



Impact of insufficient weight gain after GDM diagnosis on small for gestational age and adverse perinatal outcomes

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Abstract

Aim: In the current study, we purposed to examine the role of insufficient weight gain after GDM diagnosis in small for gestational age (SGA) and other adverse perinatal outcomes.

Materials and Methods: This retrospective cohort study conducted in a referral center over a 5-year period from 2017 through 2022 and 260 pregnant women who met the inclusion criteria were classified as insufficient weight gain (n:68) or appropriate weight gain as a control group (n:192) based on the United States Institute of Medicine (IOM) recommendations for body mass index as calculated by gestational weight gain per week after a diagnosis of GDM.

Results: Maternal demographic characteristics and delivery outcomes were similar between groups. BMI at the first visit, BMI at GDM screening, and BMI at delivery were significantly higher in the appropriate gain group compared to the insufficient gain group. After adjusting for the variables, we observed that insufficient weight gain after a GDM diagnosis was not associated with SGA (adjusted odds ratio [aOR], 1.964; 95% confidence interval [CI], 0.306–12.590). In addition, we found that other variables such as the prematurity (aOR, 1.205; 95% CI, 0.335–4.320) and NICU admission rates (aOR, 2.361; 95% CI, 0.456–12.231) were not associated with insufficient weight gain after a GDM diagnosis.

Conclusion: Our results indicate that insufficient weight gain after a GDM diagnosis is not a risk factor for SGA, prematurity, and NICU admission rates.



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Introduction

Gestational diabetes mellitus (GDM) is a second and third trimester glucose intolerance which is the most common medical complication of pregnancy. Due to an increase in obesity and maternal age, the global incidence of GDM has increased [1, 2]. Fetal macrosomia, preeclampsia, birth trauma, neonatal metabolic disorders and, stillbirth are well known complications of GDM. It also increases the risk of the mother for metabolic syndrome and type 2 DM [3].

Globally, GDM was determined as oral glucose tolerance test (OGTT) between 24 and 28 weeks of gestation. After a diagnosis of GDM, patients experience serious anxiety about what to do due to GDM's association with adverse perinatal outcomes. Patients often ask how much weight should be gained. Healthcare workers were provided updated guidelines on healthy gestational weight

gain (GWG) by the United States Institute of Medicine (IOM) in 2009. In large-scale studies and meta-analyses, excessive GWG has consistently been identified as a risk factor for the previously mentioned adverse perinatal outcomes [4, 5], whereas GDM and excessive body fat cause adverse perinatal outcomes [6]. Viecceli et al.'s meta-analysis indicates that excessive GWG is associated with an increase in pharmacological treatment and adverse perinatal outcomes [7].

Despite the IOM recommendations, some mothers eat insufficient calories and gain less weight than recommended to prevent harm to the fetus from excessive weight gain after the diagnosis of GDM. Studies reported that restricting weight gain in patients with GDM improved pregnancy outcomes [7, 8], but we hypothesized that accelerated fetal growth occurs in the third trimester and excessive calorie restriction and insufficient weight gain during this period may affect fetal development. Herein, we aimed to evaluate the role of insufficient weight gain after GDM diagnosis with small for gestational age (SGA), prematurity, and neonatal intensive care unit (NICU) admission rates.

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Materials and Methods

This retrospective cohort study was conducted from 2017 through 2022 in a single tertiary referral center. Study was approved by the ethics committee of Kayseri City Hospital Clinical Research Ethics Committee (decision number: 519) and all procedures conformed to the Declaration of Helsinki.

