Effect of Educational Program on Maternity Nurses' Knowledge and Practices Regarding Non-invasive Fetal Wellbeing Assessment Methods

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Abstract

Background: Non-invasive fetal wellbeing is crucial to prevent fetal and maternal distress, especially in high-risk pregnancies. To promote the initiatives aimed at reducing fetal death, the maternity nurses must be skilled in performing different fetal wellbeing assessment methods. Aim **of the study**: Evaluate the effect of educational program on maternity nurses' knowledge and practices regarding Non-invasive fetal wellbeing assessment methods. **Subjects and method**: **Research Design**: - A quasi-experimental research design with pre/posttest and follow up was used. **Setting:** The present study was conducted at the fetal wellbeing assessment unit at antenatal outpatient clinic affiliated in Zagazig University hospitals. **Subject**: A convenient sample of all available 35 nurses who were working in the previous mentioned settings. **Tools of data collection:** ***Two tools*** were used: **Tool I**: A structured interviewing sheet containing two parts: **Part I:** Demographic characteristics of nurses and **part II:** Nurse's knowledge questionnaire concerning non- invasive fetal well beings' assessment methods and **Tool II**: Fetal wellbeing procedures practice checklist. **Results:** it was indicated that, there were highly statistically significant variations in nurses' knowledge & practices pre, post and throughout the follow-up phase. In addition, there was a statistically significant correlation between total level of knowledge and total level of practice during post & follow up phase. **Conclusion:** There was a significant improvement of maternity nurses' knowledge and practices. The educational program positively significantly affected on maternity nurses' knowledge and practices towards non- invasive fetal wellbeing assessment methods. **Recommendations**: A regular planned in-service training programs for both new and current maternity nurses should be applied to improve their performance regarding non-invasive fetal wellbeing, assessment methods.

Keywords: Educational program, Maternity nurses, Knowledge, Practices Non-invasive fetal wellbeing, assessment methods.

Introduction

The field of prenatal fetal assessment testing is vast, and techniques have significantly advanced recently. The assessment of fetal health, which determines the fetal' well-being, is the major emphasis of maternal and fetal health. Assessment of fetal wellbeing is done using both invasive and noninvasive methods*. [(1)]*

Non-invasive methods in high-risk pregnancy are crucial to minimize fetal and maternal distress during pregnancy and labour. Through the use of physiological measurements, such as fetal movement, temperature, fetal heart rate, ultrasound, biophysical profile, uterine contraction, and maternal cardiotocography & amniotic fluid pH, it is possible to identify and evaluate the feto-maternal well-being in real time.[(2)]

Fetal monitoring refers to an indirect method of assessing the health and oxygenation of the fetus.[(3)] Early knowledge about the fetal health is one of the main indications of fetal monitoring throughout pregnancy and childbirth. The assessment of fetal distress helps the maternity to decide if a disease is acute or chronic. The presence of a chronic disease suggests improper fetal nutrition intake, which leads to abnormal intrauterine fetal growth. Asphyxia of the fetus is an acute disorder that can cause severe hypoxic ischemic organ damage which resulted in serious long-term problems. *[(4)]* The primary objective of prenatal care is to evaluate maternal &fetal health. Among the nurse's duties is to educate women during their pregnancies. Each prenatal appointment for a woman involves the nurse assessing the patient, monitoring vital signs,

doing additional checks as directed, responding to questions, and delivering the necessary information. A nurse or other qualified healthcare professional is most suited to convey to women the advantages of early and ongoing prenatal care.[5]

Maternity nurses have a critical role in the early identification of high-risk fetuses and the monitoring of the growing fetus. They are in charge of ensuring the woman's and the fetus' safety during the testing time, helping with setup and guiding the pregnant mother through each stage of the procedure to ease her anxiety. Also, nurses should inform pregnant women of the results so they can make the best decision possible. [6]

Significance of the study:

Inadequate monitoring and care provided by qualified medical staff throughout pregnancy and childbirth is the main cause of perinatal mortality. The worldwide maternal mortality ratio (MMR), which is the number of deaths per 100,000 live births, decreased by 34%, from 342 to 223 deaths. The perinatal death rate might be significantly decreased due to the effective maternal health care [7]. In order to support the efforts and policies aimed at minimizing the fetal death, nurses, who are in contact with the pregnant woman throughout pregnancy and during birth, must be capable of performing several types of fetal wellbeing assessment methods.[8] Therefore, it is vitally necessary to conduct this study in order to assess the effectiveness of educational program on maternity nurses' knowledge and practices with reference to the non-invasive fetal wellbeing assessment methods.

Aim of the study:

The aim of the study was to evaluate the effect of educational program on maternity nurses' knowledge and practices regarding Non-invasive fetal wellbeing assessment methods.

Such aim had been fulfilled through the following objectives:

- Determine the maternity nurses' knowledge regarding Non-invasive fetal wellbeing assessment methods.
- Assess the maternity nurses' practices regarding Non-invasive fetal wellbeing assessment methods.
- Design, implement and evaluate the effect of educational program on maternity nurses' knowledge and practices regarding noninvasive fetal wellbeing assessment methods.

Research Hypothesis:

Maternity nurses' knowledge and practices will be enhanced after receiving the educational program.

Subjects and method:

Research design:

A quasi-experimental study design for nurses in one group utilizing pre/posttest and follow up.

