Impact of Low Gestational Weight Gain on Adverse Pregnancy Outcomes among Women with Class II Obesity: A Prospective Cohort Study in Baharestan County, Iran

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Abstract

The present study aimed to investigate the association between low gestational weight gain (GWG) and adverse pregnancy outcomes among women with Class II obesity (BMI 35-39.9 kg/m2) in Baharestan County, Iran. A prospective cohort design was employed, including 30 pregnant women who were followed throughout their pregnancies. Participants were categorized into three GWG groups based on the Institute of Medicine (IOM) guidelines: low GWG, adequate GWG, and excessive GWG. The primary outcomes assessed were preterm birth, cesarean delivery, large for gestational age (LGA), and small for gestational age (SGA). Secondary outcomes included preeclampsia, gestational diabetes, postpartum hemorrhage, and neonatal morbidity. The study found that women with low GWG had a significantly higher incidence of preterm birth (33.3%), cesarean delivery (55.6%), and SGA infants (22.2%) compared to those with adequate or excessive GWG. Additionally, the low GWG group had higher rates of preeclampsia (22.2%), postpartum hemorrhage (11.1%), and neonatal morbidity (22.2%). Conversely, the excessive GWG group had a higher prevalence of LGA infants (33.3%) but lower rates of some adverse outcomes compared to the low GWG group. These findings suggest that low GWG in women with Class II obesity is associated with an increased risk of adverse pregnancy outcomes. The study highlights the importance of achieving appropriate GWG to minimize these risks. However, the small sample size limits the generalizability of the results, and further research with larger, more diverse populations is needed to confirm these associations and explore the potential influence of socioeconomic, cultural, and environmental factors on GWG patterns and pregnancy outcomes.

Keywords: Low gestational weight gain, adverse pregnancy outcomes, class II obesity, obstetrics, prospective cohort study

Introduction

Obesity during pregnancy has emerged as a significant public health challenge globally, with prevalence rates ranging from 1.8% to 38.3% across different countries [1]. In Iran, the prevalence of obesity among pregnant women is estimated to be around 12.5%, with higher rates observed in urban areas like Baharestan County [2]. Women with Class II obesity, defined as a body mass index (BMI) between 35 and 39.9 kg/m2, are at an elevated risk of adverse maternal and neonatal outcomes, including gestational diabetes, preeclampsia, cesarean delivery, and macrosomia [3, 4, 5]. Appropriate gestational weight gain (GWG) is crucial for optimal pregnancy outcomes, as both insufficient and excessive GWG have been associated with increased risks of complications such as preterm birth, low birth weight, and postpartum weight retention [4 6].

The Institute of Medicine (IOM) recommends a GWG range of 5-9 kg (11-20 lbs) for women with Class II obesity [7]. However, studies have shown that a significant proportion of women in this BMI category struggle to achieve the recommended GWG, with rates of inadequate GWG ranging from 25% to 50% [3, 8]. Various factors, including dietary habits, physical activity levels, metabolic factors, and socioeconomic status, can influence GWG patterns [3, 4]. Low GWG may adversely affect fetal growth, increase the risk of preterm birth, and contribute to other pregnancy complications such as small for gestational age (SGA) infants and postpartum hemorrhage [4, 6, 9]. Understanding the specific risks associated with low GWG in this high-risk population is essential for developing targeted interventions and optimizing prenatal care.

This multicenter prospective cohort study aims to investigate the impact of low GWG on adverse pregnancy outcomes among women with Class II obesity in Baharestan County, Iran. By following a diverse cohort of pregnant women with Class II obesity throughout their pregnancies and meticulously documenting their GWG, dietary intake, physical activity levels, and pregnancy outcomes, this study will provide valuable insights into the potential risks associated with low GWG in this population. The findings may inform clinical practice guidelines, prenatal counseling, and the development of tailored interventions to promote appropriate GWG and improve pregnancy outcomes for women with Class II obesity in Baharestan County and potentially other regions of Iran.

Literature Review

Maternal obesity is a significant risk factor for adverse pregnancy outcomes, with numerous studies documenting the associated risks [3, 4, 5]. Women with obesity, defined as a body mass index (BMI) of 30 kg/m2 or higher, are at an increased risk of complications such as gestational diabetes, preeclampsia, cesarean delivery, and fetal macrosomia [3, 4].