The study included pregnant women aged between 18 and 40 years who were diagnosed with GDM during gestational weeks 24–28 with a 75g OGTT screening who attended follow-up visits and delivered at Kayseri City Hospital. We checked and analyzed all pregnant women's data between a 5 year periods from 2017 through 2022. Patients were excluded for the following reasons: multiple pregnancy, congenital or chromosomal abnormalities, chronic/gestational hypertension and preeclampsia, abnormal umbilical artery doppler flows, premature preterm rupture of membranes, placenta invasion anomalies, intrahepatic cholestasis of pregnancy, systemic chronic disease, smoking or alcohol use, and cases with missing data. A total of, 260 patients who met the criteria were included and classified as insufficient weight gain (n: 68) or appropriate weight gain (n: 192) according to IOM recommendations calculated using weight gain per week after a GDM diagnosis. Maternal weight at GDM screening and delivery were measured in the hospital, but pre-pregnancy maternal weight was self-reported. GWG was calculated as weight at delivery minus weight at GDM diagnosis. Pre-pregnancy BMI was used to classify participants as underweight (BMI < 18.5 kg/m²), normal weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²), or obese (BMI, ≥ 30 kg/m²). The sufficient range of weight gain was determined according to the IOM recommendations [9]. The lower and upper limits of weight gain per week of pregnancy in the second and third trimesters recommend that underweight women should gain 1 to 1.3 lb/week, normal weight women should gain 0.8 to 1 lb/week, overweight women should gain 0.5 to 0.7 lb/week, and obese women should gain 0.4 to 0.6 lb/week [9]. The patient flow chart is presented as Figure 1.

To determine gestational age, the beginning date of the patient's last menstrual cycle was used. The GDM screen occurred between 24 and 28 weeks gestational using a 75 g OGTT. It was classified according to the guidelines from the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) (one or more values greater than or equal to the standard thresholds) [10]. If abnormal Doppler findings were not found, late fetal SGA was defined at ≥ 32 weeks using the Delphi consensus criteria [11, 12]. Prematurity was defined as delivery prior to 37+0 gestational weeks. The primary outcome of the study was the presence SGA and the second outcome was presence other adverse perinatal outcomes.

Statistical analysis

The data analysis was performed by using Statistical Package for Social Sciences Program for Windows version 23.0 (SPSS Inc., Chicago, IL, USA). Quantitative variables included in the analysis with a normal distribution were reported as mean ± standard deviation, and non-normally

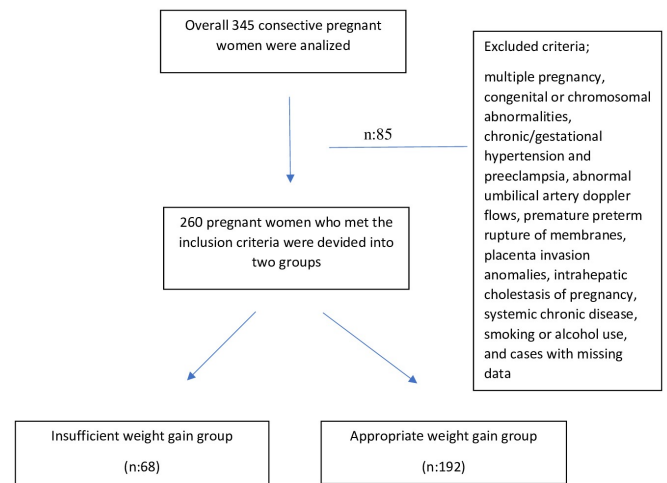


Figure 1. Patient flow chart.

distributed variables were reported as median (interquartile range). Categorical variables were shown as number and percentage values. The variables were investigated using visual and analytical methods (Kolmogorov-Smirnov/Shapiro–Wilk's test) to determine whether or not they were normally distributed. Nonparametric comparisons were made using the Mann–Whitney U test and parametric comparisons were made using the Student's t-test. A comparison of categorical data in paired groups was made with the Chi-square test. A p-value of less than 0.05 was considered to show statistically significant results.

We analyzed 260 patients which is actually not very low. Because when the sample size was calculated after the data was collected, 80% power and 5% error rate, and when the odds ratio was calculated between 0.5 and 1.5 were found, and a sufficient number of patients was reached. Multivariable logistic or linear regression analysis was used to compare between groups for neonatal outcomes. For these comparisons, maternal age, BMI at the first visit, BMI at first GDM screening, BMI at delivery and nulliparity, ethnicity, fetal gender, gestational age at delivery, use of insulin, and cesarean delivery were considered as potential confounders.

Results

Overall, 260 patients were included and divided into two groups: 192 gained within IOM recommendations and 68 gained an insufficient amount according to IOM recommendations. Maternal demographic characteristics and OGTT results are presented in Table 1.

