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The relationship between maternal BMI and neonatal birth weight: A literature review

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Abstract

Introduction: Birth weight is a key indicator of neonatal health and fetal growth during pregnancy. Abnormal birth weight, whether low or high, can increase the risk of neonatal morbidity and mortality. One maternal factor closely related to birth weight is maternal nutritional status, often measured using the Body Mass Index (BMI). BMI is an anthropometric indicator that reflects the balance between a person's weight and height. Research shows that mothers with a low BMI have a higher risk of delivering low birth weight babies due to insufficient energy reserves and impaired intrauterine growth. Conversely, excessive BMI and maternal obesity are associated with an increased incidence of macrosomia and other obstetric complications. In Indonesia, low birth weight (LBW) remains a significant public health problem. Analysis of the 2017 Indonesian Demographic and Health Survey (IDHS) showed that maternal characteristics, including nutritional status, are associated with the incidence of low birth weight. Based on this description, the relationship between maternal BMI and infant birth weight is a crucial issue in maternal and neonatal health.

Method: This study is a literature review, drawing from sources in Google Scholar, PUBMED, and Science Direct, focusing on research published between 2022 and 2026. The study included only original research articles in English with all the required components.

Result and Discussion: From the literature search, 10 studies met the inclusion criteria. Among them, 9 studies found a correlation between maternal BMI and neonatal birth weight and 1 study found no significant association between maternal BMI and neonatal birth weight.

Conclusion: According to reviews, 9 out of 10 researchers agree that there is a relationship between the mother's BMI and the baby's birth weight

Keywords: Maternal BMI; Neonatal Birth Weight; Nutritional Status; Makrosomia; Low Birth Weight; Obesity; Pregnancy;

1. Introduction

Birth weight is a key indicator of neonatal health and fetal growth during pregnancy. Abnormal birth weight, whether low or high, can increase the risk of neonatal morbidity and mortality. Low birth weight (LBW) babies are at higher risk of various complications, including growth retardation, infection, delayed neurological development, and even neonatal death. Meanwhile, babies with excess birth weight, or macrosomia, are at risk of birth trauma, shoulder dystocia, and metabolic complications later in life (1).

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One maternal factor closely related to birth weight is maternal nutritional status, often measured using the Body Mass Index (BMI). BMI is an anthropometric indicator that reflects the balance between a person's weight and height. Maternal BMI before and during pregnancy reflects maternal nutritional status, which influences fetal growth and development through nutrient transfer and placental function. Research shows that mothers with a low BMI have a higher risk of delivering low birth weight babies due to insufficient energy reserves and impaired intrauterine growth. Conversely, excessive BMI and maternal obesity are associated with an increased incidence of macrosomia and other obstetric complications (1).

The nutritional status of pregnant women remains a global challenge, including in developing countries. On the one hand, malnutrition among pregnant women remains widespread, leading to a high risk of low birth weight (LBW). On the other hand, the prevalence of overweight and obesity among women of reproductive age continues to rise, leading to increased maternal and neonatal complications. Recent research suggests that pre-pregnancy BMI has a greater influence on neonatal outcomes than weight control during pregnancy, particularly in obese mothers (1).

In Indonesia, low birth weight (LBW) remains a significant public health problem. Analysis of the 2017 Indonesian Demographic and Health Survey (IDHS) showed that maternal characteristics, including nutritional status, are associated with the incidence of low birth weight. This situation highlights the importance of monitoring maternal nutritional status from preconception through pregnancy to optimize fetal growth and prevent neonatal complications (2).

Several recent studies have also shown a significant association between maternal BMI and infant birth weight. A longitudinal study by Bramsved et al. (2023) found that maternal BMI in early pregnancy was positively associated with infant birth weight. Furthermore, a cohort study in India showed that maternal nutritional status and body composition significantly influenced the risk of LBW and small for gestational age (SGA) (3).

Based on this description, the relationship between maternal BMI and infant birth weight is a crucial issue in maternal and neonatal health. A more focused understanding of this relationship is expected to form the basis for promotive and preventive efforts to improve the health status of pregnant women and reduce the incidence of low birth weight (LBW) and complications due to macrosomia.

