

Gestational Diabetic Women's Compliance with Their Therapeutic Regimen

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Abstract: Gestational diabetes mellitus (GDM) is a global health concern, not only because its prevalence is high and on the increase, but also because of the potential implications for the health of mothers and their offspring. It is defined as any degree of glucose intolerance with an onset or first recognition during pregnancy and diagnosed in the second or third trimester of pregnancy. **Objective:** This study aimed to identify gestational diabetic women's compliance with their therapeutic regimen. **Design:** A descriptive research design was used to accomplish this study. **Setting:** EL-Shatby Maternity University Hospital affiliated to Alexandria University. **Tools:** two tools was used to collect the necessary data, Tool(I) Gestational diabetic women's basic data structured interview schedule, Tool (II) gestational diabetic women's compliance with their therapeutic regimen interview schedule. **Results:** It was found that (62%) of studied women with gestational diabetes were moderately compliant with their therapeutic regimen, about one-third (34%) of them were not compliant with their therapeutic regimen. On the other hand, only (4%) were compliant with their therapeutic regimen. **Conclusion:** Women with gestational diabetes tend to moderately comply with their therapeutic regimen.

Keywords: Gestational Diabetes, Compliance, Therapeutic Regimen.

1. INTRODUCTION

Pregnancy is a state of high metabolic activity associated with insulin resistance (IR) and hyperinsulinemia. Physiological resistance to insulin action during pregnancy becomes more apparent in the second trimester, and insulin resistance increases progressively to term. If resistance to maternal insulin action becomes too pronounced, maternal hyperglycemia occurs and gestational diabetes mellitus (GDM) may be diagnosed (Farrar et al., 2016).

Gestational diabetes mellitus (GDM) is a global health concern, not only because its prevalence is high and on the increase, but also because of the potential implications for the health of mothers and their offspring. It is defined as any degree of glucose intolerance with an onset or first recognition during pregnancy and diagnosed in the second or third trimester of pregnancy (Koning, Hoogenberg, Lutgers, Van den Berg & Wolfenbuttel, 2016).

The International Diabetes Federation (IDF) estimated that 16.2% of live births to women in 2017 had some form of hyperglycemia in pregnancy, an estimated 86.4% of those cases were due to gestational diabetes mellitus there are some regional differences in the prevalence of hyperglycemia in pregnancy, with the South-East Asia Region having the highest prevalence at 24.2% compared to Middle East and North Africa 21.8% (Ceriello & Colagiuri, 2008).

GDM has wide-ranging consequences for both the mother and the fetus; GDM increases the risk of a number of short-term and long-term maternal health issues and may increase the risk of additional pregnancy complications, including preterm birth and preeclampsia, and, in many cases, surgical delivery of the baby is required.

Approximately 60% of women with a past history of gestational diabetes develop T2DM later in life. GDM can cause fetal overgrowth, often resulting in macrosomia at birth and a risk factor for shoulder dystocia—a form of obstructed labor. Thus, babies are usually delivered by caesarean section. Once delivered these babies have increased risk of hypoglycemia. In the long term, babies are at increased risk of obesity and T2DM (Plows, Stanley, Baker, Reynolds & Vickers, 2018).

All pregnant women without known pre-existing diabetes should be screened for gestational diabetes between 24 to 28 weeks of pregnancy. GDM can be diagnosed by using the same criteria used to diagnose type one diabetes mellitus (T1D) and T2D: fasting plasma glucose (FPG) concentration of >126 mg/dl on two separate occasions or a random blood glucose concentration of >200 mg/dl on two separate occasions. HbA1c is important to detect pre-gestational diabetes but is often normal in GDM particularly in the first trimester (Qvigstad, 2018).

Most cases of gestational diabetes (GDM) can be managed by lifestyle modification specifically, medical nutrition therapy (MNT) and exercise. Pharmacologic agents are recommended if lifestyle interventions alone fail to control glucose levels. The recommended glycemic targets for women with GDM are as follows: Fasting blood glucose ≤ 5.3 mmol/L (95 mg/dl); 1h post-prandial ≤ 7.8 mmol/L (140 mg/dl) or 2h post-prandial ≤ 6.7 mmol/L (120 mg/dl) (Bhavadarini et al., 2016).

MNT is first-line therapy in the treatment of GDM. So, adherence to this dietary pattern has been associated with a 30% reduction in the incidence of GDM, as well as a reduction in adverse perinatal outcomes (Negrato, Mattar & Gomes, 2012). According to the American Diabetes Association (ADA) and American College of Sports, participation in regular physical activity improves blood glucose control. Most benefits of physical activity on diabetes management are realized through acute and chronic improvements in insulin action, accomplished with both aerobic and resistance training (Hayashi & Suganuma, 2016).

Blood Glucose test during pregnancy is an integral part of standard diabetes care. It allows pregnant women and their healthcare providers to determine the most effective therapeutic modality to control glucose levels and reduce risks of diabetes-related complications (Negrato et al., 2012). If MNT and physical activity are not successful in bringing blood glucose levels to below 95 mg/dL (<5.3 mmol/L) fasting, below 140 mg/dL (7.8 mmol/L) 1-hour postprandial, and below 120 mg/dL (6.7 mmol/L) 2-hour postprandial, then insulin should be initiated. Approximately 20% of women with GDM require insulin during their pregnancy (Berry, Johnson & Stuebe, 2015).

Optimal glucose control can be achieved through strict compliance to insulin therapy, diet, and lifestyle modifications. Compliance is defined as the extent to which an individual's medication use behavior coincides with medical advice, and persistence as the duration of time from initiation to discontinuation of therapy for diabetic women. Medication use 'behavior' includes taking insulin injections, following diets, blood glucose monitoring, and making several lifestyle changes (Attyia, El Bahnasy, Abu Salem, Al-Batanony & Ahamed, 2013).

Women non-compliance to therapeutic strategies is a serious concern that poses a great challenge to the successful delivery of healthcare. This is widespread and has been reported from all over the world. Compliance to diabetes management (Bhandiwad, Divyasree & Gowda, 2015). Hence the current study aimed to identify gestational diabetic women's compliance with their therapeutic regimen. Such knowledge would enlighten the path to improve the quality of the services, which would ultimately lead to a decrease in both maternal morbidity and mortality.

Aim of the Study:

To identify gestational diabetic women's compliance with their therapeutic regimen.

Research Question:

What is the compliance level of gestational diabetic women's with their therapeutic regimen.

2. MATERIALS AND METHODS

Research design:

A descriptive research design was utilized in this study.

Setting:

This study was conducted at ante-natal of outpatient clinic of El-Shatby Maternity University Hospital affiliated to Alexandria University. This hospital was selected because it is concerned with provision of maternity care within the city of Alexandria and the surrounded rural areas

Subjects:

A convenient sample of 150 women with GDM was recruited from the previously mentioned setting according to the following criteria:

- Pregnant women 1st diagnosed with GDM
- Free from co existing medical diseases
- Free from associated obstetric complications.
- In the 2nd and 3rd trimester of pregnancy.
- Willing to participate in the study.

