ORIGINAL RESEARCH PAPER

Volume-7 | Issue-8 | August-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREVALENCE OF GESTATIONAL DIABETES MELLITUS, PREGNANCY OUTCOMES, AND AWARENESS OF POSTPARTUM GESTATIONAL DIABETES MELLITUS AMONG SAUDI WOMEN DELIVERED AT MATERNITY AND CHILDREN HOSPITAL IN DAMMAM, SAUDI ARABIA: 2017-2018

Obstetrics & Gynecology

Dr.Ranyah Al Ameer Ministry of Health Family Medicine Post-Graduate Program in Eastern Province in Saudi Arabia

Dr.Waleed Al Harbi* Ministry of Health Family Medicine Post-Graduate Program in Eastern Province in Saudi Arabia *Corresponding Author

ABSTRACT

Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy. The aim of this study was to evaluate the prevalence, risk factors, and maternal and infant outcomes of women with GDM and to assess the awareness toward postpartum GDM. This is a descriptive cross-sectional study of 1050 women who attended and delivered at Maternity and Children Hospital, Dammam, Saudi Arabia,. The prevalence of GDM was 3.05%, and its only risk factor was history of GDM. GDM mothers were at increased risk of pregnancy-induced hypertension, preterm labor, intensive care unit admission, and delivery with caesarian section. Infants born to GDM mothers were at high risk of macrosomia, neonatal hypoglycemia, neonatal hypocalcaemia, and respiratory distress syndrome. Approximately half of GDM mothers had postpartum GDM. Thirty percent of women had adequate level of awareness and the importance of postpartum follow-up.

KEYWORDS

gestational diabetes mellitus (GDM), oral glucose tolerance test (OGTT), neonatal intensive care unit (NICU)

BACKGROUND

Diabetes is one of the major public health concerns, and its prevalence is progressively increasing worldwide, especially in developing countries, owing to the lack of qualified health-care professionals specialized in the prevention and treatment of the disease. According to the latest report of the World Health Organization on diabetes, global prevalence has quadrupled to 422 million adults,[1] and similar patterns are noted in Saudi Arabia. It is estimated that about 3.5 million of the Saudi population have diabetes. Diabetes is causing a financial crisis of the Saudi health care system," and in the next 10 years, the cost of medical health-care including treatment of diabetes and its related complications is estimated to be 6.5 billion Saudi Riyals.[2]

Fortunately, this epidemic can be reduced by early recognition of factors that increase the risk of diabetes. One of the common preventable forms of diabetes is gestational diabetes mellitus (GDM). Early detection of this condition and providing the best care to the mother and her fetus can prevent the progression to chronic diabetes later on life.

Pregnancy is associated with relative increase in insulin resistance due to secretion of human placental lactogen hormone, especially during the third trimester. Consequently, when the body cannot overcome these normal physiological changes, GDM occurs.[3] GDM is defined as "a condition of glucose intolerance with onset or first recognition during in pregnancy that is not clearly overt diabetes."[4]

The prevalence of GDM varies between countries depending on the area of study, ethnicity, study design, and diagnostic criteria used. The prevalence of GDM has increased worldwide, in concordance with the increasing prevalence of type 2 diabetes and obesity worldwide.[5] During the last 5 years, a number of national studies have reported different prevalence rates of GDM, varying from 12.5% to 51%.[6] The latest study conducted in Madinah Maternity and Children Hospital evaluated the prevalence of GDM among Saudi women using a new diagnostic criteria (International Association of Diabetes and Pregnancy) and determined that it increased to 51%.[7]

GDM has many risk factors including family history of diabetes, higher body mass index, GDM in previous pregnancies, ethnicity, maternal age >35 years, multiparity, and history of macrosomia in pervious pregnancies.[8] Although the risk factors of GDM are well identified, the prevalence of risk factors of GDM differs among societies. A prospective study in Jeddah, Saudi Arabia, found that the most significant risk factors were maternal age, weight, and parity.[9]

The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study conducted in Saudi women with GDM found that the prevalence of GDM increased with previous history of GDM, babies with macrosomia (>4.5 kg), and higher BMI.[10]

Currently, the American Diabetes Association (ADA) recommends "screening all pregnant women at risk of diabetes during the first antenatal visit using standard diagnostic criteria and those without known diabetes should be screened at 24-28 weeks using oral glucose tolerance test (OGTT) either of two strategies: one-step approach, administering a 75-g oral glucose challenge test or two-step approach with a 50-g non fasting, followed by a 100-g fasting test for those who screen positive."[11]

