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Association of Maternal Body Mass Index and Gestational Weight Gain on Maternal and Neonatal Outcomes

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ABSTRACT

Introduction: Maternal body mass index (BMI) and gestational weight gain (GWG) are important determinants of pregnancy outcomes. Both maternal obesity and inappropriate GWG have been associated with increased maternal and neonatal morbidity. This study evaluated the independent and combined effects of maternal BMI and GWG on maternal and neonatal outcomes.

Material and Methods: A prospective observational cohort study was conducted among 400 singleton pregnancies at a tertiary care hospital. Maternal BMI was recorded at or before 14 weeks of gestation and categorized according to World Health Organization criteria as overweight or obese. GWG was classified as ideal, excessive, or inadequate according to Institute of Medicine recommendations. Maternal and neonatal outcomes were analyzed using Chi-square or Fisher's exact test. Crude relative risks (RRs) with 95% confidence intervals (CIs) were calculated, and $p<0.05$ was considered statistically significant.

Results: Of the 400 women, 330 (82.5%) were overweight and 70 (17.5%) were obese. Excessive GWG occurred in 71.4% of obese women compared with 33.3% of overweight women. In obese women, there were significantly increased the risk of cesarean delivery (50.0% vs. 24.8%; RR 2.01, 95% CI 1.49–2.71; $p<0.001$), operative vaginal delivery (18.6% vs. 8.8%; RR 2.12, 95% CI 1.18–3.82; $p=0.01$), low birth weight (45.7% vs. 26.4%; RR 1.73, 95% CI 1.24–2.41; $p=0.001$), and neonatal intensive care unit admission (58.6% vs. 35.2%; RR 1.66, 95% CI 1.28–2.16; $p<0.001$). Compared with ideal GWG, excessive GWG independently increased the risk of labour induction (RR 1.43, 95% CI 1.02–2.00; $p=0.036$), cesarean delivery (RR 1.64, 95% CI 1.19–2.26; $p=0.003$), low birth weight (RR 1.70, 95% CI 1.21–2.39; $p=0.002$), and NICU admission (RR 1.89, 95% CI 1.46–2.45; $p<0.001$). Shoulder dystocia occurred exclusively among obese women with excessive GWG.

Conclusions: Maternal overweight, obesity, and inappropriate gestational weight gain were significantly associated with adverse maternal and neonatal outcomes. Early identification of women at risk, preconception weight optimization, nutritional counseling, and close antenatal surveillance may help reduce pregnancy-related complications and improve neonatal outcomes.

Keywords: Maternal Body Mass Index, Gestational Weight Gain, Pregnancy Outcomes, Maternal Complications, Neonatal Outcomes.

INTRODUCTION

In general, pregnancy in women is considered unique, physiologically normal episode in women's life. Maternal nutritional status and gestational tracking are critical determinants of health for both the mother and the growing fetus. Among the various indicators of maternal nutritional status, Body Mass Index (BMI) before or during early pregnancy and Gestational Weight Gain (GWG) are widely recognized as important predictors of pregnancy outcome. Appropriate maternal weight and recommended gestational weight gain contribute to optimal fetal growth, whereas deviations from these recommendations are associated with increased maternal and perinatal morbidity and mortality. [1-3]

Over the past few decades, the prevalence of overweight and obesity among women of reproductive age has increased dramatically worldwide. The World Health Organization (WHO) has identified obesity as one of the most significant non-communicable diseases affecting maternal and child health. [4] In India, the burden of maternal overweight and obesity is also rising steadily. According to the National Family Health Survey (NFHS-5), approximately 24% of women aged 15–49 years are overweight or obese, highlighting a growing public health concern. [5] This epidemiological transition has important implications for pregnancy outcomes, particularly in developing countries where maternal undernutrition and obesity coexist.

