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A Study of Maternal Weight Gain in Pregnancy and Its Consequences on Maternal Complications and Pregnancy Outcome: A Retrospective Analysis

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Abstract

Objective : This study aims to assess the relation between maternal weight gain during pregnancy and its effects on maternal complications and pregnancy outcomes, including gestational diabetes mellitus (GDM), hypertensive disorders, cesarean delivery, preterm birth, and neonatal birth weight. **Methods:** This retrospective study analysed data from 1500 pregnant women who received prenatal care at Rama Medical College Hospital & Research Centre, Kanpur between September 2022 and September 2024. Maternal demographics, including age, ethnicity, education level, and pre-pregnancy BMI, were collected from medical records. Maternal weight gain during pregnancy was categorised according to Institute of Medicine (IOM) guidelines. Pregnancy outcomes, including gestational hypertension, preeclampsia, gestational diabetes mellitus, cesarean section delivery, and infant macrosomia , were also obtained from medical records. Descriptive statistics were used to summarise maternal characteristics and pregnancy outcomes. Chi-square tests and logistic regression assessed associations between weight gain categories and outcomes. **Results :** Adequate weight gain according to IOM guidelines was linked to lower rates of GDM, hypertensive disorders, and cesarean delivery. Excessive weight gain was significantly associated with higher rates of GDM, hypertensive disorders, cesarean delivery, and macrosomia—insufficient weight gain correlated with lower birth weights and an increased risk of preterm birth. **Conclusion :** Maternal weight gain during pregnancy is a significant factor influencing both maternal complications and pregnancy outcomes. Systematic efforts to reduce weight before pregnancy through pre-pregnancy dietary counselling, regular physical activity, and a healthy lifestyle should be the primary goal.

Key words: maternal weight gain, pregnancy, pregnancy complications, pregnancy outcome

Introduction

Gestational weight gain and the BMI of pregnant women play a crucial role in determining pregnancy outcomes and the health of both the mother and the baby. It has become recognised that regular weight assessment of expectant mothers is an essential part of prenatal care in modern obstetrics (Abrams, 1995). Women are weighed during their first prenatal visit to establish their initial weight, and then at each subsequent appointment. The difference in weight between the last and initial visits represents the total weight gained during the pregnancy, a standard practice in antenatal clinics.

The recommended weight gain during pregnancy, based on BMI, is as follows:

- 13–18 kg for lean women with a BMI of less than 18.5
- 11–16 kg for those with a BMI of 18.5–24.9
- 7 to 11 kg for overweight women with a BMI of 25–29.9
- 5 to 9 kg for obese women with a BMI of 30 or higher (F Gary Cunningham and J Whitridge Williams, 2010).

- Gestational weight gain is essential for ensuring the health of the foetus, but both excessive and inadequate gestational weight gain have been linked to negative outcomes.

Inadequate weight gain is a significant risk factor for adverse fetal and neonatal outcomes, such as intrauterine growth restriction, preterm birth, and low birth weight (Brawarsky et al., 2005). It also has long-term health effects on the child, including respiratory distress syndrome, infections, developmental delays, hypoglycemia, and jaundice. Moreover, it can lead to maternal malnutrition, anemia , pregnancy-induced hypertension, cesarean delivery, and postpartum weight retention issues. Pregnant women must gain enough weight to prevent these risks (American College of Obstetricians and Gynecologists, 2013).

On the other hand, excessive weight gain during pregnancy can lead to poor neonatal outcomes, such as early asphyxia, birth injury, and hypoglycemia (Catalano and Shankar, 2017; Asvanarunat, 2014). It is also associated with various pregnancy complications, including preterm birth, intrauterine growth restriction (IUGR), stillbirth, thromboembolism, preeclampsia, gestational hypertension, fetal macrosomia, gestational diabetes mellitus, intrapartum and postpartum complications, and neonatal mortality. Obesity during pregnancy is linked to a higher rate of cesarean sections and a lower rate of lactating mothers compared to women with a normal BMI. Maternal mortality may also be associated with obesity (Nair et al., 2015). According to the World Health Organization, 1.8% to 25.3% of pregnant women are obese (World Health Organization, 2022).