Tools:

Two tools were used to collect data of the present study

Tool one: Gestational diabetic women's basic data structured interview schedule:

This tool was developed by the researcher. It included two main parts:

Part I: Socio-demographic characteristics and clinical data:

Part II: Reproductive history such as: _Gravidity, parity, number of abortions, stillbirths, number and sex of living children. The profile of current pregnancy: whether it was planned or not, weeks of gestation, time of first antenatal visit, number of antenatal visits, reasons for current visit, inter-pregnancy interval as well as the sex and condition of the fetus according to the ultrasound report.

Tool two: gestational diabetic women's compliance with their therapeutic regimen interview schedule:

This tool was developed by the researcher after extensive review of recent & relevant literatures to identify gestational diabetic women's compliance with their therapeutic regimen through the previous 72 hrs. It entailed 30 items divided into 4 sections related to insulin therapy (6 items), diet (9 items), physical activity \ exercise (11 items), and self-blood sugar test (4 items).

Each one item was scored on a three point likert - scale ranging from 1-3: always (3); sometimes (2) and never (1)

Total scores ranged from (30 -90) subject's compliance level was categorized as follow:-

- Compliant (≥ 70)
- Moderate compliant (50-<70)
- Not compliant (<50)

Method:

- Permission from Faculty of Nursing - University of Alexandria was directed to the responsible authorities of the previously mentioned study setting.
- Tools were developed by the researcher based on extensive review of recent and relevant literatures.
- Tools were tested for content validity by a Jury of five experts in the field. The recommended modifications were done and the final form was prepared after proving valid.
- Tools reliability were accomplished by cronbach's alpha test and the result was statistically acceptable at $r = 0.776$.

- A pilot study was conducted on 15 pregnant women from the previously mentioned setting (excluded from the study subjects) to ascertain the clarity, feasibility and applicability of the tools and to identify obstacles that might interfere with the process of data collection.
- Each subject was individually interviewed during her ante-natal visit. The duration of each interview ranged between 20-30 minutes. Two days / week were specified for data collection over a period of six months, started from the end of June till the end of December 2019. An average of 2- 3 interviews were performed /day.
- RBS test was done by the researcher for all study subjects by using the same glucose check device and sterile blood lancets. The value of the test was used as a reference value for women's compliance.

Statistical analysis:

-The collected data was revised, categorized, coded, computerized, tabulated & analyzed. Analysis of data was carried out using statistical package for social sciences (SPSS) version 18.

-Analysis of categorical data: cross tabulation with percentages were used to explore relationships between variables.

Appropriate tests such as Chi-square at 0.05 level of significance were used

Ethical considerations:

The purpose of the study was explained to each nurse and then securing the subjects, informed written consent, keeping her privacy & right to withdraw at any time as well as assuring confidentiality of her data.

3. RESULTS

Table (1): Distribution of women with gestational diabetes according to their socio-demographic characteristics:

Socio-demographic characteristics	Total N=150	
	No	%
Age (years)		
▪ 20-	14	9.3
▪ 25-	25	16.7
▪ 30-	55	36.7
▪ 35-40	56	37.3
Min – Max	20 – 40	Mean ± SD32.29±4.931
Marital status		
▪ Married	147	98.0
▪ Divorced/ Separated	3	2.0
Level of education		
▪ Illiterate	35	23.3
▪ Read & Write	15	10.0
▪ Basic education	23	15.3
▪ Secondary / technical education	62	41.3
▪ University / Post university education	15	10.0
Occupation		
▪ Housewife	112	74.7
▪ Working	38	25.3

Current residence		
▪ Urban	78	52.0
▪ Rural	72	48.0
Type of family		
▪ Nuclear	90	60.0
▪ Extended	60	40.0
Family income/ month		
▪ Enough	11	7.3
▪ Hardly enough	105	70.0
▪ Not enough	34	22.7
Smoking status		
▪ Non smoker	116	77.3
▪ Passive smoker	34	22.7

Table (1): show Distribution of women with gestational diabetes according to their socio-demographic characteristics It was found that women’s age of the study subjects ranged from 20 to 40 years with a mean of 32.29 ± 4.931 , more than one-third (36.7%) of them aged 30 to less than 35 years and 37.3% had 35 or more. The majority of the study subjects were married (98%), slightly more than two-fifths of them (41.3%) had secondary or technical education while less than one-quarter of them (23.3%) were illiterate. An equal proportion of them (10%) was just read and writes or had university and post university education. About three-quarters (74.7%) of the study subjects were housewives while the rest of them (25.3%) were working. Also, more than one-half (52%) comes from urban areas and three-fifths of them (60%) live within nuclear families. 70% of them reported that they had hardly enough income and only (7.3%) had enough monthly income. Lastly, it was observed that more than three-quarters (77.3%) of women of the study subjects were non smokers while about one-quarter (22.7%) of them were passive smokers

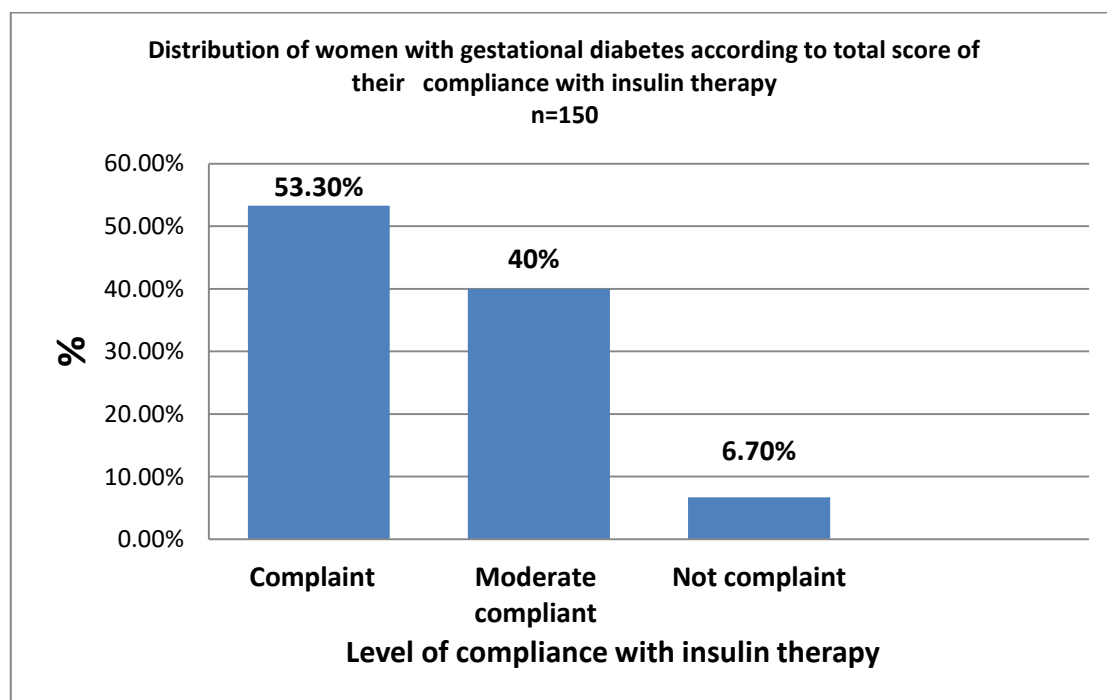


Figure (1): Distribution of women with gestational diabetes according to total score of their compliance with insulin therapy. More than one-half (53.3%) of women with gestational diabetes of the study subjects were compliant

with their insulin therapy, two-fifths (40%) of them were moderately compliant while only (6.7%) of them were not compliant with their insulin therapy.