In addition to baseline BMI, gestational weight gain is an important and potentially modifiable factor affecting pregnancy outcomes. In 2009, the Institute of Medicine (IOM) revised its recommendations for gestational weight gain according to pre-pregnancy BMI categories. [1] Adequate gestational weight gain is necessary to support fetal growth and maternal physiological adaptations; however, excessive or inadequate weight gain has been linked to adverse maternal and neonatal outcomes. Excessive GWG increases the risk of gestational diabetes, hypertensive disorders, operative delivery, postpartum weight retention, fetal overgrowth, and neonatal complications, whereas inadequate GWG has been associated with low birth weight, fetal growth restriction, and preterm birth. [1,2,6]

Maternal BMI reflects pre-pregnancy nutritional status and has been extensively studied as a determinant of obstetric outcomes. Women entering pregnancy with elevated BMI are at increased risk of several complications, including gestational diabetes mellitus (GDM), pregnancy-induced hypertension (PIH), preeclampsia, prolonged labor, cesarean delivery, postpartum hemorrhage, and postpartum infections. [2,7,8] Maternal obesity is also associated with chronic low-grade inflammation, insulin resistance, endothelial dysfunction, and altered placental nutrient transport, all of which may adversely influence maternal and fetal health. [7-9]

Maternal obesity and excessive gestational weight gain also exert important effects on fetal and neonatal outcomes. Previous studies have reported higher rates of preterm birth, neonatal intensive care unit (NICU) admission, birth trauma, respiratory complications, and long-term metabolic disorders among infants born to overweight and obese mothers. [8-10] These associations are believed to result from alterations in maternal metabolism, placental function, and fetal programming mechanisms occurring throughout pregnancy.

However, despite global and national recognition of these associations, local data remains insufficient, especially from rural and semi-urban regions where healthcare infrastructure is limited, and early nutritional counselling is often absent. [13] Therefore, this study aims to comprehensively analyse the association of maternal body mass index and gestational weight gain on maternal and neonatal outcomes, providing actionable data to improve preconception counselling and antenatal surveillance strategies.

MATERIALS & METHODS

A prospective observational cohort study was conducted at our teaching and tertiary care hospital. The sample size was calculated using Cochran's formula for estimating a single population proportion. Assuming an expected prevalence of maternal overweight/obesity (BMI ≥25 kg/m²) of 30%, based on previous epidemiological data, with a 95% confidence level (Z = 1.96) and 5% absolute precision, anticipated 10% rate of incomplete data or participant attrition, the final required sample size was 343. Total 400 pregnant women were enrolled in the study. A convenience sampling method was employed in this study. All eligible pregnant women at our tertiary care hospital during the study period (December 2024 to November 2025), fulfilled the below inclusion criteria were consecutively recruited until the required sample size of 400 participants was achieved. Convenience sampling was selected because the study was conducted in a busy tertiary care center with a continuous inflow of eligible participants, making it a practical and feasible approach for recruiting participants within the stipulated study period. Written informed consent was obtained from all participants prior to enrollment.

Inclusion Criteria:

- All women with singleton pregnancy.
- Age group between 18 to 40 years.
- Maternal height >120cm
- Women receive first antenatal care at or before 14wks.
- Weight and height measurement at first examination (at or before14weeks)

Pregnant woman with multiple gestations, polyhydramnios, chronic hypertension, Overt DM, fetus having congenital anomaly and those who are delivered before 24 weeks of gestational age were excluded from this study.

Ethical Approval was taken from Institutional Ethics Committee (Reference Number: 278/2024). Informed written consent was taken from 400 respondents to collect their response with standard set of proforma. Weight and height were measured and BMI was calculated on 1st antenatal visit that should be at or before 14 weeks. Weight was measured on each antenatal visit and at time of delivery. The mean maternal GWG was calculated by dividing the total weight gain (kilograms [kg]) between the first examination and at time of delivery by the number of weeks between those two dates, making it independent of the pregnancy duration. The maternal BMI in early pregnancy was categorized according to the WHO definitions: overweight 25.0–29.9 kg/m^2 and obesity ≥30 kg/m^2. GWG is categorized as Ideal, Excessive and inadequate categories (Institute of Medicine (IOM) guideline: Weight Gain During Pregnancy) in both overweight {Ideal (7–11.5), Excessive (>11.5), Inadequate (<7)} and obese {Ideal (5–9), Excessive (>9), Inadequate (<5)} categories. Various Maternal antenatal, intrapartum and postnatal outcomes and Neonatal Outcomes were measured.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Continuous variables were summarized as mean ± standard deviation, and categorical variables as frequencies and percentages. Univariable analysis was performed to assess the association between maternal BMI and GWG category and each maternal and neonatal outcome. Associations were evaluated using the Chi-square test or Fisher's exact test, as appropriate. Crude relative risks (RRs), and their 95% confidence intervals (CIs) were calculated from 2×2 contingency tables. A two-sided p-value <0.05 was considered statistically significant.

