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Original Research Article

The impact of obesity on maternal and fetal outcome

Mansi Tuteja*, Chandrakala S. Patil

Department of Obstetrics and Gynecology, Maharashtra Institute of Medical Sciences & Research (MIT), Latur, Maharashtra, India

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***Correspondence:**
Dr. Mansi Tuteja,
E-mail: mansi.tuteja@gmail.com

ABSTRACT

Background: Maternal obesity has emerged as a major global health concern, exerting profound effects on pregnancy and long-term offspring health. The obesogenic intrauterine environment influences fetal growth, metabolic regulation, and developmental programming, thereby increasing the risk of adverse maternal and neonatal outcomes. This study aimed to investigate the influence of maternal obesity on maternal and fetal outcomes during pregnancy.
Methods: A case-control study was conducted in the Department of Obstetrics and Gynecology of a tertiary care centre from July 2023 to December 2024. A total of 72 pregnant women were enrolled, comprising 36 obese (BMI ≥30 kg/m²) and 36 non-obese women with singleton pregnancies. Data were collected using a structured proforma covering sociodemographic characteristics, obstetric history, laboratory parameters, antenatal sonography, maternal complications, and neonatal outcomes. Statistical analysis was performed using SPSS 24.0; Chi-square and t-tests were applied with a significance level of $p<0.05$.
Results: Obese women demonstrated higher pre-pregnancy weight and BMI, with comorbidities reported more frequently. LSCS rates were high in both groups, with a greater proportion among obese women (94.44%). Neonates of obese mothers showed significantly higher birth weights ($p<0.001$), wider variation in neonatal RBS ($p=0.0045$), and more USG abnormalities ($p=0.0016$). Fetal complications including jaundice, hypoglycemia, macrosomia, and congenital defects were observed exclusively in the obese group.
Conclusions: Maternal obesity is associated with significant adverse fetal and neonatal outcomes, particularly increased birth weight, metabolic instability, and abnormal antenatal imaging. Strengthening preconception counseling, weight optimization, and close antenatal surveillance is essential to mitigate obesity-related pregnancy risks.

Keywords: Birth weight, Fetal outcomes, Gestational weight gain, Macrosomia, Maternal obesity, Neonatal complications, Pregnancy outcomes

INTRODUCTION

The rising global prevalence of obesity represents one of the most significant public health challenges of the 21st century. While its implications for non-communicable diseases are well established, increasing attention is being directed toward its impact during pregnancy, where maternal metabolic status influences not only obstetric outcomes but also long-term offspring health. Maternal obesity is now recognized as a critical determinant of developmental programming, with emerging evidence suggesting that the intrauterine metabolic milieu plays a pivotal role in shaping fetal susceptibility to chronic metabolic disorders.[1,2]

The prevalence of maternal obesity is a significant public health concern worldwide, with estimates indicating that over 50% of pregnancies in developed countries are in women who are overweight or have obesity.[3] This reflects a broader global trend, as the proportion of adult women

with overweight increased from 29.8% in 1980 to 38.0% in 2013, a trend observed across both high-income and middle-income nations.[4] Approximately 40% of women also commence pregnancy already overweight or obese.[5] According to GBD 2022 estimates, the global prevalence of overweight and obesity among women of reproductive age now exceeds one-third of the population, highlighting the rapid escalation of maternal adiposity over recent decades.[6] In India, obesity has emerged as a particularly significant public health concern among ever-married women of reproductive age, with projections indicating a two-thirds increase in the prevalence of overweight and obesity in South and Southeast Asia by 2030.[7,8] This escalating trend has serious implications for both maternal and fetal health, extending from immediate pregnancy complications to long-term health trajectories for the offspring.[9-11]

Maternal obesity fosters an "obesogenic" or "metabolically imbalanced" intrauterine environment, characterized by altered levels of metabolic substrates, hormones, and inflammatory signals that directly impact fetal development. This complex influence primarily involves developmental programming, where the prenatal environment can predispose offspring to adult-onset metabolic syndromes like obesity, high blood pressure, dyslipidemia, insulin resistance, and diabetes.[12-14] Furthermore, maternal obesity induces epigenetic modifications changes in gene expression without altering the DNA sequence that have long-term metabolic consequences for the offspring, affecting critical processes such as gamete formation, placentation, adipogenesis, and the development of brain appetite control circuits.[14,15] Finally, placental dysfunction, as the placenta mediates the maternal environment's impact on fetal development, is observed, with maternal obesity leading to various placental defects that compromise the maternal-fetal axis through effects on lipid and glucose metabolism, stress response, inflammation, immune regulation, and epigenetics.[16,17]

