

## Effect of High Fidelity Simulation Based Training Program on Nursing Students' Performance, Self-efficacy and Confidence regarding Prevention of Postpartum Hemorrhage

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### Abstract

**Background:** Postpartum Hemorrhage (PPH) is an obstetric complication that is lead to maternal morbidity and mortality. Training nursing students to prevent and manage PPH is a fundamental principle of risk management. Using high-fidelity simulation at nursing colleges can bridge the gap between theory and practice by using all learning domains. **The aim of this study:** was to determine the effect of high-fidelity simulation-based training program on nursing students' performance, self-efficacy and confidence regarding prevention of PPH. **Subjects and method:** the study was conducted in two **Settings;** (1) Clinical obstetric laboratory skills for academic third year at Faculty of Nursing, Tanta University and (2) Labor unit in obstetric department at Tanta University Hospital. **Subjects:** A cluster random sample of 60 nursing students in the third academic year who fulfilled the inclusive criteria was included in the study and was divided into two groups; each of them consisted of 30 students. **Four tools** were used for data collection; **Tool (I):** A structured interview schedule, comprised of two parts as follows; **Part I:** Socio-demographic characteristics of nursing students. **Part II:** Students' knowledge regarding PPH. **Tool (II):** Students' performance observational checklist contained two parts as following; **Part I:** Prevention of atonic PPH during the third stage of labor and **Part II:** Prevention and management of PPH of atonic PPH during fourth stage of labor. **Tool (III):** Self-efficacy Scale. **Tool (IV):** Modified self-confidence measurement scale. **Results:** Students' knowledge, performance, self-confidence, as well as self-efficacy regarding prevention and management of PPH were higher after using high fidelity simulation-based training program. **Conclusion and recommendations:** The use of high fidelity simulation in teaching improved the nursing students' three domains of learning; knowledge, skills, and attitude for prevention and rapid effective nursing response for managing PPH. Therefore, high-fidelity simulation training programs and refreshing courses should be incorporated in the basic nursing educational curriculum as well as for maternity nurses to improve their knowledge, practice, self-efficacy, and confidence.

**Keywords:** Postpartum haemorrhage, Simulation, Performance, Self-efficacy, Self-confidence.

## Introduction

Childbirth is a life-changing event for most women and families all over the world, but it is associated with great risks, disability and even death for some mothers and newborns. Every year, nearly 600 000 women worldwide between the age of (15-49) die due to complications from pregnancy and childbirth. The four major causes of maternal deaths are obstetric hemorrhage, infections, hypertensive disorders and obstructed labor <sup>(1)</sup>. Obstetric hemorrhage is the most common and dangerous complication of childbirth. It can be broadly categorized as antepartum hemorrhage and postpartum hemorrhage (PPH). PPH is a potentially life-threatening obstetric emergency associated with both the vaginal birth (2-4%) and the cesarean birth (6-7%) as a consequence of the third stage of labor <sup>(2)</sup>.

According to the World Health Organization (WHO), PPH is the common leading cause of maternal morbidity and mortality worldwide. Globally, 35% of maternal deaths are associated with PPH. In Egypt, the maternal mortality ratio associated with PPH accounts 45 deaths per 100,000 live births in 2014 <sup>(3)</sup>. Ministry of Health and Population in Egypt reported that PPH is responsible for 19.7% of all maternal deaths <sup>(4)</sup>. PPH is commonly defined as blood loss exceeding 500 ML

following vaginal birth and 1000 ML following cesarean birth. Definitions vary; however, the diagnosis of PPH is subjective and often based on inaccurate estimates of blood loss <sup>(5)</sup>. The American College of Obstetricians and Gynecologists (ACOG) defines Primary PPH as accumulative blood loss greater than or equal to 1000 ML or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours after the birth process including the intrapartum loss regardless of the route of birth<sup>(6)</sup>. On the other hand, secondary PPH is defined as bleeding in excess of normal lochia after 24 hours and up to 6 weeks postpartum. Secondary PPH is less common than primary PPH. It affects 1-3% of all deliveries. The etiologies of primary PPH are classically divided into four different categories, known as the four T's – Tone (70%), Trauma (20%), Tissue (10%), and Thrombin (1%) <sup>(5,7-10)</sup>. The prevention and treatment of PPH can be a life-saving and considered as the vital steps towards improving the health of women during childbirth. Maternity nurses and obstetricians need to be engaged in ongoing simulation training in developing and maintaining update knowledge, vigilant clinical competencies skills, and proper accurate clinical judgments based on universal guideline protocol for the early detection and critical nursing management

in a timely manner. Consequently, maternity nurses can save the life of women, who are clinically deteriorating as a result of PPH<sup>(11-14)</sup>.

Clinical teaching is a hallmark of nursing education. It provides an opportunity for nursing students to apply, practice, and develop problem solving, critical thinking, decision-making and communication skills, as well as improves their legal and ethical issue<sup>(15, 16)</sup>. Simulation-based learning is one of the innovative teaching strategies that have increasingly incorporated in clinical nursing education. It is the most important trend in nursing education today as a way to move from learning to doing. It is a teaching and learning strategy aims to replicate real-life experience to develop students' knowledge and skills within a safe environment. Nursing education mandates the use of clinical simulation and facilities to assure that learners have adequate knowledge and skills of clinical background required for transition from student to professional practitioner<sup>(17,18)</sup>. The level of simulation fidelity is based on the degree to which the simulation imitates reality. High fidelity human patient simulators are computerized full body interactive mannequins that mimics interaction with students to control the simulated clinical setting<sup>(19)</sup>.

The use of high-fidelity simulation in clinical education has many benefits. It provides an opportunity for nursing students to practice nursing skills before engaging in clinical practice, thereby assuring that they have the knowledge to be confident in providing safe and effective care. Self-confidence is conceptually defined as trusting the soundness of one's own judgment and performance. On the other hand, self-efficacy is commonly defined as the belief in one's capabilities to achieve a goal or an outcome. Students with a strong sense of efficacy are more likely to challenge themselves with difficult tasks and be intrinsically motivated. Furthermore, the interactive nature of simulation motivates students and promotes better learning that allows students to understand more, remember longer, be more successful in the evaluation and improve clinical performance of nursing students<sup>(17)</sup>. Maternity nurses are the frontline health care providers multifaceted with responsibilities to improve women health, decrease morbidity and mortality associated with PPH and save the mother's life. Maternity nursing students are the future maternity nurses who will assume this responsibility<sup>(1, 20)</sup>. So, the aim of this study is to determine the effect of high fidelity simulation based training program on nursing students' performance, self-

efficacy and confidence regarding prevention of PPH.

### **Aim of the study**

The aim of this study was to determine the effect of high fidelity simulation based training program on nursing students' performance, self-efficacy and confidence regarding prevention of postpartum hemorrhage.

### **Research Hypothesis**

The nursing students who receive high fidelity simulation based training program are expected to have better knowledge, clinical performance and high level of self-efficacy and confidence than those who didn't receive it.

### **Subjects and Method**

#### **Study design:**

Experimental study design was used in this study. Such design fits the nature of the study, in which the researcher tried to determine the effect of high fidelity simulation based training program on nursing students' performance, self-efficacy and confidence regarding prevention of PPH. The comparison was done between two groups; study group and control group.

#### **Setting:**

The study was conducted in two settings; **(1)** Clinical obstetric laboratory skills for academic third year at Faculty of Nursing, Tanta University which contained high

fidelity simulator (SimMom) equipment and symbols. **(2)** Labor unit in obstetric department at Tanta University Hospital where the students' basic obstetrical routine clinical training course was conducted.

