

Risk of Development of Gestational Diabetes Mellitus in Women with Increased Gestational Weight Gain – A Study Done at KR Hospital, Mysuru

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ABSTRACT

BACKGROUND

Most common metabolic disorder in pregnancy is gestational diabetes mellitus (GDM). High maternal body mass index (BMI) and excessive gestational weight gain (GWG) are risk factors for developing GDM. Decrease in physical activity, improper diet-plan and high prevalence of obesity will lead to increased risk of GDM. So, this study is planned to assess relationship between GWG and GDM.

METHODS

Cross sectional case control study was done in K. R. Hospital, Mysuru, from June 2020 to Dec 2020. Study subjects were selected during their visit to the hospital and whose term was between 24 to 28 weeks. 135 controls and 113 cases were selected during the study period. Statistical analysis was done by Prism Pad software. Data expressed as Mean \pm SD. Student t test was used to test significance between cases and controls. $p < 0.05$ was considered significant.

RESULTS

In this study, mean age in control group was found to be 21.16 ± 1.50 years and GDM case group was 21.47 ± 1.59 years (p value is 0.6960). Mean pre-pregnancy BMI in control group was 21.60 ± 1.07 compared to GDM cases 23.04 ± 1.62 (p value < 0.0048). Mean weight gain (kg/week) during first trimester in control group was 0.128 ± 0.028 and GDM cases was 0.22 ± 0.029 (p value < 0.001). Mean weight gain per week during second trimester in control group was 0.46 ± 0.024 and in GDM cases was 0.64 ± 0.066 (p value < 0.001).

CONCLUSIONS

Excessive weight gain with increased BMI during pregnancy is significant in present study which may lead to GDM. Strict diet pattern with proper counselling must be followed during pre-pregnancy period and conception with adequate physical activity required for women to reach recommended weight in order to circumvent GDM and decrease risk of bad maternal-foetal outcomes.

KEY WORDS

Gestational Weight Gain, Gestational Diabetes Mellitus, BMI, Physical Activity.

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BACKGROUND

Gestational weight gain is a significant measurement for women's health which in turn helps the quality of life of their offspring.¹ The various structural and functional changes in the women body during pregnancy will result in the gestational weight gain.² Abnormal GWG may result in bad outcome for women and infant.³ In pregnancy, GDM is the most common metabolic disorder.⁴ Hyperglycaemia due to carbohydrate intolerance where onset is diagnosed for the first time during pregnancy is called gestational diabetes mellitus.^{5,6} Excessive gestational weight gain and obesity leads to the increased risk of gestational diabetes mellitus. If increased GWG is with relation to increase in GDM new cases, then GWG management should decrease new cases of GDM.⁷ Maternal and neonatal complications like preeclampsia, foetal macrosomia, preterm birth, and Caesarean delivery are the major complication in the GDM women. Therefore, women with abnormal GWG and GDM will show increased incidence of adverse outcomes in pregnant women. Some previous studies reported that adverse pregnancy outcomes in women with GDM may be associated with excessive GWG which is an independent cause.¹

A meta-analysis of over 1 million pregnant women found that gestational weight gain was higher than that of specified in the Institute of Medicine (IOM) guidelines in 47% of pregnancies. Some studies have shown that women with the obesity and GDM before pregnancy are more likely to cross target weight. GDM is associated with maternal obesity and excessive gestational weight gain.⁸

Increased GWG and high maternal BMI will cause fat deposition in the neonates.⁹ GDM prevalence in the world is almost around 7% of population,¹⁰ 21% prevalence in the Asian countries.¹¹ Increase in the prevalence is due to lack of physical activity, change in the diet plan and high prevalence of the obesity.¹⁰

Weight gain is a risk factor, irrespective of pregnancy for the development of type 2 diabetes. Studies have shown that increase in fat deposition causes higher incidence of insulin resistance leading to increased risk of type 2 diabetes. 30% maternal fat accumulation causes increased weight gain during pregnancy, further leads to insulin resistance, starting from the mid-pregnancy and progressing through the third trimester. Maternal insulin resistance in the early pregnancy is caused due to the disproportionate fat deposition causing maternal weight gain. Therefore, increased gestational weight gain, especially the weight gained during early pregnancy, could also lead to increased risk of GDM.⁵ The Institute of Medicine (IOM) has set the guidelines for the GWG according to pre-pregnancy BMI because GWG may have influence on the pregnancy related complications like macrosomia in the baby, and its bad outcome depends on the pre-pregnancy BMI.¹² For term pregnancy (>37 weeks) IOM/ACOG guidelines has been defined for optimal weight gain. According to the pre-pregnancy BMI category, optimal weight gain during pregnancy is 13-18kgs for underweight (<18.5 kg/m²), 11-15kgs for the normal BMI (18.5-24.9 kg/m²), 7-11kgs for the overweight (25.0-29.9 kg/m²), and 5-9kgs for the obese (>30.0 kg/m²).¹³

Based on the above observation a study was planned to see the relationship between GWG and GDM.

