

## Effect of Intervention PRECEDE Model on Knowledge and Practice of Preventive Behaviors among High-Risk Pregnant Women regarding Gestational Diabetes

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### Abstract

Because of its high prevalence and possible problems for pregnant women and their offspring, gestational diabetes is a global health concern. As a result, patient education is one of the most important factors in increasing women's knowledge and habits. Early detection of high-risk factors for gestational diabetes can be prevented by educational programs designed and implemented to decrease the high prevalence and prevent complications. **Aim:** To evaluate the effect of intervention PRECEDE model on knowledge and practice of preventive behaviors among high-risk pregnant women regarding gestational diabetes. **Subjects and method: Design:** Quasi-experimental research design pre-post-test was used to achieve the aim of this study. **Settings:** The study was applied in the antenatal outpatient clinics at Beni-Suef University Hospitals. **Sample:** A purposive sample of 200 pregnant women diagnosed as high-risk for gestational diabetes was recruited from the selected settings. **Tools:** Four tools were used: (1) a Structured interviewing questionnaire, (2) Predisposing, Enabling, and Reinforcing Questionnaire (PRECEDE model questionnaire), (3) a High-risk pregnant women's reported practices questionnaire of gestational diabetes preventive behavior, and (4) High-risk pregnant women's attitude questionnaire regarding gestational diabetes prevention. **Results:** The current results revealed that the mean score of knowledge, enabling factors, and reinforcing factors have been increased with statistical significance immediately and after one month of the intervention. High-risk pregnant women had adequate practices toward gestational diabetes preventive measures one-month post-intervention compared to pre-intervention. High-risk pregnant women had a positive attitude toward gestational diabetes preventive measures one-month post-intervention compared to pre-intervention. There was a statistically significant relationship between knowledge, enabling, reinforcing factors scores, and practices scores of gestational diabetes preventive measures throughout the intervention phases. **Conclusion:** It was concluded that implementing intervention based on PRECEDE model for high-risk pregnant women was effective in improving knowledge and practice regarding the prevention of gestational diabetes. **Recommendation:** The intervention based on PRECEDE model regarding gestational diabetes prevention should be integrated into the antenatal care for pregnant women in the different study settings.

**Keywords:** Intervention, Gestational diabetes, PRECEDE model, Knowledge and preventive behavior, Pregnant women.

### Introduction:

Gestational diabetes mellitus (GDM) is a type of glucose intolerance that develops during pregnancy and normally goes away after the baby is born (Brown et al., 2017). It is diagnosed during pregnancy that does not type 1 or 2 diabetes. It is diagnosed in the second or third trimester. It is a common medical complication in pregnancy that has been

rapidly increasing worldwide (American Diabetes Association, 2020).

GDM refers to a high blood sugar level that is primarily diagnosed during pregnancy which leads to severe maternal and fetal complications. Maternal complications as preeclampsia, premature membrane rupture, preterm delivery, cesarean section, and polyhydramnios. Fetal complications as fetal macrosomia, damage during delivery including dislocation of the shoulder, bone fractures,

nerve paralysis, low birth weight, and fetal metabolic disorders (**Hedayati et al., 2019**).

According to the most recent International Diabetes Federation (IDF) estimates, GDM affects about 14% of pregnancies worldwide, or about 18 million births each year. (**Knowler et al, 2018**). The frequency of GDM (5.1–37.7%) in Arab Gulf countries is among the highest in the world, and it is still on the rise. Egypt, like most other nations, has a wide range of GDM prevalence reports. The frequency of GDM was determined to be 8% in 250 pregnant women who visited a rural family health clinic in Egypt (**Agarwal M., 2020**).

Overweight/obesity, westernized diet and micronutrient deficiencies, advanced maternal age, and a family history of insulin resistance and/or diabetes are all risk factors for GDM (**Natamba et al, 2019**). Diabetes increases the risk for both the mother and the fetus during pregnancy. Spontaneous abortion, fetal abnormalities, preeclampsia, fetal mortality, macrosomia, neonatal hypoglycemia, and neonatal hyperbilirubinemia are all dangers of uncontrolled diabetes in pregnancy. Furthermore, diabetes during pregnancy has been linked to an increased incidence of obesity and type 2 diabetes in offspring (**Alejandro et al, 2020**).

During pregnancy, women with GDM are more likely to develop high blood pressure or pre-eclampsia, have their labor induced, give birth by cesarean section, and experience perineal trauma. Their children are more likely to be admitted to the neonatal intensive care unit. In addition, they are more likely to develop metabolic syndrome as children and later in life (**Brown et al, 2017**).