#### **Subjects:**

According to the equation of power analysis, the study compromised of cluster random sample of 60 nursing students in the third academic year, Faculty of Nursing, Tanta University. Those students whose training were through the period of first semester 2019 at the first previously mentioned setting. The calculation of sample size was by using Epi-Info software statistical package that based on type I error ( $\alpha$ ) 5% and power of the test 90%. The students were selected randomly from the previously mentioned setting according to the following inclusion criteria:

1. Male or female students.
2. Third academic year nursing students (Obstetric and gynecological semester).
3. Willing to participate in the study.

They were divided into two equal groups; **(1) Study group:** consisted of 30 students who received both theoretical part through powerpoint presentation by the researcher in addition to the students' basic obstetrical routine clinical training course as well as

simulation based training program about prevention of PPH using high fidelity birthing simulator “SimMom”. **(2) Control group:** consisted of the other 30 students who received both theoretical part through powerpoint presentation by the researcher as well as the students’ basic obstetrical routine clinical training course about prevention of PPH.

**Tools of data collection:** to achieve the aim of the study the following tools were used:

**Tool (I): A structured interview schedule;** comprised of two main parts as follows: **Part I: Socio demographic characteristics of nursing students** as age, sex, residence, and previous simulation training program participation.

**Part II: Students’ knowledge regarding PPH;** It included 20 questions related to the following items; definition, causes, risk factors, signs & symptoms, classification, complications, nursing management and evidence based guidelines for prevention and treatment of PPH.

The scoring system of knowledge was developed by the researcher and categorized as follows: Correct and complete answers were scored as (2), Correct and incomplete answers were scored as (1) and Incorrect answers or don't know were scored as zero (0).

The total score was ranged from (0 - 40). The total score of knowledge was summed up and categorized as follows:

- **Good knowledge:** 75-100% (for total score 30 - 40)
- **Fair knowledge:** 50- to less than 75% (for total score 20 - 29).
- **Poor knowledge:** 0- to less than 50% (for total score 0 -19).

**Tool (II): Students’ performance observational checklist:** This tool was adapted by the researcher guided by Health Service Executive (2016) <sup>(20)</sup> and World Health Organization (2018) <sup>(21)</sup>. It included data related to prevention and management of atonic PPH. It was contained in two parts as following:

**Part I: Prevention during third stage of labor** that included active management of the third stage of labor (administration of a uterotonic drug, controlled cord traction, and uterine massage); emptying urinary bladder and also avoidance of prolonged labor. In addition, proper bearing down; proper timing for episiotomy; applying perineal support as well as avoidance of fundal pressure; and finally exploration/examination of the birth canal, placenta and membranes.

**Part II: Prevention and management of PPH during immediate post-natal period (fourth stage of labor):** (a) Prevention of PPH comprised of

careful/close observation in the fourth stage of labor; fundal examination and bladder assessment; in addition routine use of ecbolics after delivery; as well as early breast feeding. (b) Management of PPH included the estimation of the amount of blood loss; assessment of general condition of the parturient woman; good communication/call for help; and resuscitation and drug administration in PPH. In addition, the initial measures to stop/control bleeding (external bimanual uterine massage, internal bimanual uterine compression, and abdominal aortic compression); health education (counseling the woman on self-care); as well as evaluation and documentation.

The total scoring system of performance skills was developed and adapted by the researcher and categorized as follows: Correct and competently done were scored as (3), Correct and incompetently done were scored as (2), and Not done were scored as (1).

The total score was ranged from (114-342). The score of each item of performance skills was summed up and converted into percent score as follows:

- Satisfactory performance: 60 - 100% for total score (251-342).
- Unsatisfactory performance: 0 - to less than 60% for total score (114-250).

**Tool (III): Self-efficacy Scale:** This tool was developed and adapted by the researcher from Schwarzer and Jerusalem (1996)<sup>(22)</sup> and Rimm and Jerusalem (1999)<sup>(23)</sup> and was used to assess students' sense of perceived self-efficacy in the training program regarding prevention of PPH. Self-efficacy rating scale was as the following: Not at all true were scored as (1), Hardly true were scored as (2), Moderately true were scored as (3) and Exactly true were scored as (4).

The total score of self-efficacy scale was developed by the researcher. It was ranged from (12- 48). The total score of self-efficacy was summed up and categorized as follows:

- Positive perception: 60 - 100% for total score (34-48).
- Negative perception: 0 - to less than 60% for total score (12-33).

**Tool (IV): Modified self-confidence measurement scale:** This tool was adapted from the National League for Nursing (2012)<sup>(24)</sup> by AbdElhakm and Elbana (2018)<sup>(25)</sup> and used by the researcher to measure how confident students feel about their skills when they participate in the training program regarding prevention of PPH.

The self-confidence scale was consisted of 7- items measured on a three-point Likert scale as follows:

Agree answers were scored as (3), Uncertain/or (neither agree nor disagree) answers were scored as (2), and Disagree answers were scored as (1).

The total score was ranged from (7-21). The score of self-confidence measurement scale was summed up and converted into percent score as follows:

- Confident: 60-100% (for total score 16-21).
- Not confident: 0- to less than 60% (for total score 7-15).

## **Method**

### **Administrative approval:**

Official permission for carrying out the study was obtained from the responsible authority before conducting this study through official letters from the Faculty of Nursing Tanta University.

### **Developing the tools:**

Four tools were developed and used in this study after reviewing recent literature; **1)** a structured interview schedule, **2)** Students' performance observational checklist, **3)** General Self-efficacy Scale, and **4)** Modified self-confidence measurement scale. The interview sheet was reviewed by supervisors of thesis. Then, they were translated and tested for content and construct validity by a jury of 5 experts

in the related field and modifications were carried out accordingly. Tool's reliability was tested using appropriate statistical test. The tools were used by the researcher to collect data of the present study.

### **Ethical consideration:**

All students who were approached to participate in the study were informed orally about the purpose of the study, confidentiality of information and the right to withdraw from the study at any time if desired. Students who agreed to participate in the study were asked to give their written informed consent.

### **The pilot study:**

A pilot study to test the clarity, feasibility and applicability of the different items of the study tools was carried out before the actual study on 10% of the sample (6 students), 3 students (study group) and 3 students (control group) in the third academic year, Faculty of Nursing, Tanta University and whose training was through the period of first semester 2019 were selected. The necessary modifications, rephrasing, and some additional terms were done by the researcher before the actual study. Data obtained from the pilot study were excluded from the current study data.

**The actual study (field work):**

- Data were collected through a cluster random sample of 60 students over a period of six months from the beginning of August 2019 to the end of January 2020 from academic third year at Faculty of Nursing, Tanta University.

**The study was conducted through four phases:**

**Assessment phase (Pre-test):**

- It was conducted at the start of August 2019 in clinical obstetric laboratory skills for academic third year at Faculty of Nursing, Tanta University which contained high fidelity simulator (Sim Mom) equipment and symbols.
- The researcher introduced herself and explained the aim of the study to all the students (study & control group) who were approached to participate in the study.
- After all students given their informed written consent, the researcher used (**Tool I**) to assess socio-demographic characteristics and knowledge of the study and control groups regarding PPH. It was explained to the students, so they were able to fill it by a self-report on an individual basis in the presence of the researcher prior to the theoretical teaching sessions for both groups. The students recorded the

answer in tool I in about 10 minutes and returned it back to the researcher.

- Students were asked to perform clinical skills procedure regarding prevention and management of atonic PPH before program implementation that was assessed and filled by the researcher using **Tool (II)**, time taken to perform steps was about 10-15 minutes for each student.
- Then the researcher used (**Tool III & Tool IV**) for the measurement of perceived self-efficacy and confidentially among students regarding their skills about prevention and management of PPH. It was explained to the students and filled by a self-report on an individual basis. It was conducted for about 10 minutes.
- Depending on the results of pre-test questionnaire of knowledge and performance, contents of simulation based training program were prepared and revised by 5 experts in the related field.

