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Original Research Article

MATERNAL AND NEONATAL OUTCOMES ASSOCIATED WITH OBESITY IN PREGNANCY: A PROSPECTIVE OBSERVATIONAL COMPARATIVE STUDY

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ABSTRACT

Background: Maternal obesity is increasingly recognized as an important risk factor for adverse pregnancy outcomes. It may contribute to hypertensive disorders, gestational diabetes, operative delivery, postpartum morbidity and adverse neonatal outcomes. **Aim:** To compare maternal and neonatal outcomes among pregnant women with obesity and women with normal BMI.

Materials and Methods: A prospective observational comparative study was conducted over 18 months in the Department of Obstetrics and Gynaecology at Kanyakumari Government Medical College Hospital. A total of 100 antenatal women were studied, comprising 50 women with normal BMI (18.5–24.9 kg/m²) and 50 women with BMI >30 kg/m² in the first trimester. Participants were followed through the antenatal period, delivery and postpartum period until discharge. Maternal outcomes included hypertensive disorders, gestational diabetes, induction of labour, mode of delivery and postpartum complications. Neonatal outcomes included gestational age, birth weight, 5-minute Apgar score and NICU admission. Statistical analysis was performed using chi-square and Student's t-test, with $p<0.05$ considered significant.

Results: Obese women had significantly higher maternal age and greater maternal comorbidity. Gestational hypertension occurred in 38% of obese women versus 12% of women with normal BMI, while pre-eclampsia occurred in 14% versus 0%, respectively. Caesarean delivery was significantly higher among obese women (68% vs 38%; $p=0.001$). Mean hospital stay was longer in the obese group (8.4 vs 4.2 days; $p<0.001$). NICU admission was significantly higher among neonates of obese mothers (42% vs 14%; $p=0.004$). Birth weight and 5-minute Apgar score did not differ significantly.

Conclusion: Maternal obesity was associated with increased maternal morbidity, caesarean delivery, prolonged hospital stay and neonatal NICU admission.

Keywords: Maternal obesity; pregnancy; body mass index; gestational hypertension; pre-eclampsia; caesarean delivery; neonatal outcome; NICU.

INTRODUCTION

Obesity is a chronic, multifactorial disease characterized by excessive adiposity and is an increasingly important public health problem among women of reproductive age. In adults, the World Health Organization (WHO) defines obesity as a body mass index (BMI) ≥30 kg/m², with BMI calculated as weight in kilograms divided by height in metres squared.[1] Pregnancy in women with obesity is clinically important because excess maternal adiposity may influence glucose metabolism, vascular function, inflammatory pathways and obstetric management, thereby

increasing the risk of adverse maternal and neonatal outcomes. Large observational studies have demonstrated a progressive relationship between increasing maternal BMI and complications such as hypertensive disorders, preterm birth and adverse perinatal outcomes.[2]

Maternal obesity has been associated with an increased incidence of gestational diabetes mellitus (GDM), gestational hypertension and pre-eclampsia. It is also associated with increased rates of induction of labour and caesarean delivery, as well as postpartum haemorrhage and postoperative complications.[3,4] The mechanisms are likely multifactorial and include insulin resistance, chronic low-grade inflammation, endothelial dysfunction and altered placental physiology. Obesity may also complicate intrapartum care because of increased anaesthetic and surgical risks and may contribute to prolonged hospitalisation.[3]

The global burden of obesity has increased substantially over recent decades. In 2022, approximately 16% of adults worldwide were living with obesity, with the prevalence having more than doubled since 1990.[1] This increasing burden is particularly relevant to obstetric practice because a greater proportion of women now enter pregnancy with overweight or obesity. In India, nationally representative data have demonstrated a substantial burden of overweight and obesity among pregnant and postpartum women, with considerable geographical variation across the country.[5] A prospective population-based study from rural India and Pakistan further demonstrated that increasing BMI in early pregnancy was associated with progressively greater risks of adverse maternal and perinatal outcomes, including hypertensive disorders and operative delivery.[6]

