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Post-partum follow-up of women with gestational diabetes mellitus: Effectiveness, determinants, and barriers

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ORIGINAL ARTICLE

Post-partum follow-up of women with gestational diabetes mellitus: effectiveness, determinants, and barriers

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ABSTRACT

Background: Despite the recommendations for postpartum blood glucose monitoring post gestational diabetes mellitus (GDM); scientific evidence reveals that these recommendations may not be fully complied to. This study aimed to follow-up women up to 2 years post-delivery with pregnancies complicated by GDM and healthy controls to assess this fact.

Methods: Women with GDM ($n = 78$) and normal glucose tolerant ($n = 89$) delivered in 2014 were followed up for 2 years. They were informed and enquired via telephone about their blood glucose screening, physical activity, postpartum complications, and current weight status of mother and baby.

Results: Women with previous GDM were older and reported higher body weight 2 years post-delivery. At the 2 year follow-up, $n = 11$ (14.1%) participants had developed diabetes, all with previous GDM. Both weight at birth (3.8 ± 0.5 kg) and at 2-year (10.7 ± 2.3 kg) for the babies born to GDM mothers was significantly higher than the NGT group babies (2.6 ± 0.63 and 7.1 ± 1.4 kg; $p < .05$). Only 27 women regularly opted for T2DM screening via monitoring blood glucose or HbA1c levels postpartum. The top reason for failed screening included: believing that GDM would disappear after delivery, and being occupied with the baby.

Conclusions: The high incidence of T2DM in women with previous GDM is an alarming finding. Given this trend, systematic follow-up programs are needed to reduce obesity and diabetes risk.

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Gestational Diabetes Mellitus; screening; diabetes mellitus; maternal–fetal outcomes

Introduction

Glucose levels are regulated and controlled within set limits that are physiologically ideal for the body to perform all functions. For most healthy individuals, blood glucose levels are tightly controlled between fasting and fed state [1]. Any derangement in these levels may lead to development of diabetes in an individual. One such form of diabetes seen during pregnancy (irrespective of whether the condition prolongs post-partum or not) is commonly referred to as Gestational diabetes (GDM). GDM is widespread around the world, however, the prevalence depends on the country, region within the country, socio-economic status, and dietary habits of an individual, and the criteria used for diagnosis [2]. One in 250 pregnant women in the United Kingdom are diabetic, majority of these cases (87.5%) have GDM [3]. In a recent study conducted by our group, a GDM prevalence of 17% for women visiting tertiary care hospitals in Karachi was reported [4], which is comparable to Western statistics [5]. However, reports have shown that the complication rates are far greater, plausibly due to poor glycemic control in our population [6].

Like other forms of diabetes, gestational diabetes can affect glucose usage by cells which can have repercussions on maternal, fetal, and neonatal health and presently GDM can be used as a predictive indicator of morbidity in index pregnancies [7]. Several trials and studies have shown that it is associated with multiple fetal and maternal complications, some of which are shown in schematic ~~Figures 1 and 2~~ [8]. Even though serious perinatal complications which are specifically related to GDM are uncommon, macrosomia is known to be the predominant complication in cases of GDM. Moreover, the neonate is also at risk of developing several problems shown in ~~Figure 3~~ [9]. In order to prevent these, early screening and strict blood glucose control is recommended in GDM patients. Apart from the complications listed above, an additional

