Effect of Counseling Program based on Health Literacy Model regarding Gestational Diabetes on Maternal and Fetal outcomes

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Abstract
Background: Gestational diabetes is associated with adverse maternal and fetal complications. Nurses have a significant role in counseling based on health literacy of women about proper lifestyle and health related skills in coping with gestational diabetes to prevent and reduce adverse effects on pregnancy outcomes. **Aim**: Evaluate the effect of counseling program based on health literacy model regarding gestational diabetes on maternal and fetal outcomes. **Subjects and Method: Design**: A quasi-experimental one group pre-test, post-test design was used for this study. **Setting**: It was conducted at out-patient clinic at Obstetrics and Gynecological department in Benha University Hospitals. **Subjects:** A purposive sample of 171 pregnant women medically diagnosed with gestational diabetes was included in the study. **Tools**: Five tools were used for data collection: **Tool (I)** A structured interviewing questionnaire sheet, **Tool (II)** Diabetic Attitude Scale, **Tool (III)** Diabetic Self-Care Practices sheet, **Tool (IV)** Self-administered Health literacy questionnaire and **Tool (IIV)** Assessment of Maternal and fetal outcomes. **Results**: There were a high statistically significant correlation between knowledge, self-care practices of the studied pregnant women and counseling based on health literacy model pre and immediately post program, and significant correlation between attitudes and counseling based on health literacy model pre and immediately post program, High statistically significant relation between self-care practices and pregnancy complication and neonatal complication, significant statistically relation between self-care practices and labor complications during follow up at time of delivery **Conclusion**: Counseling program based on health literacy model regarding gestational diabetes has a positive effect on women's knowledge ,attitudes and self-care practices with favorable maternal & fetal outcomes. **Recommendations**: Development of a training program and evidence based interventions to provide a better view of the women health literacy promotion strategies related to gestational diabetes.
Keywords: Counseling, Gestational Diabetes, Health literacy.

Introduction

Gestational diabetes Mellitus (GDM) is a type of diabetes in which a woman   without diabetes develops high blood sugar levels during pregnancy. It affects pregnant women during the second and third trimester due to insulin resistance that has resulted from

hormone production by the placenta or reduced production of insulin [1]. It has been estimated that 75–90% of cases of high blood glucose during pregnancy are GDM [2].

The prevalence of gestational diabetes differs in different regions. Risk factors of GDM include overweight/obesity, westernized diet and micronutrient deficiencies, advanced maternal age and family history of insulin resistance and/or diabetes, previously having gestational diabetes, and having polycystic ovarian syndrome . While GDM usually resolves following delivery, it can have long-lasting health consequences, including increased risk of short-and long-term complications for mother and child [3].

Gestational diabetes leads to maternal, fetal and neonatal complications as preeclampsia, polyhydramnios, preterm labor, shoulder dystocia, infection, cesarean section, fetal demise, fetal malformation, macrosomia, hypoglycemia, hyperbilirubinemia, respiratory distress syndrome and perinatal mortality. Furthermore, in later life, other complications may develop and affect both women and their infants as obesity, type 2 diabetes mellitus, heart diseases and neuropsychological problems [4].

Counseling during pregnancy along with effective management is crucial for good perinatal outcomes. The maternity nurse's key role during antenatal period is preventing and reducing complications as much as possible by teaching pregnant women with gestational diabetes about exercise, diet regimen and treatment. In addition, maternity nurses should empower high risk women by raising their awareness,

giving advice and support to decrease the risks of adverse perinatal outcomes[5,6].

Health literacy refers to one's capacity for acquiring, interpreting and understanding primary health information and services required for proper health decision making [7]. Enhancing the awareness and preparedness during pregnancy help the mother passes this stage of life with fewer complications. So pregnancy is a good opportunity for teaching and counseling pregnant women regarding GDM [8]. Given the importance of pregnant women as a vulnerable social class, the fifth goal of United Nations Millennium Development Goals (2019), stated that 75% reduction in maternal mortality through improving mothers' health , and the significance of gestational diabetes which is the most common pregnancy complication and a threat to the mother's and baby's health[9].

Today, health literacy improves health behaviors, creates a healthy lifestyle and promotes the quality of life. Health literacy in pregnant women is important for two reasons. First, pregnancy might be the first experience of a woman with the health care system. In fact dealing with such a complex system for the first time can be full of surprises even for those with adequate literacy skills. Additionally, women with limited health literacy would find it very difficult to obtain new information or follow the given instructions. Secondly, the health status of a woman and her understanding of health information before pregnancy, during pregnancy, and in the course of growth and

development years will directly affects her child [10].

Nurses have a major part of GDM management involves health literacy through educating mothers about diet, exercise, self-monitoring, and insulin treatment to decrease morbidity and mortality rates. In addition, educating women about how to prevent and reduce GDM adverse effects on pregnancy outcomes. Health education plays an important role in increasing women's awareness regarding the GDM risk and its proper management, in order to reduce maternal and fetal complications [6].

Significance of the study

Gestational diabetes is a global health problem due to its high prevalence and major adverse effects on maternal and fetal health. The International Diabetes Federation (IDF) listed Egypt among the world top 10 countries in the number of patients with diabetes. According to the most recent IDF estimates, GDM affects approximately 204 million women worldwide and is expected to increase to 308 million by 2045 [11]. In Egypt, the rate of gestational diabetes among pregnant women is between 2-14% of all pregnancies [12].

Complications associated with GDM are numerous and affect both mother and baby as increase the risk of pre-eclampsia, depression, and requiring a caesarean section. Babies born to mothers with poorly treated gestational diabetes are at increased risk of being too   large, having low   blood sugar after   birth,   and jaundice. If untreated, it can also result in a stillbirth. Long term, children are at higher risk of being overweight and developing type 2 diabetes [13]. Inadequate health literacy is

considered a global issue. It is of paramount importance to involve pregnant women in health promotion and preventive health care to improve their performance regarding lifestyle behaviors depends on their level of literacy, which exerts a key effect on preventing and controlling high risk diseases such as gestational diabetes. So it is very important to assess the effect of counseling program based on health literacy model regarding gestational diabetes on maternal and fetal outcomes, also, scarce studies exist related to this topic.

