

Effect of Nursing Intervention Guided by PRECEDE Model on Knowledge and Practice of Preventive Behavior of High-Risk Pregnant Women regarding Preeclampsia

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Abstract

Background: Preeclampsia during pregnancy is considered one of the major obstetrical problems in developing countries that cause maternal mortality and preterm birth throughout the world. **Aim:** To evaluate the effect of nursing intervention guided by PRECEDE model on knowledge and practice of preventive behavior of high-risk pregnant women regarding preeclampsia. **Subjects and method: Design:** Quasi-experimental research design pre-post-test was utilized in this research. **Settings:** The study was applied in the antenatal outpatient clinics at Tanta and Sohag University Hospitals. **Sample:** A purposive sample of 120 high-risk pregnant women was recruited from the selected settings. **Tools:** Four tools were used: (1) Structured interviewing questionnaire, (2) Predisposing, Enabling, and Reinforcing Questionnaire (PRECEDE model questionnaire), (3) Pregnant women's reported practices of preeclampsia preventive behavior tool and (4) Pregnant women attitude questionnaire regarding preeclampsia prevention. **Results:** Mean score of knowledge, enabling factors and reinforcing factors have been increased with statistical significance immediately and after one month of nursing intervention implementation. Pregnant women had good practices toward preeclampsia preventive measures one-month post-intervention in comparison to the pre-intervention implementation. Pregnant women had a positive attitude toward preeclampsia preventive measures one-month post-intervention in comparison to the pre-intervention implementation. There was a statistically significant relationship between knowledge, enabling, reinforcing factors score and practices scores of preeclampsia preventive measures throughout the intervention phases. **Conclusion:** It was concluded that implementing nursing intervention guided by PRECEDE model in high-risk pregnant women was effective in improving knowledge and practice regarding the prevention of preeclampsia. **Recommendation:** The nursing intervention guided by PRECEDE model regarding preeclampsia prevention should be integrated into the antenatal care for pregnant women in the study setting. Replication of the current study on a larger probability sample is recommended to achieve generalizability.

Keywords: Preeclampsia prevention, nursing intervention, Precede model, knowledge and preventive behavior, pregnant women.

Introduction:

Preeclampsia during pregnancy is considered one of the major obstetrical problems in developing countries that cause maternal mortality and preterm birth throughout the world. Preeclampsia is a pregnancy-specific syndrome characterized by hypertension and proteinuria that occurs after the 20th week of pregnancy for women with normal blood pressure and no protein in their urine in the past. 15.9% of cases deaths result from preeclampsia and the condition is also considered the main cause of prenatal mortality and morbidity. In Iranian, about one percent to eight percent of women suffer from preeclampsia (**Irion et al., 2017**).

World Health Organization reports indicated that every day, approximately 830 women die from preeclampsia in some developing countries. PE included early-onset and late-onset of the disease. The early onset PE is accompanied by fetal growth restriction (FGR), umbilical artery forms, and abnormal uterine and negative effects on maternal and neonatal outcomes. On the other hand, the late-onset of PE is associated with low maternal disease and a low in fetal involvement, and perinatal outcomes (**Alkema et al., 2016**).

Although preeclampsia affected a low percentage of pregnancies, it remains a leading cause of maternal morbidity and mortality. Hypertensive disorders are responsible for roughly 14% of pregnancy-related maternal deaths worldwide (**Say, 2014**) and about 7.4% of such deaths in the United States (**Centers for Disease Control and Prevention, 2017**) -and preeclampsia is the most common hypertensive disorder of pregnancy. Preeclampsia can affect virtually every organ system, putting the mother at risk for morbidities, causes

respiratory, cerebrovascular, cardiovascular, liver, kidney, uterine, and neurologic dysfunction (**Abalos, 2014**).

For infants exposed to preeclampsia in utero, preeclampsia-related morbidity is associated primarily with prematurity, though these infants tend to have an unfavorable cardiometabolic profile such as increased blood pressure, increased body mass index, and altered cardiac function and structure) among adolescence or adulthood women. No test can reliably predict preeclampsia and no known practices can prevent its occurrence. Clinical preeclampsia management is symptom-based, and the only known cure for preeclampsia is delivery (**Timpka, 2016**).

There are several risk factors associated with preeclampsia that can be assessed at or before 16 weeks' gestation such as the personal history of preeclampsia, prior placental abruption, prior fetal growth restriction, prior stillbirth, null parity, maternal age over 35 and over 40, overweight and increased BMI above 25 kg/m² and obesity above 30 kg/m², chronic hypertension, prepregnancy diabetes mellitus, chronic kidney disease, systemic lupus erythematosus, antiphospholipid antibody syndrome, assisted reproduction, and multifetal pregnancy (**Bartsch, 2016**).

