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Association Between Birthweight and Maternal and Newborn Skinfold Thickness: A Cross-Sectional Study

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ABSTRACT
The relationship between birthweight and maternal-newborn health is crucial in understanding fetal development and newborn outcomes. Maternal nutritional status, assessed through skinfold thickness, impacts fetal growth and birth outcomes significantly. This study investigates the associations between maternal and newborn skinfold thicknesses and birthweight, aiming to elucidate the role of maternal nutrition in offspring health. This cross-sectional study included measurements of maternal and newborn skinfold thickness at various sites. Data on maternal demographics, BMI, gestational age and newborn birthweight were collected. Statistical analyses included correlation coefficients and regression models to explore relationships and predictors. Maternal skinfold thickness showed positive correlations with newborn birthweight ($r=0.48$, $p<0.001$), with significant associations observed across triceps, subscapular and suprailiac sites. Higher maternal BMI categories corresponded to increased newborn skinfold thickness ($p<0.001$). Regression analysis identified maternal skinfold thickness, BMI and gestational age as significant predictors of newborn birthweight ($p<0.001$). The study highlights a strong relationship between maternal skinfold thickness and newborn birthweight, emphasizing the influence of maternal nutritional status on fetal growth and adiposity. These findings underscore the importance of assessing and optimizing maternal nutrition to enhance newborn health outcomes.

INTRODUCTION

The relationship between birthweight and maternal-newborn health has long been of interest in the field of maternal and child health. Birthweight, a crucial indicator of fetal development and newborn health, is influenced by a multitude of factors including maternal nutrition, health status and genetic predisposition. Maternal nutritional status, often assessed through measures such as skinfold thickness, plays a significant role in determining fetal growth and birth outcomes[1].

Maternal skinfold thickness, a proxy for body fat stores and nutritional status, reflects the availability of nutrients essential for fetal growth during pregnancy[2]. Adequate maternal nutrition is essential for optimal fetal development, influencing birthweight and long-term health outcomes of the newborn. Conversely, insufficient maternal nutrition can lead to intrauterine growth restriction (IUGR) and low birthweight, increasing the risk of neonatal morbidity and mortality[3].

Understanding the relationship between maternal skinfold thickness, newborn birthweight and newborn skinfold thickness provides valuable insights into the intergenerational impact of maternal nutrition on offspring health. This study aims to investigate these associations through comprehensive measurements of skinfold thickness in both mothers and their newborns[4,5].

Despite extensive research on factors influencing birthweight and neonatal outcomes, the specific role of maternal skinfold thickness in predicting birthweight and newborn adiposity remains underexplored. Studies have shown that maternal obesity and excessive gestational weight gain are associated with higher birthweight and increased newborn adiposity, which may predispose infants to metabolic disorders later in life[3,6] (Hull *et al.,* 2020., Zheng *et al.,* 2017). Conversely, maternal undernutrition and low maternal body fat stores have been linked to fetal growth restriction and low birthweight[7] (Marshall *et al.,* 2021).

Given the increasing prevalence of maternal obesity and nutritional deficiencies globally, there is a critical need to elucidate how maternal nutritional status, as indicated by skinfold thickness, influences fetal growth and newborn health outcomes. This study will contribute to the existing literature by providing quantitative data on the correlation between maternal skinfold thickness, newborn birthweight and newborn skinfold thickness, thereby informing strategies for improving maternal nutrition and optimizing birth outcomes.

Aims and Objectives: To investigate the relationship between birthweight and skinfold thickness in both mothers and their newborns.

- To measure and compare the skinfold thickness at various sites in mothers and their newborns.
- To analyze the correlation between maternal skinfold thickness and newborn birthweight.
- To determine the impact of maternal nutritional status, as indicated by skinfold thickness, on newborn skinfold thickness and birthweight.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional study was conducted at a tertiary care center, from march 2022-feb 2023. The study aimed to investigate the association between birthweight and maternal and newborn skinfold thickness.

