HIGH RATE WEIGHT GAIN AND DEVELOPMENT OF GESTATIONAL DIABETES

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ABSTRACT

Background

Excessive gestational weight gain and gestational diabetes mellitus (GDM) significantly increase morbidity and mortality for both the mother and the fetus.

Objectives

To assess maternal weight gain at 28 weeks of gestation in women developing GDM compared with pregnant women without GDM.

Patients and Methods

This study is a case-control study of weight gain in pregnant women at 28 weeks of gestation. Data analysis of weight gain was obtained in 225 pregnant women (75 cases of GDM and 150 pregnant women without GDM-controls).

Results

Two hundred twenty-five women (GDM group of 75 women and 150 control pregnant women) were evaluated. Demographics characteristics of both groups (case-controls) were compatible. There was a significant difference between mean weight gain among GDM groups (17.36 ±2.89) in comparison to mean weight gain in controls groups (15.67± 2.34) giving a P-value =0.001. Furthermore, we subdivided the rate of weight gain into three categories: pregnant women who gained weight 0-10kg, 10-20, and above 20kg. There was a significant difference according to these categories, 25.3% of women with GDM had an increase of weight of more than 20 kg while only 7.3% of women without GDM increased their weight more than 20kg making P-value=0.001.

Conclusion

Weight gain is higher in women diagnosed with GDM at 28 weeks of gestation in comparison to women without GDM.

Keywords: *Gestational weight gain, Gestational diabetes mellitus.*

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INTRODUCTION

Gestational diabetes mellitus GDM is defined as hyperglycemia that develops during pregnancy as a result of subsequently increased insulin resistance and insufficient insulin release [1].GDM affects 5% of all pregnancies [2] which may ahave many consequences that affect both mother and the fetus, such as large for gestation age, neonatal hypoglycemia, maternal high blood pressure, and operative delivery. The risk for type 2 diabetes in mothers and the offspring is also increased [3]. It is believed that the risk of GDM increases in women with excessive weight gain during pregnancy [1]; the pathophysiology of the high risk of diabetes mellitus among women who gain weight excessively, is that when adipose tissue adversely affects the insulin sensitivity [4, 5]. The sensitivity of insulin declined by 40–50% compared to pre-pregnancy measures [6]. Women with a history of GDM are at higher risk of redeveloping gestational diabetes in their future pregnancies. In general, women with a history of macrosomic infants, age of more than 35 years, and high pre-pregnancy BMI also hold the risk of developing GDM [7]. Weight gain in pregnancy (gestational weight gain) is the rate of weight that is gained from fertilization and just before delivery. Balance between energy consumption and energy expenditure determines the rate of weight gain in pregnancy. The energy requirement during pregnancy significantly increases by nearly 200 kcal/day in the first twelve weeks of gestation to 400 kcal/day in the last trimester, and it varies according to height and weight (BMI)[8, 9].

In an uncomplicated pregnancy, 35% of the overall gestational weight gain is from the products of fertilization such as placenta, fetus and amniotic fluid with the increase in the size of maternal breasts, intra and extravascular fluid volume and subcutaneous adipose tissue comprising the rest of maternal weight gain. As for gestational diabetes, excessive weight gain increases the risk of many conditions for the mother and the fetus like pre-eclampsia, macrosomia, and the development of type 2 diabetes [10]. The latest studies found that a high rate of weight gain early in pregnancy has been associated with an increase in the incidence of gestational diabetes mellitus [11, 12]. The Institute of Medicine (IOM) has determined an ideal weight gain according to pre-pregnancy BMI. IOM proposed a weight gain of 7–11.5 kg for women with body mass index BMI of 25.0–29.9 kg/m2, and 5–9 kg for women with a BMI of 30 kg/m2. The proposed weight gain for all pregnant women during the first trimester is 0.5–2 kg [4].

This study aims to find the increased rate of weight gain among pregnant women with gestational diabetes in comparison to pregnant women without gestational diabetes.

PATIENTS AND METHODS

This study is a retrospective case-controlled study of pregnant women who developed gestational diabetes and who attended the diabetic center for follow up at Sulaimani Maternity Teaching Hospital.

Pregnant women who developed gestational diabetes and who have to follow up in the diabetic center at Sulaimani Maternity Teaching Hospital. Patients diagnosed with gestational diabetes were identified randomly from those who received care at the diabetic center between April and October of 2018.

Inclusion criteria included any woman with a singleton pregnancy diagnosed with gestational diabetes at 28 weeks of gestation. Exclusion criteria includeded diagnosis of pre-existing diabetes, hypertension, thyroid disease or chronic drug users such as steroids.