Preeclampsia screening included identifying risk factors for preeclampsia before the development, maternal signs and symptoms indicative of preeclampsia widespread. Emerging screening tests are focusing on pathologies that are related to biomarkers present in maternal blood and placental development and perfusion (**Tsiakkas, 2016**). It was very important to screen for PE to know high-risk pregnancy and help in promoting care during the antenatal period and maintain

preventive management to minimize complications and deaths (**Rastegari et al., 2019**).

Antioxidants such as lutein may play a role in preeclampsia prevention and are considered potential preeclampsia prophylaxis (**Cohen, 2015**). In contrast, two studies found no benefit to routine antioxidant supplementation with vitamins C or E for this purpose, and the ACOG Task Force does not recommend routine use of either to prevent preeclampsia (**Rumbold, 2015**).

Early detection and prevention of preeclampsia (PE) are very important to avoid morbidity and mortality associated with them. Potential interventions for reducing the risk of preeclampsia include taking rest, dietary salt restriction, and calcium supplementation in pregnancy and prevent its complications and vitamin D supplementation (**Irion et al., 2017**).

Prevention of preeclampsia may be primary, secondary, or tertiary (**Alkema et al., 2016**). Primary prevention includes avoiding pregnancy in women at high risk for PE, improving women's nutrients intake, modifying their lifestyles to minimize the occurrence of the disease and reduce the stressors associated with these pregnancies and improve mental health in mothers with high-risk pregnancies (**Hadian et al., 2018**).

For women at high risk for preeclampsia, the use of low-dose aspirin started at or before 16 weeks gestation is believed to target placental pathology by balancing the endothelial products prostacyclin, a vasodilator, and thromboxane, a vasoconstrictor that induces platelet aggregation (**Mone, 2016**).

Secondary prevention is based on the interruption of known pathophysiological mechanisms of the disease before its establishment. Recent efforts have focused on the selection of high-risk women and have proposed an effective intervention, as early as it is possible, to avoid the disease or its severe complications because it helps indicate that prenatal outcomes improve with expected management (**Poon & Sahota, 2019**). Tertiary prevention relies on using treatment to avoid PE complications. Magnesium sulfate can reduce the rate of PE, but 71% of pregnant women needed to be treated to prevent eclampsia. Therefore, tertiary prevention can be difficult to achieve if women exposing to unnecessary risks, so that the provision of care can lead to decrease premature birth and hospitalization costs in a low birth-weight neonate due to high-risk pregnancy (**Ichikawa K, et al., 2015**).

At present PRECEDE model is considered one of the most important and applicable theories (**Didehvar et al., 2016**). It can be used to design and evaluate a health promotion plan. The PRECEDE component allows the researchers to work backward from the goal of the research to create a project to instruct the formation of the educational intervention. PRECEDE stands for Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation. In studies conducted by **Hosseini et al., (2014)** and **Hazavei et al., (2012)** they have reported and approved the efficiency of this model and obtained acceptable educational results. Moreover, the PRECEDE model has been recognized as an effective method for creating and providing the phases which are necessary for improving health.

Nurses play an important role in preeclampsia management which includes

providing guidance and teach women regarding evidence-based approaches for minimizing preeclampsia risk. Encouraging all women during pregnancy to plan and work toward achieving a healthy body weight and consume a healthy diet with recommended nutrients. Providing guidance regarding limit foods with added sugars and those that are high in fat and eat a variety of fruits, grains, vegetables, low-fat or fat-free dairy, and proteins, avoiding such sources of mercury as shark, swordfish, mackerel, and tilefish, and limiting the consumption of another source, tuna, to less than six ounces per week (Black, 2014).

Nurses can help in preeclampsia risk identification through the collection of demographic information and comprehensive personal and family history. Nurses also, play a key role in teaching pregnant women about these subjective warning signs and identification of warning signs of preeclampsia can occur during the second half of pregnancy and in the postpartum period such as headache, right upper quadrant epigastric pain, nausea, visual changes, difficulty breathing, and swelling in areas such as the face or hands. Measurement of blood pressure and changes in body weight may indicate fluid imbalance associated with generalized edema. Maternal assessment includes evaluation of subjective symptoms, serial blood pressure measurement, physical assessment, and laboratory analyses to guide intervention (American College of Obstetricians and Gynecologists, 2017).

Aim of the study

The study aimed to evaluate the effect of nursing intervention guided by PRECEDE model on knowledge and practice of preventive behavior of high-

risk pregnant women regarding preeclampsia.

Research Hypotheses:

Hypothesis (1): pregnant women's knowledge regarding preeclampsia will be enhanced after the application of nursing Intervention guided by PRECEDE model than before.