Maternal weight gain during pregnancy is a critical factor in determining both maternal and neonatal health outcomes. This study aims to explore the relationship between maternal weight gain and maternal

complications such as gestational diabetes mellitus (GDM) and hypertensive disorders, as well as pregnancy outcomes including cesarean delivery, preterm birth, and neonatal birth weight.

Methods and Materials

Study Design and Population :

A retrospective cohort study was conducted using data from 1,500 women with singleton pregnancies who delivered at Rama Medical College Hospital & Research Centre, Kanpur between September 2022 and September 2024. The women were categorized into four groups based on their pre-pregnancy BMI (underweight, normal weight, overweight, and obese), and three groups of gestational weight gain (GWG) relative to the IOM guidelines (inadequate, adequate, excessive).

Pregnancy weight was measured during the first trimester and at delivery, using an electronic digital scale with kilogram mode, with the women barefoot and wearing light clothes.

Weight gain was categorized based on IOM guidelines as follows:

- Underweight (BMI < 18.5): 28-40 lbs (12.7 - 18.1kg)
- Normal weight (BMI 18.5-24.9): 25-35 lbs (11.3 - 15.9 kg)
- Overweight (BMI 25-29.9): 15-25 lbs (6.8 - 11.3 kg)
- Obese (BMI ≥ 30): 11-20 lbs (5 - 9 kg)

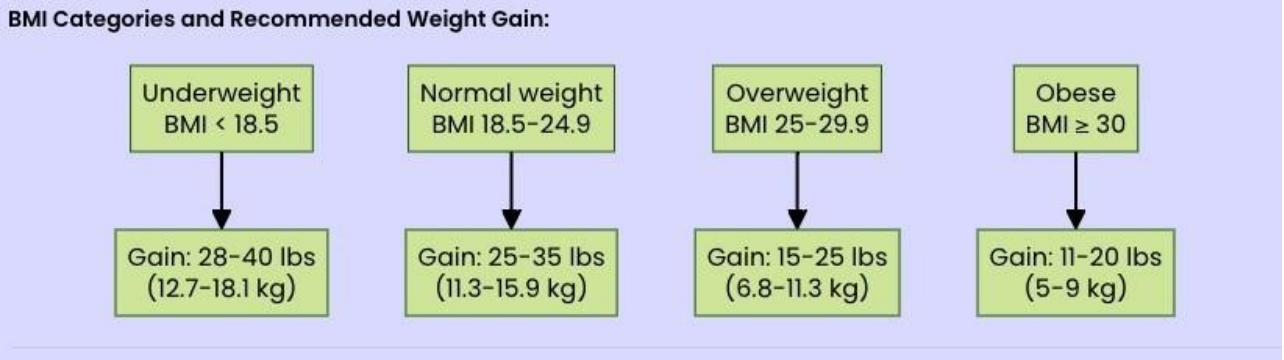

Figure 1: BMI categories and recommended weight gain

Gestational weight gain, based on pre-pregnancy BMI and GWG relative to the IOM guidelines, was classified into three groups:

1. Inadequate
2. Adequate
3. Excessive

The study used a 50g oral glucose challenge test (OGCT) at 24-28 weeks of gestation to screen for gestational diabetes mellitus.

Gestational hypertension, defined as systolic pressure above 140 mm Hg or diastolic pressure above 90 mm Hg after 20 weeks, is a condition that can lead to preeclampsia, a condition characterized by proteinuria, defined as greater than or equal to 300 mg in a 24-hour sample.

Inclusion criteria - Complete medical records with documented pre-pregnancy BMI, gestational weight gain, and delivery outcomes.

Exclusion criteria -Multiple pregnancies, pre-existing medical conditions affecting weight gain, and incomplete records.

Data Collection

Data were collected from medical records, including maternal age, pre-pregnancy BMI, total gestational weight gain, gestational age at delivery, birth weight, delivery method, and the occurrence of GDM and hypertensive disorders.

