Effect of Maternal Body Mass Index on Neonatal Outcomes among Pregnant Women: A Prospective Cohort Study

Ms. Kaveriben Pandya[1]*, Dr. Jagdish T Gohil[2]

[1.] Ph.D Scholar, Faculty of Nursing, Parul University, Waghodia, Vadodara, Gujarat – 391760, India
[2.] Professor and Dean, Department of Obstetrics and Gynaecology, Parul Institute of Medical Sciences and Research, Faculty of Medicine, Parul University, Waghodia, Vadodara, Gujarat – 391760, India
*Corresponding Author: Ms. Kaveriben Pandya, Email: kaveri486@gmail.com, https://orcid.org/0009-0001-5704-9724

Abstract

Background: Maternal nutritional status during pregnancy plays a crucial role in determining neonatal health outcomes. Body Mass Index (BMI) is a widely used indicator of maternal nutritional status and has been associated with various adverse neonatal outcomes. Understanding the relationship between maternal BMI and neonatal outcomes is essential for identifying high-risk pregnancies and improving perinatal care.

Objective: To assess the effect of maternal Body Mass Index on neonatal outcomes among pregnant women attending selected hospitals in Dadra and Nagar Haveli.

Methods: A quantitative prospective cohort study was conducted among 200 antenatal mothers recruited during early pregnancy from selected hospitals in Dadra and Nagar Haveli. Maternal BMI was calculated using measured height and weight and categorized according to the World Health Organization classification as underweight, normal weight, overweight, and obese. Participants were followed until delivery, and neonatal outcomes including birth weight, gestational age at birth, APGAR score at 5 minutes, and neonatal intensive care unit (NICU) admission were assessed. Data were analysed using descriptive statistics, Chi-square test, one-way ANOVA, and multivariable logistic regression. Statistical significance was considered at $p < 0.05$.

Results: The mean maternal BMI was 24.18 ± 4.71 kg/m². Of the participants, 13.0% were underweight, 49.0% had normal BMI, 24.5% were overweight, and 13.5% were obese. Significant associations were observed between maternal BMI and neonatal birth weight ($\chi^2 = 24.76$, $p < 0.001$), gestational age at birth ($F = 4.91$, $p = 0.003$), APGAR score at 5 minutes ($F = 9.84$, $p < 0.001$), and NICU admission ($\chi^2 = 13.41$, $p = 0.004$). Logistic regression analysis identified underweight BMI (AOR = 2.84, $p = 0.006$) and obese BMI (AOR = 3.21, $p = 0.003$) as significant predictors of adverse neonatal outcomes.

Conclusion: Maternal BMI significantly influences neonatal outcomes. Both underweight and obese mothers were at increased risk of adverse neonatal outcomes, highlighting the importance of routine BMI assessment, nutritional counselling, and targeted antenatal interventions to optimize neonatal health.

Keywords: Maternal Body Mass Index, Neonatal Outcomes, Birth Weight, Apgar score, Pregnancy, Antenatal Mothers, Prospective Cohort Study, Maternal Nutrition

Introduction

Maternal nutritional status is a critical determinant of pregnancy outcomes and neonatal health. Body Mass Index (BMI), a widely used indicator of nutritional status, has emerged as an important predictor of maternal and fetal well-being. Both under nutrition and excessive weight before and during pregnancy can adversely affect maternal health, fetal growth, and neonatal outcomes. In recent decades, the prevalence of overweight and obesity among women of reproductive age has increased significantly worldwide, making maternal BMI an important public health concern [(1)]. Evidence suggests that maternal overweight and obesity are associated with several pregnancy-related complications, including gestational diabetes mellitus, hypertensive disorders, caesarean delivery, postpartum complications, and increased healthcare utilization [(2,3)]. Maternal obesity has also been linked with unfavourable neonatal outcomes such as microsomal, low Apgar scores, preterm birth, neonatal intensive care unit admission, congenital anomalies, and increased neonatal morbidity and mortality [(1,4,5)]. Furthermore, these adverse effects may extend beyond the neonatal period, influencing the long-term metabolic and cardiovascular health of offspring [(5)]. Recent systematic reviews have highlighted the substantial impact of maternal obesity on neonatal outcomes, particularly among women with gestational diabetes mellitus, where the combined effects of obesity and metabolic dysregulation further increase the risk of adverse neonatal events [(6)]. Similarly, excessive gestational weight gain has been identified as an independent risk factor for poor maternal and neonatal outcomes, emphasizing the importance of maintaining optimal weight throughout pregnancy [(7)].