**Planning phase:**

- **Program development phase:** High fidelity simulation based training program was developed by the researcher based on results of assessment phase (pre-test) and after a thorough review of literature.



**Program objectives:** The main objectives of this program were:

1. The students' knowledge will be improved regarding PPH.
2. The students would be able to perform/apply active management of the third stage of labor for the prevention of PPH.
3. The students would be able to perform/apply management of atonic PPH.
4. Perceived self-efficacy and confidence of students would be increased about their skills regarding prevention and management of PPH.

**Program content:** High fidelity simulation based training program was entailed two main parts:

**1. Theoretical part:** It was planned based on the training program objectives and students assessment needs guided by relevant literature. The theoretical part included general knowledge regarding PPH (definition, causes, risk factors, signs & symptoms, classification (primary and secondary PPH), complications, nursing management, and also evidence based guidelines for prevention and treatment of PPH). It was provided by the researcher for the two groups (study & control group).

**2. Clinical part:** It was included high fidelity simulator (SimMom simulator) and PPH scenarios that prepared by the researcher based on extensive review of recent relevant literature and tested for content validity by a jury of 5 experts in the related field. It was provided by the researcher only for the study group.

**Implementation phase:**

- **The study group:** The first 30 students were assigned randomly into 5 subgroups; each subgroup contained 6 students for the purpose of demonstration. High fidelity simulation based training program with its two main parts (theoretical and clinical part) was conducted over three consecutive days/week; one day for each subgroup in clinical obstetric laboratory skills for academic third year at Faculty of Nursing by the researcher after completion of basic obstetrical routine clinical training course of the students. The program was implemented through three sessions (one session for the theoretical part and two sessions for the clinical part). The time of each session was ranged between 30 to 45 minutes.
- **The high fidelity simulation based training program sessions** were as the following:

**Session (1): Orientation, expectation and an overview of postpartum hemorrhage:**

- The aim of this session was to provide a brief orientation to the students of the study group about the educational environment, needed equipment, learning objectives of the high fidelity simulation training program, sessions and also their expectation of each session.
- The theoretical part about PPH also, was offered by the researcher to each subgroup through powerpoint presentation. It provided the students with the basic knowledge about PPH (definition, causes, risk factors, signs & symptoms, classification, complications, nursing management, and also evidence based guidelines for prevention and treatment of PPH). It was followed by the researcher demonstration of nursing assessment of early detection and prevention of PPH (assessment of history, risk factors, and selected laboratory studies that may predispose to PPH and also the clinical /physical examination (general & local exam) to confirm signs & symptoms of PPH by using SimMom simulator.

**Session (2): Nursing skills of active management of the third stage of labor:**

- **The aim of this session** was to provide students of the study group with performance skills of active management of the third stage of labor for the prevention of PPH that included (step 1: Administration of uterotonic drug, step 2: Controlled cord traction, and step 3: Uterine massage). This was followed by simulation training with the proper scenario through demonstration & re-demonstration of students' performance skills using high fidelity SimMom simulator.

**Session (3): Nursing management of atonic PPH:**

- The aim of this session was to provide students of the study group with performance skills of management of atonic PPH which included {Careful observation of 4<sup>th</sup> stage of labor through general and local examination; estimation of the amount of blood loss; good communication between the multi-disciplinary team/call for help; resuscitation and drug administration; initial measures to stop/control bleeding (uterine massage, bimanual uterine compression, and abdominal aortic compression); health education for the woman on self-care as well as

evaluation and documentation of all procedures}. This was followed by demonstration and re-demonstration of students' performance skills using high fidelity SimMom simulator.

**Debriefing/feedback:** Immediately, following the simulation, the researcher conducted debriefing session by, assessed students' needs, feedback and if there were any more questions.

- **The control group:** The other 30 students were assigned randomly into 5 subgroups; each subgroup contained 6 students. *The theoretical part about PPH*; was given by the researcher to each subgroup through powerpoint presentation. It was conducted over three consecutive days/week; one day for each subgroup in Clinical Obstetric Laboratory Skills.
- On the other hand, students in the control group already had the clinical procedures book (basic clinical course) included the preventive measures of PPH as part of basic obstetrical routine clinical training course.
- Both the control and the study groups were received the basic lectures and clinical training course regarding the preventive measures of PPH of the third year that planned by the obstetric and gynecological nursing department

at the faculty of nursing, Tanta University.

#### **Evaluation phase (Post-test):**

##### **Immediate Follow up:**

- It was conducted at August 2019 immediately after implementation of high fidelity simulation based training program for both (study & control) groups.
- The researcher used the same previously mentioned assessment tools (**Tool I**), and (**Tool II**) to evaluate students' knowledge and performance regarding prevention and management of atonic PPH on SimMom simulator at the clinical obstetric laboratory skills for academic third year at Faculty of Nursing.
- Students' perceived self-efficacy was also, assessed using self-efficacy scale (**Tool III**) and self-confidence measurement scale (**Tool IV**) which measures how confident students about the skills they practiced regarding prevention and management of PPH.

##### **After one month follow up:**

- It was conducted after one month from implementation of high fidelity simulation based training program (from October 2019 to

- January 2020) for both (study & control) groups.
- **Students’ knowledge** regarding PPH was assessed using (**Tool I**). It was distributed to be filled by the students. It was conducted for about 10 minutes.
  - **Students’ performance** regarding prevention of atonic PPH at one month follow up was evaluated by the researcher on real parturient women at labor unit in obstetric department at Tanta University Hospital that was conducted through their daily clinical training course.
  - The researcher arranged with the students daily through telephone call the time of the presence and admitted parturient women at the hospital. This was conducted after the end of their daily clinical training at morning/or afternoon shifts until the predetermined sample size were collected.
  - The parturient women who were presented at labor unit in obstetric department at Tanta University Hospital at the time of data collection were taken and included in the study.
  - The researcher introduced herself and the student to each parturient woman and explained the aim of the study. The parturient woman who agreed to participate in the study was asked to give their consent orally.
  - Students’ performance was observed and assessed by the researcher two times on each real parturient woman: First, during active management of third stage using (**Tool II**). The time needed for each student to complete the performance observational checklist (**Tool II, Part I**) ranged between 10-30 minutes according to the duration of 3<sup>rd</sup> stage of labor for each parturient woman. Second, the student assessment during 4<sup>th</sup> stage of labor two hours after delivery (**Tool II, Part II; a**).
  - After the student had applied the preventive measures of PPH on real parturient women during active management of third stage of labor at labor unit. The students’ performance of management of atonic PPH (**Tool II, Part II; b**) was observed and assessed by the researcher on SimMom birthing simulator at the clinical obstetric laboratory skills for academic third year at Faculty of Nursing due to

lack of atonic PPH cases at hospital.

- **Students' perceived self-efficacy (Tool III) and self-confidence (Tool IV)** regarding prevention and management of PPH were also evaluated by self-report on an individual basis in the presence of the researcher. Time taken was about 10 minutes.
- After completion of the evaluation of the effect of simulation on students' knowledge, performance, self-efficacy and confidence regarding prevention and management of PPH, comparison between the control group and the study group has been done.

#### **Data analysis:**

- The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 19, SPSS Inc. Chicago, IL, USA)<sup>(26)</sup>.