RESULT

A total of 400 pregnant women fulfilling the inclusion criteria were included in this prospective observational cohort study. The baseline characteristics are presented in

Table 1. Most participants were aged 18–29 years (72.5%, n=290), while 27.5% (n=110) were aged 30–40 years. Primigravida and multigravida accounted for 49.5% and 50.5% of the study population, respectively. Based on first-trimester BMI, 330 (82.5%) women were overweight and 70 (17.5%) were obese.

Table 1. Characteristics of Patients

Characteristics	Categories	Frequency (%)
Age (Years)	18-29	290(72.5%)
	30–40	110 (27.5%)
Gravidity	Primigravida	198 (49.5%)
	Multigravida	202 (50.5%)
BMI (kg/m^2)	Overweight	330 (82.5%)
	Obese	70 (17.5%)

The distribution of gestational weight gain (GWG) according to maternal BMI is shown in **Figure 1**. Among overweight women, 54.5% achieved ideal GWG, whereas 33.3% and 12.1% had excessive and inadequate GWG, respectively. In contrast, excessive GWG was observed in 71.4% of obese women, while only 14.3% achieved the recommended GWG.

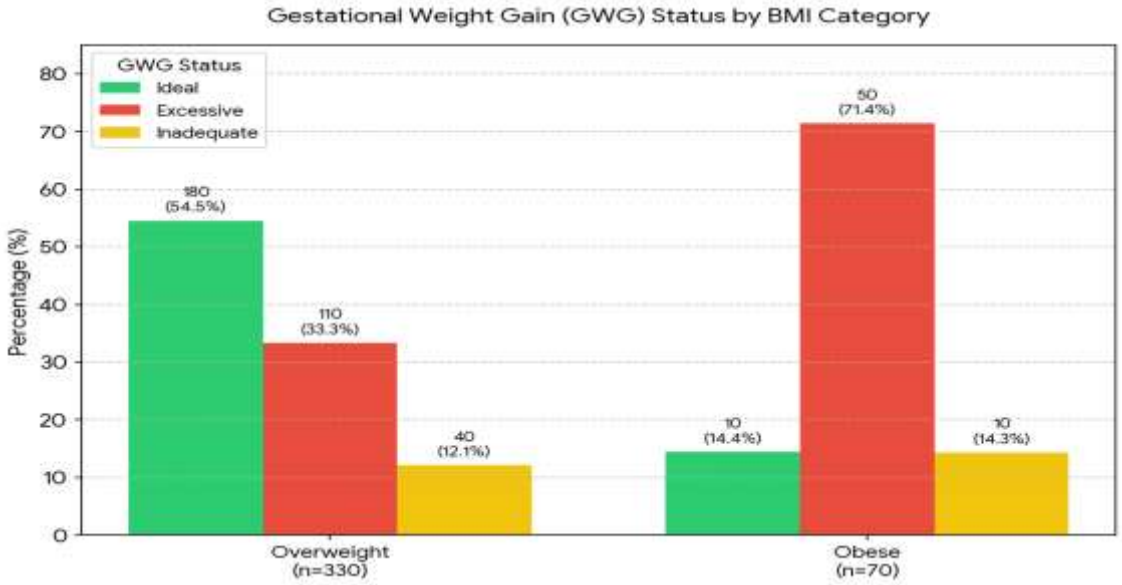

Figure 1. Weight Gain Distribution amongst different BMI categories

Maternal antenatal outcomes are summarized in **Table 2**, with the associations according to BMI and GWG presented in **Tables 6 and 7**, respectively. Obese women showed higher rates of gestational diabetes mellitus (18.6% vs. 13.9%) and antepartum haemorrhage (15.7% vs. 9.7%) than overweight women; however, these differences were not statistically significant. Pregnancy-induced hypertension occurred at comparable rates in both BMI groups (15.7% vs. 17.6%; RR 0.89, 95% CI 0.50–1.58; p=0.70). Obese women with excessive GWG demonstrated the highest incidence of gestational diabetes (22.0%), but neither excessive nor inadequate GWG was significantly associated with PIH, APH, or GDM (**Table 7**).

Table 2. Maternal Antenatal Outcomes

BMI Category	GWG Category (kg)	PIH Patients n (%)	APH Patients n (%)	GDM Patients n (%)
Overweight (n = 330)	Ideal Excessive Inadequate	34(18.8%) 20(18.1%) 04(10.0%)	18(10.0%) 10(9.0%) 04(10.0%)	25(13.8%) 17(15.4%) 04 (10.0%)
Obese (n = 70)	Ideal Excessive Inadequate	01(10.0%) 08(16.0%) 02(20.0%)	02(20.0%) 08(16.0%) 01(10.0%)	00(0.0%) 11(22.0%) 02(20.0%)

*PIH= Pregnancy Induced Hypertension, APH = Antepartum Haemorrhage, GDM = Gestational Diabetes

