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Original Research Article

Association of Maternal Body Mass Index with Mode of Delivery and Perinatal Outcome: Prospective Observational Study

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Abstract:

Background: Maternal body mass index (BMI) is an important indicator of nutritional status and has a significant influence on pregnancy, labour and neonatal outcomes. Both low and high maternal BMI have been associated with adverse obstetric and perinatal outcomes, including altered birth weight, increased operative delivery and neonatal morbidity.

Aim and Objectives: This study aimed to assess the association of maternal BMI with mode of delivery and perinatal outcomes among term pregnant women. The primary objective was to evaluate the association between maternal BMI and mode of delivery, particularly caesarean section. The secondary objectives were to assess the association between maternal BMI and induction of labour, birth weight, 5-minute Apgar score, and neonatal intensive care unit admission.

Methods: This prospective observational study included 120 term pregnant women with singleton pregnancies admitted for delivery. Maternal BMI was calculated as weight in kilograms divided by height in metres squared, and women were categorized into underweight, normal BMI, overweight and obese groups. Labour details, induction of labour, mode of delivery and neonatal outcomes were recorded prospectively. Perinatal outcomes included birth weight, 5-minute Apgar score and neonatal intensive care unit admission. Data were analysed using appropriate statistical tests, and a p value of less than 0.05 was considered statistically significant.

Results: Among 120 women, 18 were underweight, 48 had normal BMI, 34 were overweight, and 20 were obese. Induction of labour increased significantly with increasing BMI and was highest among obese women (60.0%; $p = 0.018$). Caesarean section rate was lowest among women with normal BMI (25.0%) and highest among obese women (55.0%; $p = 0.041$). Mean birth weight increased significantly across BMI categories, from 2.54 ± 0.36 kg in underweight women to 3.28 ± 0.52 kg in obese women ($p = 0.003$). Low birth weight was significantly more frequent among underweight women ($p = 0.027$). Macrosomia, low 5-minute Apgar score and neonatal intensive care unit admission were more frequent among obese women; however, these associations did not reach statistical significance.

Conclusion: Maternal BMI was significantly associated with induction of labour, caesarean section and birth weight. Obese women had higher rates of induction of labour and caesarean section, whereas underweight women had a greater frequency of low-birth-weight neonates. Routine BMI assessment during antenatal care may help in early risk identification, nutritional counselling, individualized labour planning and appropriate neonatal preparedness.

Keywords: Maternal Body Mass Index; Obesity In Pregnancy; Caesarean Section; Induction Of Labour; Birth Weight; Apgar Score; Neonatal Intensive Care Unit Admission.

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Introduction

Maternal nutritional status is an important determinant of pregnancy outcome, and body mass index (BMI) is one of the simplest and most widely used clinical indicators for assessing maternal weight status. BMI is calculated as weight in kilograms divided by height in metres squared and is commonly used to classify women as underweight, normal weight, overweight or obese [1]. Although BMI does not directly measure body fat distribution, it is practical, inexpensive and easily applicable during routine antenatal care, particularly in resource-limited settings.

The increasing prevalence of overweight and obesity among women of reproductive age has become an important public health and obstetric concern. Maternal obesity is associated with several antenatal and intrapartum complications, including gestational diabetes mellitus, hypertensive disorders of pregnancy, prolonged labour, failed induction, operative delivery, postpartum complications and adverse neonatal outcomes [2,3]. At the other end of the nutritional spectrum, low maternal BMI is also clinically important, as it has been associated with fetal growth restriction, low birth weight and increased perinatal morbidity [1]. Therefore, both extremes of maternal BMI may influence the course of pregnancy, labour and neonatal outcome.

Several studies have shown that increasing maternal BMI is associated with a higher frequency of induction of labour and caesarean section. This association may be explained by obesity-related complications such as gestational diabetes, hypertensive disorders, suspected macrosomia, post-dated pregnancy, poor cervical favourability and poor progress of labour [4,5]. Maternal obesity has also been linked with neonatal complications, including increased birth weight, macrosomia, lower Apgar score, respiratory morbidity and neonatal intensive care unit admission [6]. In contrast, women with low BMI are more likely to deliver low-birth-weight neonates, reflecting the adverse effect of maternal undernutrition on fetal growth [1].

Indian data are particularly important because pregnant women in India represent a dual burden of malnutrition, where undernutrition and overweight or obesity may coexist within the same population. In addition, BMI distribution, access to antenatal care, obstetric decision-making, and availability of neonatal care may vary across regions and institutions. Therefore, locally generated data are required to understand the association of maternal BMI with clinically relevant delivery and neonatal outcomes in Indian obstetric settings [7].

