EFFECT OF HIGH FIDELITY SIMULATION-BASED VERSUS TRADITIONAL CLINICAL TRAINING ON NURSING STUDENTS' KNOWLEDGE AND SKILLS ABOUT THE IMMEDIATE CARE OF THE NEWBORN

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Abstract: **Introduction: High-fidelity simulators (HFS) are tremendously technical, life-like human mannequins that can breathe, talk, have heart and lung sounds and used to demonstrate evidence-based clinical eventualities for training purposes. Despite the boom in the use of tutorial simulation, the evidence about its effectiveness as an educational approach is inconsistent. Therefore, the evaluation of high-fidelity simulation in clinical teaching is critical in figuring out how nursing students retaining knowledge and having effective clinical experiences. Aim of the study: This study aimed to investigate the effect of high fidelity simulation-based versus traditional clinical training on nursing students' knowledge and skills about the immediate care of the newborn. Methodology: A quasi-experimental was employed to complete this study. Eighty students enrolled in the obstetric nursing course were randomly assigned to two equal groups; the study group received clinical training on the immediate care of the newborn using the high fidelity simulation and the control group was trained using the traditional clinical training. The study was carried out over a period of two months from the beginning to the end of obstetric nursing course. Results: students of the study group had more knowledge and skills retention than those of traditional group all over the study period. A statistically significant difference was found between the two groups after two weeks and after two months evaluation from the implementation of the study. Conclusion: students who received the clinical training on the immediate care of the newborn using the high fidelity simulation show higher scores of knowledge and skills' performance retention than those who received traditional clinical training.**

Keywords: **High fidelity simulation, Traditional clinical training, Nursing students, Knowledge, Skills and Immediate care of the newborn.**

1. INTRODUCTION

The most critical times for neonatal and maternal survival are labor, birth, and the immediate postnatal period. Regrettably, in low-and middle-income countries, most mothers and newborns do not receive adequate treatment during those years. Studies have shown that the use of interventions that require simple technology can save many newborn lives. Most of these interventions may take place by assigning a single skilled birth attendant caring for the mother and the

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newborn. Care of all newborns includes immediate and thorough drying, skin-to-skin contact with the mother, cord clamping and cutting after the first few minutes of birth, early and exclusive breastfeeding [1-3].

A key part of nursing education is taking part in "clinical areas" which is basically following actual nurses around and interacting with actual patients. This is an invaluable possibility for nursing students to get hands-on training with patients in workplace. But unfortunately, not all hospitals can accommodate the clinical training of the increased number of nursing students. There is a global suffering from restricted clinical sites for the nursing students and those restrictions pose troubles at nursing schools that have to limit their students' enrollment especially in areas like maternity and pediatrics. But there may be a silver lining to the problem of having constrained medical sites for nursing students; as there may be a growing acceptable percentage of nursing colleges that will change their scientific hours with virtual simulations. High fidelity simulators allow nursing students to enjoy many different hands-on scenarios [4-6].

Simulation-based education (SBE) is a teaching strategy which can triumph over the barriers of medical training for the prelicensure nursing students. Although nursing programs have adopted simulation as a teaching method for scientific instruction, the effectiveness of SBE has remained limited to the literature. Clinical simulations can bridge the gap between information gained inside the study room and the actual medical practice with cases. Through using this technology; learners will be engaged in authentic replicated clinical situations without causing harms to real patients [7-9].

High-fidelity simulators (HFS) are tremendously technical, life-like human mannequins that can breathe, talk, have heart and lung sounds and used to copy evidence-based clinical eventualities for training purposes. Despite the boom in the use of tutorial simulation the evidence about its effectiveness as an educational approach is inconsistent. Therefore, the evaluation of high-fidelity simulation in clinical teaching is critical in figuring out how nursing students retaining knowledge and having effective clinical experiences [10-12].

2. AIM OF THE STUDY

This study aimed to:

Investigate the effect of high fidelity simulation-based training versus traditional clinical training on nursing students' knowledge and skills about the immediate care of the newborn.

3. RESEARCH HYPOTHESES

1. Students who receive high fidelity simulation-based training about the immediate care of the newborn will exhibit more skills and knowledge retaining than those who do not receive.

2. Students who receive traditional clinical training about the immediate care of the newborn will exhibit more skills and knowledge retaining than those who do not receive.

3. Students who receive high fidelity simulation-based training about the immediate care of the newborn will exhibit more skills and knowledge retaining than those who receive traditional clinical training.

4. MATERIALS AND METHOD

Materials

I-Research design:

A Quasi-experimental research design was employed to accomplish this study.

II- Setting:

The study was conducted at two settings as follows:

1. Objective Structured Clinical Examination (OSCE) laboratory at Alexandria Faculty of Nursing. In this lab, the high fidelity simulator (Newborn Hal Simulator: 40 week tether less newborn with breathing, pulses, color and vital signs that are responsive to hypoxic events and interventions. Also includes trending, crying, convulsions, oral and nasal intubation, airway sounds and extra tablet PC for control) was used to train the students on the immediate care of the newborn.

