# Revolutionizing Postpartum Care: Efficacy Of High-Fidelity Simulation Training On Maternity Nurses' Performance And Self- Efficacy Regarding Primary Postpartum Hemorrhage

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**Key-words:**

High-fidelity simulation, Performance, Primary postpartum hemorrhage, self-efficacy.

**Abstract**

**Background:** Postpartum Hemorrhage is one of obstetric complications that can result in maternal morbidity and death. High-fidelity simulation is expected to improve women's care especially high-risk cases where immediate and rapid response is required.
**Aim:** To evaluate efficacy of high-fidelity simulation training on maternity nurses' performance and self-efficacy regarding primary postpartum hemorrhage. Design: A quasi-experimental research design had been utilized.
**Setting**: The study was carried out at obstetrics and gynecology emergency department of Benha University hospital and simulation lab at Faculty of Nursing, Benha University, Benha city, Egypt.
**Sample:** A convenient sample of 83 maternity nurses.
**Tools of data collection:** A structured self- administered questionnaire, postpartum hemorrhage management checklist and postpartum hemorrhage self-efficacy scale.
**Results:** Ahigh statistically significant difference among the maternity nurses' knowledge, practices and self-efficacy concerning management of primary postpartum hemorrhage was observed pre intervention, post intervention and four weeks after implementation of the high-fidelity simulation program ($p \leq 0.001$). Also, a significant positive correlation

| | |
|---|---|
| | between total self-efficacy and both total knowledge and total performance at all stages pre-intervention, post-intervention, and Follow-up.<br>**Conclusion:** Application of high-fidelity simulation-based training program had improved maternity nurses' knowledge, practices and self-efficacy regarding management of primary postpartum hemorrhage.<br>**Recommendations:** High fidelity simulation programs should be provided for all obstetrics health care givers to improve their knowledge, practices and self-efficacy. |

**Introduction**

Postpartum hemorrhage (PPH) remains one of the most significant causes of maternal illness and death globally. It is defined as the loss of roughly 500 milliliters of blood following a vaginal delivery or 1,000 milliliters after a cesarean section within the first 24 hours after childbirth, often accompanied by signs of hypovolemia. PPH is responsible for approximately 25% or more of maternal deaths related to pregnancy worldwide **(Martínez-Rodríguez et al., 2025).** This condition is a serious obstetric emergency, occurring in about 2–4% of vaginal deliveries and 6–7% of cesarean births (Richardson et al., 2022).

According to the World Health Organization (2021), postpartum hemorrhage is considered the most common cause of maternal complications and death around the world, contributing to more than 35% of maternal fatalities.

Postpartum hemorrhage continues to be especially widespread in countries with limited financial resources, influencing up to 14% of all deliveries. However, a concerning increase in its occurrence has also been noted in wealthier countries, with incidence rates reported between 3% and 5% (Patek & Friedman, 2023).

The causes of primary postpartum hemorrhage are traditionally categorized into four main groups, commonly referred to as the "four T's": Tone (accounting for 70% of cases), Trauma (20%), Tissue retention (10%), and issues related to Thrombin or clotting disorders (1%) (Yunas et al., 2025). Implementing effective strategies for preventing and managing primary PPH is essential and can play a critical role in safeguarding maternal health during childbirth (Wormer et al., 2021).

Timely identification and immediate intervention for primary postpartum hemorrhage are essential, as delayed recognition is a major factor contributing to related maternal deaths. However, when healthcare providers maintain a high level of awareness and act quickly to identify risk factors, the likelihood of severe complications can be significantly reduced, and fatalities can often be prevented (El Hassan & Edwin, 2025).

Nurses involved in labor and postpartum care are essential in preventing, promptly identifying, and managing postpartum hemorrhage, particularly during the critical early postpartum phase. Effective monitoring and appropriate interventions during this time are vital. The level of nurses' knowledge and clinical training has a significant impact on how well PPH is managed. However, gaps in knowledge, practical skills, and confidence in handling PPH cases remain a concern (Muthoni et al., 2021).

Consequently, it is imperative for nurses and healthcare providers to engage in regular simulation-based education to enhance and sustain up-to-date knowledge, sharpen clinical skills, and strengthen accurate decision-making aligned with standardized guidelines. Such training guarantees prompt identification and efficient care of postpartum hemorrhage. As a result, maternity nurses are better equipped to intervene promptly and potentially save the lives of women experiencing clinical decline due to primary PPH (Almutairi et al., 2025).

In resource-limited settings, maternity nurses can engage in high-fidelity simulation training to practice various clinical scenarios, including those involving critical care procedures. Simulation serves as an effective educational tool for training nursing staff who may have fewer resources compared to those in more developed healthcare environments. As such, it offers a valuable opportunity to build fundamental obstetric and gynecologic skills, particularly where access to hands-on training is limited (Wu, 2025).

High-fidelity simulation involves the use of advanced, lifelike mannequins that can breathe, speak, and exhibit heart and lung sounds, enabling the realistic replication of clinical situations based on evidence-based practices. In modern nursing education, simulation is recognized as a highly effective learning strategy. It provides a controlled, simulated environment that mimics real-life clinical experiences, allowing trainees to enhance their psychomotor and decision-making abilities (Bailey and Emory, 2022).

As a result, high-fidelity training using simulations is a useful teaching strategy that improves the clinical expertise of maternity nurses, confidence, and skillset, ultimately helping to prevent the decline of women's health due to postpartum hemorrhage (Coşkun et al., 2024).

Skills gained through simulation training are successfully carried over into real clinical settings, enhancing overall performance, critical thinking, and clinical decision-making. Simulation creates an organized and secure scenario where trainees can identify areas that require development, build confidence, and attain lasting educational benefits (Blaak et al., 2025).

**Significance of research:**

As reported by the World Health Organization (WHO, 2023), more than 14 million women worldwide are impacted by postpartum hemorrhage each year, leading to approximately 70,000 maternal deaths. The primary underlying cause is uterine atony, which is responsible for between 60% and 80% of all cases (Bláha & Bartošová, 2022).

Egypt's maternal mortality rate has dramatically declined from 141 deaths per 100,000 live births in 1985 to just 17 per 100,000 in 2023 (WHO, 2023). Despite this progress, postpartum hemorrhage remains a major concern, contributing to 19.7% of maternal deaths, according to data from the Egyptian Ministry of Health and Population (2019).

It has been demonstrated that high-fidelity simulation training is a successful strategy for improving maternity nurses' competence, clinical skills, and confidence, ultimately helping to improve health outcomes for women affected by postpartum hemorrhage (Lei et al., 2022). According to a review of the literature, few studies have examined how high-fidelity simulation, like Sim Mom, affects maternity nurses' performance and self-efficacy in controlling primary postpartum hemorrhage, In order to fill this gap, this study was conducted.