Setting:

The current study was conducted at the prenatal outpatient clinic's fetal wellbeing assessment unit at Zagazig University hospitals, which are associated with Egypt's El-Sharkia Governorate. The location is situated on the second floor of the zagazig hospitals' outpatient clinics. The location previously mentioned had been chosen because it hosted the primary medical facilities for Zagazig University Hospital, where women seek prenatal screening treatments, intended to reduce fetal deaths.

Sampling:

A convenient sample of all available nurses (35) working in the above- mentioned setting and accepted to enroll in the study.

Tools of data collection:

Two tools were used in this study:

Tool I: Structured Interviewing Questionnaire:

The researchers created it after looking through recent literatures that were relevant. [9] It was prepared in Arabic language and was divided into **two parts**:

Part 1: Personal characteristics of the nurses: It included data related to; age, marital status, educational level, residence, total experience expressed in years and the previous participation in previous program regarding non-invasive fetal wellbeing assessment methods.

Part 2: Nurses' knowledge concerning non -invasive fetal wellbeing assessment methods: It included two main sections. **Section (I)** included data related to **basic knowledge about non- invasive fetal wellbeing**. It was consisted of (**6**) open ended questions related to (definition, indications, components , different types of non-invasive fetal wellbeing tests during 1st, 2nd and 3rd trimester). ***Section (II)*** included

data related to ***knowledge about different non-invasive fetal wellbeing diagnostic procedures*****.** It was represented in (**15**) open and closed ended questions regarding the main seven **(7)** noninvasive fetal wellbeing procedures as; Biophysical profile: Cardio tocogram (CTG), Fetal movement kick count, Ultrasonography, Oxytocin challenging test, Non-stress test & Contraction stress test. This section covered data related to definition, parameters, and indications of each test.

Scoring system for knowledge:

The researchers calculated the nurses' responses based on the answers using the model key answer sheet they had previously developed. Every item of knowledge was assigned a rating: (2) for completely correct answer, (1) for partially correct and (0) for incorrect responses. ***The overall total knowledge score was ranged from (0-42).*** All nurses were assessed by using the same format for all study phases. The results of adding up the item scores for each knowledge area and dividing the total by the number of items for obtaining mean score.

The total score level of knowledge assessed as follows:

- **Unsatisfactory level** < 60% of total scores. (0-25)
- **Satisfactory level** ≥ 60% of total scores. (More than 25).

Toll II. Observational checklist regarding Non-invasive fetal wellbeing procedures:

It was designed by the researchers and adapted from published literature ***(Jain & Acharya)*** [10] ***and (American College of Obstetricians and Gynecologists)*** [11]. It was concerned with assessing the maternity nurses' practices regarding non-invasive fetal wellbeing procedures. It was divided into (7) procedures which consisted of (**55** items) that identify the steps of different Non-invasive fetal wellbeing assessment methods. It includes Biophysical fetal profile (BPP) includes (7 steps), Cardio tocogram (CTG) includes (10 steps), fetal kick count includes (5 steps), Ultrasonography includes (7 items), Oxytocin challenge test includes (8 steps), Non stress test (NST) includes (8 steps), and Contraction stress test (CST) include (10 steps).

Scoring: Each item was scored as (0) for not done, and (1) for done and ***total practice score was ranged from (0-55)***. Then summing up the scores of the items in each procedure and the overall scores gave practice score. The mean and standard deviation were calculated. As well as nurses' total practice score was classified as the following:

- **Incompetent practice**< 60% of total scores.
- **Competent practice** ≥ 60% of total scores

Preparatory phase: -

The researchers investigated historical and contemporary literature related to the study topic to gain a complete theoretical understanding of the numerous facets of the problem and to prepare the observational checklists. For this, articles from books, journals, textbooks, newspapers, and magazines as well as articles from online scientific publications were used. This makes it simpler to choose trustworthy and useful data collecting system.

Content validity and reliability

The educational materials and tools were assessed for comprehensiveness, applicability, and readability by a jury of three experts, which included two professors of obstetrics and gynecology nursing and one professor of obstetrics and gynecology medicine. The panel validated the authenticity of the tools. Rephrasing a few sentences and modifying a few things accounted for the majority of the minor but significant changes. The reliability of the tool's items was assessed using Cronbach's alpha coefficients to calculate the tools' internal consistency. Cronbach's alpha values for the study tools were dependable at 0.81 for knowledge, and 0.79 for practice. All of the coefficients were acceptable and satisfactory.

Field work:

The researchers identified and met the maternity nurses at the study setting. The researchers introduced themselves, and after explaining the study's objectives to the nurses, a verbal agreement was taken from them to enroll in the study. The researchers then conducted the data collection using the interview questionnaire sheet. The study lasted five months from the beginning of first of October 2021 to the end of February 2022. Based on a thorough analysis of the nurses' needs, educational sessions were developed to improve the nurses' knowledge and practices about non -invasive fetal wellbeing

assessment methods. In order to achieve the study's objectives, the following phases were established:

Assessment phase:

This phase was carried out once agreement was obtained in the study setting. It was able to determine knowledge and practice gaps for non-invasive fetal wellbeing assessment methods during the (pre-test) by gathering and reviewing the baseline data obtained from the finished tools. The researchers used the interview questionnaire that was written in plain Arabic to evaluate nurses' personal data as well as their knowledge about non-invasive fetal wellbeing. It was given to every nurse by using the personal interview method. It took between 10-15 minutes to be completed and was utilized in the pre-, post and follow-up phases. Also, the development of the educational program included evaluating nurses' practice regarding non-invasive fetal wellbeing procedures before conducting the program by using the observational checklists which were filled by the researchers. The maternity nurses weren't aware that they were being watched while doing procedures, thus each observation sheet was filled up right away. Checklist was utilized (pre -posttest & follow up phase). The researchers gathered information three days per week.