Hypothesis (1): pregnant women's practice of preeclampsia prevention will be improved after the application of nursing Intervention guided by PRECEDE model than before.

Subjects and Methods:

Research design:

A quasi-experimental research design pre-post-test was used in this study. Quasi-experimental research is a prospective or retrospective study in which patients self-select or are selected into one of some different treatment groups to compare the real effectiveness and safety of non-randomized treatments (Maciejewski, 2020).

Setting:

The study was applied in the antenatal outpatients' clinics at Sohag and Tanta University Hospitals, Egypt, which is located on the ground floor of the outpatient building. They consist of five rooms for sonar, antenatal examination, gynecological examination, lab, and nursing staff. Also, there was a waiting area for women and a lecture room which included an adequate number of seats, and data show where the researchers interviewed the recruited pregnant women to conduct this study. The antenatal outpatients' clinics provide diagnostic and therapeutic services for

pregnant women from Saturday to Wednesday, from 9 a.m. to 1 p.m.

Subjects

Sample type: A Purposive sample was used.

Sample size:

It was included 120 pregnant women were recruited from the mentioned settings, who attended the antenatal outpatient clinics at Sohag and Tanta University Hospital.

Sample size calculation:

Sample size was calculated based on considering level of significance of 5%, study power of 80%, and by using the following formula: $n = [2(Z \alpha/2 + Z \beta) \sqrt{p(1-p)}] / (p_1 - p_2)^2$, Type of test = two-sided where n = sample size required, p = pooled proportion of event, $p_1 - p_2$ = difference in proportion of event, $Z \alpha/2$: This depends on level of significance, for 5% this is 1.96, $Z \beta$: This depends on power, for 80% this is 0.84, $n = [2(1.96 + 0.84) \sqrt{0.55(1-0.55)}] / (0.2)^2 = 97$. Based on the previously mentioned formula, 120 pregnant women were recruited.

Inclusion criteria included:

High-risk pregnant women: have hypertension before pregnancy, have a previous history of preeclampsia, have a family history of preeclampsia, and agree to participate in this study.

Exclusion criteria included:

Pregnant women suffering from mental and chronic diseases like heart disease, gestational diabetes were excluded from the study.

Tools of data collection:

Three tools were used to collect the data of the study as the following:

Tool I: Structured interviewing questionnaire: it was developed by researchers and consisted of two parts as follow:

Part (1): It included demographic data of the pregnant women such as age, educational level, occupation, and residence.

Part (2): It included the obstetrical history of pregnant women; it contained three questions about the gravida, parity, and gestational age.

Tool II: Predisposing, Enabling, and Reinforcing Questionnaire:

(PRECEDE **Model questionnaire**): it was developed by researchers after reviewing the literature (**Green & Kreuter, 2005**) and based on the educational and ecological approach of PRECEDE model. It included the following Parts:

Part I: Predisposing factor which included pregnant women's knowledge regarding preeclampsia: it was developed by the researchers after an extensive reviewing of the related literature to identify the level of pregnant women's knowledge regarding preeclampsia and their source of information. It included 6 questions about the definition of preeclampsia, risk factors, symptoms, complications, and management & prevention.

Scoring system:

The scoring system was calculated as: (2) for the "correct" answer and (0) for the "incorrect" answer. The total score

ranges from 0 – 12, a higher score indicates good knowledge. It was categorized for each woman into "good, fair and poor knowledge" as follows: poor<50 %. Fair was from 50% to 75 %, and good>75 %.

Part II: Enabling factors assessment: It included 3 questions as do you previously receive an educational program regarding preeclampsia, do you know available resources and facilities for preeclampsia prevention and management. Do you have easy access to healthcare facilities? Scores were given in the following way: A response of "Yes" to each question was given one score and a response of "No" to questions received no score.

Part III: Reinforcing factors assessment: It included two questions as do you have emotional support from your family? Will you have support from family and your health care provider in implementing preeclampsia preventive behavior? Scores were given in the following way: A response of "Yes" to each question was given one score and a response of "No" to questions received no score.

Tool III: Pregnant women's reported practices of preeclampsia preventive behavior (pre-post tool); it included ten questions to assess the pregnant women's practices as: Do you have rest during the day?, Do you practice exercise at least 30 minutes daily (walking)?, Do you consume recommended diet for preeclampsia prevention (high protein, low salt, low-fat diet)? Do you consume calcium and vitamin D supplementation during pregnancy? Do you engage in activities that make you relax (watching TV)?, Do you measure your blood pressure frequently?, Do you check your urine for protein and your weight frequently?, Do

you follow the medication regimen as prescribed? Do you have regular follow up with your physician?, Do you take enough sleep (8 hours or more per day)?.