**Aim of the research**

The research's aim was to evaluate efficacy of high-fidelity simulation training on maternity nurses' performance and self- efficacy regarding primary postpartum hemorrhage.

**Research hypotheses**

**H1:** Following the high-fidelity simulation-based training program, maternity nurses will demonstrate a higher score of overall performance (knowledge and practices) in managing primary PPH than before.

**H2:** Following the high-fidelity simulation-based training program, maternity nurses will demonstrate a higher degree of self-efficacy in managing primary PPH than before.

**2. Subjects and method:**

### 2.1. Research Design

A quasi-experimental research design was used (one group pre/posttest).

### 2.2. Setting

This research took place within the obstetrics and gynecology emergency unit of Benha University Hospital, as well as in the simulation lab at the Faculty of Nursing, Benha University, located in Benha City, Egypt. Benha University hospital is the primary healthcare facility at Qualubyia Governorate that provides prenatal, natal, and postnatal care to the local population.

### 2.3. Sampling

A convenient sample of 83 maternity nurses who were interested to get involved in the study and are employed in the prior illustrated setting.

### 2.4 Tools of Data Collection

Five data collection tools were developed based on a comprehensive review of relevant literature, and these included the following:

**Tool I: A structured self- administered questionnaire:** It Comprised of two main parts as follows:

**Part I**: personal Characteristics of maternity nurses including (age, marital status, place of residence, level of education, job description, years of experience, previous participation in high-fidelity simulation training programs regarding PPH).
**Part 2:** study the knowledge of maternity nurses' about PPH, it included 10 multiple-choice questions covering key domains such as the meaning, causes, risk factors, S&S, categorizing, complications, the action a nurse should take when postpartum hemorrhage is suspected, purpose of uterine massage, uterotonic drugs that is typically used first in postpartum hemorrhage management and when should a hysterectomy be considered in postpartum hemorrhage.
**Knowledge scoring system:**
A three-point Likert scale was employed to score each question: a fully correct answer received a score of 3, a partially correct answer was scored as 2, and a score of 1 was given for incorrect answers or responses indicating "I do not know." The overall score for knowledge varied from10 to 30. The overall scores were categorized into:
Good knowledge ≥75% (23-30)
Average 60-<75% (18-22)
Poor knowledge <60% (10-17).
**Tool (II) Postpartum Hemorrhage Management Checklist**:
The Postpartum Hemorrhage Management Checklist was used to evaluate maternity nurses' performance in controlling primary PPH. This checklist, based on the guidelines provided by the **Health Service Executive (2020)**, consists of eight key items, including the recognition of PPH symptoms, timeliness of response, monitoring vital signs, uterine massage, medication administration, blood loss documentation, and communication with the healthcare team and the patient. It aims to assess the nurses' adherence to best practice guidelines in PPH management, and its purpose is to measure the efficiency of high-fidelity simulation-based training in enhancing the clinical performance of maternity nurses in the management of primary PPH.
**Scoring System**
Each item in the checklist is scored as follows: Score 3 for actions that were completely performed correctly, score 2 for actions that were partially performed or with some delays, and Score 1 for actions that were not performed or incorrectly executed. The maximum possible score is 24 points, and the total score is converted into a percentage. Nurses with a score of 90%

or higher (22 points or more) are classified as performing satisfactory practice, while those with a score of less than 90% are considered to have unsatisfactory practice.

**Tool III: Postpartum Hemorrhage Self-Efficacy Scale (PPHSE)**

The PPHSE was developed by **Egenberg et al., (2017)** to assess individual healthcare professionals' confidence in performing tasks regarding managing PPH. This scale aims to measure Self-efficacy is the conviction that one is capable of organizing and carrying out the actions necessary to handle any potential situations. The scale comprises eight items, each designed to evaluate a specific aspect of self-efficacy in the context of postpartum hemorrhage management.

**Scoring System:**

Participants rate each item on an 8-point Likert scale, where:1 = Always, 2 = Almost always, 3 = Often, 4 = Sometimes, 5 = Rarely, 6 = Almost never, 7 = Never and 8 = Not applicable. The overall score varies from 8 to 64. A high score reflects a low level of self-efficacy, reflecting less confidence in performing the task. Conversely, a low score reflects high level of self-efficacy, reflecting greater confidence. Nurses' self-efficacy levels were categorized as high (scores 8–24), moderate (25–44), and low (45–64) based on the total PPHSE scores.

**2.5. Method**

The following procedures were used to carry out this study:

**2.5.1 Administrative Approval**

The director of Benha University Hospital received a letter in writing from the dean of the faculty of nursing. The Ethical Committee of Benha University's Faculty of Nursing approved the conduct of this study. Following a thorough and appropriate explanation, each nurse participating in the study was asked to provide their consent during data collection.

**2.5.2. Validity**

Three nursing professors evaluated the tool's content validity by reviewing it. adjusted based on the advice of the panel to ensure sentences are clear, content is consistent, relevant, simple, and applicable. Changes were made based on helpful feedback, including adjusting certain words to ensure the clearest interpretation for items that were unclear.

**2.5.3. Reliability**

The researchers made sure the tools were consistent with each other by testing their reliability. The Cronbach's alpha coefficient for Tool (I) Assessment of maternity nurses' knowledge about primary PPH was $\alpha = 0.84$ for tool (II) Postpartum Hemorrhage Management Checklist it was $\alpha = 0.87$ and for tool (III) Postpartum Hemorrhage Self-Efficacy Scale (PPHSE) it was $\alpha = 0.91$

**2.5.4. Ethical considerations**

Formal approval from Benha University's Faculty of Nursing's Scientific Research Ethical Committee was acquired prior to the study's execution. Before being enrolled in the study, all nurses who decided to participate were given an oral explanation of aim and given their informed consent. Participants are free to leave the study at any moment if they decide to do so. All information submitted for the study will be kept private and used exclusively for statistics and scientific research.

**2.5.5. A Pilot Study**

To evaluate the effectiveness, practicality, and comprehensibility of the data collection instruments, a pilot study including eight nurses, or 10% of the total sample, was conducted. All maternity nurses who participated in the pilot study were incorporated into the final total sample after a few minor changes were made, such as modifying and clarifying some words.

**2.5.6. Field Work**

Data collection commenced at the start of November, 2024 to the end of April, 2025, three days per week (Sunday, Tuesday and Thursday) from 9 AM to 2 PM.