Aim of the Study

The current study aimed to evaluate the effect of counseling program based on health literacy model regarding gestational diabetes on maternal and fetal outcomes

Research hypothesis:

Pregnant women with GDM who will receive counseling program based on health literacy model regarding gestational diabetes will have favorable maternal and fetal outcomes

Research subhypotheses:

H. 1: Pregnant women with GDM who will receive counseling based on health literacy model regarding gestational diabetes will have higher total knowledge score than pre-intervention.

H. 2: Pregnant women with GDM who will receive counseling based on health literacy model regarding gestational diabetes will exhibit positive attitude than pre intervention.

H.3: Pregnant women with GDM who will receive counseling based on health literacy model regarding gestational diabetes will have better self-care practices than pre-intervention.

Subject and Methods

Research Design:
A Quasi-experimental research design one group (pre/post-test) was used for conducting the study.

Research Setting
The study was conducted in out-patient clinic at obstetrics and gynecological department in Benha University Hospitals, Egypt.

Subject type:
A purposive sample.

Subject Size:
This study included one hundred and seventy-one (171) pregnant women who attended the previously mentioned setting. The sample size who determined based on the flow rate obtained from the statistical office of Benha University Hospitals in the previous year (2021) [14]. It revealed that the total population size was (300 women) diagnosed with GDM so the sample size of this study was calculated according to the following equation that is adopted from Yamane, (1967) [15].

$$n = \frac{N}{1+N(e)2}$$

Where: n= sample size, N= total population size, and e= margin error (0.05)

$$171 = \frac{300}{1+300(0.05)2}$$

Inclusion Criteria:
1-   All pregnant women who were medically diagnosed with gestational diabetes.
2-   Gestational age not less than 24 weeks.
3-   Agreed to participate in the counseling program.

Exclusion Criteria:
1-   The women with diabetes history before pregnancy or overt diabetes mellitus (DM) (fasting ≥ 126 mg / dl or two hours post-prandial ≥ 200 mg/dl) were excluded from the study.
2-   Women suffering from any other diseases such as asthma, hypertension, epilepsy, thyroid dysfunction, anemia, respiratory, cardiac diseases and psychological complications.

Tools for Data Collection
Five tools were utilized for data collection, prepared by the researchers after reviewing related literatures and tested by a panel of experts in the field of the study for validity.

Tool (1): A structured interviewing questionnaire: It Included four parts:

  Part 1: General characteristics of the studied pregnant women (age, residence, educational level, employment, family income weight, height, Body Mass Index (BMI), attendance of previous educational program related to gestational diabetes).

  Part 2: Obstetric history as gravidity, parity, gestational weeks, previous gestational diabetes, and history of delivery of a baby weighing greater than or equal to 4 kg, previous pregnancy complications

  Part 3: It included mother multiple risk factor as first degree relative with diabetes mellitus (DM), as well as history of twins, Poly Cystic Ovary (PCO), microcosmic baby and GDM.

  Part 4: Pregnant women's knowledge regarding gestational diabetes (G.D) and its management

It was developed by the researchers after an extensive reviewing of the local and international related literatures [16,17]. To assess pregnant women's knowledge regarding gestational diabetes. It included 7 questions about definition of gestational diabetes, causes, risk factors, clinical

picture, diagnosis, complications, lifestyle and management of G.D.

Scoring System for part 4

The questions were scored as the following; score (2) was given for the correct answer, score (1) for the incorrect or don't know before and after implementation of the counseling program. The total knowledge score was classified as the following:

- Adequate knowledge: ≥ 75%
- Inadequate knowledge < 75%

Tool (2): Diabetic Attitude Scale this scale was adapted from Anderson et al. 1998 [18] to assess attitudes of pregnant women regarding gestational diabetes. It was modified slightly to be more sensitive to questions regarding GDM rather than diabetes types 1 and 2. This modification included replacing the words diabetes or diabetes 2 with gestational diabetes, for example Q 31. ...women with type 2 diabetes do not usually get complications? Was amended to read. ...women with gestational diabetes do not usually get complications? It consisted of 33 items in five subscales: 1) Need for special training to provide GDM care, 2) Seriousness of GDM, 3) Value of tight glucose control, 4) Psychosocial impact of GDM, and 5) Attitude toward patient autonomy. The scoring system was calculated as: (1) for "agree" and (0) for disagree. The questionnaire was evaluated giving a score of 0 – 33. The total score was classified as either Negative attitude < 50% or Positive attitude > 50%.

Tool (3): Diabetic Self-Care Practices sheet:

It was a self-report adapted from Toobert et al. 2000 [19] It consisted of 7 items to address specific self-care practices related to following specific designed diet regimen, self-measurement of blood glucose level, health related practices to avoid GD complications, practice safe regular exercise physical activity, taking medication regularly, learning how to use insulin and injection-associated problems.

The scoring system

It was calculated as: (0) for "not done" and (1) for "done". The questionnaire was evaluated giving a score of 0 – 7. The total score of each woman was categorized into. Satisfactory practices ≥50%. Unsatisfactory practices < 50%

Tool (4) Self-administered Health Literacy Questionnaire (HLQ):

It was adopted from Montazeri et al. (2014) [20] and consisted of five sub scales and 33 items. The sub scales covered both intrinsic and extrinsic dimensions of health literacy. The five subscales included reading health information; understanding health information; appraisal of health information; ability to access health information and decision making. A full explanation of the HLQ and its five subscales was described as follow:

1- Reading health information: It is a four-item subscale that was evaluated on a five-point Likert-type scale ranging from 1 to 5 (1 = completely difficult through 5 = completely easy). An example of this aspect was: "reading health education materials such as booklet, pamphlet, and educational brochures was easy for me". Cronbach's alpha for this subscale was measured as 0.72. The total possible scores varied from 4 to 20. The higher the score, the greater the reading abilities.