2. El-Shatby Maternity University Hospital which is affiliated to Alexandria University. The labor department was the traditional clinical training setting which was used to train students on the immediate care of the newborn.

III- Subjects:

Eighty students enrolled in the obstetric and gynecological nursing course represented the study sample. This was in the second semester of the academic year **2018-2019**. Those students were previously enrolled in the pediatric nursing course. They had an idea about the basic five steps of the immediate care of the newborn (Clear airway, establish respiration, maintain temperature, prevent hemorrhage and identification) and demonstrated them on the newborn manikins as a traditional laboratory-based training. Sample size was estimated based on the output of the Epi- Info program using the following parameters:

- Population size = **290** nursing students.

- Expected frequency =**50%**.

- Acceptable error =**5%**.

- Confidence coefficient = **95%**.

- Minimum sample size = **79** nursing students.

IV-Tools:

Data was collected using two tools as following:

Tool I: Nursing Student's Knowledge about the Immediate Care Of the Newborn Questionnaire: It comprised two parts as follows:

Part A: Nursing Student's Profile:

This part consisted of data about student's age, gender, residence, educational level, years of experience in nursing and attendance of training programs on the immediate care of the newborn.

Part B: Basic Knowledge about the Immediate Care of the Newborn:

This part was developed by the research team after extensive review of recent & relevant literature [7, 9, 13]. It consisted of **7** questions with **45** responses which covers the **5** main domains of knowledge about the immediate care of the newborn as follows:

- *1b: General knowledge:* It consisted of the definition of newborn, definition of the immediate care of the newborn and the nine purposes of performing the immediate nursing care of the newborn *(N=11)*.

- *2b: The general characteristics of normal newborn:* It consisted of the knowledge about the neonatal anthropometric measurements, vital signs, normal posture, vernix caseosa, lanugo hair, mongolian spot, milia, head shape *(N=16)*.

- *3b: Differences between caput succedaneum and cephalhematoma:* It consisted of knowledge about the time of appearance, time of disappearance, border shape, cross over the suture line, causes, complications *(N=6)*.

- *4b: APGAR scoring:* It consisted of knowledge about the **5** parameters which are assessed with APGAR scoring (Color, heart rate, respiration, muscle tone, reflex activity), interpretations of scores (Total score, score's range indicating the normal score of the newborn, score's range indicating the mild asphyxia and score's range indicating the severe asphyxia) *(N=9)*.

- *5b: Medications:* It consisted of knowledge about the two medications which are commonly used during the immediate care of the newborn period *(N=2)*.

Nursing student's response was evaluated based on three points Likert Scale in which:

- Incorrect answers = **1**.

- Correct but incomplete answers = **2**.

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- Correct and complete answers = **3**.

The total score was ranged from **45-135**. Nursing student's knowledge was ranked as follows:

- Poor for the total score which was equal **75** or less.

- Fair for the total score which was ranged from **75** to less than **106**.

- Good for the total score which was equal **106** up to **135**.

Tool II: Nursing Student' Skills about the Immediate Care of Newborn Observational Checklist:

This tool was adapted from the WHO workbook of the year **2011** about "Essential Newborn care Course Clinical Practice" [14]. It was formulated in a form of checklist to assess nursing students' skills about the immediate care of the newborn. It covered **10** domains of **47** steps of the immediate care of the newborn as follows:

a. Equipment's preparation: It consisted of the items of equipment to be prepared as follows: Dry gauze, **2** warm towel, dry cotton sponge, **2** iodine balls, non-sterile gloves, penguin suction, newborn' clothes, insulin syringe, eye drops or ointment, cord clamp, scissor and **3** artery forceps thermometer, weighing scale, measuring tape, **2** identification bands *(N=12)*.

b. Care of the newborn immediately after head delivery: It consisted of the following steps: Hand washing and wearing gloves, wiping the newborn's eyes off secretions from the inner to the outer canthus with a dry gauze and then wiping nose and mouth, clamping and cutting cord after putting **2** artery forceps (Proximal one at the mother's side and distal one at the newborn's side) *(N=3)*.

c. Maintaining thermoregulation: It consisted of the following steps: receiving the newborn in clean and warm towel just after birth then drying him/her thoroughly, removing wet towel and putting another warm towel and putting the newborn under a previously turned on radiant warmer while covering the newborn's head with flannel cap *(N=4)*.

d. Maintaining airway patency and establishing respiration: It consisted of the following steps: Postponing suctioning if the newborn starts crying, performing oral the nasal suction with penguin apparatus if the newborn does not crying then rubbing newborn's back, flicking his/her heels or slapping soles and performing modified trendlenburg's position if he/she does not initiate breathing spontaneously *(N=3)*.