#### **Results**

**Table (1):** Shows distribution of student's socio-demographic characteristics. It was evident that the mean age of the study group was  $30.63 \pm 0.72$  years corresponding to a mean age of  $20.80 \pm 0.75$  years among the control group with a total mean age of  $20.80 \pm 0.75$  between both study and control

group. It was also, noticed that three quarters (75%) of the studied students were female. They constitute slightly more than four fifth (83.3 %) in the study group and 66.7% in the control group. The table also reveals that (53.3% and 66.7% respectively) of the study and control group were from rural areas. Moreover, it was observed that the majority (80.0%) and more than three fifth (63.3%) respectively of the study and control groups did not attend any simulation training programs. While 20% of students among the study group had participated in previous simulation training programs compared to 36.7% in the control group. It is also found that nasal suction and mental imagery training program were the most reported simulation program attended by (66.7% and 81.8% respectively) of the study and control group.

**Figure (1):** Illustrates distribution of student's total score level of knowledge regarding PPH before, immediately, and one month after implementation of the training program (study and control groups). It was noticed that none of students within the study and control groups exhibited good level of knowledge regarding PPH before implementation of training program. While (13.3% and 86.7% respectively) of the study group had fair and poor level of knowledge regarding

PPH compared to (6.7% and 93.3% respectively) among the control group. On the other hand, the vast majority (90.0% and 93.3% respectively) of the study group immediately and one month after implementation of the training program had good level of knowledge compared to slightly more than half (53.3%, 56.7% respectively) among the control group.

**Table (2):** Presents distribution of student's according to their total mean score of performance regarding prevention and management of atonic PPH before, immediately and one month after implementation of the training program (study and control group). It was observed that there was no significant difference between the study and control groups before implementation of the training program in their mean scores of performance of all studied items regarding prevention and management of atonic PPH (3<sup>rd</sup> stage of labor and immediate post-natal prevention of PPH, as well as management of PPH) ( $P = 0.427$ ). In contrast, there were statistically significant differences between the two groups immediately and one month after implementation of the training program ( $P = 0.0001^*$ , and  $P = 0.0001^*$  respectively). Moreover, this table demonstrate that the mean total score of study group performance regarding prevention and

management of atonic PPH before, immediately, and one month after implementation of the training program were ( $154.83 \pm 34.54$ ,  $339.37 \pm 3.47$ , and  $340.60 \pm 1.19$  respectively) with statistically significant difference ( $P = 0.0001^*$ ), compared with ( $148.50 \pm 26.20$ ,  $274.57 \pm 50.58$ , and  $258.43 \pm 43.12$  respectively) among the control group with significant difference ( $P = 0.0001^*$ ).

**Figure (2):** Illustrates distribution of the student's total score level of self-efficacy regarding prevention and management of atonic PPH before, immediately, and one month after implementation of the training program (study and control group). As regard to students' total self-efficacy score level; it was noticed that 100% of both study and control group had negative perception of their self-efficacy before implementation of the training program. On the other hand, the majority (83.3% and 90.0% respectively) of the study group had positive perception of their self-efficacy immediately and one month after implementation of the training program compared to (0.0%, and 3.3% respectively) among the control group.

**Figure (3):** Exhibits distribution of the student's total score level of self-confidence regarding prevention and management of atonic PPH before, immediately, and one month after

implementation of the training program (study and control group). As regard to students' total score level of self-confidence; it was noticed that 100% of both study and control group were not confident about their skills before implementation of the training program. On the other hand, the majority (80.0% and 96.7% respectively) of the study group revealed self-confidence immediately and one month after implementation of the training program compared to (3.3%, and 10.0% respectively) among the control group.

**Figure (4):** Demonstrates the **correlation** of students' total knowledge score, and total self-efficacy score regarding prevention and management of PPH immediately after implementation of the training program. A significant positive correlation is observed between the study group total score of knowledge and total score of self-efficacy immediately after implementation of the training program ( $r = 0.744, P = 0.0001^*$ ).

**Figure (5):** Illustrates the correlation of students' total knowledge score, and total self-confidence score regarding prevention and management of PPH immediately after implementation of the training program. A

significant positive correlation is observed between the study group total score of knowledge and total score of self-confidence immediately after implementation of the training program ( $r = 0.543, P = 0.0001^*$ ).

**Figure (6):** Exhibits the correlation of students' total performance score, and total self-efficacy score regarding prevention and management of PPH immediately after implementation of the training program. A significant positive correlation is found between study group total score of self-efficacy and total score of performance immediately after implementation of the training program ( $r = 0.519, P = 0.003^*$ ).

**Figure (7):** Shows the correlation of students' total self-efficacy score, and total self-confidence score regarding prevention and management of atonic PPH immediately after implementation of the training program. A significant positive correlation is found between study group total score of self-confidence and total score of self-efficacy immediately after implementation of the training program ( $r = 0.498, P = 0.007^*$ ).

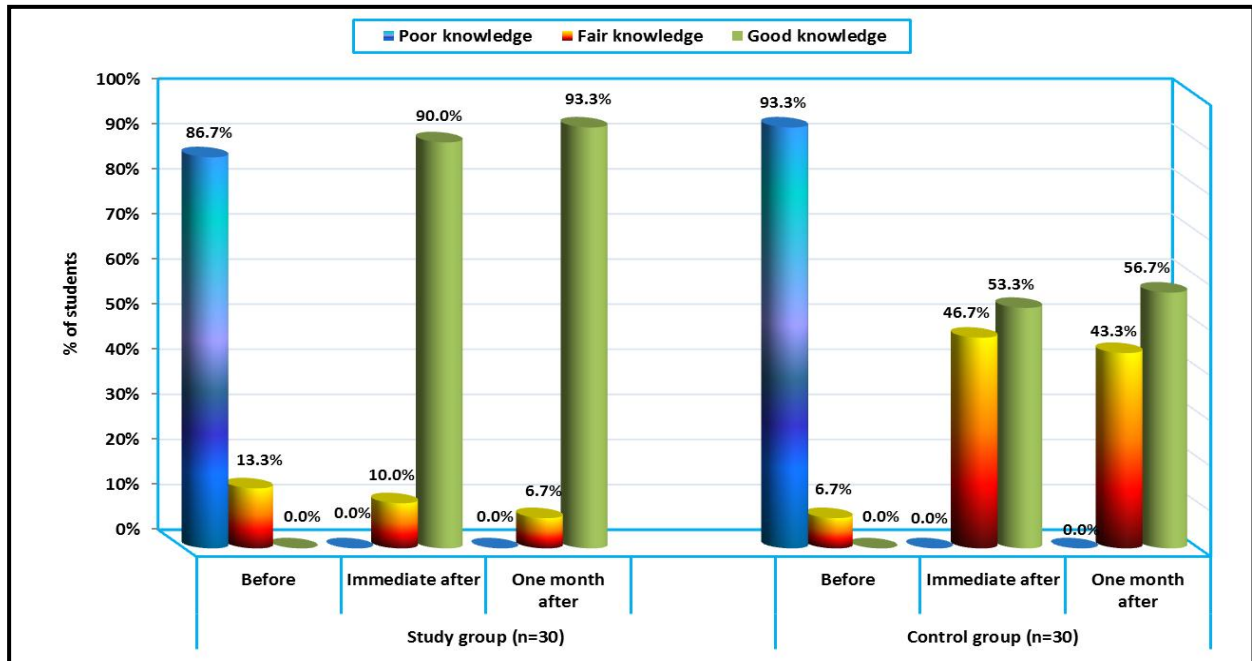
**Table (1): Distribution of the student's socio-demographic characteristics among study and control group (n=60)**