Maternal age (p=0.230), nulliparity (p=0.780), ethnicity (p=0.140), and previous cesarean delivery rates (p=0.450) were similar between groups. The BMI at the first visit, GDM screening, and delivery was significantly higher in the normal gained group compared to the insufficient gained group (both are p<0.001). Gestational age at GDM screening (p=0.640), fasting glucose levels (p=0.960), 1-hour glucose levels (p=0.460), 2-hour glucose levels (p=0.330), and insulin requirement rates (p=0.610) were similar between groups.

Comparisons of the perinatal outcomes between groups are presented in Table 2. Gestational age at delivery,

Table 1. Maternal demographic characteristics and oral glucose test results of the study groups.

Characteristic	Normal weight gain group (n:192)	Insufficient Weight Gain group (n:68)	p value
Maternal age (year)	30.1 ± 3.7	31.6 ± 3.8	0.230
BMI at first visit (kg/m ²)	29.0 ± 2.4	25.8 ± 2.1	<0.001
BMI at first GDM screening (kg/m ²)	31.4 ± 2.8	27.8 ± 2.3	<0.001
BMI at delivery (kg/m ²)	33.8 ± 2.6	29.2 ± 2.2	<0.001
Nulliparity	33 (17.1)	10 (14.7)	0.780*
Ethnicity (Caucasian)	161 (83.8)	63 (92.6)	0.140*
Previous cesarean delivery	76 (39.5)	30 (44.1)	0.450*
GDM screening parameters			
Gestational age at screening (week) (75g OGTT)	26 (25-27)	26 (25-27)	0.640
Fasting glucose(mg/dL)	98.7 ± 6.8	96.7 ± 6.1	0.960
1-h glucose (mg/dL)	184.8 ± 25.2	181.1 ± 24.8	0.460
2-h glucose (mg/dL)	156.7 ± 18.3	153.5 ± 19.9	0.330
Insulin recruitment after screening	98 (51.0)	32 (47.0)	0.610*

Notes: BMI, body mass index; GDM, gestational diabetes mellitus. Values are presented as mean ± SD or n (%). * calculated by Chi-square test.

Table 2. Comparison of perinatal outcomes between groups.

	Normal weight gain group (n:192)	Insufficient Weight Gain group (n:68)	p value	Adjusted p value	Odds ratio	Adjusted odds ratio
Gestational age at delivery (week)	38.0 (38-39)	37 (37-38)	0.090			
Fetal weight (g)	3390 ± 350	3200 ± 290	0.006			
Male gender	94 (48.9)	38 (55.8)	0.060			
Delivery mode (Cesarean)	97 (50.5)	40 (58.8)	0.560			
5 min.Apgar score	9 (8-10)	9 88-10)	0.840			
Prematurity	24 (12.5)	13 (19.1)	0.126	0.774	2.154 (0.795-5.835)	1.205 (0.335-4.320)
SGA	6 (3.1)	6 (8.8)	0.174	0.476	3.000 (0.576-15.638)	1.964 (0.306-12.590)
NICU admission	10 (5)	11 (16.1)	0.025	0.306	3.900 (1.1106-13.751)	2.361 (0.456-12.213)

male gender, delivery mode, and 5 min Apgar scores were similar between groups (p=0.090, p=0.060, p=0.560, and p=0.840, respectively).

The incidence of prematurity was 24 (12.5%) in the control group and 13 (19.1%) in the insufficient weight gain group (p=0.774), SGA was 6 (3.1%) in the control group and 6 (8.8%) in the insufficient weight gain group (p=0.476), and NICU admission was 10 (5%) in the control group and 11 (16.1%) in the insufficient weight gain group (p=0.306).

The results were adjusted for major confounding variables, such as maternal age, BMI at the first visit, BMI at first GDM screening, BMI at delivery, nulliparity, ethnicity, fetal gender, gestational age at delivery, use of insulin, and cesarean delivery. After adjusting for the variables, we observed that insufficient weight gain after GDM diagnosis was not associated with SGA (adjusted odds ratio [aOR], 1.964; 95% confidence interval [CI], 0.306–12.590). In addition, we found that other variables such as prematurity (aOR, 1.205; 95% CI, 0.335–4.320) and NICU admission rates (aOR, 2.361; 95% CI, 0.456–12.231) were not associated with insufficient weight gain after GDM diagnosis (Table 2).