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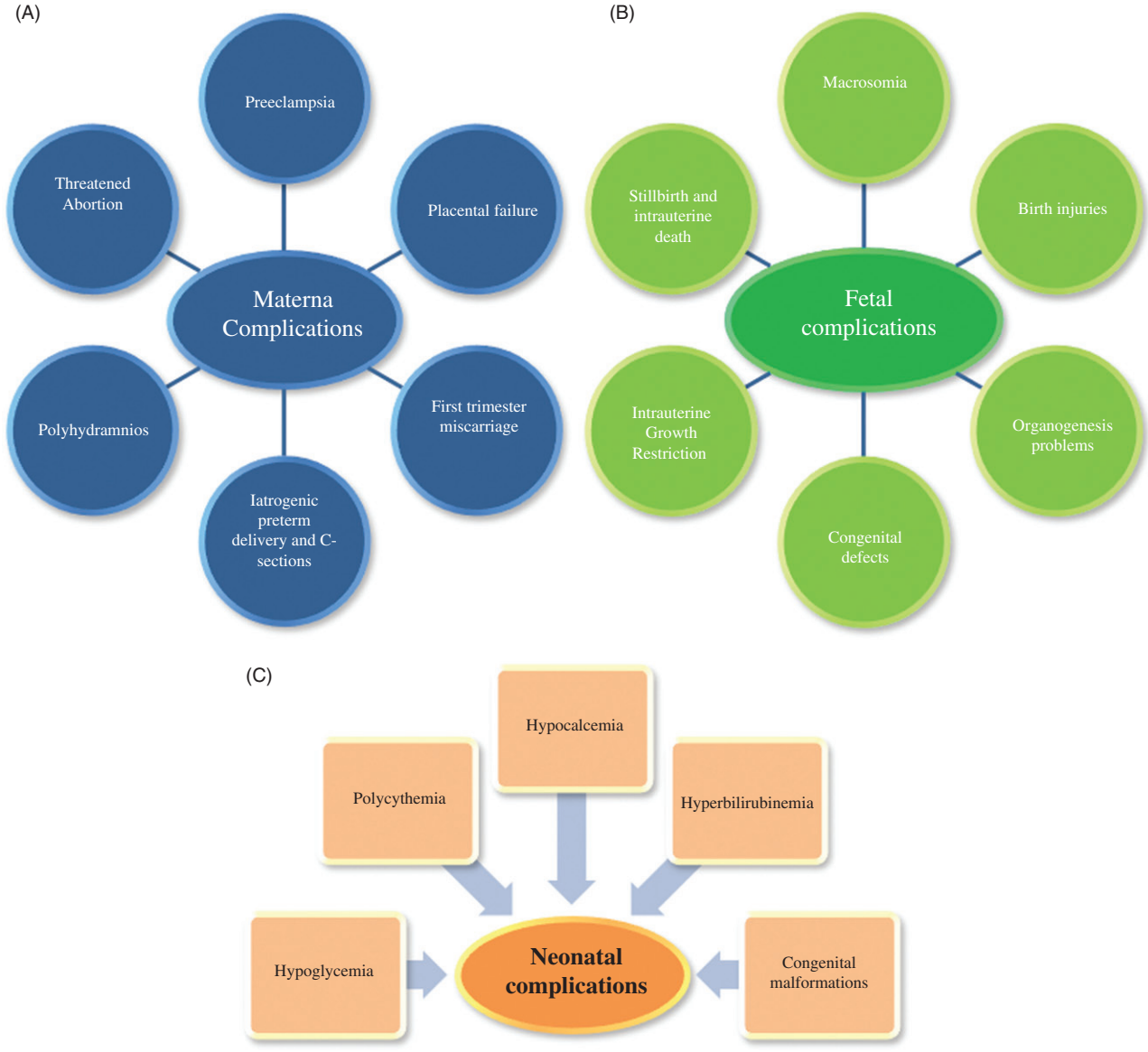

Figure 1. (A–C) Sumarizes the maternal, fetal, and neonatal complications.

burden on these females is due to the fact that a previous diagnosis of GDM results in a lifetime risk of development to Type 2 diabetes mellitus (T2DM) [10]. Though there are no guarantees when they will develop T2DM postpartum, however, some precautionary measure can reduce the risk of developing it. These include maintaining high fiber and low fat diet, regular exercise, and losing excess weight before pregnancy and the most important factor regular blood glucose screening [11,12]. Though, all these facts are well-known but a vast majority of GDM females do not follow them. Therefore, we aimed to conduct a follow up study to identify how many GDM positive females followed the blood glucose screening instructions and developed any complications during or after pregnancy at tertiary care hospitals in Karachi, Pakistan.

Materials and methods

This follow-up study included women with and without GDM with uncomplicated pregnancies delivered in the year 2014. These women were recruited for the antenatal care clinics of Abassi Shaheed Hospital, Karachi. Over 500 pregnant females, less the 20 weeks' gestation were identified as possible candidates for the study. Out of the potential subjects, 179 females (35.8%) consented to participate in the follow-up study. Eventually, we lost 12 more subjects due to concurrent pregnancies or failure to respond. The final sample at the completion of this study was $n = 167$ and this was considered appropriate to achieve a power of 80% with an alpha of 5% [13]. Subjects with a pre-pregnancy history of diabetes, hypertension, conception due to assisted reproductive techniques

