ORIGINAL RESEARCH

Association of Maternal BMI with Fetomaternal Outcomes: A Prospective Observational Study in Jharkhand, India

[1]Lovely Kumari, [2]Shilpa Tigga, [3]Samarina Kamal, [4]Shikha Rani, [5]Shashibala Singh

[1]Senior Resident, Department of Obstetrics & Gynaecology, M.R.M.C.H., Palamu, Jharkhand, India
[2]Specialist, Department of Obstetrics &Gynaecology, Sadar Hospital, Ranchi, Jharkhand, India
[3]Assistant Professor, [4]Professor, Department of Obstetrics &Gynaecology, Mahatma Gandhi Memorial Medical College, Jamshedpur, Jharkhand, India
[5]Professor, Department of Obstetrics & Gynaecology, India

Corresponding author
Samarina Kamal
Assistant Professor, Department of Obstetrics &Gynaecology, Mahatma Gandhi Memorial Medical College, Jamshedpur, Jharkhand, India

ABSTRACT
Maternal obesity and malnutrition both impact the fetomaternal outcomes. This prospective observational study conducted at a tertiary care center in Jharkhand, India, aimed to assess fetomaternal outcomes across different BMI categories. A total of 160 primigravida women with singleton pregnancies were categorized based on WHO BMI classifications (underweight, normal weight, overweight, and obesity). Maternal and fetal data were collected, including demographic details, medical histories, mode of delivery, and neonatal outcomes. Statistical analysis of the data revealed significant associations between higher BMI categories and increased incidence of hypertensive disorders, gestational diabetes, cesarean deliveries, and neonatal complications. Also mothers with low BMI or poor nutritional status were prone to have preterm and low birthweight babies. These findings underscore the importance of BMI monitoring and management in improving maternal and fetal health outcomes. **Method:** This prospective observational study was done in Department Obstetrics and Gynaecology, Rajendra Institute of Medical Sciences,Ranchi. Written and informed consent was obtained by the women satisfying the inclusion and the exclusion criteria. Detailed history was taken and body mass index was calculated by weight in kg/height in meter square.the women were followed up during antepartum, intrapartum and postpartum period for variables neonatal outcomes were also documented. **Result:** Significant associations were observed between maternal BMI categories and various pregnancy-related conditions and outcomes. Higher BMI categories (overweight and obesity) correlated significantly with increased incidence of hypertensive disorders ($p = 0.017$), gestational diabetes ($p < 0.001$), and cesarean deliveries ($p < 0.001$). Additionally, higher BMI was associated with prolonged labor duration ($p = 0.004$) and increased incidence of severe perineal tears ($p = 0.004$). Neonatal outcomes such as macrosomia , NICU admissions, also show correlation with BMI. **Conclusion**: Maternal BMI serves as a crucial determinant of pregnancy outcomes, influencing the incidence of gestational complications and neonatal health. This study underscores the importance of BMI monitoring in prenatal care settings to improve maternal and fetal health outcomes. Future research should explore longitudinal effects and interventions targeting maternal obesity to enhance maternal healthcare strategies.
Keywords: BMI, obesity, fetomaternal outcomes, neonatal outcomes

INTRODUCTION

Obesity is a growing epidemic worldwide. It has led to rise in medical ailments like hypertension, Diabetes, arthritis, cardiovascular diseases resulting in increasing mortality and morbidity .Its effect on maternal and fetal wellbeing is also being perceived widely and various studies aimed at studying the effect of maternal nutritional status on fetal and maternal outcomes suggest a close association. India too is going through widespread socioeconomic changes which have resulted in lifestyle and dietary changes in women. Jharkhand is still among the economically poor states in India and has a burden of both malnutrition as well as growing obesity. Studies indicate that maternal obesity has strong correlation with various antenatal ,intrapartum ,and neonatal complications like gestational diabetes, hypertensive disorders, prolonged duration of labour,increased rates of ceasarean section, post partumheamorrhage , wound infections,and adverse fetal outcomes such as

macrosomia,shoulder dystocia, congenital anomalies and other neonatal complications. Where as underweight and low BMI are also linked to adverse outcomes like intrauterine growth restriction(IUGR) and preterm birth [1,2].

BMI (Body Mass Index) is a widely accepted toolto assess nutritional status,and has been recommended by organizations such as the World Health Organization (WHO) and the National Health Institute [3,4]. Its widespread acceptability makes it an ideal tool to study correlation between maternal nutrional status and fetal and maternal outcomes. BMI can be used as a standard method to categorise the pregnant women into different weight classification based on height and weight.The WHO classifies BMI into several categories based on the BMI calculation. These classifications are: Underweight: BMI less than 18.5 kg/m, Normal weight: BMI 18.5 to 24.9 kg/m², Overweight: BMI 25.0 to 29.9 kg/m², Obesity: BMI more than 30 kg/m2 [3].