Scoring system:

The scoring system was calculated as: (0) for "no", and (1) for "yes". The questionnaire was evaluated giving a score of 0 – 10. The total score of each woman was categorized into "good and bad practices" as follows: bad< 50% and good >50%.

Tool IV: Pregnant women attitude questionnaire regarding preeclampsia prevention was developed by the researchers. It included 5 questions: Do you think that stress may cause preeclampsia? Do you think that a high salt diet may cause preeclampsia? Do you think that exercise may cause preeclampsia? Do you think obesity may cause preeclampsia? Do you think that regular medical follow-up is important? and is divided into 3 score (neutral =0 ,disagree =1, and agree = 2) . A total score equal 10. Total attitude scores ≥ 5 considered positive attitude, score less than 5 considered negative attitude.

Validity and reliability of the tools:

The content validity was tested for clarity, comprehensiveness, appropriateness, and reviewed by five experts in the obstetrics and gynecology nursing field and the community health nursing field. No modifications were done. The reliability of the tools was assessed through Cronbach's alpha test was $\alpha= 0. 891$ for the first tool, $\alpha= 0. 822$ for the second tool, $\alpha=0.751$ for the third tool, and $\alpha=0.751$ for the fourth tool.

Pilot study

A pilot study was carried out on 10% of the sample (12) pregnant women to observe the clarity and testing of the feasibility of the research process. No modifications were done. Pregnant women involved in the pilot study were included in the study.

Ethical considerations:

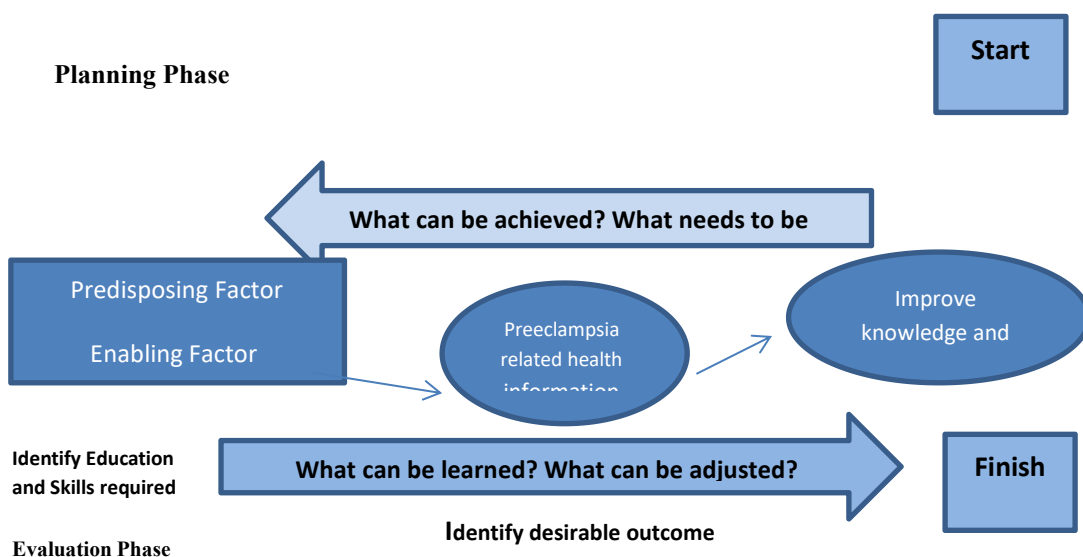
Before starting the research, ethical approval was obtained from the scientific research ethics committees of the faculties of nursing, Sohag, and Tanta Universities. The researchers met both medical and nursing directors of the selected settings to clarify the purpose of the study and take their approval. Written consent was obtained from the pregnant women to participate in the study after the objective of the study was explained to them. The researchers informed the pregnant women that, the study was voluntary, they were allowed not to participate and they had the right to withdraw from the study at any time, without giving any reason. Moreover,

they were assured that their information would be confidential.

Field Work:

The study was carried out in the period from August to December 2020. The researchers attended the previously mentioned setting three days per week, (Saturday, Sunday, and Monday); from 9 a.m. to 11 p.m. until the researchers completed the sample size of women. It included the application of nursing intervention guided by PRECEDE model with focusing on predisposing factors included knowledge, regarding preeclampsia. Enabling factors are identified as those that assist the progress of the performance of the health action such as resources and supportive approaches that are vital to conducting behavior. In this study, the enabling factors are knowledge regarding available health facilities and informational resources (Educational sessions and Booklet), the reinforcing factors are comprised of support from family and health workers.