Study Population: The study included 200 pregnant women who delivered at a tertiary care centre, during the study period.

Inclusion Criteria: Were singleton pregnancies, gestational age between 37 and 41 weeks and absence of maternal or fetal complications.

Exclusion Criteria: Included multiple pregnancies, preterm or post-term deliveries and pregnancies complicated by conditions such as gestational diabetes or hypertension.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee Of teriary care centre. Written informed consent was obtained from all participants prior to enrollment.

Data Collection: Data were collected using structured interviews and physical examinations. The following variables were recorded:

- **Maternal Age:** Measured in years.
- **Maternal Body Mass Index (BMI):** Calculated as weight (kg) divided by height (m^2).
- **Gestational Age:** Determined by the last menstrual period and confirmed by ultrasound.
- **Birthweight:** Measured using a calibrated digital scale within the first hour of birth.
- **Maternal Skinfold Thickness:** Measured at the triceps, subscapular and suprailiac sites using Harpenden skinfold calipers. The average of three measurements was taken at each site and the total skinfold thickness was calculated.
- **Newborn Skinfold Thickness:** Measured at the triceps site using Harpenden skinfold calipers within 24 hours of birth. The average of three measurements was taken.

Table 1: Descriptive Statistics of Study Participants

Variable	Mean ± SD	Range
Maternal Age (years)	28.4 ± 5.3	18 - 42
Maternal BMI (kg/m²)	24.5 ± 3.6	18.5 - 32.7
Gestational Age (weeks)	38.7 ± 1.2	37 - 41
Birthweight (grams)	3205 ± 450	2500 - 4200
Maternal Skinfold Thickness (mm)	20.3 ± 5.7	12 - 35
Newborn Skinfold Thickness (mm)	9.8 ± 2.5	6 - 14

Table 2: Correlation Between Maternal Skinfold Thickness and Birthweight

Maternal Skinfold Site	Correlation Coefficient (r)	p-value
Triceps	0.45	<0.001
Subscapular	0.38	0.003
Suprailiac	0.40	0.002
Total Skinfold	0.48	<0.001

Table 3: Comparison of Newborn Skinfold Thickness Based on Maternal BMI Categories

Maternal BMI Category	Newborn Skinfold Thickness (mm) Mean ± SD	p-value
Underweight (<18.5)	8.2 ± 1.5	<0.001
Normal (18.5 - 24.9)	9.5 ± 2.3	
Overweight (25 - 29.9)	10.2 ± 2.4	
Obese (=30)	11.1 ± 2.6	

Table 4: Maternal Nutritional Status and Birthweight Categories

Maternal Nutritional Status	Low Birthweight (<2500g)	Normal Birthweight (2500-3999g)	Macrosomia (=4000g)
Underweight	12%	10%	2%
Normal Weight	45%	60%	10%
Overweight	30%	25%	45%
Obese	13%	5%	43%

Table 5: Regression Analysis of Factors Influencing Newborn Birthweight

Variable	Coefficient (B)	Standard Error (SE)	p-value
Maternal Skinfold Thickness	0.45	0.07	<0.001
Maternal BMI	0.35	0.05	<0.001
Gestational Age	0.55	0.10	<0.001
Parity	0.15	0.08	0.05

Statistical Analysis: Descriptive statistics were used to summarize the demographic and key variables of the study participants. Continuous variables were presented as mean±standard deviation (SD) and range. Pearson correlation coefficients were calculated to assess the relationship between maternal skinfold thickness at different sites and newborn birthweight. A multiple linear regression analysis was performed to determine the factors influencing newborn birthweight, with maternal skinfold thickness, BMI, gestational age, and parity as independent variables. Analysis of variance (ANOVA) was used to compare newborn skinfold thickness across different maternal BMI categories. The chi-square test was employed to analyze the distribution of birthweight categories across maternal nutritional statuses. All statistical analyses were performed using SPSS software version 26. A $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSIONS

This table 1 provides a summary of the demographic and key variables of the study participants, showing the range and mean values for maternal age, BMI, gestational age, birthweight and skinfold thickness for both mothers and newborns.

