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Original Research Article

Gestational weight gain and its association with obstetric and fetal outcome

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ABSTRACT

Background: Gestational weight gain (GWG) is a key determinant of maternal and neonatal outcomes, influenced by maternal pre-pregnancy body mass index (BMI), nutrition, and adherence to guidelines. Deviations from optimal GWG, particularly inadequate weight gain, are associated with adverse outcomes, including preterm birth, low birth weight (LBW), and increased caesarean delivery rates. While Institute of Medicine (IOM) guidelines offer recommendations for appropriate GWG, adherence remains suboptimal in many populations, particularly in developing countries.
Methods: A retrospective observational study was conducted at Chettinad Hospital and Research Institute, involving 264 postnatal mothers. Participants were categorized into two groups based on GWG relative to IOM guidelines: group 1 (inadequate GWG) and group 2 (adequate GWG). Data on maternal height, pre-pregnancy weight, first- and third-trimester weight, and outcomes were retrieved from antenatal records. Statistical analyses were performed to evaluate associations, with significance set at $p<0.05$.
Results: Inadequate GWG was observed in 50% of participants. Group 1 had higher rates of caesarean delivery (52.3% versus 32.6%, p=0.02), preterm births (21.9% versus 9.1%, p=0.01) and LBW neonates (28.8% versus 9.1%, $p<0.001$) compared to group 2. Mean birth weight was significantly lower in group 1 (2.7±0.4 kg versus 3.2±0.3 kg, $p<0.001$).
Conclusions: Inadequate GWG is significantly associated with adverse maternal and neonatal outcomes, including increased caesarean delivery rates, preterm births, and LBW. Pre-pregnancy BMI is a critical determinant of GWG adequacy. These findings underscore the need for tailored antenatal interventions to promote optimal GWG and improve pregnancy outcomes.

Keywords: Gestational weight gain, Obstetric outcomes, BMI, Neonatal outcomes

INTRODUCTION

Gestational weight gain (GWG) represents an essential component of maternal health during pregnancy, directly influencing maternal, obstetric, and fetal outcomes. GWG is a multifaceted phenomenon shaped by maternal pre-pregnancy weight, nutritional status, metabolic changes, and adherence to recommended guidelines. Optimal GWG is crucial for ensuring positive pregnancy outcomes, including the reduction of complications such as gestational diabetes, preeclampsia, preterm birth, and fetal growth restrictions. Deviations from recommended GWG, either insufficient or excessive, pose significant risks for adverse maternal and neonatal outcomes.

The Institute of Medicine (IOM) provides guidelines for GWG based on maternal pre-pregnancy body mass index (BMI), which are widely used to assess appropriate weight gain during pregnancy. These recommendations emphasize a balanced approach, aiming to mitigate risks of adverse events such as caesarean delivery, postpartum hemorrhage, macrosomia, and neonatal morbidity.[1] However, adherence to these guidelines remains

suboptimal in many populations, driven by factors including cultural practices, socioeconomic disparities, and access to healthcare. Recent studies highlight a growing prevalence of excessive GWG, particularly in high-income countries, correlating with increasing trends of maternal obesity.[2]

Maternal obesity, compounded by excessive GWG, is associated with complications such as gestational hypertension, prolonged labor, and increased surgical interventions.[3] On the other hand, inadequate GWG, often linked to maternal undernutrition or high-risk pregnancies, has been implicated in intrauterine growth restriction and low birth weight, which are major contributors to neonatal morbidity and mortality.[4] These associations underscore the importance of investigating GWG trends and their implications for both short- and long-term health outcomes. Understanding the patterns and impacts of GWG is particularly relevant in light of rising global health challenges, including obesity and malnutrition. While GWG is a modifiable risk factor, interventions targeting appropriate weight gain require evidence-based strategies tailored to individual needs and population-specific risks.

Research addressing the interplay between GWG and obstetric or fetal outcomes is essential for informing clinical guidelines and public health initiatives. By elucidating these associations, healthcare providers can better support maternal health, optimize neonatal outcomes, and mitigate the burden of pregnancy-related complications.

This study aims to explore the relationship between GWG and obstetric and fetal outcomes, contributing to a deeper understanding of this critical aspect of maternal health. The findings may provide valuable insights into improving antenatal care practices and guiding policy decisions.

Aim

Aim was to study the effects gestational weight gain on obstetric and fetal outcomes such as mode of delivery, gestational age at delivery and weight of the baby.

METHODS

Study design

This research is designed as a retrospective observational study, analyzing data collected from postnatal mothers who received antenatal care and delivered at the Department of Obstetrics and Gynecology, Chettinad Hospital and Research Institute (CHRI).

