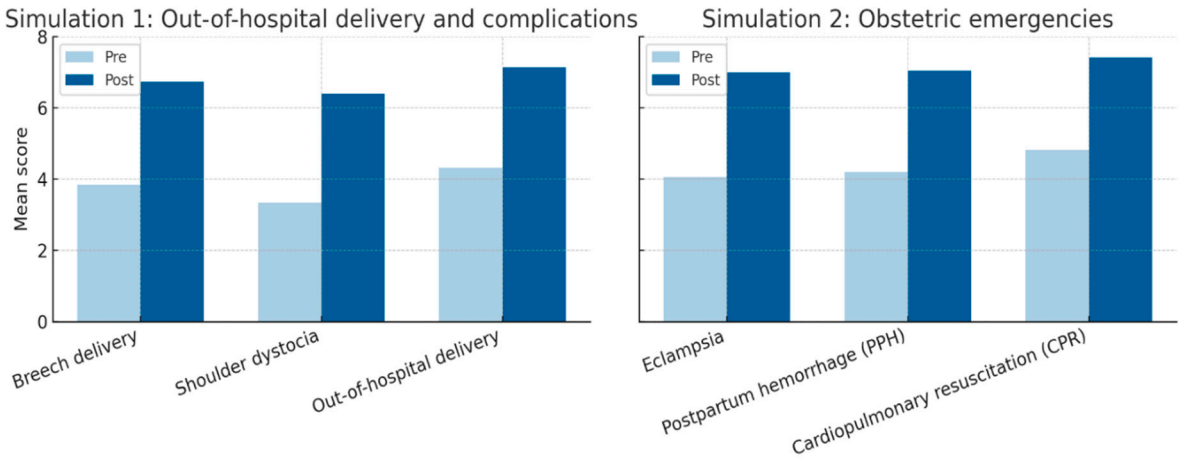
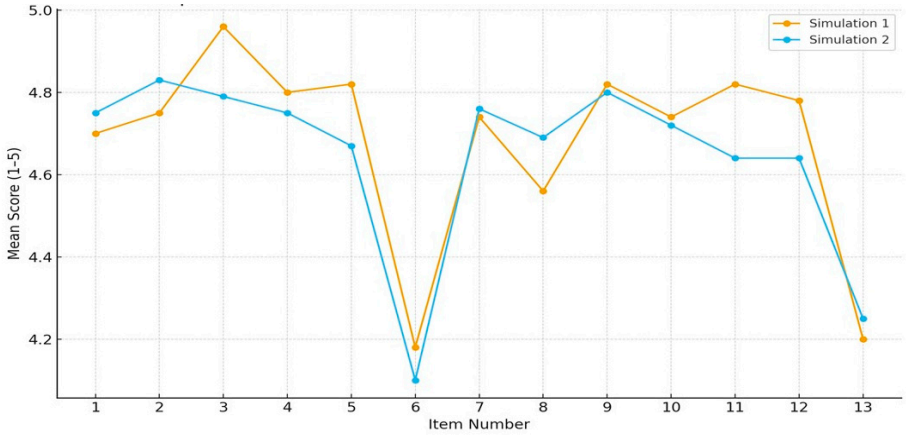


Figure 2. Perceived safety before and after simulation.

SCLS scores showed high overall satisfaction, with medians of 4–5 and consistent interquartile ranges. Top-rated items included instructor facilitation (Me = 5; IQR = 4–5), materials, and teaching resources. Lower scores related to content mastery and prebriefing, suggesting areas for improvement. Median response time was 3 minutes, indicating strong engagement. Similar trends were observed in emergency scenarios, reinforcing the need to enhance pre-simulation preparation (Figure 3).



1) Usefulness of teaching methods; 2) Access to appropriate materials and scenarios, 3) Instructor's performance during the simulation; 4) Motivating and useful learning materials; 5) Teaching adapted to the student's learning style; 6) Confidence in mastering the content; 7) Relevance of the content for professional training; 8) Development of competencies for clinical tasks; 9) Effective use of instructional resources by the instructor;10) Student's responsibility in the learning process;11) Knowledge of how to seek assistance; 12) Usefulness of simulation for learning clinical competencias; 13) Instructor's responsibility during the prebriefing

Figure 3. Comparisón of SCLS Scores between Simultion 1 vs Simultion 2.