The adverse outcomes associated with maternal obesity are extensive, impacting both the mother and the developing fetus. For the mother, risks include gestational diabetes mellitus, hypertensive disorders of pregnancy, higher rates of cesarean section, and postpartum hemorrhage.[9] Fetal and offspring complications encompass an increased risk of being large-for-gestational-age, higher susceptibility to childhood obesity and metabolic syndrome, elevated risk of cardiovascular disease and type 2 diabetes later in life, and neurological morbidities such as altered brain pathology and suspected sepsis in newborns.[18-20] Despite significant mechanistic insights from animal models regarding developmental features and associated epigenetic changes, clinical demonstration in humans remains an active area of research. Unanswered questions persist regarding the precise causal mechanisms and the full magnitude of effects produced by fetal exposure to an obesogenic environment.[21]

This study aimed to investigate the influence of obesity on maternal and fetal outcomes during pregnancy.

METHODS

The present study was conducted in the Department of Obstetrics and Gynecology of a tertiary care centre, which functions as a referral hospital providing comprehensive antenatal, intrapartum and newborn care. This research followed a case-control study design and was carried out over a duration of two years (1st July 2023 to 31st December 2024). The study population consisted of pregnant women with singleton gestations attending the antenatal clinic or admitted for delivery. Women meeting the inclusion criteria singleton pregnancy, willingness to participate, and a pre-pregnancy BMI ≥30 kg/m² for the obese group were enrolled after informed consent. The exclusion criteria included maternal age >45 years, multiple gestation, fetal malpresentation, pre-existing cardiac disease, severe anemia (Hb <6 g/dL), antepartum eclampsia, hemorrhage, cephalopelvic disproportion, epidural analgesia, and refusal to provide consent. A sampling method of consecutive sampling was used, enrolling eligible women until the calculated sample size was reached. The sample size, calculated using Lwanga and Lameshow (WHO, 1991) formula based on maternal complication proportions (33.3% vs 72.7%) at 99% confidence and 80% power, was 72 participants, divided equally into 36 obese and 36 non-obese women. A structured study tool (pre-tested proforma) was used to collect information on demographics, obstetric history, anthropometry, laboratory values, maternal complications, and neonatal outcomes.

Data collection followed a systematic protocol where each participant underwent a detailed history-taking, physical examination, BMI assessment, and relevant laboratory investigations such as hemoglobin, thyroid profile, and random blood sugar. Ultrasound findings, maternal outcomes (GDM, hypertension, operative delivery), fetal outcomes (birth weight, APGAR scores, NICU admission), and pregnancy complications were recorded in the master chart. Ethical considerations were strictly observed, with prior approval obtained from the Institutional Ethics Committee and written informed consent secured from all participants. All patient data were kept confidential. Operational definitions, including obesity classification (BMI ≥30 kg/m²), macrosomia (>4 kg), gestational diabetes, hypertensive disorders, and adverse neonatal outcomes, were standardized according to WHO/ACOG guidelines.

Statistical analysis was performed using IBM SPSS 24.0. Descriptive statistics (mean, SD, percentages) summarized the data, while inferential tests Chi-square/Fisher's exact test for categorical variables and t-tests for continuous variables were applied. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 72 pregnant women were included in the study, of whom 36 were non-obese and 36 were obese. Table 1 presents the baseline characteristics of the study participants. Among non-obese women, more than half (52.78%) had a pre-pregnancy weight of 60-69 kg, followed by 30.56% in the 50-59 kg category, while only 2.78% weighed 40-49 kg. None of the non-obese women had a pre-pregnancy weight above 79 kg. In contrast, most obese women had pre-pregnancy weights of 80-89 kg (58.33%) or 70-79 kg (36.11%), with 5.56% weighing 90-99 kg. Regarding BMI distribution, 97.22% of non-obese women fell into the 21-30 kg/m² category, whereas obese women were predominantly in the 31-40 kg/m² range (91.67%), with 8.33% exceeding a BMI of 40 kg/m². A history of comorbidities was reported by 11.11% of non-obese and 22.22% of obese participants, while the majority in both groups reported no comorbid illnesses.