e. Initial assessment: It consisted of the following steps: Assessing the newborn's condition immediately after birth at (1 minute) using the APGAR score (N=2) and repeating APGAR score at 5 minutes *(N=2)*.

f. Transitional assessment: It consisted of the following steps: Weighing the newborn by weight scale and measuring the newborn's length, head and chest circumferences *(N=2)*.

g. Neonatal systematic physical examination: It consisted of the steps of examining the following: head for fontanels, mouth of any anomaly, nose for any deformity, eyes & ear, neck wrinkles & joint mobility, chest for breathing sounds & the apical pulse, skin (For birth marks, lanugo hair, vernix caseosa, pigmentation and mongolian spots, abdomen, back, genitalia, rectum, extremities umbilical cord for the number of vessels and care *(N=13)*.

h. Administering prescribed medications: It consisted of the steps of the installation of erythromycin eye drops and giving the intramuscular vitamin K *(N=2)*.

i. Proper identification: It consisted of the following steps: providing the suitable clothes, putting two identification bands one around the newborn's wrist & the another one around the ankle and putting am identification band around the mother's wrist *(N=3)*.

j. Post care: It consisted of the following steps: removing gloves & washing hands, recording all finding & reporting any abnormalities and initiating breastfeeding within half hour *(N=3)*.

Nursing student's performance was evaluated based on three points Likert Scale in which:

- Incorrect steps = **1**.
- Correct but incomplete steps = **2**.

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- Correct and complete steps = **3**.

The total score was ranged from **47 - 141**. Nursing student's skills performance was ranked as follows:

- Poor for the total score which was equal **78** or less.

- Fair for the total score which was ranged from **79** to less than **110**.

- Good for the total score which was equal **110** up to **141**.

Method:

1. The agreement of Research Ethics' Committee of Alexandria Faculty of Nursing was obtained before conducting the research.

2. Written permissions to conduct the study were obtained from the head of the Obstetric & Gynecologic Nursing Department and the medical director of El-Shatby Maternity University Hospital after explaining the purpose of the study.

3. The research team attended a training session on using high-fidelity simulator by a subject matter expert.

4. The study variables were defined as follows:

a. The independent variables: there were two independent variables.

- The first one was the experimental intervention which was the high fidelity simulation-based training. It was developed in a form of training program.

- The second one was the traditional clinical training in the hospital setting.

b. The dependent variable: nursing students represented the dependent variable which was manipulated by the two independent variables.

5. The training program was developed after extensive review of the related literature [7,9,13]. The program contained two parts as follows:

a. ***The theoretical part (didactic):*** It included general knowledge about the immediate care of the newborn as definition of newborn and immediate newborn care as well as purposes of this type of nursing care, characteristics of normal newborn, difference between caput succedaneum and cephalhematoma, the five parameters of APGAR scoring and medications which are commonly used during the immediate period after birth.

b. ***Clinical part (Simulated Clinical Environment SCE):*** It included the features of Newborn Hal High Fidelity Simulator and the scenarios to be added to the computer program which is responsible for operating simulator.

6. **Tool I** was developed by the researchers based on the theoretical part of the program.

7. **Tool II** was adapted from the WHO guidelines workbook about: "Essential Newborn care Course Clinical Practice " [14]. Some modifications were done in the form of omissions of the repeated details of immediate newborn care which might confuse the undergraduate students.Its content was also based on the clinical part of the program.

8. The reliability of **Tool I** and **Tool II** were ascertained by measuring the internal consistency of their items using the Cronbach alpha coefficient test. The two tools were highly reliable as the results of the test for **Tool I** was   **α = 0.994** and as for **Tool II it** was **α = 0.995**.

9. Eighty students from student's list were randomly selected (One was chosen and one was left until the needed number were selected). Then, students were randomly assigned to two equal groups as follows:

- ***Study group which contained 40 students*** who received their training about the immediate care of the newborn using high fidelity simulator.

- ***Control group which contained 40 students*** who received their training about the immediate care of the newborn through traditional methods on actual newborns in the hospital setting.

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10. A pilot study was carried out on **8** nursing students (**4** students were trained using simulator and **4** were trained on actual newborns) to test the feasibility of the study and the applicability of the tools. Those **8** students were excluded from the total study sample. After finishing the pilot study; tools were revised and the needed modifications were done accordingly. Some detailed items about the normal characteristics of the newborn were omitted and the main ones were kept.

11. The study was carried out through three phases as follows:

a. *Preparation phase (Pre-test):* In this phase, nursing students were assessed for their knowledge about the immediate care of the newborn using **Tool I**. This was done as a self report on an individual basis and in the presence of the researchers. On the other hand, each nursing student was observed by the researchers using **Tool II** to assess their skills' performance about the immediate care of the newborn during the morning shift of traditional clinical training. This assessment was complemented by using newborn high fidelity simulator for items which could not be totally covered during the real situation clinical training as in such cases who need resuscitation.

b. *Implementation phase:* This phase included three sessions:

- **Session (1):** It included introducing the theoretical part about the immediate care of the newborn for both control and study groups. This session was conducted on the first day of clinical rotation at the classrooms of Faculty of Nursing. It lasted about four hours.