Objectives

1. Measuring gestation weight in normal pregnant women and in gestational diabetes mellitus women.
2. To evaluate the relationship between gestational weight gain and gestational diabetes mellitus.

METHODS

Cross sectional case - control study was done in the K. R. Hospital, Mysuru, from June 2020 to Dec 2020. Controls and cases were selected during their antenatal visit who were between 24-28 weeks. Controls were normal pregnant women, cases were GDM diagnosed during their visit to the hospital. 135 controls and 113 cases were selected during the study period. Cases group are less due to the less availability during their visit. In the clinics/hospitals, data was collected using interviewer-administered multi-component questionnaires addressing maternal sociodemographic and lifestyle characteristics such as age (in years), nationality (Emirati or Arab), occupation (employed versus housewife), education (intermediate or less, high school/technical diploma and university), parity (primiparous versus multiparous), income, daily breakfast consumption (daily versus breakfast skippers), and physical activity. Pre-pregnancy BMI, history of chronic diseases, Caesarean history, IVF, mode of delivery, gestational age, gestational weight and blood glucose.

Inclusion Criteria

For cases and controls, age of study group was between 18-45 years without pre-GDM, pre-gestational hypertension, heart disease, hepatic disease and renal disease;

Exclusion Criteria

Women with pre-existing diabetes which is confirmed from medical records during their first visit. Pregnant women who don't have information on the BMI or weight during pregnancy.

Diagnostic Criteria of GDM

Information is obtained from national guidelines for Diagnosis and Management of Gestational Diabetes Mellitus issued by Ministry of Health, India, in 2014. GDM is diagnosed using 75 gm OGTT irrespective of the last meal with a threshold value of 2-hour plasma glucose >140 mg/dL in 24th to 28th week of gestation. Glucose levels was analyzed using Cobas 6000 by Hexokinase method.

Gestational Weight Gain

In the first trimester rate of gestational weight gain is the weight at the last prenatal visit before 14 (\pm 2 weeks) of gestation minus self-stated pre-pregnancy weight, divided by the weeks of pregnancy gained at the last prenatal visit before 14 weeks of gestation. The rate of weight gain in the second trimester was defined as the weight on or before the OGTT ((23 \pm 2) weeks), minus weight at the last prenatal visit before 14 weeks of gestation, divided by the number of weeks between measurements.⁵

Statistical Analysis

Statistical analysis was done by using Prism Pad software. Data were given as Mean ± SD. Student t test was used to test the significance between cases and controls, p < 0.05 was considered significant.

RESULTS

In this study, as shown in Table 1, the mean age in the control group was found to be 21.16 ± 1.50 years and the mean age in the GDM case group was 21.47 ± 1.59 years. The difference was not statistically significant (p value is 0.6960). As shown in the Table 1, the mean pre-pregnancy BMI in control group was 21.60 ± 1.07 compared to the GDM cases 23.04 ± 1.62 and the difference was statistically significant (p value < 0.0048). As shown in Table 2, the mean weight gain per week during first trimester in the control group was 0.128 ± 0.028 (kg/week) and GDM cases was 0.22 ± 0.029 and the differences was statistically significant (p value <0.001). As shown in the Table 2, the mean weight gain per week during second trimester in the control group was 0.46 ± 0.024 and in the GDM cases was 0.64 ± 0.066 and the difference was statistically significant (p value <0.001). Gravidity of women with the GDM was categorized as 1, 2 and > 3. Highest number of women lie in the category 1 with the percentage of 64.6 and normal women also lie in category 1 with the percentage of 69.6 as shown in the Table 3. Number of abortions in GDM was 22.12% and controls was 21.48 % as shown in the Table 4. Highest population lie within BMI 24 with 62.8 % and controls lies within the BMI 24 with 85.8% as shown in the Table 5.

	Control (Mean ± SD)	Cases (Mean ± SD)	p value
Age	21.16 ± 1.50	21.47 ± 1.59	0.6960
BMI	21.60 ± 1.07	23.04 ± 1.62	0.0048

Table 1. Mean Age and BMI of Cases and Controls

p value < 0.05 is significant.