Assessment of BMI during antenatal registration provides a simple opportunity for risk stratification, nutritional counselling, monitoring of gestational weight gain, planning of intrapartum care and anticipation of neonatal needs. However, institution-specific data from Indian obstetric settings remain limited, particularly regarding the combined association of maternal BMI with induction of labour, mode of delivery and early neonatal outcomes. Therefore, the present prospective observational study was conducted to evaluate the association between maternal BMI and induction of labour, mode of delivery, birth weight, 5-minute Apgar score, and neonatal intensive care unit admission among term pregnant women.

Materials and Methods

Study Design and Setting: This was a prospective observational study conducted in the Department of Obstetrics and Gynaecology at Paradkar Hospital and Research Center over 6 months from March 2025 to August 2025. The study was designed to assess the association between maternal body mass index (BMI) and the induction of labour, mode of delivery, and selected perinatal outcomes among term pregnant women.

Study Population: The study included term pregnant women with singleton pregnancies who were admitted for delivery during the study period. Eligible women were enrolled consecutively after written informed consent was obtained. Maternal demographic details, obstetric history, antenatal risk factors, labour-related details, mode of delivery and neonatal outcomes were recorded using a predesigned structured proforma.

Sample Size and Sampling Method: A total of 120 eligible term-pregnant women who met the inclusion and exclusion criteria were included in the study. Participants were enrolled consecutively during the study period using a convenient sampling method.

Inclusion Criteria: Pregnant women aged 18 years or above with a singleton pregnancy, a gestational age of 37 completed weeks or more, and available maternal height and weight records were included in the study. Only women who provided written informed consent were enrolled.

Exclusion Criteria: Women with multiple pregnancy, major fetal congenital anomaly, intrauterine fetal demise at admission, severe medical illness unrelated to pregnancy, incomplete clinical records, or referral after delivery from another centre were excluded from the study. Women referred after delivery were excluded because complete intrapartum and delivery details were not available.

Assessment of Maternal Body Mass Index: Maternal height was measured in metres using a standard stadiometer, and weight was recorded in kilograms using a calibrated weighing scale. BMI was calculated using the following formula:

BMI = weight in kilograms/height in metres^2

Women were categorized according to the World Health Organization BMI classification. Underweight was defined as BMI <18.5 kg/m^2, normal BMI as 18.5–24.9 kg/m^2, overweight as 25.0–29.9 kg/m^2 and obesity as BMI ≥30.0 kg/m^2. Antenatal booking BMI was used wherever available. In women without available booking BMI records, BMI recorded at admission for delivery was used and documented separately, because late-pregnancy BMI may be influenced by gestational weight gain and may not fully represent pre-pregnancy nutritional status.

Labour and Delivery Assessment: All women were followed prospectively from admission until delivery. Details regarding the spontaneous onset of labour, induction of labour, indications for induction, progress of labour, and the final mode of delivery were recorded. Mode of delivery was categorized as vaginal delivery, instrumental vaginal delivery or caesarean section. Caesarean sections were further assessed according to indication, including fetal distress, failed induction, non-progress of labour, cephalopelvic disproportion, previous caesarean section or other obstetric indications.

Perinatal Outcome Assessment: Perinatal outcomes assessed in the study included birth weight, Apgar score and neonatal intensive care unit (NICU) admission. Birth weight was recorded in grams immediately after delivery using a standard neonatal weighing scale. Low birth weight was defined as birth weight less than 2500 g. Macrosomia was defined as a birth weight of 4000 g or more. Apgar scores were recorded at 1 and 5 minutes after birth. A low 5-minute Apgar score was defined as a 5-minute Apgar score less than 7. NICU admission was recorded along with the primary reason for admission, such as respiratory distress, birth asphyxia, meconium aspiration, hypoglycaemia, observation for maternal risk factors or other neonatal complications.

Outcome Variables: The primary outcome of the study was the association between maternal BMI category and mode of delivery, particularly caesarean section. Secondary outcomes included induction of labour, birth weight, low birth weight, macrosomia, 5-minute Apgar score less than 7 and NICU admission.

Data Collection Procedure: Data were collected prospectively from antenatal records, labour room records, delivery notes and neonatal records. Maternal age, parity, gestational age, height, weight, BMI, antenatal complications, induction status, mode of delivery, and neonatal outcomes were recorded on a structured data collection sheet. Data were checked for completeness and consistency before final analysis.