A healthy diet, physical activity, and self-monitoring of blood glucose concentrations are the most popular lifestyle modifications used as a major therapeutic method (**Abha et al, 2020**).

Early detection of high-risk factors for diabetes can be prevented by informative programs designed and implemented to decrease the high prevalence and prevent complications. The main method of control is the prevention of its occurrence in high-risk individuals by enhancing their knowledge and

understanding of the predisposing factors, complications, and course of the disease (**Zareban et al., 2019**).

The PRECEDE (Predisposing, Reinforcing, Enabling, Causes in Educational Diagnosis, and Evaluation) model developed by Green and Kreuter is one of the different educational models that focus on factors influencing health-related behavior, based on the relationship between the health professional and the patient, and is particularly appropriate for application in chronic diseases (**Green & Kreuter, 2005**). The efficiency of the PRECEDE model has been proven in different studies in the health environment, such as improving care habits among asthmatic children and improving medication adherence in patients with a chronic disease; however, it has rarely been used in DM2 (**American Diabetes Association, 2020**).

The PRECEDE –proceed model is among the models used for programming behavioral changes. This model was first introduced by Green et al. in 1970 and titled the preceding model. The PRECEDE –proceed model has specific phases as other programming models. As researchers gained more knowledge of and experience in using it, this model underwent some modifications. In 2005, Green and Kreuter introduced the latest modified version of the precede–proceed model containing four phases of programming, one phase of implementation, and three phases of assessment as follows: social assessment, epidemiological assessment, behavioral and environmental assessments, educational and ecological assessments, management and political assessments, program implementation, assessment of the process, assessment of the effect, and assessment of the outcome. This model determines the factors affecting health status and helps the policymakers achieve the program goals (**Green & Kreuter, 2005**). 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)** 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 equipping pregnant women with the proper knowledge to mitigate their risk of developing GDM or the associated complications is critical. Nurses should assess the pregnant women's knowledge related to GDM care and provide education regarding dietary intake (such as limiting carbohydrate intake), exercise, and medications since these factors influence blood glucose levels. While providing pregnant women education, the nurse should also assess for any potential barriers such as limited access to healthy foods in the community, limited income, or language barriers (**International Weight Management in Pregnancy, 2017**). Nurses are also responsible for teaching certain skills such as conducting self-monitoring of blood glucose and how administering insulin injections. Furthermore, the nurse should encourage pregnant women's self-monitoring of blood glucose, and improve their health in the fight against pregnancy obesity and GDM. Also, nurses help in 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 (**Laredo-Aguilera et al, 2020**).

#### **Significance of study:**

GDM is the most important health-related concern in pregnancy in the 21<sup>st</sup> century. In latest years, the occurrence of GDM has expanded around the world, with its incidence varying from 1.4% to 18.5% in different countries. GDM affects approximately 6% of pregnancies in the United States, and it is increasing in prevalence (**Mirfeizi, et al, 2019**)

Maternal and neonatal outcomes such as macrosomia, increased cesarean section, hypertension, fetal hyperinsulinemia, preterm labor, shoulder dystocia, birth defects, need for neonatal intensive care unit care, hyperbilirubinemia, and preeclampsia are all

linked to gestational diabetes mellitus, but it also increases the risk of long-term problems in the mother and infant (**Nasiri et al, 2020**).

However, it is now widely recognized that exercise has numerous benefits for both the fetus and the mother. A reduction in cramps, lower back discomfort, edema, depression, urine incontinence, labor duration, and constipation, as well as the mother's number of cesarean sections, are among the maternal benefits. Physical activity provides several advantages for the fetus, including reduced fat mass, increased stress tolerance, and faster neurobehavioral maturation (**Laredo-Aguilera, et al, 2020**). As a result, the researchers are interested to evaluate the effect of intervention PRECEDE model on knowledge and practice of preventive behaviors among high-risk pregnant women regarding gestational diabetes

#### **Operational definitions:**

##### **Precede**

It refers to Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation.

##### **Predisposing factors:**

They included some characteristics or socioeconomic situations that put an individual at risk of developing a disease or disorder. Educational intervention can affect some of the predisposing factors which include: knowledge, attitude, self-efficacy, and self-care.

##### **Enabling factors**

They mean the availability and accessibility of resources and skills.

##### **Reinforcing factors**

They included the attitudes of influential people (family, friends, peers, healthcare providers, media, teachers, community leaders, policymakers, etc.) who influence adopting healthy behaviors. An intervention may aim the influential people to successfully reach the actual target group.

