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Original Article

Relationship of Gestational Weight Gain with Cesarean Delivery Risk, Perinatal Birth Weight, and Gestational Age in Overweight and Obese Women

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ABSTRACT

***Background*:** Gestational weight gain (GWG) is an important issue for all pregnant women due to its effect on pregnancy outcomes. Regarding this, the aim of the present study was to assess the relationship of GWG with cesarean section, birth weight, and gestational age at birth in the women with a pre-pregnancy body mass index (BMI) of ≥ 25 kg/m^2.

***Methods*:** This cross-sectional study was conducted on 2,147 obese or overweight pregnant females who had singleton births as a secondary analysis. The data were collected by filling out a checklist in 103 hospitals, which were equipped with department of obstetrics and gynecology, in Tehran province, Iran, in 2015. Data analysis was performed using binomial logistic regression model in Stata software version 14.

***Results*:** According to the results, the prevalence of cesarean section was 74.35%. Furthermore, the mean GWG was 11.7 kg. The odds of cesarean delivery in the women with low and high GWG were 0.62 times smaller and 1.20 times larger than that for normal GWG, respectively (95% CI: 0.42-0.92, P=0.019 and 95% CI:0.90-1.59, P=0.197, respectively). After adjusting for confounding variables, GWG had no significant association with birth weight and gestational age at birth in the overweight and obese women.

Conclusion: The findings of this study revealed a significant relationship between GWG and cesarean section. Furthermore, the odds of cesarean section in the women with low GWG was less than that in the women with normal GWG. Regarding this, GWG should be considered as one of the determinants of cesarean delivery. Therefore, it is suggested to conduct further prospective cohort studies to clarify the impact of GWG on pregnancy complications.

Keywords: Cesarean delivery, Gestational weight gain, Low birth weight, Preterm delivery

Introduction

Gestational weight gain (GWG) is an important issue for all pregnant women due to its impact on pregnancy outcomes. In the recent decades, GWG guidelines have been properly designed and modified, which concern about preeclampsia, birth defects, and weight retention after postpartum. However, the guidelines have their own limitations (1).

The Institute of Medicine (IOM) has recommended a value for appropriate GWG based on the pre-pregnancy body mass index (BMI). Accordingly, the pregnant women with low pre-pregnancy BMI should have more weight gain, and those with high pre-pregnancy BMI are needed to get less GWG (2-4).

Maternal obesity is accompanied by adverse effects on pregnancy outcomes. Nonetheless, the prevalence of this condition is on a growing trend worldwide. Cesarean section, which is significantly common in the obese women, is associated with surgical and anesthetic challenges in this group (5, 6). In addition, obesity is one of

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the most common risk factors for the adverse outcomes of pregnancy (7, 8).

Preterm birth is referred to a live birth or stillbirth that takes place after at least 20 weeks, but before the completion of 37 weeks of gestation (9-12). In 2010, it was estimated that nearly 15 million neonates were born before 37 weeks of gestation throughout the world (13).

Preterm birth rate varies from 5% to 18% in different parts of the world (14). In this regard, the prevalence rate of preterm birth was reported to be 5.1-8.4% in Iran (15, 16). Preterm birth is a leading cause of mortality and susceptibility to various diseases. Accordingly, this condition is responsible for approximately 75% of disease cases and 70% of deaths in the newborns (12).

According to the World Health Organization, the prevalence of low birth weight (LBW; i.e., birth weight less than 25,00 g) is 15.5% worldwide, including almost 20 million cases annually, 96.5% of which occurs in the less developed countries (17). Like preterm birth, LBW is one of the main causes of mortality and morbidity in the newborns and children (18-20).

Cesarean section is another interested outcome in the present study. Although cesarean section is associated with large consequences, its prevalence has increased throughout the world. However, the prevalence of this surgery varies in different regions with the maximum amount in the developing countries, especially Asian countries (21).