Several studies have demonstrated a strong relationship between maternal pre-pregnancy BMI and neonatal birth weight. Women with higher BMI are more likely to deliver large-for-gestational-age infants, whereas underweight mothers are at greater risk of delivering low-birth-weight infants [(3,4)]. A cross-sectional study conducted in Türkiye reported significant associations between maternal BMI categories and both maternal and neonatal health outcomes, reinforcing the role of maternal nutritional status in determining pregnancy success [(2)]. Additionally, maternal overweight and obesity before conception have been associated with increased risks of gestational complications and adverse neonatal outcomes across diverse populations [(8)]. Maternal BMI assessment provides a simple, cost-effective, and reliable method for identifying women at risk of pregnancy complications. Recent

evidence supports the use of maternal BMI as a key component of antenatal nutritional assessment and risk stratification strategies [9]. Understanding the relationship between maternal BMI and neonatal outcomes is therefore essential for developing effective interventions aimed at improving maternal and child health. Early identification and management of women with abnormal BMI can contribute significantly to reducing preventable maternal and neonatal complications and promoting healthier pregnancy outcomes [10]. Therefore, the present study aims to assess the relationship between maternal Body Mass Index and neonatal outcomes among postnatal mothers, thereby generating evidence that may support targeted nutritional interventions and improved maternal and neonatal healthcare practices.

Methodology

A quantitative research approach with a prospective cohort study design was adopted to assess the effect of maternal Body Mass Index (BMI) on neonatal outcomes among pregnant women attending selected hospitals in Dadra and Nagar Haveli, India. The study was conducted over a period of 12 months in the antenatal outpatient departments and maternity units of selected tertiary care hospitals. A total of 200 antenatal mothers were recruited during their first antenatal visit using a consecutive sampling technique and were prospectively followed until delivery.

Pregnant women aged 18–40 years with singleton pregnancies and gestational age of ≤13 weeks were eligible for inclusion. Mothers with multiple pregnancies, pre-existing chronic medical disorders such as diabetes mellitus, chronic hypertension, renal disease, cardiac disease, or pregnancies complicated by major congenital fetal anomalies were excluded from the study. Written informed consent was obtained from all participants before Enrollment.

Baseline demographic and obstetric data were collected using a structured data collection form. Maternal height and weight were measured using standardized procedures, and Body Mass Index was calculated using the formula BMI = weight (kg)/height² (m^2). Based on the World Health Organization (WHO) classification, participants were categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30.0 kg/m^2).

The enrolled mothers were followed throughout pregnancy during routine antenatal visits. Information regarding pregnancy progress and delivery details was obtained from antenatal records and hospital case files. Following childbirth, neonatal outcomes were assessed and documented from labor room records, neonatal assessment records, and discharge summaries. The neonatal outcomes evaluated included birth weight, low birth weight, macrosomia, gestational age at birth, preterm birth, APGAR scores at 1 and 5 minutes, small for gestational age (SGA), large for gestational age (LGA), neonatal intensive care unit (NICU) admission, neonatal respiratory distress, neonatal jaundice, neonatal hypoglycemia, and neonatal mortality.

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics including frequency, percentage, mean, and standard deviation were used to summarize participant characteristics and neonatal outcomes. Inferential statistics including Chi-square test, Fisher's exact test, one-way analysis of variance (ANOVA), and logistic regression analysis were used to determine the association between maternal BMI categories and neonatal outcomes. Relative risks (RR) with 95% confidence intervals were calculated where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to data collection. Administrative permission was obtained from the selected hospitals. Confidentiality and anonymity of participants were maintained throughout the study, and all data were used solely for research purposes.