GDM is the most common metabolic disease during pregnancy, and women with GDM are at risk of developing serious antepartum, intrapartum, and postpartum complications. A hospital-based study conducted in Qatar Women's Hospital in 2011 found a significant association between GDM and development of preeclampsia, antepartum hemorrhage, pregnancy induced hypertension, preterm labor and cesarean delivery.[12]

In 2010, the *Journal of Maternal-Fetal and Neonatal medicine* published a new article about the fetal and maternal consequences of GDM, stating that the most frequent cause of morbidity for infants of GDM mothers were large for gestational age (LGA) and respiratory distress syndrome. LGA is associated with significantly increased risk of cesarean delivery, shoulder dystocia, and neonatal asphyxia.[13]

A prospective cohort study conducted in Riyadh that evaluated the risk of neonatal intensive care unit (NICU) admission among infants delivered by diabetic mothers found that the rate of admissions, pregnancy complications, and mode of delivery were highly significant. The risk of NICU admission is 2.5 times higher in women delivered with non-spontaneous delivery and 4.6 times higher with preterm births and 2 times higher with polyhydramnios and LGA.[14]

GDM has long-term health implications on the mother and her offspring. Women with GDM are at increased risk for developing type 2 diabetes. A systematic review and meta-analysis of 20 cohort studies evaluated the risk of type 2 diabetes in women diagnosed with GDM and found that the risk of developing chronic diabetes is higher among GDM women, with a relative risk 7.4%.[15]

A retrospective cohort study of 344 women diagnosed at the Women and Infants Hospital of Rhode Island and referred for maternal diabetes from 2001 to 2004 assessed the postpartum glucose testing rates and prevalence of women with persistent hyperglycemia and found that "45% of the participants underwent the test at 6 weeks postpartum and about 36% of them had persistent glucose intolerance."[16]

Prevention of type 2 diabetes especially in high-risk groups is essential to prevent coronary artery disease. A large prospective cohort study showed that mothers with previous GDM are at higher risk for developing coronary vascular disease events following pregnancy and that the risk is increased mainly due to subsequent development of type 2 diabetes.[17]

The *American Journal of Obstetrics and Gynecology* published an

article in 2010 about the risk of recurrence of GDM in subsequent pregnancies, stating that the recurrence rate is increased by 13.2-fold in the second pregnancy and increased by 25-fold in the third pregnancy.[18]

A large retrospective cohort study conducted in Nova Scotia, Canada, from 1980 to 1996 found that the recurrence rate of GDM was 35% higher with subsequent pregnancies. Maternal obesity and infant birth weight are significantly associated with the recurrence rate.[19]

Children of GDM mothers are more likely to develop early-onset type 2 diabetes and obesity. Childhood obesity is high among Saudi adolescents.[20] It is associated with multiple factors including high blood pressure, type 2 diabetes, cardiovascular disease and psychosocial dysfunction. Hence, stopping this cycle through early detection of GDM and providing the best care to the mother during pregnancy is essential.

A review of studies found that the offspring of GDM mother have double risk of developing obesity, type 2 diabetes, and/or metabolic syndrome later in life compared with the control group.[21]

GDM is one of the most common metabolic diseases during pregnancy. Effective glycemic control is essential to reduce the adverse maternal outcomes. A study was conducted in 2016 suggested that medical nutrition therapy plays an important role in the management of GDM and in positive maternal and neonatal outcomes. The main objective of medical nutrition therapy is to ensure adequate pregnancy weight gain and fetal growth while maintaining a euglycemic state. If glycemic control is not achieved through this measure, insulin and/or oral hypoglycemic medications should be initiated.[2Y] A systematic review and meta-analysis of randomized controlled trials compared the effect of oral hypoglycemic medications versus insulin in GDM management and found no differences in glycemic control or pregnancy outcomes between both groups.[23]

Postpartum follow-up is essential for all women diagnosed with GDM. Early diagnosis and adequate treatment of prediabetes or type 2 diabetes can prevent long-term diabetic complications. Therefore, the latest recommendation of the ADA is to "test women with GDM for persistent diabetes at 4-12 week's postpartum using the OGTT and women with history of diabetes mellitus should have lifelong screening at least every three years."[24]

Awareness of GDM among women in reproductive age is essential for prevention and early diagnosis of disease. Identifying the gap in the knowledge is of particular importance to determine the needs for establishing health educational program. In 2013, a cross-sectional study determined the awareness of GDM among 120 Indian women in primary health-care centers. The data were collected using a pretested questionnaire, and 17.5% of the participants were found to have good knowledge, 56.7%, fair knowledge, and 25.8%, poor knowledge of GDM.[25]

GDM is a condition that can be effectively controlled, thereby decreasing the associated risks and eventually leading to the delivery of healthy infant. Appropriate management of GDM will improve both maternal and neonatal outcomes.