Statistical Analysis: All collected data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) software version 26.0. Continuous variables such as maternal age, gestational age, BMI, and birth weight were expressed as the mean and standard deviation or the median and interquartile range, depending on the data distribution. Categorical variables such as BMI category, induction of labour, mode of delivery, low birth weight, macrosomia, low 5-minute Apgar score, and NICU admission were expressed as frequencies and percentages.

The association between maternal BMI category and categorical outcomes was assessed using the chi-square test or Fisher's exact test, as appropriate. Continuous variables across BMI groups were compared using one-way analysis of variance or the Kruskal–Wallis test, depending on the distribution of data. A p-value of less than 0.05 was considered statistically significant. No multivariable adjustment was performed; therefore, the results were interpreted as associations rather than causal relationships.

Results

A total of 120 term-pregnant women were included in the present prospective observational study. The mean age of the study participants was 25.9 ± 4.1 years, and the mean gestational age at delivery was 38.4 ± 1.1 weeks. Of the total participants, 52 women were primigravida, and 68 were multigravida. The mean maternal body mass index (BMI) was 25.1 ± 4.3 kg/m². Based on BMI category, 18 women were underweight, 48 had a normal BMI, 34 were overweight, and 20 were obese.

Table 1: Demographic and obstetric characteristics of the study population

Characteristic	Value
Total participants	120
Maternal age, years, mean ± SD	25.9 ± 4.1
Gestational age at delivery, weeks, mean ± SD	38.4 ± 1.1
Primigravida	52 (43.3%)
Multigravida	68 (56.7%)
BMI, kg/m², mean ± SD	25.1 ± 4.3
Underweight	18 (15.0%)
Normal BMI	48 (40.0%)
Overweight	34 (28.3%)
Obese	20 (16.7%)

BMI: body mass index; SD: standard deviation.

Induction of labour was required in 42 women. The proportion of women requiring induction of labour increased with increasing BMI. Induction was required in 4 underweight women (22.2%), 12 women with normal BMI (25.0%), 14 overweight women (41.2%) and 12 obese women (60.0%). The association between maternal BMI category and induction of labour was statistically significant (p = 0.018).

Mode of delivery differed significantly across BMI categories (p = 0.041). Vaginal delivery was most frequent among women with normal BMI, observed in 34 women (70.8%), and lowest among obese women, observed in 8 women (40.0%). Caesarean section was performed on 42 women overall. The caesarean section rate was lowest among women with normal BMI, 12 women (25.0%), and highest among obese women, 11 women (55.0%). Caesarean section was performed in 6 underweight women (33.3%) and 13 overweight women (38.2%). Instrumental vaginal delivery was uncommon across all BMI categories.

Mean birth weight increased significantly with increasing maternal BMI. The mean birth weight was 2.54 ± 0.36 kg among underweight women, 2.83 ± 0.41 kg among women with normal BMI, 3.06 ± 0.46 kg among overweight women and 3.28 ± 0.52 kg among obese women (p = 0.003). Low birth weight was significantly more frequent among underweight women, occurring in 6 neonates (33.3%), compared with 5 neonates (10.4%) in the normal BMI group, 2 neonates (5.9%) in the overweight group and 1 neonate (5.0%) in the obese group (p = 0.027). Macrosomia was numerically more frequent among overweight and obese women, but the association was not statistically significant (p = 0.084).

A 5-minute Apgar score of less than 7 was observed in 2 neonates (11.1%) in the underweight group, 2 neonates (4.2%) in the normal BMI group, 2 neonates (5.9%) in the overweight group and 3 neonates (15.0%) in the obese group. This association was not statistically significant (p = 0.218). Neonatal intensive care unit (NICU) admission was recorded in 4 neonates (22.2%) born to underweight women, 4 neonates (8.3%) born to women with normal BMI, 5 neonates (14.7%) born to overweight women and 5 neonates (25.0%) born to obese women. Although NICU admission was numerically higher among obese and underweight women, the association was not statistically significant (p = 0.132).

Table 2: Association of maternal BMI with mode of delivery and perinatal outcomes

Outcome	**Underweight n = 18**	**Normal BMI n = 48**	**Overweight n = 34**	**Obese n = 20**	**p value**
Induction of labour	4 (22.2%)	12 (25.0%)	14 (41.2%)	12 (60.0%)	0.018
Mode of delivery					0.041
Vaginal delivery	12 (66.7%)	34 (70.8%)	18 (52.9%)	8 (40.0%)	
Instrumental delivery	0 (0.0%)	2 (4.2%)	3 (8.8%)	1 (5.0%)	
Caesarean section	6 (33.3%)	12 (25.0%)	13 (38.2%)	11 (55.0%)	
Mean birth weight, kg, mean ± SD	2.54 ± 0.36	2.83 ± 0.41	3.06 ± 0.46	3.28 ± 0.52	0.003
Low birth weight	6 (33.3%)	5 (10.4%)	2 (5.9%)	1 (5.0%)	0.027
Macrosomia	0 (0.0%)	1 (2.1%)	3 (8.8%)	3 (15.0%)	0.084
5-minute Apgar score <7	2 (11.1%)	2 (4.2%)	2 (5.9%)	3 (15.0%)	0.218
NICU admission	4 (22.2%)	4 (8.3%)	5 (14.7%)	5 (25.0%)	0.132