According to the National Family Health Survey (NFHS-5) conducted between 2019 and 2021, obesity increased from 20.6% in 2015-2016 to 24.0% in 2019-2021, while the incidence of underweight declined marginally from 22.9% in 2015-2016 to 18.7% in 2019-2021 [7].. BMI can be used as an indicator of adiposity, helping healthcare providers assess maternal weight status and anticipate potential risks during pregnancy. Higher BMI levels, particularly in the overweight and obese category women, are associated with increased incidences of gestational diabetes, hypertension, preeclampsia, cesarean deliveries, and macrosomia (large birth weight) [8]. These conditions predispose mother and fetus to significant health risks. Maternal obesity,has been linked fetal risks like increased incidence of stillbirth, congenital anomalies, and long-term health issues in children [9].

Understanding these correlations is vital for public health initiatives which are aimed at reducing maternal and fetal morbidity and mortality. By identifying populations at higher risk based on BMI categories, healthcare providers can implement targeted interventions, such as nutritional counseling, weight management programs, and close monitoring during pregnancy [10]. Moreover, research into the BMI-fetal/maternal outcomes relationship helps to make evidence-based guidelines and recommendations for optimal maternal health practices. This evidence helps healthcare professionals make rational and valid decisions regarding patient care, thereby improving maternal and child health outcomes both during and after pregnancy [11].

It can be inferred that studying the correlation between BMI and fetomaternal outcomes provides valuable insights into the role of maternal nutritional status on pregnancy outcomes and long-term health implications for both mothers and children. This knowledge can influence clinical practice, public health strategies, and research efforts aimed at the health and well-being of mothers and their children.

The objective of this study is to study and compare the incidence of fetal and maternal complications across different BMI categories

MATERIAL AND METHODS
Study Design
This was a prospective observational study carried out at a tertiary care center in Jharkhand, India, over an 18-month period from April 2021 to September 2022. The study aimed to assess the fetomaternal outcomes in women of different BMI groups.

Study Population
The study population consisted of pregnant women who attended the antenatal clinic and were admitted for delivery at the tertiary care center.

Inclusion criteria
All primigravida women
Singleton pregnancies with cephalic pregnancy
Women aged 25-35 years
Gestational age more than 28 weeks
Pregnancy related medical complications like gestational diabetes mellitus, pregnancy induced hypertension

Exclusion criteria
Pregnancy with infertility treatment and ART technique
Pregnancies with positive genetic screening, major congenital defects
Multiple pregnancies
Pregnancies complicated by known fetal anomalies
Pregnancies with pre-existing chronic medical conditions (e.g., diabetes, hypertension)
Pregnancies with intrauterine fetal demise (IUFD)
Pregnancies with placenta previa

Sample Size
A total of 160 pregnant women were enrolled in the study. They were categorized into three groups based on their BMI according to the WHO classification:
Underweight: BMI less than 18.5 kg/m²
Normal weight: BMI 18.5 to 24.9 kg/m²
Overweight: BMI 25.0 to 29.9 kg/m²
Obesity: BMI more than 30 kg/m2

Data Collection
Maternal Data
Maternal data were gathered through structured interviews and medical record reviews. The following information was recorded:
Demographic details (age, parity, socioeconomic status)
weight and height (used to calculate BMI)
Medical and obstetric history
Gestational age at delivery
Mode of delivery (vaginal, cesarean section)

Complications like 3rd and 4th degree perineal tear
Puerperal sepsis
Post operative complications like infection

Fetal Data
Fetal data were collected from medical records and included:
Birth weight
Apgar scores at 1 and 5 minutes
Neonatal complications (e.g., respiratory distress, hypoglycemia)
Admission to neonatal intensive care unit (NICU)
Maternal Outcomes
The study examined various maternal outcomes, including:
Gestational diabetes
Hypertensive disorders of pregnancy (gestational hypertension, preeclampsia)
Mode of delivery
Postpartum hemorrhage
Fetal Outcomes
The study examined various fetal outcomes, including:

Birth weight (macrosomia, low birth weight)
Preterm birth (delivery before 37 weeks of gestation)
Neonatal complications
NICU admission

Data Analysis
Data were analyzed using statistical software (e.g., SPSS). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize the data. Comparative analysis between the different BMI groups was performed using chi-square tests for categorical variables and t-tests or ANOVA for continuous variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations
The study was approved by the Institutional Ethics Committee of the tertiary care center. Informed consent was obtained from all participants before enrollment. Confidentiality and privacy of the participants were maintained throughout the study.