Results

Table 1. Demographic and Obstetric Characteristics of Antenatal Mothers (N = 200)

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	<20	18	9.0
	20–25	82	41.0
	26–30	67	33.5
	>30	33	16.5
Education	Primary Education	34	17.0
	Secondary Education	76	38.0
	Higher Secondary Education	48	24.0
	Graduate and Above	42	21.0
Occupation	Homemaker	122	61.0
	Employed	78	39.0
Residence	Rural	118	59.0
	Urban	82	41.0
Family Type	Nuclear Family	124	62.0
	Joint Family	76	38.0
Monthly Family Income (INR)	< ₹15,000	38	19.0
	₹15,001–₹25,000	82	41.0
	₹25,001–₹35,000	52	26.0

	> ₹35,000	28	14.0

Among the 200 antenatal mothers, the majority (41.0%) were aged between 20–25 years, followed by 33.5% in the 26–30 years age group. The mean age of the participants was 24.96 ± 4.38 years. Regarding educational status, 38.0% had completed secondary education, while 21.0% were graduates or above. Most participants were homemakers (61.0%), resided in rural areas (59.0%), and belonged to nuclear families (62.0%). The mean monthly family income was ₹24,850 ± ₹9,760, with 41.0% of participants reporting an income between ₹15,001 and ₹25,000 per month.

Table 2. Obstetric Characteristics of Antenatal Mothers (N = 200)

Variable	Category	Frequency (n)	Percentage (%)
Gravidity	Primigravida	96	48.0
	Multigravida	104	52.0
Parity	Nulliparous (0)	96	48.0
	Para 1–2	82	41.0
	Para ≥3	22	11.0
History of Previous Abortion	Yes	36	18.0
	No	164	82.0
Gestational Age at Enrollment	≤12 weeks	138	69.0
	13–16 weeks	62	31.0
Number of Antenatal Care (ANC) Visits	<8 Visits	58	29.0
	8–10 Visits	96	48.0
	>10 Visits	46	23.0

Of the 200 antenatal mothers, 52.0% were multigravida and 48.0% were primigravida. Regarding parity, nearly half of the participants (48.0%) were nulliparous, while 41.0% had one to two previous births and 11.0% had three or more previous births. A history of previous abortion was reported by 18.0% of mothers. The majority of participants (69.0%) were enrolled during the first trimester (≤12 weeks gestation), with a mean gestational age at enrollment of 10.84 ± 2.15 weeks. The mean number of antenatal care visits was 8.72 ± 1.96, and nearly half of the mothers (48.0%) attended 8–10 ANC visits during pregnancy.

Table 3. Maternal Anthropometric Characteristics of Antenatal Mothers (N = 200)

Variable	Mean ± SD	Minimum	Maximum
Height (m)	1.58 ± 0.07	1.45	1.76
Weight (kg)	60.42 ± 11.53	39.0	98.0
Body Mass Index (kg/m²)	24.18 ± 4.71	16.2	38.5

Table 3A. Distribution of Antenatal Mothers According to BMI Categories (N = 200)

BMI Category	BMI Range (kg/m²)	Frequency (n)	Percentage (%)
Underweight	<18.5	26	13.0
Normal Weight	18.5–24.9	98	49.0
Overweight	25.0–29.9	49	24.5
Obese	≥30.0	27	13.5
Total		**200**	**100.0**

The mean maternal height was 1.58 ± 0.07 m, ranging from 1.45 m to 1.76 m. The mean maternal weight was 60.42 ± 11.53 kg, with values ranging from 39.0 kg to 98.0 kg. The mean Body Mass Index (BMI) of the antenatal mothers was 24.18 ± 4.71 kg/m², with a minimum BMI of 16.2 kg/m² and a maximum BMI of 38.5 kg/m². Based on the WHO BMI classification, nearly half of the mothers (49.0%) had normal BMI, while 24.5% were overweight, 13.5% were obese, and 13.0% were underweight. These findings indicate that a substantial proportion (38.0%) of the study participants were either overweight or obese during pregnancy.

