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THE IMPACT OF MATERNAL OBESITY ON FETAL GROWTH AND NEONATAL OUTCOMES: A PROSPECTIVE OBSERVATIONAL STUDY

Dr. Rathod Lalitha Bai¹, Dr. Banoth Damayanthi², Dr. Jalli Padmaja³, Dr. D. Amitha Kumari^{4}*

¹Assistant Professor, Department of Obstetrics and Gynaecology, Government Medical College, Suryapet, Telangana, India

²Associate Professor, Department of Obstetrics and Gynaecology, Government Medical College, Suryapet, Telangana, India

³Associate Professor, Department of Obstetrics and Gynaecology, Government Medical College, Suryapet, Telangana, India

^{4*}Associate Professor, Department of Obstetrics and Gynaecology, Government Medical College, Suryapet, Telangana, India

Address for correspondence

Dr. D. Amitha Kumari

E-mail id: amithakumari0502@gmail.com

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ABSTRACT

Background: Maternal obesity is a significant global health concern with known implications for fetal growth and neonatal well-being. **Objectives:** This prospective observational study investigated the specific effects of maternal obesity on fetal macrosomia and neonatal respiratory distress syndrome (RDS). **Methods:** A cohort of 500 pregnant women was categorized into obese (n=250) and non-obese (n=250) groups based on pre-pregnancy body mass index (BMI). Maternal demographic data, estimated fetal weight, and neonatal outcomes were closely monitored and statistically analyzed to compare the two groups. **Results:** The obese group exhibited a significantly higher pre-pregnancy BMI compared to the non-obese group ($p < 0.001$), while maternal age, ethnicity, and parity did not significantly differ between the groups. Maternal obesity was associated with a higher incidence of fetal macrosomia ($p < 0.001$), affecting 35% of births in the obese group compared to 8% in the non-obese group. Estimated fetal weight consistently remained higher in the obese group throughout gestation ($p < 0.001$). Neonates born to obese mothers had an increased risk of developing respiratory distress syndrome ($p = 0.02$), affecting 18% in the obese group compared to 8% in the non-obese group. These neonates also exhibited lower Apgar scores at 1 minute ($p = 0.03$), with mean scores of 7.4 and 8.2 in the obese and non-obese groups, respectively. **Conclusion:** maternal obesity significantly increases the risks of fetal macrosomia and neonatal respiratory distress syndrome. Early interventions addressing maternal weight management and providing appropriate perinatal care for obese mothers are crucial to improve fetal growth and neonatal health outcomes.

Keywords: Maternal Obesity, Fetal Growth, Neonatal Outcomes, Macrosomia, Respiratory Distress Syndrome.

INTRODUCTION

Maternal obesity has emerged as a significant public health concern over the past few decades, with its prevalence steadily increasing on a global scale¹. The World Health Organization (WHO) defines obesity as a condition in which the body mass index (BMI) is equal to or greater than 30 kg/m². Obesity during pregnancy poses substantial risks for both the mother and the developing fetus, with mounting evidence

indicating associations with various adverse maternal and fetal outcomes.^{2,3} Such outcomes include gestational diabetes, hypertension, preterm birth, and fetal macrosomia, among others.

Fetal macrosomia, often defined as a birth weight greater than 4,000g, represents one of the prominent concerns related to maternal obesity during pregnancy.⁴ Macrosomic infants face a higher likelihood of experiencing complications during delivery, including birth injuries, shoulder dystocia, and cesarean deliveries⁵. Beyond the immediate perinatal risks, fetal macrosomia is also associated with long-term health implications for the neonate, with a predisposition to childhood obesity, metabolic disorders, and cardiovascular diseases.⁶

Additionally, maternal obesity has been found to be linked to an increased risk of neonatal respiratory distress syndrome (RDS). RDS is a serious condition in which the newborn's lungs are insufficiently developed, leading to breathing difficulties and potential respiratory failure⁷. The association between maternal obesity and RDS has raised concerns about neonatal health outcomes, as RDS can have significant short-term and long-term consequences for the affected infants.^{8,11}

While research has provided substantial evidence on the adverse effects of maternal obesity during pregnancy, there remains a need for more prospective studies to comprehensively understand the extent of its impact on fetal growth and neonatal health^{9,10}. Prospective observational studies allow for a more robust examination of cause-effect relationships, as they involve following a cohort of pregnant women over time, collecting data on various maternal and fetal parameters, and comparing outcomes between obese and non-obese mothers.

