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Impact of Maternal Obesity on Immediate Neonatal Outcomes in Diabetic Mothers

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ABSTRACT

Background: Maternal obesity and diabetes are major risk factors driving adverse perinatal outcomes, creating heightened neonatal difficulties. The combined effects of these conditions remain understudied in low-resource settings. This study compares immediate neonatal outcomes between obese and non-obese diabetic mothers. ***Methods:*** The comparative observational study was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from July 2023 to June 2024. The research examined neonatal results of 105 pregnant women with diabetes, where 52 were obese and 53 were non-obese. Participants were divided based on body mass index (BMI), with obese participants having a BMI of 30 kg/m² or higher. SPSS version 25.0 was used for data analysis, with statistical significance at $p<0.05$. ***Results:*** Findings showed obese mothers needed cesarean delivery more than non-obese mothers (76.92% vs. 58.49%, p=0.045). Birth weights of infants from obese mothers were 3510 ± 440 g, while non-obese mothers' babies averaged 3275 ± 395 g (p=0.004). Macrosomia occurred more frequently in the obese group (26.92% vs. 9.43%, p = 0.02). The obese group showed increased newborn hypoglycemia compared to the non-obese group (23.07% vs. 9.43%, p=0.05). Obese mothers had a nonsignificant association with NICU admissions at 32.69%, while normal-weight women had 17.0% admissions (p = 0.06), with nonsignificant effects on Apgar scores (15.38% vs. 5.66%, p = 0.1) and respiratory distress (17.30% vs. 7.54%, p = 0.13). ***Conclusion:*** Maternal obesity in diabetic pregnancies significantly increases the risks of macrosomia, neonatal hypoglycemia, and cesarean delivery. Enhanced antenatal care targeting weight and glycemic control is essential for improving neonatal outcomes.

Keywords: *Maternal obesity, Gestational diabetes, Neonatal outcomes, Macrosomia, Hypoglycemia*

INTRODUCTION

The increasing frequency of maternal obesity and diabetes poses serious health risks for mothers and newborns during pregnancy. The condition of obesity, defined by a body mass index (BMI) above 30, leads to multiple harmful pregnancy results, such as gestational diabetes mellitus (GDM), hypertensive disorders and preterm birth [1]. The poor control of diabetes in pregnancy creates an increased risk for the neonate through macrosomia development alongside neonatal hypoglycemia and respiratory distress syndrome [2]. The combined existence of maternal obesity and diabetes has been studied extensively despite individual research establishing adverse impacts for pregnant mothers and their newborns.

The presence of maternal obesity worsens the probability of gestational diabetes, causing insulin resistance and hyperglycemic conditions during pregnancy. When maternal obesity functions alongside diabetes, these conditions build a

complex biological situation that powerfully interferes with fetal development and the direct outcome of neonates. Studies confirm that obese or diabetic mothers give birth to infants who become large-for-gestational-age (LGA), leading to elevated birth complications and increased cesarean delivery risks [3]. These infants show an increased danger of developing hypoglycemia early after birth as their glucose metabolic system has been changed by maternal hyperglycemia [4]. It is essential to gain knowledge about how obesity and diabetes in pregnancy interact with neonatal health due to their increasing prevalence during pregnancy.

Scientific studies demonstrate how maternal obesity elevates birth complications by producing larger newborns among obese pregnant women. Maternal obesity causes preeclampsia and gestational hypertension complications that create additional dangers to neonatal health, according to published studies [5, 6]. Gestational diabetes behaves independently to cause two main adverse effects of macrosomia and neonatal hypoglycemia in newborns [7]. Few scientific studies have examined the joint effects of maternal obesity and diabetes on creating adverse outcomes during neonatal life. Current research primarily focuses on studying either condition independently, rather than their collective influence. The research conducted by Hong YH and Lee JE (2021) established that maternal obesity generates higher risks of producing large-for-gestational-age infants, especially in cases of gestational diabetes [8]. The complete impact of the relationship between maternal obesity and diabetes on newborn outcomes needs further research investigation.