##### **PRECEDE-PROCEED model:**

According to this model, there are two categories of enabling resources that affect the use of health services which include community and personal enabling resources.

## Aim of the study

The study aimed to evaluate the effect of intervention PRECEDE model on knowledge and practice of preventive behaviors among high-risk pregnant women regarding gestational diabetes.

## Research Hypotheses:

Hypothesis (1): High-risk pregnant women's knowledge regarding gestational diabetes will be enhanced after the intervention based on PRECEDE model than before.

Hypothesis (2): High-risk pregnant women's practices toward the gestational diabetes prevention will be improved after the intervention based on PRECEDE model than before.

## Subjects and Methods:

### Research design:

A Quasi-experimental research design pre-post-test was used to achieve the aim of this 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 outpatient clinics at Beni-Suef University Hospitals, Egypt, which is located on the first floor of the hospital. 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 that 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:

A purposive sample of 200 pregnant women who were diagnosed as high-risk for gestational diabetes was recruited from the selected settings.

## Sample size calculation:

The sample size was calculated using the Epi info program with a population size of 395 people and a 95 percent confidence coefficient, 10% tolerable error, Based on the previously mentioned formula, 200 high-risk individuals were recruited.

## Inclusion criteria included:

High-risk pregnant women: who are diagnosed as high-risk for gestational diabetes as (excessive thirsty, polyuria, fatigue, rapid abdominal distention, and vaginitis), aged from  $\geq 18$ -  $\leq 40$ , more than 24 weeks of gestation have a family history of gestational diabetes and agree to participate in this study.

## Exclusion criteria included:

Pregnant women suffering from mental and chronic diseases were excluded from the study.

## Tools of data collection:

Four tools were used to collect the data for the study as the following:

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

**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 high-risk pregnant women's knowledge regarding gestational diabetes:** it was developed by the researchers after an extensive review of the related literature to identify the level of pregnant women's

knowledge regarding gestational diabetes and their source of information. It included six questions about the definition of gestational diabetes, 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 – to 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 do you previously receive an educational program regarding gestational diabetes, do you know available resources and facilities for gestational diabetes prevention and management. Do you have easy access to healthcare facilities?

#### Scoring system:

Scores were given in the following way: A response of "Yes" to each question was given one score and response of "No" to questions received no score.

**Part III: Reinforcing factors assessment:** It included two questions do you have emotional support from your family? Will you have support from your family and your health care provider in implementing gestational diabetes preventive behavior?

#### Scoring system:

Scores were given in the following way: A response of "Yes" to each question was given one score and response of "No" to questions received no score.

**Tool III: High-risk pregnant women's reported practices of gestational diabetes preventive behavior (Abha et al., 2020; Agarwal & Mukesh (2020); (pre-post tool);** it included ten questions to assess the pregnant women's practices such as Do you have rest during the day?, Do you practice exercise at least 30 minutes daily (walking)?, Do you consume recommended diet for gestational diabetes prevention (low-carbohydrate diet, eating fruits and vegetables) 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 sugar 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 "adequate and inadequate practices" as follows: inadequate < 50% and adequate >50%.

**Tool IV: High-risk pregnant women attitude Scale regarding gestational diabetes prevention was developed by the researchers (American Diabetes Association, 2020).** It included 5 questions: Do you think that stress may cause gestational diabetes? Do you think that a high carbohydrate diet may cause gestational diabetes? Do you think that exercise may cause gestational diabetes? Do you think obesity may cause gestational diabetes? 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 equals 10. Total attitude scores  $\geq 5$  are considered a positive attitude and a score less than 5 is considered a negative attitude.

#### Validity and reliability of the tools:

The content validity was tested for clarity, comprehensiveness, appropriateness, and reviewed by five experts, three experts in the obstetrics and gynecology nursing field and two experts in the community health nursing field. No modifications were done. The reliability of the tools was assessed through Cronbach's alpha test was  $\alpha= 0.881$  for the first tool,  $\alpha= 0.87$  for the second tool,  $\alpha=0.89$  for the third tool, and  $\alpha=0.76$  for the fourth tool.