Maternal intrapartum outcomes are presented in **Table 3**, with their statistical associations illustrated in **Tables 6 and 7**. Labour induction was significantly associated with excessive GWG (RR 1.43, 95% CI 1.02–2.00; p=0.036) but not with maternal BMI (RR 1.04, 95% CI 0.68–1.58; p=0.85). Cesarean delivery was significantly more frequent among obese women than overweight women (50.0% vs. 24.8%; RR 2.01, 95% CI 1.49–2.71; p<0.001). Compared with ideal GWG, excessive GWG increased the risk of cesarean delivery by 64% (RR 1.64, 95% CI 1.19–2.26; p=0.003), whereas inadequate GWG more than doubled the risk (RR 2.34, 95% CI 1.61–3.39; p<0.001). Operative vaginal delivery was also significantly more common among obese women (RR 2.12, 95% CI 1.18–3.82; p=0.01). Shoulder dystocia occurred exclusively in obese women with excessive-obese GWG and showed a significant association with maternal BMI (p=0.005).

Table 3. Maternal Intrapartum Outcomes

BMI Category	GWG Category (kg)	Labor Induction n (%)	LSCS Delivery n (%)	OVD Patients n (%)	DTA Patients n (%)	Shoulder Dystocia n (%)
Overweight (n = 330)	Ideal Excessive Inadequate	43(23.8%) 37(33.6%) 06(15.0%)	29(16.1%) 37(33.6%) 16 (40.0%)	17(9.4%) 08(7.2%) 04 (10.0%)	04(2.2%) 04(3.6%) 02(5.0%)	00(0.0%) 00(0.0%) 00(0.0%)
Obese (n = 70)	Ideal Excessive Inadequate	02(20.0%) 17(34.0%) 00 (0.0%)	10(100.0%) 17(34.0%) 08 (80.0%)	00(0.0%) 13(26.0%) 00 (0.0%)	00(0.0%) 03(6.0%) 00(0.0%)	00(0.0%) 03(6.0%) 00(0.0%)

*LSCS= Lower Segment Caesarean Section, OVD = Operative Vaginal Delivery, DTA = Deep Transverse Arrest

Table 4. Maternal Postnatal Outcomes

BMI Category	GWG Category (kg)	PPH Patients n (%)	Wound Repair n (%)
Overweight *(n = 330)*	Ideal Excessive Inadequate	11(6.1%) 10(9.0%) 04(10.0%)	04(2.2%) 02(1.8%) 01(2.5%)
Obese *(n = 70)*	Ideal Excessive Inadequate	00(0.0%) 07(14.0%) 00(0.0%)	00(0.0%) 02(4.0%) 00(0.0%)

*PPH = Postpartum Haemorrhage

Maternal postnatal outcomes are shown in **Table 4**, while their associations with BMI and GWG are presented in **Tables 6 and 7**. Postpartum haemorrhage was more frequent among obese women than overweight women (10.0% vs. 7.6%), with the highest incidence observed in obese women with excessive GWG (14.0%). However, neither BMI nor GWG demonstrated a statistically significant association with postpartum haemorrhage or wound repair.