Socio-demographic Characteristics	Students in the third academic year(n=60)						$\chi^2$ P
	Study group (n=30)		Control group (n=30)		Total (n=60)		
	N	%	N	%	N	%	
<b>Age years:</b>							
20-	15	50.0	9	30.0	24	40.0	3.000 0.223
21-	11	36.7	13	43.3	24	40.0	
22	4	13.3	8	26.7	12	20.0	
<b>Range</b>	20-22		20-22		20-22		
<b>Mean±SD</b>	30.63±0.72		20.97±0.76		20.80±0.75		
<b>t-test</b>	1.740						
<b>P</b>	0.087						
<b>Sex:</b>							
Female	25	83.3	20	66.7	45	75.0	2.222
Male	5	16.7	10	33.3	15	25.0	0.136
<b>Residence:</b>							
Rural	16	53.3	20	66.7	36	60.0	1.111
Urban	14	46.7	10	33.3	24	40.0	0.292
<b>Previous participation in simulation training program:</b>							
No	24	80.0	19	63.3	43	71.7	2.052
Yes	6	20.0	11	36.7	17	28.3	0.152
<b>If yes, name of training program:</b>							
Nasal suction	1	16.7	1	11.1	2	11.8	0.500
Mental imagery	1	16.7	1	11.1	2	11.8	0.781
Nasal suction & mental imagery	4	66.7	9	81.8	13	76.5	

**Study group** = students who received basic obstetrical routine clinical training course as well as simulation based training program using high fidelity simulator "SimMom".

**Control group** = Students who received only basic obstetrical routine clinical training.





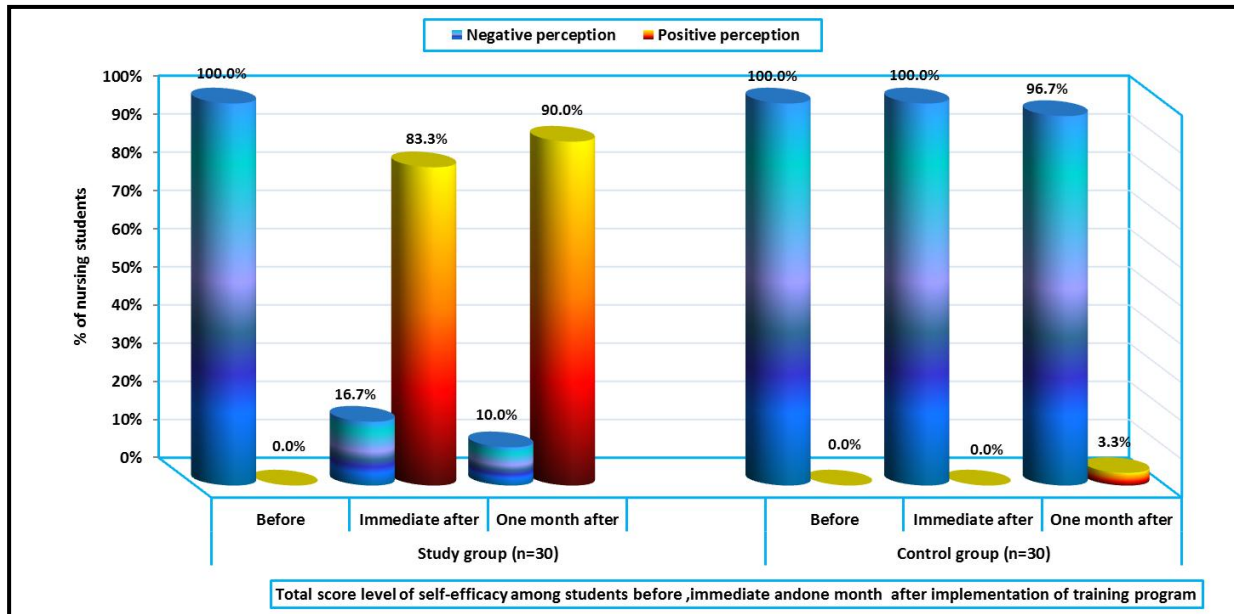
**Figure (1): Distribution of student's total score level of knowledge regarding PPH before, immediately, and one month after implementation of the training program among study and control group (n=60).**

**Table (2): Distribution of student's according to their total mean score of performance regarding prevention and management of atonic PPH before, immediately and one month after implementation of the training program among study and control group (n=60)**

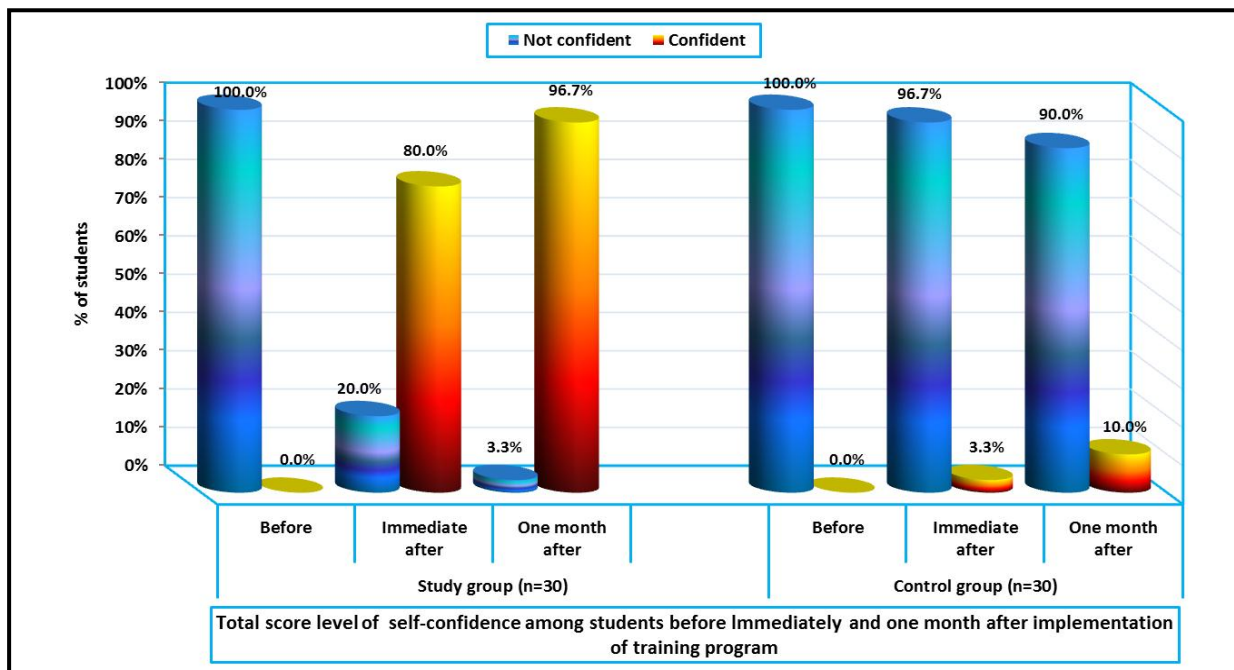
Students' performance main sub-items regarding prevention and management atonic PPH (Each item was scored 1-3)	No. of items (Score)	Mean score of students' performance before, immediately and one month after implementation of the training program						Z value P (Study vs Control group)		
		Study group (n=30)			Control group (n=30)			Before program	Immediately after program	One month after program
		Before program	Immediately after program	One month after program	Before Program	Immediately after program	One month after program			
I. Performance score of 3 <sup>rd</sup> stage of labor prevention of PPH $\chi^2$ value (P)	41 (41-123)	43-89 54.7±14.59	115-123 121.43±1.85	121-123 122.43±0.77	42-106 52.33±18.98	54-123 101.07±26.36	65-121 96.30±23.6	0.397 0.693	4.221 0.0001*	5.995 0.0001*
		64.184 (0.0001*)			46.585 (0.0001*)					
II. Performance score of immediate post-natal (4 <sup>th</sup> stage of labor) prevention of PPH $\chi^2$ value (P)	19 (19-57)	20-48 27.60±7.57	52-57 56.53±1.01	55-57 56.70±0.53	20-53 25.63±9.53	30-57 46.50±10.94	32-55 42.73±10.74	0.885 0.380	5.003 0.0001*	7.111 0.0001*
		66.946 (0.0001*)			43.474 (0.0001*)					
III. Performance score of immediate post-natal (4 <sup>th</sup> stage of labor) management of PPH $\chi^2$ value (P)	54 (54-162)	60-101 73.17±13.33	157-162 161.40±1.19	159-162 161.47±0.82	56-128 70.53±21.90	68-162 127.00±35.79	95-160 119.40±29.38	0.563 0.576	5.261 0.0001*	7.839 0.0001*
		65.291 (0.0001*)			35.975 (0.0001*)					
Total mean score of performance regarding prevention and management of PPH $\chi^2$ value P	114 (114-342)	128-236 154.83±34.54	324-342 339.37±3.47	338-342 340.60±1.19	121-196 148.50±26.20	166-342 274.57±50.58	198-331 258.43±43.12	0.800 0.427	7.000 0.0001*	10.432 0.0001*
		60.915 0.0001*			58.476 0.0001*					