Owing to the differences among national study results and the lack of studies determining the prevalence of GDM in the eastern province in Saudi Arabia, accurate determination of GDM prevalence in our community using appropriate research methodology and summarizing the most prevalent modifiable and non-modifiable influencing factors for better monitoring and better planning is necessary.

METHODS

This cross-sectional study was conducted at the Maternity and Children Hospital in Dammam, Saudi Arabia. The study included all Saudi pregnant women who delivered at the hospital between May 1, 2017, to April 30, 2018. Exclusion criteria included non-Saudi nationality, multiple gestation, known case of diabetes, long-term medical and surgical conditions, and drugs that may affect glucose metabolism. The Institutional Review Board (IRB) research committee and the local committee of the Saudi Board of Family Medicine, Maternity and Children Hospital, approved the study prior to its implementation.

A national study in Riyadh has previously estimated the prevalence of GDM to be 12.5%, with a precision of 2% and a 95% confidence interval (CI). The sample size needed was estimated to be 1050 pregnant women.

The list of all pregnant Saudi women who attended and delivered at Maternity and Children Hospital from May 1, 2017, to April 30, 2018, was generated along with the month of delivery. A probability proportional to the sample size was done to randomly select pregnant women in order to assess the prevalence of GDM and its risk factors.

The data were collected from antenatal medical records. There were 41 questions classified into four parts: personal data, risk factors of GDM, OGTT results, glycemic control during pregnancy, and maternal and neonatal outcomes. The checklist form adapted from the ADA, which included age and nationality, family history of diabetes, history of recurrent abortion, history of GDM in prior pregnancies, history of preterm delivery, history of stillbirth, history of neonatal deaths, history of large baby, history of malformed baby, history of gestational HTN, history of preeclampsia, gestational hypertension, polycystic ovary syndrome, and glycosuria.

Maternal and neonatal outcomes obtained after delivery included pregnancy-induced hypertension, preeclampsia, urinary tract infections, antepartum hemorrhage, preterm labor, premature rapture of membrane, polyhydramnios, gestational age at delivery (weeks), type of delivery, shoulder dystocia, intensive care unit (ICU) admission, abortion, stillbirth, neonatal death, fetal injury, birth weight, hypoglycemia, hyperbilirubinemia, hypocalcemia, hypomagnesemia congenital malformation, respiratory distress syndrome, and NICU admission.

Fasting plasma glucose, glycated hemoglobin, and random plasma glucose concentrations were obtained for all participants at the first antenatal visit. In women with normal results, screening for GDM was performed at 24 to 28 weeks of gestation, with a two-step 75-g OGTT. GDM was diagnosed if one or more the following values equaled or exceeded its threshold. High-risk women were screened with OGTT at the first antenatal visit and women who had GDM were treated with diet, exercise, and insulin, as needed.

The data were collected by telephone interview to assess the awareness toward postpartum GDM follow-up using a validated questionnaire. A pilot study with 100 pregnant women responded to the questionnaire on postpartum care for GDM. The reliability of the questionnaire was calculated using Cronbach's alpha, with 0.805 showing good internal consistency. A group of six experts rated each question of the postpartum questionnaire and scored it to assess the content validity of the questionnaire. The content validity index was 0.97, showing that the questionnaire is valid.

The sample collected for the pilot was used to assess the level of awareness of postpartum GDM follow-up among pregnant women. The questionnaire consisted of 13 questionnaire, and 11 were questions on awareness. Each correct response was given a score of 1 and all other responses were given a score of 0. The total scores were converted into percentages and categorized for the level of awareness. If the total score was <50%, the level of awareness was low; between 50 and 74.99, moderate level of awareness; 75%, adequate level of awareness. Thus, among the 104 women studied in the pilot study, 18 (17.3%) had adequate level of awareness, 44 (42.3%) had moderate level of awareness, and 42 (40.4%) had low level of awareness on postpartum DM follow-up.