BMI: body mass index; NICU: neonatal intensive care unit; SD: standard deviation. Categorical variables are presented as frequencies and percentages. Continuous variables are presented as mean ± standard deviation. p values were calculated using chi-square test/Fisher's exact test for categorical variables and one-way analysis of variance/Kruskal–Wallis test for continuous variables, as appropriate.

Overall, increasing maternal BMI was significantly associated with higher rates of induction of labour, caesarean section, and mean birth weight. Obese women had the highest rates of induction of labour and caesarean section, whereas underweight women had the highest proportion of low-birth-weight neonates. Macrosomia, low 5-minute Apgar score and NICU admission showed numerical variation across BMI categories; however, these associations were not statistically significant.

Figure 1 shows the caesarean section rate according to maternal BMI category. The caesarean section rate was lowest among women with normal BMI and highest among obese women, showing an increasing trend in operative delivery with higher maternal BMI.

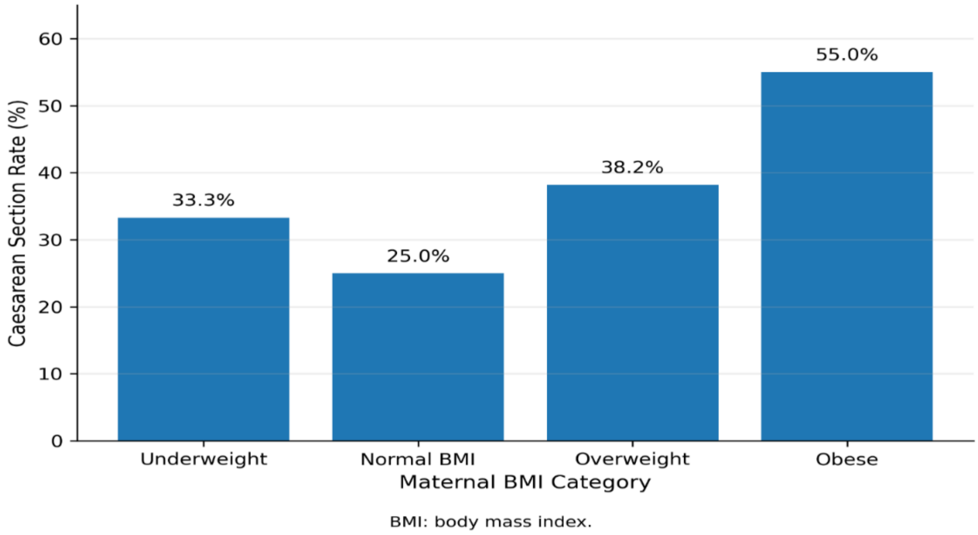

Figure 1: Caesarean section rate according to maternal BMI category. Bar graph showing caesarean section rate according to maternal body mass index category. BMI: body mass index.

Discussion

The present prospective observational study evaluated the association between maternal body mass index (BMI) and the induction of labour, mode of delivery, and selected perinatal outcomes among term pregnant women. The main findings of the study were that increasing maternal BMI was significantly associated with higher rates of induction of labour and caesarean section, and higher mean birth weight. Obese women had the highest frequency of induction of labour and caesarean section, whereas underweight women had the highest proportion of low-birth-weight neonates. Macrosomia, low 5-minute Apgar score and neonatal intensive care unit (NICU) admission showed numerical variation across BMI categories, but these associations were not statistically significant.

In the present study, induction of labour increased progressively with increasing BMI and was highest among obese women. This finding is consistent with previous evidence showing that maternal obesity is associated with a higher likelihood of labour induction and an increased risk of caesarean delivery following induction [8]. The higher induction rate among obese women may be related to associated obstetric complications such as hypertensive disorders, gestational diabetes mellitus, suspected fetal macrosomia, post-dated pregnancy and reduced cervical favourability. These factors may increase the need for planned induction and may also contribute to prolonged or unsuccessful labour.