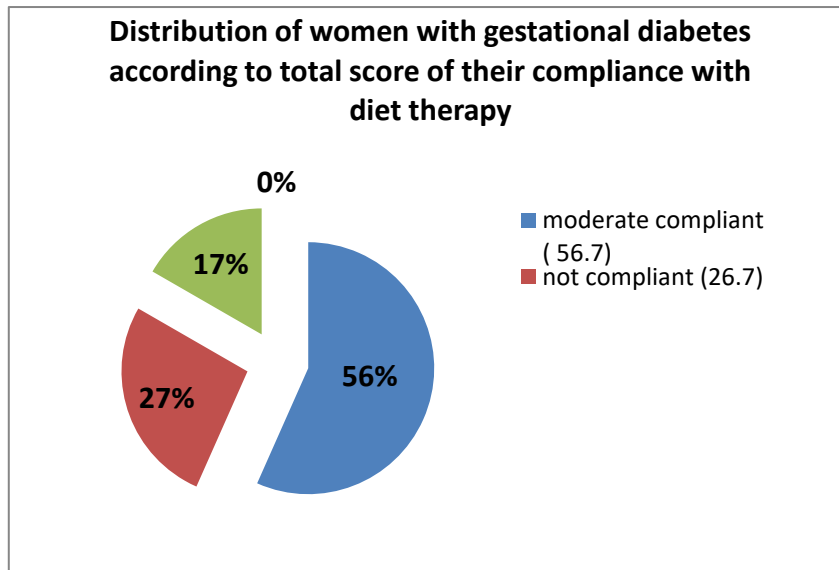


Figure (2) illustrates distribution of women with gestational diabetes according to total score of their compliance with diet therapy. It was noted that more than one-half (56.7%) of women were moderately compliant with their diet therapy, more than one-quarter (26.7%) of them were not compliant with their therapy. On the other hand, only (16.6%) of them were compliant with their diet therapy.

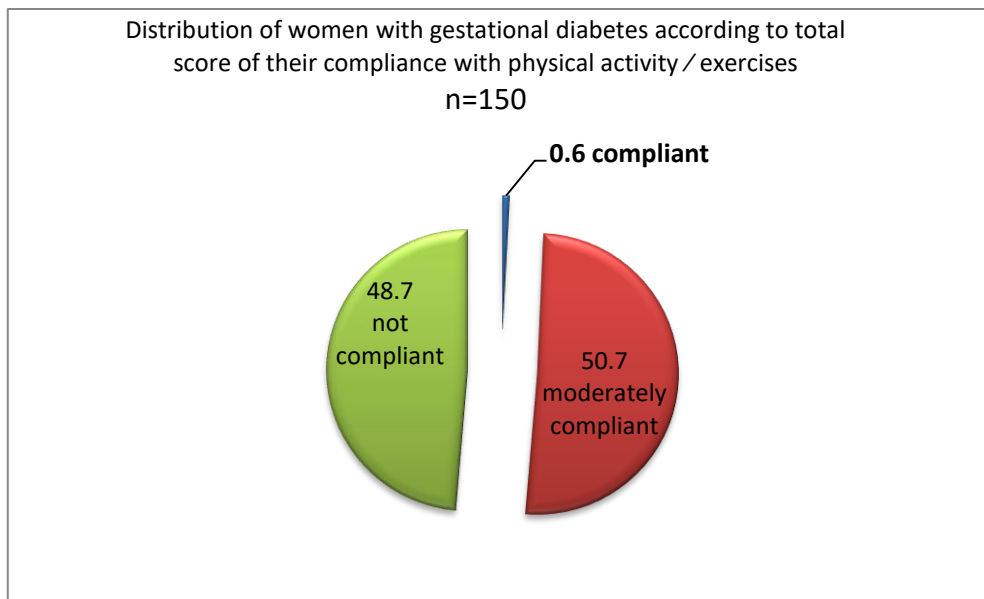


Figure (3) presents distribution of women with gestational diabetes according to total score of their compliance with physical activity / exercises. The figure reveals that about one-half (50.7%) of study subjects with gestational diabetes were moderately compliant with their physical activity/exercises, less than one-half (48.7%) of them were not compliant with their therapy. A minority (0.6%) of studied women were compliant with their physical activity/exercises therapy.

Table (2): Distribution of women with gestational diabetes according to their level of compliance with blood sugar testing:

Blood sugar testing	Levels of Compliance					
	Never		Sometimes		Always	
	No	%	No	%	No	%
Regular self checking of blood sugar level	1	0.7	128	85.3	21	14.0
Checking blood sugar at least 3 times / day	132	88.0	17	11.3	1	0.7
Recording results of the test	71	43.3	62	41.3	17	11.3
Communicating the results with doctor.	46	30.7	78	52.0	26	17.3

Table (2) exhibits distribution of women with gestational diabetes according to their level of compliance with blood sugar test. Results revealed that the majority (85.3%) of the women were sometimes compliant with regular self checking of blood sugar level while (88%) of them were never compliant with checking blood sugar test at least 3 times / day.

Furthermore, more than two-fifths (43.3%) of the women were never compliant with recording results of the blood test. Slightly more than one-half (52%) of them were sometimes compliant with communicating the results with doctor

Figure (4): Distribution of women with gestational diabetes according to their overall total score of compliance with therapeutic regimen:

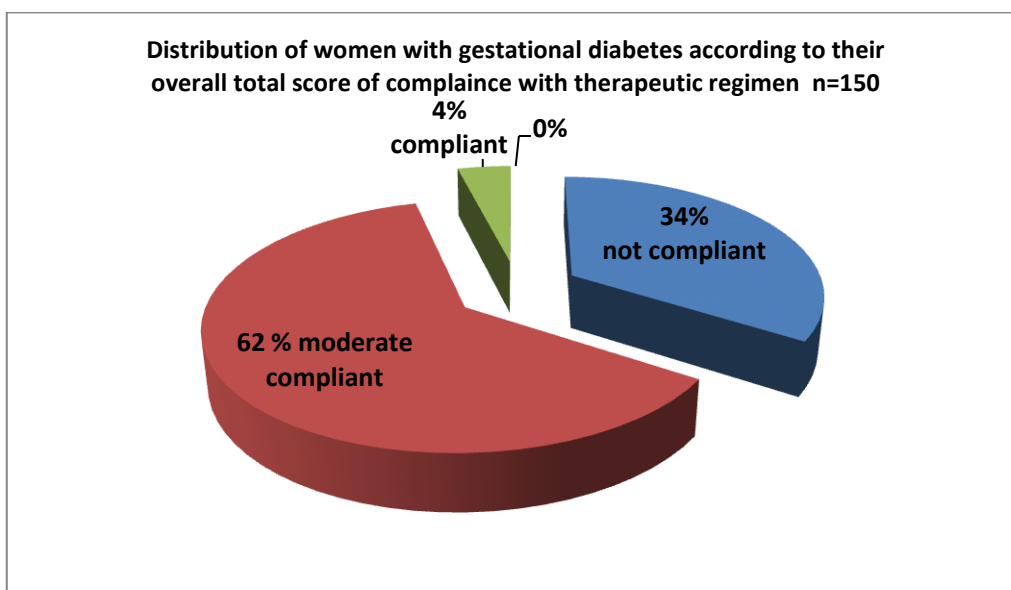


Figure (4) shows distribution of women with gestational diabetes according to their overall total score of compliance with their therapeutic regimen. The figure shows that about two-thirds (62%) of studied women with gestational diabetes were moderately compliant with their therapeutic regimen, about one-third (34%) of them were not compliant with their therapeutic regimen. On the other hand, only (4%) were compliant with their therapeutic regimen