2. Material and methods

This study is a literature review that analyzes 10 articles selected according to specific inclusion criteria. The chosen articles contain original research related to the association between maternal body mass index (BMI) and neonatal birth weight. All included articles were published in English between 2022 and 2026. Articles discussing maternal BMI and neonatal birth weight using approaches other than original research were excluded from the review. The articles were obtained from several databases, including Google Scholar, PubMed, and ScienceDirect. Each selected article was analyzed descriptively based on the author and publication year, study location, research methodology, study subjects, and the main findings of the research.

3. Results

Ten articles— ten in English—have been reviewed and analyzed as follows.

Table 1 Results of Review of 10 Articles

No	Author	Research Title	Location	Method	Subject	Result
1	Gyamfi, SA, et al. (2023)	Maternal risk factors for low birthweight and macrosomia: a cross-sectional study in Northern Region, Ghana	Savelugu Municipality, Northern Region, Ghana, from February to March 2022	retrospective cross-sectional study.	The study involved 356 mothers, aged 16–46 years, who had neonates and attended postnatal care services.	The prevalence rate was 22.2% for low birth weight and 8.7% for macrosomia. Maternal anemia in the first trimester (AOR 3.226; 95% CI 1.372-7.784) and third trimester (AOR 23.94; 95% CI 7.442-70.01) was a strong predictor of low birth weight. Mothers from ethnic minority groups (AOR 0.104; 95% CI 0.011–0.995), those with ≥ 8 antenatal care visits (AOR 0.249; 95% CI 0.13—0.602), and those with neonates with birth length > 47.5 cm (AOR 0.271; 95% CI 0.13–0.651) had reduced odds of low birth weight. Mothers with gestational weeks ≥ 42 (AOR 23.21; 95% CI 4.603—56.19) and those from the wealthiest households (AOR 14.25; 95% CI 1.638—23.91) were more likely to give birth to macrosomic babies. This study showed no significant association between overweight/obesity and macrosomia.
2	Aji, AS, et al (2022)	Association between pre-pregnancy body mass index and gestational weight gain on pregnancy outcomes: a cohort study in Indonesian pregnant women	Minangkabau Highlands of West Sumatra, Indonesia	Observational analysis	The study involved 195 pregnant women and their newborns from the Vitamin D Pregnant Women (VDPM) cohort study.	Women who were overweight or obese pre-pregnancy were 4.09 times more likely to experience excessive gestational weight gain (GWG) (AOR=4.09, 95% CI: 1.38—12.12, p=0.011). Women with excessive GWG were 27.11 times more likely to have babies with macrosomia (AOR=27.11, 95% CI: 2.99—245.14) (p=0.001). Women with inadequate GWG were 9.6 times more likely to give birth to low birth weight (LBW) babies (AOR=9.60, 95% CI; 0.88-105.2) (p=0.002). Socioeconomic characteristics, demographics, education level of pregnant women, employment status, dietary intake, and obstetric history were not significantly associated with GWG status. Pregnant women with overweight/ obese nutritional status significantly have inadequate total GWG status.
3	Ambreen, S. et al (2024)	Association of maternal nutritional status and small for gestational age neonates in peri-	Karachi, Pakistan	This study is a secondary analysis of an ongoing	926 pregnant women with viable intrauterine pregnancies <14	26.6% of women had low MUAC (< 23 cm) and 18.4% were underweight (BMI < 18.5 kg/m2). Nearly one-third of low MUAC and underweight women gave birth to SGA babies (34.4% and 35.1%, respectively).