Table 5. Neonatal Outcomes

BMI Category	GWG Category (kg)	Preterm Birth n (%)	Post-term Birth n (%)	LBW Neonates n (%)	NICU Admission n (%)
Overweight ***(n = 330)***	Ideal Excessive Inadequate	20(11.1%) 07(6.3%) 04 (10.0%)	49(27.2%) 25(22.7%) 06(15.0%)	40(22.2%) 35(31.8%) 12(30.0%)	54(30.0%) 54(49.0%) 08(20.0%)
Obese ***(n = 70)***	Ideal Excessive Inadequate	00(0.0%) 10(20.0%) 02 (20.0%)	02(20.0%) 02(4.0%) 01(10.0%)	02(20.0%) 25(50.0%) 05(50.0%)	02(20.0%) 35(70.0%) 04(40.0%)

*LBW = Low Birth Weight, NICU= Neonatal Intensive Care Unit

Neonatal outcomes are summarized in **Table 5**, with their associations according to BMI and GWG presented in **Tables 6 and 7**. Preterm birth was more frequent among obese women (17.1% vs. 9.4%), although the association did not reach statistical significance (RR 1.82, 95% CI 0.98–3.39; p=0.06). Conversely, post-term birth was significantly less common among obese women (RR 0.29, 95% CI 0.12–0.69; p=0.001), while excessive GWG significantly reduced the risk compared with ideal GWG (RR 0.63, 95% CI 0.41–0.95; p=0.020).

Low birth weight occurred significantly more often among obese women than overweight women (45.7% vs. 26.4%; RR 1.73, 95% CI 1.24–2.41; p=0.001). Excessive GWG independently increased the risk of low birth weight (RR 1.70, 95% CI 1.21–2.39; p=0.002). NICU admission was the most frequent neonatal complication, occurring in 58.6% of neonates born to obese women compared with 35.2% of those born to overweight women (RR 1.66, 95% CI 1.28–2.16; p<0.001). Obese women with excessive GWG had the highest NICU admission rate (70.0%). Independent of BMI, excessive GWG increased the risk of NICU admission by 89% compared with ideal GWG (RR 1.89, 95% CI 1.46–2.45; p<0.001), whereas inadequate GWG showed no significant association.

Table 6. Association of body mass index with maternal and neonatal outcomes

Outcome	Overweight n (%)	Obese n (%)	Risk Ratio (95% CI)	p-value
PIH	58 (17.6)	11 (15.7)	0.89 (0.50-1.58)	0.70
APH	32 (9.7)	11 (15.7)	1.62 (0.86-3.07)	0.14
GDM	46 (13.9)	13 (18.6)	1.34 (0.75-2.39)	0.32
Labour induction	86 (26.1)	19 (27.1)	1.04 (0.68-1.58)	0.85
LSCS	82 (24.8)	35 (50.0)	2.01 (1.49-2.71)	<0.001
Operative vaginal delivery	29 (8.8)	13 (18.6)	2.12 (1.18-3.82)	0.01
Deep transverse arrest	10 (3.0)	3 (4.3)	1.41 (0.40-4.98)	0.59*
Postpartum haemorrhage	25 (7.6)	7 (10.0)	1.32 (0.59-2.95)	0.5
Wound repair	7 (2.1)	2 (2.9)	1.35 (0.29-6.29)	0.71*
Preterm birth	31 (9.4)	12 (17.1)	1.82 (0.98-3.39)	0.06
Post-term birth	80 (24.2)	5 (7.1)	0.29 (0.12-0.69)	0.001
Low birth weight	87 (26.4)	32 (45.7)	1.73 (1.24-2.41)	0.001
NICU admission	116 (35.2)	41 (58.6)	1.66 (1.28-2.16)	<0.001