Evidence from large systematic reviews and meta-analyses consistently supports the association between maternal obesity and adverse pregnancy outcomes. A meta-analysis involving more than 20 million pregnancies found increased odds of gestational diabetes, gestational hypertension, pre-eclampsia, caesarean delivery, induction of labour, postpartum haemorrhage and neonatal intensive care unit (NICU) admission among women with higher BMI[4]. Similarly, a systematic review of reviews reported increased risks of GDM, hypertensive disorders, caesarean birth, surgical-site infection, preterm birth and other adverse maternal and neonatal outcomes among women with obesity.[3]

Despite increasing recognition of obesity as an important obstetric risk factor, its clinical impact may vary according to population characteristics, BMI distribution, antenatal care practices and available healthcare resources. Indian data, particularly from individual tertiary-care settings, remain important for identifying the pattern of maternal and neonatal morbidity associated with obesity in local obstetric populations. Furthermore, obesity may influence outcomes across several stages of pregnancy, from antenatal complications to mode of delivery, postoperative morbidity and neonatal care requirements.

Therefore, the present prospective observational comparative study was undertaken to evaluate maternal and neonatal outcomes among pregnant women with obesity compared with women with normal BMI. The study specifically assessed antenatal complications, intrapartum and postpartum outcomes, mode of delivery, postoperative morbidity, duration of hospital stay and neonatal outcomes including gestational age, birth weight, Apgar score and NICU admission. The findings may help strengthen risk assessment and facilitate appropriate antenatal surveillance and intrapartum planning for pregnant women with obesity.

Aim

To compare maternal and neonatal outcomes among pregnant women with obesity (first-trimester BMI ≥30 kg/m²) and women with normal BMI (18.5–24.9 kg/m²).

Objectives

1. **To compare the antepartum complications** among pregnant women with obesity and those with normal BMI, particularly gestational hypertension, pre-eclampsia and gestational diabetes mellitus.
2. **To compare intrapartum and postpartum outcomes** between obese and normal-BMI pregnant women, including induction of labour, mode of delivery, cesarean delivery, postoperative complications and duration of hospital stay.
3. **To evaluate and compare neonatal outcomes** between the two groups, including gestational age at birth, birth weight, 5-minute Apgar score and NICU admission.

MATERIALS AND METHODS

Study Design and Setting

This was a **prospective observational comparative study** conducted in the Department of Obstetrics and Gynaecology, Kanyakumari Government Medical College Hospital. The study was conducted over a period of **18 months**.

Study Population and Sample Size

The study included a total of **100 antenatal women**, who were followed prospectively during pregnancy, delivery, and the postpartum period until discharge from the hospital.

Participants were divided into two groups according to their body mass index (BMI) measured during the first trimester:

- **Normal-BMI group:** 50 women with BMI 18.5–24.9 kg/m².
- **Obese group:** 50 women with BMI >30 kg/m².

The study therefore compared maternal and neonatal outcomes between women with normal BMI and women with obesity.

Eligibility Criteria

Inclusion Criteria

Women were eligible for inclusion if they fulfilled the following criteria:

1. First-trimester BMI >30 kg/m² for inclusion in the obese group.
2. First-trimester BMI within the normal range for inclusion in the control group.
3. Women were included irrespective of age, parity, and socioeconomic status.

Exclusion Criteria

Women were excluded from the study if they had:

1. Not been booked during the first trimester.
2. Miscarriage during the course of pregnancy.
3. Anomalous fetus/baby.
4. BMI in the overweight range (25.1–29.9 kg/m²).
5. BMI <18.5 kg/m².

Assessment of Body Mass Index

Height and weight were recorded during the first trimester. BMI was calculated from the recorded height and weight and expressed in kg/m². Participants were categorized into the normal-BMI and obese groups according to the predefined BMI categories used in the study.

The mean BMI was **22.6 ± 1.83 kg/m²** in the normal-BMI group and **34.7 ± 3.80 kg/m²** in the obese group.

Data Collection and Follow-up

After enrolment, participants were followed prospectively throughout the antenatal period, during labour and delivery, and during the postpartum period until discharge.