#### Pilot study

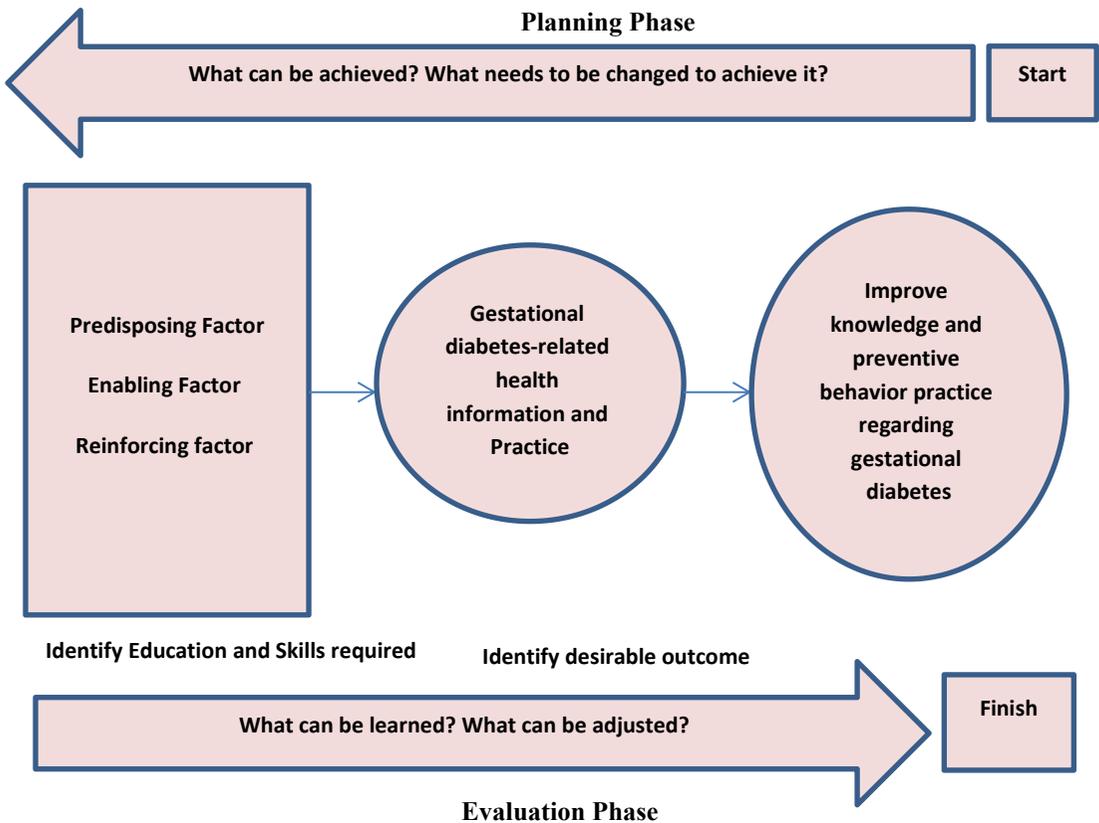
A pilot study was carried out on 10% of the sample (20) high-risk pregnant women to observe the clarity and testing of the feasibility of the research process. No modifications were done. High-risk pregnant women involved in the pilot study were excluded from the study.

#### Ethical considerations:

Before starting the research, ethical approval was obtained from the scientific research ethics committees of the faculty of nursing, Beni-Suef University Hospital. The researchers met both medical and nursing directors of the selected setting to clarify the purpose of the study and take their approval. Written consent was obtained from the high-risk pregnant women to participate in the study after the aim of the study was explained to them. The researchers informed the high-risk 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 applied in the period from March 2021 and ending in December 2021. The researchers attended the previously mentioned setting two days per week (Saturday and Sunday); from 9 a.m. to 12 p.m. It included the application of educational intervention based on PRECEDE model which focuses on the predisposing factors that included knowledge regarding gestational diabetes. Enabling factors are defined as those that help the progress of the performance of the health action such as resources and supportive approaches that are important 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 included support from family and health workers.



**Figure 1:** Application of PRECEDE model for improving knowledge and Practice of preventive behavior regarding gestational diabetes

Application of nursing intervention based on PRECEDE model was done through the following phases:

**A-Preparatory phase:**

Contents of the educational sessions based on PRECEDE model about gestational diabetes

were designed. Several methods of teaching were used (videos, attractive pictures, and a 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, high-risk pregnant women's predisposing factors, enabling factors, and reinforcing factors were assessed based on Predisposing, Enabling, and Reinforcing Questionnaires (PRECEDE Model questionnaire). The practice of preventive behavior regarding gestational diabetes was assessed by using high-risk pregnant women's reported practices of gestational diabetes preventive behavior tool and also the attitude towards gestational diabetes by using an attitude questionnaire regarding gestational diabetes prevention as a pretest. The questionnaires were distributed to high-risk pregnant women and collected after filling.

