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Research Article

**ANALYSIS OF GESTATIONAL WEIGHT GAIN AMONG
WOMEN WITH GESTATIONAL DIABETES MELLITUS**Dr Maniba Habib¹, Dr. Javeria Gul², Dr. Waqas Ahmad³¹ Divisional Head Quarter Hospital Mirpur AJK² Jinnah Medical and Dental College³ Aziz Bhati Shaheed Teaching Hospital, Gujrat

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Abstract:

Objectives: To evaluate the correlation between gestational weight gain (GWG) and pregnancy outcomes in women with gestational diabetes mellitus (GDM).

Methodology: A cross-sectional observational study was undertaken at Name of the hospital, City, Country from [Duration of the study]. A total of 65 pregnant women with gestational diabetes mellitus were enrolled in the study and a same number of control participants. Women with multiple gestations and those with cardiac heart disease or diabetes mellitus (type 1 or type 2) were excluded from the study. Data regarding maternal demographics including prepregnancy BMI, parity, and age were collected using standardized pro formas. Maternal weight gain during pregnancy was calculated from the patient's self-reported prepregnancy weight at each trimester. The Statistical Package for the Social Sciences (SPSS v.25) was used to analyze the data. P-value of <0.05 was considered statistically significant.

Results: The mean age + SD for GDM patients was 30.6 + 6.3 years and with the mean parity of 3.4 + 1.2. Whereas, the mean age + SD for controls was 24.7 + 5.3 years with the mean parity of 4.6 + 1.5. The mean prepregnancy BMI of 28.2 + 7.6 kg/m² in GDM patients while a mean prepregnancy BMI of 24.9 + 5.7 kg/m² was reported in the study (p=0.01). The mean total gestational weight gain was 13.6 + 1.3 kg in patients with GDM while 14.99 + 1.69 kg in the control group. It was observed that the maternal age was associated with increased risk of developing GDM. Furthermore, it was reported that the increase of 1 unit of prepregnancy BMI increased the risk for GDM by 14%.

Conclusion: Our results emphasize that first trimester weight gain is a risk factor that is independent of other traditional predictors, including prepregnancy BMI.

Key words: Gestational weight gain, gestational diabetes mellitus, first trimester, body weight index (BMI)

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INTRODUCTION:

Gestational diabetes mellitus (GDM) is defined as the new onset of diabetes mellitus in a pregnant woman during the second or third trimester of her pregnancy.¹ Gestational diabetes mellitus (GDM) complicates about 4 to 7% of pregnancies in the United States.² In Asia, women have a higher risk of developing GDM as compared to women in the United States.³ It is estimated that in China, the prevalence of GDM has aggravated from 2.4% in 1999 to 8.2% in 2012 according to the WHO's criteria.^{4,5}

It is well known that gestational diabetes mellitus (GDM) is associated with many known risk factors which increases the risk of perinatal complications for both the mother and the infant.⁶ It has been observed that women with a history of GDM are at greater risk of developing postpartum diabetes mellitus type 2.⁷

Weight gain during pregnancy is an important factor contributing to the development of gestational diabetes among women. The increased weight during pregnancy is because of maternal fat accretion leading to progressive insulin resistance.⁸ The Institute of Medicine (IOM) in 2009, published new recommendations for gestational weight gain, including specific recommendations for rate of weight gain by prepregnancy body mass index (BMI).⁹ The IOM report noted there was a lack of evidence regarding the role of gestational weight gain in relation to GDM.

It is well-established that maternal obesity and abnormal gestational weight gain are strongly associated with adverse maternal and neonatal outcomes which includes spontaneous abortion, gestational diabetes mellitus (GDM), cesarean delivery, preeclampsia, neonatal macrosomia, and operative and anesthetic complications.¹⁰ However, only a handful of studies have attempted to evaluate the association between gestational weight gain and the incidence of gestational diabetes. Nevertheless, there is no direct evidence to establish the association of gestational weight gain and the gestational diabetes mellitus. Hence, this study was undertaken to address this question and to evaluate the gestational weight gain among women with gestational diabetes mellitus.

METHODOLOGY:

A prospective observational study was undertaken at Name of the hospital, City, Country from [Duration of the study]. After obtaining ethical approval from the Institutional Review Board (IRB) of NAME OF

INSTITUTE, [IRB number], and informed written consent by the participants, 67 women with singleton pregnancies, diagnosed with Gestational DM were enrolled in the study. Women with multiple gestations, cardiac disease, and pregestational diabetes (type 1 or type 2) were excluded from the study.

Information regarding maternal demographics, prenatal and perinatal care were collected using standardized pro formas. Maternal weight gain during pregnancy was calculated from the patient's self-reported prepregnancy weight.