\*Statistically significant (P<0.05)

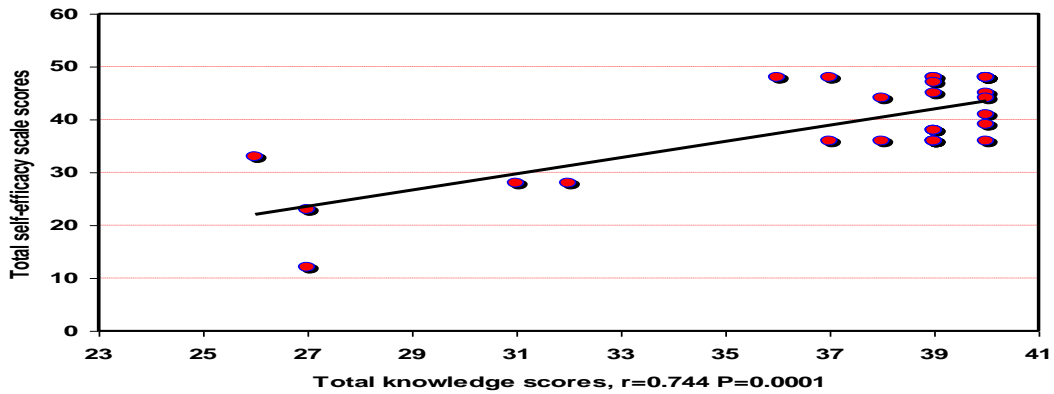
Data are presented as range, Mean±SD



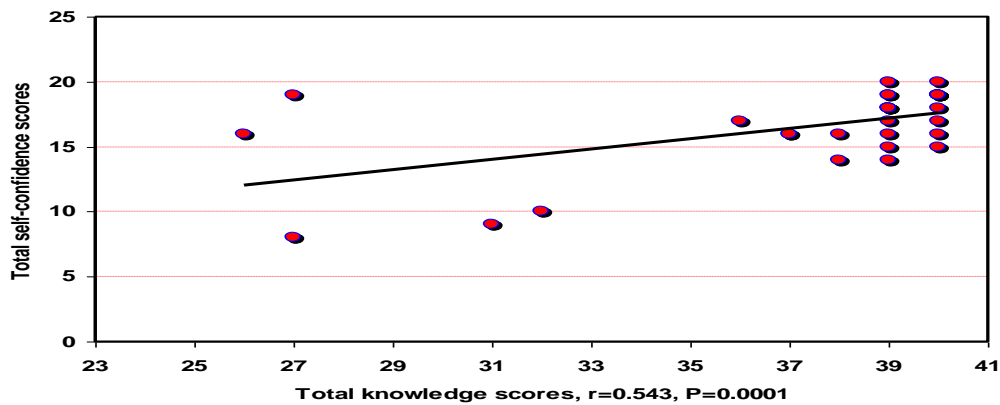
**Figure (2):** Distribution of the student's total score level of self-efficacy regarding prevention and management of atonic PPH before, immediately, and one month after implementation of the training program among study and control group (n=60)



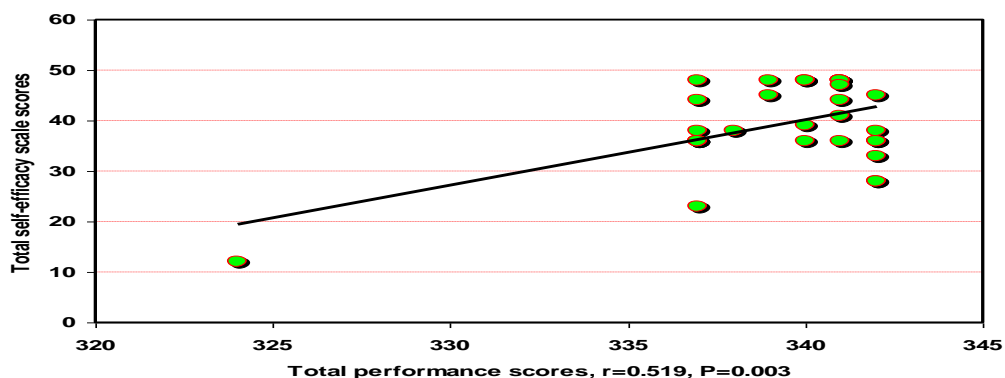
**Figure (3):** Distribution of the student's total score level of self-confidence regarding prevention and management of atonic PPH before, immediately, and one month after implementation of the training program among study and control group (n=60)



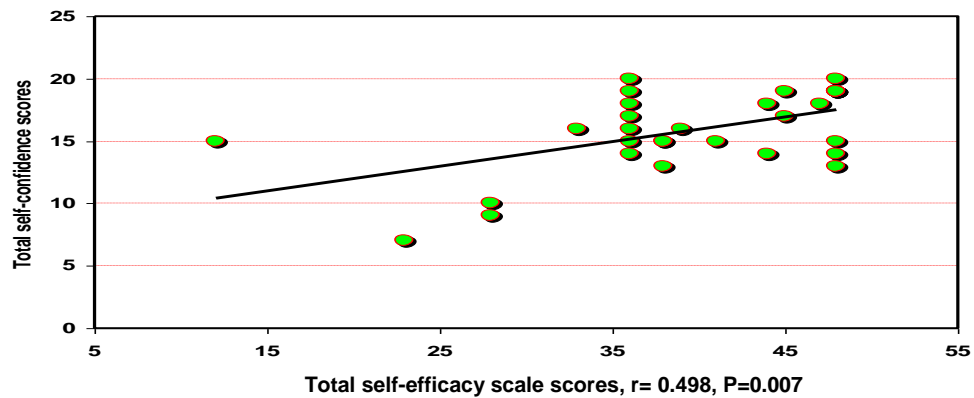
**Figure (4):** Correlation of students' total knowledge score, and total self-efficacy score regarding prevention and management of PPH immediately after implementation of the training program among study group (n=30)



**Figure (5):** Correlation of students' total knowledge score, and total self-confidence score regarding prevention and management of PPH immediately after implementation of the training program among study group (n=30)



**Figure (6):** Correlation of students' total performance score, and total self-efficacy score regarding prevention and management of PPH immediately after implementation of the training program among study group (n=30)



**Figure (7): Correlation of students' total self-efficacy score, and total self-confidence score regarding prevention and management of PPH immediately after implementation of the training program among study group (n=30)**

### **Discussion**

Training of health professionals including nursing staff and students to prevent and manage PPH is a fundamental principle of risk management. In higher education, students need to be prepared for their future profession by improving their competences of critical thinking, problem solving, communication self-efficacy, self-confidence and collaboration. In addition to the domain-specific knowledge and skills to be able to make professional decisions and implement solutions for obstetrical emergencies including PPH. However, nursing students are unable to acquire high quality experiences because of difficulties to reach cases in real health care setting. So simulation of the actual clinical emergency situation including PPH can be a kind of solution to enhance student nurses' abilities needed for safe and effective women care. Simulation-based learning offers a wide range of opportunities to practice complex skills in higher education and to implement different types of frames to facilitate effective learning <sup>(17,27,28)</sup>. Therefore this study was conducted to determine the effect of high fidelity simulation based training program on nursing students' performance, self-efficacy and confidence regarding prevention of PPH.

