

CORRELATION BETWEEN MATERNAL PRE-PREGNANCY WEIGHT, GESTATIONAL WEIGHT GAIN, PHYSICAL ACTIVITY, SLEEP PATTERN, DIET DIVERSITY AND NEONATAL ANTHROPOMETRIC MEASUREMENTS

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ABSTRACT

Background: Neonatal anthropometric indicators play a significant role as indicators of intrauterine growth. Maternal factors, including pre-pregnancy weight, weight gain during pregnancy, dietary adequacy, physical exercise, and sleep habit, could have an impact on the birth weight of the infant and general growth measures.

Aim: To estimate the correlation between maternal factors and anthropometrical values of the term neonates.

Methods: A cross-sectional study was done in the Neonatology Unit of Chettinad Health and Research Institute and had 419 mother-neonate pairs chosen through consecutive sampling. We included term neonates whose antenatal history was normal and who did not have any congenital anomaly. Standardized anthropometric measurements were done for Neonates. Structured interviews and antenatal records were used to collect maternal data. Pearson correlation and odds ratios with 95% confidence intervals were used in the statistical analysis.

Findings: The average birth weight was 2.85 kg/m². It was found that 26 percent of neonates had low weight at birth. The MUAC and head circumference had a significant positive correlation with birth weight ($r = 0.15$, $p = 0.001$ and $r = 0.25$, $p = 0.001$ respectively). Low maternal weight had a connection with low birth weight (OR = 3.62; 95% CI: 1.51–8.61; $p = 0.002$).

Conclusion: Maternal nutrition have a significant relationship with birth weight. Enhancing antenatal nutrition interventions could be used to improve birth weight.

Keywords: Low birth weight; Neonatal anthropometry; Gestational weight gain; Maternal nutrition; Physical activity; Sleep pattern; Diet diversity.

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Introduction:

Major indicators of intrauterine growth and early neonatal health are anthropometric parameters of birth weight and mid-upper arm circumference (MUAC) and head circumference. Low birth weight (LBW) is a significant social health issue and is

linked to a high level of morbidity and mortality among neonates as well as the future risk of metabolic and cardiovascular complications [1,2].

The pre-pregnancy and pre-natal status of the maternity have a key role to play in determining fetal growth. Motherly nutritional reserves are indicated by pre-pregnancy weight and the

cumulative outcomes of fetal growth and maternal tissue expansion are indicated by the gestational weight gain (GWG). Poor and excessive GWG have been linked to poor neonatal outcomes such as LBW and distorted neonatal body composition [3,4]. In this regard, the Institute of Medicine highlights the best GWG owing to pre-pregnancy body mass index to enhance the perinatal results [5].

Micronutrient adequacy and overall nutritional intake is considered through dietary quality in pregnancy, which is usually measured in terms of dietary diversity. There is evidence that dietary low diversity has a great linkage with LBW and neonatal growth retardation especially in low and middle-income environments [6,7]. In addition to nutrition, other lifestyle aspects of mothers including physical exercise and sleep patterns affect the metabolic regulation of pregnancy. Moderate exercise has been reported to positively affect the outcome of pregnancies whereas poor sleep duration and quality have been linked to gestational metabolic disruptions and negative outcome in the new baby [8-10].

Although there are findings on the individual determinants, there are few studies that have assessed the overall effect of maternal pre-pregnancy weight, GWG, dietary diversity, physical activity, and sleep patterns on anthropometric measurements of the babies. This research will determine the relationship between these maternal variables and neonatal anthropometry in a cohort of mother-newborns.

Aim:

To estimate the correlation between maternal factors and neonatal anthropometrical values of the term neonates.

Methodology:

This cross-sectional study was carried out in the Neonatology Unit of Chettinad Health and Research Institute between June 2025 and January 2026. A total of 419 mother–neonate pairs were recruited using consecutive sampling. Only mothers with an uncomplicated antenatal history who delivered term babies without congenital anomalies or neonatal complications were included. Pregnancies with complications, preterm births, or neonates with postnatal issues were excluded to ensure a homogenous study population.

On the first day of life, each newborn underwent standardized anthropometric assessment. Birth weight was measured using a calibrated electronic scale with a precision error of 0.010 g. Length was recorded with an infantometer, while head circumference was measured using a non-stretchable tape, following validated anatomical landmarks. Mid-upper arm circumference was also assessed to provide a comprehensive profile of neonatal growth [11].

Maternal information was collected through structured interviews and review of

antenatal records. Particular attention was given to dietary practices during pregnancy, as maternal nutrition was considered a key exposure variable in relation to neonatal birth outcomes [12].

Statistical analysis:

Pearson correlation, Chi-square test, odds ratios were used as a statistical test to compare maternal factors and newborn weight and 95% confidence intervals were used to analyze the data; $p < 0.05$ was the statistically significant.

Table 1: Characteristics of Patients

Characteristics	No of Participants (n = 419)
Maternal age (years)	26.11 ± 3.05
Working women	90 (21)
Home maker	329 (79)
Rural	92 (22)
Urban	327 (78)
Pregnancy weight gain (kg)	10.68 ± 3.964

A total of 419 mother–neonate pairs were included in the study. The mean maternal age was 26.11 ± 3.05 years. Most mothers were homemakers (79%) With regard to place of residence, a predominantly urban population was observed, with 327 mothers (78%) residing in urban areas and 92 (22%) from rural settings. The mean gestational weight gain among the mothers was 10.68 ± 3.96 kg.