- **Session (2):** It included the demonstration of the skills about the immediate care of the newborn for the study group. This session was conducted in the OSCE lab at the Faculty of Nursing using the Newborn Hal High Fidelity Simulator for the study group. It lasted for **2** days; as **4** hours each day.

- **Session (3):** It included the demonstration of the skills about the immediate care of the newborn for the control group. This session was conducted at the immediate newborn care unit of El-Shatby Maternity University Hospital. Students were trained using the traditional training strategy on real newborns. It lasted for **2** days; as **4** hours each day.

c. *Evaluation of the effectiveness of training program phase (Post-test):* In this phase, the students of both groups were revaluated for the retaining of their knowledge and skills about the immediate care of the newborn. Evaluation was performed **3** times as follows:

- At the end of the 1st week of obstetric nursing rotation.

- At the end of the 2nd week of obstetric nursing rotation.

- At the end of obstetric nursing experience; this was **12** weeks after the clinical training.

12. **Ethical consideration:** For each recruited subject; the following issues were considered:

- Securing the subject's informed written consent.

- Keeping his/her privacy.

- Confirming the right to withdraw from the study at any time.

- Assuring confidentiality of subjects' data.

Statistical analysis:

- Collected data was revised, coded and transformed into a specially designed format to be suitable for computer feeding.

- Following data entry, checking and verification processes were carried out to discover and correct any errors that might have taken place during data entry.

- Data was analyzed using IBM SPSS (Statistical Package for

- Social Sciences) version 16 on a personal computer.

- The significance of the obtained results was judged at the 5% level. The tests used for data analysis were:

- *Chi-square test:* Used for categorical variables to test the association between the variables.

- *Fisher's Exact or Monte Carlo tests:* Used to test the association between the variables of chi-square when more than 20% of the cells have expected count of less than 5.

- *Cronbach's Alpha:* Used for Reliability Statistics.

5. RESULTS

Table (I) shows the number and the percent distribution of the study subjects according to their socio- demographic characteristics. The vast majority (95% &87.5%) of the study and control groups were 20 to less than 22 years old, respectively. A sizeable proportion of the students (87.5% & 72.5%) in the study & control groups respectively were rural dwellers. The majority (85, 82.5%) of the study and control group had secondary certificate respectively.

Moreover, Previous academic achievement reveals that both the study and control groups obtained a grade of C+ (26.67% & 36.67) respectively. Compared to one third and more of them obtained a grade of B- (33.33% & 36.67) respectively. While one third of them obtained a grade of B (33.33% & 26.67%) respectively, compared to a minority (3.33%) of the study group obtained a grade of B+. Considering years of experience in nursing, it was clear that the vast majority (85 & 82.5%) of the study and control groups were less than one year respectively. No statistically significant differences were found between the study and control groups in relation to socio-demographic data. This means that both groups were matching .

Table (1): The Number and Percent Distribution of the Study Subjects According to Their Socio- Demographic Characteristics:

Socio-Demographic data	Study Group (n=40)		Control Group (n=40)		$\chi2(P)$
	No	%	No	%	
Age (years):					
• 20-	38	95.00	35	87.50	1.79
• 22-	2	5.00	4	10.00	(0.408)
• 24-26	0	0.00	1	2.50	
Original residence :					
• Urban	5	12.50	11	27.50	2.812
• Rural	35	87.50	29	72.50	(0.093)
level of education:					0.092
• Secondary	34	85.00	33	82.50	(0.761)
• Technical nursing institute	6	15.00	7	17.50	
Previous academic achievement					
• A-	0	0.0	1	2.5	1.413
• B+	2	5.0	1	2.5	(0.842)
• B	13	32.5	13	32.5	
• B-	13	32.5	12	30.0	
• C+	12	30.0	13	32.5	
Years of experience in nursing:					0.092
• <1	34	85.00	33	82.50	(0.761)
• 1-4	6	15.00	7	17.50	

χ^2 (P): Chi-Square Test & P for χ^2 Test

FET (P): Fisher Exact Test & P for FET-Test

*: Significant at P ≤0.05

Table (2) shows the percent distribution of the study and control groups in relation to their knowledge as before, immediately after, after two weeks and two months after the implementation of the immediate care of the newborn training. As for the general knowledge about the immediate care of the newborn it can be noticed that, 75% of the study group and 62.5% of the control group had incorrect information before the implementation of the program. While after two months of the program, 95% of the study compared to 70% of the control group had correct information about the immediate care of the newborn.