Planning & Implementation phase:

Based on the results obtained from pre training assessment, education and training programs were developed to fill the study nurses' knowledge and practice gaps related non-invasive fetal wellbeing assessment methods. The results of the assessment phase served as a guide for the researchers as they created the training materials for non-invasive fetal well-being examinations. The researchers created the educational program utilizing up-to-date, trustworthy scientific information. They prepared a self-learning booklet in simple Arabic about non-invasive fetal wellbeing assessment methods using recent, evidence-based data and was given to each nurse. The total number of sessions was 5 sessions which lasted for 5 hours for each group. There were 35 nurses in all, with 7 nurses in each of the 5 groups and for each group, the material was applied independently. For each session, just 7 nurses were present to promote understanding. Each observational checklist took an average of 15 to 20 minutes to be completed. Nursing sessions continued throughout the afternoon shift beginning at 12 PM when their duties were finished at 2 PM. This time was ideal and most suitable for them.

Description of the educational program:

The initial stage of this educational program creation was determining its primary purpose and goals. Based on the needs that the nurses determined, these objectives were created.

General objective of the educational program: -

To enhance maternity nurses' knowledge and practices regarding non- invasive fetal wellbeing assessment methods.

Specific objectives:

When the sessions completed, the nurse should be able to:

- Define non -invasive fetal wellbeing, enumerate its indications, components & different types throughout pregnancy.
- Determine the definition and mention the indications of each non -invasive fetal wellbeing test.

Each group received the organized educational program over the course of five sessions, which were divided into training and educational sessions. A total of three sessions for the practical part, which is three hours a long time, and two sessions for the theoretical part which is two hours a long time. Using audio-visual technology, the nurse was given handouts on health topics and video simulations of non-invasive fetal wellbeing assessment methods during lectures and group discussions. To win the nurses' participation, a brief explanation of the educational sessions' goal was given at the beginning of the first meeting. This comprised justifications for the objective, import of the subjects, tools, context, and setting.

The sessions were as follows:

The educational theoretical part was carried out in ***(2) sessions***: -

- ***Session 1***: - Initial session was about general overview related to non- invasive fetal wellbeing such as; definition, components and its indications.
- ***Session (2):*** - knowledge about different types of Non-invasive fetal wellbeing procedures.

*__The intervention practical sessions__: were carried out in __(3) sessions__, to cover practical part of Non-invasive of fetal wellbeing procedures.

The definition, indications, diagnostic procedures, and processes of non-invasive fetal well-being procedures were all discussed in the lectures. To make sure the nurses understood the educational intervention material, every meeting began with a summary of what had been discussed in the previous one and an outline of the objectives for the one that followed. At the conclusion of the educational program, a free 15-minute conversation about this subject with the nurses was also planned. At the end of the training, nurses got instruction sessions with fast, non-invasive assessments of fetal wellbeing.

Evaluation phase: -

After completion of the educational program sessions the same pretest questionnaire was used to re-fill the observation sheet and questionnaire format in order to assess the success of the educational program. Immediately following the completion of all program sessions, the post-test was administered. The questionnaire was then given once more during the follow-up phase after two months to assess how well the participant was remembering the material and applying the instructions. The aforementioned score was used to determine the result.

pilot study: -

After the tools were developed, a pilot study was carried out with three nurses representing 10% of the nurses in the previous settings to evaluate the viability, and clarity of the tools. Their findings demonstrated that there were no significant mistakes or changes. The tool was so completed and ready for use. Due to the limited size of the research's population, the pilot study sample was included in the study's participants.

Ethical consideration and administration design.

The research study was conducted after obtaining approval from the ethical committee at faculty of nursing Zagazig University. Following assurances from researchers that the data gathered would be kept private, each nurse was given a brief explanation of the study's objectives in an effort to inspire confidence and respect enough for her to take part in the study. The nurses were made aware of their right to leave the study at any moment. The dean of faculty of nursing at Zagazig University formally requested authorization to gather data from the administrative building in a letter to the dean of the faculty of medicine.

Statistical design:-

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA 2011)). Quantitative data were expressed as the mean ± SD and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). Wilcoxon signed ranks test was used to compare between two dependent groups of non-normally distributed variables. The student "t" test was used for comparison of means of two independent groups of quantitative data which were normally distributed. ANOVA (One way analysis of variance) test was used for comparison between more than two different groups of quantitative data which were normally distributed. Pearson correlation coefficient was calculated to assess relationship between study variables, (+) sign indicate direct correlation & (-) sign indicate inverse correlation, also values near to 1 indicate strong correlation & values near 0 indicate weak correlation. Multiple linear regressions (step-wise) was also used to predict factors which affect practice score. Cronbach alpha coefficient was calculated to assess the reliability of the scales through their internal consistency. P-value < 0.05 was considered statistically significant, p-value < 0.001 was considered statistically highly significant, and p-value ≥ 0.05 was considered statistically non-significant.