Table 4. Neonatal Characteristics and Outcomes Among Newborns of Study Participants (N = 200)
Table 4A. Continuous Neonatal Outcome Variables

Variable	Mean ± SD	Minimum	Maximum
Birth Weight (kg)	2.89 ± 0.56	1.60	4.65
Gestational Age at Birth (weeks)	38.12 ± 1.84	32.0	42.0
APGAR Score at 1 Minute	7.28 ± 1.31	3	10
APGAR Score at 5 Minutes	8.71 ± 0.92	5	10

Table 4B. Distribution of Neonatal Outcomes

Neonatal Outcome	Category	Frequency (n)	Percentage (%)
Birth Weight	Low Birth Weight (<2.5 kg)	42	21.0
	Normal Birth Weight (2.5–3.99 kg)	144	72.0

	Macrosomia (≥4.0 kg)	14	7.0
Gestational Age at Birth	Preterm (<37 weeks)	32	16.0
	Term (37–42 weeks)	162	81.0
	Post-term (>42 weeks)	6	3.0
APGAR Score at 5 Minutes	<7	24	12.0
	≥7	176	88.0
NICU Admission	Yes	38	19.0
	No	162	81.0
Respiratory Distress	Present	18	9.0
	Absent	182	91.0
Neonatal Jaundice	Present	31	15.5
	Absent	169	84.5
Neonatal Hypoglycaemia	Present	12	6.0
	Absent	188	94.0

The mean birth weight of the neonates was 2.89 ± 0.56 kg, ranging from 1.60 kg to 4.65 kg. The mean gestational age at birth was 38.12 ± 1.84 weeks, indicating that most deliveries occurred at term. The mean APGAR scores at 1 minute and 5 minutes were 7.28 ± 1.31 and 8.71 ± 0.92, respectively.

Regarding neonatal outcomes, 21.0% of neonates were born with low birth weight, while 7.0% had macrosomia. The majority of neonates (81.0%) were delivered at term, whereas 16.0% were preterm births. Approximately 19.0% required NICU admission. Neonatal jaundice was observed in 15.5% of neonates, respiratory distress in 9.0%, and hypoglycemia in 6.0%. Overall, most newborns demonstrated favorable neonatal outcomes with satisfactory APGAR scores and normal birth weights.

Table 6. Comparison of Mean Gestational Age at Birth across Maternal BMI Categories (N = 200)

Maternal BMI Category	n	Mean Gestational Age at Birth (Weeks)	SD	95% CI
Underweight (<18.5 kg/m²)	26	37.18	1.92	36.40–37.96
Normal Weight (18.5–24.9 kg/m²)	98	38.46	1.41	38.18–38.74
Overweight (25.0–29.9 kg/m²)	49	38.24	1.68	37.76–38.72
Obese (≥30.0 kg/m²)	27	37.62	2.15	36.77–38.47

Statistical Test: One-Way Analysis of Variance (ANOVA) *Significant at $p < 0.05$

The overall mean gestational age at birth among neonates was 38.12 ± 1.84 weeks. Neonates born to mothers with normal BMI had the highest mean gestational age (38.46 ± 1.41 weeks), followed by those born to overweight mothers (38.24 ± 1.68 weeks). Lower mean gestational ages were observed among neonates born to underweight (37.18 ± 1.92 weeks) and obese mothers (37.62 ± 2.15 weeks).

Table 7. Comparison of Mean Apgar score at 5 Minutes Across Maternal BMI Categories (N = 200)

Maternal BMI Category	n	Mean APGAR Score at 5 Minutes	SD	95% CI
Underweight (<18.5 kg/m²)	26	8.02	1.16	7.55–8.49
Normal Weight (18.5–24.9 kg/m²)	98	8.93	0.72	8.79–9.07
Overweight (25.0–29.9 kg/m²)	49	8.82	0.84	8.58–9.06
Obese (≥30.0 kg/m²)	27	8.18	1.08	7.75–8.61

Statistical Test: One-Way Analysis of Variance (ANOVA) *Significant at $p < 0.05$

The overall mean APGAR score at 5 minutes among neonates was 8.71 ± 0.92. Neonates born to mothers with normal BMI demonstrated the highest mean APGAR score (8.93 ± 0.72), followed by those born to overweight mothers (8.82 ± 0.84). Comparatively lower APGAR scores were observed among neonates born to underweight (8.02 ± 1.16) and obese mothers (8.18 ± 1.08). One-way ANOVA revealed a statistically significant difference in mean APGAR scores across maternal BMI categories ($F = 9.84$, $p < 0.001$).