Women with high random or fasting blood sugar, rapid excessive weight gain, previous history of a baby with large for gestational age, history of gestational diabetes or development of polyhydramnios visit the diabetic center to exclude or confirm gestational diabetes. They are referred either from private clinics by obstetricians or from primary care units.

Women were screened for gestational diabetes in our center after 24 weeks of gestation by oral glucose tolerance test (OGTT) which requires the patient to fast overnight (eight hours minimum). A blood sample for fasting blood sugar is taken; thereafter, 75 g glucose load is given orally in 250-300ml of water and the plasma glucose is measured after the two hours. If the result of fasting blood sugar is ≥7mmol/l and/or 2- hour glucose ≥ 11 mmol/l, the patient diagnosed in both conditions as gestational diabetes.

During antenatal screening for GDM in the diabetic center, 79 pregnant women were identified as GDM, but only 75 patients met this study's inclusion criteria who were matched to 150 pregnant women without gestational diabetes.

The researcher measured and recorded both the weight and height of these women. The weight was measured

by using a digital weighing scale and the height was measured using a height measuring instrument. Total weight gain at 28 weeks was assessed as the difference between the documented maternal weight at 28 weeks and the patients' self-reported pre-pregnancy weight. The pre-pregnancy BMI was measured using the patient self-reported pre-pregnancy weight (in kilograms) divided by the maternal height (in meters squared) documented at the first prenatal visit (BMI=kg/m2). Patients were then classified by pre-pregnancy BMI categories as follows: underweight (less than 18.5), normal weight (18.5–24.9), overweight (25.0 –29.9), and obese (30.0 or higher). Mean weight gain in 36-weeks was then compared between the two groups (cases and controls) within each BMI category.

The Kurdistan board has approved the study for Medical Specialties. Verbal informed consent was taken from each participant, and they were reassured about the confidentiality of their information.

After data collection and before data entry and analysis, the questions of the study were coded. Data entry was performed via using an excel spreadsheet then the statistical analysis was performed by SPSS program, version 21 (IBM SPSS Statistical Package for the Social Sciences). The compliance of quantitative random variables with the Gaussian curve (normal distribution) was analyzed using Kolmogorov-Smirnov and Shapiro-Wilk tests. Age, BMI, weight gain were shown to be not normally distributed continuous quantitative variables and described by mean, median SD (standard deviation) and mean rank. The statistical significance of the difference in mean between two groups (cases and controls) was assessed using an independent sample t-test. The difference in the mean rank between 2 groups was assessed by non-parametric test (Mann- Whitney). Chi-square tests were used to compare the categorical data between these two groups of patients with respect to different variables that as age, parity, educational status, BMI weight gain, and age categories. Bar charts and Box plot charts were used to describe some variables of the study diagrammatically. P values of 0.05 were used as a cut off point for the significance of statistical tests.

RESULTS

In this study, 75 women diagnosed with GDM and 150 controls who met the inclusion criteria for our investigation were included. Table 1 represents the demographic characteristics of women in both groups. Both groups (cases and control groups) were matched for the maternal race, age, level of education, parity or pre-pregnancy BMI (with no significant differences). The age of more than two thirds of participants were between 22 to 34 years of age and the rest (29.3% of cases and 26% of the control group) were above 35 years of age with the mean age of (32.21±4.71vs 31.09± 4.54) for the GDM and control group respectively (statistically not different) .

The average pre-pregnancy BMI (kg/m2) between both groups (GDM vs. no GDM) is (27.19 ± 3.17) and (26.61± 2.20) respectively which shows women with GDM had more pre-pregnancy BMI in comparison to the control group; however, statistically not significant. According to the BMI before pregnancy, only 24.7% of women without GDM had normal body weight, and the large proportion (75.3%) being classified as overweight or obese based on the self-reported pre-pregnancy weight. Women with GDM majority were overweight or obese (77.4%), even most of the women with GDM were slightly overweight or obese according to their pre-pregnancy BMI, in comparison to those without GDM; however, they are statically insignificant. The percentage of parity among the two groups was different, 68% of the GDM group were multipara (≥2) whereas (58%) of the control group are multipara (≥2), but statistically, they were not different.

Mean weight gain between the two groups were compared (Table2). Women with GDM gained more weight (17.36 ±2.89) in comparison to women without GDM (15.67± 2.34) the difference was statistically significant (p- value<0.001).

Furthermore, we divided the weight gains into three categories, those who increase weight less than 10 kg, those between 10 to 20 kg and those more than 20 kg. When we compared the two groups according to these categories, we found that those with GDM had an increase in weight of more than 20 kg (25.3%). On the other hand, only 7.3% of women without GDM gained more than 20 kg making it statistically significant (p=< 0.001). The weight gain by 28 weeks of gestation within each category of BMI is compared between women with GDM and women without GDM

Table 1. Demographic characteristics of women in both groups.