Data management

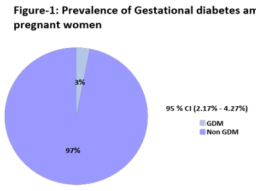
The collected data were entered into MS Excel 2010 and was later imported into SPSS version 23 (IBM, Chicago, IL, USA). The prevalence of GDM among the pregnant women was expressed as proportion with 95% CIs. A chi-squared test or Fisher's exact test was used determine the differences in the proportions in the risk factors between the GDM and non-GDM groups. A univariate logistic regression analysis was used determine the significant risk factors for GDM, and those that were significant at 10% level were included in the multivariate logistic regression analysis using the enter method. The risks for various outcomes of pregnancy caused by GDM were reported using odds ratio (OR) and 95% CIs. A P value <0.05 was considered statistically significant.

Results

Prevalence of GDM

Of the 1050 pregnant women studied, 32 had GDM; thus, the prevalence of GDM was 3.05% (95% CI 2.17%-4.27%) (Figure 1).

Figure 1: Prevalence of gestational diabetes among pregnant women



Risk factors of GDM

The risk factors of GDM are given in Table 1. The unadjusted logistic regression analysis showed family history of diabetes, larger categories of BMI, history of GDM, history of large baby, history of GDM, history of large baby, history of gestational hypertension, and history of polycystic ovary syndrome in previous pregnancy were significant risk factors for GDM. However, the multivariate (adjusted) logistic regression showed that the history of GDM in the previous pregnancy was the only significant risk factor for GDM.

Table 1: Logistic regression to identify the risk factors of gestational diabetes mellitus

Characteristic	Unadjusted			Adjusted		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Parity						
<2	1.412	0.605-3.296	0.425	1.800	0. 653-4.964	0.256
2-3	0.524	0.180-1.530	0.237	0.666	0.198-2.240	0.512
>3 (Reference)						
Family history						
Yes	2.994	0.865-10.358	0.083	1.343	0.292-6.176	0.705
No (Reference)						
BMI						
<22.9 (Reference)						
23-24.9	1.299	0.080-21.059	0.854	1.383	0.085-22.521	0.820
25-29.9	1.771	0.205-15.323	0.604	1.555	0.168-14.376	0.697
>30	5.589	0.747-41.825	0.094	4.429	0.571-34.358	0.155
History of GDM in previous pregnancy						
Yes						
No (Reference)	36.214	6.998-187.395	0.000	70.792	9.046-554.000	0.000
History of large baby						
Yes						
No (Reference)	7.724	1.597-37.351	0.011	1.322	0.082-21.269	0.844
History of Gestational Hypertension						
Yes						
No (Reference)	9.799	2.590-37.075	0.001	2.742	0.321-23.387	0.356
History of PCO						
Yes						
No (Reference)	16.879	1.488-191.481	0.023	9.079	0.657-125.413	0.100

OR: odds ratio; CI: confidence interval.

Maternal and neonatal complications associated with GDM

Table 2 shows the risk for various pregnancy complications related to GDM. The presence of GDM was found to increase the risk of pregnancy-induced hypertension with OR=7.019 (95% CI 2.255-21.850, P=0.001), preterm labor with OR=2.972 (95% CI 1.183-7.465, P=0.020), ICU admission with OR=8.408 (95% CI 0.912-77.510, P=0.060), birth with lower gestational age with OR=3.931 (95% CI 1.752-8.818, P=0.001), neonatal hypoglycemia with OR=15.474 (95% CI 3.802-62.982, P=0.000), neonatal hypoglycemia with OR=2.877 (95% CI 1.328-6.235, P=0.007), neonatal hypocalcemia with OR=33.867 (95% CI 2.069-554.418, P=0.014), and respiratory distress syndrome with OR=2.965 (95% CI 1.101-7.988, P=0.032)