Regarding the characteristics of the newborn, it is observed that 62.5% of the study group and 75% of the control group had incorrect information before implementing the training program. But after two months of program implementation, 95% of the study group compared to 70% of the control group had correct information about the general characteristics of normal newborn.

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As regards the differences between the caput succedaneum and cephalhematoma, it can be obtained from the table that 80% of the study group and 95% of the control group had incorrect information before implementing the program. While after two months of the program implementation, it can be noticed that 62.5% of students in the study group compared to none of the control group had correct information about the differences between caput succedaneum and cephalhematoma.

For the APGAR scoring, it can be observed that before implementing the program 75% of the study group and 87.5 % of the control group had incorrect information. But after two months after implementing the program, it can be observed that all students of the study group compared to 22.5% of the control group had correct information about the APGAR scoring.

Concerning the medications which commonly used in the postnatal period, it can be observed that before implementing the program 90% of the study group and 97.5% of the control group had incorrect information. But two months after implementing the program, it can be noticed that 82.5% of the study group compared to 20% of the control group had correct information about the common medications used in the post natal period.

There were statistically significant differences between the study and control group regarding the evaluation of the program immediately after, two weeks later and two months after implementing the program with χ^2 (^{MC}p) = 235.452 (<0.001), 31.431 (<0.001) and 213.067 (<0.001) respectively.

Table (2): Comparison of Students' Knowledge about Immediate Newborn Care Before, Immediate, After Two Weeks and After Two Months from the Implementation of Immediate Newborn Care Training:

Student's knowledge about the immediate care of the newborn		Before		Immediate		After two weeks		After two months	
		Study	Control	Study	Control	Study	Control	Study	Control
		%	%	%	%	%	%	%	%
General Knowledge about the immediate care of the Newborn	Incorrect	62.5	62.5	0.0	12.5	0.0	0.0	0.0	25.0
	Incomplete	27.5	30.0	0.0	0.0	5.0	0.0	5.0	5.0
	Correct	10.0	7.5	100.0	87.5	95.0	100.0	95.0	70.0
Characteristics of Normal Newborn	Incorrect	80.0	75.0	0.0	15.0	0.0	0.0	0.0	42.5
	Incomplete	17.5	20.0	2.5	50.0	5.0	0.0	5.0	30.0
	Correct	2.5	5.0	97.5	35.0	95.0	100.0	95.0	27.5
Differences between Caput Succedeneum & Cephalheematoma	Incorrect	75.0	95.0	0.0	72.5	5.0	0.0	5.0	85.0
	Incomplete	15.0	5.0	20.0	27.5	32.5	0.0	32.5	15.0
	Correct	10.0	0.0	80.0	0.0	62.5	100.0	62.5	0.0
APGAR Scoring	Incorrect	90.0	87.5	0.0	52.5	0.0	0.0	0.0	67.5
	Incomplete	2.5	5.0	0.0	22.5	0.0	0.0	0.0	10.0
	Correct	7.5	7.5	100.0	25.0	100.0	100.0	100.0	22.5
Medications Commonly Used in Postnatal Period	Incorrect	62.5	97.5	0.0	17.5	17.5	0.0	17.5	80.0
	Incomplete	27.5	0.0	0.0	62.5	0.0	0.0	0.0	0.0
	Correct	10.0	2.5	100.0	20.0	82.5	100.0	82.5	20.0
χ^2 (^{MC}p)		11.685 (0.633)		235.452* (<0.001*)		31.431* (<0.001*)		213.067* (<0.001*)	
χ^2: Chi square test MC: Monte Carlo *: Statistically significant at p ≤ 0.05									

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Table (3) shows the number and percent distribution of the study and control groups regarding their practice before, immediate, after two weeks and two months after the implementation immediate newborn care training. It clarifies that **before the intervention**, the majority (70 &80 %), (85 & 95 %), (92 &100%) of the study and control groups had not done skills regarding preparing equipment, immediate care of newborn's head and maintain thermoregulation respectively. As well as (82 &95 %), (75 & 90 %), (55 &65%) of the study and control groups had not done skills regarding maintain patent airway, initial and transitional assessment and post care respectively. The difference between groups denotes no statistically significant differences between both groups (p=0.844).

On the other hand, **immediately after the intervention** it was noticed that the majority (97.5, 100 & 97.5%) of the study group compared to only (22.5, 20 & 7.5%) of the control group had correctly done skills regarding preparing equipment, immediate care of newborn's head and maintain thermoregulation respectively. In addition, (85, 95%) of the study group compared to only (5, 20 %) of the control group had correctly done skills regarding maintain patent airway and initial and transitional assessment respectively. The difference between groups was statistically significant (p=0.001).

After two weeks of the intervention, it was noticed that the majority (100%) of the study subjects had correctly done skills regarding all practices items, except, majority (95%) of the study group had correctly done compared to 100% of the control group had incorrectly done regarding maintain patent airway. The difference between groups was statistically significant (p=0.001).