Outcomes Measured

Primary outcomes included:

- Gestational diabetes mellitus (GDM)
- Hypertensive disorders (gestational hypertension, preeclampsia)
- Cesarean delivery rates
- Preterm birth (<37 weeks)
- Neonatal birth weight (categorized as low birth weight <2500g, normal birth weight 2500-4000g, and macrosomia >4000g)

Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics summarized maternal demographics and pregnancy outcomes. Chi-square tests and logistic regression were used to assess associations between weight gain categories and outcomes. Significance was set at $p < 0.05$.

Results

Participant Characteristics

Out of the 1,500 participants, the distribution of pre-pregnancy BMI categories was as follows: 12% underweight, 55% normal weight, 22% overweight, and 11% obese. The mean maternal age was 29 years (SD ±4 years).

Thus, out of the 1,500 participants:

- 55% were normal weight, 825 participants
- 22% were overweight, 330 participants
- 11% were obese, 165 participants
- 12% were underweight, 180 participants

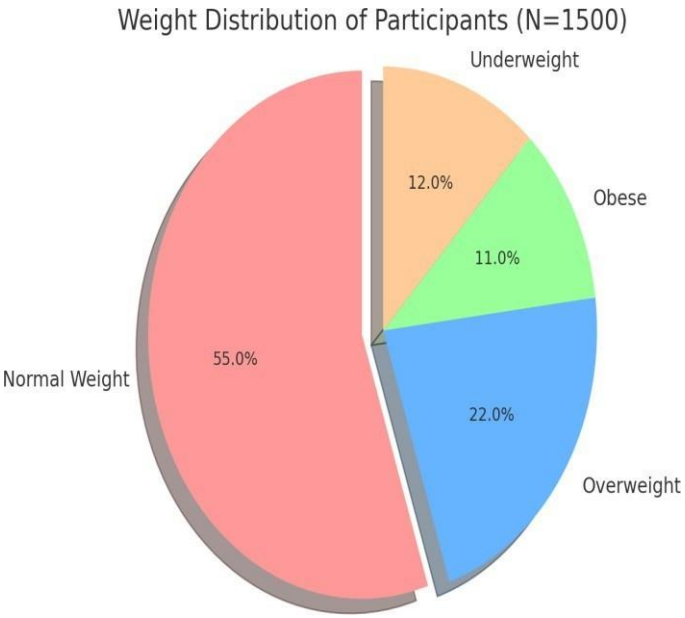

Figure 2: Weight distribution of participants

Maternal Weight Gain and Maternal Complications

Women with weight gain within IOM guidelines had the lowest incidence of GDM (5%) and hypertensive disorders (6%). Excessive weight gain was associated with a significantly higher incidence of GDM (15%) and hypertensive disorders (18%). Insufficient weight gain was associated with an increased risk of preterm birth (14%) and low birth weight (10%).