Table 2: Comparison between GDM and non-GDM on various pregnancy outcomes

Variable	Non-GDM	GDM	OR	95% CI	P value
Polyhydraminos	0.8	3.4	4.509	0.545-3.2847	0.162
Pregnancy induced hypertension	2.1	12.9	7.019	2.255-21.850	0.001
Preeclampsia	1.4	3.2	2.390	0.304-18.774	0.407
UTI	4.4	3.2	0.720	0.096-5.399	0.749
Preterm labor	7.5	19.4	2.972	1.183-7.465	0.020
Pre mature rupture of membrane	6.2	9.7	1.622	0.480-5.483	0.436
Laceration	11.3	6.9	0.584	0.137-2.489	0.467
ICU admission	0.4	3.2	8.408	0.912-77.510	0.060
Birth (Preterm)	9.8	30.0	3.931	1.752-8.818	0.001
Neonatal hypoglycemia	0.7	9.7	15.474	3.802-62.982	0.000
Neonatal hyperbilirubinemia	14.2	32.3	2.877	1.328-6.235	0.007
Neonatal hypocalcemia	0.1	3.2	33.867	2.069-554.418	0.014
Respiratory distress syndrome	6.1	16.1	2.965	1.101-7.988	0.032
NICU admission	6.8	12.9	2.025	0.689-5.951	0.200

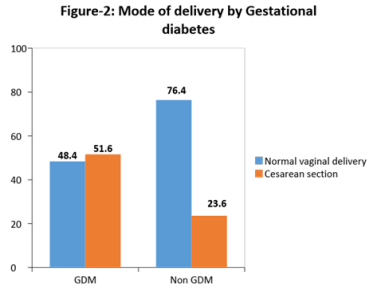
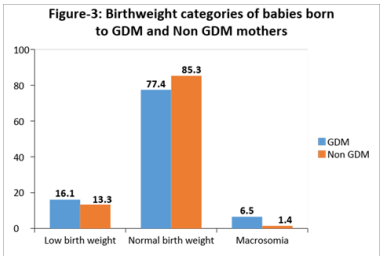


Figure 3: Birth weight categories of babies born to mothers with and without gestational diabetes mellitus



The comparison of mode of delivery among GDM and non-GDM mothers was given in Figure 2. It shows that cesarean section was predominantly seen more in the GDM (51.6%) than in the non-GDM (23.6%) group. The birth weight categories of babies born to GDM and non-GDM mothers showed that in both the group normal birth weight was predominantly see in both groups (Figure 3).

Postpartum follow-up of GDM mothers

Of the 32 GDM mothers, only 20 responded to the postpartum follow-up survey (response rate, 62.5%). Table 3 shows the general characteristics of the GDM mothers.

Table 3: General characteristics of postpartum GDM mothers

Characteristics	Frequency	Percentage
Age		
<25 years	4	20.0
25-34 years	11	55.0
35-45 years	5	25.0
Education		
Primary	3	15.0
Secondary	2	10.0
University	15	75.0
Occupation		
Not working	16	80.0
Working	4	20.0
House type		
Villa	1	5.0
Traditional house	1	5.0
Apartment	18	90.0
Monthly income		
<5000	4	20.0
5000-9999	7	35.0
10000-14999	4	20.0
15000-20000	5	25.0
Consanguinity		
Yes	8	40.0
No	12	60.0
History of smoking		
Yes	1	5.0
No	19	95.0
Physical activity		
Sedentary	6	30.0
Light	10	50.0
Moderate	4	20.0

Table 4: Postpartum follow-up of GDM mothers

Characteristics	Frequency	Percentage
Being delivered with GDM will (are) you follow(ing) up?		
Yes	10	50.0
No	10	50.0
Being delivered with GDM where will you follow up?		
PHC	1	11.1
Hospital	6	66.7
Home	2	22.2
When did(will) you visit the doctor?		
After 6 weeks of delivery	7	35.0
After 6 months of delivery	1	5.0
After 1 year of delivery	-	-
I don't know	12	60.0
Being positive for GDM for this delivery, when will you get yourself tested during your next pregnancy?		
First trimester	11	55.0
Second trimester	3	15.0
Third trimester	-	-
I don't know	6	30.0
Do you think it is necessary to stop taking the medications for GDM immediately after delivery?		
Yes	7	35.0
No	4	20.0
I don't know	9	45.0
Do you think that GDM will increase the risk of being diabetic?		
Yes	12	60.0
No	2	10.0
I don't know	6	30.0
Do you think being positive for GDM in this pregnancy will increase the risk of being GDM positive in your next pregnancy too?		
Yes	12	60.0
No	2	10.0
I don't know	6	30.0
If you are a GDM mother, do you think is it necessary for an ultrasound in the second trimester to detect any congenital anomaly?		
Yes	16	80.0
No	-	-
I don't know	4	20.0
Do you think GDM will increase the risk of congenital anomaly?		
Yes	13	65.0
No	1	5.0
I don't know	6	30.0
Do you think uncontrolled GDM will increase the risk of abortion?		
Yes	13	65.0
No	3	15.0
I don't know	4	20.0
Do you think uncontrolled GDM will increase the risk of premature delivery?		
Yes	17	85.0
No	-	-
I don't know	3	15.0
Do you think uncontrolled GDM will increase the risk of IUFD?		
Yes	12	60.0
No	1	5.0
I don't know	7	35.0
Do you think uncontrolled GDM will increase the risk for the infant being admitted in the ICU?		
Yes	18	90.0
No	-	-
I don't know	2	10.0