### **Implementation phase:**

Two educational sessions regarding gestational diabetes based on PRECEDE model were given to high-risk pregnant women. Three theoretical and Two practical sessions were provided to them in twenty groups of 9–11 high-risk pregnant women, one session every two weeks for four weeks in the lecture room at the antenatal outpatient clinics of Beni-Suef 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 gestational diabetes, risk factors, symptoms, complications, and management & prevention were discussed. Also, education regarding enabling factors included education regarding resources and supportive approaches that are vital to conducting behavior and reinforcing factors which included the importance of support from family and health providers.

While the 2nd session was concerned with the discussion of pregnant women's practices of preventive behavior about gestational diabetes such as taking rest during the day, and low carbohydrate consumption 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 sugar, self-measuring body weight, and checking sugar 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 for 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 educational intervention based on precede model was evaluated immediately and after one month of the implementation phase using the same tools II, III, and IV.

### **Administrative design:**

Approval was obtained from the Dean of the Faculty of Nursing and the directors of antenatal outpatient clinics at Beni-Suef University Hospital 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. A Chi-square test was 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 tools.

### **Results:**

**Table (1):** Represented that 80% of pregnant women whose age ranged between 18 < 30 years with a mean  $\pm$  SD of  $23.14 \pm 4.68$ , (34%) of them had primary education,

meanwhile, it is pointed out that 71% of pregnant women were not working.

**Figure (1):** Demonstrated that (62%) of pregnant women lived in rural areas and 38% 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. Concerning mean gestational age among the studied pregnant women was  $26.34 \pm 3.56$ .

**Figure (2)** highlighted that the majority common source of information among the studied high-risk pregnant women was a doctor (55%)

**Table (3):** Revealed that, the mean knowledge, enabling, and reinforcing factors score regarding gestational diabetes was decreased pre-educational 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 educational intervention.

**Figure (3)** clarified the gestational diabetes preventive behavior total practices score of the high-risk pregnant women pre and

one-month post-intervention. It observed that most of the high-risk pregnant women (83%) had inadequate practices toward gestational diabetes prevention pre-intervention and decreased to become (17%) one-month post-intervention. Reversely, 9% of the high-risk pregnant women had adequate practices toward gestational diabetes prevention pre-educational intervention in comparison to 91 % one-month post-intervention.

**Figure (4)** clarified the total attitude scores of the studied high-risk pregnant women regarding **gestational diabetes** prevention pre and one month post-intervention. It observed that 69% of pregnant women had a negative attitude toward **gestational diabetes** prevention pre-intervention and decreased to become 14% one-month post-intervention. Reversely, 31% of the pregnant women had a positive attitude toward **gestational diabetes** prevention pre-intervention compared to 86 % one-month post-intervention.

**Table (4):** Showed that there was a statistically significant relationship between knowledge, enabling factors, and reinforcing factors scores and gestational diabetes preventive behavior practices scores of the high-risk pregnant women throughout the educational intervention phases.

**Table (1):** Distribution of studied high-risk pregnant women according to their demographic characteristics (n=200)

Items	No.	%
<b>Age in years</b>		
18 < 30	160	80
30 ≤ 40	40	20
<b>Mean ±Stander deviation</b>	23.14 ± 4.68	
<b>Educational level</b>		
- Illiterate	30	15
-Primary education	68	34
-Secondary education	48	24
-University education	54	27
<b>Occupation</b>		
Working	58	29
Not working	142	71

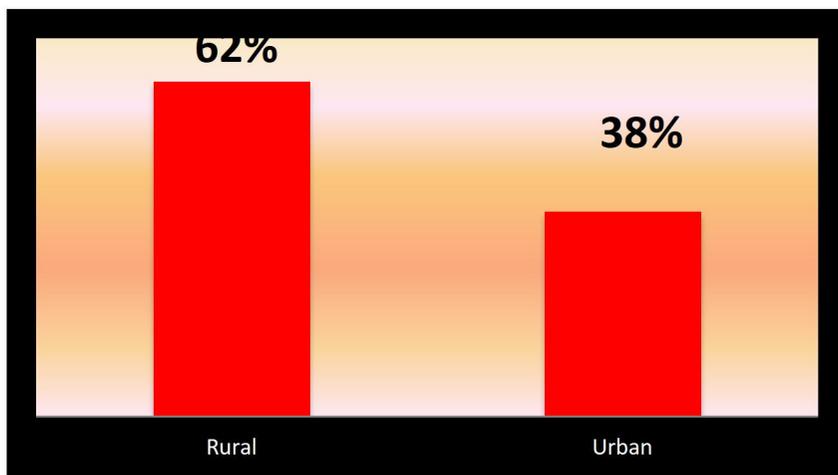


Figure (1): Distribution of studied high-risk pregnant women according to their residence (n=200)