RESULTS
Table 1 Association of BMI with maternal complications:

BMI/complications	Hypertensive Disorders (%)	Gestational Diabetes (GDM) (%)	Mode of Delivery (CS/FD/VD) (%)	Duration of Labour <18 Hours (%)	3rd or 4th Degree Perineal Tear (%)	PPH(%)
<18.5	0 (0.0%)	0 (0.0%)	0/0/12 (0.0/0.0/12.9)	12 (12.9%)	0 (0.0%)	0 (0.0%)
18.5-22.9	12 (41.4%)	0 (0.0%)	32/0/46 (41.0/0.0/49.5)	46 (49.5%)	0 (0.0%)	5(38.5%)
23.0-24.9	6 (20.7%)	3 (37.5%)	23/0/24 (29.5/0.0/25.8)	24 (25.8%)	0 (0.0%)	0(0.0%)
25.0-29.9	11 (37.9%)	2 (25.0%)	17/3/11 (21.8/100.0/11.8)	11 (11.8%)	3 (100.0%)	3 (100.0%)
30.0-34.9	0 (0.0%)	3 (37.5%)	6/0/0 (7.7/0.0/0.0)	0 (0.0%)	N/A	0 (0.0%)
Total	29 (100%)	8 (100%)	78/3/93 (100.0/100.0/100.0)	93 (100%)	3 (100%)	3 (100%)
Chi square	12.110	33.119	34.854	18.138	18.138	20.451
P Value	0.017	<0.001	<0.001	0.004	0.004	0.002

Hypertensive Disorders:The occurrence of hypertensive disorders is notably higher in the 18.5-22.9 Kg/m² and 25.0-29.9 Kg/m² BMI categories, with rates of 41.4% and 37.9%, respectively. There were no cases reported in the <18.5 Kg/m² and 30.0-34.9 Kg/m² categories.

Gestational Diabetes (GDM): In present study higher BMI categories (23.0-24.9 Kg/m² and 30.0-34.9 Kg/m²) had a significantly higher prevalence of GDM compared to lower BMI categories (p<0.001). This indicates that women with higher BMI are at a greater risk for developing gestational diabetes, which

can have serious implications for both maternal and fetal health.

Mode of Delivery: In the present study higher BMI categories were associated with more Cesarean sections (CS) and forceps deliveries (FD). Women with higher BMI (25.0-29.9 Kg/m²) were more likely to require surgical or assisted deliveries compared to those with lower BMI, who had a higher prevalence of vaginal deliveries (VD). This may reflect increased complications during labor in women with higher BMI.

Duration of Labour<18 Hours: The association between BMI labour duration (<18 hours) is significant (p=0.004). Higher BMI categories (18.5-22.9 Kg/m² and 23.0-24.9 Kg/m²) had a higher prevalence of shorter labor durations. This finding suggests that moderate BMI categories might experience more efficient labor compared to lower or higher BMI groups.

3rd or 4th Degree Perineal Tear: Women in the 25.0-29.9 Kg/m² BMI category showed a significantly higher prevalence of severe perineal tears compared to other BMI categories (p=0.004). This suggests that higher BMI may increase the risk of significant perineal trauma during delivery.

Puerperal Sepsis & Febrile Illness: There is a significant association between higher BMI and puerperal sepsis and febrile illness (p=0.025). Women with higher BMI (25.0-29.9 Kg/m²) showed a higher prevalence of these conditions, indicating that obesity may increase the risk of postpartum infections and complications.

Postpartum Hemorrhage (PPH): Only 3 women had PPH but they all belonged there wasHigher prevalence in the 25.0-29.9 Kg/m² group (61.5%), significant association ($\chi^2 = 20.451$, p=0.002).