The mothers answered the survey questions regarding the postpartum follow-up now or during the next pregnancy with regard to GDM. Table 4 shows that 50% of them had or would follow up and 50% hadn't

(wouldn't) follow up with regards to GDM. On the question on where would they follow up there was only 9 responses and 6(66.7%) would follow up at the hospital. About 7(35.0%) visited the doctor after 6 weeks of delivery. During the next pregnancy 11 (55.0%) would visit the doctor during their first trimester. About 9(45.0%) didn't know and 7 (35.0%) said yes for the question "Is it necessary to stop taking the medications for GDM immediately after delivery?" And 12(60.0%) of them believed that being GDM positive would increase their risk for diabetes and 12(60.0%) of them believed that being GDM positive would increase their risk for GDM in their next pregnancy too. Sixteen (80.0%) said that it would be necessary for an ultrasound in the second trimester to detect any congenital anomaly. Thirteen (65.0%) said that GDM will increase the risk for congenital anomaly and a same proportion believed that it would increase the risk for abortion. Around 17 (85.0%) believed that it would increase the risk for premature delivery, 12 (60.0%) believed that it would increase the risk for IUFD and 18 (90.0%) believed that it would increase the risk for the infant being admitted to the ICU.

The level of awareness of postpartum GDM follow-up among mothers who delivered with GDM was assessed. The postpartum questionnaire and the scoring pattern were the same as in the pilot study. Of the 20 GDM mothers who delivered and responded to the questionnaire, 6 (30.0%) had inadequate level of awareness, 8 (40.0%) had moderate level of awareness, and 6 (30.0%) had adequate level of awareness on postpartum follow-up for GDM.

Discussion

To our knowledge, this is the first study in the eastern province in Saudi Arabia emphasizing on the prevalence, risk factors, and outcome of GDM. It is important to measure the prevalence in our community to provide evidence of the magnitude of the problem and to determine the needs in the health-care system, particularly to improve prevention and screening at the primary care level. Recognizing the most prevalent modifiable risk factors of GDM in the society is necessary to develop clinical strategies for primary prevention. Identifying the gap in the knowledge toward GDM and the importance and barriers to postpartum follow-up among childbearing women is essential to increase the awareness for healthier lifestyle, better health-care–seeking pattern, better self-care, and early detection of the disease.

The prevalence of GDM varies worldwide and even within the same country in relation to ethnicity and the screening methods and diagnostic criteria used.

In the present study, the prevalence of GDM was 3.05%. We found a decrease in GDM prevalence in accordance with a previous national study that showed a prevalence of GDM ranging from 10.5% to as high as 51%. [6]

Unlike the other study done in 2015 in Taibha University, Madinah, Saudi Arabia.[7] which suggested that GDM tends to occur more in patients with older age, history of delivering baby with malformation, family history of diabetes, higher BMI, history of GDM, history of large baby, history of gestational hypertension, we found that the history of GDM in the previous pregnancy was the only significant risk factor for GDM. (Table 1).

Our results agree with the findings of a prior national study that showed that infants born to GDM mothers were more likely to develop neonatal hypoglycemia than those born to non-GDM mothers[26] (Table1).

This study showed that the rate of cesarean section was 51.6%, which is higher than that in non-GDM mothers (23.6%) (Figure 2). Similar studies done also showed that women with GDM are more at risk for cesarean sections.[27]The present study found that 22.6% of the birth weight was abnormal, with 16.5% having low birth weight and 6.5% having macrosomia. The increased risk of macrosomia in GDM is mainly due to the increased insulin resistance of the mother, which is similar with the results of a prospective study done in Jeddah, Saudi Arabia, which found that heavier fetal birth weight is a statistically significant complication of GDM.[28]

In our study, we found that preterm delivery was strongly associated with infants born of GDM mothers with OR=2.972 (95% CI 1.183-7.465, P=0.020), which is similar to the findings of a retrospective cohort study performed in northern and central Alberta in Canada between 1991 through 1997.[29]