Results

Table 1: Reveals that 65.7% of the studied nurses were aged 20-<30 years and 60% had a bachelor education. As for the studied nurses' years of experience, the same table portrays that 51.4% had less than five years of experience and only 17.1% had participated in previous training courses regarding non-invasive fetal wellbeing measures.

Table 2: Shows a highly statistically significant difference between mean scores of knowledge related to the all items of non-invasive fetal wellbeing methods between the pre and post intervention phases (p<0.001).

Also, there was a highly statistically significant difference between mean scores of knowledge between the follow up and pre intervention phases (p<0.001).

Table 3 : Represents total mean score of studied nurses' knowledge regarding the noninvasive diagnostic procedures .The table reveals that the mean score of knowledge was improved in post and follow-up study phases than pre phase with highly statistically significant (p< 0.001**).

Figure 1 illustrates the total knowledge score of the studied nurses' regarding noninvasive fetal wellbeing assessment methods. It was found that only 22.8% of the studied nurses had satisfactory knowledge before intervention whereas immediately post intervention the percentage was increased to 74.2% and slightly decreased to 68.5% at follow up phase.

Table 4 compares the total mean score of the studied nursing practices regarding different types of the diagnostic noninvasive tests throughout the study phases. It represents a highly statistically significant increase (p<0.001) in total mean score immediately post intervention compared to pre intervention, additionally, there's a highly statistically significant improvement between total mean score between follow up and pre intervention(p<0.001) .

Figure 2: Demonstrates an improvement in nursing practice competence throughout the study phases. It was observed that only 28.5% of nurses were had a competent practice pre intervention, meanwhile in immediately post intervention and at follow up, these percentages were increased to 85.7% & 82.8% respectively.

Table 5: Reveals that, there is a statistically significant relation between total knowledge scores of studied nurses and their age & the year of experience at post intervention, meanwhile at follow up phase there is a statistically significant relation between the total knowledge score and age only. Additionally, there's a highly statistical significance differences between nurses' total knowledge and their level of education, whereas, the highest mean score was observed among nurses, who had a bachelor of nursing at post intervention phase (p<0.001). Also, there is no statistically significance difference between the scores of knowledges in relation to their residence, and attendance of training courses regarding Non-invasive fetal wellbeing at both post and follow up phases.

Table 6: - Shows the relation between personal characteristics of the studied nurses and their total practice score, it portrays a statistically significant relation between age and total practice score at post and follow up phases. Additionally, there is a highly statistically significant relation between educational level, years of experience and total practice in post and follow up phases at (P= < 0.001). While, there was no statistically significant relation between residence, previous training and total practice through the intervention phases (P= > 0.05).

Table 7: Discovers no statistically correlation between total level of knowledge and total level of practice at pre intervention, meanwhile in post and follow-up intervention there's a statistically significant correlation between total level of knowledge and total level of practice.

Discussion: -

The wellbeing of the mother and fetus is interdependent. Regular monitoring of fetal health conditions during pregnancy and labour creates the impression that the fetus is in good health, which promotes the health of infants after delivery ***Brady etal .,*** [12] There are several methods for evaluating fetal health, from straightforward mother observation of fetal movement to more intricate diagnostic procedures guided by ultrasonography (***Cecil,***.[13] In addition to their responsibility for implementing independent nursing interventions, maternity nurses played a critical role in educating patients about fetal monitoring techniques. They also regularly reported non-abnormal findings to doctors to enable timely and accurate assessments of the health and development of the fetus ***(Said and Ali*** [14]

The present study was aimed to evaluate the effect of educational program on the maternity nurses' knowledge and practices

regarding noninvasive fetal wellbeing assessment methods. The present study supported the stated hypothesis that the educational program had improved the maternity nurses' knowledge and practice regarding non-invasive fetal wellbeing assessment methods.

In order to prepare nurses for the huge changes that are now affecting the health care system, continuing education is crucial. Regarding ***mean score of knowledge*** of studied nurses about the all items of noninvasive fetal wellbeing, the results of the present study showed a highly statistically significant difference between mean scores of knowledge's related to the overview of the–non-invasive fetal wellbeing knowledge between the pre and post intervention phases and also between the follow up and pre intervention phases. This finding was consistent with ***Ramadan et al.,*** (4) in their study entitled "*Maternity Nurses' Performance Regarding Non-invasive Fetal Wellbeing Measures: Educational Intervention* "at Benha university, Egypt, who reported a highly statistical significance difference in pre and post intervention regarding studied nurses' knowledge about non-invasive fetal wellbeing measures .Also, this was in accordance with the study by ***Rosy, (15)*** in India, who mentioned that the majority of midwives in their study had an improvement in knowledge means post-program.

Moreover; these findings were in conformity with ***Mohammed et al., (16)*** and ***Said & Ali, (14)*** in their studies in Egypt who mentioned that the mean score of knowledge among the majority of the studied nurses had improved during the post program compared to preprogram with statistically significant differences. *From the researchers' point* of view, this improvement in knowledge among maternity nurses during the immediate post- program demonstrated the effectiveness of the supporting educational intervention, and the nurses had learned about and were capable of handling non-invasive measures for fetal wellbeing. Furthermore, the majority of maternity nurses continued to have high mean knowledge scores during the two-month follow-up with just a little reduction because of nurses' retention of information.