	Gestational Diabetes (n= 75)	Control (n= 150)	P Value
Maternal age Mean ± SD	32.21±4.72	31.56± 4.34	0.3
Age groups, n (%)			
22 - 34 years	53 (70.7%)	111 (74.0%)	0.6
35 years and more	22 (29.3%)	39 (26.0%)	
Maternal BMI Mean ± SD	27.19 ± 3.17	26.61± 2.20	0.17
BMI category, n (%)			
Normal weight	17 (22.7%)	37 (24.7%)	0.58
Overweight	47 (62.7%)	98 (65.3%)	
Obese	11 (14.7%)	15 (10.0%)	
Educational status, n (%)			
illiterate	29 (38.7%)	40 (26.7%)	0.16
Primary or secondary school	18 (24.0 %)	48 (32.0%)	
University graduate	28 (37.3%)	62 (41.3%)	
Parity, n (%)			
Primi-gravida	2 (2.7%)	6 (4.0%)	0.34
Para one	22 (29.3%)	57 (38.0%)	
Para two and above	51 (68.0%)	87 (58.0%)	

Table 2. Maternal weight gain in patients diagnosed with GDM compared with pregnant women without GDM.

	Gestational Diabetes (n= 75)	Control (n= 150)	P Value
Mean weight gain ± SD	17.36 ±2.89	15.67± 2.34	< 0.001 *
Weight gain categories, n (%)			
0-10 kg increase	8 (10.7%)	36 (24.0%)	
10-20 kg increase	48 (64.0%)	103 (68.7%)	0.001***
More than 20 increase	19 (25.3%)	11 (7.3%)	

*** Independent t-test, ** Mann Whitney test, *** Chi-square test**

DISCUSSION

There are relationships between excessive weight gain during the first and second trimester and development of GDM. Women who developed gestational diabetes had a higher weight gain before glycemic screening. There is a pronounced effect of excessive maternal weight gain during pregnancy on insulin sensitivities and glucose metabolism. Although the rate of maternal weight gain and GDM is debatable [13, 14], however many studies including our study showed a clear link between excessive maternal weight gain in early pregnancy and risk of developing GDM, which is mostly explained by inverse relationships between maternal weight gain and insulin sensitivity [15].

In the current study, it was concluded that women with GDM gained more weight in both early and mid-pregnancy in comparison with women without GDM.

Although a limited amount of published data exists, the results of this study are yet correspondent with the studies conducted by Hedderson et al., Gibson et al., Saldana et al., Kabiru et al. [11, 16, 17, 18].

Kabiru et al. [18] have concluded that excessive maternal weight gain increases the likelihood of GDM. Saldana et al. [17] determined excessive weight gain during the early months of pregnancy as a risk factor for GDM. Moreover, similar effects of excessive first-trimester weight gain on the risk of GDM has been shown by Hedderson et al. [11].

Tovar et al. [19] also found that only obese women who exceed their target weight gain had more chance to develop abnormal glucose tolerance compared to women within their target weight.

A recent study by Herring et al. [20] explored the influence of gestational weight gain before GDM diagnosis of maternal hyperglycemia. A recent meta-analysis has established the increased risk of GDM among women who were overweight, obese and severely obese, to be two-fold, four-fold and eight-fold higher respectively [18, 21]. Gibson et al. [16] assessed maternal weight gain before 24 weeks in women who developed GDM in comparison to those with normal glucose tolerance. GDM subjects had experienced more weight gain over 24 weeks. MacDonald et al. [22] studied the relationships between excessive weight gain in the first trimester and second trimester, although first-trimester weight gain increases the risk of development of gestational diabetes substantiality, second-trimester weight gain did not correlate with increased risk of gestational diabetes.

In contrast to this study, the link between weight gain before screening and the risk of gestational diabetes was undetermined by some authors. Kieffer et al. [23] examined weight gain in more than 500 pregnant women until screening; the author failed to find a connection between weight gain and GDM. Furthermore, two secondary types of research did not find associations between excessive mid-trimester weights gain and abnormal glucose tolerance test results [24,25].

Excess weight gains during the early trimesters of pregnancy make them more susceptible to complications and adverse pregnancy outcomes. It is strongly recommended to carry out screening for gestational weight gain especially in the early trimester and identification of abnormal weight gain as an opportunity to reduce the risks on the mother and the fetus.

In conclusion, pregnant women diagnosed with GDM during screening for gestational diabetes had experienced a higher rate of gestational weight gain in the early trimesters in comparison to non-diabetic women.

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