*Fisher's Exact test used, Pearson Chi-Square test used in all other outcomes,
+ Shoulder Dystocia p-value = 0.005*

Table 7. Association of gestational weight gain with maternal and neonatal outcomes independent of BMI (Ideal GWG as reference)

Outcome	Excessive vs Ideal GWG RR (95% CI)	p-value	Inadequate vs Ideal GWG RR (95% CI)	p-value
PIH	0.95 (0.60-1.51)	0.84	0.65 (0.27-1.56)	0.30
APH	1.07 (0.58-1.98)	0.82	0.95 (0.36-2.47)	0.90
GDM	1.33 (0.81-2.18)	0.26	0.91 (0.39-2.12)	0.84

Labour induction	1.43 (1.02-2.00)	0.036	0.51 (0.24-1.08)	0.06
LSCS	1.64 (1.19-2.26)	0.003	2.34 (1.61-3.39)	<0.001
Operative vaginal delivery	1.47 (0.79-2.73)	0.20	0.89 (0.31-2.53)	0.84
Deep transverse arrest	2.08 (0.63-6.86)	0.21	1.90 (0.37-9.82)	0.44*
Postpartum haemorrhage	1.84 (0.84-4.03)	0.12	1.38 (0.46-4.14)	0.57
Wound repair	1.19 (0.31-4.58)	0.80	0.95 (0.11-8.17)	0.96*
Preterm birth	1.01 (0.55-1.84)	0.94	1.14 (0.48-2.71)	0.72
Post-term birth	0.63 (0.41-0.95)	0.020	0.52 (0.25-1.08)	0.07
Low birth weight	1.70 (1.21-2.39)	0.002	1.54 (0.96-2.48)	0.07
NICU admission	1.89 (1.46-2.45)	<0.001	0.81 (0.48-1.36)	0.44

*Fisher's Exact test used, Pearson Chi-Square test used in other outcomes

DISCUSSION

Maternal first trimester BMI and gestational weight gain reflect nutritional status before and during pregnancy. First trimester BMI and GWG is an important predictor of adverse maternal and neonatal outcomes. Maternal overweight and obesity have emerged as significant public health concerns worldwide, and their prevalence continues to increase in developing countries, including India.

The findings of this study demonstrate that both elevated maternal BMI and excessive gestational weight gain are associated with adverse maternal and neonatal outcomes. In our study, majority of pregnant women were between 18–29 years, reflecting the natural demographic of peak fertility. This aligns with the NFHS-5[5] data, which highlights that over 75% of Indian pregnancies occur in this age range. In the present study, 82.5% of participants were classified as overweight and 17.5% as obese at their first antenatal visit. Furthermore, excessive gestational weight gain was observed in 71.4% of obese women compared to 33.3% of overweight women. These findings suggest that women entering pregnancy with a higher BMI are more likely to exceed the recommended gestational weight gain limits. Similar observations were reported by Goldstein et al. [2], who demonstrated that excessive GWG is significantly more common among overweight and obese women and is associated with increased obstetric complications. Likewise, Voerman et al. [6] reported that maternal obesity predisposes women to excessive weight gain during pregnancy, thereby amplifying pregnancy-related risks. These findings emphasize that antenatal care should address not only maternal BMI but also continuous monitoring of weight gain throughout pregnancy.