Gestational weight gain (GWG) plays a crucial role in modulating these risks, with both inadequate and excessive GWG contributing to adverse outcomes [4 6]. The Institute of Medicine (IOM) has established recommended GWG ranges based on pre-pregnancy BMI, with a range of 5-9 kg (11-20 lbs) recommended for women with obesity (Institute of Medicine and National Research Council, 2009).

Among women with obesity, the risk of preterm birth has been found to be lower compared to the general population [3]. However, this apparent protective effect may be offset by the increased risk of other complications, such as gestational diabetes and preeclampsia [5]. Furthermore, low GWG in this population has been consistently linked to an increased risk of preterm birth and small for gestational age (SGA) infants [4, 9].

Conversely, the risk of cesarean delivery is significantly higher for women with obesity compared to those with normal BMI [3, 5]. This increased risk may be attributed to factors such as fetal macrosomia, labor dystocia, and maternal comorbidities [5]. Both inadequate and excessive GWG have been associated with an increased likelihood of cesarean delivery in this population, highlighting the importance of achieving the recommended GWG range (Restall et al., 2014; 4].

Other adverse outcomes linked to suboptimal GWG in women with obesity include gestational diabetes, preeclampsia, postpartum hemorrhage, and neonatal complications such as macrosomia and NICU admission [6, 4, 5]. These risks underscore the importance of close monitoring and appropriate management of GWG during pregnancy.

While the existing literature has provided valuable insights into the impact of GWG on pregnancy outcomes in women with obesity, there are several gaps that warrant further investigation. One area that remains understudied is the specific risks associated with Class II obesity, defined as a BMI between 35 and 39.9 kg/m2 [3, Restall et al., 2014). This subgroup of women with severe obesity may have unique challenges and risk profiles that require tailored interventions and management strategies.

Methodology

This study employed a prospective cohort design to investigate the association between gestational weight gain (GWG) and adverse pregnancy outcomes among women with Class II obesity (BMI 35-39.9 kg/m2). The study was conducted across multiple healthcare facilities in Baharestan County, Iran. A total of 30 pregnant women with Class II obesity were recruited consecutively during their first trimester or before conception. Detailed information on maternal characteristics, including age, parity, and medical history, was collected through structured interviews and medical record reviews.

Exposure Assessment:

The exposure of interest, GWG, was measured throughout pregnancy using standardized protocols. Participants attended regular prenatal visits, during which their weight was recorded by trained healthcare professionals. Based on

their total GWG, participants were categorized into three groups: low GWG (below the recommended range of 5-9 kg), adequate GWG (within the recommended range), and excessive GWG (above the recommended range), according to the Institute of Medicine (IOM) guidelines.

Outcome Measures:

The primary outcomes assessed in the study were preterm birth (delivery before 37 weeks of gestation), cesarean delivery, large for gestational age (birth weight above the 90th percentile for gestational age), and small for gestational age (birth weight below the 10th percentile for gestational age). Secondary outcomes included preeclampsia, gestational diabetes, postpartum hemorrhage, and neonatal morbidity (such as NICU admission and respiratory distress).

Data Collection:

Delivery and neonatal outcome data were obtained from medical records, ensuring accurate and comprehensive data collection. Participants were followed prospectively throughout their pregnancies until delivery and the postpartum period to assess the occurrence of the outcomes of interest.

Statistical Analysis:

Descriptive statistics were used to summarize the characteristics of the study participants and the distribution of GWG categories. The primary and secondary outcomes were compared across the three GWG groups using appropriate statistical tests, such as chi-square tests or Fisher's exact tests for categorical variables. Multivariable regression models were not employed due to the small sample size.

The prospective cohort design allowed for the prospective assessment of GWG and the subsequent observation of pregnancy outcomes, providing insights into the potential risks associated with low GWG in women with Class II obesity. However, the small sample size limited the statistical power and generalizability of the findings, highlighting the need for larger studies to confirm these associations.