Maternal weight at enrollment in the study was also recorded and used to calculate gestational weight gain before enrollment (weight difference between weight at first visit and prepregnancy weight) and gestational weight gain post enrollment (weight difference between weight at last and weight at first visit). Maternal prepregnancy BMI was calculated using prepregnancy weight and height (BMI is calculated as weight (kg)/[height (m)]²).

Gestational weight gain and rate of weight gain were measured for each trimester. Gestational weight gain was compared to the 2009 recommendations by the Institute of Medicine (IOM). Women with GDM were diagnosed and treated according to the Canadian Diabetes Association guidelines.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS v.25) was used to analyze the gestational weight gain among women diagnosed with gestational diabetes and its association was determined with perinatal outcomes using the Chi-square test. Categorical and continuous variables such as parity, age at conception, ethnicity, prepregnancy weight and BMI, age at which GDM was diagnosed, severity of GDM, and gestational age at delivery were presented as frequency or mean + SD, respectively. A p value of less than 0.05 was considered as statistically significant.

RESULTS:

The mean age + SD for GDM patients was 30.6 + 6.3 years and with the mean parity of 3.4 + 1.2. Whereas, the mean age + SD for controls was 24.7 + 5.3 years with the mean parity of 4.6 + 1.5. The demographic and clinical characteristics of all the patients are given in table 1. A mean prepregnancy BMI of 25.5 + 6.2 kg/m² was recorded. The mean prepregnancy BMI of 28.2 + 7.6 kg/m² in GDM patients while a mean prepregnancy BMI of 24.9 + 5.7 kg/m² was reported in the study (p=0.01).

Table 1. The demographic and clinical characteristics of patients and controls in the study

| Variables | GDM Patients (n=67) | Control (n=67) | P-value |
|---------------------------------------|---------------------|------------------|---------|
| Mean Age + SD | 30.6 + 6.3 years | 24.7 + 5.3 years | 0.000 |
| Parity, n (%) | | | 0.335 |
| 0 | 26 (47.3) | 136 (56.9) | |
| 1 | 19 (34.5) | 73 (30.5) | |
| >2 | 10 (18.2) | 30 (12.6) | |
| Prepregnancy BMI (kg/m ²) | 28.2 + 7.6 | 24.9 + 5.7 | 0.01 |
| 1-hour blood glucose (mg/dl) | 175.8 + 23.4 | 113.5 + 25.6 | 0.021 |

The mean total gestational weight gain was 13.6 + 1.3 kg in patients with GDM while 14.99 + 1.69 kg in the control group. Women with GDM were significantly older with a mean age + SD of 30.6 + 6.3 years and had a significantly higher prepregnancy BMI value of 28.2 + 7.6 kg/m² compared to controls with p-value of 0.01 and 0.021, respectively.

Gestational weight gain is shown in Figure 1. We did not report any significant difference in the overall gestational weight gain between the study participants and the control (p=0.889). However, we reported a significantly lower gestational weight gain among the patients as compared to the control in the third trimester with a p=0.002.

Mean Gestational Weight Gain GWG (kg)

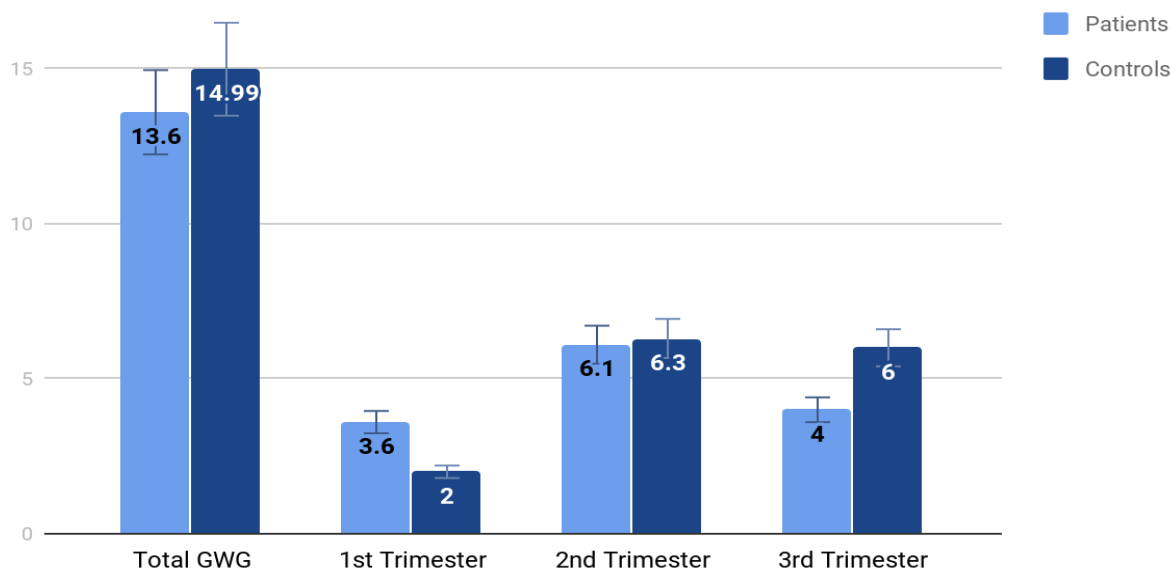


Figure 1. Detailed gestational weight gain in gestational diabetes mellitus (GDM) and controls.