**Concerning, the study subjects socio-demographic characteristics;** it is found that half of the students in the study group and slightly less than one third in the control group were 20 years old, while nearly two fifth of the students in the study group were 21 years old. In addition, three quarters of studied students (both groups) were females. Slightly more than one half and more than two thirds respectively of students among both the study and control groups were from rural areas. Moreover, it is observed that the majority and nearly two thirds respectively of the students within the study and control groups did not attend any simulation training programs, except nasal suction and mental imagery training programs were attended by slightly more than two thirds of the study group and slightly more than four fifth of the control group. Specifically, all students who participated in this study did not attend any previous PPH simulation training program and there was no significant difference between the study and control group regarding their socio-demographic characteristics. Thus, the two groups are homogenous and the difference between them is not significant and related to the dependent variables.

**Concerning students' knowledge regarding prevention and management of PPH,** the finding of the present study revealed that **before implementation of**

**the training program;** the majority of the studied students (both groups) had poor level of knowledge regarding PPH with no significant difference between them ( $P=0.393$ ). It is not astonishing; it can be attributed to the fact that they did not attend any previous simulation training program regarding PPH. Moreover, the students' first interaction with the obstetrical and gynecological curriculum was in the third year of their academic basic educational years of nursing in which the study was conducted. This result is in agreement with **Abd-Elhakm and Elbana (2018)<sup>(25)</sup>** and **Mahmoud (2019)<sup>(29)</sup>** who found that there was no statistically significant differences between the study and control groups regarding their knowledge level before implementation of the training program ( $P > 0.05$ ). On the other hand, these results are in contrast with **Zaky (2017)<sup>(30)</sup>** who Indeed that around two-thirds of the study subjects (both groups) had fair and good level of general knowledge regarding PPH before implementation of the training program. This dispensary may be attributed to the fact that the participants within the previous study were postgraduate staff nurses and may attended periodic didactic courses of obstetrics emergency including PPH within previous five years of their nursing study.

**Pertaining to immediately after implementation of the training program;** the current study figured out that there was a significant improvement in the studied students' total score level of knowledge regarding PPH, but the improvement was higher in the study group who received basic obstetrical routine clinical training as well as simulation based training program using high fidelity simulator than the control group who received only the basic obstetrical routine clinical training on static manikin with a statistically significant difference between them ( $P=0.002^*$ ). These findings were expected, as both groups received a theoretical part for PPH and reviewed the content during their educational interventions and also are consistent with what is found in the literature by **Hayden et al (2014)<sup>(31)</sup>**. Where the educational intervention should result in an increase in students' knowledge base. Moreover, the study group exposed to life-like simulated experiences using different learning activities during simulation based training sessions such as simulation scenarios, and debriefing instead of memorizing knowledge learned in the classroom.

This finding is supported by **Podlinski (2016)<sup>(32)</sup>** who showed that the most studied nursing students who completed a

post simulation survey on emergency preparedness, stated that simulation increased their knowledge in both handling and emergency. In addition, **Abd-Elhakm and Elbana (2018)**<sup>(25)</sup> implied a significant improvement of nurses' knowledge immediately post intervention ( $P = <0.001^*$ ). Again the study finding is also in coherent with the findings of the current study carried out by **Tawalbeh (2020)**<sup>(33)</sup>. The results clarified that knowledge and confidence in the experimental group are significantly enhanced immediately after implementation of the simulation training program compared to the control group ( $P = <0.001^*$ ). The similarities between the previous studies and the finding of the present study can be explained by **Ameh et al. (2012)**<sup>(34)</sup>, **Kumar et al. (2016)**<sup>(35)</sup> and **Zaky (2017)**<sup>(30)</sup>, who concluded that simulation-based teaching is an effective educational strategy which can further help in improvement of knowledge and skills, as well as increase confidence to recognize and manage obstetric emergencies on live patients and to avoid drawbacks in real life scenario at the working environment.

In relation to students' total score level of knowledge regarding PPH one month after implementation of the training program; the current study clarified that the study group still had higher scores in comparison with the control group who received only

basic routine clinical training with a statistically significant difference ( $P = 0.001^*$ ). This finding matches with the study of **Mahmoud (2019)**<sup>(29)</sup>, who reported that there was a statistically significant difference between the study and control groups in their knowledge level one month after the simulation training ( $P = 0.000^*$ ). The similarity between the previous study and the finding of the present study may stem from the fact that; before exposure to actual clinical areas, the process of simulating a scenario to practice various responses and actions in a safe and real life situation is extremely effective. Thus, the high fidelity simulation helps to improve students' learning and increase the retention of their knowledge through active simulation learning. Moreover, **Roma (2018)**<sup>(36)</sup> and **Tawalbeh (2020)**<sup>(33)</sup> mentioned that simulation is an effective way of retaining knowledge and improving skills which affects the cognitive domain of learning by moving the learner beyond the basic memorization to actual application and understanding.

The findings of the present study revealed that the mean total score of students' performance regarding prevention and management PPH was approximately similar in both groups before the intervention with no statistically significant difference ( $P = 0.427$ ). While, there was



significant enhancement in the mean total score of students' performance immediately and one month after implementation of the training program among the study group more than the control group with highly significant difference between them ( $P=0.0001^*$ ). This is in line with **Abusaad and Ebrahem (2015)** <sup>(37)</sup> study in Mansura, Egypt. They found that the total mean score of clinical performance of the studied nurses in the traditional group (demonstration on a static manikin) was ( $8.96\pm 4.90$ ) approximately similar to simulated group (demonstration on a high fidelity simulator) ( $7.10\pm 4.03$ ) pre the intervention with no statistical difference ( $P>0.05$ ) and this score improved both immediate and three months after the intervention among both group, especially among the study group than the control group with highly significant difference between them ( $P=0.0001^*$ ).

The results of the current study also in accordance with the findings of Indian study by **kumar et al. (2016)** <sup>(35)</sup>. Their study results revealed that both groups showed no difference pre-lecture observational checklist. However, a significant improvement was observed post-training compared to pre-training (Group1:  $7.60\pm 1.26$  & Group2:  $4.20\pm 1.01$ ), with greater improvement among the

simulation group. This could be attributed to the fact that, simulation environment aids to stimulate visual, auditory and tangible learning methods. It enables students to attain essential skills through trial and error, in a safe/harmless and non-threatening environment as mentioned by **Alanazi et al. (2017)** <sup>(38)</sup> and **Roma (2018)** <sup>(36)</sup>. On contrast with the present study, a quasi-experimental research study was done by **Bowling and Underwood (2016)** <sup>(39)</sup>. They revealed significant increase in students' skill performance between the pre-test and post-test for both groups, but not between the groups. The discrepancy with the finding of the present study may be due to different educational program, different educational environment infrastructure, and/or different socio-demographic factors of the study subjects.