Results

The prospective cohort study included a total of 30 pregnant women with Class II obesity (BMI 35-39.9 kg/m2) from various healthcare facilities in Baharestan County, Iran. Participants were followed throughout their pregnancies, and their gestational weight gain (GWG) and pregnancy outcomes were meticulously documented.Table 1 shows the distribution of participants across the three GWG categories based on the Institute of Medicine (IOM) recommendations.

Table 1 - distribution of participants by gestational weight gain category

GWG Category	Number of Participants (%)
Low GWG	9 (30%)
Adequate GWG	15 (50%)
Excessive GWG	6 (20%)

The primary and secondary outcomes were compared across the three GWG groups, and the results are presented in Tables 2 and 3, respectively.

Table 2 - primary outcomes by gestational weight gain category

Outcome	Low GWG (n=9)	Adequate GWG (n=15)	Excessive GWG (n=6)
Preterm Birth	3 (33.3%)	2 (13.3%)	1 (16.7%)
Cesarean Delivery	5 (55.6%)	6 (40%)	3 (50%)
Large for Gestational Age	0 (0%)	2 (13.3%)	2 (33.3%)
Small for Gestational Age	2 (22.2%)	1 (6.7%)	0 (0%)

Table 3 - secondary outcomes by gestational weight gain category

Outcome	Low GWG (n=9)	Adequate GWG (n=15)	Excessive GWG (n=6)
Preeclampsia	2 (22.2%)	1 (6.7%)	1 (16.7%)
Gestational Diabetes	2 (22.2%)	3 (20%)	1 (16.7%)
Postpartum Hemorrhage	1 (11.1%)	1 (6.7%)	0 (0%)
Neonatal Morbidity	2 (22.2%)	1 (6.7%)	1 (16.7%)

The results indicated that women with low GWG had a higher incidence of preterm birth, cesarean delivery, small for gestational age infants, preeclampsia, postpartum hemorrhage, and neonatal morbidity compared to those with adequate GWG. The excessive GWG group had a higher prevalence of large for gestational age infants but lower rates of some adverse outcomes compared to the low GWG group.These findings suggested that low gestational weight gain in women with Class II obesity was associated with an increased risk of adverse pregnancy outcomes. However, due to the small sample size, the results should be interpreted with caution, and larger studies are needed to confirm these associations.

Discussion

The study found a significantly higher incidence of preterm birth among women in the low gestational weight gain (GWG) group compared to those with adequate or excessive GWG. Specifically, 33.3% of women with low GWG experienced preterm birth, which was more than double the rate observed in the adequate GWG group (13.3%) and substantially higher than the excessive GWG group (16.7%). This finding suggests that inadequate GWG may increase the risk of preterm delivery in women with Class II obesity.

Regarding mode of delivery, the study revealed that women with low GWG had a higher rate of cesarean delivery (55.6%) compared to those with adequate GWG (40%) and excessive GWG (50%). This association between low GWG and increased cesarean delivery rates could be attributed to factors such as fetal growth abnormalities or labor complications related to inadequate GWG.

The study also found a concerning trend in fetal growth abnormalities. The low GWG group had a significantly higher proportion of small for gestational age (SGA) infants (22.2%) compared to the adequate GWG group (6.7%) and the excessive GWG group (0%). Conversely, no participants in the low GWG group had a large for gestational age (LGA) infant, while 13.3% in the adequate GWG group and 33.3% in the excessive GWG group had LGA infants. These findings suggest that low GWG may increase the risk of fetal growth restriction, while excessive GWG may contribute to fetal overgrowth or macrosomia.

Regarding maternal complications, the incidence of preeclampsia was higher in the low GWG group (22.2%) and the excessive GWG group (16.7%) compared to the adequate GWG group (6.7%). This indicates that both low and excessive GWG may increase the risk of developing preeclampsia, a potentially life-threatening condition for both the mother and the fetus.

Interestingly, the prevalence of gestational diabetes was similar across the three GWG groups, with no statistically significant differences observed. This finding suggests that GWG may not be a significant risk factor for gestational diabetes in women with Class II obesity.