According to the literature, GWG is associated with cesarean delivery, birth weight, and preterm birth (22-29). Nonetheless, the pattern of GWG depends on maternal pre-pregnancy BMI. Accordingly, the obese women have a tendency to gain less weight than their non-obese counterparts.

To the best of our knowledge, there is no similar study in Iran investigating this domain. Therefore, the current study has a different setting in comparison to the previous studies since the prevalence of cesarean section is very high in Iran (30). Furthermore, this study was limited to obese and overweight women.

Therefore, the determination of the effective factors in this different setting is critical for the policy makers. With this background in mind, the present study aimed to assess the relationship of GWG with cesarean section, birth weight, and gestational age at birth in the women with BMI of ≥ 25 kg/m^2.

Methods

This secondary analysis, cross-sectional study was conducted on 2,147 obese or overweight pregnant females who had singleton births. The present study was part of a large pregnancy survey carried out in Tehran, Iran. More details regarding design and methodology were reported elsewhere (31-36).

The collected data were related to 5170 deliveries within July 6 to 21, 2015 in 103 hospitals, which were equipped with obstetrics and gynecology departments in Tehran, Iran. The mothers were interviewed by 103 trained midwives or nurses. In our study, all women who gave birth were included in the study regardless of the type of delivery (i.e., vaginal and cesarean delivery) or pregnancy outcomes (i.e., live birth, stillbirth, and spontaneous miscarriage).

The pregnant women who had twin or multiple pregnancies and those with a BMI less than 25 kg/m^2 were excluded from the study. Finally, 2,147 obese or overweight pregnant women were entered to the analysis.

The investigated outcomes were cesarean delivery, LBW, and preterm birth. Furthermore, GWG was considered as an independent variable. The confounding variables controlled in the analysis included maternal age, socioeconomic status score, gravidity, parity, history of preeclampsia, and BMI.

The economic status of the women was measured by means of the asset-based method. To this aim, the women were asked about having some equipment at home (including vacuum cleaner, handicraft carpet, laptop, freezer, dish washing machine, private cars, touch mobile, three-dimensional TV, side by side refrigerator, microwave, number of rooms, and area of residence). Principal components analysis was used to estimate the economic status of these pregnant women. The GWG was categorized based on IOM recommendations as shown in Table 1 (37, 38).

The data were collected using a checklist, the content validity of which was confirmed by a group

Table 1. Categories of gestational weight gain based on Institute of Medicine recommendations by body mass index

BMI	GWG (lb)	GWG (kg)
Thin: <18.5	28-40	12.7-18.14
Normal: 18.5-24.9	25-35	11.33-15.87
Overweight: 25-29.9	15-25	6.80-11.33
Obese: ≥30	11-20	4.98-9.07

GWG: gestational weight gain, BMI: body mass index, IOM: Institute of medicine

of specialists. As it was previously mentioned, this study was part of a large pregnancy survey performed in Tehran in which 92 variables were extracted from the medical records of pregnant women and the prenatal care records.

At the onset of the study, the needed variables were recommended and checked by a group of obstetricians, gynecologists, midwifes, and epidemiologists. Subsequently, some of the recommended variables were included in the study based on the study objectives.

Ethical Considerations

The current study was approved by the Ethics Committee of Royan Institute, Tehran, Iran. This research was performed according to the Helsinki declaration. In this regard, the participants were informed about the objectives of the study prior to the investigation. Voluntary completion of the questionnaire was considered as consent. The eligible individuals were also assured regarding their confidentiality and anonymity.

Data Analysis

The data were analyzed using descriptive statistics (i.e., mean, standard deviation, frequency, and percentage) and logistic regression. In addition, the age, economic status score, gravidity, parity, history of preeclampsia, and BMI were controlled as confounding variables and entered to the logistic model. *P*-value less than 0.05 was considered statistically significant. Data analysis was performed in the Stata software, version 14 (Stata, College Station, TX, USA).