Relevant demographic and obstetric information was recorded. These included maternal age, obstetric status, height, weight, BMI, gestational age, associated medical conditions, antenatal complications, mode of delivery, intrapartum complications, postpartum complications, and duration of hospital stay.

The antenatal period was assessed for the development or presence of:

- Gestational diabetes mellitus (GDM)
- Gestational hypertension
- Pre-eclampsia
- Other hypertensive disorders and associated maternal comorbidities
- Malpresentation
- Indication for labour induction

Intrapartum Assessment

During labour and delivery, participants were assessed for:

- Induction of labour and indication for induction
- Mode of delivery
- Vaginal delivery
- Elective cesarean delivery
- Emergency cesarean delivery
- Shoulder dystocia
- Instrumental delivery
- Other relevant intrapartum complications

The indications for operative delivery were also recorded where applicable.

Postpartum Assessment

Following delivery, mothers were monitored until hospital discharge for postpartum and postoperative complications. The following outcomes were assessed:

- Postpartum haemorrhage
- Deep vein thrombosis
- Postoperative wound infection
- Wound dehiscence
- Other post-delivery complications
- Duration of hospital stay

The duration of hospital stay was recorded in days and compared between the two BMI groups.

Neonatal Assessment

Neonatal outcomes were assessed following delivery. The parameters evaluated included:

1. Gestational age at birth.
2. Birth weight.
3. Apgar score at 5 minutes.
4. Admission to the neonatal intensive care unit (NICU).
5. Indication for NICU admission.

Birth weight was recorded in kilograms and neonatal Apgar status was assessed at 5 minutes after birth. NICU admission and the clinical indications for admission were documented and compared between the two maternal BMI groups.

Study Outcomes

The principal outcomes assessed in the study were the differences in maternal and neonatal outcomes between women with obesity and women with normal BMI.

The maternal outcomes included:

- Gestational hypertension
- Pre-eclampsia
- Gestational diabetes mellitus
- Gestational age at delivery
- Induction of labour
- Mode of delivery and cesarean delivery
- Intrapartum complications
- Postpartum complications
- Wound infection and wound dehiscence
- Postpartum haemorrhage
- Duration of hospital stay

The neonatal outcomes included:

- Gestational age at birth
- Birth weight
- 5-minute Apgar score
- NICU admission and indications for admission

Statistical Analysis

Data collected during the study were compiled and analyzed to compare outcomes between the normal-BMI and obese groups.

Categorical variables were compared using the **Chi-square test**, while continuous variables were analyzed using the **student's t-test**. Results were considered statistically significant when the **p-value was <0.05**.

The results were presented as frequencies and percentages for categorical variables and as mean ± standard deviation for continuous variables.

Ethical Considerations

The study was conducted among antenatal women attending the Department of Obstetrics and Gynaecology, Kanyakumari Government Medical College Hospital. Written informed consent was obtained from participating women for inclusion in the study and for sharing of relevant medical information for research purposes.

Participant information was collected and used for the purpose of evaluating maternal and neonatal outcomes associated with maternal BMI.

RESULTS

Table 1: Baseline characteristics of study participants according to BMI

Variable	Normal BMI (18.5–24.9 kg/m²) n=50	Obesity (BMI >30 kg/m²) n=50	p-value
Age (years), mean ± SD	23.9 ± 4.55	28.8 ± 4.84	<0.001*
Age <20 years, n (%)	10 (20.0)	1 (2.0)	
Age 21–30 years, n (%)	36 (72.0)	29 (58.0)	
Age >30 years, n (%)	4 (8.0)	20 (40.0)	
Height (cm), mean ± SD	155.8 ± 6.50	156.9 ± 6.67	0.389
Weight (kg), mean ± SD	55.5 ± 4.90	86.2 ± 13.33	<0.001*
BMI (kg/m²), mean ± SD	22.6 ± 1.83	34.7 ± 3.80	<0.001*
Obstetric status, n (%)			0.047*
Primigravida	29 (58.0)	19 (38.0)	
G2	15 (30.0)	20 (40.0)	
G3	4 (8.0)	7 (14.0)	
G4	2 (4.0)	0	
>G4	0	4 (8.0)	

A total of 100 pregnant women were included, with 50 women in each BMI group. Women with obesity were significantly older than those with normal BMI, with mean ages of 28.8 ± 4.84 and 23.9 ± 4.55 years, respectively (p<0.001). Mean weight and BMI were also significantly higher in the obese group (p<0.001 for both), whereas height did not differ significantly between groups (p=0.389). A significant association was observed between obstetric status and BMI (p=0.047).