Table (2): Distribution of the studied high-risk pregnant women according to their obstetric history (n=200)

Items	No.	%
<b>Gravida</b>		
Primigravida	82	41
Multigravida	118	59
<b>Parity</b>		
Nullipara	54	27
Primipara	40	20
Multipara	106	53
<b>Gestational age</b>	26.34 ± 3.56	

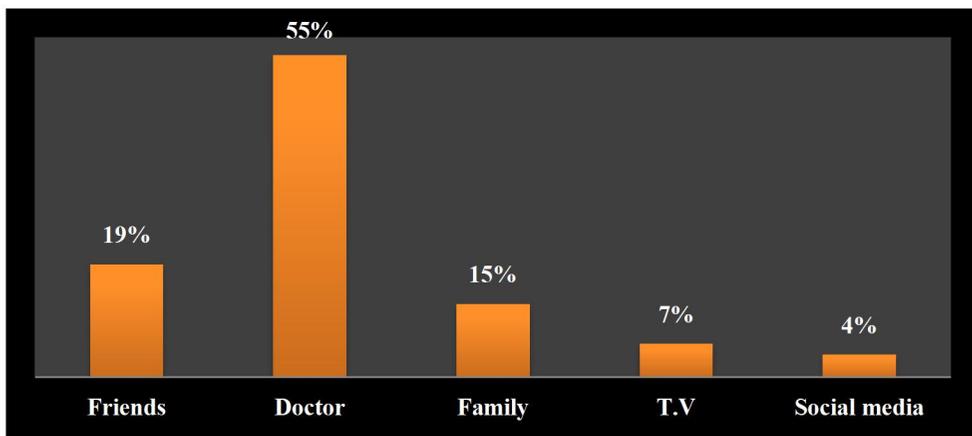


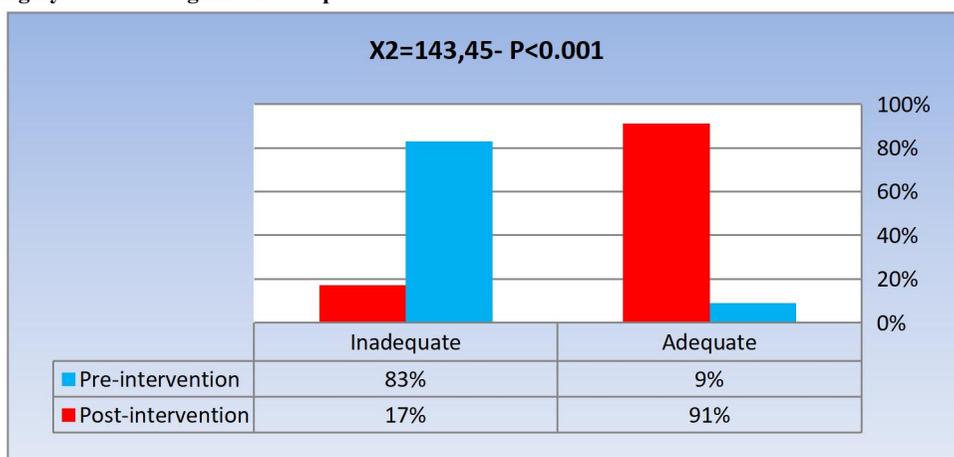
Figure (2): Percentage distribution of studied high-risk pregnant women according to their source of information about gestational diabetes (n=200)

**Table (3):** Comparison between the mean score of studied high-risk pregnant women related to their knowledge about gestational diabetes, enabling factors, and reinforcing factors pre, immediately, and after one month of educational intervention (n=200).