Results

In this study, out of 2,147 pregnant women, 1,629 (74.93%) and 545 (25.7%) cases were overweight and obese, respectively. Furthermore, 529 (25.65%) and 1,533 (74.35%) women had vaginal delivery and cesarean section, respectively. The mean age of the pregnant women was 30.21 years (95% CI: 29.98-30.44 years). About 29%, 42.8%, and 28.1% of the participants had under diploma, diploma, and academic degrees, respectively.

Regarding the occupational status, 89.1% of the participants were housewife, while 10.9% of them were employed. The mean BMI was 28.68 kg/m^2 (95% CI: 28.53-28.82). The mean GWG was 11.7 kg (95% CI: 11.44-11.96 kg). The GWG was below, within, and above the IOM recommended value in 317 (14.62%), 645 (29.75%), and 1206 (55.6%) women, respectively (Table 2). In this study, the mean birth weight and gestational age at birth were 3263 g (95% CI: 3282-3243 g) and 37.39±5.69 weeks, respectively.

The distribution of GWG based on cesarean delivery, birth weight, and gestational age at birth is shown in Table 3. The prevalence rates of cesarean delivery in the women with low, normal, and high GWG were 56.86%, 71.88%, and 79.39%, respectively. However, the women with GWG lower than the IOM recommendation had lower cesarean section rate than the other groups.

As shown in Table 4, the odds of cesarean delivery in the women with low GWG was 0.62 times (95% CI: 0.42-0.92, P=0.019) smaller than the that of the cases with normal GWG. In

Table 2. Gestational weight gain in overweight and obese women

BMI	GWG	Number (%)	95% confidence interval
Overweight pregnant women	Low	225 (13.86)	12.26-15.65
	Normal	497 (30.62)	28.42-32.91
	High	901 (55.51)	53.08-57.91
Obese pregnant women	Low	92 (16.88)	13.95-20.27
	Normal	148 (27.16)	23.57-31.05
	High	305 (55.96)	51.74-60.09
Total	Low	317 (14.64)	13.19-16.17
	Normal	645 (29.75)	27.86-31.71
	High	1206 (55.63)	53.52-57.70

GWG: gestational weight gain, BMI: body mass index

Table 3. Distribution of gestational weight gain by cesarean delivery, birth weight, and gestational age at birth

Variable		GWG categories based on IOM		
		Low	Normal	High
Type of delivery	Vaginal	110 (43.14)	176 (28.12)	243 (20.61)
	Cesarean	145 (56.86)	450 (71.88)	936 (79.39)
Birth weight	<2500 g	10 (4.46)	24 (3.85)	35 (3.12)
	2500-4000 g	214 (95.54)	600 (96.15)	1086 (96.88)
Gestational age	<37 gestational weeks	94 (30.72)	31 (4.90)	65 (5.52)
	37-42 gestational weeks	212 (69.28)	602 (95.10)	1113 (94.48)

GWG: gestational weight gain, IOM: Institute of medicine

Table 4. Adjusted relationship of gestational weight gain with cesarean delivery, low birth weight, and preterm birth

Adverse outcomes	GWG below IOM limits			GWG above IOM limits		
	OR	95% CI for OR	P-value	OR	95% CI for OR	P- value
Cesarean [a]	0.62	0.42-0.92	0.019	1.20	0.90-1.59	0.197
Low birth weight [b]	0.93	0.34-2.58	0.905	0.81	0.40-1.67	0.583
Preterm birth[c]	2.05	0.87-4.80	0.096	1.18	0.64-2.19	0.584

a: adjusted for maternal age, economic status score, gravidity, parity, history of preeclampsia in current pregnancy, gestational age, birth weight, and body mass index

b: adjusted for maternal age, economic status score, gravidity, parity, history of preeclampsia in current pregnancy, gestational age, cesarean section, and body mass index

c: adjusted for maternal age, economic status score, gravidity, parity, history of preeclampsia in current pregnancy, birth weight, cesarean section, and body mass index

GWG: gestational weight gain, BMI: body mass index, IOM: Institute of medicine, OR: odds ratio, CI: confidence interval

addition, the odds of cesarean delivery in the women with high GWG was 1.20 times (95 CI: 0.90-1.59, P=0.197) larger than the odds of those with normal GWG. After adjusting for the confounding variables, no significant association was detected between GWG, birth weight, and gestational age at birth in the overweight and obese women.