		urban communities of Karachi, Pakistan: findings from the PRISMA study		pregnancy cohort, PRISMA.	weeks gestation, confirmed by ultrasound. Participants from the PRISMA Cohort, enrolled between January 2021 and August 2022.	Underweight women had a higher likelihood of SGA (OR 1.49, 95% CI 1.1, 2.2) and LBW (OR 1.63, 95% CI 1.1, 2.4). Women with low MUAC had higher odds of SGA (OR 1.64, 95% CI 1.2, 2.3) and LBW (OR 1.63, 95% CI 1.2, 2.3). The ROC curve showed that MUAC and BMI had modest predictability for SGA (AUC < 0.7)
4	Rouhana, S., et al. (2024).	The Association of Maternal Pre-Pregnancy Body Mass Index and Gestational Weight Gain with Pregnancy and Neonatal Outcomes	Notre Dame de Secours University Hospital (CHU-NDS) Jbeil-Lebanon.	A retrospective study	The data was collected from the hospital archive. Out of 804 deliveries during 2020, 583 women were included after randomly choosing their files and eliminating those with exclusion criteria or incomplete data.	Underweight/healthy BMI mothers had a higher chance of having low GWG (45.5%), vaginal delivery (51.3%), and a baby of appropriate size (78.6%) or small size for gestational age (10.4%). Obese women have a higher risk of excessive GWG (49.3%), delivery via C-section. (69.3%), and large for gestational age babies (26.7%). Mothers who had low GWG were at a higher risk of having babies of appropriate size (80.1%) or small size for gestational age (13.1%). Mothers who had high GWG had a higher risk of having baby boys (58.9%), large for their gestational age (26.1%), with hypoglycemia at birth (20.6%).
5	Neal, K., et al. (2022).	Obesity Class Impacts Adverse Maternal and Neonatal Outcomes Independent of Diabetes	Northern Sydney Local Health District in Sydney, Australia	retrospectively analyzed data	all singleton births from mothers with obesity from 2013-2017	There were 2466 births to women with obesity, class (69.1%), class II (21.8%), and class III (9.2%). 42.5% delivered by Caesarean section, 22.3% developed GDM and 11.2% had a hypertensive disorder in pregnancy, and Caesarean section and GDM were more common in women with higher class obesity. LGA occurred in 27.3% and SGA occurred in 4.0% of women across all classes of obesity. LGA rates were 49% more likely in women with class III compared to women with class I obesity (OR=1.49, CI 1.06-2.09, p=0.02). The presence of diabetes in the index pregnancy did not significantly impact the risk of neonatal LGA between maternal obesity classes. Other neonatal adverse outcomes such as stillbirth and birth defects were more common in women with higher class obesity. SGA, neonatal hypoglycaemia, gestational age at delivery, APGAR 5-minute score

						and NICU admissions were similar across classes obesity, after adjustment for covariates.
6	Chen, YH, et al. (2023).	Association between maternal factors and fetal macrosomia in full-term singleton births	Taipei Veterans General Hospital.	Retrospective review of medical records.Chi-square/Fisher's exact test for categorical variables; ANOVA for group comparisons; and univariate/multivariate logistic regression for odds ratios (OR)	pregnant women and newborns from January 2013 to June 2016.	The mean birth weight was 3156 ± 383g, with 1.8% of cases having a birth weight ≥4000g and 3.6% with <2500g. Neonatal birth weight was positively correlated with maternal weight, height, BMI, 6mgWg, gestational age, and placental weight ($p < 0.05$). Maternal age was not significantly correlated with neonatal birth weight ($p = 0.08$). The odds ratio for macrosomia was 3.1 for mothers with 6mgWg ≥15kg, 6.3 for those with gestational diabetes mellitus, and 4.1 for those with BMI ≥30kg/m^2. Macrosomia was associated with adverse events, including hypoglycemia rates of 33.3% (initial blood sugar 40-59 mg/dL) and 15.4% (initial blood sugar <40 mg/dL).
7	Chen, HM, et al. (2022).	Relationship of maternal body weight and gestational diabetes mellitus with large-for-gestational-age babies at birth in Taiwan: The TMICS cohort	Nine hospitals throughout Taiwan.	prospective cohort study.	1428 pregnant women in the late stages of pregnancy from nine hospitals across Taiwan.	Maternal overweight/obesity and GDM were independently associated with LGA. The combination of GDM and overweight/obesity has a greater impact on LGA than either condition alone. Subjects with a pre-pregnancy BMI ≥24 were 2.46 times more likely to give birth to an LGA (WHO growth reference) baby. Subjects with a gestational BMI > 28.4 were 3.28 times more likely to deliver an LGA (WHO growth reference) baby. Subjects with GDM were 7.55 times more likely to deliver LGA (WHO growth reference) babies.
8	Zhu, SM, et al.. (2022)	Maternal lipid profile during early pregnancy and birth weight: A retrospective study	Two major maternity centers in Shanghai, China	Retrospective cohort study	57,516 women with a singleton live birth between January 2018 and October 2020	Higher maternal concentrations of TC, TG, and LDL-c in early pregnancy are associated with increased birth weight. Ln-transformed TG and LDL-c showed a positive association with LGA and macrosomia. Ln transformed TG and levels showed a negative association with SGA (OR = 0.73, 95% CI: 0.62, 0.85). The high TG group (>75th percentile, 1.67 mmol/L) showed a higher risk of LGA and macrosomia and a decreased prevalence of SGA. A significant combined effect of pre-pregnancy BMI and lipid profile on LGA and macrosomia was identified.