Table 1: Profile of study population.

Variable	Category	Non-obese (n=36) (%)	Obese (n=36) (%)
Pre-pregnancy Weight (kg)	40-49	1 (2.78)	0 (0)
	50-59	11 (30.56)	0 (0)
	60-69	19 (52.78)	0 (0)
	70-79	5 (13.89)	13 (36.11)
	80-89	0 (0)	21 (58.33)
	90-99	0 (0)	2 (5.56)
BMI Category	≤20	1 (2.78)	0 (0)
	21-30	35 (97.22)	0 (0)
	31-40	0 (0)	33 (91.67)
	>40	0 (0)	3 (8.33)
History of comorbidities	Yes	4 (11.11)	8 (22.22)
	No	32 (88.89)	28 (77.78)

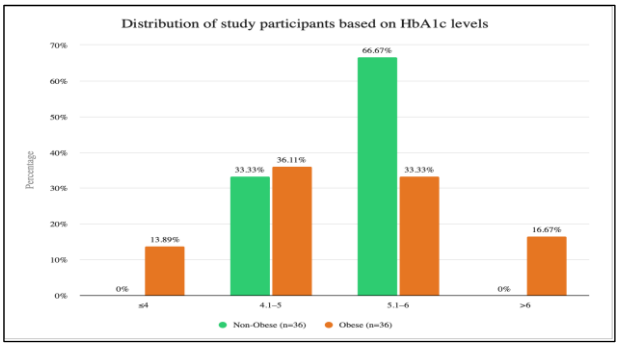

Figure 1: Distribution of study participants based on HbA1c levels.

Figures 1 and 2 illustrate the distribution of HbA1c levels and weight gain during pregnancy among the two groups. HbA1c values of 5.1-6 were more frequently observed in the non-obese group, whereas the obese group showed a wider distribution across categories including ≤4 and >6. Weight-gain patterns differed between the groups, with half of the non-obese women gaining 12.6-15 kg, while over half of the obese women gained 10-12.5 kg during pregnancy.

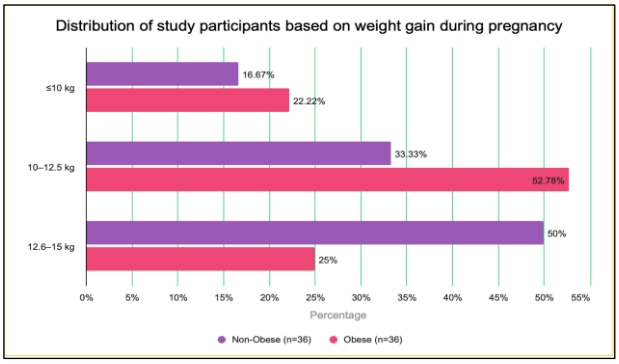

Figure 2: Distribution of study participants based on weight during pregnancy.

Table 2: Association between maternal outcome and obesity status.

Maternal outcome variable	Category	Non-obese (n=36) (%)	Obese (n=36) (%)	Chi-square	P value
Mode of delivery	LSCS	30 (83.33)	34 (94.44)	1.27	0.261
	FTND	6 (16.67)	2 (5.56)		
Maternal complications	None	27 (75)	30 (83.33)	0.8	0.67
	Gestational hypertension	4 (11.11)	3 (8.33)		
	Gestational diabetes	5 (13.89)	3 (8.33)		

Table 2 summarizes the maternal outcomes. Among non-obese women, 83.33% delivered by LSCS and 16.67% had a full-term normal delivery, whereas 94.44% of obese women underwent LSCS and 5.56% delivered vaginally. Most women in both categories had no maternal complications, with 75% in the non-obese group and 83.33% in the obese group. Gestational hypertension occurred in 11.11% of non-obese and 8.33% of obese participants, while gestational diabetes was observed in 13.89% of non-obese and 8.33% of obese women. Table 3 outlines the fetal and neonatal outcomes. All non-obese women had live births, while 97.22% of obese women had live births and one (2.78%) had an intrauterine death. Birth-weight distribution differed between groups, with 30.56% of neonates in the non-obese group weighing ≤2

kg and 55.56% in the obese group weighing more than 3 kg. APGAR scores were similarly distributed between groups, with most neonates scoring 6, 7, or 8 at birth. Fetal complications occurred only in the obese group and included jaundice, neonatal hypoglycemia, macrosomia, and congenital heart defects. Neonatal random blood sugar showed wider variation in infants born to obese women, with values ranging from ≤50 to >80 mg/dL. Significant USG or anomaly scan findings, including polyhydramnios and abnormal Doppler indices, were also noted more frequently in the obese group.