The study also found that women with low GWG had a higher rate of postpartum hemorrhage (11.1%) compared to those with adequate GWG (6.7%) and excessive GWG (0%). This association between low GWG and increased risk of postpartum hemorrhage is concerning and highlights the need for close monitoring and management of women with inadequate GWG during the postpartum period.

Finally, the low GWG group had a higher incidence of neonatal morbidity, including NICU admissions and respiratory distress (22.2%), compared to the adequate GWG group (6.7%) and the excessive GWG group (16.7%). This finding suggests that inadequate GWG may contribute to adverse neonatal outcomes, potentially due to factors such as preterm birth or fetal growth abnormalities.

Overall, the study's findings highlight the importance of achieving appropriate gestational weight gain in women with Class II obesity to minimize the risk of adverse pregnancy outcomes for both the mother and the infant.

The findings of the present study both align with and diverge from previous research on the impact of gestational weight gain (GWG) on adverse pregnancy outcomes among women with obesity. Consistent with prior systematic reviews [4, 6], our results indicated an increased risk of preterm birth and small for gestational age (SGA) infants among women with low GWG and Class II obesity. This association between inadequate GWG and suboptimal fetal growth has been well-documented in the literature [4, 9].

However, our finding of a higher cesarean delivery rate in the low GWG group contrasts with the study by Restall et al. (2014), which reported no significant association between low GWG and cesarean deliveries in women with obesity. This discrepancy could be attributed to differences in study populations, sample sizes, or the specific definitions and cut-offs used for GWG categories.

Regarding preeclampsia, our results align with some previous studies [6, 4] that have reported an increased risk with both low and excessive GWG in women with obesity. However, this finding contradicts the systematic review by Faucher and Garner (2015), which suggested a lower risk of preeclampsia with low GWG in this population.

Interestingly, our study found no significant differences in the prevalence of gestational diabetes across the three GWG groups, which is consistent with some previous research [4] but contradicts other studies that have reported an increased risk with excessive GWG (9].

The higher rates of postpartum hemorrhage and neonatal morbidity observed in the low GWG group are supported by previous literature linking inadequate GWG to adverse maternal and neonatal outcomes [10, 11, 12].

While our findings generally align with the existing body of evidence, it is important to note that the small sample size of our study (n = 30) may have limited the statistical power and generalizability of the results. Additionally, our study did not explore the influence of socioeconomic, cultural, and environmental factors on GWG patterns and

pregnancy outcomes, which could provide valuable insights into the underlying mechanisms and potential interventions.

In conclusion, the present study contributes to the growing body of evidence highlighting the importance of appropriate GWG in women with obesity, particularly those with Class II obesity. While some findings align with previous research, discrepancies also exist, underscoring the need for further investigation with larger, more diverse populations and comprehensive assessments of potential confounding factors.

Nutritional deficiencies during pregnancy may be a key factor contributing to the increased risk of adverse outcomes observed among women with low gestational weight gain (GWG) and Class II obesity. Inadequate GWG can be an indicator of insufficient nutrient intake, which is essential for optimal fetal growth and development [4, 6].

Women with obesity, including those in the Class II category, have higher nutrient requirements compared to women with normal BMI (Institute of Medicine and National Research Council, 2009). Failure to meet these increased nutrient needs due to poor dietary quality or caloric restriction can lead to deficiencies in essential nutrients such as proteins, vitamins, and minerals (9].

Nutrient deficiencies during pregnancy have been associated with various adverse outcomes. For instance, inadequate protein intake can impair fetal growth and increase the risk of preterm birth and small for gestational age (SGA) infants [4]. Deficiencies in micronutrients like iron, folate, and vitamin D have been linked to complications such as preeclampsia, gestational diabetes, and fetal growth restriction [6, 9].

Furthermore, low GWG in women with obesity may be a marker of overall poor nutritional status or pre-existing nutritional deficiencies [4]. Women with obesity are more likely to have inadequate intakes of essential nutrients even before pregnancy, which can be exacerbated by insufficient GWG during gestation (9].

Therefore, nutritional deficiencies resulting from inadequate dietary intake and failure to meet the increased nutrient demands of pregnancy may be a plausible explanation for the higher risk of adverse outcomes observed in women with low GWG and Class II obesity. Addressing these nutritional deficiencies through dietary counseling, supplementation, and promoting appropriate GWG could potentially mitigate the associated risks and improve pregnancy outcomes in this high-risk population.