The present study evaluated antenatal complications including pregnancy-induced hypertension (PIH), antepartum hemorrhage (APH), and gestational diabetes mellitus (GDM). Although PIH and APH rates did not show marked differences across all weight gain categories, Gestational Diabetes Mellitus (GDM) reached its absolute peak (22.0%) among obese patients experiencing excessive weight gain, compared to 13.8% in the overweight-ideal category. Similarly, Pregnancy-Induced Hypertension (PIH) reached 20.0% within the obese-inadequate subgroup. These findings are consistent with previous literature demonstrating a strong association between obesity and glucose intolerance during pregnancy. These findings are supported by studies such as those by Kutchi et al. [11] and Macdonald-Wallis et al. [12] which reported a 4–6-fold increase in GDM risk among obese mothers, highlighting the need for early oral glucose tolerance testing (OGTT) and vigilant antenatal metabolic monitoring in this population. Marchi et al. [7] reported also that obese pregnant women have significantly higher rates of gestational diabetes compared with women of normal BMI.

Although the associations between BMI, GWG, and hypertensive disorders were not

statistically significant, the observed trends remain clinically relevant. Hypertensive disorders of pregnancy are multifactorial and are influenced by maternal adiposity, endothelial dysfunction, oxidative stress, and placental vascular abnormalities. [7,12] The absence of statistical significance in our cohort may reflect the relatively modest sample size, particularly within the obese subgroup, rather than the absence of a true biological association. Larger multicenter studies have consistently reported obesity as an important independent predictor of hypertensive disorders during pregnancy. [12,13]

Women with excessive GWG had a 43% higher risk of labour induction than those with ideal GWG (RR 1.43, 95% CI 1.02–2.00; p=0.036), whereas maternal BMI alone was not significantly associated with induction of labour. This finding suggests that excessive weight gain during pregnancy may independently increase the likelihood of obstetric intervention, possibly because of prolonged pregnancy, suspected fetal macrosomia, or the development of pregnancy-related complications requiring planned delivery. These findings are consistent with literature by Ovesen et al [13] and Cedergren et al [14], which report a higher rate of medically-indicated inductions among women with excessive weight gain or higher BMI due to the increased risk of obstetric complications and suboptimal labour progression.

Statistical analysis demonstrated highly significant associations between both BMI and GWG with LSCS delivery. Cesarean delivery rates increased substantially among overweight and obese women, particularly those with obese-ideal and obese-inadequate GWG categories, where rates reached 100% and 80%, respectively. This aligns with prior findings by Cedergren et al [14], both of whom report a significant increase in cesarean delivery among obese women, particularly when excessive gestational weight gain or other comorbidities coexist. A systematic review by Marchi et al. [7] reported that maternal obesity significantly increases the risk of cesarean section due to labor dystocia, fetal macrosomia, and obstetric complications. Goldstein et al. [2] similarly demonstrated that excessive GWG independently increases cesarean delivery risk regardless of baseline BMI. The data reinforces the need for both preconception weight optimization and targeted intrapartum planning to mitigate the need for surgical deliveries in high-risk pregnancies.

Operative vaginal delivery was also significantly associated with maternal obesity, with obese women experiencing more than twice the risk compared with overweight women (RR 2.12, 95% CI 1.18–3.82; p=0.01). Operative vaginal deliveries were also more frequent among obese women with excessive GWG. This suggests that excessive gestational weight gain in obese women significantly increases the likelihood of instrumental deliveries, possibly due to macrosomia, prolonged second stage of labour, or ineffective maternal expulsive efforts. Sheiner et al [15] and Morken NH et al [16], which emphasize that maternal obesity and weight gain beyond recommendations are significant associated with prolonged labour and operative interventions. Shoulder dystocia occurred exclusively among obese women with excessive gestational weight gain and showed a significant association with maternal BMI. Although the absolute number of events was small, these findings support previous evidence indicating that maternal obesity contributes to dysfunctional labor and fetal size abnormalities, both of which increase the likelihood of operative interventions. Aune et al. [10] and Marchi et al. [7] reported significantly elevated risks of shoulder dystocia among obese mothers, particularly when excessive gestational weight gain is present.

Postpartum haemorrhage was more common among obese women than overweight women, with the highest frequency observed in obese women with excessive GWG, reaching a high rate of 14.0%. However, neither maternal BMI nor gestational weight gain demonstrated a statistically significant

association with postpartum haemorrhage or wound repair. The absence of statistical significance should be interpreted cautiously, as these complications occurred relatively infrequently and the study may have been underpowered to detect modest differences. Marchi et al. suggested that prolonged labor, uterine atony, larger placental mass, and operative delivery contribute to the increased incidence of postpartum hemorrhage among obese women. Therefore, careful intrapartum management and active management of the third stage of labour remain particularly important in obese women and those with excessive GWG.