Table (3): Relationship between the gestational diabetic women’s levels of compliance and their socio-demographic characteristics:

Socio-demographic characteristics	Levels of Compliance						Total N=150		Test of significance
	Non-compliant (N=51)		Moderate compliant (N=93)		Compliant (N=6)				
	No	%	No	%	No	%	No	%	
Age									
• 20-	6	42.9	7	50.0	1	7.1	14	9.3	X ² =9.013 P=0.173
• 25-	9	36.0	14	56.0	2	8.0	25	16.7	

▪ 30-	12	21.8	42	76.4	1	1.8	55	36.7	
▪ 35-40	24	42.9	30	53.6	2	3.6	56	37.3	
Marital status									
▪ Married	49	33.3	93	63.3	5	3.7	147	98.0	X ² = 28.071
▪ Divorced / Separated	2	66.7	0	0.0	1	33.3	3	2.0	P=0.000*
Level of education									
▪ Illiterate	13	37.1	20	57.1	2	5.7	35	23.3	X ² = 8.501 P=0.580
▪ Read & Write	4	26.7	11	73.3	0	0.0	15	10.0	
▪ Basic education	9	39.1	13	56.5	1	4.3	23	15.3	
▪ Secondary/ technical education	21	33.9	40	64.5	1	1.6	62	41.3	
▪ University/ Post university education	4	30.8	9	9.7	2	15.4	15	10	
Occupation									
▪ Housewife	41	36.6	69	61.6	2	1.8	112	74.7	X ² = 6.314
▪ Working	10	26.3	24	63.2	4	10.5	38	25.3	P=0.043*
Current residence									
▪ Urban	26	33.3	48	61.5	4	5.1	78	52.0	X ² = 0.544
▪ Rural	25	34.7	45	62.5	2	2.8	72	48.0	P=0.762
Type of family									
▪ Nuclear	38	42.2	50	55.6	2	2.2	90	60.0	X ² = 7.759
▪ Extended	13	21.7	43	71.7	4	6.7	60	40.0	P=0.021*
Family income/ month									
▪ Not enough	5	45.5	4	36.4	2	18.2	11	7.3	X ² = 9.109 P=0.054*
▪ Hardly enough	36	34.3	65	61.9	4	3.8	105	70.0	
▪ Enough	10	29.4	24	70.6	0	0.0	34	22.7	
Smoking status									
▪ No	43	37.1	68	58.6	5	4.3	116	77.3	X ² = 2.484
▪ Yes (passive smoker)	8	23.5	25	73.5	1	2.9	34	22.7	P=0.289

Table (3): Elaborates the relationship between the gestational diabetic women’s levels of compliance and their socio-demographic characteristics: A highly statistical significant relation was noticed between women’s marital status and their compliance level (X²= 28.071, P=0.000) where about two-thirds (63.3%) of married women were moderately compliant compared to divorced / separated women. Also, a statistically significant relation was observed between women’s occupation and compliance level (X²= 6.314, P=0.043) where compliance level was more encountered among housewives compared to working women.

The same table reveals a statistically significant relations between women’s level of compliance and type of family (X²= 7.759, P=0.021) as well as their monthly income (X²=9.109, P=0.054) where compliance level was more encountered among women with extended families and who had hardly enough income. However, no statistical relations were found between gestational diabetic women’s level of compliance and their age (X²= 9.013, P=0.173), level of education (X²= 8.501, P=0.580) as well as smoking status (X²= 2.484, P=0.289).

Table (4): Relationship between the gestational diabetic women’s levels of compliance and their current pregnancy status:

Current pregnancy status	Levels of Compliance						Total N=150		Test of significance
	Non-compliant (N=51)		Moderate compliant (N=93)		Compliant (N=6)				
	No	%	No	%	No	%	No	%	
Weeks of gestation									
▪ 24-	10	66.7	5	33.3	0	0.0	15	10.0	X ² = 12.349 P=0.055
▪ 28-	16	26.2	43	70.5	2	3.3	61	40.7	
▪ 32-	18	40.0	24	53.3	3	6.7	45	30.0	
▪ 36-40	7	24.1	21	72.4	1	3.4	29	19.3	
Desire of the current fetus									
▪ No	24	57.1	18	42.9	0	0.0	42	28.0	X ² = 14.970 P=0.001*
▪ Yes	27	25.0	75	69.4	6	5.6	108	72.0	

Sex of fetus									
▪ Male	22	28.9	54	71.1	0	0.0	76	50.7	X ² = 12.285 P=0.015*
▪ Female	24	38.7	34	54.8	4	6.5	62	41.3	
▪ Don't know	5	41.7	5	41.7	2	16.7	12	8.0	
Ultrasonic fetal condition									
▪ Normal	16	22.5	49	69.0	6	8.5	71	47.3	X ² = 12.988 P=0.011*
▪ Increase in fetal size	34	44.2	43	55.8	0	0.0	77	51.3	
▪ Presence of fetal abnormality	1	50.0	1	50.0	0	0.0	2	1.3	
Number of follow up visits									
▪ < 4	22	37.9	36	62.1	0	0.0	58	38.7	X ² = 4.212 P=0.122
▪ 4 and more	29	31.5	57	62.0	6	6.5	92	61.3	
Time of first follow up visit									
▪ First trimester	31	34.1	54	59.3	6	6.6	91	60.7	X ² = 4.156 P=0.385
▪ Second trimester	17	34.0	33	66.0	0	0.0	50	33.3	
▪ Third trimester	3	33.3	6	66.7	0	0.0	9	6.0	

X² Chi Square Test* statistically significant at ≤ 0.05

Table (4) illustrates the relationship between the gestational diabetic women’s levels of compliance and their current pregnancy status: No significant relations were observed between women’s level of compliance, their duration of pregnancies (X²= 12.349, P=0.055) and pattern of antenatal follow up such as number of follow up visits (X²= 4.212, P=0.122) and time of first visit(X²= 4.156, P=0.385).on the other hand, a significant relationships were observed between women’s level of compliance and their desire for the current pregnancies (X²= 14.970, P=0.001) , fetal sex (X²= 12.285, P=0.015) as well as the ultrasonic fetal conditions(X²= 12.988, P=0.011) where non- compliance is more observed among women who did not desire the current pregnancy (57.1%),didn’t know fetal sex (41.7 %) as well as those who knew the presence of fetal abnormality (50.0%).

4. DISCUSSION

Gestational diabetes mellitus is considered to be the most prevalent metabolic disorder during pregnancy characterized by glucose intolerance of varying severity during pregnancy. It typically occurs during the second trimester of pregnancy and is diagnosed at 24 to 28 week of gestation and usually resolves postpartum and can be controlled by subordinate therapeutic regimen which includes: a meal plan, regular exercise, self-monitoring blood glucose and insulin use. One of the most important factors affecting GDM management is women's compliance with the prescribed regimen. Hence, this study aimed to identify gestational diabetic women's compliance with their therapeutic regimen.