2- Understanding health information: was assessed using seven items such as "I can acquire the required health and medical information from various sources". Each item was scored on a 5-point likert scale ranged from 1 to 5 (1 = completely difficult through 5 = completely easy). For this subscale, Cronbach's alpha was 0.86. The theoretical range for this subscale was 7–35 and the higher the ratings, the more comprehensible to understand health information.

3- Appraisal of health information: was assessed by applying four items such as "I can get information about healthy nutrition". Each item was scored on a fivepoint Likert-type scale that ranged from 1 (never) to 5 (always). Cronbach's alpha for this subscale was 0.77. The total score on this subscale ranged from 4 to 20. A high total score shows a high ability of appraisal of health information.

4- Ability to access health information: was measured by six items such as "I can obtain information about my illness". A five-point Likert-type scale was used (always = 5, most of the time = 4, sometimes = 3, seldom = 2 and never = 1). Cronbach's alpha for this subscale was 0.86. The total possible scores ranged from 6 to 30. The higher score reveals the more ability to access health information.

5- Decision making: was assessed using a twelve-item subscale designed to measure the ability to decide health-related behaviors. Sample of items is: "I avoid doing things or taking materials that might increase my weight" even if the symptoms of the disease would be disappeared. The items were scored on a five-point Likert-type scale ranging from 1 to 5 (always = 5, most of the time = 4, sometimes = 3, seldom = 2 and never = 1). For this subscale, Cronbach's alpha was 0.89. The higher the ranking, the better decision making was concluded.

Tool (5): Assessment of maternal and fetal outcomes:

 Part (1): Maternal outcomes as preterm labor, postpartum hemorrhage, and genital tract infection.

 Part (2): Fetal outcomes as respiratory distress and prematurity and macrosomia baby

 Method:

Tools validity and reliability:

The content validity of the tools was revised by three experts in the field of Obstetrics and Gynecological nursing and general medicine. Reliability of the tools was assessed by suitable tests**.** Cronbach's alpha of knowledge sheet was 0.78, attitude was 0.88, practices was 0.82**,** while reliability of Health literacy questionnaire was examined using Raykovs procedures rather than Cronbach's alpha where >0.80 was sought.

Ethical consideration:

        Ethical aspects were considered before starting the study as the following:

• The current research was conducted under the approval of the Faculty of Nursing Ethical Committee, Benha University.

• An official letter was obtained from Faculty of Nursing Benha University and forwarded to the director of the previously mentioned setting.

 • The aim of the research was explained to each of the studied women before

applying the tools to gain their confidence and trust.

• An oral consent was obtained from each woman to participate in the study.

• Tools of data collection didn't included items that hurt human dignity, cultural, human right and ethical issues.

• Each studied woman has the right to withdraw from the study at any phase of the study.

• Privacy and confidentiality of the collected data were assured.

Pilot study:

A pilot study was conducted on (10%) of the total sample 17 pregnant woman who were medically diagnosed with G.D.M and fulfilled the inclusion criteria to assess the efficiency, clarity and applicability of the tools used. No modifications were done in the tools as there were no major problems. So, these subjects were not excluded from the main the study sample.

Fieldwork:

The study was conducted at the beginning of November 2021 to the end of May 2022. The study procedure included five sequential phases (preparatory phase, interviewing and assessment phase, planning phase, implementation phase and evaluation phase.

1-Preparatory phase: During this phase the researchers reviewed the national and international advanced literatures, then designed the tools of data collection and conducted a pilot study to a certain content validity of tools used.

2-Interviewing and assessment phase:

This phase encompassed interviewing pregnant women .At the beginning of the interview the researchers greeted the women ,introduced themselves ,explained the purpose of the study and take oral consent to participate in the study. Data were collected by the researchers through administration of tools 1 (Structured interviewing questionnaire), 2 (Diabetic Attitude Scale), 3 (Diabetic Self-Care Practices sheet) and 4 (Health Literacy Questionnaire) to each woman. Average time for completion of each woman interview was around 45-60 minutes. Number of interviewed women varied weekly according to convenient pregnant women who fulfilled the inclusion criteria. These steps were repeated until the predetermined sample size was completed.

3-Planning phase:

Based on the needs of pregnant women and base line data obtained from pretest during assessment phase the counseling program were developed by the researchers .Sessions number and its contents ,different methods of teaching and instructional media were determined. Objectives of program were constructed.

4-Implementation phase:

The researchers were visited the previously mentioned setting three days/week (Saturday, Sunday and Monday) from 9 a.m. to 2 p.m. after taking the legal aspects of ethics in research.

The pregnant women with GDM participating in counseling program through receiving three scheduled sessions (2 theoretical and 1 practices) .Each session took about 30-45 minutes. At the beginning of the first session women were with counseling program contents. Each woman was informed about the time of next sessions at the end of the session, the subsequent session started by a feedback about the previous session and the objectives of the new session.

- **The first session**

At the beginning of the first theoretical session the researcher gave the pregnant woman with GDM the handout and introduced an orientation of the handout including the general and specific objectives by using Arabic language to suit all level of education. Then the researchers provided studied women with knowledge about G.D.M and its management including (definition of gestational diabetes, causes, risk factors, clinical picture, diagnosis, complications, life style and management of G.D.M).

- **The second session**: it is the second theoretical session included healthy attitudes of pregnant women regarding gestational diabetes such as special intervention to provide GDM care, seriousness of GDM, value of tight glucose control and psychosocial impact of GDM.