McDonald et al. (2011) [17] noted that even within recommended GWG limits, overweight women carry residual inflammatory and vascular risks due to underlying adiposity, which may increase susceptibility to preterm delivery. In our study, although preterm birth occurred more frequently among overweight women than obese women, the association narrowly missed statistical significance (RR 1.82, 95% CI 0.98–3.39; p=0.06).

An unexpected finding of the present study was the significantly higher incidence of low birth weight (LBW) among overweight women (RR 1.73, 95% CI 1.24–2.41; p=0.001). Independent of maternal BMI, excessive gestational weight gain also increased the risk of LBW compared with ideal GWG (RR 1.70, 95% CI 1.21–2.39; p=0.002). This finding differs from several international studies that commonly report macrosomia among obese mothers. However, such variations may be attributable to differences in maternal nutritional status, socioeconomic conditions, placental insufficiency, genetic influences, and healthcare accessibility within the study population.

Statistical analysis confirmed highly significant associations between both maternal BMI and GWG with NICU admissions. These findings are supported by Voerman et al. [6], who demonstrated that excessive GWG is associated with increased neonatal morbidity requiring intensive care support. Several studies, including those by Hedderson et al. [18] and Balsells et al. [19], have demonstrated that neonates born to obese women are more likely to require NICU admission due to conditions such as respiratory distress syndrome (RDS), neonatal hypoglycemia, meconium aspiration, and delivery trauma, even in the absence of gestational diabetes.

The findings of the present study reinforce the concept that maternal BMI and gestational weight gain are important and potentially modifiable determinants of pregnancy outcome. Unlike many non-modifiable obstetric risk factors, maternal nutritional status can be addressed through preconception counselling, weight optimization programs, individualized dietary guidance, and close antenatal surveillance. Early identification of women at risk for excessive weight gain may allow healthcare providers to implement preventive strategies and reduce maternal and neonatal morbidity.

The strengths of this study include a relatively large sample size of 400 participants and comprehensive evaluation of both maternal and neonatal outcomes. In addition, the independent assessment of gestational weight gain according to BMI categories provides clinically relevant evidence regarding the contribution of GWG beyond baseline maternal adiposity. However, certain limitations should be acknowledged. The study was conducted at a single tertiary care center and employed convenience sampling, which may limit generalizability. Additionally, the absence of a normal BMI comparison group prevents evaluation of outcomes across the full spectrum of maternal BMI categories.

CONCLUSION

This prospective observational cohort study demonstrates that maternal Body Mass Index (BMI) and Gestational Weight Gain (GWG) are significant associated with altered maternal and neonatal outcomes. Women with obesity were considerably more likely to experience excessive gestational weight

gain, which was associated with increased rates of gestational diabetes mellitus, labor induction, operative vaginal delivery, cesarean section, postpartum hemorrhage, and shoulder dystocia. Furthermore, adverse neonatal outcomes, including preterm birth, low birth weight, and neonatal intensive care unit (NICU) admission, were observed more frequently among women with higher BMI and inappropriate gestational weight gain.

The findings emphasize that maternal nutritional status before conception and weight gain during pregnancy are important and potentially modifiable risk factors. Early identification of women at risk, coupled with preconception counselling, individualized nutritional guidance, regular weight monitoring, and targeted antenatal surveillance, may help reduce pregnancy-related complications and improve maternal and neonatal health outcomes.

Given the rising prevalence of overweight and obesity among women of reproductive age, particularly in developing countries, incorporation of BMI assessment and evidence-based gestational weight gain counselling into routine antenatal care should be prioritized. Further multicentric prospective studies including women across all BMI categories are recommended to strengthen the evidence base and develop population-specific guidelines for optimizing pregnancy outcomes.

Declaration by Authors

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