Table2: association of maternal BMI with fetal complications

Outcome / BMI Category	<18.5 Kg/m2	18.5-22.9 Kg/m2	23.0-24.9 Kg/m2	25.0-29.9 Kg/m2	30.0-34.9 Kg/m2	Total
IUFD & Still Birth (Yes)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (9.7%)	0 (0.0%)	3 (1.7%)
IUFD & Still Birth (No)	12 (100%)	78 (100%)	47 (100%)	28 (90.3%)	6 (100%)	171 (98.3%)
Pre-Term Labour (Yes)	3 (21.4%)	8 (57.1%)	0 (0.0%)	3 (21.4%)	0 (0.0%)	14 (100%)
Pre-Term Labour (No)	9 (5.7%)	70 (44.6%)	47 (29.9%)	25 (15.9%)	6 (3.8%)	157 (100%)
Macrosomia (Yes)	0 (0.0%)	0 (0.0%)	5 (62.5%)	3 (100%)	0 (0.0%)	8 (100%)
Macrosomia (No)	12 (7.1%)	78 (46.4%)	42 (25.8%)	25 (14.9%)	6 (3.6%)	163 (100%)
SNCU Admission (Yes)	0 (0.0%)	0 (0.0%)	5 (62.5%)	0 (0.0%)	3 (37.5%)	8 (100%)
SNCU Admission (No)	12 (7.4%)	78 (47.9%)	42 (25.8%)	28 (17.2%)	3 (1.8%)	163 (100%)
LBW (Yes)	5 (62.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (100%)
LBW (No)	7 (4.3%)	75 (46.0%)	47 (28.8%)	28 (17.2%)	6 (3.7%)	163 (100%)

Chi-Square Test Results
Pre-Term Labour: $\chi^2 = 9.921$, P = 0.022
Macrosomia: $\chi^2 = 15.595$, P = 0.019
SNCU Admission: $\chi^2 = 37.171$, P < 0.001
LBW: $\chi^2 = 40.912$, P < 0.001
IUFD & Still Birth: $\chi^2 = 14.081$, P = 0.025

Pre-Term Labour: In this study there is a statistically significant association between BMI category and Pre-Term Labour ($\chi^2 = 9.921$, P = 0.022).BMI categories <18.5 Kg/m² and 18.5-22.9 Kg/m² show higher proportions of Pre-Term Labour compared to other categories.

Macrosomia: There is a statistically significant association between BMI category and Macrosomia ($\chi^2 = 15.595$, P = 0.019). BMI category 25.0-29.9 Kg/m² shows a higher likelihood of Macrosomia compared to other categories.

SNCU Admission: There is a highly significant association between BMI category and SNCU Admission ($\chi^2 = 37.171$, P < 0.001). BMI categories <18.5 Kg/m², 23.0-24.9 Kg/m², and 30.0-34.9 Kg/m² are associated with a higher likelihood of newborns being admitted to the SNCU compared to other categories.

Low Birth Weight (LBW): BMI category <18.5 Kg/m² shows a significantly higher proportion of LBW cases compared to other BMI categories (P < 0.001).This suggests that individuals with BMI <18.5 Kg/m² are more likely to have newborns classified as LBW compared to those in higher BMI categories.

IUFD & Still Birth: There is a significant association ($\chi^2 = 14.081$, P = 0.025) between BMI and IUFD & still birth, with higher rates in the 25.0-29.9 Kg/m2 category.

DISCUSSION
This study aimed to investigate the correlation between BMI and Fetomaternal outcomes among pregnant women in Jharkhand. This study reveals a correlation between fetomaternal complications and their association with different BMI categories. Higher BMI i.e.23.0-24.9 Kg/m², and 30.0-34.9 Kg/m² was found to be associated with increased risk of gestational diabetes, hypertensive disorders, ceasarean section , Post partum heamorrhage,wound

infection, prolonged labour fetal macrosomia , intrauterine fetal demise, increased admission in SNCU where as low BMI <18.5 Kg/m² was associated with low birth weight and preterm labour. The findings of this study are consistent with the prior studies and adds to the increasing evidencewhich suggest close association of maternal nutritional status with the fetomaternal outcomes.

In this study GDM was reported only among women with BMI >23.0kg/m² where as no cases were reported among women with low or normal BMI this suggestes that overweight and obese women are more likely to develop insulin resistance. This study finds a comparativel higher incidence of hypertensive disorders among the occurrence of hypertensive disorders is notably higher in the 18.5-22.9 Kg/m² and 25.0-29.9 Kg/m² BMI categories, with rates of 41.4% and 37.9%, respectively. There were no cases reported in the <18.5 Kg/m² and 30.0-34.9 Kg/m² categories. this may be because prevelance of anemia very high among women in Jharkhand. According to NFHS-5 65.3% of women aged 15-49 years in Jharkhand are anemic.

Implications of this study will help in planning inteventions for reducing maternal and fetal mortality and morbidity in Jharkhand through improving the nutritional status of women . regular health monitoring , nutritional counseling and timely interventions will reduce the risk of pregnancy complications.

The strength of our study is it prospective design but being a single centric study in Jharkhand itsfindings may have limited generalizability to the broader population of Jharkhand.

CONCLUSION

A multifaceted approach of preconceptional counseling, regular antenatal monitoring, nutritional supplementation and community based programs focused on nutritional education will definitely help improve fetomaternal outcomes. Specially in Jharkhand which has very high prevelance and of malnutrition in rural areas and rising obesity in urban areas.

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