Concerning to the studied ***nurses' knowledge regarding the non-invasive diagnostic tests*** as (CTG and biophysical profile), the current study revealed a highly statistical improvement in the mean of knowledge in pre intervention than post and follow up. These findings are in agreement with **Abd El-Razek, (9)** who mentioned in their study "*Impact of educational programs about methods of assessment of fetal wellbeing during pregnancy among staff nurses*" Egypt, that the majority of their participants had answered correctly and had a higher significantly knowledge on posttest than on pretest about the diagnostic fetal wellbeing.

As for the ***total knowledge score*** the current study showed that there was only more than one fifth of the maternity nurse who had satisfactory level of knowledge before intervention, while immediately post intervention the percentage was increased to nearly three quarters and slightly decreased to more than two thirds at follow up phase. This may be due to the majority of maternity nurses were untrained in non-invasive fetal wellbeing methods, highlighting the value of ongoing education and regularly updated clinical courses for nurses to advance nursing knowledge and skills. The previously mentioned findings were similar to ***Ramadan et al., (4)*** and ***Mohammed et al., (16)*** in Egypt who reported that the majority of the studied nurses had unsatisfactory knowledge before the implementation of the educational intervention which was improved to satisfactory level among the majority of them during post intervention.

Furthermore; ***Thellesen et al., (17)***, who studied " *Cardiotocography interpretation skills and the association with the size of the maternity unit, years of obstetric work experience and healthcare professional background*", in Denmark who reported that more than half of nurses had good total knowledge score during immediate post program. Moreover; ***Sowmya et al., (18)*** in India, reported that the level of nurses' knowledge on general facts on cardiotocography was inadequate during the preprogram while in the immediate post-program the majority of them had an adequate level of knowledge.

Antepartum testing may be done and interpreted by skilled nurses, which will raise the standard of care. Concerning the ***total mean score of the studied nurses' practices*** regarding different types of the diagnostic non-invasive tests throughout the study phases. The present study represented a highly statistically significant increase in total mean score immediately post intervention compared to pre intervention and between follow up and pre intervention phase. *From the researchers' point of view* this improvement may be related to improved nurses' knowledge which attributes to improve their practices. Furthermore, following the program's implementation, nurses started to understand their role in non-invasive methods to improve foetal health.

This was in the agreement with ***Ramadan et al ., (4)*** who reported that there was a high statistical significance difference of studied nurses mean practices score concerning non-invasive fetal wellbeing assessment methods as fetal heart sound and fetal kick count pre and post intervention .Additionally, these results were in agreement with ***El-Sayed, (19)***, who reported significant improvements in mean score of practice in preprogram as compared to immediate post-program, and after 3 months later. Also, ***Kelly et al., (20),*** who studied" *Training in the use of intrapartum electronic fetal monitoring with cardiotocography*" Bristol, UK and revealed a highly statistically significant difference before and after training instructions during fetal monitoring procedures.

As for ***total practice score*** of the studied nurses regarding non-invasive fetal wellbeing procedures, the present study demonstrated that there was an improvement in nursing practice competence throughout the study phases of the educational program. This improvement in nurses' practice emphasized that the educational program had a significant impact on the maternity nurses' knowledge as well as their nursing care practices.

This was in agreement with ***Arief and Ibrahim, (21)***, who studied "*Effect of electronic fetal monitoring educational program on knowledge" and interpretations of internship nursing student,*, Assiut, Egypt and reported that more than three-quarters of studied nurses have an unsatisfactory practice score before supportive nursing instructions which was improved during post intervention. Also, ***Said and Ali, (14)*** showed that, there was a highly statistically significant difference before and after training supportive nursing instructions among the studied nurses during fetal monitoring procedures.

Furthermore; ***Mohammed et al.,(16)*** reported that; most of the studied nurses were had unsatisfactory scores during pre-intervention, this unsatisfactory practice was due to poor knowledge of nurses regarding cardiotocography and before the execution of the teaching program, the nurses thought that cardiotocography was an invasive treatment that was only carried out by physician. While, during the immediate post program, and after 3 months follow-up most common nurses were had satisfactory practice scores.

Concerning ***the relation between total knowledge scores of studied nurses and their personal characteristics***, the current study findings revealed that; there was a statistically significant relation between total knowledge scores of studied nurses and their age & the year of experience at post intervention, meanwhile at follow up phase there was a statistically significant relation between the total knowledge score and age only. Additionally, there's a highly statistical significance relation between nurses' total knowledge and their level of education.

This was similar with ***Kelly et al., (20)***, who revealed that there was a highly statistically significant relation between studied nurses' total knowledge score, and their personnel characteristics. Furthermore, the present study was in conformity with **Sangeetha, (22)**, who studied "*assess knowledge attitude and practice regarding Cardiotocography among staff nurses*", in Bangalora found that there was a significant difference between nurse' knowledge, their educational level and work experience. Meanwhile, this was contradicted with ***Sowmya et al., (18)*** in India & ***Lamé et al., (23)*** in UK who mentioned that there was no significant difference between the total knowledge score and years of experience. This may be attributed to difference in study settings and subjects.