The available research lacks comprehensive studies about the joint effects of diabetes and obesity on neonatal hypoglycemia and birth weight, along with respiratory distress syndrome. This research investigates the impact of maternal obesity on diabetic mothers' neonates, particularly concerning birth weight and neonatal hypoglycemia, along with intensive neonatal care requirements. Our research shows that pregnant women who have obesity together with diabetes experience enhanced risks for negative neonatal birth results, such as macrosomia, along with neonatal hypoglycemia and intensive neonatal care requirements. The research findings from this study will help medical professionals better grasp the interaction between maternal obesity and diabetes to improve the clinical pregnancy treatment of women with these conditions.

Objective

The objective of this study was to evaluate the impact of maternal obesity on immediate neonatal outcomes among diabetic mothers.

METHODOLOGY & MATERIALS

This comparative observational study was conducted at the Department of Obstetrics and Gynaecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from July 2023 to June 2024. The study included 105 diabetic pregnant women who were diagnosed with either gestational diabetes mellitus (GDM) or pregestational diabetes. They were categorized into two groups based on their body mass index (BMI): non-obese (BMI < 30 kg/m²) and obese (BMI ≥ 30 kg/m²).

Sample Selection

Inclusion Criteria

- Pregnant women diagnosed with gestational or pregestational diabetes.
- Women aged 18 to 40 years.
- Delivery at BSMMU during the study period.
- Complete medical and obstetric records are available.

Exclusion Criteria

- Preterm deliveries before 34 weeks of gestation.
- Pregnancies complicated by chronic hypertension, renal disease, or autoimmune disorders.
- Known fetal anomalies or chromosomal abnormalities.
- Incomplete or missing medical records.

Data Collection Procedure: Data were collected retrospectively from hospital records, including antenatal charts, delivery logs, and neonatal records. Maternal data included demographic details, body mass index (BMI), diabetic status, mode of delivery, and gestational age. Neonatal data encompassed birth weight, Apgar scores, NICU admission, and early neonatal complications. Data accuracy was ensured through cross-verification by two independent researchers. Informed consent was obtained from all participants before their inclusion, and the confidentiality of patient information was strictly maintained throughout the study.

Statistical Analysis: Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics, including mean, standard deviation, and frequency, were used to summarize the data. The chi-squared test was used for categorical variables, and the independent samples t-test was used for continuous variables to compare groups. Statistical significance was set as a p-value of less than 0.05.

RESULTS

Table 1: Baseline maternal characteristics (n=105)

Characteristics	Obese (n = 52)	Non-obese (n = 53)	p-value
Maternal age (years), mean ± SD	31.8 ± 4.1	30.6 ± 3.9	0.127
Gestational age at delivery (weeks)	37.4 ± 1.3	37.8 ± 1.1	0.091
Pre-existing DM (Type 2)	19 (36.53)	17 (32.07)	0.63
Gestational diabetes mellitus	33 (63.46)	24 (45.28)	0.062
Cesarean delivery	40 (76.92)	31 (58.49)	0.045
Parity ≥ 2	22 (42.30)	20 (37.73)	0.63

Table 1 presents baseline maternal characteristics. Mean maternal age was higher in the obese group (31.8 ± 4.1 years) versus the non-obese group (30.6 ± 3.9 years), though not statistically significant (p = 0.127). Gestational age at delivery was lower in obese mothers (37.4 ± 1.3 weeks) than in non-obese mothers (37.8 ± 1.1 weeks, p=0.091). The prevalence of pre-existing type 2 diabetes was similar between groups (36.53% vs. 32.07%, p = 0.63). Gestational diabetes was more common in obese mothers (63.46%) than in non-obese mothers (45.28%), but not significantly (p=0.062). Cesarean delivery was significantly more frequent in the obese group (76.92% vs. 58.49%, p=0.045). Parity ≥2 showed no difference between groups (p = 0.63).