-**The third session** it is a practical session included diabetic self-care practices and health literacy model .At the end of each session women's questions were discussed to correct any miss understanding.

-Different methods of teaching were used such as discussion, demonstration, re-demonstration and brain storming.

-Instructional media included handout which covering all counseling program contents in a simple Arabic languish.

3- Evaluation phase

- During this phase the effect of counseling program based on health literacy model on women's knowledge, attitude and self-care practices regarding G.D.M. was evaluated. The researchers used tool 1 part 4, 2, 3 and 4 as (posttest). Immediate evaluation was conducted after implementation of the program to evaluate women's knowledge gain, self-care and healthy attitude about GDM.

- Also, the researchers follow up the women at time of delivery in order to assess the effect of counseling program based on health literacy model regarding gestational diabetes on maternal and fetal outcomes using tool 5 (assessment of maternal and fetal outcomes).

 Statistical analysis:

 Data was verified prior to computerized entry. The statistical package for the social sciences (SPSS version 22) was used for that purpose followed by data tabulation and analysis. Descriptive statistics were applied as frequency and percent, mean, standard deviation SD, maximum and minimum. Analytical statistics were applied as pearson correlation coefficient was used to test the association between the study variables. Statistical significant difference obtained at $p<0.05$. Highly statistical significant difference obtained at $p<0.001$. Chi-square test used to measure association between qualitative variables. Paired t-test used to compare mean and SD of paired quantitative normally distributed data.

Results

Table 1: Demonstrates general characteristics of the studied pregnant women. It was clear that 69.6% of studied women's age was between 30<40 years with the mean age of 31.85±5.88. Also, it reveals that 31% of the studied pregnant women had above middle education. 58.5% of them lived in urban areas. Besides, 62% of the studied pregnant women were housewives and 60.8% of their family

income was somewhat enough. Moreover 68.4% of them did not attend previous educational program related to G.D.

Table 2: Reveals pre pregnancy anthropometric measurement of the studied pregnant women. It shows weight Mean ±SD 79.8304±6.30503, height Mean ±SD 158.1579± 5.98859 and body mass index   Mean ±SD 31.8977±1.62413.

Table 3: Shows obstetric history of the studied pregnant women. It was clear that 49.7% multigravida (more than three) and 42.1% were multiparas from 2<4. In addition, 69.0% had no abortion before , 40.9 % of them were gestational week's ≥28 with Mean ±SD 26.4152±2.09133, 71.3% complained from previous pregnancy complications and 30.3% of them complained from vaginal bleeding.

Table 4: Clarifies the risk factors of gestational diabetes. It reveals that 60.2 % of studied pregnant women had first degree relative with DM, 19.3% had history of twins, 29.2 % had history of PCO, 70.2% had history of overweight baby and 18.7% had Previous G.D.

Table 5: Shows mean and standard deviation of knowledge, attitude and self-care practices among the studied pregnant women pre and immediate post counseling program. It revealed mean ± SD knowledge 12.30±2.53, attitudes 21.87±3.83, and self-care practice 8.49± 1.59 preprogram compared to knowledge 18.54±1.63, attitudes 36.86±3.11, and self-care practice 12.97 ±1.19 immediately post counseling program with high statistically significant difference in knowledge t= 39.078, P= 0.000, attitude t=63.888 P= 0.000, and self-care practices t= 56.577

p= 0.000 between pre and immediately post counseling program respectively.

Figure 1: Clarifies percentage distribution of the studied pregnant women regarding their total knowledge level pre and post program. It identifies that 78.4% of them had inadequate knowledge preprogram compared to 80.7% of them had adequate knowledge immediately post counseling program.

Figure 2: Illustrates percentage distribution of the studied pregnant women regarding their total attitude level pre and post program. It shows that, 51.5% had negative attitude preprogram compared to 70.2% had positive attitude immediately post counseling program.

Figure 3: Illustrates percentage distribution of the studied pregnant women regarding their total self-care practices level pre and post program. It clarifies that70.2% had unsatisfactory self-care practices level preprogram compared to 81.9% had satisfactory self-care practices level immediately post counseling program.

.**Table 6:** Demonstrates comparison regarding counseling based on health literacy model among the studied pregnant women pre and immediately post counseling program. It shows that the highest mean score was "decision making" mean± SD= 17.90±5.26 pre , 51.04± 5.84 immediately post counseling program T= 82.85 P= 0.000 and the lowest mean score was "reading health information" 5.95±2.01 pre and 17.10 ±2.31 immediately post counseling program, T= 73.02 P= 0.000 with high statistically significant difference between pre and immediately post counseling program. The table also reveals that the mean and standard

deviation of the total counseling based on health literacy model were 52.42 ± 9.41 preprogram compared 144.83 ± 8.30 immediately post program with high statistically significant difference between pre and post program t=152.11 p= 0.000 respectively.

Table 7: Presents correlation between total knowledge, attitudes, and self-care practices and counseling based on health literacy model of the studied pregnant women between pre and post program. It shows that there high statistically significant correlation between counseling based on health literacy model and knowledge preprogram r=.441p=.006, immediately post counseling program r= .811 p=.000 , attitude preprogram r= .172 p= .024, immediately post counseling program r= .630 p=.003. Self-care practices preprogram r= .550 p=.046 immediately post counseling program r=.705p=.000.

Table 8: Shows frequency distribution of the studied pregnant women regarding effect of counseling based on health literacy model on maternal and neonatal outcomes at time of delivery follow up. 20.5% suffered from pregnancy complication, 54.3% of them complain from genital tract infection. In addition, 32.2% suffered from labor complication, 36.4% of them had cesarean section. Moreover 49.7% suffered from neonatal complication, 44.7 % had macrosomic baby.