Pregnant women's compliance with therapeutic regimen.

At a glance the present study revealed that about two- thirds of women with gestational diabetes were moderately complying with their therapeutic regimen and about one-third of them were not compliant. These findings may be due to a lack of knowledge about the disease process, the complexity of therapeutic regimen with low motivation to comply with the therapeutic regimen where about half of the study subjects had less than secondary level of education. Also, financial constraint can explain these results where about three-quarters of women's with GDM in the study subjects had hardly enough monthly income. In lower-income groups, the cost can be a reason for a lack of compliance(Nielsen, Kapur, Damm, de Courten & Bygbjerg, 2014).In line with these finding, a cross-sectional analysis of baseline information in a randomized, controlled diabetes intervention study in the USA showed that barriers challenging compliance could be related to socioeconomic issues, paying for medications was a reason for the lack of adherence(Odegard & Gray, 2008; Currie et al., 2012; Antoine, Pieper, Mathes & Eikermann, 2014). similarly, a study in France byGarcía-Pérez, Alvarez, Dilla, Gil-Guillén and Orozco-Beltrán (2013), used a multivariate regression analysis to examine factors associated with adherence, they were determined from a patient-reported questionnaire which concluded that poor adherence was significantly associated with financial difficulties.

On the other hand, these findings contradicted those of Mahmoud et al. (2018), who reported that about two-thirds of the study subjects were unsatisfactory comply with diabetic regimen. Meanwhile less than one third of the study subjects

were satisfactory compliant with their regimen. This variation may be explained by the existing difference between study subjects regarding level of education as well as socio-economic conditions. However, Carolan, Gill and Steele (2012) explained factors that facilitate or inhibit gestational diabetes self-management and denoted that the increased percentage of adequate compliance in women with GDM may be due to the high motivation level of women and fear about their babies, which was reported as a compliance facilitating factor.

Women's compliance with insulin therapy

The current study showed that more than half of women with gestational diabetes were compliant with their insulin therapy. This result may be explained by the fact that women's concerns regarding their health conditions and its subsequent effects on their babies are likely to influence their compliance with insulin therapy as an important aspect of their therapeutic regimen. This was evidenced in their compliance with regular intake of recommended dose of insulin even when this condition was fine. This finding is in an agreement with the previously mentioned study done by Carolan et al. (2012) they also found that women in their study identified the use of insulin as an easier option, rather than dietary control alone and none of the women on insulin therapy expressed any concern about long-term implications of insulin use and were mostly happy to accept it as a solution to the current situation. The researchers related these findings to women's concerns about hyperglycaemia at the same time as encountering difficulties with dietary restrictions and behavioral change. In contrary, Russell-Jones, Pouwer and Khunti (2018) observed that participants in their study had challenges in adherence to insulin therapy and reported a complicated therapeutic regimen that they found overwhelming to follow. They cited the complexity of storage of insulin and self-injection with pricking oneself daily for insulin was very painful and uncomfortable and other barriers may be psychological, including fear of injections and/or fear of self-measuring blood glucose.

Women's compliance with diet therapy

The current study noted that more than one-half of women were moderately compliant with their diet therapy. They tended to eat a balanced diet and always drank at least 2-3 L water/ day. This result is consistent with the study finding of Kio, Kio-Umoru and Olukoso (2015) titled " Assessment of dietary and drug compliance among diabetic pregnant women attending antenatal clinic in Nigeria" who reported that the respondents showed good compliance for most of the dietary recommendations. This result may be attributed to women's interest in maximizing fetal health and this desire motivated them to avoid prohibited food items and to adhere to dietary recommendations as closely as possible.

Parsons et al. (2018) found that women with GDM described being willing to do whatever they were required to do, in the baby's best interests and feeling valued solely as a means to produce a healthy infant, and felt chastised if they failed to adhere to the behaviors required to achieve this. Most understood clearly that GDM could impact negatively on the baby's health. On the other hand, the current study revealed that more than one-quarter of the study subjects showed noncompliance with their dietary therapy. This result may be related to women's socio-demographic characteristics such as: low educational level; limited income and living within extended families which may affect women's dietary choice, decision and adherence with diet therapy. In the same context, two studies support this finding. *First:* a study done by Vizcarra et al. (2019), who demonstrate that Participants explained that they cooked or bought specific types of foods due to the preferences of their family members; they ate or cooked certain foods because it represented a family routine. And added that participants mentioned some situation related to "financial issues" (i.e., situations associated with purchasing food). They had to refrain from eating certain foods and did not have the ability to buy certain kinds of meat such as fish or beef. They also avoided these foods because they did not have enough money to buy them.

Second: a study done by Carolan et al. (2012) denoted that participants in their study, found dietary self-management was difficult, related to the time required to learn food values, and to cook healthy food. Social factors such as eating with family and friends also contributed to the dilemmas women faced, while a lack of clear guidelines was identified as hindering the process of diet control. They added that dietary self-management is recognized as challenging and as requiring motivation, understanding of food values and of the amount to eat. Also, Mukona et al. (2017) explained problems of pregnancy, nausea and vomiting, lack of appetite, cravings, and aversion for certain foods were cited as barriers to adherence to diet. Women reported that they sometimes had aversion to certain healthy foods. Some complained that water was tasteless and difficult to have as the only fluid. Other studies examined women's compliance with diet therapy and documented that women worried that diet was too restrictive for their growing babies and would not

provide the nutrients that the baby required. Also, women with GDM had a specific culture-related diet discussing the impact and difficulty of applying or tailoring the dietary recommendations (Cosson et al., 2017; Craig, Sims, Glasziou & Thomas, 2020).

Women's compliance with physical activity/exercises.

the current study revealed that slightly more than one-half of the study subjects with gestational diabetes were moderately complying with their physical activity \ exercises while, the other half of them were not compliant with maintaining physical activity. This may be attributed to the fact that about one-half of the study subjects were rural resident which in turn affects their compliance with their therapeutic regimen. Moreover, they reported that following exercise plan is too much effort and their time schedule does not allow for regular exercise. They added that bad weather interferes with regular exercise as they worry about low blood sugar when exercising and difficulty to balance between exercise and food intake. These results are consistent with those of Memon et al. (2017), in Saudi Arabia who showed that Patients residing in urban areas followed physicians' advices for daily exercise more in comparison to patients residing in rural areas. Arasoo et al. (2018), in Malaysia examined " Perceived barriers to exercise in women with gestational diabetes mellitus" they demonstrated that full time jobs, tiredness, childcare duties and lack of time were the most common perceived barriers to exercise.

Physical restrictions to exercise in pregnancy were also reported in an Australian study on women with GDM Carolan et al. (2012). Clinical features of diabetes such as polyuria, polydipsia, polyphagia, and fatigue were also mentioned, and these together with the effects of pregnancy further reduce adherence to therapy (Mukona et al., 2019). Although studies suggest that exercise is good in pregnant women, in reality, compliance to diet, exercise, and medications is a major challenge to care in GDM women, given one's cultural habits. There is a need to increase awareness among women on the importance of diet, exercise, and medication while educating them on myths and health facts (Craig et al., 2020).