Overall evaluation scores were high for both simulations. Obstetric maneuvers received a mean of 4.83 (Me = 5), and emergencies 4.80 (IQR = 5–5), reflecting strong satisfaction and perceived educational value. These results confirm simulation's effectiveness in enhancing knowledge, confidence, and learning in complex obstetric care. The qualitative analysis identified eight themes that synthesize students' perceptions of their experiences in the simulation scenarios.

During Simulation 1: out-of-hospital childbirth and complications, four main themes emerged: Theme 1. Active learning and motivation in a realistic environment. Students described the simulation as a dynamic and motivating experience that facilitated participation and autonomous learning: *"The session was very dynamic and engaging."* (E11). They also emphasized the realism of the scenarios and the usefulness of errors as opportunities for reflection and improvement. Theme 2.

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Structural conditions for learning. Students pointed out limitations related to available time and large group size: *"There wasn't enough time to fully assimilate and review the maneuvers."* (E3). They suggested optimizing organization and increasing the technical fidelity of materials to promote more equitable and effective learning. Theme 3. Instructor support, reflection, and feedback. Debriefing was perceived as essential for consolidating learning, particularly when conducted after each scenario: *"I'd prefer to have the debriefing right after each simulation."* (E5). Students valued the instructor's guidance and the opportunity to clarify doubts during the activity. Theme 4. Emotional factors and learning climate. Some participants expressed nervousness when being observed by peers: *"It's stressful to have all your classmates watching you."* (E1). However, the supportive and humorous atmosphere during sessions encouraged participation and reduced anxiety.

During Simulation 2: management of obstetric emergencies, four additional themes were identified: Theme 5. Human and emotional realism as a key learning element. The use of a standardized patient was considered the most valuable aspect of the experience, adding authenticity and emotional engagement: *"The simulation with the student actress made it much more realistic."* (E27). This interaction enhanced students' sense of involvement, respect, and responsibility. Theme 6. Structured planning and group engagement. Students appreciated the clear organization and sequence of the sessions, as well as the active participation of all groups: *"It was well structured, and we were given the necessary information to know how to proceed."* (E58). This structure promoted attention, clinical judgment, and peer-to-peer observation. Theme 7. Reflective and safe learning: the value of debriefing and error. Debriefing was identified as the most meaningful phase, allowing performance analysis and reflection on mistakes within a supportive environment: *"What I liked most was that mistakes weren't criticized, but explained."* (E21). Students highlighted the instructor's empathy and the opportunity to learn from experience. Theme 8. Emotional load and areas for organizational improvement. Although overall feedback was positive, participants noted emotional tension and limited time as key challenges: *"We would need a bit more time."* (E11). Nervousness from being observed by peers was recognized as a factor influencing performance and should be considered in future implementations.

4. Discussion

This study confirmed that obstetric simulation enhances nursing students' knowledge, perceived safety, satisfaction, and learning. Aligned with prior evidence [1,7] and Kolb's experiential learning model [27], simulation offers a safe, structured environment for practicing complex clinical scenarios often unavailable in real-life obstetric training [28]. Beyond its educational value, this finding is especially relevant in emergency care settings, where professionals must respond rapidly and effectively while maintaining safe, coordinated, and compassionate care. In obstetrics, simulation may therefore serve not only as a pedagogical strategy, but also as a means of preparing future nurses for the cognitive, technical, and relational demands of high-pressure clinical situations.

Quantitative findings showed significant knowledge gains in complex maneuvers like Bracht and Zavanelli, confirming simulation's role in consolidating advanced skills. These results support prior evidence on the benefits of deliberate practice and real-time feedback for knowledge retention [7,29]. The absence of knowledge gains in emergency scenarios may reflect a ceiling effect or their procedural nature. Research suggests simulation impacts self-efficacy and clinical reasoning more than declarative knowledge, highlighting the need to complement it with theoretical or asynchronous preparation [30,31]. From the perspective of emergency nursing education, this distinction is particularly important, as urgent care often depends less on the recall of isolated facts and more on the integration of procedural competence, situational awareness, and rapid clinical judgment under pressure.

The intervention also led to significant gains in perceived safety and self-confidence, highlighting the role of simulation in enhancing professional readiness for high-risk obstetric events [2,5]. Drawing on Bandura's theory of self-efficacy, these results support the idea that mastery experiences and positive feedback are key determinants of confidence [21]. The creation of

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psychological safety during structured prebriefing and debriefing phases facilitated open discussion of errors and emotions without fear of judgment; conditions that are essential for meaningful learning [22]. For emergency care education, this suggests that simulation may be most effective when embedded within broader pedagogical strategies that combine prior theoretical preparation, scenario-based training, and reflective debriefing. Such integration may be especially valuable in preparing students for low-frequency but high-risk events, where timely and well-coordinated action is essential for patient safety.