Figure 1: Application of PRECEDE model for improving knowledge and Practice of preventive behavior regarding Preeclampsia



Application of nursing intervention guided by precede model: was done through the following phases:

A-Preparatory phase:

Contents of the educational sessions guided by PRECEDE model about preeclampsia were designed. Several methods of teaching were used (videos, attractive pictures, and booklet) were prepared. Booklet was written in Arabic language, covered all contents of the sessions, printed out regarding the sample size, and given to them.

B-Assessment phase:

Data was collected by all the researchers and they introduced themselves to the pregnant women. Clear and simple explanations about the aim and nature of the study were discussed by the researchers with pregnant women. The structured interviewing questionnaire was used to collect pregnant women's characteristics.

During this phase, pregnant women's predisposing factor, enabling factor, reinforcing factors were assessed based on Predisposing, Enabling, and Reinforcing Questionnaires (PRECEDE Model questionnaire). The practice of preventive behavior regarding preeclampsia was assessed by using pregnant women's reported practices of preeclampsia preventive behavior tool and also the attitude towards preeclampsia by using attitude questionnaire regarding preeclampsia prevention as a pretest. The questionnaires were distributed to pregnant women and collected after filling.

Implementation phase:

Two educational sessions regarding preeclampsia based on PRECEDE model were given to pregnant women. One theoretical and one practical session were provided to them in twelve groups of 11–12 pregnant women, one session every two weeks for four weeks at the lecture's room at the antenatal outpatient clinics of Sohag and Tanta University Hospitals in the form of lectures and group discussion with a duration of 45 - 60 minutes for each session. In the 1st session, the definition of preeclampsia, risk factors, symptoms, complications, and management & prevention were discussed. Also education regarding enabling factor which included education regarding resources and supportive approaches that are vital to conducting behavior and reinforcing factor which included the importance of support from family and health provider. While the 2nd session was concerned with the discussion of pregnant women's practices of preventive behavior about preeclampsia such as taking rest during the day, dietary salt restriction, calcium, and vitamin D supplementation during pregnancy. Practice exercise at least 30 minutes daily, Engage in activities that make relaxation (watching TV), Follow the medication regimen as prescribed by a physician, regular follow up with a physician, Taking enough sleep (8 hours or more per day). Pregnant women training on self-monitoring of blood pressure, self-measuring body weight, checking protein in urine were done. Prepared videos and attractive pictures were presented. At the end of each session, the important points were reviewed. The educational sessions were repeated to each group of women. Each pregnant woman was provided with the educational booklet at the end of the 1st session as a guide and was informed about the time of the next session.

The Evaluation phase:

The effect of the nursing intervention guided by precede model was evaluated immediately and after one month of implementation phase using the same Tool II, III, and IV.

Administrative design:

An Approval was obtained from the deans of faculties of nursing and the directors of antenatal outpatient clinics at Sohag and Tanta University Hospitals to carry out this study.

Statistical Analysis:

Statistical Package for Social Sciences (SPSS) version 21 was used for statistical analysis of the obtained data. Data presented using descriptive measures in the form of a number, percentage, mean and standard deviation. Chi-square test used for the differences between variables pre and post-intervention. Pearson correlation test was used to the association between variables. The Cronbach's alpha was used to assess the reliability of the second, third and fourth tool.

Results:

Table (1): Represented that 80% of pregnant women their age ranged between $18 < 30$ years with mean \pm SD 22.12 ± 4.57 , (35%) of them had basic education, meanwhile, and also, it is pointed out that 73% of pregnant women were not working.

Figure (1): Demonstrated that (73%) of pregnant women lived in rural areas and 27% of them were from urban areas.

Table 2 presented the obstetric history of the studied pregnant women, It

was noticed that (59%) of the pregnant women were multigravida and (53%) were multipara. 51% of the women were between 20 weeks and 25 weeks and 49% of them were between more than 25 weeks to 30 weeks.

Figure (2) highlighted that the majority common source of information among the studied pregnant women was doctors (60%)

Table (3): Revealed that, the mean knowledge, enabling, and reinforcing factors score regarding preeclampsia was decreased pre-nursing intervention implementation. While there was an increase in the mean score of knowledge, enabling and reinforcing factors score with statistical significance immediately and after one month of nursing intervention implementation.

Figure (3) clarified that the preeclampsia preventive behavior total practices score of the pregnant women pre and one-month post-intervention. It observed that most of the pregnant women (93%) had bad practices toward preeclampsia prevention pre-intervention and decreased to become 10% one-month post-intervention. Reversely, 7% of the pregnant women had good practices toward preeclampsia prevention pre-intervention in comparison to 90 % one-month post-intervention.