After two months of the intervention it was represented that the majority (100 %) of the study group compared to only (22.5, 17.5 & 5%) of the control group had correctly done skills regarding preparing equipment, immediate care of newborn's head and maintain thermoregulation respectively. As well as, (95, 92%) of the study group compared to only (5, 20 %) of the control group had correctly done skills regarding maintain patent airway and initial and transitional assessment respectively. The difference between groups was statistically significant (p=0.001). Furthermore, both the study and control groups had improvement in their performance of immediate newborn care procedure after providing teaching session. Where, students of simulation retained more skill than those of traditional group all over the three period of the study.

Table (3): Comparison of Students' Practice about Immediate Newborn Care Before, Immediate, After Two Weeks and After Two Months from the Implementation of Immediate Newborn Care Training:

Student's knowledge about the immediate care of the newborn		Before		Immediate		After two weeks		After two months	
		Study	Control	Study	Control	Study	Control	Study	Control
		%	%	%	%	%	%	%	%
Preparing equipment	**Not done**	70.0	80.0	0.0	30.0	0.0	0.0	0.0	57.5
	Incorrectly done	15.0	12.5	2.5	47.5	0.0	0.0	0.0	20.0
	Correctly done	15.0	7.5	97.5	22.5	100.0	100.0	100.0	22.5
Immediate care of newborn's head	**Not done**	85.0	95.0	0.0	57.5	0.0	0.0	0.0	77.5
	Incorrectly done	10.0	2.5	0.0	22.5	0.0	0.0	0.0	5.0
	Correctly done	5.0	2.5	100.0	20.0	100.0	100.0	100.0	17.5
Maintain thermoregulation	**Not done**	92.5	100.0	2.5	87.5	0.0	0.0	0.0	92.5
	Incorrectly done	5.0	0.0	0.0	5.0	0.0	0.0	0.0	2.5
	Correctly done	2.5	0.0	97.5	7.5	100.0	100.0	100.0	5.0

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Maintain patent airway	**Not done**	82.5	95.0	0.0	65.0	5.0	0.0	5.0	85.0
	Incorrectly done	12.5	5.0	15.0	30.0	0.0	100.0	0.0	10.0
	Correctly done	5.0	0.0	85.0	5.0	95.0	0.0	95.0	5.0
Initial and transitional assessment	**Not done**	75.0	90.0	0.0	62.5	0.0	0.0	0.0	77.5
	Incorrectly done	17.5	27.5	5.0	17.5	7.5	0.0	7.5	2.5
	Correctly done	7.5	7.5	95.0	20.0	92.5	100.0	92.5	20.0
Post care	**Not done**	55.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0
	Incorrectly done	12.5	10.0	0.0	0.0	0.0	0.0	0.0	0.0
	Correctly done	32.5	25.0	100.0	100.0	100.0	100.0	100.0	100.0
χ^2 (^{MC}p)		**12.736 (0.844)**		**239.925* (<0.001*)**		**104.284* (<0.001*)**		**346.354* (<0.001*)**	

χ^2: Chi square test   MC: Monte Carlo *: Statistically significant at $p \leq 0.05$

Table (4) shows the comparison of students' knowledge levels of the studied students regarding the immediate care of the newborn before and after the application of the program. It can be observed that 65% of the study group and 72.5% of the control group had poor total score of knowledge regarding the immediate care of the newborn. Whereas after two months of program implementation, it can be noticed that 95% of the study group compared to 17.5% of the control group had good total score of knowledge in relation to the immediate care of the newborn. There were statistically significant differences between the study and control groups regarding the total scores of knowledge immediately after and after two months of implementing the program with χ^2 (^{MC}p)= 61.009* (<0.001*) and 49.198* (<0.001*) respectively

Table (4): Comparison of Students' Knowledge Levels of the Studied Students Regarding the Immediate Care of the Newborn Before and After the Application of the Program:

Total score of knowledge	Before				Immediate				After two weeks				After two months			
	Study		Control		Study		Control		Study		Control		Study		Control	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Poor	26	65.0	29	72.5	0	0.0	7	17.5	0	0.0	0	0.0	0	0.0	16	40.0
Fair	12	30.0	10	25.0	0	0.0	25	62.5	0	0.0	2	5.0	2	5.0	17	42.5
Good	2	5.0	1	2.5	40	100.0	8	20.0	40	100.0	38	95.0	38	95.0	7	17.5
χ^2 (^{MC}p)	0.772 (0.716)				61.009* (<0.001*)				2.051 (0.494)				49.198* (<0.001*)			

χ^2: **Chi square test**   MC: **Monte Carlo** *: Statistically significant at $p \leq 0.05$

Table (5) shows the comparison of students' knowledge levels of the studied students within the same group regarding neonatal care before and after the application of the program. It can be observed that within the study group, there was a statistically significant difference between the total score of knowledge before and immediately after implementing the program with χ^2(^{MC}p1) = 72.381 (<0.001). As for the comparison within the control group, it can be noticed that there were statistically significant differences regarding the total scores of knowledge before compared to immediately after implementing the program and immediately after implementation and two weeks later with χ^2(^{MC}p1)= 25.811 (<0.001) and χ^2(^{MC}p2)= 61.009 (<0.001) respectively.