**Regarding students' total self-efficacy score level;** the findings of the current study donated that approximately all students among both study and control groups had negative perception of self-efficacy regarding prevention and management of atonic PPH before implementation of training program. On the other hand, almost all of study group had positive perception of self-efficacy immediately and one month after implementation of the training program in comparison with the control group with a

statistically significant difference ( $P = 0.0001^*$ ). This finding is consistent with **Demirel et al. (2020)** <sup>(40)</sup> in their study which conducted at the midwifery department of a state university in Turkey. Significant difference in the self-efficacy scores was observed before and after the program among the study subjects, as the students exhibited improved self-efficacy levels after the program ( $P = <0.05$ ). Again, **Kimhi et al. (2016)** <sup>(41)</sup> instituted that simulation increased self-confidence/self-efficacy equivalently if placed either before or after clinical experience. Additionally, **Lee et al. (2016)** <sup>(42)</sup> found that, simulation-based training has a positive impact on improving self-efficacy. Specifically, high-fidelity simulation is more effective than medium-fidelity simulation in improving nursing students' self-efficacy.

Moreover, the study conducted by **Gamal El-deen (2015)** <sup>(43)</sup> on nursing students at Tanta University revealed that the study group reported increased self-efficacy after simulation based training than traditional teaching. The harmony with the previous studies may be attributed to categories that may affect and contribute to individual's self-efficacy development. These categories include; students' previous experience; academic self-efficacy; as well as students' emotional responses after

completion their task. All the previously mentioned categories were incorporated/enhanced through high fidelity training program during simulation and debriefing sessions <sup>(44)</sup>. On the contrary, **Saied (2017)** <sup>(45)</sup> findings indicated that the total self-efficacy of the students was lower after the simulation session. The discrepancy with the finding of the present study may be due to the use of different self-efficacy tool not specific to prevention/management of PPH simulation.

**As regards students' total score level of self-confidence;** the findings of the current study reported that before the implementation of training program, all students among both study and control groups were approximately not confident about their skills regarding prevention and management of PPH. On the other hand, immediately and one month after implementation of the training program there was a significant difference ( $P = 0.0001^*$ ) between the study and control groups as almost all of students among the study group become more confident about their skills.

These findings match with **Thomas and Mackey (2012)** <sup>(46)</sup> and **Leila et al. (2013)** <sup>(47)</sup>. They pointed out that a significant increase was observed in the level of nursing students' confidence, who were

trained using simulation compared to the traditional training group. Additionally, the findings of the present study are identical with studies conducted by **Tawalbeh (2020)**<sup>(33)</sup>, **Kim et al. (2016)**<sup>(48)</sup>, **Karacay and Kaya (2020)**<sup>(49)</sup>, and **Stoodley et al. (2020)**<sup>(50)</sup>. They reported that simulation significantly improved confidence applying critical care nursing practices. Moreover, **Haddeland (2020)**<sup>(51)</sup> results declared that self-confidence level increased among undergraduate nursing students who receive a tailored educational program that includes high-fidelity simulations compared to other students who did not attend them. The harmony of previous studies with the current study may stem from that the supervised simulation experiences served to decrease associated fears of failure with live patients. Furthermore, **Ayed and Khalaf (2018)**<sup>(52)</sup> mentioned that high fidelity simulation in nursing education provides diverse learning experiences, promotes decision-making and clinical judgment, self-satisfaction and self-confidence for conducting safe practice.

On the other hand, these results are in contrast with a study conducted by **Oliveira et al. (2021)**<sup>(53)</sup>. They concluded that both the traditional teaching strategies (lecture classes and skill training) and the simulation promote student satisfaction

and self-confidence in learning with no statistical significance in the learning satisfaction subscale ( $P = \geq 0.05$ ) and learning self-confidence ( $P = \geq 0.05$ ). They generate that, simulation and traditional strategies can be mutually and cumulatively used in nursing education to enhance satisfaction and self-confidence. This dispensary with the findings of the current study may be due to- that the type of simulation models used in the previous studies ranged from low- to mid-fidelity. These simulators missed to imitates reality when compared with the high fidelity simulator used in the present study.

**Concerning the correlation of total scores of students' knowledge, performance, self-efficacy and self-confidence regarding prevention and management of PPH;** the present study documented that significant positive correlation is observed between study group total score of self-efficacy and total score of knowledge regarding prevention and management of PPH immediately implementation of the training program ( $r = 0.744$ ,  $P = 0.0001^*$ ), as well as between students' total score of self-confidence and total score of knowledge immediately after implementation of the training program in the study group ( $r = 0.543$ ,  $P = 0.0001^*$ ,  $P = 0.0001^*$ ). This finding is supported by **Abd-Elhakm and Elbana (2018)**<sup>(25)</sup>

whose study showed that there was a positive association between studied nurse's total knowledge, and self-confidence scores at post intervention phase. In the same line **Lindsey and Jenkins (2013)** <sup>(54)</sup> reported a significant positive association between knowledge and performance and self-confidence. They also revealed that simulation training permits opportunities to capture the essential knowledge and skills for developing self-confidence. Consequently, nurses integrated their knowledge and experience in creating accurate clinical judgments and thus, their self-confidence is increased.

Additionally, the present study showed a significant positive correlation between study group total score of self-efficacy and total score of performance regarding prevention and management of PPH immediately after implementation of the training program ( $r= 0.519$ ,  $P = 0.003^*$ ). This finding is in agreement with **Hsin-Hsin (2016)** <sup>(55)</sup>, who reported that students in their study indicated greater self-efficacy in caring for patients after the simulation sessions. The similarity with the present finding could be explained by **Pinar et al. (2015)** <sup>(56)</sup>, who mentioned that according to social cognitive theory, individuals with high self-efficacy have higher performance because self-efficacy

plays a mediating role in relation to motivation, learning, and performance of the learner. Where, the approach learned in simulation may then be transferred to the clinical settings where student's practice. Moreover, in the present study; a positive correlation is found between study group total score of self-confidence and total score of self-efficacy regarding prevention and management of PPH immediately after implementation of the training program with a statistically significant relation ( $r= 0.498$ ,  $P = 0.007^*$ ). This is compatible with a study conducted by **Saied (2017)** <sup>(45)</sup> who illustrated that the post simulation self-efficacy was positively correlated with self-confidence ( $r= 0.50$ ,  $P = 0.001$ ). As nursing students build skill sets during simulation sessions that transferred into clinical environments, and increased their self-efficacy and confidence as mentioned by **Oetker-Black et al. (2014)** <sup>(57)</sup>.

### **Conclusion**

**Based on the findings of the present study, it can be concluded that** the students' knowledge regarding PPH was higher after using a high fidelity simulation-based training program than the routine clinical training on a static manikin. In addition, there were significant improvements regarding most of the studied items of students' performance

regarding prevention and management of atonic PPH among nursing students immediately and also one month after the implementation of the training program. The progress was higher among students who had training using high fidelity simulation-based training program in comparison with the students who trained only on a static manikin. Moreover, the levels of students' self-confidence and self-efficacy were high after high fidelity simulation-based training program regarding prevention and management of PPH.

### **Recommendations**

**Based on the findings of the present study, the following recommendations are suggested:**

- The use of high fidelity simulation-based learning in combination with the traditional teaching methods are essential for the enhancement of the students' self-efficacy and self-confidence, knowledge as well as skills acquisition level for prevention, early detection and rapid effective nursing response for management of PPH.
- Replication of this study on various topics related to nursing care provided to women at all branches in maternity and gynecological care.

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