Discussion

According to the results, the prevalence of cesarean delivery among the women with a BMI ≥ 25 kg/m^2 was 74.35%. The participants had the mean GWG of 11.70 kg. Nonetheless, GWG was below, within, and above the GWG recommended by the IOM in 14.62%, 29.75%, and 55.63% of the women, respectively. After adjusting for the confounding variables, the odds of cesarean delivery was 0.62 times smaller in the women with low GWG than in those with normal GWG.

The odds of cesarean delivery in the women with high GWG was 1.20 times as compared to the that of the women with normal GWG; however, it was not significant. After adjusting for confounding variables, no significant association was observed between GWG, birth weight, and gestational age at birth among the overweight and obese women.

The normal GWG recommended by the IOM for the overweight and obese women are about 6.8-11.33 and 5-9 kg, respectively. However, the mean GWG obtained in this study was 11.7, which was higher than the recommended level. In this regard, less than 30% of the pregnant women had normal GWG.

In a study conducted on obese women by Gante et al. (37) in Portuguese in 2015, only 35% of the women had normal GWG. Furthermore, nearly 28% and 37% of the subjects were reported to have lower and higher GWG than the recommended value. In the mentioned study, the mean GWG was 8.1 kg, which was lower than the mean GWG obtained in our study and closer to the IOM recommended GWG.

The results of this study showed that the risk of cesarean delivery was lower in the patients with GWG less than the recommended amount, compared to that in the women with the recommended GWG (OR=0.62). Accordingly, other studies have shown that the obese women with GWG less than the IOM recommended value had better pregnancy outcomes than the other women (39, 40).

In a study performed by Gante et al. (37) on obese women with gestational diabetes, it was found that GWG less than the recommended amount led to better obstetric and neonatal outcomes than the normal or high GWG. Deborah et al. (41) also revealed similar findings in this regard.

The present study highlighted the need for the revision and modification of the recommended GWG by IOM for the overweight and obese women. Similar studies have found that the obese pregnant women with lower than recommended GWG had better maternal and neonatal outcomes than the other women (41, 42).

In some studies, the lack of weight gain or limited weight gain has been recommend for the obese women in order to reduce the childbirth and pregnancy complications (41). In this study, no significant association was observed between GWG and preterm birth. On the contrary, there are several studies reporting a significant relationship between these two variables (43, 44).

Therefore, it is necessary to conduct studies concerning the safety and effectiveness of gestational weight loss (GWL) in the obese women (45). The available data suggest that GWL leads to the reduction of obesity-related complications during pregnancy (such as large for gestational age and pregnancy-related hypertension) (46), which may be associated with an increased risk of preterm delivery (47) and an increase in LBW neonates (48). In the present study, there was no significant association between LBW and GWG.

Although the prevention of GWL is a priority for the physicians, recent studies have shown that GWL may have beneficial effects on the obese pregnant women. In a meta-analysis carried out by Beyerlein et al. (47), it was demonstrated that GWL was associated with reduced risk of pregnancy problems, such as preeclampsia and non-selective caesarean, in the overweight and obese pregnant women. In addition, in the mentioned study, the risk of premature birth was also significantly higher in the women with overweight and obesity.

To the best of our knowledge, there is no study investigating this issue in Iran using large sample size. Moreover, the collection of data by trained midwives from 103 public and private hospitals in Tehran was one of the strength of this study. The limitation of this study was that it was not performed at the national level. Consequently, it is suggested to conduct a prospective study with larger sample size at national level.

Conclusion

The findings of this study demonstrated a significant relationship between GWG and cesarean section after adjusting for the confounding variables. In addition, the odds of cesarean section in the women with low GWG was smaller than that in the women with normal GWG.

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