Figure (4) clarified that the total attitude scores of the pregnant women regarding preeclampsia prevention pre and one-month post-intervention. It observed that 67% of pregnant women had a negative attitude toward preeclampsia prevention pre-intervention and decreased to become 17% one-month post-intervention. Reversely, 33% of the pregnant women had a positive attitude toward preeclampsia prevention pre-intervention in comparison to 83 % one-month post-intervention.

Table (4): Showed that there was a statistically significant relationship between knowledge, enabling factors, and reinforcing factors score and preeclampsia preventive behavior practices scores of the pregnant women throughout the intervention phases.

Table (1): Distribution of studied pregnant women according to their demographic characteristics (n=120)

Items	No.	%
Age in years		
18 < 30	96	80
30 < 40	24	20
Mean ± Stander deviation	22.12 ± 4.57	
Educational level		
- Illiterate	17	14
- Basic education	42	35
- Secondary education	28	23
- University education	33	28
Occupation		
- Working	32	27
- Not working	88	73

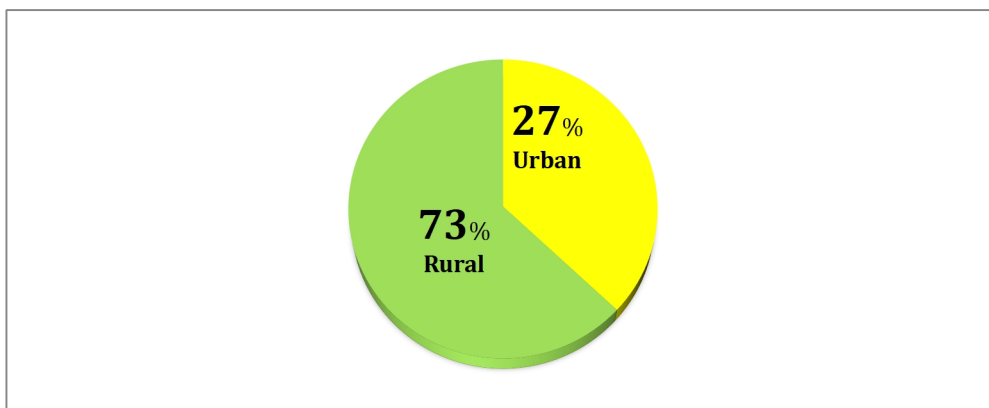


Figure (1): Distribution of studied pregnant women according to their residence (n=120).

Table (2): Distribution of pregnant women according to their obstetric history (n=120)

Items	No.	%
Gravida		
- Primigravida	49	41
- Multigravida	71	59
Parity		
- Nullipara	32	27
- Primipara	24	20
- Multipara	64	53
Gestational age		
- 20-25	61	51
- 25-30	59	49

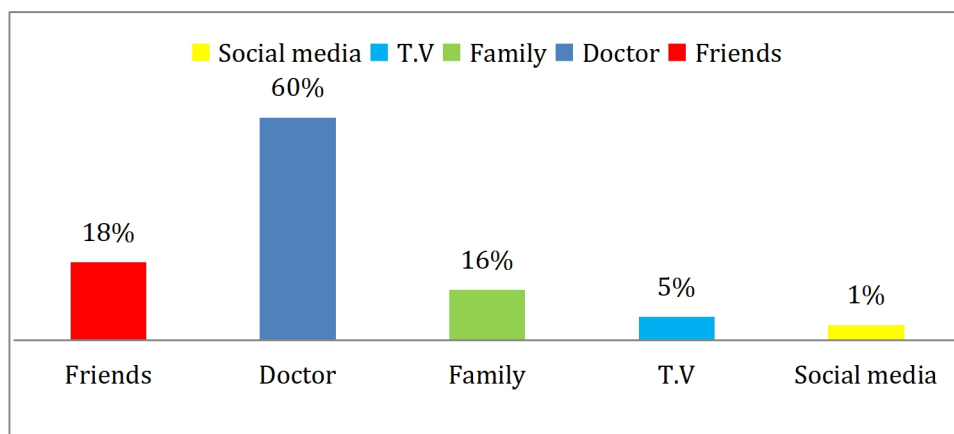


Figure (2): Percentage distribution of studied pregnant women according to their source of information about preeclampsia (n=120)

Table (3) Comparison between the mean score of studied pregnant women related to their knowledge about preeclampsia, enabling factor and reinforcing factor pre, immediately, and after one month of nursing intervention implementation (n=120).