**The study had conducted through five phases:**

**First: the preparatory Phase**: A comprehensive literature review was conducted to establish a strong knowledge basis pertinent to the topic of the study. Prior to data collection, the dean of Benha University's faculty of nursing gave written approval to collect data of the study. This

approval was subsequently sent to the Director of Benha University Hospital to ensure institutional compliance and coordination. All research instruments were developed and subjected to rigorous evaluation for validity and reliability. A preliminary study was conducted to evaluate the practicality and clarity of the instruments. Based on the findings from the pilot phase, appropriate modifications were made to enhance the scientific accuracy and applicability of the instruments.

**Second: the assessment phase:** All maternity nurses who took part in the study received an orientation from the researchers, who ensured that they fully understood the study's objectives and purpose before obtaining their informed written consent. Subsequently, maternity nurses' interviews were conducted in a private and suitable setting to ensure confidentiality and comfort.
During the first phase of data collection, the researchers utilized Tool I: A Structured Self-Administered Questionnaire (Pre/Post-Test) to assess participants' personal characteristics and their knowledge related to primary postpartum hemorrhage (PPH). This portion of the assessment required approximately 15–20 minutes per participant. In the following phase, Tool II: Postpartum Hemorrhage Management Checklist (Pre/Post-Test) was used to evaluate maternity nurses' skills in managing cases of primary PPH during patient care. This assessment phase took approximately 10–15 minutes per nurse. Following that, Maternity nurses' perceived self-efficacy in preventing and treating primary postpartum hemorrhage is evaluated using the Postpartum Hemorrhage Self-Efficacy Scale (Pre/Post-Test). This phase of data collection required approximately 10 minutes for each participant.

**Third: Planning phase**
The design of the high-fidelity simulation training program was informed by the results obtained during the assessment phase and subsequently reviewed by three experts in obstetrics and gynecology nursing to ensure relevance, accuracy, and scientific rigor. The researchers developed all necessary components related to the high-fidelity simulator (Sim Mom) for the management of primary postpartum hemorrhage (PPH). This process included the preparation of the Sim Mom equipment, as well as the development of the training objectives, clinical scenarios, and evaluation criteria, all tailored to reflect realistic and evidence-based practices.

Program content: High-fidelity simulation-based training program consisted of two main parts:
❖ **Theoretical part:** It included general knowledge regarding primary post-partum hemorrhage such as (definition, causes, risk factors, signs and symptoms, classification, complications, the action a nurse should take when postpartum hemorrhage is suspected, purpose of uterine massage, uterotonic drugs also evidence-based guidelines for prevention and treatment of primary PPH).

❖ **Practical part:** The training program utilized a high-fidelity simulator (Sim Mom) alongside specially crafted clinical scenarios for postpartum hemorrhage, both developed by the researchers following a comprehensive review of the relevant literature. To ensure the accuracy and appropriateness of the content, the simulation scenarios were subjected to content validity assessment by a committee of five experts specializing in the field of obstetrics and gynecology nursing.

**4. Implementation phase:**
The maternity nurses were divided randomly into 10 subgroups; each subgroup involved 8 nurses. The program was carried out across four sessions: one for the theoretical component and three for the practical component).
**Session (1)**: it included the presentation of the theoretical part of the program regarding management of primary postpartum hemorrhage using discussion assisted with audiovisual

material as PowerPoint presentation on laptop and printed booklet, this session lasted for 30 minutes and conducted at obstetrics and gynecology department of Benha University Hospital.
**Session (2)**: it encompassed demonstration and redemonstration of practical skills concerning active management of primary PPH by using high-fidelity Sim Mom simulator with various scenarios that included (Administration of uterotonic agents, controlled cord traction, massage of uterine, meticulous monitoring of the fourth stage of labor; examination of vital signs, estimation of blood loss; evaluation of fundal height, bimanual uterine compression, and abdominal aortic compression). This session lasted 60 minutes and conducted at the simulation lab at Faculty of Nursing, Benha University.
**Session (3):** this session involved the application of the practical skills that were learned at the simulation lab. During this phase the researchers observed maternity nurses' performance while providing care to women complained of primary PPH at obstetrics and gynecology department.
**Session (4):** this phase involved debriefing and feedback from maternity nurses and lasted for approximately 30 minutes.

**4. Evaluation phase:**
The maternity nurses' knowledge, clinical practice, and perceived self-efficacy were assessed immediately after completing the high-fidelity simulation training program. This evaluation was conducted using the same assessment instruments previously described: Tool I (Structured Self-Administered Questionnaire), Tool II (Postpartum Hemorrhage Management Checklist), and Tool III (Postpartum Hemorrhage Self-Efficacy Scale), administered as post-tests.

**5. Follow-up phase:**
Following four weeks of implementing the program, the researchers employed similar assessment tools (follow up) to evaluate the impact of the high-fidelity simulation training program on maternity nurses' knowledge, skills and self-efficacy in managing primary postpartum hemorrhage.

**Statistical Analysis:** Before entering the data into the computer system, it was thoroughly verified. The collected data were processed using SPSS version 25.00 and organized into tables. Initial exploration involved calculating averages, dispersion measures, counts, and percentages. To investigate associations and differences among variables, statistical tests including paired t-tests, Chi-square, and Pearson correlation were utilized. Results were interpreted with the following criteria: p-values above 0.05 suggested no meaningful difference, values below 0.05 indicated significant findings, and those at or below 0.001 denoted highly significant outcomes.

**Results**

**Table (1): Distribution of the studied nurses according to their general characteristics (n=83).**

| General characteristics | No | % |
|---|---|---|
| **Age (years)** | | |
| < 25 | 15 | 18.1 |
| 25-35 | 35 | 42.2 |
| > 35 | 33 | 39.8 |
| **Mean ±SD** | **37.87±10.33** | |
| **Marital Status** | | |
| Single | 10 | 12.0 |
| Married | 62 | 74.7 |
| Divorced | 7 | 8.4 |
| Widow | 4 | 4.8 |
| **Residence** | | |
| Rural | 58 | 69.9 |
| Urban | 25 | 30.1 |
| **Educational qualification** | | |
| Secondary nursing education | 20 | 24.1 |
| Technical nursing education | 40 | 48.2 |
| Bachelor of nursing | 23 | 27.7 |
| **Job description** | | |
| Nurse | 45 | 54.2 |
| Supervisor | 23 | 27.7 |
| Head nurse | 15 | 18.1 |
| **Years of experience** | | |
| <5 years | 21 | 25.3 |
| 5-10 years | 25 | 30.1 |
| >10 years | 37 | 44.6 |
| **Mean ±SD** | **13.18±8.48** | |
| **previous attendance of high-fidelity simulation training programs regarding PPH** | | |
| Yes | 14 | 16.9 |
| No | 69 | 83.1 |

**Table (1)** illustrates the overall characteristics of the nurses examined in the study. It shows that 42. 2% of the nurses analyzed were aged between 25-35 years, with an average age of 37.87±10. 33 years. Among them, 74.7% were married. Additionally, 69.9% and 48.2% of the nurses studied came from rural backgrounds and possessed technical nursing education, respectively. Of the sample analyzed, 54. 2% were nurses, and 44.6% had over ten years of experience, averaging 13.18±8. 48 years. Moreover, 83.1% of the nurses examined did not participate in high-fidelity simulation training programs related to PPH.