Study area

The study was conducted within the Department of Obstetrics and Gynecology at CHRI, a tertiary care center known for comprehensive maternal and child healthcare services.

Sample size

A total of 264 postnatal mothers were included in this study. The sample size was determined based on feasibility and the availability of complete clinical records, ensuring sufficient statistical power for evaluating GWG and its association with obstetric and fetal outcomes.

Study duration

The study covered a 1-year retrospective period, analyzing patient records from the preceding 12 months from October 2023 to October 2024.

Procedure

Subject selection and inclusion criteria

The inclusion criteria were: postnatal mothers whose height and weight were documented within the first trimester and at term or just before delivery and postnatal mothers with singleton pregnancies who received antenatal care and delivered at CHRI.

The exclusion criteria were postnatal mothers with multiple gestations and patients who were known cases of cardiac disease, severe anemia, diabetes mellitus, or chronic hypertension.

Data collection procedures

Data were retrieved from antenatal care (ANC) case records maintained at CHRI. The following procedures were implemented.

Weight measurements

Weight during the first trimester and third trimester (at term) was recorded using a standardized weighing scale by trained personnel in the ANC outpatient department (OPD).

The same calibrated weighing scale was used for consistency.

Height measurement

It was documented in the first trimester using a stadiometer under standard conditions.

Body mass index calculation

BMI was calculated based on pre-pregnancy height and weight using the formula.

$$BMI = Weight\ (kg)/Height(m)^2$$

BMI categories were determined according to Institute of Medicine (IOM) guidelines.

Gestational weight gain

GWG was calculated as the difference between weight at term and weight during the first trimester. Participants were divided into two groups based on adherence to IOM recommendations - group 1: mothers who gained less than the recommended weight and group 2: mothers who gained weight equal to or within the recommended range.

Outcome measures

The following obstetric and neonatal outcomes were recorded from the hospital case records - mode of delivery: categorized as vaginal delivery or LSCS, gestational age at delivery: classified as term (≥37 weeks) or preterm (<37 weeks), and birth weight of the neonate: classified as: normal birth weight (≥2.5 kg) and low birth weight (LBW) (<2.5 kg).

Study outcome

The primary outcomes included the association of GWG with obstetric outcomes (mode of delivery and gestational age) and fetal outcomes (birth weight). The study also aimed to evaluate the role of pre-pregnancy BMI as a determinant for appropriate weight gain and its subsequent impact on maternal and neonatal health.

Statistical analysis

Descriptive statistics were used to summarize the data, and inferential statistics (e.g., Chi-square tests, and t-tests) were applied to examine associations between GWG categories and study outcomes. Statistical significance was set at $p<0.05$. Analysis was performed using statistical package for the social sciences (SPSS) version 25.0.

RESULTS

Participant characteristics

The study included 264 postnatal mothers who met the inclusion criteria. The participants were categorized into two groups based on their GWG relative to the IOM recommendations: group 1 (inadequate GWG): 132 participants (50%) and group 2 (adequate GWG): 132 participants (50%).

The mean age of the participants was 26.3±4.1 years, with no significant age difference between the two groups. The mean pre-pregnancy BMI was 23.1±2.8 kg/m², with participants distributed across BMI categories as per IOM guidelines.

Gestational weight gain

The mean GWG for group 1 (inadequate gain) was 8.5±2.1 kg, significantly lower than group 2 (adequate gain) at 12.8±1.9 kg ($p<0.001$). 60% of women in the inadequate GWG group had a pre-pregnancy BMI in the overweight or obese categories.

Obstetric outcomes

Mode of delivery

It included vaginal delivery - group 1: 63 (47.7%), and group 2: 89 (67.4%); LSCS - group 1: 69 (52.3%), and group 2: 43 (32.6%).

Adequate GWG was significantly associated with higher rates of vaginal delivery (p=0.02).

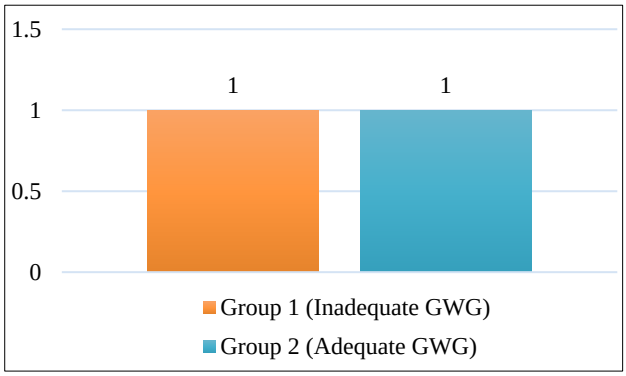

Figure 1: Mode of delivery.