Table 3: Association between fetal outcome and obesity status.

Variable	Category	Non-obese (n=36) (%)	Obese (n=36) (%)	Chi-square	P value
Fetal outcome	Live birth	36 (100)	35 (97.22)	1.01	0.313
	IUD	0 (0)	1 (2.78)		
Birth weight (kg)	≤2	11 (30.56)	0 (0)	18.8	<0.001
	2.1-3	19 (52.78)	16 (44.44)		
	>3	6 (16.67)	20 (55.56)		
APGAR score	0	0 (0)	1 (2.78)	3.24	0.356
	6	12 (33.33)	16 (44.44)		
	7	14 (38.89)	14 (38.89)		
	8	10 (27.78)	5 (13.89)		
Fetal complications	None	36 (100)	29 (80.56)	7.75	0.101
	Jaundice	0 (0)	3 (8.33)		
	Neonatal hypoglycemia	0 (0)	2 (5.56)		
	Macrosomia	0 (0)	1 (2.78)		
	Congenital heart defect	0 (0)	1 (2.78)		
Neonatal RBS (mg/dL)	≤50	0 (0)	3 (8.33)	15.1	0.0045
	51-60	0 (0)	7 (19.44)		
	61-70	8 (22.22)	9 (25)		
	71-80	15 (41.67)	5 (13.89)		
	>80	13 (36.11)	12 (33.33)		
USG/anomaly scan findings	Normal	32 (88.89)	23 (63.89)	15.27	0.0016
	Polyhydramnios	0 (0)	8 (22.22)		
	Doppler-UPI abnormal	0 (0)	4 (11.11)		
	Other doppler abnormalities	4 (11.11)	1 (2.78)		

DISCUSSION

The current study aimed to investigate the influence of obesity on maternal and fetal outcomes during pregnancy. The current study findings reveal several significant associations between maternal obesity and adverse maternal and neonatal health indicators, which align with both established literature and, in some aspects, present nuances warranting further discussion.

The present study observed a higher incidence of pre-pregnancy obesity, with the majority of obese women having pre-pregnancy weights of 70-99 kg and BMI predominantly in the 31-40 kg/m² range, with 8.33% exceeding 40 kg/m². This high prevalence of obesity among pregnant women is consistent with global trends, where over 50% of pregnancies in developed countries involve overweight or obese women[3], and the proportion of adult women with overweight increased significantly between 1980 and 2013.[4] The observed higher rate of comorbidities (22.22%) in obese participants compared to non-obese (11.11%) also aligns with the understanding that obesity is often associated with a greater burden of health issues.[9]

Regarding maternal outcomes, the present study found a notably high rate of lower segment cesarean section in both groups, with 94.44% of obese women and 83.33% of non-obese women undergoing LSCS. While the obese group had a higher LSCS rate, the overall high percentage in both categories suggests other contributing factors within the tertiary care setting where the study was conducted. However, the higher proportion in obese women is consistent with extensive research indicating that maternal obesity is a significant risk factor for operative deliveries, including LSCS.[9] We found that excessive weight in pregnancy, characterized by dysregulation of adipokines, partly explains the predisposition of pregnant women with obesity to these maternal obstetric complications.[22]

Interestingly, the present study reported relatively low rates of gestational hypertension (11.11% in non-obese, 8.33% in obese) and gestational diabetes (13.89% in non-obese, 8.33% in obese). These figures for gestational hypertension and gestational diabetes, particularly in the obese group, are lower than the widely reported increased risk associated with maternal obesity in other studies. For instance, global reviews indicate that maternal obesity significantly increases the risk of gestational diabetes

mellitus and hypertensive disorders of pregnancy.[9,23] Some studies link pre-pregnancy obesity to increased risk of gestational hypertension, with potential mechanisms involving estrogen accumulation, effects on the renin-angiotensin system, and abnormal lipid metabolism.[24] The discrepancy in The present study might be attributed to the relatively small sample size, specific demographic characteristics of the study population, or perhaps variations in diagnostic criteria. Many studies suggest that the prevalence of gestational diabetes in obese women can be considerably higher, reflecting a strong association.[25]

