

ROLE OF MATERNAL PRE-CONCEPTION BMI AND GESTATIONAL WEIGHT GAIN IN PREDICTING EMERGENCY CESAREAN DELIVERY

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Abstract

Background: Maternal pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) may influence labor progression and the likelihood of operative delivery. This study evaluated their association with emergency cesarean delivery among women undergoing a trial of labor.

Methods: A hospital-based observational cohort study was conducted at the Department of Obstetrics and Gynecology, Pakistan Ordnance Factories Hospital, Wah Cantt, from 10 January 2024 to 05 October 2025. A total of 400 women undergoing a trial of labor were included. Pre-pregnancy BMI was categorized as underweight, normal weight, overweight, or obese, while GWG was classified as inadequate, adequate, or excessive according to Institute of Medicine recommendations. The primary outcome was emergency cesarean delivery. Associations were assessed using multivariable binary logistic regression, with adjusted odds ratios (aORs) and 95% confidence intervals (CIs) reported.

Results: Emergency cesarean delivery occurred in 154 (38.5%) women. The emergency cesarean rate increased progressively across BMI categories, from 22.2% in underweight women and 29.4% in women with normal BMI to 44.0% in overweight and 72.2% in obese women. Compared with normal BMI, overweight and obesity were independently associated with emergency cesarean delivery (aOR 1.72, 95% CI 1.05–2.82; and aOR 3.84, 95% CI 2.03–7.27, respectively). Each 1 kg/m² increase in BMI was associated with higher odds of emergency cesarean delivery (aOR 1.09, 95% CI 1.04–1.14). Excessive GWG was also independently associated with emergency cesarean delivery compared with adequate GWG (aOR 2.31, 95% CI 1.43–3.73). Nulliparity and induction of labor were additional independent predictors.

Conclusion: Higher pre-pregnancy BMI and excessive gestational weight gain were independently associated with emergency cesarean delivery among women undergoing a trial of labor. Early assessment of maternal BMI and appropriate monitoring of gestational weight gain may help identify women at increased risk of emergency operative delivery.

INTRODUCTION:

Maternal nutritional status before conception and the pattern of weight gain during pregnancy are important determinants of maternal, fetal, and neonatal health. Maternal body mass index (BMI) before pregnancy provides an objective measure of nutritional status at the beginning of gestation, whereas gestational weight gain (GWG) reflects the cumulative physiological, metabolic, and fetal changes occurring throughout pregnancy. Both parameters are potentially modifiable and can therefore provide opportunities for risk identification and intervention before and during pregnancy. Increasing maternal overweight and obesity have become major public health concerns worldwide, while inappropriate gestational weight gain remains common across different populations.^{1,2} Evidence from large observational studies and meta-analyses indicates that abnormal maternal BMI and GWG are associated with a range of adverse pregnancy outcomes, including gestational diabetes mellitus (GDM), hypertensive disorders, abnormal fetal growth, preterm birth, macrosomia, and cesarean delivery.³⁻⁵

Maternal BMI is particularly relevant to the mode of delivery because increasing adiposity may influence several physiological processes involved in labor. Obesity has been associated with altered glucose metabolism, chronic low-grade inflammation, increased fetal growth, higher rates of GDM and hypertensive disorders, and greater frequency of labor induction. These factors may individually or collectively increase the likelihood of operative delivery. A large systematic review and meta-analysis including more than 3.7 million pregnancies demonstrated that adverse pregnancy outcomes generally increased with increasing BMI category. Women with severe obesity had substantially higher risks of GDM, hypertensive disorders, and cesarean delivery compared with women with normal BMI.⁶ Similar findings have been reported in broader international evidence, with overweight and obese women showing increased risks of both planned and emergency cesarean delivery compared with women with normal BMI.⁷

The relationship between BMI and cesarean delivery is clinically important because cesarean birth is associated with additional maternal and neonatal consequences compared with uncomplicated vaginal delivery. Cesarean delivery may be necessary and life-saving when complications arise, but unnecessary or avoidable operative delivery may increase maternal morbidity, postoperative infection, hemorrhage, thromboembolic complications, longer hospital stay, and implications for subsequent pregnancies. Therefore, identification of potentially modifiable maternal characteristics associated with emergency cesarean delivery may contribute to improved antenatal counselling and intrapartum risk assessment. In particular, understanding whether maternal BMI before pregnancy independently predicts emergency cesarean delivery after a trial of labor may help distinguish pre-existing maternal risk from factors arising during pregnancy or labor.

In addition to prepregnancy BMI, the amount of weight gained during pregnancy is an important determinant of pregnancy outcomes. The Institute of Medicine (IOM) revised its recommendations for gestational weight gain in 2009 and emphasized that appropriate weight gain should be individualized according to prepregnancy BMI. The recommended total gain is 12.5–18 kg for women who are underweight, 11.5–16 kg for women with normal BMI, 7–11.5 kg for overweight women, and 5–9 kg for women with obesity.⁸ These recommendations recognize that women entering pregnancy at different BMI levels have different physiological requirements and different risks associated with excessive or insufficient weight gain.

Despite these recommendations, inappropriate GWG remains common. A large systematic review and meta-analysis involving more than one million women found that approximately 47% of pregnancies were associated with weight gain above IOM recommendations, while approximately 23% had weight gain below recommendations. Excessive GWG was associated with higher risks of large-for-gestational-age birth, macrosomia, and cesarean

delivery, whereas insufficient GWG was associated with increased risks of small-for-gestational-age birth and preterm delivery.⁴ Global analyses have similarly demonstrated substantial regional variation in weight gain patterns, but the association between excessive GWG and cesarean delivery has remained relatively consistent across several populations.⁹

The mechanisms linking excessive GWG to cesarean delivery are likely multifactorial. Excessive maternal weight gain may contribute to increased fetal growth and macrosomia, which can increase the risk of labor dystocia, cephalopelvic disproportion, prolonged labor, and failed induction. Excessive GWG may also be associated with a higher incidence of GDM and hypertensive disorders, both of which can influence decisions regarding induction and operative delivery. Furthermore, increasing maternal adiposity may be associated with reduced uterine contractility and prolonged labor, potentially increasing the probability of arrest disorders. These mechanisms provide biological plausibility for an association between excessive GWG and emergency cesarean delivery.^{4, 5}

Several observational studies have examined BMI and GWG simultaneously, suggesting that the two variables may have independent and complementary associations with cesarean delivery. In a prospective cohort of Hispanic women, prepregnancy obesity was associated with approximately twice the odds of cesarean delivery compared with normal BMI, even after adjustment for GWG. Excessive total GWG was also independently associated with increased odds of cesarean delivery.¹⁰ Similarly, a large Chinese study of term pregnancies reported that both prepregnancy BMI and GWG were associated with cesarean section, supporting the importance of considering maternal weight status before conception together with weight trajectory during pregnancy.¹¹ A separate large cohort study also demonstrated a positive association between GWG and cesarean delivery among nulliparous women, further suggesting that weight gain during pregnancy may influence labor outcomes

independently of baseline maternal characteristics.¹²

Importantly, the relationship between maternal weight and delivery mode may vary according to population characteristics, parity, ethnicity, healthcare practices, and the criteria used for cesarean delivery. Findings from high-income countries cannot necessarily be directly extrapolated to South Asian populations, where maternal body composition, nutritional status, patterns of gestational weight gain, prevalence of underweight and overweight, and obstetric practices may differ. A systematic review examining more than one million women across the United States, western Europe, and Asia found substantial regional differences in prepregnancy BMI and GWG. Nevertheless, excessive GWG was associated with increased risk of cesarean delivery across regions.⁹

Evidence from Pakistan is particularly relevant because maternal nutritional patterns and obstetric outcomes may differ from those reported in Western populations. In a large Pakistani cohort of 4,735 women receiving antenatal care at Aga Khan University, the mean gestational weight gain was approximately 8.5 kg. The investigators found that obese women were more likely to undergo cesarean delivery than women with normal BMI, while abnormal GWG was also associated with adverse pregnancy outcomes.¹³ Another Pakistani study involving primigravid women with normal prepregnancy BMI reported a significant association between higher GWG and cesarean delivery, with cesarean rates being greatest among women with high gestational weight gain.¹⁴ More recent Pakistani data have likewise suggested higher cesarean rates among overweight and obese women compared with women in lower BMI categories.¹⁵ These findings indicate that maternal weight status and gestational weight trajectory are clinically relevant within the local population, although available Pakistani studies have generally been conducted in specific populations or have examined broader pregnancy outcomes rather than focusing specifically on

emergency cesarean delivery following a trial of labor.