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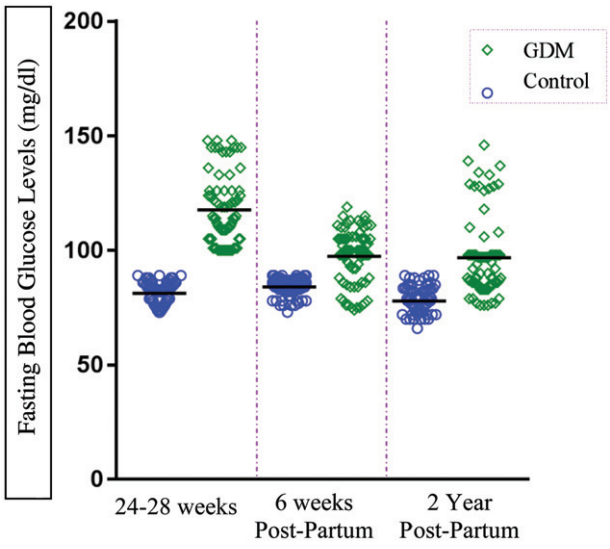

Figure 2. Periodic fasting blood glucose levels of the study subjects. The FBG levels at 24–28 weeks for NGT and GDM were77.95 ± 5.39 mg/dl; 96.83 ± 17.27 mg/dl; at 6 weeks post-partum was 81.18 ± 4.77 mg/dl; 117.71 ± 15.05 mg/dl and at 2 year postpartum was 84.01 ± 3.64 mg/dl and GDM was 97.42 ± 11.70 mg/dl, respectively.

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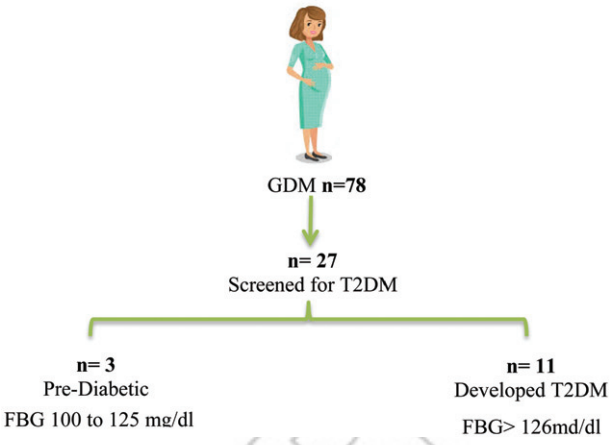

Figure 3. Screening and incidence of T2DM in GDM positive females.

and any other maternal–fetal health issues were excluded from this study. A 75 g oral glucose test was used to diagnose GDM and normal glucose tolerance (NGT) in study subjects. The GDM diagnostic criteria and the desired glucose levels used as a reference in this study are shown in Table 1. A total of 78 GDM positive women and 89 healthy controls were followed up from the time of delivery till 2 year postpartum. GDM women were managed by either medical nutrition therapy ($n = 32$) or medicine (insulin $n = 35$ and metformin $n = 11$). Periodic records were made as follows: (i) antenatal data included pre-pregnancy weight, body mass index (BMI), family history of diabetes, fasting blood glucose (FBG), HbA1c, fetal growth scans,

Table 1. Diagnostic criteria and glycemic targets for GDM.

International Association of Diabetes and Pregnancy Study Group (IADPSG) Criteria for GDM diagnosis [1]
GDM is diagnosed when any of the following reading is observed:
Fasting blood glucose (FPG): ≥92 mg/dL (5.1 mmol/L)
1-h blood glucose: ≥180 mg/dL (10.0 mmol/L)
2-h blood glucose: ≥153 mg/dL (8.5 mmol/L)
Recommendation for post-partum screening
Women with a history of GDM should have lifelong screening for the development of diabetes or pre-diabetes at least every 3 years
Women with a history of GDM found to have pre-diabetes should receive lifestyle interventions or metformin to prevent diabetes
Diabetes is diagnosed when any of the following is observed
HbA1C: ≥6.5%
FBG: ≥126 mg/dL (7.0 mmol/L)
2-h blood glucose: ≥200 mg/dL (11.1 mmol/L) during an OGTT
A random plasma glucose: ≥200 mg/dL (11.1 mmol/L)