Gestational age at delivery

It included - preterm delivery (<37 weeks): group 1: 29 (21.9%), and group 2: 12 (9.1%); term delivery (≥37 weeks): group 1: 103 (78.1%), and group 2: 120 (90.9%).

Women with inadequate GWG were more likely to deliver preterm (p=0.01).

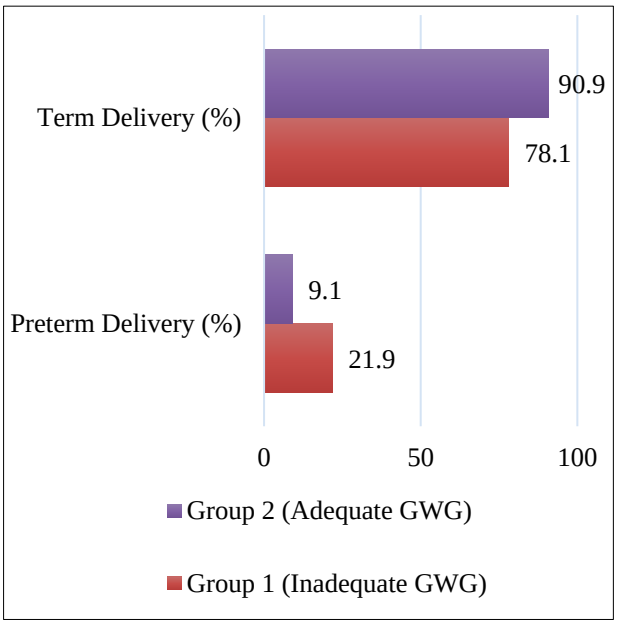

Figure 2: Gestational age at delivery.

Fetal outcomes

Birth weight

It included - low birth weight (LBW, <2.5 kg): group 1: 38 (28.8%), and group 2: 12 (9.1%); normal birth weight (≥2.5 kg): group 1: 94 (71.2%), and group 2: 120 (90.9%).

LBW was significantly more common in the inadequate GWG group (p<0.001).

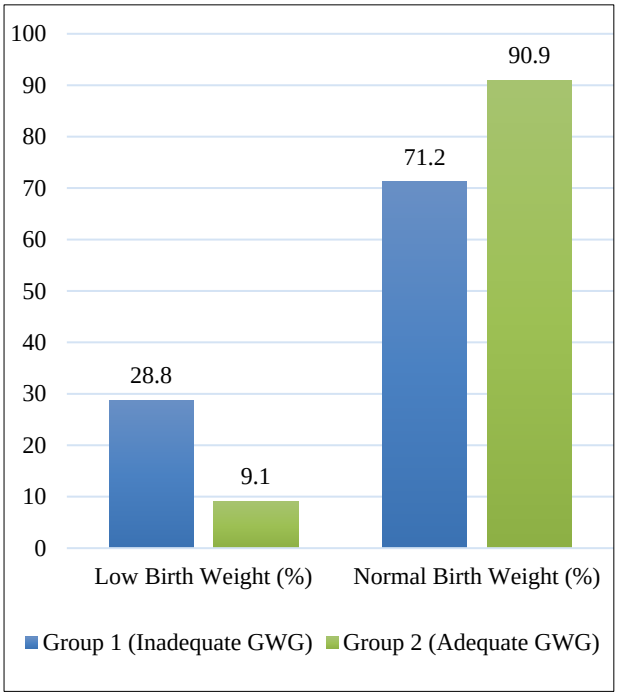

Figure 3: Fetal outcomes.

Mean birth weight

It included - group 1: 2.7±0.4 kg, and group 2: 3.2±0.3 kg.

The mean birth weight was significantly lower in group 1 compared to group 2 (p<0.001).

Associations with pre-pregnancy BMI

Women with pre-pregnancy obesity were more likely to have inadequate GWG and adverse outcomes, including cesarean delivery and preterm birth.

Underweight women with inadequate GWG had the highest risk for LBW (p<0.01).

DISCUSSION

The findings from this study emphasize the significant role of GWG in determining maternal and fetal outcomes. The sample's even distribution into two groups, based on adherence to IOM guidelines, provided a balanced comparative framework. The observed association between inadequate GWG and adverse outcomes aligns with prior studies in similar populations.

Research by Deputy et al highlighted similar trends, where inadequate GWG was linked to suboptimal pregnancy outcomes, particularly among overweight and obese women, consistent with our findings that 60% of women with inadequate GWG had a pre-pregnancy BMI in the overweight or obese range.[2] This study complements existing evidence by focusing on an Indian cohort, where cultural, dietary, and healthcare factors may influence GWG trends differently from Western populations.