Table 8. Association between Maternal BMI Category and Birth Weight Category of Neonates (N = 200)

Maternal BMI Category	Low Birth Weight (<2.5 kg) n (%)	Normal Birth Weight (2.5–3.99 kg) n (%)	Macrosomia (≥4.0 kg) n (%)	Total n (%)
Underweight	12 (46.2)	14 (53.8)	0 (0.0)	26 (100.0)
Normal Weight	16 (16.3)	80 (81.6)	2 (2.1)	98 (100.0)
Overweight	8 (16.3)	35 (71.4)	6 (12.3)	49 (100.0)
Obese	6 (22.2)	15 (55.6)	6 (22.2)	27 (100.0)
Total	**42 (21.0)**	**144 (72.0)**	**14 (7.0)**	**200 (100.0)**

$\chi^2 = 24.76$, df = 6, $p < 0.001$* *Chi-square test; significant at $p < 0.05$.*

Table 8 depicts the association between maternal BMI category and neonatal birth weight. Among underweight mothers, 46.2% delivered low birth weight infants, while none of the neonates were macrosomic. In the normal BMI group, the majority of neonates (81.6%) had normal birth weight, with only 2.1% experiencing macrosomia. Among overweight mothers, 12.3% of neonates were macrosomic, whereas in the obese group, the prevalence of macrosomia increased to 22.2%. Additionally, 22.2% of obese mothers delivered low birth weight infants.

Table 9. Association between Maternal BMI Category and Birth Weight Category of Neonates (N = 200)

Maternal BMI Category	Low Birth Weight (<2.5 kg) n (%)	Normal Birth Weight (2.5–3.99 kg) n (%)	Macrosomia (≥4.0 kg) n (%)	Total n (%)
Underweight (n = 26)	12 (46.2)	14 (53.8)	0 (0.0)	26 (100.0)
Normal Weight (n = 98)	16 (16.3)	80 (81.6)	2 (2.1)	98 (100.0)
Overweight (n = 49)	8 (16.3)	35 (71.4)	6 (12.3)	49 (100.0)
Obese (n = 27)	6 (22.2)	15 (55.6)	6 (22.2)	27 (100.0)
Total	**42 (21.0)**	**144 (72.0)**	**14 (7.0)**	**200 (100.0)**

Chi-square (χ^2) = 24.76 Degrees of Freedom (df) = 6 p-value < 0.001* *Statistically significant at $p < 0.05$.

Table 9 presents the association between maternal BMI category and neonatal birth weight. Among underweight mothers, nearly half of the neonates (**46.2%**) were born with low birth weight, whereas none of the neonates were macrosomic. In contrast, neonates born to overweight and obese mothers showed a higher prevalence of macrosomia, accounting for **12.3%** and **22.2%**, respectively. The highest proportion of normal birth weight neonates was observed among mothers with normal BMI (**81.6%**). The Chi-square test demonstrated a statistically significant association between maternal BMI category and neonatal birth weight (**$\chi^2 = 24.76$, df = 6, $p < 0.001$**).