Mode of delivery differed significantly across BMI categories in the present study. The caesarean section rate was lowest among women with normal BMI and highest among obese women. Caesarean section was performed in 25.0% of women with normal BMI compared with 55.0% of obese women. This finding supports previous studies showing that increasing maternal BMI is associated with a higher risk of operative delivery [9,10]. The increased caesarean section rate among obese women may be due to labour dystocia, poor uterine contractility, cephalopelvic disproportion, failed induction, fetal macrosomia and intrapartum fetal compromise.

The association between maternal obesity and labour dysfunction has biological and clinical plausibility. Increased maternal adiposity may influence myometrial contractility, inflammatory pathways and metabolic function, which can contribute to poor progress of labour. In addition, clinical assessment of fetal size, abdominal palpation, and monitoring of labour progress may be more difficult in obese women. Obesity-related comorbidities may also lower the threshold for operative delivery, particularly in the presence of suspected fetal compromise or failed induction.

The present study also found that mean birth weight increased significantly with increasing maternal BMI. Mean birth weight increased from 2.54 ± 0.36 kg among underweight women to 3.28 ± 0.52 kg among obese women. Low birth weight was significantly more frequent among underweight women, whereas higher mean birth weight and macrosomia were more common among overweight and obese women. This pattern is consistent with previous evidence showing that low maternal BMI is associated with fetal growth restriction and low birth weight. In contrast, higher maternal BMI is associated with large-for-gestational-age neonates and macrosomia [11,12].

The higher frequency of low birth weight among underweight women may be explained by reduced maternal nutritional reserves, inadequate gestational weight gain, maternal anaemia and impaired fetal growth. In contrast, overweight and obese women may have increased insulin resistance and a higher frequency of gestational diabetes mellitus, which can increase fetal growth and birth weight. Although macrosomia was more frequent among obese women in the present study, this association was not statistically significant, possibly due to the modest sample size and limited number of macrosomic neonates.

Low 5-minute Apgar score and NICU admission were numerically more frequent among obese women, but these associations did not reach statistical significance. Previous studies have reported that maternal obesity may be associated with adverse neonatal outcomes, including respiratory morbidity, low Apgar score, hypoglycaemia, birth trauma and NICU admission [13]. In the present study, the absence of statistical significance may be due to the relatively small number of adverse neonatal events. However, the observed trend remains clinically relevant because obese women had the highest NICU admission rate. At the same time, underweight women also had a comparatively higher NICU admission rate, possibly due to the greater frequency of low-birth-weight neonates in this group.

The findings of the present study have important clinical implications. BMI assessment is simple, inexpensive and feasible during routine antenatal care. Early identification of women with underweight, overweight or obesity can help in nutritional counselling, monitoring of gestational weight gain, screening for associated complications and individualized intrapartum planning. Women with obesity may require closer monitoring during induction and labour because of the higher probability of caesarean section. Similarly, underweight women require nutritional assessment and fetal growth surveillance because of the increased risk of low birth weight.

The study has certain limitations. It was conducted at a single centre with a modest sample size, which may limit the generalizability of the findings. Pre-pregnancy or early booking BMI was not available for all women, and admission BMI may have been influenced by gestational weight gain. Potential confounders such as parity, previous caesarean section, gestational diabetes mellitus, hypertensive disorders, socioeconomic status and indication for induction were not adjusted through multivariable analysis. Therefore, the findings should be interpreted as associations rather than causal relationships.

Overall, the present study supports the role of maternal BMI as an important clinical marker for obstetric and perinatal risk assessment. Obesity was associated with increased induction of labour, higher caesarean section rate and increased mean birth weight, whereas underweight was associated with a higher frequency of low birth weight. Routine BMI assessment during antenatal care should therefore be used not only as a nutritional measure but also as a simple risk-stratification tool to guide antenatal counselling, labour planning, and neonatal preparedness.

Conclusion

The present study showed that maternal body mass index was significantly associated with induction of labour, mode of delivery and birth weight among term pregnant women. Higher maternal BMI was associated with increased induction of labour, higher caesarean section rate and greater mean birth weight. In contrast, underweight women had a higher frequency of low-birth-weight neonates. Although macrosomia, low 5-minute Apgar score and neonatal intensive care unit admission were numerically more frequent among obese women, these associations were not statistically significant.

These findings suggest that both low and high maternal BMI are clinically important in pregnancy. Routine BMI assessment during antenatal care may help in early risk identification, nutritional counselling, monitoring of gestational weight gain, individualized intrapartum planning and neonatal preparedness. As this was an observational study, the findings should be interpreted as associations rather than causal relationships.

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