Table 9: Demonstrates relation between total self-care practices and maternal and neonatal outcome during follow up at time of delivery. It clarifies presence high statistically significant relation between total self-care practice and pregnancy complication (x^2=147 .13 p= .000) labour complication (X^2=8.923p=003) and neonatal outcomes (X^2 =38.31 p= .000).

Table (1): Frequency distribution of the studied pregnant women regarding their general characteristics (n=171)

General characteristics	No	%
Age		
20<30	36	21.0
30<40	119	69.6
≥ 40	16	9.4
Mean ±SD	**31.85±5.88**	
Education		
Read and write	19	11.1
Primary education	52	30.4
Secondary education	32	18.7
Above middle education	53	31.0
High education	15	8.8
Residence		
Rural	71	41.5
Urban	100	58.5
Employment		
House wife	106	62.0
Employed	65	38.0
Family income status		
Enough	32	18.7
Somewhat enough	104	60.8
Not enough	35	20.5
Attending previous educational program related to gestational diabetes		
Yes	54	31.6
No	117	68.4

Table (2): Mean and standard deviation of the studied pregnant women regarding their pre pregnancy anthropometric measurement(n=171)

Anthropometric measurement	Min	Max	Mean	Std. Deviation
Weight	66.00	89.00	79.8304	6.30503
Height	150.00	170.00	158.1579	5.98859
BMI	29.33	34.67	31.8977	1.62413

Table (3): Frequency distribution of the studied pregnant women regarding their obstetric history (n=171)

Variable	No	%
Gravida		
Primigravida	21	12.3
2-3 Gravida	65	38.0
> 3 gravida	85	49.7
Parity		
Nullipara	50	29.2
<2	49	28.7
2<4	72	42.1
Abortion		

No Abortion	118	69.0
1-2	53	31.0
Gestational week		
24<26 weeks	68	39.8
26<28weeks	33	19.3
≥28 weeks	70	40.9
Mean ±SD	26.4152±2.09133	
Previous pregnancy complications		
No cases	49	28.7
Yes	122	71.3
If yes (n=122).		
Pregnancy Induce Hypertension	18	14.8
Vaginal bleeding	37	30.3
Preeclampsia	17	13.9
Gestational diabetes	32	26.2
Decrease fetal movement	18	14.8

Table (4): Frequency distribution of the studied pregnant women regarding their risk factors for gestational diabetes (GD) (n=171)

Items	No	%
first degree relative with DM		
Yes	103	60.2
No	68	39.8
History of twins		
Yes	33	19.3
No	138	80.7
History of PCO		
Yes	50	29.2
No	121	70.8
history of overweight baby		
Yes	120	70.2
No	51	29.8
Previous G.D		
Yes	32	18.7
No	139	81.3

Table (5): Mean and standard deviation of knowledge, attitudes and self-care practices among the studied pregnant women pre and immediately post counselling program(n=171)

Item	Preprogram		Post program		T test	P-value
	Mean	±SD	Mean	±SD		
Knowledge	12.30	2.53	18.54	1.63	39.078	.000**
Attitudes	21.87	3.83	36.86	3.11	63.888	.000**
Self-care Practices	8.49	1.59	12.97	1.19	56.577	.000**

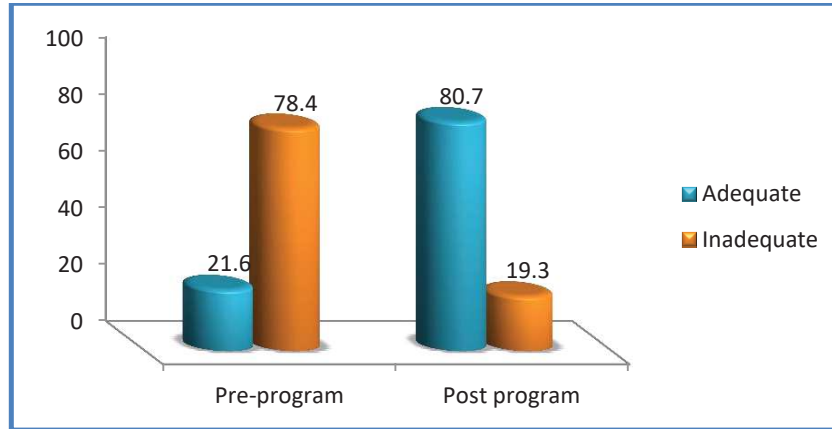*paired t test was used   ** highly significance $p<0.001$

Figure (1): Percentage distribution of the studied pregnant women regarding their total knowledge level pre and immediately post counseling program (n=171)
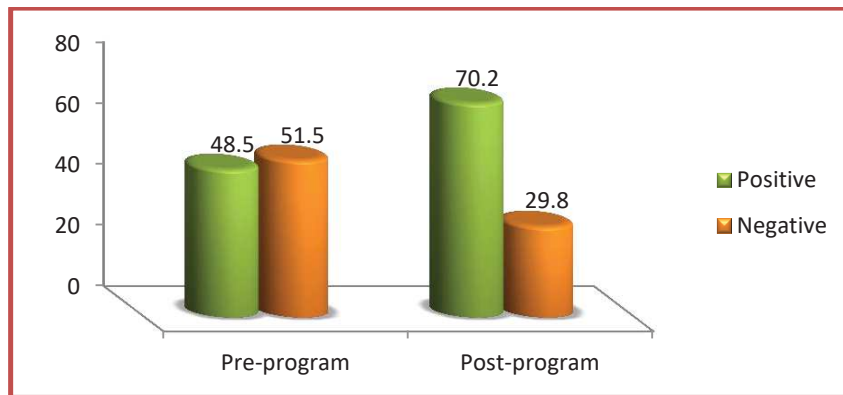