**Table (2): Distribution of the studied nurses' knowledge regarding postpartum hemorrhage at Pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

| Times of assessment | Pre-Intervention | Post-Intervention | Follow up | Chi-square test |
|---|---|---|---|---|

| Items | No. | % | No. | % | No. | % | $X^2$ (1) | P value | $X^2$ (2) | P value |
|---|---|---|---|---|---|---|---|---|---|---|
| **Definition of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 22 | 26.5 | 38 | 45.8 | 36 | 43.4 | | | | |
| Incomplete correct | 30 | 36.2 | 35 | 42.2 | 39 | 47.0 | 5.40 | 0.000** | 18.11 | 0.000** |
| Incorrect answer | 31 | 37.3 | 10 | 12.0 | 8 | 9.6 | | | | |
| **Etiology of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 16 | 19.2 | 35 | 42.2 | 33 | 39.8 | | | | |
| Incomplete correct | 35 | 42.2 | 35 | 42.2 | 37 | 44.6 | 15.10 | 0.001** | 13.97 | 0.001** |
| Incorrect answer | 32 | 38.6 | 13 | 15.6 | 13 | 15.7 | | | | |
| **Predisposing factors of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 19 | 22.9 | 41 | 49.4 | 38 | 45.8 | | | | |
| Incomplete correct | 36 | 43.4 | 34 | 41.0 | 35 | 42.2 | 19.23 | 0.000** | 14.87 | 0.001** |
| Incorrect answer | 28 | 33.7 | 8 | 9.6 | 10 | 12.0 | | | | |
| **Types of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 22 | 26.5 | 47 | 56.6 | 47 | 56.6 | | | | |
| Incomplete correct | 35 | 42.2 | 26 | 31.4 | 23 | 27.7 | 17.49 | 0.000** | 15.87 | 0.000** |
| Incorrect answer | 26 | 31.3 | 10 | 12.0 | 13 | 15.7 | | | | |
| **Clinical manifestations of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 23 | 27.7 | 46 | 55.4 | 43 | 51.8 | | | | |
| Incomplete correct | 35 | 42.2 | 26 | 31.3 | 32 | 38.6 | 14.43 | 0.001** | 14.95 | 0.001** |
| Incorrect answer | 25 | 30.1 | 11 | 13.3 | 8 | 9.6 | | | | |
| **Complications of postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 25 | 30.1 | 50 | 60.2 | 48 | 57.8 | | | | |
| Incomplete correct | 36 | 43.4 | 25 | 30.2 | 24 | 28.9 | 17.25 | 0.000** | 13.53 | 0.001** |
| Incorrect answer | 22 | 26.5 | 8 | 9.6 | 11 | 13.3 | | | | |
| **The action a nurse should take when postpartum hemorrhage is suspected** | | | | | | | | | | |
| Complete correct | 22 | 26.5 | 45 | 54.2 | 47 | 56.6 | | | | |
| Incomplete correct | 42 | 50.6 | 28 | 33.7 | 24 | 28.9 | 13.48 | 0.001** | 15.54 | 0.000** |
| Incorrect answer | 19 | 22.9 | 10 | 12.0 | 12 | 14.5 | | | | |
| **The purpose of uterine massage in postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 26 | 31.3 | 42 | 50.6 | 44 | 53.0 | | | | |
| Incomplete correct | 32 | 38.6 | 34 | 41.0 | 31 | 37.3 | 13.95 | 0.001** | 13.40 | 0.001** |
| Incorrect answer | 25 | 30.1 | 7 | 8.4 | 8 | 9.6 | | | | |
| **The uterotonic drugs that is typically used first in postpartum hemorrhage management** | | | | | | | | | | |
| Complete correct | 23 | 27.7 | 45 | 54.2 | 45 | 54.2 | | | | |
| Incomplete correct | 40 | 48.2 | 30 | 36.2 | 31 | 37.3 | 13.68 | 0.001** | 14.51 | 0.001** |
| Incorrect answer | 20 | 24.1 | 8 | 9.6 | 7 | 8.4 | | | | |
| **When should a hysterectomy be considered in postpartum hemorrhage** | | | | | | | | | | |
| Complete correct | 19 | 22.9 | 40 | 48.2 | 44 | 53.0 | | | | |
| Incomplete correct | 37 | 44.6 | 35 | 42.2 | 30 | 36.1 | 17.84 | 0.000** | 12.06 | 0.002* |
| Incorrect answer | 27 | 32.5 | 8 | 9.6 | 9 | 10.8 | | | | |

****A highly statistically significant difference (P ≤ 0.001)**
***A statistically significant difference (P ≤ 0.05)**
**$X^2$ 1 between pre-intervention and post-intervention**
**$X^2$ 2 between Pre-intervention and follow-up**

**Table (2)** indicates a highly significant difference between the pre-intervention phase and both the immediate post-intervention and 4-week follow-up assessments. The greatest improvement was observed immediately post-intervention, demonstrating the effectiveness of the intervention in the short term. Although there was a slight decline in scores at follow-up

compared to the immediate post-intervention phase, the reduction was minimal, suggesting a relatively stable retention of the intervention's effects over time."