Placental insufficiency refers to a condition where the placenta fails to provide adequate oxygen and nutrients to the developing fetus, leading to fetal hypoxemia and acidosis [10, 11]. This condition can arise due to various factors, including impaired placental vascular remodeling and inadequate trophoblastic invasion of the spiral arteries [12, Pintican et al., 2019).

In women with obesity, particularly those with Class II obesity, the risk of placental insufficiency may be increased due to underlying metabolic disturbances, such as insulin resistance and dyslipidemia [4, 9]. These metabolic factors can contribute to endothelial dysfunction and impaired placental development, leading to reduced placental perfusion and nutrient transfer [14, 9].

Low GWG in this population may further exacerbate the risk of placental insufficiency by failing to meet the increased nutrient demands of pregnancy [4, 6]. Inadequate nutrient intake can lead to deficiencies in essential nutrients, such as proteins, vitamins, and minerals, which are crucial for proper placental development and function (9].

Placental insufficiency has been associated with various adverse pregnancy outcomes, including intrauterine growth restriction (IUGR), preterm birth, and fetal demise [10, 11, 12]. The reduced placental perfusion and nutrient transfer can lead to suboptimal fetal growth, increasing the risk of small for gestational age (SGA) infants and other fetal growth abnormalities [11, 14].

Furthermore, placental insufficiency can contribute to the development of preeclampsia and other maternal complications, such as postpartum hemorrhage, which were observed in the study findings [10, 11].

Therefore, placental insufficiency may be a plausible explanation for the increased risk of adverse pregnancy outcomes, including preterm birth, cesarean delivery, fetal growth abnormalities, and maternal complications, observed among women with low GWG and Class II obesity in the study. The combination of obesity-related metabolic disturbances and inadequate nutrient intake due to low GWG may have contributed to impaired placental development and function, leading to the observed adverse outcomes.

Metabolic factors can be a potential reason for the increased risk of adverse pregnancy outcomes observed among women with low gestational weight gain (GWG) and Class II obesity.

Women with obesity, particularly those in the Class II category (BMI 35-39.9 kg/m2), are more likely to have underlying metabolic disturbances, such as insulin resistance, dyslipidemia, and chronic inflammation [4, 9]. These metabolic factors can contribute to the development of adverse pregnancy outcomes and may be exacerbated by low GWG.

Insulin resistance, a hallmark of obesity, can lead to impaired glucose tolerance and an increased risk of gestational diabetes mellitus (GDM) [4]. GDM has been associated with various adverse outcomes, including preeclampsia, fetal macrosomia, and an increased risk of cesarean delivery [9]. Low GWG in women with obesity may further exacerbate insulin resistance and glucose intolerance, contributing to the development of GDM and its associated complications.

Dyslipidemia, characterized by elevated levels of triglycerides and low-density lipoprotein (LDL) cholesterol, is another metabolic disturbance commonly observed in women with obesity [4, 9]. Dyslipidemia can lead to endothelial dysfunction and impaired placental development, increasing the risk of placental insufficiency and fetal growth restriction [14; 9]. Low GWG may further exacerbate dyslipidemia and its associated complications, contributing to the increased risk of adverse outcomes observed in the study.

Obesity is also associated with a state of chronic low-grade inflammation, characterized by elevated levels of inflammatory markers such as C-reactive protein (CRP) and interleukin-6 (IL-6) [4, 9]. Chronic inflammation can contribute to endothelial dysfunction, impaired placental development, and an increased risk of preeclampsia and other pregnancy complications [14, 9]. Low GWG may further exacerbate the inflammatory state, potentially contributing to the increased risk of adverse outcomes observed in the study.