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Table (5): Comparison of Students' Knowledge Levels of the Studied Students within the Same Group Regarding Neonatal Care Before and After the Application of the Program:

Total score of knowledge	Study group								Control group							
	Before		Immediate		After 2 weeks		After 2 months		Before		Immediate		After 2 weeks		After 2 months	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Poor	26	65.0	0	0.0	0	0.0	0	0.0	29	72.5	7	17.5	0	0.0	16	40.0
Fair	12	30.0	0	0.0	2	5.0	2	5.0	10	25.0	25	62.5	0	0.0	17	42.5
Good	2	5.0	40	100.0	38	95.0	38	95.0	1	2.5	8	20.0	40	100.0	7	17.5
$\chi^2(^{MC}p1)$	72.381* (<0.001*)								25.811* (<0.001*)							
$\chi^2(^{MC}p2)$	2.051 (0.494)								61.009* (<0.001*)							
$\chi^2(^{MC}p3)$	2.051 (0.494)								5.112 (0.078)							

χ^2: **Chi square test**   MC: **Monte Carlo** *: Statistically significant at $p \leq 0.05$

P1: Significance between before and immediately after.

P2: Significance between immediately after and after two week.

P3: Significance between immediately after and after two month.

Table (6) shows that both study and control groups had improvement in their practice regarding neonatal care after providing teaching session. Where, students of study retained more skill than those of control group all over the three period of the study. A Statistically significant difference was found between the two groups after two weeks and after two months later P = (0.001 & 0.001) respectively. This denotes that long retention of skill among students of the study better than that in the traditional group.

Table (6): Comparison of Students' Practice Levels of the Studied Students Regarding Neonatal Care Before and After the Application of the Program:

Total score of practice	Before				Immediate				After two weeks				After two months			
	Study		Control		Study		Control		Study		Control		Study		Control	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Poor	36	90.0	39	97.5	0	0.0	0	0.0	0	0.0	12	30.0	0	0.0	27	67.5
Fair	2	5.0	1	2.5	0	0.0	2	5.0	0	0.0	21	52.5	2	5.0	7	17.5
Good	2	5.0	0	0.0	40	100.0	38	95.0	40	100.0	7	17.5	38	95.0	6	15.0
$\chi^2(^{MC}p)$	2.158 (0.427)				2.051 (0.494)				56.170* (<0.001*)				61.559* (<0.001*)			

χ^2: **Chi square test**   MC: **Monte Carlo** *: Statistically significant at $p \leq 0.05$

Table (7) shows the number and percent distribution of the study and control groups according to their total score regarding neonatal care. In relation to study group, before providing teaching session, most (90%) of students had poor total scores of practice and only 5% of them had a good total score of practice. After providing teaching session, students showed improvement all over the three period of the study where 100%, 100% & 95% respectively exhibit good total scores. Statistically significant difference were found before intervention and immediately after (P= 0.001). On the others hand, there were no statistically significant differences between immediately after and after two weeks (P = 0.494), among simulated group. In addition, there were no statistically significant differences between immediately after and after two months (P = 0.494), among study group.

The same table shows that, the vast majority (97.5%) of control group had poor total practice scores and none of them had a good total score prior to the traditional intervention. Immediately after the intervention, they exhibited improvement in their practice where about the vast majority (95) achieving a good total practice scores. Two weeks after intervention, a

sharp decrease was observed in their total practice score. Whereas only 17.5% of them had good total score of practice. A further decrease in their practice was observed after two months of providing teaching session where only 15% of them had good total score. A statistically significant differences were evident across the three time periods with an initial increase immediately after teaching (p= 0.001), followed by significant declines after two weeks and two months (p=0.001&0.002) respectively.

Table (7): Comparison of Students' Practice Levels of the Studied Students Regarding Neonatal Care Before and After the Application of the Program:

Total score of practice	Study group								Control group							
	Before		Immediate		After 2 weeks		After 2 months		Before		Immediate		After 2 weeks		After 2 months	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Poor	36	90.0	0	0.0	0	0.0	0	0.0	39	97.5	0	0.0	12	30.0	27	67.5
Fair	2	5.0	0	0.0	0	0.0	2	5.0	1	2.5	2	5.0	21	52.5	7	17.5
Good	2	5.0	40	100.0	40	100.0	38	95.0	0	0.0	38	95.0	7	17.5	6	15.0
$\chi^{2(MC}$p1)	88.012* (<0.001*)								42.810* (<0.001*)							
$\chi^{2(MC}$p2)	2.051 (0.494)								56.170* (<0.001*)							
$\chi^{2(MC}$p3)	2.051 (0.494)								12.846* (0.002*)							

χ^2: Chi square test   MC: Monte Carlo *: Statistically significant at $p \leq 0.05$

P1: Significance between before and immediately after.