The fetal and neonatal outcomes in the present study revealed critical insights. We reported one intrauterine death (2.78%) in the obese group, which is a severe adverse outcome known to be associated with maternal obesity.[9] Research indicates that maternal obesity increases the risk of stillbirth, and this risk is likely multifactorial, persisting even after controlling for factors like diabetes and pre-eclampsia.[26] Some findings suggest that maternal obesity contributes to placental insufficiency and chronic hypoxia, leading to fetal demise.[20]

A significant finding was the altered birth-weight distribution: 55.56% of neonates born to obese mothers weighed more than 3 kg, indicative of macrosomia, while 30.56% of neonates in the non-obese group weighed ≤ 2 kg. This strong association between maternal obesity and increased birth weight (macrosomia) is well-established in the literature. Studies consistently show that obese mothers are more at risk of having macrosomic babies, with some reporting a 2-3 times higher incidence.[27] This excessive fetal growth can occur if maternal hyperglycemia, hyperinsulinemia, or dyslipidemia exceed the placenta's adaptive capacity.[19] Moreover, a clear causal relationship between maternal high pre-pregnancy BMI and increased birth weight has been established, with maintaining a healthy pre-pregnancy BMI significantly reducing the risk of macrosomia.[28]

Furthermore, fetal complications such as jaundice, neonatal hypoglycemia, macrosomia, and congenital heart defects were exclusively observed in the offspring of obese mothers. These findings are highly consistent with numerous studies. Neonatal complications such as increased birth weight, respiratory distress, and hypoglycemia are frequently observed in infants born to obese mothers.[29] Maternal obesity and excessive weight gain are associated with an increased likelihood of macrosomia, congenital malformations, low Apgar scores, and hypoglycemia.[30] Maternal obesity also increases the risk of neonatal morbidity, including suspected sepsis, even in the absence of hypertension or diabetes.[20] The presence of congenital heart defects in the obese group aligns with epidemiological reviews linking maternal obesity to various congenital malformations, including heart defects.[31-33] These defects are thought to be influenced by the interaction between maternal metabolism and fetal development, particularly during the critical period of cardiac formation.[32]

The wider variation in neonatal random blood sugar and the more frequent observation of significant USG findings (polyhydramnios, abnormal Doppler indices) in the obese group further underscore the compromised intrauterine environment and subsequent metabolic dysregulation in offspring of obese mothers. Polyhydramnios and abnormal Doppler indices are often associated with gestational diabetes and altered placental function, both of which are known to be impacted by maternal obesity.[9,16] The current study findings collectively support the overarching concept of developmental programming, where the maternal obesogenic environment profoundly shapes the fetal blueprint for health, increasing the offspring's susceptibility to metabolic and other chronic diseases later in life.[10,11,13] The observed disparities in birth weight, metabolic complications, and congenital anomalies between the two groups highlight the critical need for targeted interventions to manage maternal obesity both pre-conception and during pregnancy to mitigate these adverse outcomes.

CONCLUSION

The present study examined the impact of maternal obesity on maternal and fetal outcomes among pregnant women attending a tertiary care centre. The findings demonstrate that obesity during pregnancy is associated with significant alterations in maternal and neonatal profiles, particularly in terms of birth weight, neonatal metabolic indicators, and antenatal sonographic abnormalities. Obese pregnant women exhibited a higher proportion of neonates with birth weight greater than 3 kg, a wider distribution of neonatal blood glucose levels, and an exclusive occurrence of fetal complications such as jaundice, hypoglycemia, macrosomia, and congenital heart defects. Significant ultrasound and Doppler-related abnormalities were also observed more frequently in the obese group, suggesting a greater burden of antenatal and intrapartum challenges. Although the rates of gestational hypertension and gestational diabetes in this study were not markedly different between the two groups, the overall pattern of findings reinforces the substantial influence of maternal adiposity on perinatal outcomes. These results highlight the need for heightened clinical vigilance, targeted counseling, and structured antenatal monitoring among obese pregnant women. Strategies such as preconception weight optimization, personalized nutritional guidance, and close fetal surveillance may help mitigate the adverse effects of maternal obesity. The study underscores the importance of integrating obesity screening and early intervention into routine obstetric care to improve both maternal and fetal health trajectories.

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