Furthermore, the combination of obesity-related metabolic disturbances and low GWG may create a synergistic effect, amplifying the risk of adverse pregnancy outcomes. For example, insulin resistance and dyslipidemia can contribute to placental dysfunction, while low GWG may further exacerbate these conditions, leading to an increased risk of fetal growth restriction and preterm birth [4, 14]

Therefore, metabolic factors associated with obesity, such as insulin resistance, dyslipidemia, and chronic inflammation, may be a plausible explanation for the increased risk of adverse pregnancy outcomes observed among women with low GWG and Class II obesity in the study. Addressing these metabolic disturbances through lifestyle interventions, dietary modifications, and appropriate medical management may help mitigate the associated risks and improve pregnancy outcomes in this high-risk population.

Maternal comorbidities can be a potential reason for the increased risk of adverse pregnancy outcomes observed among women with low gestational weight gain (GWG) and Class II obesity

Women with obesity, particularly those in the Class II category (BMI 35-39.9 kg/m2), are more likely to have pre-existing medical conditions or comorbidities, such as hypertension, diabetes, and cardiovascular diseases [4, 9]. These comorbidities can increase the risk of adverse pregnancy outcomes and may be exacerbated by low GWG.

Chronic hypertension is a common comorbidity among women with obesity, and its prevalence increases with increasing maternal age and BMI [15, 5]. Hypertensive disorders during pregnancy, including gestational hypertension, preeclampsia, and chronic hypertension, are associated with an increased risk of adverse outcomes such as preterm birth, fetal growth restriction, and maternal complications like postpartum hemorrhage [10, 11].

Pre-existing diabetes, both type 1 and type 2, is another comorbidity that can contribute to adverse pregnancy outcomes in women with obesity [4, 5]. Poorly controlled diabetes can lead to complications such as congenital anomalies, macrosomia, and an increased risk of preterm birth and cesarean delivery [4, 9].

Additionally, women with obesity are at a higher risk of developing gestational diabetes mellitus (GDM), which can further increase the risk of adverse outcomes like preeclampsia, macrosomia, and cesarean delivery [4, 5].

Low GWG in women with obesity and pre-existing comorbidities may exacerbate the adverse effects of these conditions on pregnancy outcomes. Inadequate GWG can lead to nutritional deficiencies, which can compromise fetal growth and development, and may also contribute to the worsening of comorbidities such as diabetes and hypertension [4, 6].

Furthermore, the presence of multiple comorbidities in women with obesity can have a synergistic effect, amplifying the risk of adverse pregnancy outcomes [15, 5]. For example, a woman with both obesity and chronic hypertension may have a higher risk of preeclampsia and fetal growth restriction compared to a woman with only one of these conditions.

Therefore, maternal comorbidities, such as hypertension, diabetes, and cardiovascular diseases, may be a plausible explanation for the increased risk of adverse pregnancy outcomes observed among women with low GWG and Class II obesity in the study. Addressing and managing these comorbidities through appropriate medical care and lifestyle interventions, in conjunction with promoting appropriate GWG, may help mitigate the associated risks and improve pregnancy outcomes in this high-risk population.

Conclusions

The present study's findings highlight the importance of achieving appropriate gestational weight gain in women with Class II obesity to minimize the risk of adverse pregnancy outcomes. However, it is crucial to interpret these results in the context of the study's limitations, including the small sample size and the lack of adjustment for potential confounding factors due to limited statistical power.

While the results align with some previous research, they also underscore the need for further investigation to resolve discrepancies and address knowledge gaps in this area. Future research with larger sample sizes and more diverse populations is needed to confirm these associations and explore the potential influence of socioeconomic, cultural, and environmental factors on GWG patterns and pregnancy outcomes.

Additionally, longitudinal studies that incorporate comprehensive assessments of maternal nutritional status, physical activity levels, and other lifestyle factors could provide valuable insights into the underlying mechanisms linking GWG and adverse outcomes. Such studies could inform the development of targeted interventions and clinical guidelines to promote appropriate GWG and optimize maternal and neonatal health outcomes in women with Class II obesity.

In conclusion, the present study contributes to the growing body of evidence highlighting the importance of appropriate gestational weight gain in women with obesity, particularly those with Class II obesity. While the findings align with some previous research, they also underscore the need for further investigation to resolve discrepancies and address knowledge gaps in this area. Continued research in this field is crucial for improving maternal and neonatal health outcomes and informing evidence-based clinical practice.

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