Regarding the ***relation between nurses' practice total score and demographic characteristics***, the results of the present study portrayed a statistically significant relation between age, educational level, years of experience and total practice in post and follow up phases at (P= < 0.001). While, there was no statistically significant relation between residence, previous training and total practice through the intervention phases. This finding ensured the fact that when level of education of nurses is high and the years of experience are many, it reflects positively improvement on the level of performance.

This was in partially agreement with ***Mohammed et al., [16]*** who found a significant relation between nurses' total practice score and their age & education level while on the other hand, there was no statistically significant difference between nurses' years of experience and total practice scores. In line with this finding ***Devane, et al [24] and, Sukumaran et al., [25]*** in their studies found a highly statistically significant association between nurses' practice and their age.

On the other hand, the present study findings were contradicted with ***Sowmya et al., [18]***, who found no significant relation between nurse's skill level and their selected demographic data. This may be related to differences in study setting & subjects.

The current study showed a significant ***positive correlation between nurses' knowledge and practice*** before and after implementation of the educational program related noninvasive fetal wellbeing assessment methods. This may be explained as any training program improves nurses' knowledge, which in turn improves their practice.

This was consistent with ***Lamé et al., [23]*** who reported that there was an improvement in nurses' practice in relation to improving their knowledge in pre and post phases of the program. Also these findings were in line with studies by ***Ramadan et al ., [4], Said and Ali,*** [14] and ***Mohammed et al., [16]*** who found a statistically significant correlation between the total scores of nurses' knowledge and practices before and after the nursing intervention. This ensured the fact that improvement in knowledge reflect significantly on the level of practice.

Conclusion

Based on the findings of the current study and answering of research hypothesis, it could be concluded that: The educational program was effective in improving the level of performance of maternity nurses regarding non-invasive fetal wellbeing assessment methods where there was a significant improvement in post and follow up as compared to pre intervention. Furthermore; there was a significant positive correlation between the total score of studied nurses' knowledge and practice before and after implementation of the educational program. Therefore, the study aim was achieved and the research hypothesis was supported.

Recommendations: -

Based on the findings of the current study, the following recommendations are suggested: -

- Implementing a routinely scheduled in-service training program for maternity nurses on staff, both new and experienced ones, to enhance their performance regarding non-invasive fetal wellbeing assessment methods.
- Fetal assessment units or the Obstetrics Department should have supportive nursing policies for noninvasive fetal wellbeing.
- Periodic review of the performance of maternity nurses to determine any requirements and evaluation of non-invasive fetal wellbeing assessment techniques.
- Replicating the study with a large sample size and at several hospitals is advised in order to generalize the results.

Table (1): Personal Characteristics of the Studied Nurses (n=35).

Characteristics	No.	%
Age (years)		
20-<30	23	65.7
30-<40	7	20.0
≥40	5	14.3
Mean ± SD	**30.88±7.07**	
Educational level		
Technical nursing education	14	40.0
Bachelor of nursing	21	60.0
Residence		
Rural	16	45.7
Urban	19	54.3
Years of experience in the fetal assessment unit(years)		
<5	18	51.4
5-<10	10	28.6
10-15	7	20.0
Mean ± SD	**6.54±3.75**	
Participating in Previous educational program on non- invasive fetal wellbeing procedures		
Yes	6	17.1
No	29	82.9

Table (2): Distribution of studied nurses regarding to their mean of knowledge about Non-invasive fetal wellbeing measures Throughout study Phases. (n=35).

Items	Pre	Post	Follow up	P1	P2
	Mean ± SD				
Definition	0.17±0.38	1.28±0.45	0.94±0.48	0.001**	0.001**
Indications	0.28±0.45	1.62±0.49	1.02±0.61	0.001**	0.001**
Components	0.20±0.41	1.37±0.49	0.88±0.52	0.001**	0.001**
Types that done at the first trimester	0.25±0.44	1.57±0.50	1.03±0.71	0.001**	0.001**
Types that done at the second trimester	0.24±0.43	1.48±0.51	0.85±0.69	0.001**	0.001**
Types that done at the third trimester	0.22±0.426	1.42±0.50	0.88±0.71	0.001**	0.001**
Total Mean ± SD	**1.40±2.22**	**7.48±1.40**	**5.62±1.78**	**0.001****	**0.001****

The test used is Wilcoxon Signed Ranks Test, p1: for comparison between post and pre, p2: for comparison between follow up and pre, **: statistically highly significant (p<0.001).

Table (3): Distribution of studied nurses according to their total mean scores of knowledge's regarding the diagnostic noninvasive tests throughout study phases (n=35).

Variables of knowledge	Pre	Post	Follow up	P1	P2
	Mean ± SD				
Biophysical profile	0.88±1.25	4.45±1.09	2.97±1.27	0.001**	0.001**
Cardio-Tocography	0.71±0.86	3.40±0.77	2.34±0.93	0.001**	0.001**
Daily Fetal Movement Kick Counts	0.46±0.84	2.51±0.85	1.74±0.88	0.001**	0.001**
Ultrasonography	0.43±0.87	2.88±0.93	2.05±1.02	0.001**	0.001**
Oxytocin challenging test	0.44±0.81	2.94±0.83	2.06±1.03	0.001**	0.001**
Non-stress test	0.46±0.85	3.08±0.81	2.14±1.14	0.001**	0.001**
Contraction stress test	0.42±0.85	3.11±0.67	2.31±1.05	0.001**	0.001**
Total Mean ± SD	**6.14±5.84**	**22.40±4.62**	**20.11±4.19**	**0.001****	**0.001****

The test used is Wilcoxon Signed Ranks Test, p1: for comparison between post and pre , p2: for comparison between follow up and pre, **: statistically highly significant (p<0.001).