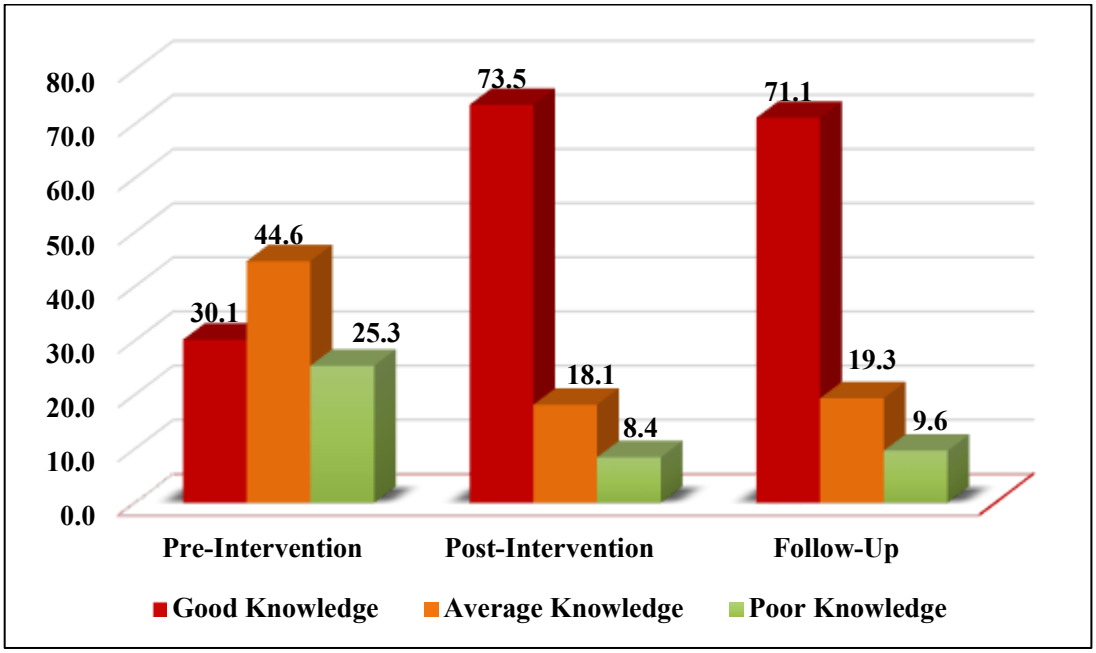


**Figure (1): Distribution of the studied nurses' total knowledge regarding postpartum hemorrhage management at pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

**Figure (1)** shows that prior to the intervention, only 30.1% of participants exhibited good knowledge, while 44.6% had average knowledge and 25.3% of them were within the poor knowledge category. Following the intervention, there was a significant increase in the proportion of participants with good knowledge, rising to 73.5%, accompanied by a notable decline in poor knowledge to just 8.4%. These improvements were sustained at the follow-up phase, with 71.1% maintaining good knowledge and only 9.6% remaining in the poor knowledge group. This indicates that the intervention was effective in enhancing knowledge about postpartum hemorrhage and that its impact persisted over time with minimal decline.

**Table (3): Comparison of the mean scores of nurses' performance in managing primary postpartum hemorrhage at pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

| Times of assessment / Items | Range of Possible Scores | Pre-Intervention | Post-Intervention | Follow up | t-test 1 P-value | t-test 2 P-value |
|---|---|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ±SD | | |
| Recognition of PPH Symptoms | 1-3 | 1.80 ± 0.74 | 2.38 ± 0.65 | 2.30 ± 0.67 | 4.00 0.000** | 3.31 0.000** |
| Timeliness of Response to PPH | 1-3 | 1.63 ± 0.67 | 2.24 ± 0.75 | 2.14 ± 0.78 | 4.03 0.000** | 3.47 0.000** |
| Monitoring Vital Signs | 1-3 | 1.98 ± 0.70 | 2.53 ± 0.59 | 2.44 ± 0.58 | 4.37 0.000** | 3.55 0.001** |
| Uterine Massage and Intervention for Uterine Atony | 1-3 | 1.74 ± 0.77 | 2.21 ± 0.76 | 2.12 ± 0.78 | 4.55 0.000** | 4.30 0.000** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Administration of Medications (e.g., Oxytocin, Misoprostol) | 1-3 | 1.60 ± 0.71 | 2.36 ± 0.70 | 2.33 ± 0.73 | 4.22 0.000** | 3.60 0.000** |
| Monitoring and Documentation of Blood Loss | 1-3 | 1.90 ± 0.70 | 2.46 ± 0.68 | 2.38 ± 0.67 | 4.18 0.000** | 3.77 0.000** |
| Communication with Healthcare Team | 1-3 | 1.67 ± 0.78 | 2.30 ± 0.76 | 2.21 ± 0.76 | 3.88 0.000** | 3.76 0.000** |
| Communication and Documentation with Patient and Family | 1-3 | 1.71 ± 0.74 | 2.32 ± 0.70 | 2.28 ± 0.74 | 4.55 0.000** | 4.18 0.000** |
| **Overall score** | 8-24 | 14.07 ± 4.29 | 18.83 ± 4.99 | 18.33±4.83 | 4.82 0.000** | 4.41 0.000** |

****A highly statistically significant difference (P ≤ 0.001)**
**Paired t-test 1 between pre-intervention and post-intervention**
**Paired t-test 2 between Pre-intervention and follow-up**

**Table (3)** illustrates a statistically significant improvement ($p < 0.001$) in all measured domains, including recognition of PPH symptoms, timeliness of response, monitoring of vital signs, uterine massage, administration of medications, communication with healthcare teams, and documentation practices. the overall performance score improved significantly from 14.07 ± 4.29 before the intervention to 18.83 ± 4.99 immediately after and 18.33 ± 4.83 at follow-up. These findings confirm the effectiveness of the intervention in enhancing nurses' competencies in managing primary PPH, with improvements sustained over time.

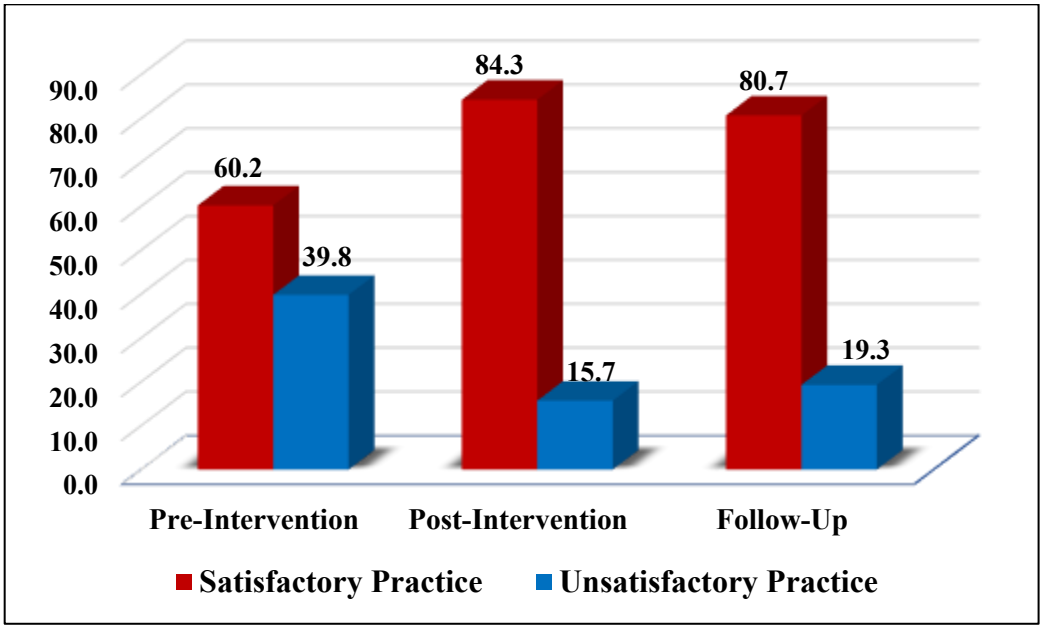


**Figure (2): Distribution of the studied nurses' total Performance regarding postpartum hemorrhage management at pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