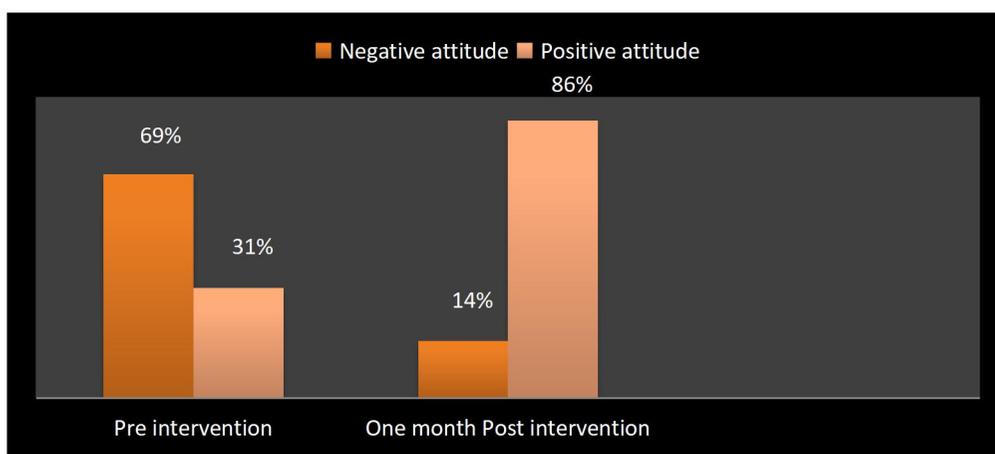
Variable	Pre-educational intervention	Immediately after educational intervention	After the one-month post-educational intervention	Paired t-test	P-value
	Mean ±SD	Mean ±SD	Mean ±SD		
Knowledge (Predisposing Factor)	.52±.42	1.95±.52	1.82±.41	16.1	<0.001
Definition of gestational diabetes	.62±.45	1.65±.45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

(\*) statistically significant at  $p \leq 0.05$

(\*\*) highly statistical significance at  $p < 0.001$



**Figure (3):** The practices score of gestational diabetes preventive behavior of the studied high-risk pregnant women pre and one-month post-educational intervention implementation (n=200).



**Figure 4:** Attitude of the studied high-risk pregnant women regarding prevention of gestational diabetes

**Table (4):** Correlation between total knowledge, enabling factors, reinforcing factors, and preventive behavior practices scores of the studied high-risk pregnant women regarding gestational diabetes pre and after one month of educational intervention implementation (n=200).

Knowledge,	Practice			
	Pre		Post	
	r	p	R	P
Pre	0.43	0.46*		
Post			0.86	0.001*

*Statistically significant at  $p < 0.01$*

### Discussion:

Gestational diabetes is commonly controlled with glycemic control, according to common experience (Mishra, & Kishore, 2018). It is prudent to achieve glycemia in women with GDM until there is absolute proof of normal fetal growth in ultrasonography to give appropriate protection against unfavorable perinatal outcomes. The cornerstone of GDM management is medical nutrition therapy, which is supplemented by physical exercise, insulin therapy, self-care, and continuous blood glucose monitoring, which ultimately aims to attain and maintain glycemia (AlSheikh M. Hmoud (2020)

Results of the present study indicated that the majority of pregnant women their ages ranged from 18 < 30 years with a mean  $\pm$  SD of 23.14  $\pm$  4.68. In the same line, a study of the prevalence and risk factors for gestational diabetes according to diabetes in the pregnancy study group in India in comparison to the international association of diabetes and pregnancy study group in El Minya by Elsagheer & Hamdi (2018) and found that the more than half of women their age ranged from 18 years to 42 years with mean age (26.5.  $\pm$ 5.5). From the researcher's point of view, this age group represents the most prevalent reproductive age group and reflects the fact that women were likely to be in middle age groups. In addition to education, this explains their cooperation, understanding, and being more receptive to information. The results of the present study indicated that less than two-thirds of pregnant women lived in rural areas. From the researchers' point of view, this may be one of the causes of knowledge deficit and resource deficiency in rural areas less than in urban areas.

As regards women's obstetric history, it was noticed that less than two-fifths of the pregnant women were multigravida and more than half of them were multipara. Concerning mean gestational age among the studied pregnant women was 26.34  $\pm$  3.56. In the same line, a study on screening for gestational diabetes among pregnant women attending a rural family health center-Menoufia governorate by Khalil et al., (2017) found that most of the studied women were multigravida and multipara.

The findings of the present study highlighted that the majority common source of information among pregnant women was doctors. From the researchers' point of view, this is reflected the importance of medical advice to promote and maintain health.

Concerning the mean knowledge, enabling, and reinforcing factors score regarding gestational diabetes, results of the current study revealed that there was an increase in the mean score of knowledge, enabling, and reinforcing factors scores with statistical significance immediately and after one month of educational intervention. This confirmed the positive effect of providing the intervention based on precede model. This finding is supported by Ibrahim, (2017) who studied the effect of an adaptation program for diabetic sexual dysfunction and found that the level of knowledge for diabetic women increases after the intervention. This finding return to the positive effect of guideline intervention for the study group. Also the sources of information for the study group from health care providers. Guideline and health care providers play an important role in improving women's awareness regarding GDM.