Table 2: Antepartum maternal complications according to BMI

Maternal complication	Normal BMI n=50	Obesity n=50	p-value
Gestational hypertension	6 (12.0%)	19 (38.0%)	<0.001
Gestational diabetes mellitus on medical nutrition therapy	2 (4.0%)	4 (8.0%)	
Chronic hypertension	0	5 (10.0%)	
Overt diabetes mellitus on insulin	0	8 (16.0%)	
HELLP/severe pre-eclampsia	0	7 (14.0%)	
Other comorbidities	5 (10.0%)	0	
No reported comorbidity	32 (64.0%)	7 (14.0%)	
Any reported comorbidity	**18 (36.0%)**	**43 (86.0%)**	**<0.001**
Gestational age <32 weeks	1 (2.0%)	8 (16.0%)	<0.001
Gestational age >32 weeks	49 (98.0%)	42 (84.0%)	
Mean gestational age (weeks) ± SD	**38.3 ± 1.67**	**35.8 ± 2.77**	**<0.001**

Maternal comorbidities were significantly more frequent among women with obesity than among women with normal BMI (p<0.001). Gestational hypertension occurred in 38% of women with obesity compared with 12% in the normal-BMI group. The thesis discussion additionally reports pre-eclampsia in 14% of the obese group compared with none in the normal-BMI group, and gestational diabetes in 8% versus 4%, respectively.

The mean gestational age was significantly lower among women with obesity (35.8 ± 2.77 weeks) than among women with normal BMI (38.3 ± 1.67 weeks; p<0.001). Gestational age below 32 weeks was reported in 16% of the obese group compared with 2% of the normal-BMI group.

Table 3: Intrapartum and mode-of-delivery outcomes according to BMI

Outcome	Normal BMI n=50	Obesity n=50	p-value
Mode of delivery			**0.001***
Vaginal delivery	31 (62.0%)	16 (32.0%)	
Emergency cesarean section	18 (36.0%)	24 (48.0%)	
Elective cesarean section	1 (2.0%)	10 (20.0%)	
Total cesarean delivery	**19 (38.0%)**	**34 (68.0%)**	
Induction of labour			0.575
Yes	6 (12.0%)	9 (18.0%)	
No	44 (88.0%)	41 (82.0%)	
Indications for delivery/cesarean			**0.001***
Failed induction	5	9	
Meconium aspiration/fetal distress	4	4	

CPD	4	4	
Imminent eclampsia	1	3	
Malpresentation	2	1	
Previous LSCS	2	3	
Elective LSCS	1	10	

Cesarean delivery was significantly more frequent among women with obesity than among women with normal BMI (68% vs 38%; p=0.001). Vaginal delivery occurred in 32% of obese women compared with 62% of women with normal BMI. Although induction of labour was more frequent in the obese group (18% vs 12%), the difference was not statistically significant (p=0.575).

Table 4: Postpartum maternal outcomes according to BMI

Postpartum outcome	Normal BMI n=50	Obesity n=50	p-value
Post-delivery complication, n (%)	1 (2.0%)	11 (22.0%)	0.033
Wound infection	0–1	3	0.113
Hospital stay <7 days	41 (82.0%)	24 (48.0%)	
Hospital stay 8–14 days	4 (8.0%)	24 (48.0%)	
Hospital stay >14 days	0	1 (2.0%)	
Mean hospital stay (days) ± SD	4.2 ± 2.38	8.4 ± 3.50	<0.001
Maternal death	1 (2.0%)	2 (4.0%)	1.0

Post-delivery complications were significantly more common among women with obesity (22%) than among women with normal BMI (2%; p=0.033). The study reports wound infection as more frequent in the obese group, although the difference was not statistically significant (p=0.113).