Table 10. Association Between Maternal BMI Category and NICU Admission Among Neonates (N = 200)

Maternal BMI Category	NICU Admission n (%)	No NICU Admission n (%)	Total n (%)
Underweight	9 (34.6)	17 (65.4)	26 (100.0)
Normal Weight	11 (11.2)	87 (88.8)	98 (100.0)
Overweight	9 (18.4)	40 (81.6)	49 (100.0)
Obese	9 (33.3)	18 (66.7)	27 (100.0)
Total	**38 (19.0)**	**162 (81.0)**	**200 (100.0)**

$\chi^2 = 13.41$, df = 3, $p = 0.004$* *Chi-square test; significant at $p < 0.05$.*

Table 10 shows the association between maternal BMI category and neonatal intensive care unit (NICU) admission. Among neonates born to underweight mothers, 34.6% required NICU admission, compared to 11.2% among those born to mothers with normal BMI. Similarly, NICU admission was observed among 18.4% of neonates born to overweight mothers and 33.3% of neonates born to obese mothers.

The lowest proportion of NICU admissions was recorded among neonates born to mothers with normal BMI (11.2%), whereas the highest proportions were observed among underweight (34.6%) and obese mothers (33.3%). Overall, 19.0% of neonates required NICU admission, while 81.0% did not require intensive neonatal care.

Chi-square analysis demonstrated a statistically significant association between maternal BMI category and NICU admission ($\chi^2 = 13.41$, df = 3, $p = 0.004$). These findings suggest that both underweight and obese maternal BMI are associated with an increased likelihood of NICU admission, indicating a higher risk of adverse neonatal outcomes among these groups compared with mothers having normal BMI.

Table 11. Multivariable Logistic Regression Analysis for Predictors of Adverse Neonatal Outcomes among Study Participants (N = 200)

Predictor Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	Wald χ^2	p-value
Underweight BMI	2.84	1.34–5.97	7.48	0.006*
Overweight BMI	1.76	0.89–3.47	2.67	0.102
Obese BMI	3.21	1.48–6.95	8.89	0.003*
Maternal Age >30 Years	1.42	0.71–2.85	1.00	0.318
Primigravida	1.61	0.84–3.09	2.11	0.147

Model $\chi^2 = 28.64$ $p < 0.001$ Nagelkerke $R^2 = 0.31$ Classification Accuracy = 78.5% *Significant at $p < 0.05$.*

Table 11 presents the results of multivariable logistic regression analysis performed to identify independent predictors of adverse neonatal outcomes. After adjusting for potential confounding variables, maternal underweight BMI and obesity remained significant predictors of adverse neonatal outcomes.

Underweight mothers were found to be **2.84 times** more likely to experience adverse neonatal outcomes compared to mothers with normal BMI (AOR = 2.84, 95% CI: 1.34–5.97, p = 0.006). Similarly, obese mothers had a **3.21-**

fold increased risk of adverse neonatal outcomes compared to mothers with normal BMI (AOR = 3.21, 95% CI: 1.48–6.95, p = 0.003).

Although overweight mothers showed an increased risk (AOR = 1.76), the association was not statistically significant (p = 0.102). Likewise, maternal age greater than 30 years (AOR = 1.42, p = 0.318) and primigravida status (AOR = 1.61, p = 0.147) were not significant predictors in the adjusted model.

The overall logistic regression model was statistically significant (Model $\chi^2 = 28.64$, $p < 0.001$), explaining approximately 31% of the variance in adverse neonatal outcomes (Nagelkerke $R^2 = 0.31$). These findings indicate that maternal BMI, particularly underweight and obesity, is an important independent predictor of adverse neonatal outcomes.

Discussion

The present prospective cohort study evaluated the effect of maternal Body Mass Index (BMI) on neonatal outcomes among 200 pregnant women attending selected hospitals in Dadra and Nagar Haveli. The findings demonstrated significant associations between maternal BMI and neonatal birth weight, gestational age at birth, APGAR score at 5 minutes, and NICU admission. Both underweight and obese mothers exhibited a higher risk of adverse neonatal outcomes compared with mothers having normal BMI.

In the present study, 13.0% of mothers were underweight, 49.0% had normal BMI, 24.5% were overweight, and 13.5% were obese. Similar findings were reported by Almutairi et al. (2024), who observed that maternal obesity was significantly associated with adverse neonatal outcomes including low APGAR scores and increased neonatal morbidity. Likewise, Singh et al. (2025) reported that approximately 48% of pregnant women were overweight or obese and experienced higher neonatal complications compared with women with normal BMI [11,12].