These findings are in the same line with results in a study conducted by **Neer et al., (2019)**, about "Dosage Effect of Prenatal Home Visiting on Pregnancy Outcomes in At-Risk, First-Time Mothers" and reported that the implementation of this model, is an efficient solution for promoting pregnancy outcomes, mother and fetus health through improving awareness of the mother and providing accessible health care.

These findings are matched with results in a study conducted by **Mahdi et al., (2016)**, about "Effect of Precede-Proceed Model on Behaviors Prevention for Diabetes Mellitus among High-Risk pregnant women" and found that implementation of an educational program based on the preceding model significantly improved the knowledge among intervention group regarding behaviors Prevention DM.

Also, these findings are in the line with a study in Mashhad city among students for the prevention of diabetes conducted by **Peyman et al. (2019)**, who studied the effect of training diabetes prevention behaviors on the promotion of their knowledge, attitude, and practice, and detected that the knowledge, attitude, and practice among students about prevention behaviors for DM were enhanced.

The results are supported by **Dehdari et al. (2019)** who conducted a study titled on evaluation of an educational intervention program among patients after coronary artery bypass graft surgery regarding the PRECEDE-PROCEED model to improve their life quality and found that the quality of life of those patients has been improved after coronary bypass surgery.

The results of the present study revealed that there was a statistically significant relationship between knowledge, enabling factors, and reinforcing factors scores and **gestational diabetes** preventive behavior practices scores of the pregnant women throughout the intervention phases. These results are consistent with **Zandinava, et al, (2019)** who studied the effect of educational packages on self-care Behavior, quality of life, and blood glucose levels in pregnant women with gestational diabetes found that, the positive effect of education on awareness and self-care in the intervention group. Also, These

results are similar to **Barasheh, et al, (2018)** who studied the effect of an education program on improving self-care management behaviors in diabetic patients, found that, and self-care behaviors, levels of knowledge, skills, and attitude (KPA) at the intervention group have been enhanced after implementation of the program. These results are in accord with what **Shakouri et al. (2019)** reported in their study in Arak among high school girl students about the effect of health education program based on PRECEDE model in controlling iron-deficiency anemia that iron deficiency anemia has been prevented among female students. And **Dizaji et al. (2018)** found that self-care behaviors and control in patients with type 2 DM have been promoted.

This result was congruent with **Latif et al., (2019)** study of Metformin's effects on Treatment satisfaction and quality of life in gestational diabetes. These results were also consistent with **Sen& Sirin, (2020)** study on Healthy lifestyle behaviors and self-efficacy showed that there was a significant difference between the intervention group and the control group in self-care behaviors as the self-care program had a positive effect on improving women practice in the study group.

Results of the present study revealed that the majority of high-risk individuals had a positive attitude toward gestational diabetes prevention one month post-intervention. This finding was supported by **Ibrahim, (2017)** found that there was a high statistically significant difference between practice level and altitude of the studied patients regarding diabetes in all items. Also, **Islam et al., (2017)** who studied knowledge and attitude regarding gestational diabetes mellitus among obese pregnant women, found positive attitudes regarding GDM control, investigation, and expressed positive responses to the GDM education program. This result is in the line with **Ranjbaran et al., (2015)** who studied "Sleep Quality Improving by Using the PRECEDE Mode among Patients after Coronary Artery Bypass Graft Surgery and observed that education based on PRECEDE Model can improve the knowledge that associated with a positive attitude toward the disease. From the researchers' point of view, this may be related to the positive effect of

education on women's knowledge, skills, and attitudes as education improve the self-care of diabetic women and its management as the essential role of health care providers for more training for women.

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)** who reported that implementing intervention using the PRECEDE model could increase enabling and reinforcing factors. Similarly, **Oruoj, et al., (2017)** reported that the precede model was effective in promoting the preventive behaviors for type 2 DM in high-risk individuals. This is reflected in the good effect of introducing the intervention based on precede model.

The findings of the present study have supported the aim and hypothesis of the study and the knowledge, attitude, and practices among high-risk pregnant women for gestational diabetes have been improved. This is reflected in the success of PRECEDE model implementation and its positive effects.

### Conclusion:

Depending on the results of the current study, It was concluded that implementing intervention based on PRECEDE model for high-risk pregnant women was effective in improving knowledge and practice regarding the prevention of gestational diabetes.

### Recommendations:

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

- 1- The educational intervention based on PRECEDE model regarding gestational diabetes prevention should be integrated into the antenatal care for pregnant women in the different study settings.
- 2- Continuous health education programs for high-risk pregnant women can help in providing continuous support and early detection of gestational diabetes.

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

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