Women's compliance with blood sugar testing

The results of the present study revealed that about three-quarters of women were not compliant with testing their blood sugar. This may be attributed to the fact that about three-quarters of the study subjects were housewives and had hardly enough income they may perceive more difficulties in perform blood testing which in turn affect their compliance with their therapeutic regimen. This result is in harmony with that of Cosson et al. (2017), who reported that a minority of women had performed the required tests and denoted that poor compliance was associated with a family history of diabetes, social deprivation, memory and non-European origin. And concluded that the usually reported barriers to self monitoring blood glucose (SMBG) include costs for the meters and strips, lower socioeconomic status, stigma of testing in public places, pain, and inconvenience. Mukona et al. (2017), concluded that the most common cited barrier across all focus groups was lack of finances. In terms of medications, participants reported lack of money to buy medications and glucose testing strips, though some of them could acquire glucometers, glucose testing strips and syringes were too expensive for them. These problems have been highlighted in the literature. Shortages of appropriate test strips have been reported to threaten continuity of care in diabetes in pregnancy. Other authors concur that glucometers are quite affordable but test strips are expensive, device-specific, and not always easy to obtain in developing countries Utz, Kolsteren and De Brouwere (2015).

This results is incongruent with the findings of two studies, *first*, by Staynova, Gueorguiev, Petkova-Gueorguieva and Petleshkova (2018) who reported that daily self-monitoring of blood glucose was performed by large proportion of studied women. *Second*, by Bansal et al. (2014), in India who reported that nearly three quarters of the studied sample performed regular monitoring of their blood glucose. This contradiction between the present study and a fare mentioned two studies may be attributed to low socio-economic status of the current study subjects where the costs of the meters and strips hinder the performance of blood glucose test and their ability to interpret the results of blood testing.

To understand the barriers to self monitoring blood glucose SMBG and the factors that determine the compliance of SMBG among GD women, systemic review included relevant articles published between March 2010 and June 2018. The studies reported the following barriers of SMBG in GD women – lack of SMBG-testing recommendation by health-care providers; poor concept; fear; and anxiety about SMBG testing; and family history of Type 2 diabetes The compliance to SMBG-testing in GDM women improved with the use of education and technology (smart phone and mobile-based) (Saha, 2019).

The relationship between the gestational diabetic women's compliance levels and their socio-demographic characteristics On examining the relationship between women's level of compliance and their demographic factors, results revealed a significant relationship between level of compliance and women's occupation, family type and their income. Regarding **occupation**, level of compliance was more encountered among housewives than working women. This result was supported by the study results of Naghavi, Mehroolhassani, Nakhaee and Yazdi-Feyzabadi (2019), in Kerman Iran titled " Effective factors in non-compliance with therapeutic orders of specialists in outpatient clinics in Iran: a qualitative study " they reported that people are involved in different work areas in the community. When people become ill, their work area may affect their compliance, as one of the interviewees stated. The interviewees also mentioned the individual's job type and its characteristics such as job-related travels and job conditions are factors that can lead to noncompliance.

Moreover, Mukona et al. (2017), found that the majority of non-compliant participants were unemployed and depended on husbands and family for support. This compromised their ability to deal with the demands of diabetes in pregnancy. This has also been reported in the literature by authors who cited non adherence to therapy related to lack of financial resources and limited access to health care among the most common barriers to care in uninsured women (Bell, 2015).

Concerning **family type**, the present study showed that about three-quarters of gestational diabetic women living within extended families were moderately compliant to their therapeutic regimen. This may be attributed to the fact that family members can actively support and care for women's with diabetes. Most individuals live within households that have a great influence on diabetes-management behaviors. So, researchers highlighted the importance of family members in improving well-being and self-management. They are often asked to share in the responsibility of disease management. They can provide many forms of support, such as instrumental support in driving women's to appointments or helping inject insulin, and social and emotional support in helping women cope with their health condition through their communications and attitudes. Family members often have a significant impact on a women's psychological well-being, decision to follow recommendations for medical treatment, and ability to initiate and maintain changes in diet and physical activity /exercise (Miller & Dimatteo, 2013; Mulala, 2017; Ramkisson, Pillay & Sibanda, 2017).

In relation to **Family income**, moderate level of compliance was more encountered among those women who had enough family income. In line with this result, Alava et al (2014), found a significant relationship between the women's income and their adherence to prescribed regimen They documented that respondents skipped taking medication due to insufficient income. Despite no significant relationship was found between women's level of compliance and their **age**, **level of education** as well as their **residency**, the results of the study have important implications for nurses caring for women's with GDM.

Concerning **age**, the results revealed that noncompliance was observed among women aged either less than 25 years or 35 years or more. In agreement with these results Kio et al. (2015), found that the lower level of compliance was reported in women more than 30 years of age. It was proven that level of compliance decreases with aging for more reasons. For example, increased the potential of mistakes in taking medications as well as increased duties. As regards **level of education**, the present study revealed that women's compliance was apparent among women with higher educational level Serap and Bayram (2015), in Turkey documented that with increasing illiteracy, the degree of compliance decreases for several reasons, for example: increased the potential of mistakes in taking medications, lack of knowledge about importance of compliance with therapeutic regimen in the management of gestational diabetes. Studies found that low literacy among disadvantaged women had a significant impact on their understanding of GDM information and their compliance. And they recommended the importance of developing new educational interventions to target those with lower health literacy as well as cultural factors when diagnosing and managing multi-ethnic populations with GDM (Carolan, 2014; Yuen & Wong, 2015). The current study results revealed that compliance was more encountered among urban than rural **residence**, this result is in line with the findings of Nashaat (2017), who showed that the compliance is affected by the residence and the social class, all the individuals living in urban areas were highly compliant to therapy than others, where several reasons as distance to health care setting, economical status of rural women, level of education, therapy center accessibility, difficulty travelling, less encouragement from family/spouse for exercise, difficulty in remembering exercises and lifestyle habits and how to relate to health services were the factors that presented association with non-adherence.

The relationship between the gestational diabetic women's compliance levels and their current pregnancy status:

The results of the current study exhibited a significant relationship between women's level of compliance and sex of their fetuses, ultrasonic fetal conditions and their desire for the current pregnancy.

As regards, **sex of the current fetus**, it was evident that women who had male fetuses were more compliant with their regimen. This result is supported by Retnakaran and Shah (2016), who explained that fetal sex should be evaluated as a factor that might potentially contribute to clinical prediction of the risk of progression to Type 2 diabetes. Specifically, fetal sex has recently emerged as a novel factor that may affect the adaptive response of the maternal β cells and the mechanism by which it does so remains unclear. They added that the negative impact of a male fetus on maternal β cell function potentially may be restricted to the pregnant state because the delivery of a boy did not appear to adversely affect future diabetic risk in the mother compared with delivery of a girl. In addition, the impact of some cultural factors such as son preference explains the existing association.