There are limited international or local data that assessed the awareness toward postpartum follow-up of DM among women in childbearing age. Of the 1050 mother who delivered at Maternity and Children Hospital, only 32 were diagnosed with GDM. The awareness toward postpartum follow-up was conducted through a validated translated Arabic questionnaire among the GDM mother, and 50% had follow-up after delivery mainly at the same hospital. This study showed that 70% of the women had moderate to inadequate understanding of the importance of DM follow-up. Along with screening, more efforts are necessary at the program level to improve the awareness about risk factors, course, and effects of GDM on the woman, as a higher level of awareness will surely improve pregnancy outcomes

Conclusion

In conclusion, the GDM prevalence obtained in this study is 3.05%, which is lower than that of other cities in Saudi Arabia. Previous history of GDM was only the significant risk factor. The presence of GDM was found to increase the risk of pregnancy-induced hypertension, preterm labor, ICU admission, neonatal hypoglycemia, neonatal hypocalcemia, and respiratory distress syndrome. Only 30% of mothers with GDM had adequate level of awareness on postpartum follow-up for DM.

Based on the results of this study, we recommend the following:

- Increase women's awareness about GDM though mass media campaign and promote a healthy lifestyle intervention to prevent GDM and improve the quality of life of pregnant women.
- Establish local Saudi guidelines of GDM as a clear and solid reference for the diagnosis and management of GDM.

Abbreviations

WHO: World Health Organization
GDM: gestational diabetes mellitus
OGTT: oral glucose tolerance test
LGA: large for gestational age
NICU: neonatal intensive care unite

Ethics approval and consent to participate

Approvals from the Ethical Committees of the Post-graduate Saudi Board Program and Ministry of Health in Eastern Province were obtained before conducting the study. Participants were informed that participation in the study was completely voluntary, and all personal information will be kept confidential.

Consent for publication

Not applicable.

Availability of data and materials

The data sets used and analyzed in the current study are available from the corresponding author upon reasonable request.

Competing interests

There are no conflicts of interest.

Funding

None.

Author's Contributions

Ranya Hekmat Al Ameer is the corresponding author; Waleed Al Harbi, a coauthor, contributed as a supervisor and participated in writing the results and discussion.

Acknowledgments

We thank Dr. Waleed Al Harbi and Dr. Nada AbdulRahman Albanian for their support of this work. We give special thanks to our families for their patience and continuous support.

References

1. Diabetes Programme. (2017). World Health Organization. Retrieved April 7, 2016.
2. Alhowaish, A. K. (2013, January 1). Economic costs of diabetes in Saudi Arabia. Journal of Family and Community Medicine, 20, 1.
3. Ecker, J. (2008). Gestational diabetes: an opportunity for improvement. Journal of Clinical Endocrinology & Metabolism, 93, 4646-4647.
4. Standards of medical care in diabetes – 2014. (2013). Diabetes Care, 37(Suppl. 1), S14-S80.
5. Hunt, K. J., & Schuller, K. L. (2007, June 30). The increasing prevalence of diabetes in