In this study, inadequate GWG was associated with higher rates of LSCS (52.3% versus 32.6% in the adequate GWG group). This is consistent with findings by Durie et al, who reported a significant association between inadequate weight gain and an increased need for caesarean delivery, likely due to compromised maternal energy reserves during labor.[5] Furthermore, maternal obesity, a common characteristic in women with inadequate GWG, is independently associated with labor dystocia and surgical delivery, reinforcing the observed outcomes.[3] The higher prevalence of preterm births in the inadequate GWG group (21.9% versus 9.1%) aligns with results from a multicenter study by Villar et al, which identified inadequate GWG as a key risk factor for preterm delivery.[6] Preterm delivery often results from insufficient placental growth and development, exacerbated by suboptimal maternal weight gain. Our findings confirm these associations in a South Asian context, where preterm birth remains a major contributor to neonatal morbidity and mortality. LBW was significantly more common in the inadequate GWG group (28.8% versus 9.1%), mirroring results from McDonald et al, who demonstrated a nearly two-fold increase in LBW risk among women with insufficient GWG.[7] Similarly, a systematic review by Han et al established a strong correlation between inadequate GWG and intrauterine growth restriction (IUGR), emphasizing the critical need for appropriate weight gain during pregnancy.[8] This relationship may be particularly pronounced in populations with a high prevalence of nutritional deficiencies, as is often observed in low- and middle-income countries. Our findings, with a mean birth weight of 2.7±0.4 kg in the inadequate GWG group compared to 3.2±0.3 kg in the adequate GWG group, corroborate results from a study by Gaillard et al, which reported a similar reduction in birth weight associated with suboptimal GWG.[9] These findings underscore the role of GWG in ensuring adequate fetal nutrition and growth.

Women with pre-pregnancy obesity were more likely to exhibit inadequate GWG and adverse outcomes. This is consistent with evidence from Catalano and Ehrenberg, who highlighted that obese women often experience lower-than-recommended GWG due to metabolic dysregulation and a heightened risk of comorbidities such as gestational diabetes and hypertension.[10] On the other hand, underweight women with inadequate GWG exhibited the highest risk for LBW, echoing findings from

a study by Han et al, which demonstrated that maternal undernutrition exacerbates risks of fetal growth restriction.[8]

Several comparative studies provide additional context to our findings. A study by Siega-Riz et al in the United States revealed that inadequate GWG is a significant predictor of preterm birth and caesarean delivery, particularly among overweight and obese women, similar to our cohort.[11] Research in Chinese populations by Cheng et al demonstrated a strong association between inadequate GWG and adverse fetal outcomes, including LBW and preterm birth, underscoring the universality of these findings across diverse ethnic and geographic populations.[12] A cohort study in Brazil by Nucci et al reported that adherence to IOM guidelines significantly reduced the risk of caesarean delivery and LBW, reinforcing the importance of standardized GWG recommendations.[13]

These findings emphasize the critical need for tailored antenatal care that incorporates pre-pregnancy BMI and GWG monitoring as central components. Comparative data from similar studies strengthen the argument for adopting a universal approach to GWG counselling and intervention. By integrating evidence from diverse populations, healthcare providers can refine antenatal care strategies to reduce disparities in maternal and neonatal outcomes. The consistency of our findings with those from previous studies highlights the critical role of adequate GWG in improving obstetric and neonatal outcomes. Future research should focus on culturally specific interventions to promote optimal GWG, particularly in regions with unique dietary practices and healthcare challenges.

CONCLUSION

This study highlights the pivotal role of GWG in influencing obstetric and neonatal outcomes among postnatal mothers. Adequate GWG, as defined by IOM guidelines, was significantly associated with favorable outcomes, including higher rates of vaginal delivery, reduced prevalence of preterm births, and a lower incidence of LBW neonates. Conversely, inadequate GWG was linked to adverse outcomes, such as increased caesarean delivery rates, higher preterm birth rates, and LBW, underscoring the importance of achieving optimal weight gain during pregnancy. The study also identified pre-pregnancy BMI as a critical determinant of GWG and its associated outcomes. Women with pre-pregnancy obesity were more likely to experience inadequate GWG and adverse maternal and neonatal outcomes, while underweight women with insufficient weight gain faced the highest risk of LBW. These findings emphasize the need for individualized antenatal care that incorporates pre-pregnancy BMI and GWG monitoring to mitigate risks. Given the increasing prevalence of maternal obesity and the unique challenges faced by women in diverse cultural and socioeconomic contexts, these findings provide a strong rationale for adopting evidence-based guidelines for GWG. Interventions such as nutritional counselling, targeted weight monitoring, and early identification of at-risk women are critical for improving maternal and neonatal health outcomes.

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