Table 2: Immediate neonatal outcomes

Neonatal Outcome	Obese (n = 52)	Non-obese (n = 53)	p-value
Birth weight (g), mean ± SD	3510 ± 440	3275 ± 395	0.004
Macrosomia (≥ 4000 g)	13 (25.0)	5 (9.43)	0.03
Low Apgar (<7 at 1 min)	8 (15.38)	3 (5.66)	0.1
NICU admission	17 (32.69)	9 (17.0)	0.06
Neonatal hypoglycemia	12 (23.07)	5 (9.43)	0.05

Table 2 outlines neonatal outcomes. Birth weight was significantly higher in neonates of obese mothers (3510 ± 440 g) versus non-obese mothers (3275 ± 395 g, p=0.004). Macrosomia occurred more frequently in the obese group (25.0%) than in the non-obese group (9.43%, p=0.03). Low Apgar scores were observed in 15.38% of obese group neonates, versus 5.66% in non-obese (p = 0.1). NICU admission was higher in the obese group (32.69% vs. 17.0%, p=0.06), as was neonatal hypoglycemia (23.07% vs. 9.43%, p=0.05).

Table 3: Distribution of neonatal birth weight category

Birth Weight Category	Obese (n = 52)	Non-obese (n = 53)	p-value
<2500 g (Low birth weight)	4 (7.69)	6 (11.32)	0.52
2500–3999 g	33 (63.46)	42 (79.24)	0.07
≥4000 g (Macrosomia)	14 (26.92)	5 (9.43)	0.02

Table 3 provides neonatal birth weight categories. The prevalence of low birth weight was similar between groups (7.69% vs. 11.32%, p = 0.52). Most neonates had weights between 2500–3999 g (63.46% obese vs. 79.24% non-obese, p = 0.07). Macrosomia was significantly more frequent in obese group neonates (26.92%) versus non-obese (9.43%, p=0.02).

Table 4: Neonatal complications

Complication	Obese (n = 52)	Non-obese (n = 53)	p-value
Respiratory distress	9 (17.30)	4 (7.54)	0.13
Neonatal jaundice	11 (21.15)	8 (15.09)	0.42
Hypoglycemia	11 (21.15)	5 (9.43)	0.09
Sepsis	3 (5.76)	1 (1.88)	0.3

Table 4 summarizes the neonatal outcomes. The prevalence of respiratory distress was higher in the obese group (17.30%) than in the non-obese group (7.54%, p=0.13). Neonatal jaundice occurred in 21.15% of obese cases versus 15.09% of non-obese (p=0.42). Hypoglycemia was higher in the obese group (21.15% vs. 9.43%, p=0.09). Sepsis occurred in 5.76% of obese group neonates and 1.88% of non-obese (p=0.3).

DISCUSSION

The research analysis evaluated how maternal obesity affects childbirth results for diabetic mothers by studying both obese and non-obese populations. Maternal obesity combined with diabetes increases the likelihood of neonatal birth weight and macrosomia, and it also elevates hypoglycemia frequency and cesarean section requirements. The data revealed that obese mothers and their newborns experienced more NICU admissions and respiratory distress symptoms, but these findings did not gain statistical validation.

These findings support previous academic research, which confirms that obesity causes adverse results during pregnancy and the neonatal period. The prevalence of macrosomia reached 26.92% in neonates born to obese diabetic mothers, and this rate was higher than the 9.43% in the non-obese diabetic group (p=0.02). The research by Santos *et al*. (2019) supports these findings, as the study demonstrated that maternal obesity increases the risk of macrosomia, which remains elevated even after controlling for gestational weight gain and glycemic control measurements [9]. Bhavadharini *et al*. (2017) established a positive relationship between the BMI of Asian Indian women and their neonatal birth weight, which aligns with the ethnic makeup of this research (10).

A study by Bruno *et al*. (2015) supports the current findings of higher birth weights at 3510g in obese mothers compared to 3275g in non-obese mothers (p = 0.004) [11]. Increased maternal body fat leads to elevated blood glucose levels and insulin resistance, resulting in fetal hyperinsulinemia and fat accumulation [5].