pregnancy. Obstetrics and Gynecology Clinics of North America, 34, 173-199.
6. Alzzaqani Ahmad Hasan, A., Alzemily Mohammed Abdulkareem, M., Alshahrani Homood Saeed, A. (2016). A status on gestational diabetes mellitus in Saudi Arabia: a systematic review. Central African Journal of Public Health, 2, 83-88.
7. Alfadhli EM, Osman EN, Basri TH, Mansuri NS, Youssef MH, Assaaedi SA, Aljohanic BA. Gestational diabetes among Saudi women: prevalence, risk factors and pregnancy outcomes. Annals of Saudi medicine. 2015 May 1;35(3):222.
8. Garrison, A. (2015, April 1). Screening, diagnosis, and management of gestational diabetes mellitus. American Family Physician, 91, 460-7
9. Ardawi, M. S., Nasrat, H. A., Jamal, H. S., Al-Sagaaf, H. M., & Mustafa, B. E. (2000). Screening for gestational diabetes mellitus in pregnant females. Saudi Medical Journal, 21, 155-60.
10. Al-Rubeaan, K., Al-Manaa, H. A., Khoja, T. A., Youssef, A. M., Al-Sharqawi, A. H., Siddiqui, K., & Ahmad NA. (2014, August 1). A community-based survey for different abnormal glucose metabolism among pregnant women in a random household study (SAUDI-DM). BMJ Open, 4, e005906.
11. Marathe, P., Gao, H., & Close, K. (2017, January). American Diabetes Association standards of medical care in diabetes 2017. Journal of Diabetes, 35, 5-26.
12. Bener, A., Saleh, N. M., & Al-Hamaq, A. O. (2011, January 1). Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: global comparisons. International Journal of Womens Health, 3, 367-173.
13. Reece, E. A. (2010, March 1). The fetal and maternal consequences of gestational diabetes mellitus. Journal of Maternal-Fetal and Neonatal Medicine, 23, 199-120.
14. Al-Hakeem, M. M. (2006, May 1). Pregnancy outcome of gestational diabetic mothers: Experience in a tertiary center. Journal of Family and Community Medicine, 13, 55.
15. Bellamy, L., Casas, J. P., Hingorani, A. D., & Williams, D. (2009, May 29). Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. The Lancet, 373, 1773-9.
16. Russell, M. A., Phipps, M. G., Olson, C. L., Welch, H. G., & Carpenter, M. W. (2006, December 1). Rates of postpartum glucose testing after gestational diabetes mellitus. Obstetrics & Gynecology, 108, 1456-62.
17. Shah, B. R., Retnakaran, R., & Booth, G. L. (2008, August 1). Increased risk of cardiovascular disease in young women following gestational diabetes mellitus. Diabetes Care, 31, 1668-9.
18. Getahun, D., Fassett, M. J., & Jacobsen, S. J. (2010, November 30). Gestational diabetes: risk of recurrence in subsequent pregnancies. American Journal of Obstetrics and Gynecology, 203, 467-e1.
19. MacNeill, S., Dodds, L., Hamilton, D. C., Armson, B. A., & VandenHof, M. (2001, April 1). Rates and risk factors for recurrence of gestational diabetes. Diabetes Care, 24, 659-62.
20. Al Dhaifallah, A., Mwanri, L., & Aljoudi, A. (2015, January 1). Childhood obesity in Saudi Arabia: opportunities and challenges. Saudi Journal of Obesity, 3, 2.
21. Vohr, B. R., & Boney, C. M. (2008, January 1). Gestational diabetes: the forerunner for the development of maternal and childhood obesity and metabolic syndrome? Journal of Maternal-Fetal and Neonatal Medicine, 21, 149-57.
22. Moreno-Castilla, C., Mauricio, D., & Hernandez, M. (2016, April 1). Role of medical nutrition therapy in the management of gestational diabetes mellitus. Current Diabetes Reports, 16, 1-9.
23. Dhulkotia, J. S., Ola, B., Fraser, R., & Farrell, T. (2010, November 30). Oral hypoglycemic agents vs insulin in management of gestational diabetes: a systematic review and metaanalysis. American Journal of Obstetrics and Gynecology, 203, 457-e1.
24. Koning, S. H., Lutgers, H. L., Hoogenberg, K., Trompert, C. A., van, den, B. erg, P. P., & Wolffenbuttel, B. H. (2016, December 7). Postpartum glucose follow-up and lifestyle management after gestational diabetes mellitus: general practitioner and patient perspectives. Journal of Diabetes & Metabolic Disorders, 15, 56.
25. Shriraam, V., Rani, S. M., Sathiyasekaran, B. C., & Mahadevan, S. (2013, January 1). Awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. Indian Journal of Endocrinology and Metabolism, 17, 146.
26. Ovesen, P., Jensen, D., Damm, P., Rasmussen, S., & Kesmodel, U. S. (2014). Maternal and neonatal outcomes in pregnancies complicated by gestational diabetes. A nation-wide study. Journal of Maternal-Fetal and Neonatal Medicine, 28, 1720–1724.
27. Metzger, B., Lowe, L., Dyer, A., Trimble, E., Chaovarindr, U., Coustan, D. The HAPO Study Cooperative Research Group. (2008). Hyperglycemia and adverse pregnancy outcomes. New England Journal of Medicine, 358, 1991-2002.
28. Ardawi, M. S. M., Nasrat, H. A., Jamal, H. S., Al-Sagaaf, H. M., & Mustafa B. E. (2000). Screening for gestational diabetes mellitus in pregnant females. Saudi Medical Journal, 21, 155-160.
29. Xiong X, Saunders LD, Wang FL, Demianczuk NN. Gestational diabetes mellitus: prevalence, risk factors, maternal and infant outcomes. Int J Gynaecol Obstet 2001;75:221–228. [PubMed: 11728481]