A further limitation of existing evidence is that many studies have evaluated total cesarean delivery without clearly distinguishing emergency cesarean delivery after labor from elective or planned cesarean delivery. This distinction is important because the mechanisms leading to emergency cesarean delivery are closely related to intrapartum events such as non-reassuring fetal status, labor dystocia, failed induction, arrest of cervical dilatation, and arrest of descent. Restricting the analysis to women who entered a trial of labor therefore provides a more clinically focused assessment of whether prepregnancy BMI and GWG are associated with failure to achieve vaginal delivery.

There is also a need to evaluate BMI and GWG both as categorical variables and as continuous measures. Categorization according to established BMI groups and IOM GWG recommendations facilitates clinical interpretation, whereas continuous analysis may identify dose-response relationships that could be obscured by arbitrary thresholds. Such an approach may help determine whether increasing maternal BMI or increasing total GWG is progressively associated with emergency cesarean delivery after accounting for important obstetric and maternal confounders.

Therefore, the present study was undertaken to investigate the role of maternal prepregnancy BMI and gestational weight gain in predicting emergency cesarean delivery among women undergoing a trial of labor at the Department of Obstetrics and Gynecology, Pakistan Ordnance Factories (POF) Hospital, Wah Cantt, Punjab, Pakistan. The study assessed the association of BMI categories and GWG categories with emergency cesarean delivery and additionally evaluated BMI and GWG as continuous exposures. Potential confounding factors, including maternal age, parity, gestational age, GDM, hypertensive disorders, and induction of labor, were considered in multivariable analysis. By examining these factors within a defined hospital-based cohort, the study aimed to provide

locally relevant evidence regarding maternal weight status and intrapartum delivery outcomes and to determine whether prepregnancy BMI and gestational weight gain could serve as clinically useful predictors of emergency cesarean delivery.

Methodology:

Study Design and Setting

A hospital-based observational cohort study was conducted in the Department of Obstetrics and Gynecology, Pakistan Ordnance Factories (POF) Hospital, Wah Cantt, Punjab, Pakistan. The study evaluated the association between maternal preconception body mass index (BMI), gestational weight gain (GWG), and the risk of emergency cesarean delivery among women undergoing a trial of labor. The study was conducted over a period from 10 January 2024 to 05 October 2025.

POF Hospital, Wah Cantt, is a tertiary-care hospital providing antenatal, obstetric, gynecological, emergency, operative, and neonatal services. The obstetrics and gynecology department provided care for both booked and un-booked pregnancies and managed vaginal deliveries, operative vaginal deliveries, emergency cesarean sections, and pregnancy-related complications.

Study Population

The study population consisted of pregnant women who received antenatal and obstetric care at POF Hospital during the study period and subsequently underwent a trial of labor. Eligible participants were assessed for preconception BMI and gestational weight gain and were followed until delivery. Maternal demographic characteristics, obstetric history, pregnancy-related complications, mode of delivery, indications for cesarean delivery, and neonatal outcomes were recorded.

Sampling Technique

A consecutive sampling technique was used. All women who fulfilled the predefined eligibility criteria and delivered at POF Hospital during the study period were considered for inclusion.

Participants were followed until delivery, and the final mode of delivery was documented.

Inclusion Criteria

Women were included if they fulfilled all of the following criteria:

1. Age ≥ 18 years at the time of delivery.
2. Singleton pregnancy.
3. Delivery at POF Hospital, Wah Cantt, between 10 January 2024 and 05 October 2025.
4. A live fetus at the onset of labor.
5. Documented preconception weight or a reliable weight measurement obtained during the first trimester.
6. Documented maternal height for calculation of BMI.
7. Sufficient antenatal weight measurements to determine gestational weight gain.
8. Eligibility for and subsequent undertaking of a trial of labor.
9. Documented final mode of delivery.
10. Adequate maternal and obstetric records for assessment of the primary exposure and outcome variables.

Exclusion Criteria

Women were excluded if they had:

1. Previous cesarean delivery or another significant uterine scar.
2. Multiple gestation.
3. Major fetal congenital anomaly diagnosed antenatally.
4. Intrauterine fetal death before the onset of labor.
5. Placenta previa or another absolute contraindication to vaginal delivery.
6. Antepartum hemorrhage requiring planned cesarean delivery before labor.
7. Planned or elective cesarean delivery before the onset of labor.
8. A maternal or fetal indication requiring cesarean delivery without a trial of labor.
9. Unreliable or unavailable preconception/early-pregnancy weight.
10. Missing maternal height preventing calculation of BMI.

11. Insufficient weight measurements to reliably calculate gestational weight gain.

12. Incomplete medical or obstetric records that prevented determination of the primary outcome.

13. Transfer to another healthcare facility before definitive delivery.

14. Any condition in which the final mode of delivery could not be reliably established.

Assessment of Preconception Body Mass Index

Maternal preconception BMI was calculated using the documented preconception weight and height according to the following formula:

$$\text{BMI (kg/m}^2\text{)} = \text{weight (kg)} / \text{height}^2 \text{ (m}^2\text{)}$$

The documented weight obtained immediately before conception was considered the preferred baseline weight. When a measured preconception weight was unavailable, the earliest reliable weight documented during the first trimester, preferably before 13 completed weeks of gestation, was used as the baseline pregnancy weight.

Maternal height was obtained from standardized clinical measurements recorded in the antenatal record. BMI was categorized according to standard adult BMI classifications:

BMI category | BMI (kg/m²)

Underweight | <18.5

Normal weight | $18.5\text{--}24.9$

Overweight | $25.0\text{--}29.9$

Obesity | ≥ 30.0

Normal BMI was considered the reference category for categorical analysis. BMI was also retained as a continuous variable for regression analysis.

Assessment of Gestational Weight Gain

Maternal weight was recorded during routine antenatal visits using a calibrated weighing scale. The baseline pregnancy weight was taken as the preconception or earliest reliable first-trimester weight, while the final pregnancy weight was defined as the last documented maternal weight before delivery.

Total gestational weight gain was calculated using the following formula:

Total GWG (kg) = final pregnancy weight (kg) – baseline pregnancy weight (kg)

Gestational weight gain was classified as inadequate, adequate, or excessive according to the Institute of Medicine recommendations for singleton pregnancies, based on pre-pregnancy BMI.