The present study found a significant association between maternal BMI and neonatal birth weight ($\chi^2 = 24.76$, $p < 0.001$). Nearly 46.2% of underweight mothers delivered low birth weight infants, whereas macrosomia was more prevalent among overweight and obese mothers. These findings are consistent with Yilmaz et al. (2025) [13], who reported that maternal BMI significantly influenced low birth weight and macrosomia among newborns. Kim et al. (2025) similarly identified elevated maternal BMI as a major determinant of adverse neonatal outcomes and abnormal fetal growth patterns [14]. Furthermore, Solanke et al. (2026) observed significantly higher odds of composite adverse neonatal outcomes among obese mothers, including abnormal birth weight [15].

The mean birth weight in the current study increased progressively across BMI categories, with obese mothers delivering infants with the highest birth weights. These findings are comparable with the cohort study conducted by researchers in 2024 involving 500 women, which demonstrated significantly higher average birth weight and macrosomia among infants born to obese mothers[16]. Similarly, an Indian study published in 2025 reported increased odds of macrosomia among overweight and obese mothers compared with women having normal BMI[17].

A statistically significant difference in gestational age at birth was observed across BMI categories in the present study ($F = 4.91$, $p = 0.003$). Underweight and obese mothers delivered at relatively lower gestational ages than mothers with normal BMI. Similar observations were reported in the Neonatology Today report (2023) [18], which identified maternal nutritional status as an important determinant of preterm birth and neonatal complications. Goldstein et al. (2025) also found that maternal weight abnormalities were associated with adverse birth outcomes, including preterm birth and NICU admission [19].

The present study demonstrated a significant association between maternal BMI and APGAR score at 5 minutes ($F = 9.84$, $p < 0.001$). These findings are supported by Almutairi et al. (2024) [20], who reported increased risks of low APGAR scores among neonates born to obese mothers. **Feng et al. (2025)** similarly observed that maternal overweight and obesity significantly increased the likelihood of low APGAR scores among newborns [21].

NICU admission was significantly associated with maternal BMI in the present study ($\chi^2 = 13.41$, $p = 0.004$). Approximately one-third of neonates born to underweight and obese mothers required NICU admission, compared with only 11.2% among mothers with normal BMI. Similar findings were reported by a study conducted in 2023, where maternal obesity was associated with increased NICU admission and neonatal complications. The 2024 cohort study on pre-pregnancy obesity also demonstrated significantly higher NICU admission rates among infants born to obese mothers. Furthermore, **Singh et al. (2025)** reported a dose-dependent increase in NICU admission rates from normal-weight to obese mothers [22].

The present study further revealed that maternal obesity and underweight status independently predicted adverse neonatal outcomes. Logistic regression analysis showed that underweight mothers were 2.84 times more likely and obese mothers were 3.21 times more likely to experience adverse neonatal outcomes compared with mothers having normal BMI. These findings agree with Kim et al. (2025) [21], who demonstrated that maternal obesity significantly increased the risk of neonatal respiratory morbidity and neonatal complications. Solanke et al. (2026) also reported significantly elevated odds of composite adverse neonatal outcomes among obese women [22]. Similarly, **Yilmaz et al. (2025)** identified maternal obesity as an independent predictor of low APGAR scores, macrosomia, neonatal hypoglycemia, and NICU admission[23]. Both maternal undernutrition and obesity contribute substantially to adverse neonatal health outcomes including low birth weight, preterm birth, low APGAR scores, and NICU admission.

Conclusion

Maternal BMI significantly influences neonatal outcomes. Both underweight and obese mothers were at increased risk of adverse neonatal outcomes, highlighting the importance of routine BMI assessment, nutritional counselling, and targeted antenatal interventions to optimize neonatal health.

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Conflict of Interest
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Ethical Approval
Ethical approval for the study was obtained from the Institutional Ethics Committee prior to data collection. Written informed consent was obtained from all participants before their inclusion in the study. Confidentiality, anonymity, and privacy of the participants were maintained throughout the research process in accordance with ethical research principles.

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