Figure (2): Percentage distribution of the studied pregnant women regarding their total attitudes level pre and immediately post counseling program (n=171)
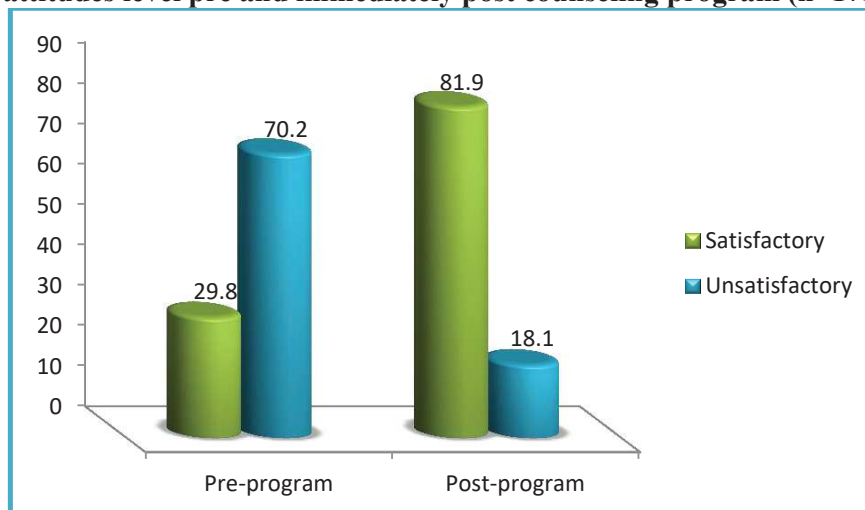

Figure (3): Percentage distribution of the studied pregnant women regarding their total self-care practices level pre and immediately post counseling program (n=171)

Table (6): Comparison regarding counseling based on health literacy model among the studied pregnant women pre and immediately post counseling program (n=171)

Health literacy scales	Pre		Post		T test	P-value
	Mean	±SD	Mean	±SD		
Reading health information	5.95	2.01	17.10	2.31	73.02	.000**
Understanding health information	12.66	4.60	31.52	2.54	46.11	.000**
Appraisal health information	7.39	2.48	18.27	1.21	62.42	.000**
Applity to access health information	8.50	2.67	26.88	2.64	64.21	.000**
Decision making	17.90	5.26	51.04	5.84	82.85	.000**
Total literacy	52.42	9.41	144.83	8.30	152.11	.000**

* Statistically significant difference (p≤0.05), **Highly statistically significant difference (p≤0.001).

Table (7): Correlation between total counseling based on health literacy model and total knowledge, attitudes, and self-care practices of the studied pregnant women pre and immediately post counseling program (n=171)

Items	Total health literacy			
	Pre		Post	
	r	p-value	r	p-value
Knowledge	.441	.006*	.811	.000**
Attitudes	.172	.024*	.630	.003*
Self-care practices	.550	.046*	.705	.000**

* Statistically significant difference (p≤0.05), **Highly statistically significant difference (p≤0.001).

Table (8): Frequency distribution of the studied pregnant women regarding their effect of counselling based on health literacy model on maternal and neonatal outcomes at time of delivery follow up (n=171)

Maternal and Neonatal Outcome	No	%
Pregnancy complications		
Yes	35	20.5
No	136	79.5
If yes (n=35).		
Pre-term labour	16	45.7
genital tract infection	19	54.3
Labor complications		
Yes	55	32.2
No	116	67.8
If yes (n=55).		
Caesarean section.	20	36.4
Genital tract laceration	17	30.9
Postpartum hemorrhage	18	32.7
Neonatal complications		
Yes	85	49.7
No	86	50.3
If yes (n=85).		
Prematurity	21	24.7
Macrosomic baby	38	44.7
Respiratory distress	21	24.7
Admission to NICU	5	5.9

Table (9): Relation between total self-care practices of the studied pregnant women and maternal and neonatal outcome at time of delivery follow up (n=171)

Maternal and Neonatal Outcome	Total self-care practices				X^2	p-value
	Unsatisfactory (n=31)		Satisfactory (n=140)			
	No	%	No	%		
Pregnancy complication						
Yes	31	100.0	4	2.9	147.13	. 000**
No	0	0.0	136	97.1		
Labor complications						
Yes	17	54.8	38	27.1	8.923	. 003*
No	14	45.2	102	72.9		
Neonatal complications						
Yes	31	100.0	54	38.6	38.31	000**
No	0	0.0	86	61.4		

* Statistically significant difference (p≤0.05), **Highly statistically significant difference (p≤0.001).

Discussion

Gestational diabetes mellitus (GDM) is a common health problem during pregnancy and associated with significant complications for both the mother and the fetus or newborn. Therefore, it is important for pregnant women to be aware regarding GDM and to understand its consequences [21]. Health literacy has been defined as the ability to 'assess, understand, appraise, and apply health information to make judgments and take decisions in everyday life concerning health care, disease prevention and health promotion. Health literacy is currently receiving considerable attention from healthcare providers, researchers and women due to a low level of health literacy being associated with adverse health outcomes[22]. Therefore, the present study aimed to evaluate the effect of counseling program based on health literacy model regarding gestational diabetes on maternal and fetal outcomes.

The results of the present study regarding general characteristics of the studied pregnant women revealed that more than two third of the studied women age 30<40 with the mean age 31.85±5.88, less two third was primary education and above middle education. More than half of them lived in urban area while less than two thirds housewife and family income somewhat enough. Moreover, more than two thirds of pregnant women have not attending any educational program regarding gestational diabetes. This result is congruent with **Abu-Qamar (2014)** [23] who evaluated Knowledge and practice of self-care among Jordanians with diabetes and reported that about 86.8% of pregnant women in GDM group were over 25 years. This study is also similar with **Han, et al. (2021)** [24] they studied maternal age at pregnancy and risk for gestational diabetes mellitus among Chinese women with singleton pregnancies and stated that the incidence of GDM increased with maternal age. Pregnant Women who got younger than 23 years had the lowest risk, followed by those who were younger than 30 years. This result could be due to that the

incidence of GDM was especially high in women who were older than 30 years.