**Figure (2)** shows a significant improvement following the intervention. Prior to the intervention, only 60.2% of nurses demonstrated satisfactory practice, while 39.8% were

classified as having unsatisfactory performance. Following the educational intervention, the percentage of nurses with satisfactory practice increased markedly to 84.3%, indicating a substantial enhancement in clinical competence. Although a slight decline was observed at the 4-week follow-up (80.7%), the level of satisfactory practice remained significantly higher than the pre-intervention baseline. Conversely, unsatisfactory practice declined from 39.8% pre-intervention to 15.7% post-intervention, with a minor increase to 19.3% at follow-up.

**Table (4): Comparison of the mean scores of nurses' self-efficacy regarding postpartum hemorrhage management at pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

| Times of assessment / Items | Range of Possible Scores | Pre-Intervention | Post-Intervention | Follow up | t-test 1 P-value | t-test 2 P-value |
|---|---|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD | | |
| I remain calm when handling PPH | 1-8 | 5.06 ± 1.15 | 3.56 ± 1.12 | 3.91 ± 0.96 | 6.11 0.000** | 5.72 0.000** |
| I have experienced being able to act in situations with PPH | 1-8 | 5.74 ± 1.19 | 4.07 ± 1.20 | 4.22 ± 1.29 | 16.72 0.000** | 18.32 0.000** |
| I can handle PPH whenever it happens | 1-8 | 4.77 ± 0.83 | 3.75 ± 1.00 | 4.22 ± 1.29 | 23.16 0.000** | 6.85 0.000** |
| I can carry out the necessary actions to handle PPH | 1-8 | 4.93 ± 1.04 | 3.67 ± 1.01 | 3.75 ± 0.94 | 5.90 0.000** | 5.90 0.000** |
| I am confident in how to treat PPH | 1-8 | 4.95 ± 1.06 | 3.69 ± 0.95 | 3.79 ± 1.06 | 16.40 0.000** | 18.37 0.000** |
| I am able to stay calm in emergency situations | 1-8 | 5.28 ± 0.94 | 4.02 ± 1.26 | 4.09 ± 1.34 | 21.22 0.000** | 17.15 0.000** |
| I am able to identify PPH at an early stage | 1-8 | 4.84 ± 0.93 | 3.90 ± 1.15 | 4.00 ± 1.23 | 14.47 0.000** | 10.61 0.000** |
| PPH will make me feel paralyzed/unable to ac | 1-8 | 5.02 ± 1.10 | 3.74 ± 1.04 | 3.84 ± 1.15 | 19.69 0.000** | 24.13 0.000** |
| **Overall score** | 8-64 | 40.62 ± 7.80 | 30.44 ± 4.32 | 31.50 ± 5.70 | 21.62 0.000** | 25.09 0.000** |

****A highly statistically significant difference (P ≤ 0.001)**
**Paired t-test 1 between pre-intervention and post-intervention**
**Paired t-test 2 between Pre-intervention and follow-up**

**Table (4)** demonstrates statistically significant improvements in studied nurses' scores across all assessed areas following the high-fidelity simulation training, as indicated by the consistently low P-values (P = 0.000**). These results suggest that the intervention had a positive overall effect on nurses' confidence, skills, and readiness in the management of PPH. The results show a significant reduction in the mean score from pre-simulation training (40.62 ± 7.80) to post-simulation training (30.44 ± 4.32), indicating that the intervention had a substantial and immediate positive effect. Furthermore, the follow-up measurement (31.50 ± 5.70) demonstrates that the improvement was largely maintained over time, with only a slight increase compared to the post-intervention phase. The paired t-tests support the statistical significance of these changes. The comparison between pre- and post-intervention yielded a p-

value of 0.000, and the comparison between pre-intervention and follow-up also showed a p-value of (0.000). These values indicate that the differences are highly significant.

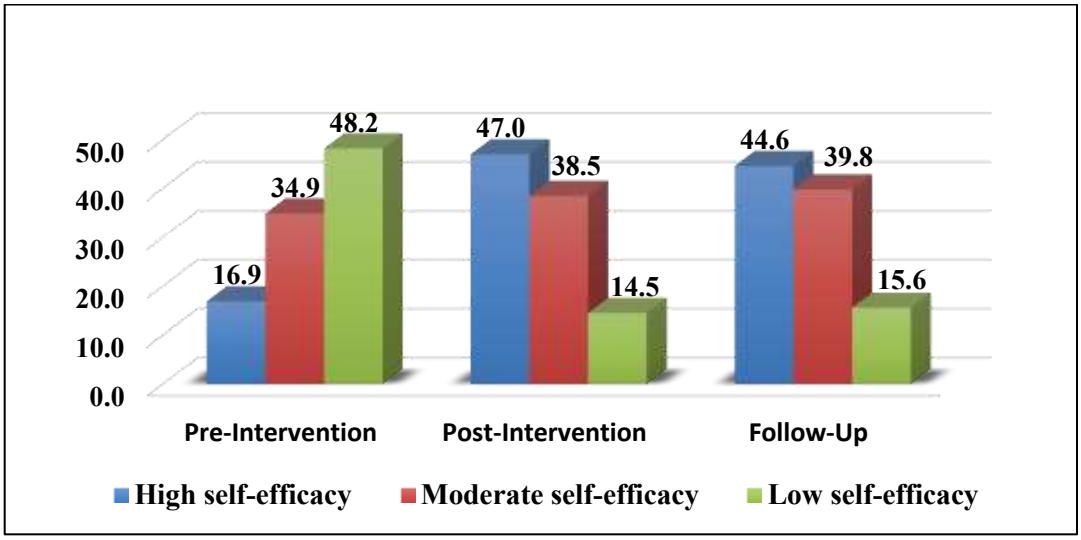


**Figure (3): Distribution of the studied nurses' total self-efficacy regarding postpartum hemorrhage management at pre- intervention, post-intervention and 4 weeks follow-up phases (n=83).**

**Figure (3)** shows distribution of the studied nurses' self-efficacy levels pre-intervention, post-intervention, and follow-up revealed a significant improvement following the intervention. Before the intervention, 48.2% of the studied nurses exhibited low self-efficacy in managing postpartum hemorrhage, while only 16.9% demonstrated high self-efficacy. After the intervention, there was a notable shift, with the proportion of participants in the high self-efficacy category increasing to 47.0%, and those in the low category decreasing substantially to 14.5%. These gains were largely sustained at follow-up, with 44.6% of participants maintaining high self-efficacy and only 15.6% remaining in the low category. This pattern indicates that the intervention was effective not only in improving immediate confidence levels but also in maintaining these improvements over time.