9	Adugna, DG and Worku, MG. (2022).	Maternal and neonatal factors associated with low birth weight among neonates delivered at the University of Gondar comprehensive specialized hospital, Northwest Ethiopia.	Gondar University Comprehensive Specialty Hospital	cross-sectional study.	481 research participants were selected using a systematic random sampling method..all mother-newborn pairs attending delivery at Gondar University Comprehensive Specialized Hospital	The prevalence of low birth weight was 12.5% (95% CI; 9.8, 15.7%). Premature birth increased the odds of low birth weight by 38 times (AOR = 38; 95% CI: 15.3, 93.0). Pregnancy-induced hypertension (PIH) increased the odds of low birth weight by 2.6 times (AOR = 2.6; 95% CI: 1.1, 6.4). Maternal BMI < 18.5 kg/m^2 increased the likelihood of low birth weight by 6.8 times (AOR = 6.8; 95% CI: 1.5, 31.1). Major multiparity increased the odds of low birth weight by 4.2 times (AOR = 4.2; 95% CI: 1.2, 16). Maternal age > 35 years reduced the likelihood of low birth weight (AOR = 0.14; 95% CI 0.03, 0.7)
10	Alannaz, WAA, et al. (2024).	Obesity Prevalence and Its Impact on Maternal and Neonatal Outcomes among Pregnant Women: A Retrospective Cross-Sectional Study Design	King Fahad National Guard Hospital, King Abdulaziz Medical City, Riyadh, Saudi Arabia	retrospective cross-sectional study	341 pregnant women with obesity from a total group of 8426	40.5% of pregnant women in the study were classified as obese, with nearly half falling into obesity class II based on BMI. Obesity is significantly correlated with adverse maternal outcomes such as gestational diabetes and increased rates of cesarean delivery. Maternal obesity is associated with adverse fetal outcomes, including higher rates of neonatal intensive care unit admission, lower APGAR scores at 1 minute, and greater odds of macrosomia. Statistically significant associations were found between obesity class and seven maternal outcome characteristics, including gestational diabetes (p = 0.00), anemia (p = 0.048), cesarean section (p = 0.050), reason for CS (p = 0.039), postpartum complications (p = 0.00), type of postpartum complications (p = 0.001), and length of maternal hospital stay (p = 0.039).

4. Discussion

4.1. Correlation Between knowledge and personal hygiene during mestruation

Based on a review of 10 articles, 9 articles showed a significant correlation between maternal BMI and neonatal birth weight and 1 articles showed no significant association between overweight/obesity and macrosomia. These studies emphasize Maternal BMI may be associated with large for gestational age in obese mothers and small for gestational age in underweight mothers. However, one article explains that nutrition plays a greater role than maternal nutritional status.

In the first study by Gyamfi et al., conducted in Northern Ghana, high rates of low birth weight (22.2%) and macrosomia (8.7%) were found. Maternal anemia in the first and third trimesters increased the risk of low birth weight, while advanced gestational age and higher socioeconomic status predicted macrosomia. The paper recommended nutritional counseling and improved health services to address this issue. The study showed no significant association between overweight/obesity and macrosomia (4).

In a second study conducted by Aji et al., the study found that pre-pregnancy BMI and gestational weight gain (GWG) significantly impact pregnancy outcomes in Indonesian women. Overweight/obese women have a higher risk of excessive GWG, while inadequate GWG increases the risk of low birth weight, and excessive GWG increases the risk of macrosomia. These findings highlight the importance of weight management for a healthy pregnancy (5).