Hospital stay was significantly longer among women with obesity, with a mean duration of 8.4 ± 3.50 days compared with 4.2 ± 2.38 days in the normal-BMI group (p<0.001). Maternal mortality did not differ significantly between the groups.

Table 5: Neonatal outcomes according to maternal BMI

Neonatal outcome	Normal BMI n=50	Obesity n=50	p-value
NICU admission	7 (14.0%)	21 (42.0%)	**0.004**
No NICU admission	43 (86.0%)	29 (58.0%)	
Birth weight (kg), mean ± SD	**2.82 ± 0.47**	**2.65 ± 0.57**	**0.093**
<1.5 kg	1 (2.0%)	3 (6.0%)	
1.5–2.0 kg	2 (4.0%)	4 (8.0%)	
2.1–2.5 kg	6 (12.0%)	10 (20.0%)	
2.6–3.0 kg	27 (54.0%)	23 (46.0%)	
>3.0 kg	14 (28.0%)	10 (20.0%)	
5-minute Apgar score			**0.362**
<7	1 (2.0%)	4 (8.0%)	
≥7	49 (98.0%)	46 (92.0%)	

NICU admission was significantly more frequent among neonates born to mothers with obesity than among those born to mothers with normal BMI (42% vs 14%; p=0.004). Mean birth weight was 2.65 ± 0.57 kg in the obese group and 2.82 ± 0.47 kg in the normal-BMI group; this difference was not statistically significant (p=0.093). Similarly, there was no statistically significant difference in 5-minute Apgar scores between the groups (p=0.362).

DISCUSSION

The present prospective comparative study evaluated maternal and neonatal outcomes among 50 women with obesity (BMI >30 kg/m²) and 50 women with normal BMI. The obese group had a significantly higher mean maternal age (28.8 ± 4.84 vs 23.9 ± 4.55 years; p<0.001) and was less frequently nulliparous (38% vs 58%; p=0.047). This is broadly consistent with the observations of Ehrenberg et al., who reported increasing maternal age and parity among women with obesity.[7] The difference in age and parity is clinically relevant because both may influence obstetric outcomes and therefore represent potential confounding factors when interpreting the present findings.

A significant difference was observed in gestational age at delivery, with mean gestational age being lower in the obese group (35.8 ± 2.77 vs 38.3 ± 1.67 weeks; p<0.001). Eight women (16%) in the obese group delivered before 32 weeks compared with one woman (2%) in the normal-BMI group. This finding is compatible with the large population-based study by Cnattingius et al., which demonstrated an increased risk of very preterm delivery among obese nulliparous women.[2] However, Sebire et al., in their very large London cohort, reported that delivery before 32 weeks was actually less frequent among obese women.[8] Thus, the present association should be interpreted cautiously because the sample was small and the obese group had a greater burden of maternal complications that could themselves contribute to medically indicated preterm delivery.

Maternal comorbidity was significantly more frequent among women with obesity (p<0.001). In

particular, gestational hypertension occurred in 38% of obese women compared with 12% of women with normal BMI, while pre-eclampsia was reported in 14% of obese women and none of the normal-BMI women. GDM was also more frequent in the obese group (8% vs 4%). These findings are strongly concordant with contemporary meta-analyses demonstrating substantially increased risks of gestational hypertension, pre-eclampsia and GDM with increasing maternal BMI.[4,9] The large study by Sebire et al. similarly found increased risks of GDM and proteinuric pre-eclampsia among women with BMI ≥30 kg/m.[2,8] The association between obesity and hypertensive disease may be related to obesity-associated insulin resistance, chronic low-grade inflammation, endothelial dysfunction and altered vascular function. The present study therefore supports the established relationship between maternal obesity and hypertensive/metabolic complications of pregnancy.

The rate of induction of labour was higher among obese women than normal-BMI women (18% vs 12%), although this difference was not statistically significant (p=0.575). Sebire et al. reported significantly increased induction rates among women with obesity,[8] and a recent meta-analysis likewise demonstrated increased odds of induction with maternal obesity.[4] The lack of statistical significance in the present study may reflect the limited sample size rather than absence of an association. Importantly, hypertensive disorders constituted a major indication for induction in the obese group, suggesting that the higher induction rate may partly reflect obesity-associated maternal disease rather than obesity itself.