**Table (5): Correlation between Maternity Nurses' Total Knowledge, Total Performance, and Total Self-Efficacy in Relation to Primary Postpartum Hemorrhage Care at pre-intervention, post-intervention and 4 weeks follow-up phases (n=83).**

| Variables | Total self-efficacy | | | | | |
|---|---|---|---|---|---|---|
| | Pre-intervention | | Post-intervention | | Follow-up | |
| | r | P value | R | P value | r | P value |
| Total Knowledge | 0.510 | 0.000** | 0.683 | 0.000** | 0.611 | 0.000** |
| Total performance | 0.492 | 0.000** | 0.605 | 0.000** | 0.593 | 0.000** |

****A Highly Statistically significant p ≤ 0.001**

**Table (5)** shows a significant positive correlation between Total Self-Efficacy and both Total Knowledge and Total Performance at all stages: Pre-intervention, Post-intervention, and Follow-up. Notably, the improvements in knowledge and performance after the intervention

contributed significantly to the enhancement of self-efficacy, with r = 0.683 for knowledge and r = 0.605 for performance post-intervention ($p < 0.001$). These improvements were sustained at follow-up, indicating that the high-fidelity simulation training not only enhanced nurses' skills and knowledge but also positively impacted their confidence in managing primary postpartum hemorrhage.

**Discussion**

The postpartum period is widely acknowledged as a particularly vulnerable stage in a woman's reproductive journey, during which serious complications can arise. Among these, primary postpartum hemorrhage (PPH) stands out as a major contributor to maternal mortality worldwide. Current global estimates suggest that a woman loses her life to PPH every four minutes, making it responsible for roughly 25% of maternal deaths across the globe. In light of this alarming statistic, the development and application of targeted educational programs focused on the prevention and management of primary PPH are considered critical interventions that can significantly improve maternal outcomes and save lives (Wang & Oyelese, 2025).

High-fidelity simulation has emerged as a highly effective educational strategy in contemporary nursing education. It serves as a valuable tool for enhancing learning experiences, particularly in emergency situations. This method has been shown to reduce anxiety and stress among participants while also significantly improving clinical performance and self-efficacy, especially among maternity nurses. By strengthening nurses' preparedness and confidence in managing obstetric emergencies, high-fidelity simulation contributes to better maternal health outcomes, especially in critical situations where delays or errors can be life-threatening (Dillon et al., 2021).

High-fidelity simulation combines clinical experience with a computerized patient simulator that provides instantaneous feedback on nursing actions via interactive functionalities. This approach actively engages nurses in the learning process and has been demonstrated to improve self-confidence, knowledge, clinical performance, satisfaction, and self-efficacy (Bakir & Ünsalatan, 2023).

The present study aimed to evaluate the effectiveness of high-fidelity simulation training in improving maternity nurses' performance and self-efficacy related to the management of primary postpartum hemorrhage. The findings of this research indicate that the objective was successfully achieved.

Concerning the general demographics of the maternity nurses, the study revealed that fewer than half of the participants were aged between 25 and 35 years, with an average age of 37.87 ± 10.33 years. About 75% of the nurses were married, and over two-thirds lived in rural areas. Nearly half possessed technical nursing qualifications, while more than half were registered nurses. These results align with those of Yang et al. (2024), who reported average ages of 37.8 ± 6.1 years for the control group and 37.6 ± 5.6 years for the study group.

Additionally, the results of research are closely supported with Abd El-Salam et al. (2022), who mentioned that over half of the nurses under study were bedside nurses, more than half resided in urban areas, and over two-thirds were married.

Regarding years of experience, less than half of the maternity nurses had under 10 years of professional experience. Additionally, more than two-thirds of the participants had not previously engaged in high-fidelity simulation training programs related to postpartum hemorrhage (PPH). Similarly, Almutairi (2025) reported that none of the nurses in their study had participated in simulation training focused on postpartum hemorrhage.

In contrast, the results of our study are not supported with Yang et al., (2024) who illustrated that 70% of control group and 57.7% of research group had >10 years of experience and 64% of control group and 61.5% of research group were familiar with simulation training. These results may be due to variation of the study setting, available resources and level of training of the studied participants.

Regarding knowledge of maternity nurses about PPH, the results of the study revealed a highly significant enhancement in the knowledge of maternity nurses following the application of high-fidelity simulation program on the management of primary postpartum hemorrhage. The immediate post-intervention scores reflect the greatest gain, indicating that the simulation-based approach was highly effective in delivering knowledge and enhancing understanding in the short term.

This notable increase in knowledge immediately after the intervention can be related to the immersive nature of high-fidelity simulation. By replicating realistic clinical scenarios, the training likely facilitated deeper cognitive engagement, improved retention of complex clinical information, and promoted active problem-solving. Such experiential learning environments are particularly valuable in preparing nurses for high-risk, low-frequency events like PPH, where theoretical knowledge must be rapidly translated into practical action.

At the 4-week follow-up, a slight decrease in scores was observed when compared to the immediate post-intervention results. However, the reduction was minimal, suggesting that nurses retained most of the knowledge gained through the training. This stability over time reflects the potential of simulation-based education to create lasting learning outcomes, especially when learners are given opportunities to apply knowledge in a context that mirrors actual clinical practice.

The retention of knowledge after four weeks also supports the idea that simulation can serve as a sustainable strategy for continuing education in maternity care. It offers an effective alternative to traditional didactic methods, particularly in enhancing readiness to manage obstetric emergencies. The findings align with Al-Momani et al. (2024) who investigated the outcomes of simulation-integrated instruction on maternity nursing students and highlighted that those who underwent high-fidelity simulation exercises scored appreciably higher in both knowledge assessments related to PPH management compared to their peers who received traditional instruction alone. This study highlighted that simulation not only enhanced cognitive understanding but also improved critical decision-making and technical skills, fostering a deeper level of engagement and retention

Similarly, Mohammed et al. (2023) carried out a study using a quasi-experimental approach involving intern nurses to assess the impact of simulation training on their knowledge, competence, and self-confidence in managing PPH. The study utilized a combination of theoretical instruction and hands-on simulation scenarios that replicated real-life obstetric emergencies. Results showed a marked improvement in the interns' knowledge scores immediately following the training.