Pre-pregnancy BMI | Recommended total GWG

<18.5 kg/m² | 12.5–18.0 kg

18.5–24.9 kg/m² | 11.5–16.0 kg

25.0–29.9 kg/m² | 7.0–11.5 kg

≥30.0 kg/m² | 5.0–9.0 kg

Weight gain below the recommended range was classified as inadequate, weight gain within the recommended range was classified as adequate, and weight gain above the recommended range was classified as excessive. GWG was also analyzed as a continuous variable in secondary analyses.

Assessment of Gestational Age

Gestational age was determined from the date of the last menstrual period when reliable and was confirmed or corrected using ultrasonographic dating, preferably first-trimester ultrasonography. When menstrual dates were uncertain, gestational age based on the earliest reliable ultrasound examination was used.

Primary Outcome

The primary outcome was emergency cesarean delivery following a trial of labor.

Emergency cesarean delivery was defined as cesarean delivery performed after the onset of labor or following an intrapartum decision that vaginal delivery was no longer considered appropriate or safe. Women who achieved vaginal delivery following the trial of labor constituted the principal comparison group.

The indications for emergency cesarean delivery were obtained from obstetric and operative records and categorized as:

- Non-reassuring fetal status/fetal distress
- Failure to progress
- Arrest of cervical dilatation
- Arrest of descent
- Cephalopelvic disproportion

- Failed induction of labor

- Maternal indications

- Other documented obstetric indications

Secondary Outcomes

Secondary outcomes included:

1. Vaginal delivery.
2. Induction of labor.
3. Labor dystocia or prolonged labor.
4. Operative vaginal delivery.
5. Gestational age at delivery.
6. Preterm birth.
7. Birth weight.
8. Low birth weight.
9. Macrosomia.
10. Neonatal intensive care unit admission.
11. Maternal postpartum complications.

Maternal and Obstetric Covariates

Potential confounding variables were collected from antenatal and hospital records. These included maternal age, gravidity, parity, previous vaginal delivery, maternal height, preconception BMI, gestational weight gain, gestational age at delivery, gestational diabetes mellitus, hypertensive disorders of pregnancy, anemia, induction of labor, fetal birth weight, and other clinically relevant pregnancy complications.

These variables were considered because maternal age, parity, diabetes, hypertensive disorders, gestational age, induction of labor, and fetal size may influence the likelihood of emergency cesarean delivery independently of maternal BMI and gestational weight gain.

Data Collection Procedure

Data were collected using a structured data collection proforma. Demographic characteristics and obstetric history were obtained from antenatal records. Maternal height, baseline weight, serial antenatal weight measurements, gestational age, and pregnancy complications were recorded.

At delivery, the mode of delivery, indication for cesarean delivery, gestational age, birth weight, and maternal and neonatal outcomes were documented. For women undergoing emergency

cesarean delivery, the indication for surgery was obtained from the obstetric and operative notes. All collected data were reviewed for completeness and consistency before entry into the study database. Each participant was assigned a unique study identification number. Personal identifiers were excluded from the analytical dataset, and confidentiality of the collected information was maintained.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were assessed for normality. Normally distributed continuous variables were expressed as mean $\pm$ standard deviation, whereas non-normally distributed variables were reported as median with interquartile range. Categorical variables were presented as frequencies and percentages.

Participants were divided into two groups according to the primary outcome:

- Emergency cesarean delivery
- Vaginal delivery

Continuous variables were compared between the two groups using the independent-samples t-test for normally distributed data or the Mann-Whitney U test for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

Univariable binary logistic regression analysis was performed to assess the association between preconception BMI, gestational weight gain, and emergency cesarean delivery. Variables considered clinically relevant potential confounders or demonstrating an association with the outcome in the univariable analysis were considered for inclusion in the multivariable model.

A multivariable binary logistic regression model was subsequently developed with emergency cesarean delivery as the dependent variable. Preconception BMI and gestational weight gain were the principal independent variables. The model was adjusted for relevant maternal and obstetric factors, including maternal age, parity, gestational age, gestational diabetes mellitus,

hypertensive disorders of pregnancy, induction of labor, and other clinically relevant confounders.

Associations were reported as odds ratios (ORs) with 95% confidence intervals (CIs). Adjusted odds ratios (aORs) were reported for the multivariable model. Preconception BMI and GWG were evaluated both as categorical variables and as continuous variables where appropriate.

The potential interaction between preconception BMI and gestational weight gain was also explored to determine whether the association of GWG with emergency cesarean delivery differed according to baseline maternal BMI.

A two-sided p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional ethical/research committee of POF Hospital, Wah Cantt before commencement of the study. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. For prospectively collected information, informed consent was obtained from eligible participants. For retrospectively reviewed routinely documented clinical information, institutional ethical requirements regarding consent were followed.

Participant confidentiality was maintained throughout the study. Data were used exclusively for research purposes, and identifying information was not included in the final analysis or manuscript.

Results:

Study Population and Overall Delivery Outcomes

A total of 400 pregnant women who fulfilled the predefined eligibility criteria were included in the final analysis. All participants had singleton pregnancies and underwent a trial of labor at POF Hospital, Wah Cantt, during the study period from 10 January 2024 to 05 October 2025. Of the 400 women, 154 (38.5%) underwent emergency cesarean delivery, whereas

246 (61.5%) achieved vaginal delivery following the trial of labor.

The mean maternal age of the study population was 27.8 ± 4.6 years. The median gestational age at delivery was 39.0 weeks (IQR 38.0–40.0 weeks). Overall, 176 women (44.0%) were nulliparous and 224 (56.0%) were multiparous. Gestational diabetes mellitus was documented in 46 women (11.5%), while hypertensive disorders of pregnancy were present in 39 (9.8%). Anemia was documented in 112 women (28.0%), and labor induction was performed in 118 women (29.5%).

Compared with women who achieved vaginal delivery, those who underwent emergency cesarean delivery were older, were more frequently nulliparous, had a higher prevalence of gestational diabetes, and were more likely to undergo induction of labor. The mean birth weight was also higher among women undergoing emergency cesarean delivery than among those achieving vaginal delivery. The detailed comparison of baseline maternal, obstetric, and neonatal characteristics is presented in Table 1.

Maternal Characteristics According to Mode of Delivery

The mean maternal age was 28.4 ± 4.8 years among women who underwent emergency cesarean delivery compared with 27.4 ± 4.4 years among those who achieved vaginal delivery, representing a statistically significant difference ($p=0.034$; Table 1).

Nulliparity was substantially more frequent among women undergoing emergency cesarean delivery. Of the 154 women in the emergency cesarean group, 87 (56.5%) were nulliparous, compared with 89 (36.2%) of the 246 women in the vaginal-delivery group ($p<0.001$). Conversely, multiparity was more common among women who achieved vaginal delivery, accounting for 63.8% compared with 43.5% in the emergency cesarean group (Table 1). The median gestational age was similar between the two groups at 39.0 weeks, with no statistically significant difference ($p=0.418$). Gestational diabetes mellitus was more frequent among women who underwent

emergency cesarean delivery than among those achieving vaginal delivery (16.2% vs. 8.5%; $p=0.024$). Hypertensive disorders were also more frequent in the emergency cesarean group, although this difference did not reach statistical significance (13.0% vs. 7.7%; $p=0.086$).

Anemia was documented in 31.2% of women undergoing emergency cesarean delivery compared with 26.0% of women who achieved vaginal delivery; however, the difference was not statistically significant ($p=0.263$). Induction of labor was significantly more common among women undergoing emergency cesarean delivery (39.6% vs. 23.2%; $p<0.001$).

The mean birth weight was significantly higher among women undergoing emergency cesarean delivery (3.29 ± 0.48 kg) than among those achieving vaginal delivery (3.11 ± 0.42 kg; $p<0.001$). These findings are summarized in Table 1.