Regarding the anthropometric measurement, the result of the current study revealed that weight Mean ±SD 79.8304±6.30503, height Mean ±SD 158.1579±5.98859 and body mass index Mean ±SD 31.8977±1.62413. This result is consistent with **Li (2020)** [25]. who studied incidence and risk factors of gestational diabetes mellitus: in Qingdao, China and showed that a pre-pregnancy BMI ≥ 30 kg/m2 had a stronger effect on GDM among those aged 30–34 years. The result of this study is also congruent with **Li et al. (2018)** [26]. who assessed short body height and pre-pregnancy overweight for increased risk of gestational diabetes mellitus: A population-based cohort study and stated that the height < 158 cm of pregnant women in urban Tianjin had a synergistic effect with pre-pregnancy overweight/obesity on the risk of GDM. Moreover, Dong **et al. (2017)** [27]. who studied The effect of pre-pregnancy body mass index and excessive gestational weight gain on the risk of gestational diabetes in advanced maternal age and reported that elevated pre-pregnancy BMI independently increased the risk of GDM, particularly in advanced maternal age. This result of weight gain may be due to sedentary lifestyle, lack of exercise, and the advanced age studied women and from previous repeated pregnancy.

Regarding obstetric history of the studied pregnant women, the present study founded that the majority of them were multigravida and multipara. In addition, more than two third of them had no history of abortion, their average gestational weeks of current pregnancy Mean ±SD 26.4152±2.09133 and the majority of them complained from previous pregnancy complications. This result partially agrees with **El-Ansary and Fouad (2020)** [28]. who studied effect of educational sessions on knowledge, attitude and self -care practices among pregnant women with gestational diabetes and reported that more than three quarters (76.3%) of the pregnant women were multigravida and more than two thirds (71.1%) were multipara. Among pregnant women, 18.6% had personal history of gestational diabetes. Women disagree with the average gestational age of the current pregnancy was 31.9 ±3.5. This result may be due to early detection gestational diabetes during antenatal care and periodic examination.

Regarding previous risk factor to gestational diabetes preprogram the current study revealed that three fifth of them had first degree relative with gestational diabetes, less than one fifth of them history of twins and previous GDM, more than one quarter of them history of PCO and less than three quarter of them history of overweight baby. This result is similar with **Ansarzadeh et al. (2020)** [29] who examined factors affecting the quality of life in women with gestational diabetes mellitus and reported that the majority of participants (73.0%) had a history of disease in their first-degree relatives. In addition, this finding is consistent with **Groof et al. (2019)** [30] who studied prevalence, risk factors, and feto maternal outcomes of gestational diabetes mellitus in kuwait: a cross sectional study and mentioned that the women with family history of GDM were more likely to have GDM than those with no family history of GDM. Moreover, **Kumari et al. (2018)** [31] evaluated maternal and perinatal outcome in gestational diabetes mellitus in a tertiary care hospital in delhi and reported that family history of diabetes was observed in a significantly higher number of GDM women. Concerning studied women total knowledge, attitudes, and self-care practice about gestational diabetes. The current study revealed that the majority of studied women had adequate knowledge, positive

attitude and satisfactory self-care practice immediately post counseling program compared to preprogram with high statistically significant difference between pre and post program. This may be due to the mothers' interest in acquiring new information, skills, and attitudes to prevent complications for them or their neonates, where less than three quarters of them who had complications in the previous pregnancy.

Also, these results were in the same line with **Mohamed and Ahmed (2019)** [32], who studied the effect of educational program for health literacy among pregnant women with gestational diabetes on maternal and fetal outcomes and reported that educational health literacy intervention was significantly effective on knowledge and attitude of the pregnant women with gestational diabetes. In addition, the current result is similar to **Saboula et al. (2018)** [33]. who studied the effect of nursing intervention on knowledge, attitude and self -care activities among gestational diabetic women and stated that the educational nursing intervention played positive effect in improving the knowledge, attitude and self-care activities of controlled uncomplicated gestational diabetic women after three months of follow up. There was a highly statistical significant difference between pre and post educational interventions regarding all attitudes scale factors and total and regarding all self-care activities subscales related to gestational diabetes among the studied GD women.

But the present study contrasts with **Alharthi et al. (2018)** [34]. who assessed gestational diabetes mellitus knowledge among saudi women and stated that there was a high prevalence of both poor awareness and knowledge relating to GDM diagnosis which may be related to the lack of any direct GDM-related educational programs and campaigns.

Regarding counselling based on health literacy (HL) model the current study showed that the highest mean score "decision making" and lowest score "reading health information" with high statistically significant difference between pre and immediately post counselling program. It also revealed that the mean and standard deviation of total health literacy scales were 52.42 ± 9.41 preprogram compare 144.83 ± 8.30 post program with high statistically significant difference between pre and immediately post counseling program. This result is similar to **Izadirad et al. (2019)** [35] who studied predicting factors influencing prenatal care based on health literacy in Balochistan primigravida women and founded that the highest and the lowest health literacy scores were in "decision-making" and "reading" respectively.

Also congruent with **Vila-Candel et al. (2020)** [36] who studied interventions to improve health among reproductive-age women of low health literacy and reported that the effect and role of counselling and the counsellor midwife in improving health literacy in mothers with gestational diabetes, as well as in diabetics women with any level of health literacy. In addition, **Tol et al. (2013)** [37] who studied the effect of educational program based on small group on promoting knowledge and health literacy among women with type 2 diabetes referring to selected hospitals affiliated to Tehran University of Medical Sciences and founded that education and counselling increased the score of health literacy in diabetic women with any levels of health literacy.