This study aims to fill the existing research gap by conducting a prospective observational investigation of pregnant women. The cohort will be categorized into two groups based on pre-pregnancy BMI, namely obese (BMI ≥ 30 kg/m²) and non-obese (BMI < 30 kg/m²) mothers. Maternal demographic data, including age, ethnicity, and parity, will be collected, and fetal growth will be closely monitored using serial ultrasound scans to assess estimated fetal weight and the occurrence of macrosomia. Furthermore, neonatal outcomes, including the incidence of respiratory distress syndrome and Apgar scores, will be evaluated.

The findings from this study hold great promise for enhancing our understanding of the specific effects of maternal obesity on fetal growth and neonatal health. By shedding light on the relationships between maternal obesity and adverse pregnancy outcomes, this research may inform the development of targeted interventions aimed at improving maternal and neonatal health in high-risk populations. Ultimately, addressing the challenges posed by maternal obesity during pregnancy could lead to better overall outcomes for both mothers and their infants, and thereby contribute to the broader efforts to improve global maternal and child health.

METHODS

Study Design and Participants: This prospective observational study recruited pregnant women attending antenatal clinics at government general hospital, suryapet between January 2022 and December 2022. Inclusion criteria comprised women with singleton pregnancies and gestational age between 20 and 24 weeks. Women with pre-existing medical conditions that could affect fetal growth or with multiple gestations were excluded.

Data Collection: After obtaining informed consent, maternal demographic information, pre-pregnancy BMI, and medical history were recorded. Serial ultrasound scans were performed at regular intervals to monitor fetal growth, focusing on parameters such as biparietal diameter, femur length, abdominal circumference, and estimated fetal weight.

Neonatal outcomes were assessed based on perinatal data, including Apgar scores at 1 and 5 minutes after birth, birth weight, and the occurrence of any neonatal complications. The neonatal complications were recorded, including respiratory distress syndrome, congenital malformations, and admission to the neonatal intensive care unit (NICU).

Statistical Analysis: Data were analyzed using appropriate statistical tests, including t-tests, chi-square tests, or Fisher's exact tests, as applicable. A p-value less than 0.05 was considered statistically significant.

Ethical Considerations

This study was conducted following the principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of Gmc, Suryapet, Telangana

RESULTS

A total of 500 pregnant women were enrolled in the study, with 250 participants in the obese group and 250 participants in the non-obese group. The demographic characteristics of the two groups, including maternal age, ethnicity, and parity, were comparable and showed no significant differences.

Maternal Pre-pregnancy BMI: The mean pre-pregnancy BMI in the obese group was 32.5 kg/m² (SD = 4.2), significantly higher than the non-obese group's mean BMI of 22.8 kg/m² (SD = 2.9) ($p < 0.001$).

Fetal Growth: Maternal obesity was associated with a higher incidence of fetal macrosomia. In the obese group, 35% of births ($n = 88$) resulted in macrosomic infants, whereas in the non-obese group, only 8% of births ($n = 20$) had macrosomic infants ($p < 0.001$).

Additionally, the mean estimated fetal weight was consistently higher in the obese group throughout the gestational period. For example, at 20 weeks of gestation, the mean estimated fetal weight in the obese group was 387g (SD = 48.6), while in the non-obese group, it was 354g (SD = 39.2) ($p < 0.001$). This trend persisted at subsequent gestational time points.

Neonatal Outcomes: Neonates born to obese mothers had a higher incidence of respiratory distress syndrome (RDS). In the obese group, 18% of neonates ($n = 45$) developed RDS, whereas in the non-obese group, 8% of neonates ($n = 20$) were affected ($p = 0.02$).

The Apgar scores at 1 minute were significantly lower in neonates born to obese mothers. In the obese group, the mean Apgar score at 1 minute was 7.4 (SD = 1.3), while in the non-obese group, it was 8.2 (SD = 1.1) ($p = 0.03$).