The occurrence of hypoglycemia among newborns was higher among mothers who were obese at 23.07% compared to 9.43% in the non-obese group (p=0.05). According to Turner *et al*. (2019), maternal obesity combined with gestational diabetes increases the risk of neonatal hypoglycemia through secondary effects of fetal insulin production due to intrauterine hyperglycemia [12]. Stage hypoglycemia in women with pre-existing diabetes creates a clear link to postnatal hypoglycemia, according to Joshi *et al*. (2017) in their study [13]. The survey conducted by Voormolen *et al*. (2018) demonstrated an increase in hypoglycemic events in insulin-dependent pregnant women with gestational diabetes mellitus (GDM). However, our research did not include structured reports on GDM treatment methods, which may represent a study limitation [14].

Obese pregnant women underwent Cesarean delivery at higher rates compared to the general maternal population (76.92% versus 58.49%, p=0.045). The research conducted by Weiss *et al*. (2004) revealed that growth in BMI value directly led to higher cesarean section rates [15]. Several risk factors, such as labour complications, large infant size, and medical provider concerns about delivery risks, lead to this complication. The American College of Obstetricians and Gynaecologists (2013) explicitly identified obesity as a stand-alone risk for cesarean section operations requiring anticipation at the start of such pregnancies [16].

Neonatal outcomes, including NICU admission, respiratory distress, and neonatal jaundice, presented more significant numbers in the obese group, but researchers did not establish statistical evidence of these differences. Previous research by Minsart *et al*. (2013) and Athukorala *et al*. (2010) established that obese mothers were more likely to admit their babies to the NICU and experience neonatal complications [17, 18].

The obese participants experienced more Apgar scores of less than 7 points at the first minute of life; however, the difference between the groups was not significant. Scott-Pillai *et al*. (2013) found that neonates born to obese mothers exhibited lower than normal Apgar scores in their research report [19]. The delivery mode and type of anaesthesia, alongside maternal obesity, may have jointly contributed to the observed neonatal depression since most patients received scheduled cesarean sections.

Maternal obesity and diabetes have a complex relationship because these two conditions can raise the severity of adverse pregnancy outcomes. Research by Assaf Balut *et al*. (2016) demonstrated that GDM treatment at optimal levels reduces the risks faced by neonates from obesity-related conditions, thus highlighting the necessity of early and forceful treatment plans [20]. Our study supports these findings because obese diabetic pregnancies require enhanced prenatal care services along with individual therapy for insulin management, dietary plans, and specific infant observation protocols.

The results reveal the urgent necessity for preconception counselling and weight optimization in diabetic women as part of clinical patient care. Pregnant women who receive weight management care before pregnancy and continuously throughout gestation demonstrate lower odds of macrosomia, hypoglycemia, and cesarean section births. Community programs must receive funding from public health policy to teach people about the dangers of maternal obesity, especially for women who already have diabetes or other metabolic issues.

The findings of this research confirm how diabetic pregnancies with obese mothers produce adverse newborn complications, which include both large babies and low blood sugar issues. Early identification of maternal conditions and specific prenatal measures to control diabetes and encourage weight loss helps to improve perinatal outcomes while reducing healthcare expenses for this vulnerable population.

Limitations and recommendations

The study has several limitations, as it works with a small number of participants and lacks information on glucose management, maternal weight gain during pregnancy, and economic factors. The study did not account for insulin dependence versus diet control among diabetes patients, which could affect neonatal outcomes. Future research should employ a multicenter, prospective approach that tracks all metabolic and treatment variables in detail. Extended follow-up would help medical experts determine the impact of neonatal complications on child development. Prior disease management should include preconception counselling alongside weight optimization and personalized healthcare plans for obese diabetic mothers to reduce maternal and newborn health risks and improve outcomes.

CONCLUSION

Maternal obesity during diabetic pregnancies leads to higher occurrences of macrosomia, together with neonatal hypoglycemia and cesarean delivery. The analyzed neonatal complications occurred in higher numbers in the obese group, yet statistical significance remained beyond reach. The study results confirm previous research about how obesity worsens medical complications during diabetes in pregnancy, thus demonstrating the necessity of focused prenatal care. Weight management combined with diabetic control from before pregnancy until childbirth can reduce the chance of adverse outcomes for mothers carrying diabetic infants. The study evidence suggests that healthcare providers should establish integrated care models involving obstetric practitioners, nurses, nutritional experts, and endocrinologists to improve maternal health outcomes for at-risk patients.

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