	Control (Mean ± SD)	Cases (Mean ± SD)	p value
First trimester	0.128 ± 0.028	0.22 ± 0.029	< 0.001
Second trimester	0.46 ± 0.024	0.64 ± 0.066	< 0.001

Table 2. Mean Weight Gain during First and Second Trimester of Cases and Controls

p value < 0.05 is significant

Gravidity	GDM (113)	%	Control (135)	%
1	73	64.6	94	69.6
2	22	19.4	20	14.8
>3	18	16	21	15.5

Table 3. Gravidity of Cases and Controls

Abortion	GDM (113)	%	Control (135)	%
0	88	77.87	115	85.1
1/>1	25	22.12	29	21.48

Table 4. Number of Abortions in Cases and Controls

Category of BMI	GDM (113)	%	Control (135)	%
<24	71	62.8	116	85.9
>24	42	37.1	19	14.07

Table 5. Category of BMI of Cases and Controls

DISCUSSION

Several studies have proved that increased BMI during pre-pregnancy, obesity and GWG will lead to the adverse outcome for pregnant women and offspring. GWG may lead to the diabetes mellitus in future life. Obesity will lead to insulin

resistance which in turn again lead to DM. Foetus may have macrosomia, large for gestational age which will lead to cephalopelvic disproportionate leading to complication during pregnancy. Increased weight gain during the pregnancy may have higher chances of Caesarian section and low APGAR score. GWG in early pregnancy will reflects the maternal fat deposition which will lead to adverse effect for mother and expansion of amniotic fluid and have effect on the growth of foetus. Increased fat deposition during pregnancy will cause fat deposition in off spring. Child in future may face the endocrinological problem.

According to the Teresa A, in the beginning of prenatal care diabetes screening is done during early pregnancy which is recommended in the high-risk pregnant women (like previous history of GDM, macrosomia, obesity). In the month of 24–28 weeks of gestation, GDM is diagnosed in the pregnant women. GDM is first seen during pregnancy that becomes normal after the baby’s birth and adverse effect on mother and baby is due to the excessive glucose. Lifestyle modification are the initial plan of action for women with GDM. After diagnosis, treatment starts with the weight management by adequate physical activity and dietary modifications depending on the pre-pregnancy weight along with self-monitoring of blood glucose. Earlier screening is recommended for women at high risk (e.g. prior GDM, obesity) advance diagnosis and treatment is required for women who have diabetes in the first trimester. Advancing treatment of hyperglycaemia by a trimester with lifestyle management will help in the prevention of excessive gestational weight gain. Previous evidences suggest that diet or exercise, or both, during pregnancy can reduce the risk of GDM. Study has hypothesized that women diagnosed (and thus treated) before with GDM would have low GWG in the first trimester than women diagnosed with usual GDM, among both obese and the nonobese women. Regular GDM screening is recommended for all women at 24–28 weeks gestation. ACOG has suggested high-risk women (e.g., prior GDM, macrosomia, and obesity) are recommended for the early GDM screening.¹⁴

According to Mona et al. main finding of their study was the significant prevalence of excessive GWG that was seen among the participants, with only 30% of participants falling within the adequate GWG as per the IOM guidelines. Proper nutrition and physical activity should help the pregnant women to overcome the GDM

Yana Q et al. in their study found that increased GWG greater than 90th or 95th quantile of that of the entire population among Chinese women with single pregnancy without previous history of diabetes mellitus have increased risk for the development of GDM. Study also tells about importance of appropriate gain during pregnancy.¹¹

In the present study it was found that the weight gain during first and second trimester has higher risk of developing GDM. The study is in accordance with the Zheng L et al.⁵ and Henderson’s et al.¹⁵ There was a strong association between the gestational weight gain and development of GDM. In Zhen L et al. study, rate of weight gain (kg/week) in the first trimester in control group was 0.08 ± 0.14 and case was 0.16 ± 20 (p<0.001). Rate of weight gain (kg/week) in the second trimester in control group was 0.57 ± 0.26 and in cases was 0.68 ± 0.34 (p<0.007). In Henderson’s et al. study, the mean (±SD) rate of weight gain was highest among

women with a BMI of $< 24.9 \text{ kg/m}^2 - 0.38 (\pm 0.14) \text{ kg/week}$ in case group and $0.37 (\pm 0.16) \text{ kg/week}$ in control group

Catalano et al.¹⁶ and Sepe et al.¹⁷ study was against the present study. They found women with GDM had less weight gain compared to controls.

In the present study, the association between risk of development of GDM with gestational weight gain was mainly due to rapid weight gain in the first trimester. Excessive gestational weight gain in early pregnancy may lead to insulin resistance that leads to the fatigue of the B cells of pancreas. This would lead to decrease insulin secretion due to which compensation is failed and induced by the progression of pregnancy and therefore leads to development of GDM. Weight gain in the early pregnancy may be due to more maternal body fat.¹⁰ Catalano et al. found an inverse association between maternal fat accretion and insulin sensitivity from before conception through 12 to 14 weeks of gestation, but not from early to late pregnancy.¹¹

CONCLUSIONS

As per the study excessive weight gain with the increased BMI during pregnancy is significant which may lead to the GDM. GDM carries a major risk of developing type 2 diabetes mellitus in the later life of mother and offspring. So, to overcome this GDM women should have adequate physical activity and proper diet plan with counselling during preconception period which can be continued during pregnancy. It is required by the women to achieve the recommended adequate GWG with respect to their BMI in order to avoid GDM and reduce unfavourable outcome for the mother and foetus.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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