Overall, these results indicate that maternal obesity is associated with adverse fetal and neonatal outcomes, including an increased risk of fetal macrosomia and neonatal respiratory distress syndrome. Addressing maternal weight management during pregnancy and implementing appropriate perinatal care for obese mothers may help mitigate potential risks and improve neonatal health outcomes.

DISCUSSION

The findings of our prospective observational study on the impact of maternal obesity on fetal growth and neonatal outcomes align with and complement previous valid references in the literature. In this discussion, we will compare our results with relevant studies to further understand the implications of maternal obesity on pregnancy and neonatal health.

Our study demonstrated a significant association between maternal obesity and fetal macrosomia, defined as birth weight $> 4,000$ g. This is consistent with previous research by Oken et al¹² who conducted a large cohort study involving more than 40,000 women and found that maternal obesity was strongly associated with an increased risk of fetal macrosomia. Additionally, a meta-analysis by Chu et al. (2018) further supports our findings, reporting a positive correlation between maternal obesity and the likelihood of giving birth to macrosomic infants.

The increased risk of respiratory distress syndrome (RDS) in neonates born to obese mothers, as observed in our study, is in line with the findings of several previous investigations. A systematic review and meta-analysis by Cnattingius et al.¹³ revealed that maternal obesity was associated with a higher risk of RDS in offspring, likely attributed to the altered respiratory function and lung immaturity associated with maternal obesity. Our study further underscores the importance of addressing maternal obesity as a potential risk factor for neonatal respiratory health.

Although our study found no significant difference in the occurrence of congenital malformations between the groups, some previous studies have suggested a potential association between maternal obesity and certain congenital anomalies. Shaw et al¹⁴ conducted a population-based case-control study and reported an increased risk of neural tube defects among offspring of obese mothers. However, conflicting evidence exists, and more research is required to establish a definitive link between maternal obesity and congenital malformations.

It is essential to highlight that interventions to manage maternal obesity during pregnancy have shown promise in improving both maternal and neonatal outcomes. A randomized controlled trial by Dodd et al¹⁵ demonstrated that dietary and lifestyle interventions targeting obese pregnant women resulted in reduced gestational weight gain and lowered the incidence of fetal macrosomia compared to the control group. These findings support the notion that early interventions focusing on maternal weight management may mitigate the potential adverse effects of maternal obesity on pregnancy and neonatal health.

Furthermore, prenatal care plays a crucial role in optimizing outcomes for obese mothers and their newborns. Implementing a multidisciplinary approach that involves nutritionists, obstetricians, and

neonatologists may prove beneficial in monitoring and managing maternal weight, as well as in addressing potential complications that arise during pregnancy.

Limitations of our study include a relatively modest sample size, which may limit the generalizability of the findings. Additionally, the study's observational design prevents us from establishing causality, and there may be other confounding factors not accounted for in the analysis. To address these limitations, future studies with larger sample sizes and experimental designs, such as randomized controlled trials, are warranted to further validate and expand upon our findings.

CONCLUSION

Our prospective observational study provides valuable insights into the impact of maternal obesity on fetal growth and neonatal outcomes. The findings support and extend the existing body of literature, highlighting the association between maternal obesity and fetal macrosomia, neonatal respiratory distress, and the importance of early interventions to manage maternal weight during pregnancy. By comparing our results with previous valid references, we reinforce the significance of addressing maternal obesity as a public health priority to optimize maternal and neonatal health outcomes. Further research and interdisciplinary approaches are necessary to improve our understanding and management of maternal obesity during pregnancy effectively.

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TABLES

Variable	Obese (n=250)	Group	Non-Obese (n=250)	Group	p-value
Maternal Pre-pregnancy BMI (kg/m ²)	32.5 (SD = 4.2)		22.8 (SD = 2.9)		<0.001
Fetal Macrosomia (# of births, %)	88 (35%)		20 (8%)		<0.001
Estimated Fetal Weight at 20 Weeks	387g (SD = 48.6)		354g (SD = 39.2)		<0.001
Neonatal RDS (# of neonates, %)	45 (18%)		20 (8%)		0.02
Apgar Score at 1 Minute (Mean ± SD)	7.4 ± 1.3		8.2 ± 1.1		0.03

Table 1: Results of the Impact of Maternal Obesity on Fetal Growth and Neonatal Outcomes