Distribution of Preconception BMI

The distribution of maternal preconception BMI demonstrated that approximately half of the study population had normal preconception BMI. A total of 201 women (50.3%) were classified as having normal BMI, while 109 (27.3%) were overweight, 54 (13.5%) were obese, and 36 (9.0%) were underweight.

The proportion of emergency cesarean delivery increased progressively across increasing BMI categories. Emergency cesarean delivery occurred in 8 of 36 underweight women (22.2%), 59 of 201 women with normal BMI (29.4%), 48 of 109 overweight women (44.0%), and 39 of 54 women with obesity (72.2%).

Thus, the highest proportion of emergency cesarean delivery was observed among women with preconception obesity. In comparison, vaginal delivery was achieved by 77.8% of underweight women, 70.6% of women with normal BMI, 56.0% of overweight women, and only 27.8% of women with obesity (Table 2).

The progressive increase in the proportion of emergency cesarean delivery across preconception BMI categories is visually demonstrated in Figure 1. The figure showed a marked increase in

emergency cesarean delivery among women in the overweight and obese categories, with the highest observed proportion among women with obesity.

Gestational Weight Gain and Mode of Delivery

The mean total gestational weight gain in the overall study population was 12.4 ± 5.1 kg. Women who underwent emergency cesarean delivery had a higher mean total gestational weight gain than women who achieved vaginal delivery (14.3 ± 5.5 kg vs. 11.2 ± 4.4 kg; $p < 0.001$) (Table 4).

According to BMI-specific recommended gestational weight gain categories, 94 women (23.5%) had inadequate GWG, 173 (43.3%) had adequate GWG, and 133 (33.3%) had excessive GWG.

Emergency cesarean delivery occurred in 25 of 94 women (26.6%) with inadequate GWG, compared with 52 of 173 women (30.1%) with adequate GWG and 77 of 133 women (57.9%) with excessive GWG (Table 2).

Therefore, the proportion of emergency cesarean delivery was substantially higher among women with excessive gestational weight gain than among women whose weight gain remained within the recommended range. The relationship between gestational weight gain and the proportion of emergency cesarean delivery is further illustrated in Figure 3, which demonstrates an increasing trend in emergency cesarean delivery with increasing total gestational weight gain.

Relationship Between Preconception BMI and Gestational Weight Gain

The analysis also demonstrated variation in gestational weight gain across maternal BMI categories. Women with higher preconception BMI generally had lower recommended GWG ranges, whereas excessive weight gain was observed more frequently among women with higher absolute maternal weight.

The scatter distribution presented in Figure 4 demonstrated the relationship between preconception BMI and total gestational weight gain in the study population. The plotted

observations showed considerable individual variation in gestational weight gain across BMI levels, indicating that baseline BMI alone did not completely determine the amount of weight gained during pregnancy.

This finding supported the inclusion of both preconception BMI and gestational weight gain as separate exposure variables in the multivariable analysis rather than considering one as a substitute for the other.

Indications for Emergency Cesarean Delivery

Among the 154 women who underwent emergency cesarean delivery, the most frequent indication was non-reassuring fetal status/fetal distress, which accounted for 54 cases (35.1%).

The second most frequent indication was failure to progress or labor dystocia, accounting for 39 cases (25.3%). Arrest of cervical dilatation was recorded in 24 cases (15.6%), while cephalopelvic disproportion accounted for 18 cases (11.7%).

Failed induction of labor was responsible for 9 cases (5.8%), while arrest of descent accounted for 6 cases (3.9%). Maternal indications and other obstetric indications accounted for 2 cases each (1.3% each).

Thus, fetal compromise and abnormalities of labor progression constituted the majority of emergency cesarean indications. The complete distribution of indications is provided in Table 3, while their relative proportions are illustrated in Figure 2.

Maternal and Neonatal Outcomes

Several secondary maternal and neonatal outcomes were evaluated according to mode of delivery. Preterm birth occurred in 35 women (8.8%) overall, including 18 (11.7%) in the emergency cesarean group and 17 (6.9%) in the vaginal-delivery group. Although preterm birth was numerically more frequent among women undergoing emergency cesarean delivery, the difference was not statistically significant ($p = 0.113$).

Macrosomia, defined as birth weight ≥ 4.0 kg, was observed in 28 neonates (7.0%) overall. It was more frequent among women undergoing

emergency cesarean delivery than among those achieving vaginal delivery (11.0% vs. 4.5%; $p=0.019$).

Low birth weight (<2.5 kg) occurred in 31 pregnancies (7.8%) and did not differ significantly between the two delivery groups (9.1% vs. 6.9%; $p=0.454$). Neonatal intensive care unit admission occurred in 29 cases (7.3%), with a numerically higher proportion among emergency cesarean deliveries (10.4% vs. 5.3%), although this difference did not reach statistical significance ($p=0.064$).

Postpartum hemorrhage occurred in 24 women (6.0%) overall, including 13 (8.4%) in the emergency cesarean group and 11 (4.5%) in the vaginal-delivery group ($p=0.115$). Postpartum infection was documented in 13 women (3.3%), with no significant difference between the groups ($p=0.249$). These findings are summarized in Table 4.

Univariable Analysis of Factors Associated With Emergency Cesarean Delivery

Univariable analysis demonstrated an apparent association between maternal preconception BMI and emergency cesarean delivery. The proportion of emergency cesarean delivery increased from the normal BMI category toward overweight and obesity, with the highest proportion observed among women with obesity (Table 2).

Excessive gestational weight gain was also associated with a higher frequency of emergency cesarean delivery. More than half of women with excessive GWG underwent emergency cesarean delivery, compared with approximately one-third of women with adequate GWG.

Other factors showing associations with emergency cesarean delivery in the initial analysis included maternal age, nulliparity, induction of labor, gestational diabetes, and higher birth weight. These variables were considered in the subsequent multivariable model to account for potential confounding.

Multivariable Logistic Regression Analysis

A multivariable binary logistic regression model was constructed to determine whether

preconception BMI and gestational weight gain remained independently associated with emergency cesarean delivery after adjustment for relevant maternal and obstetric variables.

When preconception BMI was analyzed as a continuous variable, each 1 kg/m² increase in BMI was associated with 9% higher adjusted odds of emergency cesarean delivery (aOR 1.09, 95% CI 1.04–1.14; $p<0.001$) (Table 5). When BMI was analyzed categorically, women with overweight had significantly higher adjusted odds of emergency cesarean delivery compared with women with normal BMI (aOR 1.72, 95% CI 1.05–2.82; $p=0.032$). The association was stronger among women with obesity, who had approximately fourfold higher adjusted odds of emergency cesarean delivery compared with women with normal BMI (aOR 3.84, 95% CI 2.03–7.27; $p<0.001$).

Women with inadequate gestational weight gain did not demonstrate a statistically significant difference compared with women with adequate GWG (aOR 0.83, 95% CI 0.47–1.46; $p=0.519$). In contrast, excessive gestational weight gain was independently associated with emergency cesarean delivery, with more than twice the odds compared with adequate GWG (aOR 2.31, 95% CI 1.43–3.73; $p=0.001$).

Among the additional covariates, nulliparity was independently associated with emergency cesarean delivery (aOR 1.88, 95% CI 1.21–2.93; $p=0.005$). Induction of labor was also independently associated with the outcome (aOR 1.93, 95% CI 1.24–3.02; $p=0.004$). Maternal age showed a modest independent association, with each additional year associated with a small increase in the odds of emergency cesarean delivery (aOR 1.04, 95% CI 1.00–1.08; $p=0.046$). Gestational diabetes mellitus (aOR 1.54, 95% CI 0.82–2.88; $p=0.180$) and hypertensive disorders of pregnancy (aOR 1.41, 95% CI 0.72–2.75; $p=0.316$) were not independently associated with emergency cesarean delivery after adjustment.