and baby birth weight (ii) at delivery data included maternal and baby birth weight, APGAR score (iii) at 6 weeks postpartum data included screening by GTT/HbA1c, weight status of mother and baby and maternal FBG were recorded. From this point forward all study subjects received reminders for lifestyle modification as well as blood glucose screening via telephone at 6 month, 12 month, and 24 month postpartum. An independent researcher interviewed all females and recorded their answers on a prescribed form. After 2 years these females were examined with their babies and at that point the weight status and FBG of the mother and the weight and vaccination status of the baby were recorded. The WHO growth chart guidelines were used to assess the age for weight as follows: (A) weight at birth for boys 3.0–3.7 kg (6.7–8.1 lbs.) and girls 2.9–3.5 kg (6.5–7.8 lbs.) and (B) weight at 24 months for boys 11.2–13.1 kg (24.8–28.9 lbs.) and girls 10.5–12.4 kg (23.3–27.5 lbs.) [14]. The study was approved by the institutional ethical committee (~~Table 2~~).

Data were analyzed [illegible]SPSS version 21 (IBM statistics, Chicago, IL). Quantitative data were presented as Mean ± SD while qualitative data was presented as absolute number with percentage in parenthesis. Student *t* test, Pearson chi-square test/Fisher exact test were used to compare groups. In all instances *p* values $< .05$ was considered as significant.

Results

The details of the result are shown in ~~Table 1~~. The mean age of study subjects with GDM [illegible]as 28.94 ± 2.84 year while for control was 25.68 ± 3.01 year. Women with previous GDM had higher body weight before pregnancy and postpartum compared to the control group ($p < .05$). Interestingly, no difference was observed in both groups in terms of being physically active. Cesarian section deliveries were common in

Table 2. Details of study subjects.

Variable	GDM $n = 78$	NGT $n = 89$
Antenatal data		
Maternal age (year)	28.94 ± 2.84*	25.68 ± 3.01
Maternal weight (<20 weeks gestation) (kg)	69.5 ± 8.22**	56.54 ± 5.42
Parity		
Primi-parous	63 (80%)	76 (85%)
Multi-parous	15 (20%)	13 (15%)
Intrauterine fetal growth scan		
Normal for gestational age	26 (33.3)	62 (69.6)*
Large for gestational age	47 (60.0)*	17 (19.1)
Small for gestational age	5 (6.4)	10 (11.2)*
Delivery data		
Normal vaginal delivery	38 (48.7)	56 (62.2)*
Cesarian section delivery	40 (51.2)*	33 (37.7)
Baby weight at birth (reference range 2.4–4.2 kg)	4.5 ± 0.5*	3.6 ± 0.6
Follow-up data		
Maternal weight at 6 weeks post-partum (kg)	73.26 ± 6.86**	67.23 ± 4.65
Maternal weight at 2 year postpartum (kg)	78.65 ± 12.32**	65.22 ± 4.23
Sedentary life style	69 (88.4)	74 (83.1)
30 min walk three times a week	09 (11.5)	15 (16.8)
Baby weight at 2 year (reference range 9.5–14.5 kg)	14.9 ± 2.3*	10.7 ± 1.4

*$p < .05$.
**$p < .01$.

GDM group (51%) versus control group (37%), mostly due to large for gestational age fetus. Both weight at birth (4.5 ± 0.5 kg) and at 2-year (14.9 ± 2.3) for the babies born to GDM mothers was significantly higher than the control group babies (3.6 ± 0.6 and 10.7 ± 1.4; $p < .05$). Figure 1(A) shows the blood glucose levels at 28th week of gestation, 6 weeks and 2 year post-partum. At all times the FBG for GDM group was higher than the NGT group ($p < .01$). Furthermore, in terms of screening only 27 women with GDM regularly opted for T2DM screening either by monitoring HbA1c levels or repeat 75 g glucose tolerance test postpartum. 11 were diagnosed with diabetes at the time of while three were diagnosed as pre-diabetic follow-up interview. The top reason given for not following screening instruction was that GDM would disappear after delivery, testing will falsely diagnose them as T2DM and being occupied with the baby.

Discussion

Maternal age, higher than normal BMI, high parity, previous history of gestational diabetes, and family history of diabetes can pose as risks for developing gestational diabetes [15]. Our results showed that the group of women with GDM had higher body weight as opposed to those who did not develop GDM. Obesity is an established risk factor towards the development of both gestational diabetes as well as T2DM [13]. It affects maternal health and may also have significant adverse effects on fetal, neonatal, and long-term health and well-being [16].