As regards ultrasonic fetal examination, the present study revealed that about half of non-complaint women had an increased fetal size. This result is not in agreement with the finding of the study done by Tabrizi et al. (2019), in Iran which demonstrated that reducing the risk of macrosomia, blood glucose concentrations should be monitored during pregnancy by complaint women. Also Dietary therapy and exercise should be used to decrease GDM-related adverse outcomes. In addition, Barakat, Pelaez, Lopez, Lucia and Ruiz (2013), demonstrated that 58% reduction in GDM-related risk of having a newborn with macrosomia can be achieved through practicing exercise. Moreover, Asemi, Samimi, Tabassi and Esmailzadeh (2014) and Tabrizi et al. (2019) indicated that the adherence to dietary approaches led to lower rates of macrosomic babies. The results of this study may be attributed to the fact of about three-quarters of women were obese ($BMI \geq 30$) which in turn effects on their fetal size led to macrosomia this result supported by findings of Ouzounian et al. (2011), in USA who reported that women with an obese BMI were twice as likely to have a macrosomic infant compared with women in the normal BMI and Concluded that maternal pre-pregnancy weight and weight gain during pregnancy appear to be significant and independent risk factors for macrosomia in women with gestational diabetes. In addition, the results of the current study also revealed that moderate compliance was more encountered among women who had **desire or planned for the current pregnancy** than unplanned pregnancy. This finding is supported by Exavery et al. (2013), in Tanzania who explained how mistimed and unwanted pregnancies affect timing of antenatal care initiation in three districts in Tanzania. It was proven that the initiation of antenatal care was delayed among mothers who have unwanted or mistimed pregnancy. In fact, planned pregnancy as well as adequate antenatal care and follow-up especially among women with gestational diabetes are highly recommended. Hence, it fraught with challenges, one of these challenges is the adherence to GDM therapeutic regimen.

It was surprising that no significant relation was found between women level of compliance among the current study subjects and their **patterns of ante natal visits** where, moderate compliance was evident among women who had 4 or more visits. This may be attributed to the fact about three-quarters of the study subjects had desire for current pregnancy which in turn affected compliance with their therapeutic regimen and follow-up visits. The current findings is partially in agree with the study done by Ghaffari, Salsali, Rahnavard and Parvizy (2014) in titled " Compliance with treatment regimen in women with gestational diabetes: Living with fear" , who reported that most participants understood the importance of antenatal care, and that GDM management required a holistic support system. Therefore, all the participants consulted healthcare professionals for antenatal services.

5. CONCLUSION

Gestational diabetic women tend to moderately comply with their therapeutic regimen. Women from low socio economic backgrounds such as literacy level or income often struggle to comply with GDM self-management requirements and therapeutic regimen.

6. RECOMMENDATIONS

- Decentralization of screening for gestational diabetes and initial management of uncomplicated cases at the primary level of care could ease access to care.
- Educational and supportive services that are culturally appropriate and aimed at women with low level of literacy.

- Mass media sectors should be utilized in dissemination of simple information that rise awareness of women regarding importance of pre-conceptual counseling, antenatal follow up, early screening of GDM and self- management
- Conduct a similar study at different settings on a large scale

REFERENCES

- [1] Antoine, S.L., Pieper, D., Mathes, T., & Eikermann, M. (2014). Improving the adherence of type 2 diabetes mellitus patients with pharmacy care: a systematic review of randomized controlled trials. *BMC endocrine disorders*, 14, 53.
- [2] Arasoo, V.J.T., Dominic, N.A., Ramadas, A., Lim, K.H., Tionga, C.W., Liew, E., . . . & Jeganathan, R. (2018). Perceived Barriers to Exercise in Women with Gestational Diabetes Mellitus. *IIUM Medical Journal Malaysia*, 17(3).
- [3] carolan, M., Gill, G.K., & Steele, C. (2012). Women's experiences of factors that facilitate or inhibit gestational diabetes self-management. *BMC Pregnancy Childbirth*, 12, 99.
- [4] Asemi, Z., Samimi, M., Tabassi, Z., & Esmailzadeh, A. (2014). The effect of DASH diet on pregnancy outcomes in gestational diabetes: a randomized controlled clinical trial. *European journal of clinical nutrition*, 68(4), 490-495.
- [5] Attyia, A., El Bahnasy, R., Abu Salem, M., Al-Batanony, M., & Ahamed, A. (2013). Compliance of diabetic patients with the prescribed clinical regimen. *Menoufia Medical Journal*, 26(1), 54-57.
- [6] Bansal, P., Chaudhary, A., Gupta, V.K., Satija, M., Giridhar, S., & Kaushal, P. (2014). Compliance of known diabetics regarding treatment and monitoring in rural Ludhiana. *Int J Res Health Sci*, 2(1), 172-176.
- [7] Barakat, R., Pelaez, M., Lopez, C., Lucia, A., & Ruiz, J.R. (2013). Exercise during pregnancy and gestational diabetes-related adverse effects: a randomised controlled trial. *British journal of sports medicine*, 47(10), 630-636.
- [8] Bell, J. (2015). Reducing Barriers to Glucose Control in Patients with Gestational Diabetes: How to Help Patients Overcome Knowledge Gaps, Treatment Nonadherence, and Financial Constraints. *American Nurse Today*, 10(1), 1.
- [9] Berry, D.C., Johnson, Q.B., & Stuebe, A.M. (2015). Monitoring and managing mothers with gestational diabetes mellitus: a nursing perspective. *Nursing: Research and Reviews*, 5, 91-97.
- [10] Bhandiwad, A., Divyasree, B., & Gowda, S.L. (2015). Adverse maternal and perinatal outcomes in gestational diabetes mellitus. *International Journal of Medical Research & Health Sciences*, 4(4), 775-777.
- [11] Bhavadharini, B., Mahalakshmi, M.M., Anjana, R.M., Maheswari, K., Uma, R., Deepa, M., . . . & Kayal, A. (2016). Prevalence of Gestational Diabetes Mellitus in urban and rural Tamil Nadu using IADPSG and WHO 1999 criteria (WINGS 6). *Clinical diabetes and endocrinology*, 2(1), 8.
- [12] Carolan, M. (2014). Diabetes nurse educators' experiences of providing care for women, with gestational diabetes mellitus, from disadvantaged backgrounds. *Journal of clinical nursing*, 23(9-10), 1374-1384.
- [13] Carolan, M., Gill, G.K., & Steele, C. (2012). Women's experiences of factors that facilitate or inhibit gestational diabetes self-management. *BMC Pregnancy Childbirth*, 12, 99.
- [14] Ceriello, A., & Colagiuri, S. (2008). International Diabetes Federation guideline for management of postmeal glucose: a review of recommendations. *Diabetic Medicine*, 25(10), 1151-1156
- [15] Cosson, E., Baz, B., Gary, F., Pharisien, I., Nguyen, M.T., Sandre-Banon, D., . . . & Valensi, P. (2017). Poor Reliability and Poor Adherence to Self-Monitoring of Blood Glucose Are Common in Women With Gestational Diabetes Mellitus and May Be Associated With Poor Pregnancy Outcomes. *Diabetes Care*, 40(9), 1181-1186.
- [16] Craig, L., Sims, R., Glasziou, P., & Thomas, R. (2020). Women's experiences of a diagnosis of gestational diabetes mellitus: a systematic review. *20(1)*, 76.
- [17] Exavery, A., Kanté, A.M., Hingora, A., Mbaruku, G., Pemba, S., & Phillips, J.F. (2013). How mistimed and unwanted pregnancies affect timing of antenatal care initiation in three districts in Tanzania. *BMC pregnancy and childbirth*, 13(1), 35.