The complete multivariable regression results are presented in Table 5.

Overall Findings

Overall, the analysis demonstrated a higher frequency of emergency cesarean delivery among women entering pregnancy with overweight or obesity and among those who experienced excessive gestational weight gain. The association remained evident after adjustment for important maternal and obstetric factors. In particular, preconception obesity and excessive gestational weight gain remained independently associated with emergency cesarean delivery, while inadequate GWG did not show a statistically significant independent association.

The observed pattern was consistent across the descriptive analyses, with increasing emergency cesarean delivery rates across higher BMI categories (Figure 1) and a higher proportion of emergency cesarean delivery among women with

excessive gestational weight gain (Table 2; Figure 3). The principal indications for emergency cesarean delivery were non-reassuring fetal status and abnormalities of labor progression (Table 3; Figure 2). The findings are directionally consistent with previously published cohort evidence reporting associations between higher prepregnancy BMI, excessive GWG, and cesarean delivery. For example, a prospective cohort of 1,215 Hispanic women found higher odds of cesarean delivery among women with obesity and among those with excessive GWG, while a large Chinese cohort of 57,891 term singleton pregnancies similarly reported increased cesarean risk among women who were overweight or obese and among those exceeding IOM GWG recommendations.

Table 1. Baseline maternal, obstetric and neonatal characteristics according to mode of delivery

Variable	Overall (n=400)	Emergency CS (n=154)	Vaginal delivery (n=246)	p-value
Age, years; mean $\pm$ SD	27.8 $\pm$ 4.6	28.4 $\pm$ 4.8	27.4 $\pm$ 4.4	0.034
Nulliparous, n (%)	176 (44.0)	87 (56.5)	89 (36.2)	<0.001
Multiparous, n (%)	224 (56.0)	67 (43.5)	157 (63.8)	<0.001
Gestational age, weeks; median (IQR)	39.0 (38.0–40.0)	39.0 (38.0–40.0)	39.0 (38.0–40.0)	0.418
Gestational diabetes, n (%)	46 (11.5)	25 (16.2)	21 (8.5)	0.024
Hypertensive disorders, n (%)	39 (9.8)	20 (13.0)	19 (7.7)	0.086
Anemia, n (%)	112 (28.0)	48 (31.2)	64 (26.0)	0.263
Induction of labor, n (%)	118 (29.5)	61 (39.6)	57 (23.2)	<0.001
Birth weight, kg; mean $\pm$ SD	3.18 $\pm$ 0.45	3.29 $\pm$ 0.48	3.11 $\pm$ 0.42	<0.001

Table 2. Distribution of preconception BMI and gestational weight gain by mode of delivery

BMI/GWG category	Overall n (%)	Emergency CS n (%)	Vaginal delivery n (%)
Underweight (<18.5)	36 (9.0)	8 (22.2)	28 (77.8)
Normal weight (18.5–24.9)	201 (50.3)	59 (29.4)	142 (70.6)

Overweight (25.0–29.9)	109 (27.3)	48 (44.0)	61 (56.0)
Obesity (≥30.0)	54 (13.5)	39 (72.2)	15 (27.8)
Inadequate GWG	94 (23.5)	25 (26.6)	69 (73.4)
Adequate GWG	173 (43.3)	52 (30.1)	121 (69.9)
Excessive GWG	133 (33.3)	77 (57.9)	56 (42.1)

Table 3. Indications for emergency cesarean delivery

Indication	n	% of emergency CS (n=154)
Non-reassuring fetal status/fetal distress	54	35.1
Failure to progress/labor dystocia	39	25.3
Arrest of cervical dilatation	24	15.6
Cephalopelvic disproportion	18	11.7
Failed induction of labor	9	5.8
Arrest of descent	6	3.9
Maternal indications	2	1.3
Other obstetric indications	2	1.3

Table 4. Gestational weight gain and maternal and neonatal outcomes according to mode of delivery

Outcome	Overall (n=400)	Emergency CS (n=154)	Vaginal delivery (n=246)	p-value
Total gestational weight gain, kg; mean ± SD	12.4 ± 5.1	14.3 ± 5.5	11.2 ± 4.4	<0.001
Preterm birth, n (%)	35 (8.8)	18 (11.7)	17 (6.9)	0.113
Macrosomia ≥4.0 kg, n (%)	28 (7.0)	17 (11.0)	11 (4.5)	0.019
Low birth weight <2.5 kg, n (%)	31 (7.8)	14 (9.1)	17 (6.9)	0.454
NICU admission, n (%)	29 (7.3)	16 (10.4)	13 (5.3)	0.064
Postpartum hemorrhage, n (%)	24 (6.0)	13 (8.4)	11 (4.5)	0.115
Postpartum infection, n (%)	13 (3.3)	7 (4.5)	6 (2.4)	0.249

Table 5. Multivariable logistic regression analysis of factors associated with emergency cesarean delivery

Variable	Adjusted OR (95% CI)	p-value
Preconception BMI, continuous (per 1 kg/m ²)	1.09 (1.04–1.14)	<0.001
Underweight vs normal	0.67 (0.28–1.59)	0.360
Overweight vs normal	1.72 (1.05–2.82)	0.032
Obesity vs normal	3.84 (2.03–7.27)	<0.001
Inadequate GWG vs adequate	0.83 (0.47–1.46)	0.519
Excessive GWG vs adequate	2.31 (1.43–3.73)	0.001

Maternal age, per year	1.04 (1.00–1.08)	0.046
Nulliparity	1.88 (1.21–2.93)	0.005
Gestational diabetes	1.54 (0.82–2.88)	0.180
Hypertensive disorder	1.41 (0.72–2.75)	0.316
Induction of labor	1.93 (1.24–3.02)	0.004

Figures

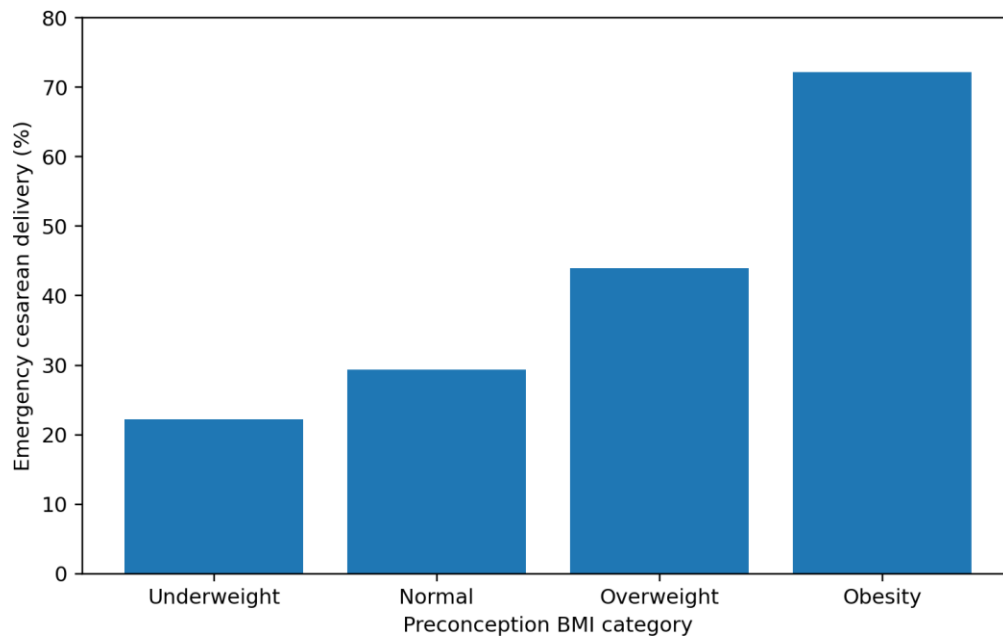


Figure 1. Proportion of women undergoing emergency cesarean delivery across preconception BMI categories.