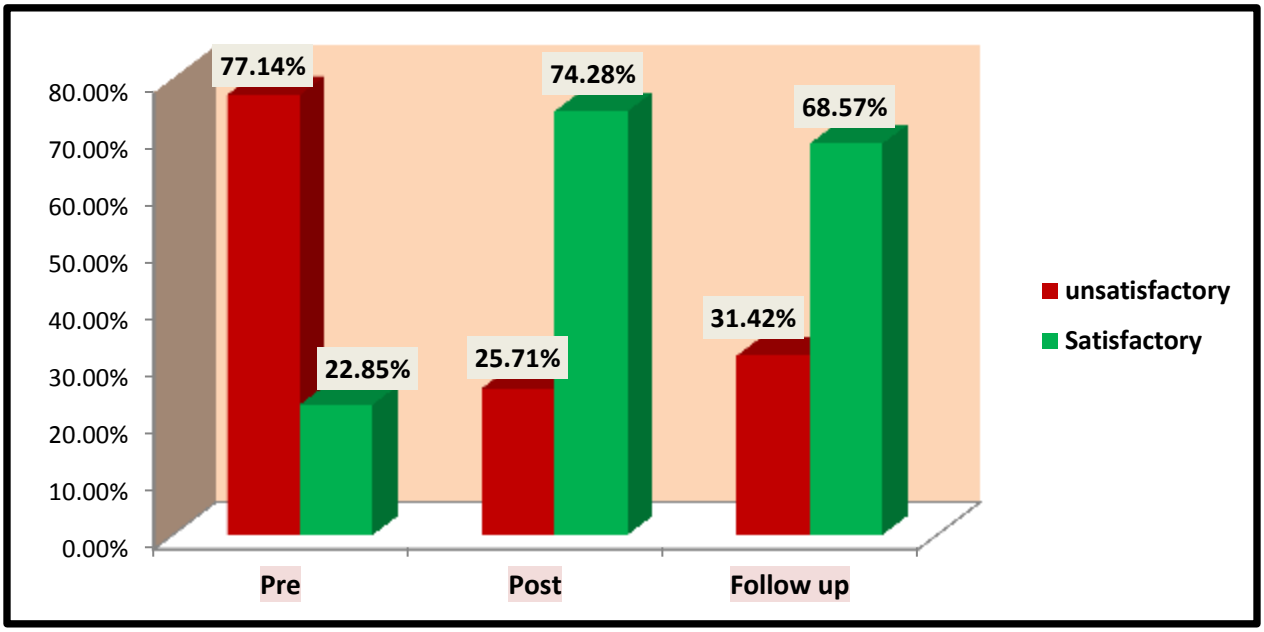

Figure (1): Total score of knowledge throughout study phases as reported by studied nurses.

Table (4): Distribution of studied nurses according to their total mean scores of practices regarding the diagnostic noninvasive tests throughout study phases (n=35).

	Pre	Post	Follow up	p1	p2
	Mean ± SD				
Biophysical profile	3.48±0.92	5.51±0.81	4.91±0.65	0.001**	0.001**
Cardio-Tocography	4.51±0.85	7.68±0.90	6.88±1.02	0.001**	0.001**
Daily Fetal Movement Kick Counts	2.40±0.73	3.25±0.70	2.94±0.68	0.001**	0.001**
Ultrasonography	3.68±0.79	4.82±0.78	4.48±0.78	0.001**	0.001**
Oxytocin Challenging Test	3.62±0.73	4.91±0.95	4.42±0.97	0.001**	0.001**
Non-Stress Test	3.02±0.78	4.65±0.83	4.31±0.79	0.001**	0.001**
Contraction Stress Test	4.31±0.83	7.20±1.13	6.60±0.94	0.001**	0.001**
Total Mean ± SD	**26.62±3.67**	**38.05±2.79**	**34.57±2.34**	**0.001****	**0.001****

The test used is Wilcoxon Signed Ranks Test, p1: for comparison between post and pre,

p2: for comparison between follow up and pre, **: statistically highly significant (p<0.001)