P2: Significance between immediately after and after two week.

P3: Significance between immediately after and after two month.

According to table (8) no significant correlation was found between students' knowledge and their performance regarding neonatal care either immediately after, after two weeks, two month later following providing teaching session. This indicates that students' knowledge had no effect on their performance regarding immediate newborn care for both groups.

Table (8): The relationship between the studied students' knowledge and practices across the study phases:

Items	Pearson's r Correlation Coefficient	Significance
Preprogram knowledge – Preprogram practice	0.577	0.000*
Post 1 program knowledge - Post 1 program practice	0.374	0.018*
Post 2 program knowledge - Post 2 program practice	0.535	0.000*
Post 3 program knowledge - Post 3 program practice	0.546	0.000*

* Statistically significant at $p \leq 0.05$

6. DISCUSSION

The current study was concerned about using the high fidelity simulation in the clinical training of nursing students about the immediate care of the newborn in order to overcome the limited traditional training settings and the obstacles of introducing the prelicensure students to the real-life workplaces.

The results of the current study showed that students who underwent the training program about the immediate care of the newborn using the high fidelity simulation had more knowledge retention than those received the traditional clinical training with statistically significant differences between the study and control groups either immediately after, two weeks later or after two months of program implementation (Table 2). This may be due to the more concentration that was

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provided by the closed faculty's environment which helps students to retain more knowledge. This was incongruent with Huang   *et al.* 2019 [15] who conducted a systematic review and meta-analysis about educational efficacy of high-fidelity simulation in neonatal resuscitation training and they found that improvements of efficacy were shown in resuscitation knowledge immediately after training but the long-time retention of knowledge was not confirmed and its benefits cannot be transferred to the real-life situations . Whereas, this was in line with Jimenez 2017[16] who made a research report about using virtual patient simulation in substitution for traditional clinical hours in undergraduate nursing. He concluded that several research studies showed that exposure to simulation up to 50% results in increases in clinical knowledge, critical thinking, debriefing skills, self-confidence, NCLEX pass rates, and overall readiness for professional practice.

As regards skills retention after implementing the training program, this study reflected that students who received the clinical training about the immediate care of the newborn using the high fidelity simulation could retain practice skills more than those who was trained by the traditional method and this was obvious on three evaluations either immediately, two weeks later or after two months of program implementation (Table 3). This could be justified by the availability of multiple training chances that provided to students using the high fidelity simulator; which is difficult to be found in the hospital settings. Similar results were found by Abusaad & Ebrahem 2015 [17] who conducted a study about the changes on knowledge, confidence and skills accuracy of nursing students at a simulated based setting versus traditional during neonatal resuscitation. They concluded that their results provide evidence to support the integration of simulation as an effective teaching strategy that helps to improve students' knowledge and confidence in applying clinical skills. Also it provides nurse educators with the opportunity to provide students with realistic learning experiences in a safe environment. While the results of the current study were different from those which were declared by Couto *et al* 2015 [18] who performed a study about the High-fidelity simulation versus case-based discussion for teaching medical students in Brazil about pediatric emergencies. They concluded that as a single intervention, simulation is not significantly different from case-based discussion in terms of acquisition and retention of skill practice but is superior in terms of student satisfaction.

With regards to the total score of knowledge and practice, the current study shows that students who underwent clinical training using the high fidelity simulation shows higher scores of knowledge and practice rather than those received the traditional clinical training (Tables 4&6). This may be due to the repeated chances of training that could be provided by the availability of the high fidelity simulator. This was congruent with the results of Abd-Elfattah *et al* 2018 [19] who conducted a quasi-experimental study about activation of simulation modules for nursing students' achievement and satisfaction of normal labor. They concluded that simulated delivery room classes were an effective training approach; they provide students with practices that result in a significantly higher practical achievements and higher satisfaction scores compared to the conventional training. The results with the current study were also similar to the results that were revealed by McCoy 2018 [20] who made a doctorate project about Implementing High-Fidelity Simulation to Meet Undergraduate Clinical Requirements. His project utilized pre- and post-simulation open-ended surveys to measure changes in knowledge, perception, and likelihood to adopt before and after training. The Results of the project demonstrated a significant improvement in faculty knowledge after the training as well improvement in perceptions and an identified increase in likelihood to adopt HFS as part of the maternal-newborn curriculum.

7. CONCLUSION

Based on the results of the current study, it can be concluded that: students who received the clinical training on the immediate care of the newborn using the high fidelity simulation show higher scores of knowledge and skills' performance retention than those who received the traditional clinical training with a statistically significant difference over the three times of evaluation over a period of two months after the implementation of the training program.

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