The rate of development of T2DM after a pregnancy complicated by gestational diabetes ranges from as low as 2–6% to as high as 70% in studies examining women from 6 weeks to 28 year post-partum [17–20]. Compared to women with a history of normo-glycemic pregnancies, those with prior GDM have more than sevenfold increased risk of developing T2DM [21]. Screening for T2DM after pregnancy is, therefore, recommended every 1–3 years in this risk group. Intervention strategies can be considered in the case of early detection, especially in women of childbearing age resulting in better prognosis [22]. To add to this burden South Asians are prone to develop diabetes after GDM at a higher rate and at an earlier stage. Despite this fact, many women do not follow the instructions of health care providers and as a result a golden opportunity of early detection is missed in most cases.

In the present study, we sent periodic telephonic reminders to our study participants for blood glucose screening. Despite all the vigilance, only a limited number of participants ($n = 27$) opted for the screening either by 75 g OGTT or by HbA1c level. We report an alarming incidence 14% ($n = 11$) of T2DM in females with a past medical history of gestational diabetes, and 3.8% ($n = 3$) diagnosed as impaired glucose tolerant. At the 5-year follow-up study from India reported the conversion rate to T2DM up to 37% in women with previous GDM [23]. Furthermore, low rates of attendance at the 6-week follow-up suggest that perhaps women with gestational diabetes do not properly acknowledge the significance of this disorder as an early warning sign of the susceptibility to develop T2DM later in life. This behavior identifies the need for enhancing awareness for both health care providers as well as women with previous GDM, which

results in missed opportunities in early identification and diagnosis.

When we asked the remaining females why they did not opt for screening despite receiving constant reminders, the top reasons for failed screening included believing that GDM would disappear after delivery, since this is commonly referred to as baby sugar; they were too occupied with the baby and if they repeated the test, it will falsely label them as diabetic. The lack of compliance for T2DM screening might be attributed to factors such as fear of insulin use and long periods of post-partum follow-up [24]. Various other barriers preventing the timely screening such as "challenges in testing women in the fasting state, need for repeated testing, screening procedure being too time consuming, scarcity of test consumables and lack of equipment" are also contributing factors for the low screening rate [25]. Yet, by utilizing e-health component in generating awareness and periodic reminders during the course of this study, we were successful in stimulating 34.6% ($n = 27$) of our GDM women to get themselves screened. The effectiveness of sending periodic reminders in improving the compliance for testing is also reported by studies from developed countries such as Canada, Australia, and USA [26–29].

In addition to the above follow-up findings, we also collected antenatal and at delivery data of the newborn. We observed that babies of GDM positive mothers both during intrauterine scans and at delivery had a higher body weight. This factor was a major contributor to the high rate of cesarean section in this group. This trend progressed for these babies and at 2 year post-partum; they were at a higher weight for age percentile when compared with babies born to NGT females. Previous literature supports a positive correlation between maternal blood glucose levels, increased birth weight, and neonatal adiposity [8], therefore our findings were consistent with them. This relationship is probably due to fetal hyper-insulinism, which is secondary to maternal hyperglycemia, and maternal obesity can act as an additional risk factor to develop macrosomia.

Like all studies, there are some limitations and strengths. First, we were unable to recruit a larger number of subjects, and second only limited number of recruits was complaint with screening protocol. Third, screening bias is a concern when there is a potential for more health-conscious women to regularly see a physician, thus increasing their chance of receiving a medical diagnosis. Yet, there are various strengths as to being a follow-up study in Pakistan where there is scarcity of follow up-based research. Moreover, based on the Pakistani population, the homogeneity of this study advantageously reduces potential sources of unmeasured confounding. Future research will result in greater advances in this field. This study also allows for recommendations to be formed and implemented, which will work towards better pregnancy care. Further, we have established that there is a dire need to spread awareness of the complications of GDM, encouraging mothers to follow-up on their glucose levels even after pregnancy. Additionally, physical activity should be advised to reduce the burden of disease in GDM patients.

Conclusions

Lack of awareness for follow-up screening in GDM positive women is high in our region. The incidence of developing T2DM in 14% women with previous GDM in a short-term follow up study is an alarming finding. Given this trend, systematic follow-up programs and awareness of both physicians and pregnant women are needed to reduce obesity and diabetes risk.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Disclosure statement

The authors declare that they have nothing to disclose.

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