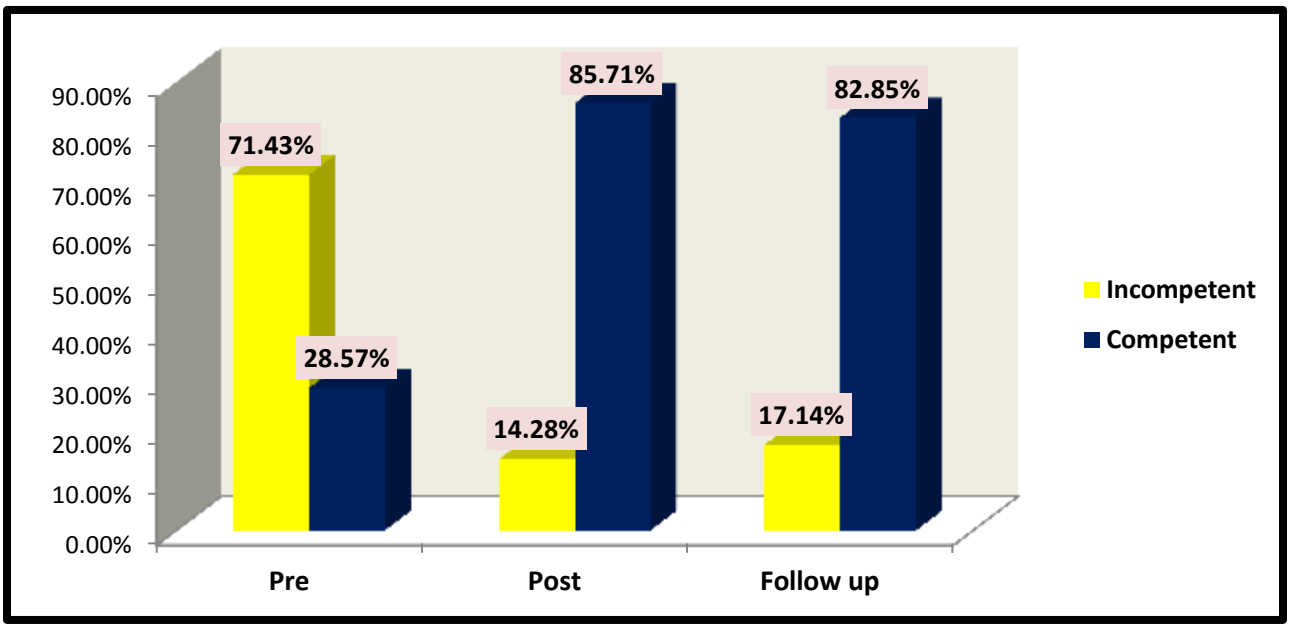

Figure (2): Total score of practice of the studied nurses throughout study phases

Table (5): Relation between personal characteristics of studied nurses and their Total knowledge score throughout study phases (n=35).

Items	Post	Follow up	
Age (years)			
20-<30		29.91±5.66	20.73±6.51
30-<40		27.85±5.45	21.57±5.22
≥40		37.00±3.74	30.20±3.89
F test and p-value		**4.559 (0.018*)**	**5.141 (0.012*)**
Educational level			
Technical nursing education		27.07±4.87	21.71±5.39
Bachelor of nursing		33.61±4.52	20.95±6.51
t-test and p-value		**4.069 (0.001**)**	**0.362 (0.719)**
Residence			
Rural		29.68±6.15	22.25±5.43
Urban		30.05±5.44	20.42±6.49
t-test and p-value		**0.186 (0.853)**	**0.893 (0.378)**
Years of experience in the fetal assessment unit			
<5		27.50±5.07	21.61±7.00
5-<10		27.20±3.11	19.90±5.04
10-15		33.42±4.96	22.28±4.82
F test and p-value		**4.858 (0.014*)**	**0.374 (0.691)**
Participating in Previous educational program on non- invasive fetal wellbeing procedures			
Yes		30.66±1.75	21.65±6.32
No		29.93±6.22	19.33±4.08
t-test and p-value		**0.102 (0.919)**	**0.857 (0.398)**

F: one way ANOVA, t: student t-test, non-significant (p>0.05), *: statistically significant (p<0.05), **: statistically highly significant (p<0.001)

Table (6): Relation between personal characteristics of studied nurses and their Total practice score throughout study phases (n=35).

Items	Post	Follow up
Age (years)		
20-<30	36.80±1.78	34.47±2.61
30-<40	37.60±2.67	35.14±1.34
≥40	40.42±2.69	38.20±2.38
F test and p-value	**3.880 (0.031*)**	**4.988 (0.013*)**
Educational level		
Technical nursing education	35.00±2.51	34.64±1.94
Bachelor of nursing	39.23±3.36	37.52±2.61
t-test and p-value	**4.022 (0.001**)**	**3.5238 (0.001**)**
Residence		
Rural	38.68±2.96	35.81±1.91
Urban	37.52±2.61	34.36±2.69
t-test and p-value	**1.233 (0.226)**	**0.553 (0.584)**
Years of experience in the fetal assessment unit		
<5	35.61±2.54	34.45±2.51
5-<10	36.70±2.54	35.01±1.35
10-15	43.00±3	38.35±2.71
F test and p-value	**20.291 (0.001**)**	**7.513 (0.001**)**
Participating in Previous educational program on non- invasive fetal wellbeing procedures		
Yes	39.00±2.61	35.16±2.63
No	37.86±2.83	34.65±2.31
t-test and p-value	**0.905 (0.372)**	**0.460 (0.649)**

F: one way ANOVA, t: student t-test, non significant(p>0.05), *: statistically significant (p<0.05), **: statistically highly significant (p<0.001)

Table (7): Correlation between knowledge and practice throughout study phases (post& follow up). (n=35)

Parameter		Knowledge					
		Pre intervention		Post Intervention		Follow up Intervention	
		(r)	P	(r)	P	(r)	P
Practice	Pre	0.312	0.07				
	Post			0.344	0.043*		
	Follow up					0.341	0.044*

*: statistically significant (p<0.05), r: correlation coefficient.

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