Variable	Pre-intervention strategy Mean \pm SD	Immediately after intervention strategy	After the one-month post-intervention strategy Mean \pm SD	Paired t-test	P-value
Knowledge (Predisposing Factor)	.52 \pm .42	1.95 \pm .52	1.82 \pm .41	16.1	<0.001
Definition of preeclampsia	.62 \pm .45	1.65 \pm .45	1.46 \pm .32	17.2	<0.001
Risk factors	.44 \pm .63	1.38 \pm .27	1.28 \pm .24	12.03	<0.001
Symptoms	.73 \pm .51	1.77 \pm .36	1.57 \pm .31	14.2	<0.001
Complications	.73 \pm .23	1.15 \pm .37	1.12 \pm .34	63.2	<0.001
Management	.54 \pm .61	1.67 \pm .34	1.57 \pm .30	12.2	<0.001
Prevention	.34 \pm .51	1.76 \pm .23	1.70 \pm .20	11.1	<0.001
Enabling factors	.53 \pm .42	1.41 \pm .39	1.38 \pm .27	9.03	<0.009
Reinforcing factor	.74 \pm .61	1.57 \pm .24	1.96 \pm .43	10.2	<0.001

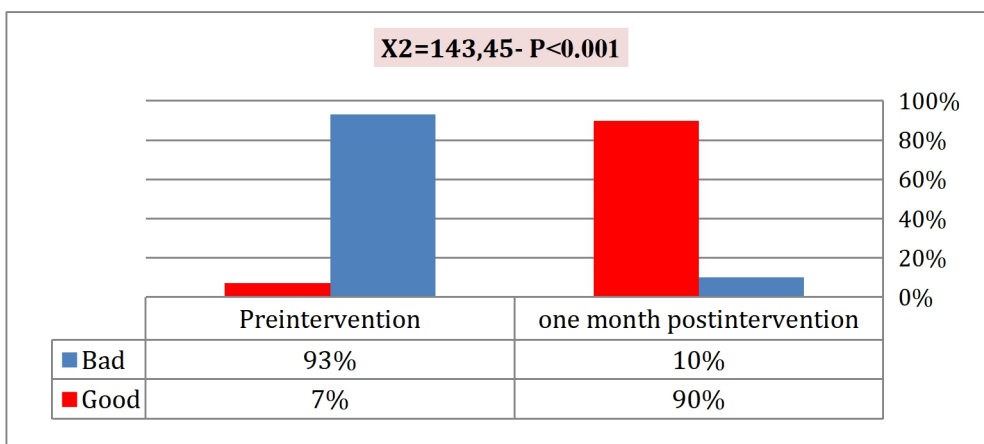


Figure (3): The practices score of preeclampsia preventive behavior of the studied pregnant women pre and one-month post-nursing intervention implementation (n=120).

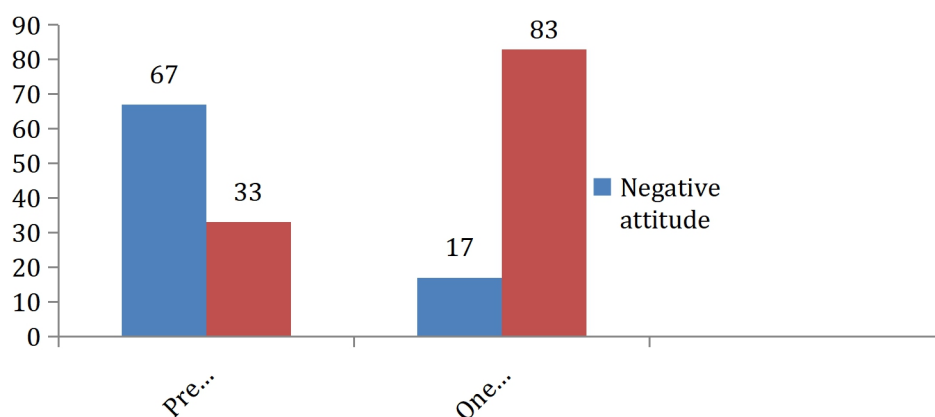


Figure 4: Attitude of pregnant women regarding prevention of preeclampsia

Table (4): Correlation between total knowledge, enabling factors, and reinforcing factors and preventive behavior practices scores of the studied pregnant women regarding preeclampsia pre and after one month of nursing intervention strategy implementation (n=120).

Knowledge,	Practice Pre		Post	
	r	p	r	p
Pre	0.42	0.47*		
Post			0.87	0.001*

Statistically significant at $p<0.01$

Discussion:

Pre-eclampsia is considered a major problem, especially in developing countries because of the increasing maternal mortality and morbidity rate (Serra, et al., 2020). The results demonstrated that PRECEDE model-based educational intervention was very effective in improving the pregnant women's knowledge and, preventive behavior, enabling and reinforcing factors score regarding preeclampsia. So, the researchers have conducted this study to evaluate the effect of nursing intervention guided by precede model on knowledge and practice of preventive behavior of high-risk pregnant women regarding preeclampsia

The results of the present study indicated that less than three-quarters of pregnant women lived in rural areas. This may be one of the causes of knowledge deficit and resource deficiency in rural areas less than urban areas.