International evidence supports these findings. In a randomized controlled trial conducted in Japan, Yamamoto et al. (2017) evaluated a simulation training program for midwives on managing PPH. The study reported significantly improved performance and knowledge levels among the intervention group, pointing to simulation as an effective approach in maternal healthcare training.

A broader perspective was provided by Kim et al. (2020) in a systematic review that synthesized findings from multiple countries. The review concluded that repeated exposure to simulation experiences significantly improves nursing students' knowledge retention, and

overall satisfaction further reinforcing the educational value of simulation in maternal and emergency care. Although focused more broadly on emergency care, a study in Malaysia by Omar et al. (2021) demonstrated that application of high-fidelity simulation has a significant impact on improving knowledge of nursing students and decision-making skills, findings that are also relevant to obstetric emergencies like PPH.

Regarding performance of maternity nurses about PPH, the results demonstrate that the high-fidelity simulation training program produced a notably positive impact on the practices of maternity nurses' performance in dealing with primary PPH. The statistically significant improvements observed across all key clinical domains including symptom recognition, timely response, vital signs monitoring, uterine massage, medication administration, communication, and documentation—underscore the comprehensive benefits of simulation-based education in enhancing clinical competencies.

This suggests that simulation scenarios provide an experiential learning environment that closely mimics the complexities and urgency of real-life obstetric emergencies. Importantly, the retention of performance gains at the 4-week follow-up illustrates that simulation fosters durable learning, which is crucial in clinical settings where emergencies are high-risk but occur infrequently. Sustained competence over time can significantly reduce delays in treatment and improve maternal outcomes, particularly in low-resource settings where early interventions can be lifesaving.

In Denmark, Hansen et al. (2021) found that simulation training improved third-year nursing students' professional self-confidence and technical proficiency, with effects lasting into subsequent semesters. This highlights the long-term benefits of simulation in building students' readiness for clinical practice. As well as, Lavoie et al. (2021) conducted a randomized controlled trial in Canada and reported significant gains in nurses' ability to promptly recognize and manage PPH after simulation training, consistent with the immediate post-intervention improvements observed in the current study.

Similarly, a French study by Tschirhart et al. (2022) compared virtual simulation to traditional supervised work in managing PPH among student midwives. The results demonstrated that virtual simulation was equally effective, making it a promising alternative in environments with limited access to high-fidelity resources. Furthermore, Smith et al. (2022) in a UK-based multi-site study found that simulation training improved both technical and decision-making skills necessary for effective PPH management, which aligns with the multifaceted performance improvements identified here across domains such as vital sign monitoring, uterine massage, and medication administration.

Importantly, the retention of improved performance at the four-week follow-up reflects the durability of skills acquired through simulation, an outcome that has been emphasized in recent longitudinal studies. Jones et al. (2020) demonstrated sustained competency in postpartum hemorrhage management up to three months following simulation training, suggesting that immersive, experiential learning methodologies produce long-lasting clinical benefits. This retention is critical given the sporadic occurrence of PPH emergencies, which require nurses to maintain a high level of preparedness despite infrequent exposure to such cases.

Self-efficacy refers to a person's confidence in their own ability to effectively carry out particular tasks or responsibilities. Observations from the study confirmed that the introduction of an interactive high-fidelity simulation training course effectively boosted the self-efficacy of maternity nurses involved in the training. These results are in line with study by Abd El-Salam et al. (2022), who observed a highly significant increase in nurses' self-efficacy levels when assessed before the simulation, immediately after its conclusion, and at the follow-up stage ($p < 0.001$).

In a similar line, Sabrina et al., (2021) demonstrated that maternity nurses' perception of their own ability to handle obstetric emergencies such as postpartum hemorrhage was successfully raised by high-fidelity simulation. Supporting this, Alsaraireh et al. (2024) illustrated that training based on simulation has significant influence on enhancing the knowledge of students ($p = 0.038$) and also promoted considerable levels of satisfaction and confidence, with participants achieving an average score of $4.05 \pm 0.65$.

The above-mentioned results reflect the positive effects of high-fidelity simulation based educational program that improve the studied maternity nurses' knowledge, practices and increases maternity nurses' self-confidence and self-efficacy in dealing with women with primary postpartum hemorrhage.

This study uncovered a statistically meaningful positive link between overall self-efficacy and both total knowledge and total performance across all assessed time points: before the intervention, immediately after, and at follow-up ($p < 0.001$). Echoing the conclusions of Abd El-Salam et al. (2022), there was a marked positive correlation between participants' practical skills and self-efficacy both post intervention and after 8 weeks. Their research further confirmed the lasting effects of simulation-based training, demonstrating that self-efficacy remained closely linked to clinical performance during both post-intervention and follow-up evaluations.

A similar trend was noted by Abd El-Hamid et al. (2021), who identified a statistically significant positive connection between the overall self-efficacy score and the overall performance score within the study group directly upon conclusion of the training was implemented ($r = 0.519$, $p = 0.003$).

**Mohammed et al. (2023)** reported that prior to and after the simulation training, participants' levels of clinical performance, satisfaction, and self-confidence have statistically significant positive correlation with their overall competency scores ($p < 0.001$ and $p \leq 0.05$).

**Conclusion**

The study's findings support the research hypotheses, demonstrating that the high-fidelity simulation training program significantly improved maternity nurses' knowledge, clinical skills, and self-efficacy in managing primary postpartum hemorrhage. Additionally, a consistent positive correlation was found between overall self-efficacy and both knowledge and performance scores across all evaluated time points: before the intervention, immediately post-training, and at the four-week follow-up.

**Recommendations:**

The following recommendations are proposed in light of the current study's findings: -

- High-fidelity simulation-based training programs should be implemented for all healthcare providers involved in obstetric care, to take an active and confident role during obstetric emergencies.
- High-fidelity simulation training should be incorporated into the nursing curriculum to enhance maternity nurses' knowledge, clinical skills, and responsiveness in the early detection and effective management of postpartum hemorrhage.
- Pre-service and in-service simulation sessions should be given priority, especially for recently hired or intern nurses to improve clinical competence, confidence, and readiness in handling obstetric emergencies.
- Future research is urged in a variety of maternity care settings and on large, more broader samples to improve the generalization of the results of current study.

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