Mean first trimester weight gain was within IOM recommendations for controls, but the mean exceeded by 1.60 kg the upper limit set at 2 kg in GDM patients.

Detailed gestational rate of weight gain is shown in Figure 2. A greater rate of weight gain in patients with GDM was observed in the first trimester with a significant p-value of <0.05. However, in the third trimester, a lower rate of weight gain was observed for patients with GDM compared to the control group (2.6 kg/week, p=0.0001).

In GDM patients, the mean rate of weight gain in the second trimester (0.49 + 0.03 kg/week) was noted to be above the recommended reference rate of 0.23-0.33 kg/week. However, it was observed that the mean weight gain rate in the third trimester was approximately equal to the recommended rate. Gestational rate of weight gain in both the second and third trimesters was above the recommended ranges in the control group (figure 2).

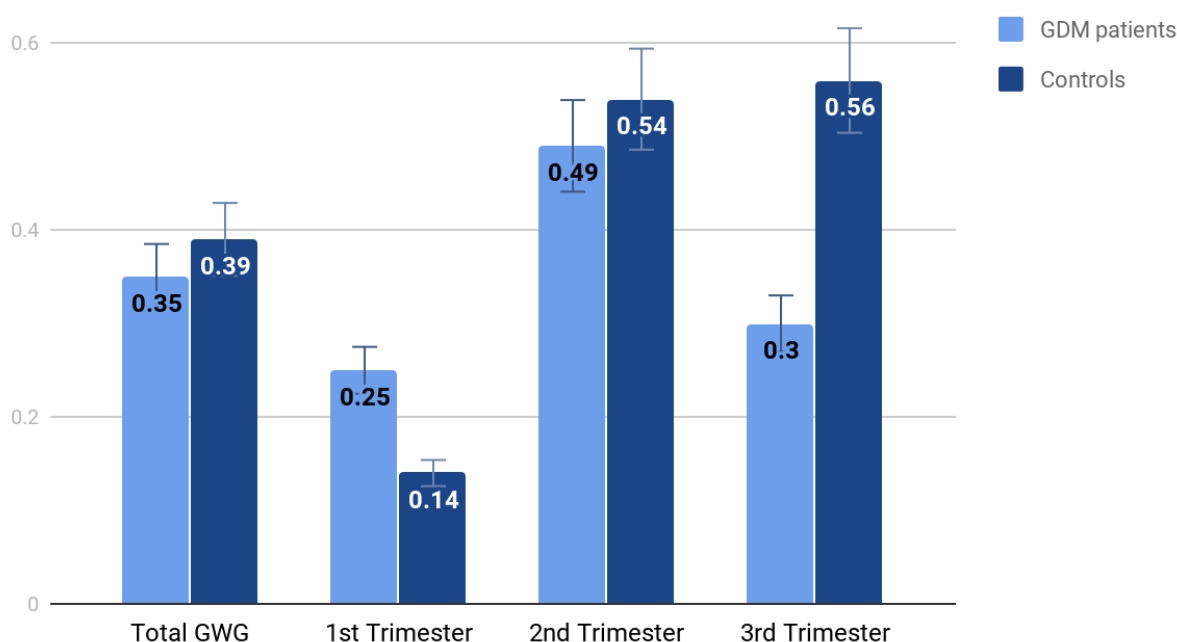
Rate of Gestational Weight Gain Among GDM patients and Control Group (kg/week)**Figure 2. Rate of gestational weight gain in gestational diabetes mellitus (GDM) patients and the control group.**

Table 2 shows a multivariate logistic regression analysis for GDM, including risk factors and first trimester weight gain. It was observed that the maternal age was associated with increased risk of developing GDM. Furthermore, it was reported that the increase of 1 unit of prepregnancy BMI increased the risk for GDM by 14%.