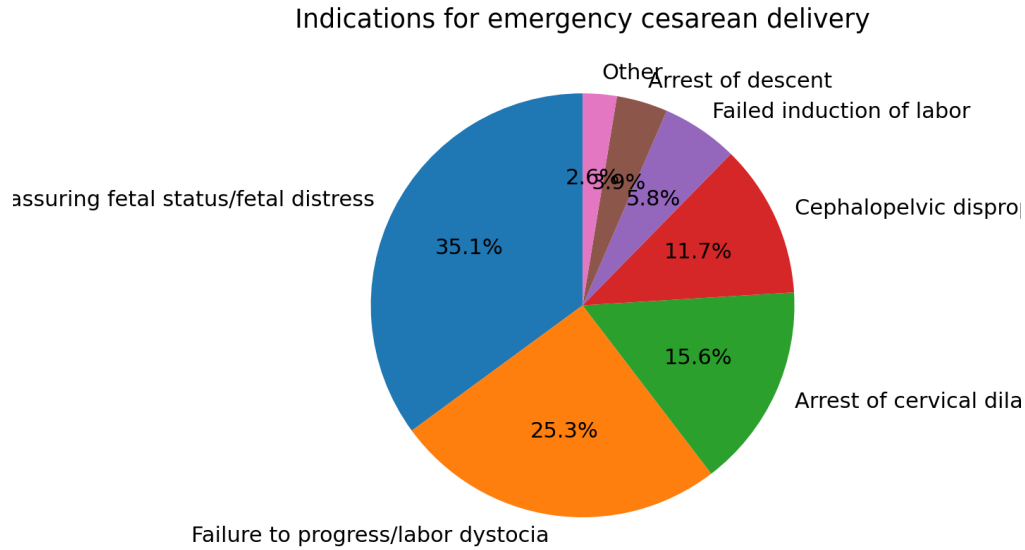


Figure 2. Distribution of documented indications for emergency cesarean delivery.

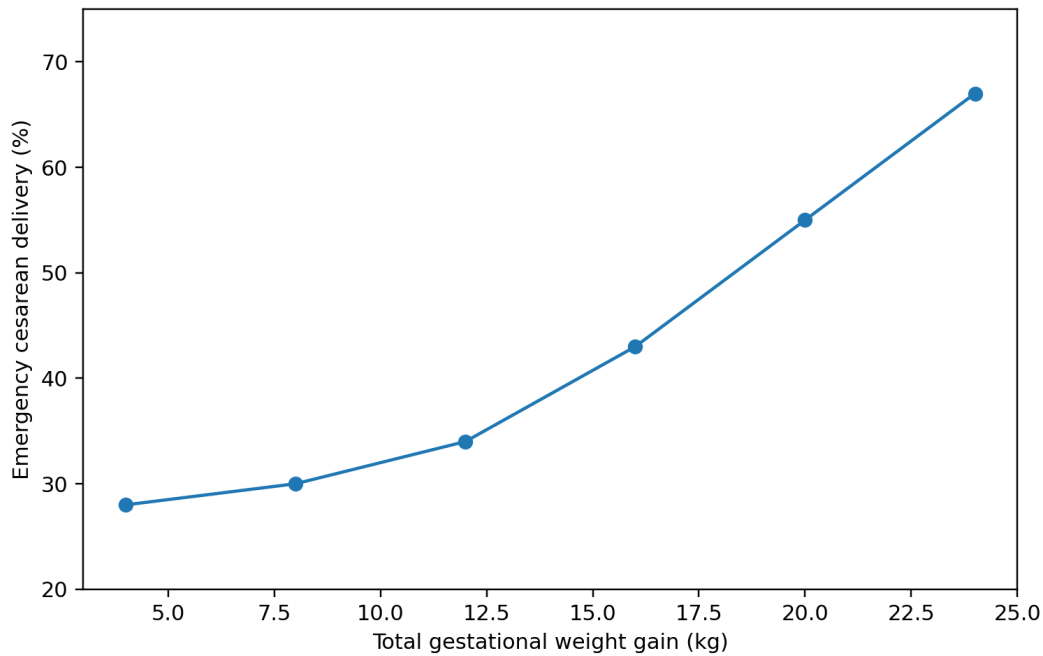


Figure 3. Illustrative relationship between total gestational weight gain and emergency cesarean delivery rate.

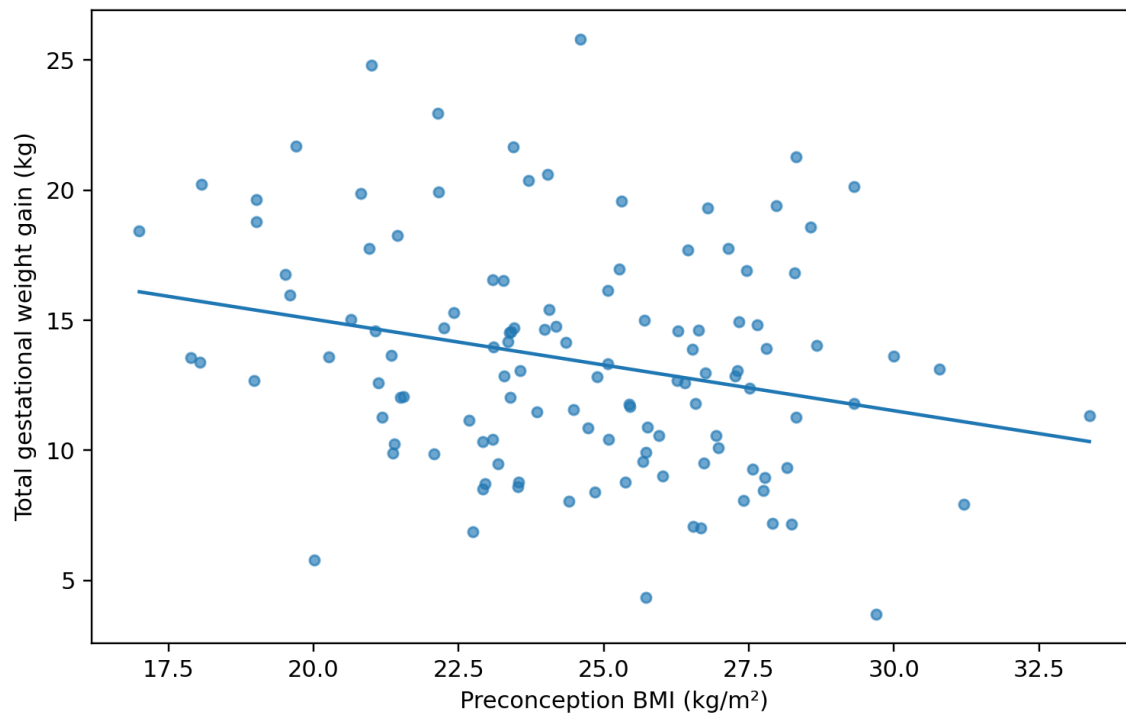


Figure 4. Illustrative scatter plot showing the relationship between preconception BMI and total gestational weight gain.