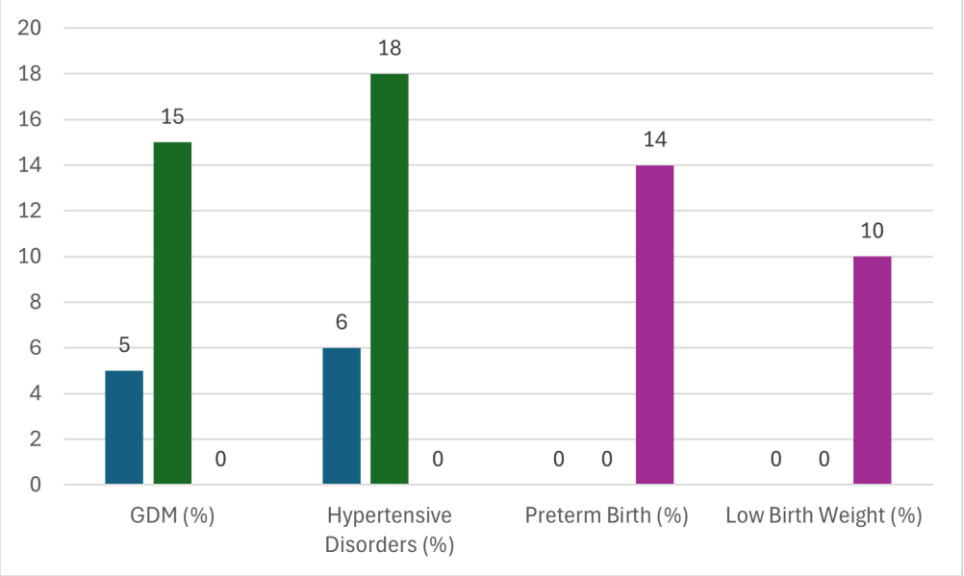

Figure 3: Maternal weight gain and maternal complications

Maternal Weight Gain and Pregnancy Outcomes

Women who gained weight within IOM guidelines had the highest proportion of normal birth weight infants (68%) and lower cesarean delivery rates (22%). Excessive weight gain was significantly associated with higher rates of macrosomia (25%), cesarean delivery (35%), and hypertensive disorders. Insufficient weight gain correlated with higher rates of low birth weight (15%) and preterm birth (12%).

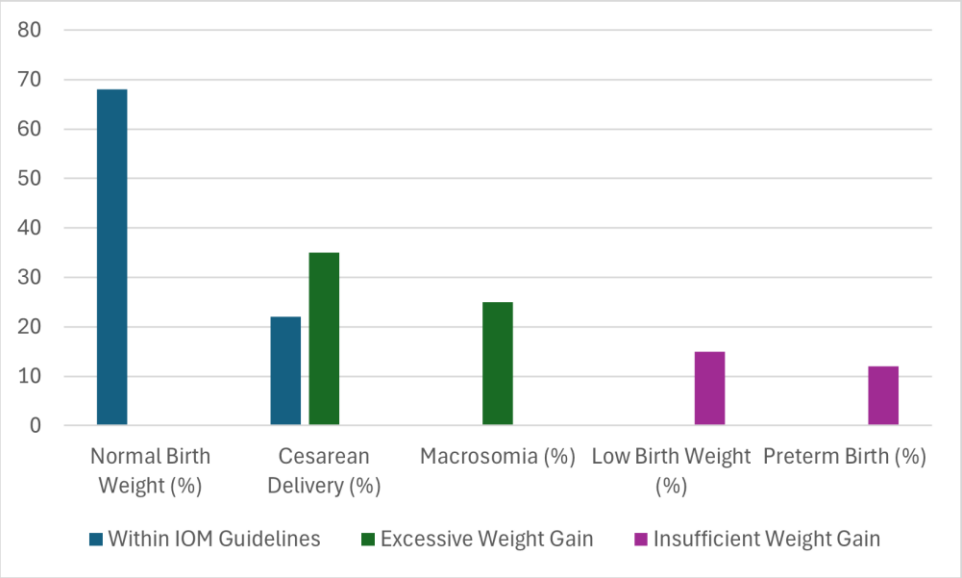

Figure 3: Maternal weight gain and pregnancy outcomes

These statistics highlight the importance of appropriate weight gain during pregnancy for both maternal and fetal health. Healthcare providers often provide guidance on recommended weight gain based on the mother's pre-pregnancy body mass index (BMI) to help reduce the risk of complications and promote healthy outcomes for both mother and baby. It's important for pregnant women to follow their healthcare provider's advice regarding nutrition and weight gain to optimise their pregnancy outcomes.

Statistical Analysis

Excessive weight gain was significantly associated with higher rates of GDM ($p < 0.01$), hypertensive disorders ($p < 0.01$), macrosomia ($p < 0.01$), and cesarean delivery ($p < 0.05$).

Discussion

This study shows that adhering to IOM guidelines for gestational weight gain is associated with lower rates of maternal complications such as GDM and hypertensive disorders, as well as favourable pregnancy outcomes including lower cesarean delivery rates and optimal neonatal birth weight. Excessive weight gain increases the risk of maternal complications and adverse neonatal outcomes, while insufficient weight gain is linked to preterm birth and low birth weight.

Obese women are at a higher risk of preterm deliveries due to antepartum complications and also have a higher likelihood of spontaneous preterm births. In overweight and obese women, the relative risk for fetal death (1.09 to 1.35), stillbirth (1.18 to 1.30), perinatal death (1.00 to 1.35), neonatal death (1.07 to 1.23), and infant mortality (1.09 to 1.28) increased with each five units increase in maternal BMI (Aune et al., 2014).