Moreover, this study result agrees with **Gharachourlo et al. (2018)** [38] who studied the effect of a health literacy approach to counseling on the lifestyle of women with gestational diabetes and mentioned there was a significant

difference in the mean score of health literacy immediately and three weeks after the intervention among the intervention group. On the other hand this result is inconsistent with **Tavananezhad et al. (2022)** [39] who studied the relationship between health literacy and empowerment in pregnant women and reported that "understanding" and "accessing" obtained the highest and the lowest scores in health literacy domains, respectively this may be due to the differences in the study population. The present study revealed that a high statistically significant correlation between knowledge, attitudes and self-care practices and counseling based on health literacy model pre and immediately post program. This may be due to effectiveness counseling based on health literacy model program among pregnant women with gestational diabetes. This result is consistent with **Johnson (2014)** [40] who mentioned that health literacy is very important to improve women's knowledge to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion. This study is congruent with **Al Sayah, et al. (2013)** [41] who studied health literacy and health outcomes in diabetes and reported consistent evidence of a positive associations between health literacy and diabetes knowledge.

In addition, this study result is similar to **Fadaiyan Arani et al. (2016)** [42]. who studied the relationship between health literacy and knowledge in rural patients with type 2 diabetes mellitus in 2016 and showed a significant relationship between health literacy and knowledge (r=0.265 and p<0.003), as people's health literacy increased their knowledge of their illness increases.

Moreover, the current study is congruent with **Rahimi, et al. (2022)** [43] who studied the relationship between health literacy and self-care in Afghan pregnant mothers with chronic diseases and indicated a significant direct linear relationship between health literacy score and self-care, meaning that with increasing health literacy of pregnant mothers with diabetes, their self-care increased. In addition, Shi **et al. (2010)** [44] studied improving glycaemic control self-efficacy and glycaemic control behaviour in Chinese patients with type 2 diabetes mellitus and showed that health literacy was associated with improving blood glucose self-monitoring behaviors.

Regarding effect of counseling based on health literacy model on maternal and neonatal outcomes follow up at time of delivery, the present study revealed that only two tenth of them were suffered from complication during pregnancy, more than half of them complained from genital tract infection during pregnancy where there was high statistically significant relation between self-care practice and pregnancy complication. And less than one third from total studied women suffered from complication during labor, more than one third of them had cesarean section, there was significant statistically relation between self-care practices and labor complication. less than half from total studied women their neonatal exposed to complication and less than half of them had macrosomic baby, there was high statistically significant relation between self-care practice and neonatal complication.

This result agrees with Reisi **et al. (2016)** [45] who studied impact of health literacy, self-efficacy, and outcome expectations on adherence to self-care behaviors in Iranians with type 2 diabetes and suggested that health literacy is effective in improving health outcomes such as self-care behaviors . The current study is also in the same line with **Yee et al. (2021)** [46] who

studied association of health literacy among nulliparous individuals and maternal and neonatal outcomes and reported that women with inadequate health literacy had higher maternal and neonatal health risks. Additionally, Participants who had inadequate health literacy had greater risk of cesarean delivery (adjusted risk ratio [aRR], 1.11; 95% CI, 1.01-1.23) and major perineal laceration (aRR, 1.44; 95% CI, 1.03-2.01). The adjusted risks of small-for-gestational-age status (aRR, 1.34; 95% CI, 1.14-1.58), low birth weight (aRR, 1.33; 95% CI, 1.07-1.65), and 5-minute Apgar score less than 4 (aRR, 2.78; 95% CI, 1.16-6.65) were greater for neonates born to participants with inadequate health literacy.

In addition, this study agrees with **Walters et al. (2020)** [47]. who studied establishing the efficacy of interventions to improve health literacy and health behaviors and indicated that health literacy interventions can improve health literacy and can also lead to changes in health behaviours. health literacy interventions offer a way to improve outcomes for women's most at risk of health inequalities. This study is also in the same line with **Nawabi, et al. (2021)**[48] who studied health literacy in pregnant women and showed that health literacy sensitive interventions during pregnancy is beneficial for all pregnant women regardless of their educational and health literacy levels. Moreover, the current study agrees with **Berkman et al. (2011)** [49] who studied low health literacy and health outcomes: an updated systematic review and reported that Low health literacy is associated with poorer health outcomes and poorer use of health care services.

On the other hand, the results of the current study contrast with **Muche et al. (2020)** [50] who studied the effects of gestational diabetes mellitus on risk of adverse maternal outcomes in Northwest Ethiopia and reported that the incidence of composite adverse maternal outcome was higher among women with GDM compared with women without GDM (8.1%). Specifically, the incidence of caesarean delivery, pregnancy induce hypertension, premature rupture of membrane, induction of labor, antepartum hemorrhage, and postpartum hemorrhage was higher among women with GDM than those without GDM. This indicated that GDM can result a higher maternal morbidity. This difference may be due to improvement self-care practice of the studied pregnant women.   .

Conclusion

Based on the findings of the present study, it can be concluded that counseling based on health literacy model regarding gestational diabetes has a positive effect on women's knowledge, attitudes and self-care practices with favorable maternal and fetal outcomes. Moreover, there was a highly statistically difference between counseling based health literacy model items among studied pregnant women pre and immediately post program. The above-mentioned findings have mainly supported the study hypotheses and achieved the aim of the study.

Recommendations:

The study suggests the following recommendations

- Development of a training program and evidence based interventions to provide a better view of the women health literacy promotion strategies.

- Conducting educational sessions and training manual aids to improve maternal health literacy.

- Providing antenatal care for group is more effective on maternal health literacy than individual care.

- Continuity of counseling intervention programs for women and nurses to promote health literacy.   .

Further studies are needed regarding:

- Effect of educational intervention based on self-efficacy theory on health literacy among pregnant women.
- Effect of a standard care model on women's health literacy.

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