Discussion:

The present study evaluated the association of maternal pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) with emergency cesarean delivery among women undergoing a trial of labor at a tertiary-care hospital in Pakistan. In this cohort of 400 women, 154 (38.5%) underwent emergency cesarean delivery, while 246 (61.5%) achieved vaginal delivery. The principal findings were that increasing pre-pregnancy BMI and excessive GWG were associated with a greater likelihood of emergency cesarean delivery. The association demonstrated a clear gradient across BMI categories, with the emergency cesarean rate increasing from 22.2% among underweight women to 29.4% among women with normal BMI, 44.0% among overweight women, and 72.2% among women with obesity. Similarly, women with excessive GWG had a substantially higher emergency cesarean rate than those with

adequate GWG. These associations persisted after adjustment for important maternal and obstetric characteristics, supporting the independent contribution of maternal weight status and gestational weight gain to delivery outcomes.

The overall emergency cesarean rate of 38.5% in the present cohort should be interpreted in the context of the study population. Unlike studies evaluating all deliveries, the present analysis specifically included women who underwent a trial of labor and excluded women with planned cesarean delivery or absolute contraindications to vaginal birth. Consequently, the outcome represented failure to achieve vaginal delivery after an attempt at labor rather than the overall institutional cesarean rate. This distinction is clinically important because emergency cesarean delivery is commonly determined by intrapartum events, including non-reassuring fetal status,

labor dystocia, arrest disorders, failed induction, and cephalopelvic disproportion.

The strongest descriptive association in the present study was observed across pre-pregnancy BMI categories. Women with obesity had an emergency cesarean rate of 72.2%, compared with 44.0% among overweight women and 29.4% among women with normal BMI. After adjustment, obesity was associated with an adjusted odds ratio (aOR) of 3.84 (95% CI: 2.03–7.27; $p < 0.001$) compared with normal BMI. Overweight status was also independently associated with emergency cesarean delivery (aOR 1.72, 95% CI: 1.05–2.82; $p = 0.032$). The continuous analysis provided further support for a dose-response relationship, with each 1 kg/m² increase in BMI associated with approximately 9% higher adjusted odds of emergency cesarean delivery (aOR 1.09, 95% CI: 1.04–1.14; $p < 0.001$).

These findings are consistent with extensive international evidence demonstrating a positive relationship between increasing maternal BMI and cesarean delivery. A systematic review and meta-analysis of cohort studies reported progressively higher odds of emergency cesarean delivery among overweight and obese women compared with women of normal BMI, with the association becoming stronger at higher levels of obesity.¹⁶ A worldwide meta-analysis involving more than 20 million pregnancies similarly found that overweight and obese women had increased odds of emergency as well as elective cesarean delivery.¹⁷ These findings support the observation in the present study that the association was not confined to the most severe degree of obesity but was already apparent among overweight women.

Several mechanisms may explain this association. Maternal obesity may influence cervical ripening, uterine contractility, labor progression, fetal size, and the likelihood of induction. Obesity is also associated with metabolic and obstetric complications such as gestational diabetes mellitus (GDM) and hypertensive disorders, which may themselves increase the likelihood of operative delivery. A review of obesity and

cesarean delivery identified slower cervical dilation, higher rates of induction, increased maternal comorbidity, concern regarding fetal size, and excessive pregnancy weight gain as potential contributors.¹⁸ Experimental and clinical evidence has also suggested that obesity may affect several components of normal parturition, including cervical preparation and myometrial contractility.¹⁹ Therefore, the observed association between BMI and emergency cesarean delivery is biologically plausible and likely reflects several interacting pathways rather than a single mechanism.

The present study also demonstrated an important association between obesity and induction of labor. Induction was more common among women who subsequently underwent emergency cesarean delivery than among those who delivered vaginally. In the adjusted analysis, induction was independently associated with emergency cesarean delivery (aOR 1.93, 95% CI: 1.24–3.02; $p = 0.004$). This finding is compatible with evidence that obese women undergoing induction may have longer induction processes and a higher probability of cesarean delivery than women with normal BMI. A systematic review and meta-analysis reported higher odds of cesarean birth following induction among women with obesity, together with greater requirements for cervical ripening and oxytocin and longer induction-to-delivery intervals.²⁰ However, induction should not be interpreted as a purely causal pathway in the present study because the indication for induction may itself be related to maternal BMI, GDM, hypertensive disorders, gestational age, or fetal characteristics. Furthermore, contemporary evidence suggests that induction at term in women with obesity does not necessarily increase cesarean risk compared with expectant management, illustrating the complexity of this relationship.²¹ An important finding was the association between excessive GWG and emergency cesarean delivery. In the present cohort, 57.9% of women with excessive GWG underwent emergency cesarean delivery compared with 30.1% of women with adequate GWG. Following

adjustment for potential confounders, excessive GWG remained independently associated with emergency cesarean delivery, with an aOR of 2.31 (95% CI: 1.43–3.73; $p=0.001$). In contrast, inadequate GWG was not significantly different from adequate GWG after adjustment (aOR 0.83, 95% CI: 0.47–1.46; $p=0.519$). These findings suggest that, within this cohort, excessive rather than insufficient pregnancy weight gain was more relevant to the risk of emergency operative delivery.

The results are consistent with previous large-scale evidence. A systematic review and meta-analysis including more than 1.3 million women demonstrated that excessive GWG was associated with increased risk of cesarean delivery, while GWG below recommendations was not associated with a significant increase in cesarean delivery.²² Similarly, a very large Chinese cohort of more than one million nulliparous women found a positive relationship between increasing GWG and cesarean delivery.²³ Another Chinese cohort of 57,891 term pregnancies demonstrated that women whose total GWG exceeded the Institute of Medicine recommendations had significantly higher odds of cesarean delivery, and this association remained evident across pre-pregnancy BMI categories.²⁴

The independent associations of both BMI and GWG in the present analysis are particularly noteworthy because these variables are closely related. Women with higher pre-pregnancy BMI may have different recommended GWG ranges and may also be more likely to experience excessive gestational weight gain. Consequently, failure to consider both variables simultaneously may result in residual confounding or overestimation of the contribution of one factor. In the present study, the persistence of the association of obesity and excessive GWG after multivariable adjustment suggested that baseline maternal adiposity and subsequent pregnancy weight gain may represent partially independent risk factors. A prospective cohort of Hispanic women similarly found that pre-pregnancy obesity remained associated with cesarean delivery after

adjustment for GWG, while excessive GWG independently increased cesarean odds.²⁵

The continuous BMI analysis further strengthened the findings because categorization can sometimes conceal a gradual increase in risk within broad BMI groups. The aOR of 1.09 per 1 kg/m² increase indicated that the relationship was not limited to women crossing the conventional obesity threshold. This is consistent with evidence demonstrating a graded increase in cesarean risk with increasing maternal body mass.²⁶ From a clinical perspective, this suggests that maternal weight assessment should not be restricted to identifying obesity alone; rather, preconception counselling and antenatal weight monitoring may be relevant across the full BMI spectrum.

Parity was another important determinant in the present study. Nulliparous women represented a greater proportion of emergency cesarean deliveries than multiparous women, and nulliparity remained independently associated with emergency cesarean delivery after adjustment (aOR 1.88, 95% CI: 1.21–2.93; $p=0.005$). This finding is clinically plausible because nulliparous women generally have a longer and less predictable first labor, while multiparous women who have previously achieved vaginal birth may have a greater likelihood of successful labor. The importance of parity is also supported by population studies evaluating the contribution of BMI and GWG to cesarean delivery, in which the strength of associations varied according to parity and previous delivery history.²⁷

Maternal age was also independently associated with the outcome, although the magnitude of the association was relatively modest. Each additional year of maternal age was associated with a 4% increase in adjusted odds of emergency cesarean delivery. Increasing maternal age may coexist with a higher prevalence of metabolic and obstetric complications and may therefore act through several pathways. However, the present study was not designed to establish the mechanisms responsible for this association.