A third study by Ambreen et al. found that low maternal nutritional status (underweight BMI and low MUAC) was strongly associated with adverse birth outcomes such as small for gestational age (SGA) and low birth weight (LBW) in suburban Karachi. Although these tools are common, their predictive ability for newborn size is modest, suggesting the need for better assessment methods or combinations of tools (6).

A fourth study conducted by Rouhana et al. using a retrospective study at Notre Dame de Secours University Hospital in Lebanon showed that maternal body mass index (BMI) and gestational weight gain (GWG) were closely associated with neonatal outcomes. Mothers with underweight/normal BMI were more likely to experience low weight gain, vaginal delivery, and deliver babies of appropriate gestational age, while obese mothers were at higher risk of excessive weight gain, cesarean delivery, and large-for-gestational-age (LGA) babies. Furthermore, low weight gain during pregnancy increased the risk of small-for-gestational-age (SGA) babies, while excessive weight gain was associated with LGA babies and neonatal hypoglycemia. These findings suggest that both extremes of BMI and GWG, whether too low or too high, can negatively impact neonatal outcomes, making monitoring maternal weight and nutritional status during pregnancy crucial for preventing maternal and neonatal complications (7).

A fifth study by Neal et al. found that higher obesity classes in pregnant women increased the risk of adverse maternal and neonatal outcomes, independent of diabetes. Specifically, increasing obesity classes were associated with higher rates of cesarean section, gestational diabetes, hypertensive disorders, and a 49% increased risk of LGA in neonates. Reducing obesity classes before pregnancy is crucial to reduce these risks (8).

In a sixth study by Chen YH et al., maternal factors such as gestational diabetes, weight gain, and BMI were significantly associated with neonatal macrosomia in full-term singleton births. Macrosomia increases the risk to both mother and newborn, emphasizing the need for maternal counseling on weight management and appropriate birth planning (9).

In the seventh study by Chen HM et al., conducted in Taiwan, they found that maternal overweight/obesity and gestational diabetes (GDM) were independently associated with having a large-for-gestational-age (LGA) baby. The combination of these factors significantly increased the risk of LGA, indicating a greater impact than either condition alone. This highlights the importance of managing maternal weight and GDM during pregnancy (10).

An eighth study by Zhu et al. found that elevated maternal lipid levels in early pregnancy were associated with higher birth weight and an increased risk of large-for-gestational-age (LGA) and macrosomia. This suggests that pre-pregnancy lipid profile and BMI screening may help identify high-risk women for better prenatal care (11).

A ninth study by Adugna and Worku. found a high prevalence of low birth weight (12.5%) in Northwest Ethiopia. Preterm birth, pregnancy-induced hypertension, low maternal BMI, and high multiparity were identified as major risk factors. Conversely, maternal age over 35 years was associated with a lower likelihood of low birth weight (12).

The tenth research conducted by Alannaz et al, found that 40.5% of pregnant women in Saudi Arabia were obese, with nearly half having class II obesity. Maternal obesity is significantly correlated with adverse outcomes such as gestational diabetes, increased cesarean section rates, and adverse fetal outcomes, including higher NICU admissions and macrosomia. Targeted educational programs focusing on BMI control and lifestyle changes are recommended to reduce these complications (13).

5. Conclusion

A review of ten journal articles demonstrated that most studies reported an association between maternal body mass index (BMI) and neonatal birth weight. Maternal BMI was found to be associated with the risk of delivering infants who are large for gestational age among obese mothers and small for gestational age among underweight mothers. However, one study suggested that maternal nutritional intake may have a greater influence on neonatal birth weight than maternal nutritional status alone. Therefore, screening for pre-pregnancy lipid profiles and BMI is important to identify women at high risk and to support improved prenatal care. In addition, targeted educational programs focusing on BMI management and healthy lifestyle modifications are recommended to reduce pregnancy-related complications. Health care professionals have an essential role in this process, not only through early screening but also by providing education and counseling regarding BMI management and adequate nutritional intake to support a healthy pregnancy.

Compliance with ethical standards

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Disclosure of conflict of interest

There is one finding that contradict the theory.

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