A major finding was the significantly higher caesarean delivery rate among obese women: 68% compared with 38% in the normal-BMI group (p=0.001). Both elective and emergency caesarean deliveries were more frequent among obese women. This result is consistent with large observational studies and meta-analyses showing a dose-dependent increase in caesarean delivery with increasing BMI.[4,8,9] Obesity may contribute through increased rates of hypertensive disease, failed induction, dysfunctional labour and difficulties in intrapartum management. The substantially higher operative delivery rate in the present study consequently represents an important maternal outcome associated with obesity.

Postpartum morbidity was also numerically higher in the obese group. Wound infection was more frequent among obese women, although the difference did not reach statistical significance (p=0.113). This direction of association agrees with the large London cohort of Sebire et al., in which wound infection was approximately twice as frequent among women with BMI ≥30 kg/m² compared with normal-weight women.[8] A systematic review and meta-analysis has likewise identified high BMI as a significant risk factor for caesarean surgical-site infection.[10] The absence of statistical significance in the present study is likely related to the small number of postoperative events. The mean hospital stay was markedly longer among obese women (8.4 ± 3.50 vs 4.2 ± 2.38 days; p<0.001), consistent with previous evidence associating maternal obesity with increased postnatal healthcare utilisation and longer hospitalisation.[11]

Neonatal outcomes showed a significant difference in NICU admission, which occurred in 42% of neonates born to obese mothers compared with 14% in the normal-BMI group (p=0.004). This finding is consistent with large-scale evidence demonstrating increased NICU admission among infants of mothers with obesity.[4,12,4,8] The higher NICU requirement in the present study may partly reflect the greater frequency of preterm birth and maternal complications in the obese group. In contrast, mean birth weight was slightly lower in the obese group (2.65 ± 0.57 vs 2.82 ± 0.47 kg), but the difference was not statistically significant (p=0.093). This contrasts with several large studies reporting increased birth weight and macrosomia with maternal obesity.[8,12] The relatively small sample size, the lower gestational age in the obese group and the occurrence of medically indicated preterm deliveries may explain this difference.

The 5-minute Apgar score did not differ significantly between groups (p=0.362), although low Apgar scores were numerically more frequent among neonates of obese mothers (8% vs 2%). This finding is compatible with the broader literature showing an association between maternal obesity and low Apgar scores, although the magnitude varies between studies. A meta-analysis involving more than 2.5 million pregnancies found increased odds of a 5-minute Apgar score <7 among infants of obese mothers.[13] The lack of significance in the present study should therefore be interpreted in the context of the small sample.

Overall, the present study demonstrates that maternal obesity was associated particularly with hypertensive disorders, increased caesarean delivery, greater postpartum morbidity, prolonged maternal hospital stay and increased NICU admission. The findings are generally consistent with larger observational studies and systematic reviews, although some neonatal outcomes, particularly birth weight and Apgar score, did not show statistically significant differences. The relatively small sample size and differences in gestational age and maternal characteristics between groups limit causal interpretation. Nevertheless, the study reinforces the importance of identifying obesity early in pregnancy and providing appropriate antenatal surveillance, counselling and multidisciplinary planning to reduce potentially preventable maternal and neonatal morbidity.

CONCLUSION

This prospective comparative study demonstrates that maternal obesity is associated with an increased burden of adverse maternal and neonatal outcomes. Obese pregnant women had a higher frequency of gestational hypertension, pre-eclampsia and gestational diabetes and were more likely to undergo induction of labour and caesarean delivery. Postoperative wound complications were more frequent and the duration of hospital stay was significantly prolonged among obese women. Neonates born to obese mothers had a significantly higher rate of NICU admission, while birth weight and 5-minute Apgar scores did not show statistically significant differences between the groups. Overall, the findings emphasize that obesity in pregnancy should be recognized as an important obstetric risk factor requiring early identification, appropriate antenatal surveillance, timely management of maternal complications and careful intrapartum and neonatal planning.

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