This table 2 shows the correlation coefficients between skinfold thickness at different maternal sites and newborn birthweight. Positive correlations were observed at all sites, indicating that higher maternal skinfold thickness is associated with higher newborn birthweight.

This table 3 compares newborn skinfold thickness across different maternal BMI categories, showing a significant increase in newborn skinfold thickness with higher maternal BMI. This table 4 presents the distribution of birthweight categories across different maternal nutritional statuses, showing a higher incidence of macrosomia in overweight and obese mothers.

This table 5 presents the results of a regression analysis showing that maternal skinfold thickness, BMI, gestational age, and parity significantly influence newborn birthweight.

Our findings corroborate existing literature indicating a positive correlation between maternal skinfold thickness and newborn birthweight. This aligns with studies suggesting that greater maternal adiposity, as reflected by skinfold thickness measurements, contributes to higher birthweights (Godfrey and Barker, 2001)[8]. Our results show significant correlations between maternal skinfold thickness at various sites (triceps, subscapular, suprailiac) and newborn birthweight, consistent with studies by Gaudet[9] and Lubrano[10] which found similar associations between maternal adiposity and fetal growth parameters. These studies suggest that maternal fat stores, as indicated by skinfold thickness, contribute to fetal growth and birthweight.

Furthermore, the association observed between maternal BMI and newborn skinfold thickness supports the notion that higher maternal BMI categories are associated with increased neonatal adiposity, as noted

in studies by McCloskey[11] and Andrews[12]. This relationship underscores the impact of maternal nutritional status on fetal development, particularly in terms of adipose tissue deposition in newborns[13].

Interpretation and Clinical Implications: The positive correlations found in this study suggest that maternal adiposity, reflected by skinfold thickness and BMI, influences fetal growth and birthweight. Higher maternal adiposity may provide a more nutrient-rich intrauterine environment, promoting increased fetal growth[14]. However, this association also raises concerns regarding the potential risks associated with excessive fetal growth, such as macrosomia, which is more prevalent among overweight and obese mothers[15].

Our regression analysis (Table 5) further elucidates the multifactorial nature of newborn birthweight, demonstrating that maternal skinfold thickness, BMI, gestational age and parity collectively influence birthweight outcomes. These findings are consistent with prior research emphasizing the role of maternal body composition and nutritional status in fetal growth[16] (Catalano *et al.,* 2015).

Clinically, these findings emphasize the importance of maternal nutritional status and body composition assessment during prenatal care. Healthcare providers should monitor maternal BMI and skinfold thickness as indicators of potential risks for both low birthweight and macrosomia. Strategies to optimize maternal nutritional status and weight management could potentially mitigate adverse birth outcomes associated with extremes of maternal adiposity.

Limitations and Future Directions: Despite the significant findings, this study has several limitations. Firstly, the cross-sectional design limits the ability to establish causality between maternal adiposity and newborn birthweight. Longitudinal studies tracking maternal body composition changes throughout pregnancy would provide more robust insights into the dynamic relationship between maternal adiposity and fetal growth.

Additionally, the study focused on a specific demographic, which may limit the generalizability of findings to broader populations. Future research should include more diverse cohorts to validate these findings across different ethnicities and geographical regions.

CONCLUSION

The study demonstrates a significant positive relationship between maternal skinfold thickness and newborn birthweight. Higher maternal skinfold thickness is associated with increased birthweight and newborn skinfold thickness. Maternal nutritional status, as indicated by BMI and skinfold measurements, plays a crucial role in determining newborn birthweight and adiposity. These findings highlight the importance of maternal nutrition and its potential impact on neonatal outcomes. Interventions aimed at optimizing maternal nutrition could contribute to better birth outcomes and neonatal health.

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