High scores on the SCLS further confirmed students' satisfaction and confidence in the learning process, in line with findings from the instrument's Spanish validation [12]. Given the close association between satisfaction, intrinsic motivation, and long-term retention of learning, these results are highly relevant [7]. Notably, slightly lower scores in areas related to prebriefing and content mastery point to a need for stronger theoretical preparation prior to simulation, as recommended by the International Nursing Association for Clinical Simulation and Learning [22].

The overall assessment of the simulation sessions was excellent, confirming the educational value of the intervention [32,33]. The incorporation of a standardized patient enhanced the realism and emotional engagement of the scenarios; both factors shown to improve motivation and perceived authenticity[30]. Moreover, the literature highlights not only educational gains but also clinical outcomes, such as reduced brachial plexus injury rates following shoulder dystocia simulation training, suggesting potential for long-term clinical impact[34]. Importantly, the use of a standardized patient may also have strengthened the human and relational dimensions of learning by allowing students to engage with the emotional needs of the woman experiencing an obstetric emergency. This is particularly relevant to emergency care, where technical interventions must often be delivered alongside reassurance, communication, and supportive care for patients and, when applicable, their families.

Qualitative findings complemented and enriched the quantitative data, revealing that simulation fosters active, reflective, and emotionally resonant learning experiences. Students emphasized the realism of the scenarios and their applicability to real clinical practice—findings that support Kolb paradigm [27] and the documented role of technical and human fidelity in promoting deeper learning[35]. Emotions such as nervousness, tension, and satisfaction were reported as learning drivers, echoing Fey et al. assertion that emotional engagement enhances motivation and knowledge integration in psychologically safe environments [21]. Key non-technical skills such as teamwork and effective communication also emerged as central elements of obstetric training [28]. These findings are closely aligned with the realities of emergency care, where non-technical skills are fundamental to safe and effective practice. Teamwork, communication, and the ability to regulate emotions under pressure are essential not only for clinical performance, but also for preserving the quality and humanity of care during moments of crisis.

Debriefing was the most valued component of the intervention, perceived by students as a reflective and emotionally safe space to explore errors and insights. This aligns with the principles of the "Debriefing with Good Judgment" model [36] and the PEARLS framework, recently enhanced to incorporate an equity lens [20]. When grounded in empathy and critical reflection, debriefing transforms simulation from a procedural activity into an experience of professional and personal growth, strengthening students' professional identity and clinical reasoning. In the context of emergency care, debriefing may be particularly valuable because it helps students process emotional responses, normalize uncertainty, and develop reflective capacity after exposure to stressful scenarios. These elements are essential for fostering resilient and compassionate practitioners who are able to sustain both technical performance and human-centered care in urgent settings.

Among the main limitations of this study are its quasi-experimental design without a control group, which limits causal inference, and the single-site, non-randomized sample, which reduces the generalizability of the findings. Additionally, the reliance on self-reported instruments may introduce response bias, and the absence of long-term follow-up prevents assessment of knowledge retention and sustained behavior change in clinical contexts. Another limitation is that, although the

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qualitative findings highlighted emotional preparedness, realism, and communication, the study did not include specific measures of non-technical skills, teamwork performance, or relational aspects of care. Future studies could strengthen this line of research by incorporating instruments that assess these dimensions more explicitly in emergency simulation contexts.

Future research should address these limitations by employing randomized controlled trials with multicenter and longitudinal designs, which would allow for a better understanding of long-term learning outcomes and patient safety implications. Comparative studies examining different simulation modalities—such as high-fidelity, virtual, or hybrid approaches—could provide further insights into best practices. Furthermore, the lower performance in prebriefing-related items suggests the need to investigate how theoretical preparation (e.g., asynchronous modules) influences simulation efficacy. Ongoing development of faculty in debriefing strategies like PEARLS and "Debriefing with Good Judgment" is also warranted [21]. It would also be valuable to explore how simulation-based education influences students' preparedness to provide supportive and family-centered care during obstetric emergencies, as well as how repeated exposure to emotionally demanding scenarios may contribute to resilience and professional development in emergency nursing practice.