- [18] Farrar, D., Simmonds, M., Griffin, S., Duarte, A., Lawlor, D.A., Sculpher, M., . . . & Bland, M. (2016). The identification and treatment of women with hyperglycaemia in pregnancy: an analysis of individual participant data, systematic reviews, meta-analyses and an economic evaluation. *Health technology assessment*, 1-348.
- [19] Ghaffari, F., Salsali, M., Rahnavard, Z., & Parvizy, S. (2014). Compliance with treatment regimen in women with gestational diabetes: living with fear. *Iranian journal of nursing and midwifery research*, 19(7 Suppl1), S103.
- [20] Hayashi, A., & Suganuma, N. (2016). Physical activity for gestational diabetes mellitus. *Clinics Mother Child Health*, 13(2), 238.
- [21] Kio, J., Kio-Umoru, O., & Olukoso, Z. (2015). Assessment of Dietary and Drug Compliance among Diabetic Pregnant Women Attending Antenatal Clinic in Nigeria. *Journal of Advances in Medicine and Medical Research*, 1-9.
- [22] Koning, S.H., Hoogenberg, K., Lutgers, H.L., Van den Berg, P.P., & Wolffenbuttel, B.H.R. (2016). Gestational Diabetes Mellitus: current knowledge and unmet needs. *Journal of diabetes*, 8(6), 770-781.
- [23] Mahmoud, N.M., yousef Mohammed, N., & Essa, R.M. (2018). The Relationship between Health Belief Model and Compliance with Therapeutic Regimen Among Diabetic Pregnant Women. *International Journal For Research In Health Sciences And Nursing*, 4(2), 40-63.
- [24] Memon, A.R., Randhawa, M.A., Alshammari, S.O.M., Alanazi, A.B., Alshammari, A.A.M.N., Alrawaili, Y.S.H., & Alrawaili, Y.S.K. (2017). Compliance to diabetic therapy. *The Professional Medical Journal*, 24(03), 466-472.
- [25] Miller, T.A., & Dimatteo, M.R. (2013). Importance of family/social support and impact on adherence to diabetic therapy. *Diabetes, metabolic syndrome and obesity : targets and therapy*, 6, 421-426.
- [26] Mukona, D., Munjanja, S.P., Zvinavashe, M., & Stray-Pederson, B. (2017). Barriers of Adherence and Possible Solutions to Nonadherence to Antidiabetic Therapy in Women with Diabetes in Pregnancy: Patients' Perspective. *Journal of diabetes research*, 2017, 3578075.
- [27] Mukona, D., Munjanja, S.P., Zvinavashe, M., Dodzo, L.G., & Chituku, S. (2019). The Subjective Impact of Diabetes in Pregnancy: A Qualitative Study. *EC Diabetes and Metabolic Research*, 3(3), 76-82.
- [28] Mulala, L.I. (2017). *Diabetes Self Care Behaviors and Social Support Among African Americans in San Francisco* (Ph.D Thesis). Walden University.
- [29] Naghavi, S., Mehroolhassani, M.H., Nakhaee, N., & Yazdi-Feyzabadi, V. (2019). Effective factors in non-compliance with therapeutic orders of specialists in outpatient clinics in Iran: a qualitative study. *19*(1), 413.
- [30] Nashaat, N. (2017). Socioeconomic Determinants Affecting Compliance to therapy in Patients with Congenital Hypothyroidism in Sharkia Governorate. *The Egyptian Family Medicine Journal*, 1(1), 1-11.
- [31] Negrato, C.A., Mattar, R., & Gomes, M.B. (2012). Adverse pregnancy outcomes in women with diabetes. *Diabetology & metabolic syndrome*, 4(1), 1-6.
- [32] Nielsen, K.K., Kapur, A., Damm, P., de Courten, M., & Bygbjerg, I.C. (2014). From screening to postpartum follow-up - the determinants and barriers for gestational diabetes mellitus (GDM) services, a systematic review. *BMC Pregnancy Childbirth*, 14, 41.
- [33] Odegard, P.S., & Gray, S.L. (2008). Barriers to medication adherence in poorly controlled diabetes mellitus. *The Diabetes educator*, 34(4), 692-697.
- [34] Ouzounian, J., Hernandez, G., Korst, L., Montoro, M., Battista, L., Walden, C., & Lee, R. (2011). Pre-pregnancy weight and excess weight gain are risk factors for macrosomia in women with gestational diabetes. *Journal of Perinatology*, 31(11), 717-721.
- [35] Parsons, J., Sparrow, K., Ismail, K., Hunt, K., Rogers, H., & Forbes, A. (2018). Experiences of gestational diabetes and gestational diabetes care: a focus group and interview study. *BMC Pregnancy Childbirth*, 18(1), 25.

- [36] Plows, J.F., Stanley, J.L., Baker, P.N., Reynolds, C.M., & Vickers, M.H. (2018). The pathophysiology of gestational diabetes mellitus. *International journal of molecular sciences*, 19(11), 3342.
- [37] Qvigstad, E. (2018). The diversity of gestational diabetes: a therapeutic challenge. *European journal of endocrinology*, 178(3), C1-C5.
- [38] Ramkisson, S., Pillay, B.J., & Sibanda, W. (2017). Social support and coping in adults with type 2 diabetes. *African journal of primary health care & family medicine*, 9(1), e1-e8.
- [39] Retnakaran, R., & Shah, B. (2016). Sex of the baby and future maternal risk of Type 2 diabetes in women who had gestational diabetes. *Diabetic Medicine*, 33(7), 956-960.
- [40] Russell-Jones, D., Pouwer, F., & Khunti, K. (2018). Identification of barriers to insulin therapy and approaches to overcoming them. *Diabetes, obesity & metabolism*, 20(3), 488-496.
- [41] Saha, S. (2019). Compliance and barriers to self-monitoring of blood glucose in patients with gestational diabetes mellitus: A systematic review. *International journal of health sciences*, 13(3), 44-52.
- [42] Serap, T., & Bayram, S. (2015). Factors influencing adherence to diabetes medication in Turkey. *Scholar Journal of Applied Medical Sciences (SJAMS)*, 3, 602-607.
- [43] Staynova, R., Gueorguiev, S., Petkova-Gueorguieva, E., & Petleshkova, P. (2018). A comparative study on diabetes self-management in pregnant women with gestational diabetes and pre-existing diabetes. *Biomedical Research*, 29(18).
- [44] Tabrizi, R., Asemi, Z., Lankarani, K.B., Akbari, M., Khatibi, S.R., Naghibzadeh-Tahami, A., . . . & Khodadost, M. (2019). Gestational diabetes mellitus in association with macrosomia in Iran: A meta-analysis. *Journal of Diabetes & Metabolic Disorders*, 18(1), 41-50.
- [45] Utz, B., Kolsteren, P., & De Brouwere, V. (2015). Screening for Gestational Diabetes Mellitus: Are Guidelines From High-Income Settings Applicable to Poorer Countries? *Clinical diabetes : a publication of the American Diabetes Association*, 33(3), 152-158.
- [46] Vizcarra, M., Palomino, A.M., Iglesias, L., Valencia, A., Gálvez Espinoza, P., & Schwingel, A. (2019). Weight Matters-Factors Influencing Eating Behaviors of Vulnerable Women. *Nutrients*, 11(8), 1809.
- [47] Yuen, L., & Wong, V.W. (2015). Gestational diabetes mellitus: challenges for different ethnic groups. *World journal of diabetes*, 6(8), 1024.