The results of the present study highlighted that the majority common source of information among pregnant women was doctors. This is reflected the importance of medical advice to maintain health.

The results of the present study revealed that the mean knowledge, enabling, and reinforcing factors score regarding preeclampsia was increased in the mean score of knowledge, enabling, and reinforcing factors scores with statistical significance immediately and after one month of nursing intervention implementation. This is confirmed the positive effect of providing the intervention based on precede model.

These findings match with results in a study conducted by Neer et al., (2013), about " Dosage Effect of Prenatal

Home Visiting on Pregnancy Outcomes in At-Risk, First-Time Mothers" and reported that implementation of these model, is an efficient solution for promoting pregnancy outcomes, mother and fetus health through improving awareness of the mother and providing accessible health care.

Also, these findings are in the line with a study conducted by Wallis et al., (2013), who studied the effect of prenatal education on improved outcomes among pregnant women with hypertensive disorders during pregnancy and reported that sufficient knowledge about any problem during pregnancy allows pregnant women to detect any signs and symptoms that leading to early disease diagnosis and management, which may prevent complications and reduce morbidity and mortality. This result is supported by John & Kibusi, (2020), in East African who revealed in their study about "Knowledge on Prevention and Management of Preeclampsia and Eclampsia among Nurses in Primary Health Settings" that education helps in the early prevention of pre-eclampsia and is managed to promote maternal and neonatal health.

These results are supported by Briceno et al., (2019) that conducted a study about "Prediction and prevention of preeclampsia," and found that preeclampsia prevention is dependent on primary interventions to prevent complications.

Similarly, Masoumeh and Hamzeh, (2019) who studied "Effect of Self-care Before and During Pregnancy to Prevention and Control Preeclampsia in High-risk Women" and found that counseling, screening, health promotion, and self-care training are effective in the prevention and control of preeclampsia in women at high risk for preeclampsia.

Also, the findings of the present study are supported by the aim and hypothesis of the current study and also, with the study conducted by (Costa et al., 2011) who done a study titling with Early screening for preeclampsia and noticed that prevention of preeclampsia is more likely to be successful by identifying women at high risk and scheduling them to proper antenatal care. Efforts should be made to find earlier PE predictors to institute interventions before 16 weeks.

The results of the present study clarified that the preeclampsia preventive behavior total practices score of the pregnant women pre and one-month post-intervention had improved to good practices most pregnant women. This reflects the importance and effectiveness of introducing education through PRECEDE Mode that commonly associated with improving practice.

The results of the present study indicated that the majority of the pregnant women had a positive attitude toward preeclampsia prevention one-month post-intervention. This result is in the same line with Ranjbaran et al., (2015) who conducted a study about Sleep Quality Improving among Patients after Coronary Artery Bypass Graft Surgery through Intervention Study Using the PRECEDE Mode and found that education through PRECEDE Model improves their knowledge that leads to a positive attitude toward the disease.

The results of the present study revealed that there was a statistically significant relationship between knowledge, enabling factors, and reinforcing factors score and preeclampsia preventive behavior practices scores of the pregnant women throughout the intervention phases. These findings agree with, Farbod et al., (2017) who studied the effect of intervention

using the PRECEDE model based on the quality of life in diabetic patients and showed that the mean score of enabling and reinforcing factors significantly increased in the intervention group compared to the control group. These findings are also, similar to Solhi et al., (2016), Ranjbaran et al., (2015), Sabzmakan et al., (2010), and Dizaj et al., (2014) who reported that implementing intervention using the PRECEDE model could increase enabling and reinforcing factors.

Similarly, Mazloomi, et al., (2014) found that implementing intervention based on the PRECEDE model improves the quality of life. Another study done by Gielen et al., (2008) showed that the preceding model can be effective in improving knowledge among heart patients. Also, Oruoij et al., (2012) reported that the precede model was effective in promoting the preventive behaviors for type 2 DM in high-risk individuals.

Conclusion:

Depend on the results of the current study, it was concluded that implementing nursing intervention guided by PRECEDE model in high-risk pregnant women was effective in improving their knowledge and practice regarding the prevention of preeclampsia.

Recommendations:

In the light of the study's findings, the researchers are recommended that:

1- The nursing intervention guided by PRECEDE model regarding preeclampsia prevention should be integrated into the antenatal care for pregnant women in the study setting.

2- Continuous health education programs to pregnant women regarding preeclampsia can help in providing continuous support and early detection of preeclampsia during pregnancy.

3- Further research should focus on replication of the current study on a larger probability sample is recommended to achieve generalizability.

Conflict of interest

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