This study highlights the value of integrating high-fidelity obstetric simulation into undergraduate nursing curricula as a means to strengthen clinical competence, perceived safety, and professional confidence. These benefits are particularly critical in obstetric care, where the high stakes and limited real-life exposure necessitate rigorous, hands-on preparation [28]. From an institutional perspective, simulation should be embedded structurally into educational programs, supported by blended learning methodologies, competency-based assessments, and faculty development in emotional facilitation and reflective debriefing[22].Beyond academia, the implementation of simulation in continuing professional education may further contribute to improving patient safety and clinical outcomes. Ultimately, simulation serves as a bridge between theoretical knowledge and practical application, fostering more confident, competent, and compassionate healthcare professionals. The present findings suggest that simulation-based obstetric education can contribute meaningfully to preparing nurses for caring in emergency settings, not only by strengthening technical competence, but also by fostering emotional preparedness, communication, teamwork, and reflective practice. These are essential components of professional nursing care in urgent and high-stakes situations, where the quality of care depends as much on human and relational capacities as on procedural expertise.

5. Conclusions

Clinical simulation is confirmed as an effective pedagogical strategy in obstetric nursing education, enhancing students' technical knowledge, self-efficacy, and perceived safety; particularly in the management of complex maneuvers such as Bracht and Zavanelli. Beyond the acquisition of procedural skills, the findings suggest that simulation also contributes to strengthening emotional preparedness, clinical reasoning, and confidence when facing high-risk obstetric situations.

The high levels of satisfaction and self-confidence reflected in the SCLS support the effectiveness of the instructional design, including structured prebriefing, guided facilitation, and reflective debriefing processes. These elements appear to create psychologically safe learning environments that allow students to engage actively with complex clinical scenarios and learn from both success and error.

From a broader perspective, high-fidelity obstetric simulation represents a valuable educational approach for preparing nursing students to provide safe, coordinated, and compassionate care in emergency settings. By promoting the integration of technical competence with non-technical skills such as communication, teamwork, and emotional regulation, simulation may contribute to improving professional readiness for urgent and high-pressure clinical situations.

For these reasons, the structural integration of simulation into undergraduate nursing curricula and continuing professional education programs is recommended, supported by blended learning

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strategies and competency-based educational approaches. Future research should incorporate controlled and longitudinal designs to explore long-term knowledge retention, the development of non-technical skills, and the potential impact of simulation training on patient safety outcomes in obstetric emergency care.

Author Contributions: MFI: Conceptualization, Methodology, Writing – Original Draft, Project Administration. JFVG: Data Curation, Resources, Writing – Review & Editing, Critical Revision. OA: Validation, Visualization, Writing – Review & Editing, Critical Revision. IZG: Data Collection, Writing – Review & Editing, Critical Revision. BAE: Formal Analysis, Writing – Review & Editing. VFA: Validation, Visualization, Writing – Review & Editing. LLP: Supervision; Methodology, Critical Revision, Writing – Review & Editing.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki. Ethical review and approval were waived for this study as it involved an educational activity with undergraduate nursing students, did not include patients or clinical interventions, and all data were collected anonymously according to institutional guidelines for educational research.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this study are not publicly available due to confidentiality agreements and ethical restrictions involving identifiable personal information. However, the data may be made available by the authors upon reasonable request, provided that appropriate measures are taken to ensure the anonymity and privacy of the participating families.

Public Involvement Statement: The study focused on undergraduate nursing students participating in simulation-based educational activities, whose feedback and reflections were used to evaluate the learning experience and improve the educational intervention.

Guidelines and Standards Statement: This study followed established reporting guidelines to ensure methodological rigor and transparency. The quantitative component adhered to the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) statement for nonrandomized intervention studies, while the qualitative component followed the SRQR (Standards for Reporting Qualitative Research) guidelines.

Use of Artificial Intelligence: During the preparation of this manuscript, the authors used ChatGPT (developed by OpenAI) solely to enhance the clarity and language of the text. Following its use, the authors thoroughly reviewed and carefully edited the content, taking full responsibility for the final version of the manuscript.

Acknowledgments: The authors would like to thank the undergraduate nursing students who participated in the simulation sessions for their engagement and willingness to share their learning experiences. We also acknowledge the support of the faculty members and the simulation center staff whose collaboration made the implementation of the simulation scenarios possible. Their contribution was essential to the development of this educational initiative.

Conflicts of Interest: The authors declare no conflicts of interest.

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