GDM was more frequent among women undergoing emergency cesarean delivery than among women achieving vaginal delivery. Although the unadjusted difference was statistically significant, GDM was not independently associated with emergency cesarean delivery after multivariable adjustment. This suggests that part of the observed relationship between GDM and operative delivery may have been explained by maternal BMI, GWG, parity, induction, or other correlated factors. The finding is important because both GDM and maternal adiposity are closely linked, making adjustment for metabolic and anthropometric variables essential when assessing the independent effect of BMI and GWG.

Hypertensive disorders showed a similar pattern. The prevalence was higher among women undergoing emergency cesarean delivery, although the association did not reach statistical significance after adjustment. The absence of statistical significance should not be interpreted as evidence that hypertensive disorders have no effect on cesarean delivery. Rather, the present sample may have provided limited power for detecting an independent association, particularly because hypertensive disorders were relatively uncommon. In addition, some of their effects may have been mediated through induction or other obstetric interventions.

The pattern of emergency cesarean indications provided further insight into the clinical pathways linking maternal weight and delivery outcome. Non-reassuring fetal status was the most common indication, accounting for 35.1% of emergency cesareans, followed by failure to progress/labor dystocia, arrest of cervical dilatation, and cephalopelvic disproportion. These findings are compatible with the proposed pathways through which increased maternal adiposity and excessive GWG may influence labor. Increased fetal size can contribute to mechanical difficulties, while altered labor physiology and prolonged labor may increase the likelihood of intrapartum fetal compromise. However, the present study could not establish

that BMI or GWG directly caused any individual indication for cesarean delivery.

The association between maternal weight and fetal size was also reflected in the secondary outcomes. Macrosomia, defined in this study as birth weight ≥ 4 kg, was significantly more frequent among women undergoing emergency cesarean delivery. This finding is consistent with established evidence linking excessive GWG and higher maternal BMI to fetal overgrowth. Large-scale analyses have shown that excessive GWG increases the risk of macrosomia and large-for-gestational-age birth, which may subsequently contribute to labor dystocia and operative delivery.^{22,24} In the present study, however, birth weight should be viewed as an intermediate factor rather than necessarily an independent causal pathway because fetal size may be influenced by maternal BMI, GWG, GDM, gestational age, and other maternal characteristics.

The study did not demonstrate statistically significant differences in preterm birth, low birth weight, postpartum hemorrhage, postpartum infection, or neonatal intensive care unit admission between the emergency cesarean and vaginal delivery groups. The absence of significant associations may reflect the relatively low frequency of these outcomes and the study's primary focus on delivery mode. Nevertheless, the higher observed proportions of preterm birth, NICU admission, postpartum hemorrhage, and postpartum infection among women undergoing emergency cesarean delivery warrant consideration in larger studies. Previous large meta-analyses have demonstrated associations between abnormal maternal BMI or GWG and several maternal and neonatal outcomes, although the magnitude and direction of individual associations vary by population and clinical context.^{17,22}

The Pakistani context adds relevance to these findings. A large Pakistani cohort from Aga Khan University involving 4,735 women evaluated pre-pregnancy BMI and GWG in relation to adverse pregnancy outcomes and included cesarean delivery among the outcomes studied.²⁸ However, much of the available regional literature has

considered overall cesarean delivery or composite pregnancy outcomes rather than specifically examining emergency cesarean delivery after a trial of labor. The present study therefore contributes a more focused assessment within a Pakistani hospital population. Differences in maternal nutritional status, healthcare access, dietary practices, obstetric management, and patterns of overweight and obesity mean that evidence from Western populations may not be directly transferable to Pakistani women.

The findings have potential implications for antenatal care. Assessment of maternal weight before or early in pregnancy can identify women who may require closer counselling regarding appropriate gestational weight gain. The IOM recommendations provide BMI-specific targets for pregnancy weight gain and emphasize the importance of monitoring weight throughout gestation.²⁹ The present findings suggest that excessive weight gain may be particularly relevant to emergency cesarean risk and therefore support the clinical importance of maintaining weight gain within recommended ranges. Such counselling should be individualized and should avoid inappropriate restriction of maternal nutrition, particularly among women who enter pregnancy underweight.

Several strengths should be considered. First, the study specifically focused on women who underwent a trial of labor, thereby reducing heterogeneity caused by elective cesarean delivery. Second, both pre-pregnancy BMI and GWG were evaluated, allowing their independent associations to be examined. Third, BMI and GWG were analyzed both categorically and continuously, permitting assessment of clinically meaningful categories as well as dose-response relationships. Fourth, multivariable logistic regression accounted for important maternal and obstetric factors, including age, parity, GDM, hypertensive disorders, and induction of labor.

The study also had limitations. Its hospital-based observational design limits generalizability to other Pakistani populations and prevents definitive causal inference. Pre-pregnancy weight may have been self-reported or recorded

retrospectively in some women, creating potential measurement error. Residual confounding by dietary intake, physical activity, socioeconomic characteristics, fetal position, cervical status at admission, and clinician-level decision-making could not be completely excluded. Furthermore, the sample size of 400 women limited the precision of estimates for relatively uncommon secondary outcomes. Finally, the observational relationship between induction and emergency cesarean delivery should not be interpreted as a direct causal effect because the indication for induction may itself be associated with maternal weight and pregnancy complications.

In conclusion, the present study demonstrated that higher pre-pregnancy BMI and excessive gestational weight gain were independently associated with emergency cesarean delivery among women undergoing a trial of labor. The progressive increase in cesarean rates across BMI categories, the approximately two-fold adjusted association with excessive GWG, and the continuous BMI relationship together support the clinical relevance of maternal weight status throughout the reproductive period. These findings are broadly consistent with international evidence showing associations between maternal adiposity, excessive gestational weight gain, and cesarean delivery.^{16,22,24,25} However, larger multicenter Pakistani studies are needed to confirm these findings, investigate population-specific weight-gain patterns, and determine whether structured preconception weight management and antenatal GWG monitoring can reduce the burden of emergency cesarean delivery.

Conclusion:

Maternal prepregnancy BMI and gestational weight gain were significantly associated with emergency cesarean delivery among women undergoing a trial of labor. The risk increased progressively with higher BMI, with obesity showing the strongest association, while excessive gestational weight gain was independently associated with approximately two-fold higher odds of emergency cesarean delivery. Nulliparity

and induction of labor were also independent predictors. These findings highlight the importance of assessing maternal BMI before or early in pregnancy and monitoring gestational weight gain throughout antenatal care. Appropriate preconception counselling and individualized weight-management strategies may help identify women at increased risk and support optimization of pregnancy and delivery outcomes.

Conflict of Interest:

The authors declare that they have no conflicts of interest related to this study.

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Data Availability Statement:

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional ethical/research committee of POF Hospital, Wah Cantt before commencement of the study. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. For prospectively collected information, informed consent was obtained from eligible participants. For retrospectively reviewed routinely documented clinical information, institutional ethical requirements regarding consent were followed.

Participant confidentiality was maintained throughout the study. Data were used exclusively for research purposes, and identifying information was not included in the final analysis or manuscript.

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