Discussion

In clinical practice after the diagnosis of GDM, patients experience serious anxiety about what to do because of GDM's association with adverse perinatal outcomes. Despite IOM recommendations, some mothers consume insufficient calories and gain less weight than recommended to prevent harm to the fetus from excessive weight gain after the diagnosis of GDM. Excessive weight gain is frequently assessed because it can worsen hyperglycemia, which further contributes to adverse pregnancy outcomes. However, the effects of insufficient weight gain are less studied.

In the current study, we evaluated the association between insufficient weight gain after GDM diagnosis and SGA, prematurity, and NICU admission rates. After multivariate logistic regression analysis for potential confounding factors, the key findings of our study were that insufficient weight gain after GDM diagnosis is not a risk factor for SGA, prematurity, and NICU admission rates.

Weight gain during early- and mid-pregnancy influences maternal and neonatal outcomes, whereas evidence regarding weight gain after a GDM diagnosis is limited. Substantial fetal growth and development occur during the last trimester, which contributes to maternal weight gain during this period [13,14]. Literature studies in non-GDM

healthy pregnancies show a higher risk of SGA infants [15,16] and preterm delivery [17] with insufficient gestational weight gain. Thus, limited, and potentially insufficient, energy intake in women with GDM might result in additional cases of SGA. Cheng et al.'s results support this hypothesis. They found a high risk of SGA neonates among women with GDM who gained less than the recommended amount of gestational weight [18]. According to a retrospective cohort study by Katon et al., weight loss after a GDM diagnosis contributes to lower infant birth weight [19]. However, in study series researcher declared that insufficient gestational weight gain did not correlate with SGA [20,21,22]. In a prospective cohort study, Zheng et al. reported that after the OGTT, excessive weight gain was related with an increased risk of adverse pregnancy outcomes, while insufficient weight gain did not increase the risk of low birth weight [23]. A meta-analysis by Viecelli et al. reported that weight gain below the guidelines reduces the risk of large and macrosomia, but does not increase the risk of small babies [24]. They concluded that an amount less than the recommended weight gain would be beneficial in GDM pregnancies and preventing excessive gain is imperative [24]. Restricted weekly weight gain using strict adherence to dietary treatment was associated with decreased HbA1c levels from the GDM diagnosis to late pregnancy. Furthermore, infants had a birth weight-SD score of 0.15 ± 1.1 and did not experience an increased prevalence of SGA [25].

We can explain our results with dietary quality and quality endocrinology follow-up. A possible reason for a lack of the predicted SGA in women with GDM in the insufficient weight gain group is that the women in our study received guidance from an experienced dietitian to create a diet sufficient in protein, minerals, and vitamins. In addition, this nutritional change after the diagnosis of GDM might have provided good glycemic control and thus, it reduced the risk of iatrogenic prematurity and NICU admission due to poor glycemic control.

We are aware that our work has some strengths and limitations. The main strength of our study is the inclusion of detailed clinical information and the presentation of the results with a multivariate logistic regression analysis by including important cofounders. GDM diagnoses were provided with a 75g OGTT for all pregnant women, and homogenization was provided for the diagnosis of GDM. In addition, another important strength is that the serum glucose regulation of the pregnant women after the diagnosis of GDM was carried out by experienced endocrinologists, accompanied by international up-to-date guidelines. The retrospective design of the study and the relatively small sample are important limitations. Another limitation was the absence of clinically measured pre-pregnancy weight. In addition, although we hypothesize that limiting gestational weight gain after a GDM diagnosis may be beneficial, there is inadequate information regarding a recommended range for appropriate gestational weight gain.

Conclusion

Our results indicate that insufficient weight gain after GDM diagnosis is not a risk factor for SGA, prematurity, and NICU admission rates.

Ethical approval

The ethics committee of Kayseri City Hospital Clinical Research Ethics Committee approved the study (decision number: 519) and all procedures conformed to the Declaration of Helsinki.

Author contributions

All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Competing interests

The authors have stated that there were no conflicts of interest associated with this study or its results.

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