Table 2. Multivariate Logistic Regression Analysis for Gestational Diabetes Mellitus

| Variables | Odds Ratio [CI 95%] | P-value |
|---------------------------------------|---------------------|---------|
| Maternal Age | 1.10 [1.02–1.18] | <0.05 |
| Parity (1 vs. 0) | 1.23 [0.58–2.58] | >0.05 |
| Parity (2 vs. 0) | 1.21 [0.47–3.11] | >0.05 |
| Prepregnancy BMI | 1.11 [1.05–1.17] | <0.001 |
| 1st trimester gestational weight gain | 1.25 [1.10–1.42] | <0.000 |

DISCUSSION:

In this study, we found that greater gestational weight gain in early pregnancy, particularly during the first trimester. Gestational weight gain was strongly associated with an increased risk of GDM especially the weight gain in the first trimester was observed to be significantly higher in GDM patients compared to controls.

First trimester weight gain in GDM patients was 1.6 kg greater than the reference range defined by IOM recommendations. In the present study, the rate of gestational weight gain and the weight gain in the first trimester of gestation were significantly correlated with gestational diabetes mellitus.

Whereas, the second trimester weight gain in GDM patients was not significantly different from the control group.

As the patients were treated and managed according to the standard protocol, the weight gain started to reduce and by the third trimester, the weight gain GDM patients was significantly lower than the controls.

In the present study, we measured the rate at which the gestational weight was being gained in all patients of GDM and the control group. It was found that the rate of gestational weight gain was identified as a risk factor for GDM. The gestational weight

gain of first trimester was observed to be an independent predictor of GDM while, the gestational weight gain in the second trimester was not significantly associated with developing GDM. Therefore, the first trimester seems to be the most determinant period of weight gain in relation to GDM.

Since many contributing and well-established risk factors like ethnicity, family history, age, and genetics are non-modifiable, weight gain on the other hand is modifiable and can be controlled by means of diet and exercise.¹¹ It can be modified with the help of proper nutritional education, dietary changes, and exercise.¹²⁻¹⁵ It has been established that women with GDM requiring pharmacotherapy are at risk of adverse maternal and neonatal outcomes, we can use the findings of the present study to counsel women with other non-modifiable risk factors, as mentioned above to control their weight gain with the help of dietary changes and exercise.¹⁴

A study by Yu Sun RM. *et al*, was conducted with the objective of assessing whether lifestyle changes in early pregnancy i.e. the first trimester can help in reducing the risk of GDM and control the gestational weight (GWG) gain among Chinese obese women. Yu Sun reported that lifestyle intervention had immensely contributed in lowering the rate of GDM development in participants in the study group as compared to the control group, which was observed as 28.1% and 55.9%, respectively ($p = 0.023$).¹³

In a study by Saldana *et al*, it was revealed that the greater weight gain prior to diagnosis of GDM, the greater the risk of impaired glucose tolerance among these women. In contrast to the findings of our study, it was also reported that those women who were already overweight before pregnancy were more at risk of weight gain and eventually developing gestational diabetes mellitus.¹⁶ Similarly, Tovar *et al.*, also reported that only obese women who exceed their target weight up to GDM screening were more likely to develop abnormal glucose tolerance compared to women within their target weight.¹⁷

Previously, it was observed that among mothers with a higher rate of early pregnancy or first trimester weight gain, there was an associated greater risk of GDM. This was also observed in the present study. For instance, Hedderson *et al.*, documented that high rates of weight gain in early pregnancy increased the risk of GDM. In their study, the participants were subcategorized into three groups according to the first trimester rate of weight gain. They found that compared to the lowest tertile of gestational rate of weight gain, women in the second and third tertile of gestational weight gain

rate had an increased risk of developing GDM, by 43% and 74%, respectively.¹⁸

There are a number of theories to explain these findings. For instance, we are aware of the fact that maternal adipose tissue represents 30% of gestational weight gain during pregnancy,¹⁹ and this proportion is more important early in pregnancy.^{18, 20} Therefore, we can assume that fast weight gain first trimester is mainly composed of maternal fat subsequently precipitating impaired glucose tolerance leading to the development of GDM.

Our study findings were faced by several limitations that must be taken into account when implementing the findings. Firstly, we used prepregnancy weights that were self-reported for all women. Nevertheless, we did not have any reason to believe that the women who developed GDM would have underreported their pre pregnancy weight as compared to the women in the control group because none of the women included had a history of GDM. Thus, we expect that any bias attributable to the misclassification of prepregnancy BMI would be nondifferential and would therefore bias our results toward the null. Secondly, our sample size was not representative of the entire population. Further research with large sample size and a longitudinal study design would be more authentic and reliable.

CONCLUSION:

In conclusion, the present study is in accordance with the previous reports that considered early pregnancy or first trimester gestational weight gain to be a risk factor for gestational diabetes mellitus (GDM). Our results emphasize that first trimester weight gain is a risk factor that is independent of other traditional predictors, including prepregnancy BMI.

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