Intra-partum obesity increases the chance of endometritis, a failed labor trial, and cesarean birth. It also doubles the risk of a composite measure of maternal morbidity and increases the risk of neonatal damage by five times. In nulliparous women, the mother's BMI has an inverse relationship with the duration of labor. Moreover, they are more likely to undergo a repeat cesarean delivery before active labor (Almshouse et al., 2016).

Moreover, excessive weight gain during pregnancy contributes to the pathogenesis of GDM through mechanisms involving adipose tissue expansion and insulin resistance resulting in an increased risk of developing Type 2 diabetes mellitus later in life, Macrosomic infants, Neonatal hypoglycemia, Respiratory distress syndrome and Hypocalcemia and other metabolic disturbances (Rudge et al., 2023).

Also, preeclampsia, which is defined as new-onset hypertension (elevated blood pressure) after 20 weeks of gestation, together with indications of organ dysfunction, such as proteinuria (excess protein in the urine) and/or other difficulties for the mother, can result from hypertension during pregnancy. If left untreated, preeclampsia can worsen quickly and cause serious problems. Due to difficulties like the following, it raises the risk of maternal death and morbidity:

Insufficient weight gain during pregnancy increases the risk of having LBW infants who face higher risks of neonatal death due to immature organ systems and vulnerability to infections and respiratory issues. Placental insufficiency can also occur.

The review emphasizes the importance of healthy pregnancy weight gain for both mother and newborn, highlighting its complex effects on immediate outcomes, delivery methods, neonatal health, and long-term health consequences as mentioned below.

- Obesity and Pregnancy

- Increased Complications: Higher risk of preterm deliveries due to antepartum complications, spontaneous preterm births, and increased likelihood of cesarean birth. - Maternal and Neonatal Risks: Elevated risks of fetal death, stillbirth, perinatal death, neonatal death, and infant mortality with increasing maternal BMI. - Labor and Delivery: Inverse relationship between maternal BMI and duration of labor in nulliparous women; increased likelihood of repeat cesarean delivery before active labor.

- Preeclampsia

- Definition and Risks: New-onset hypertension after 20 weeks of gestation with indications of organ dysfunction; can lead to serious complications and increased risk of maternal death and morbidity. – Implications

Weight Gain Category	**Description**
Normal Weight Gain	- Optimal Outcomes: Associated with the highest proportion of normal birth weight infants and lower rates of cesarean delivery. - Adherence to Guidelines: Following the Institute of Medicine (IOM) guidelines for gestational weight gain is linked to lower rates of maternal complications (e.g., gestational diabetes mellitus [GDM], hypertensive disorders) and favorable pregnancy outcomes.
Excessive Weight Gain	- Increased Risks: Higher rates of macrosomia, cesarean delivery, and hypertensive disorders. - Long-term Implications: Contribution to the pathogenesis of GDM, increasing the risk of Type 2 diabetes mellitus, neonatal complications (e.g., hypoglycemia, respiratory distress syndrome), and potentially preeclampsia.
Insufficient Weight Gain	- Adverse Outcomes: Higher rates of low birth weight (LBW) and preterm birth. - Neonatal Risks: Increased risk of neonatal death due to immature organ systems, vulnerability to infections, respiratory issues, and potential placental insufficiency.

Figure 4: Weight gain and maternal and fetal outcomes

Conclusions:

In summary, appropriate gestational weight gain, as recommended by guidelines like those from the IOM, is essential for reducing the risk of maternal and neonatal complications. Excessive and insufficient weight gain both are associated with adverse outcomes, therefore everyone mainly healthcare providers should understand need for careful monitoring and management of weight gain during pregnancy, especially in the context of obesity and overweight. It highlights the importance of pre-pregnancy counselling, nutritional guidance, and regular prenatal care to optimise maternal and neonatal health outcomes. Healthcare providers play a crucial role in educating and supporting women to achieve and maintain a healthy weight before and during pregnancy.References:

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