Table 2: Distribution of Study Participants by Key Variables

Variables	No of Participants (n = 419)
Diet	Good diet 397 (95)
	Poor diet 22 (5)
Birth weight	Normal 308 (74)
	Low birth weight 111 (26)
Mid Upper arm Circumference	>9.5 cm 309 (73.7)
	<9.5 cm 110 (22.3)
Head Circumference	34 – 36 cm 265 (63.2)
	<34 cm 154 (36.8)

Among the 419 participants, the majority reported having a good diet, with 95% falling into this category, while only a small fraction (5%) had a poor diet. Birth weight distribution showed that nearly three-fourths of the participants (74%) had a normal birth weight, whereas about one-fourth (26%) were born with low birth weight.

Nutritional status assessed through mid-upper arm circumference revealed that (73.7%) had measurements above 9.5 cm, indicating better nutritional reserves, while 22.3% had values below 9.5 cm, suggestive of undernutrition. Similarly, head circumference measurements showed that 63.2% of

participants had values within the normal range of 34–36 cm, while 36.8% had smaller head sizes.

Table 3: Anthropometry measurements

Anthropometry measurements	Mean Standard deviation
Birth weight of the newborn (kg)	2.85 ± 0.363
Mid upper arm circumference (cm)	9.73 ± 1.312
Head circumference (cm)	34.84 ± 1.60

The mean birth weight of the newborns in the study was 2.85 ± 0.36 kg, indicating that, on average, neonates had a birth weight within the normal range. The mean mid-upper arm circumference was 9.73 ± 1.31 cm, reflecting adequate soft tissue growth in most neonates. The mean head circumference was 34.84 ± 1.60 cm, suggesting that a considerable proportion of newborns had head circumference values close to the lower limit of the normal range.

Table 4: Bivariate Correlations with Neonatal Birth Weight

Parameters	Birth weight of the newborn (kg)	Correlation	p-value
Pregnancy weight gain (kg)	2.85 ± 0.363	0.37	0.001*
10.68 ± 3.964			
Mid upper arm circumference (cm)	9.73 ± 1.312	0.15	0.001*
Head circumference (cm)	34.84 ± 1.60	0.25	0.001*

**p* < 0.05 considered as significant

Pregnancy weight gain was positively correlated with neonatal birth weight (*r* = 0.37, *p* = 0.001), while mid-upper arm circumference (*r* = 0.15, *p* = 0.001) and neonatal head circumference (*r* = 0.25, *p* = 0.001) also showed significant positive associations.

Table 5: Association of Maternal Factors with Low Birth Weight

Diet	Birth weight		Odds ratio	p-value
	Normal	Low Birth weight		
Good diet	298	99	3.62 (1.51 – 8.61)	0.002*
Poor diet	10	12	–	

**p* < 0.05 considered as significant

Analysis of maternal factors revealed a significant association between dietary pattern and neonatal birth weight. Mothers with a good dietary pattern had a significantly lower likelihood of delivering low birth weight neonates compared to those with a poor diet (odds ratio [OR] = 3.62; 95% CI: 1.51–8.61; *p* = 0.002).

Discussion:

This research compared the maternal variables with the anthropometric indices of the newborn in 419 term mother-neonate and proved that neonatal biomasses of birth weight, mid-upper arm circumference (MUAC), head circumference (HC), and chosen maternal factors were significantly associated.

The reported low birth weight (LBW) prevalence of our study is 26% and Other studies by reported similar prevalence Bharati P et al 20%, Mallick A et al 20.73% and Bhilwar M et al 27% both of which is similar to our study results [13-15]. Our investigation Presented a GWG mean of 10.68 + 3.964 kg. This is a little less than the Institute of Medicine (IOM) recommendation of women with normal BMI which indicates an increase of 11.516 kg [5]. Like our results, one study conducted by Neggers Y et al. established that inadequate GWG was a direct predictor of reduced neonatal anthropometric measurements [16]. The fact that the correlation between birth weight and MUAC (*r* = 0.15) and head circumference (*r* = 0.25) in our study are positive indicates that when there is suboptimal maternal weight gain, both the soft tissue deposition (indicated by MUAC) and skeletal development (indicated by head circumference) are impaired.

The main observation in this research was a close relationship between maternal diet and birth outcome. Poor dietary status of mothers increased the risk of giving birth to LBW babies significantly (OR 3.62; 95% CI: 1.518.61). This is in line with studies by Kebede AN et al. who found that low diversity in the diet of expecting women doubles the risk of LBW almost four to one in low-income environments [17]. We have a mean MUAC of 9.73 / standard error of 1.312 cm; this result corresponds to previous studies which report that a MUAC of less than 9.5 cm is a highly sensitive predictor of LBW newborn. The mean head circumference of our study 34.84 ± 1.60 cm was less towards the lower end of the normal range. A study by Garcia-Alix A et al. found that the lower head circumference of the neonates is a risk factor of neurodevelopmental delays and maternal factors affect not only the weight of the babies, but also the development of vital organs [18].

Limitations:

The cross-sectional design does not allow casual conclusions on maternal factors and neonatal outcomes. Maternal diet, exercise and sleeping patterns were measured using self-reported data, which can be prone to recall and reporting bias. The

research was further carried out at a single tertiary care center, and this could not be generalized to other settings/populations.

Conclusion:

According to the study, there is a strong correlation between neonatal birth weight and maternal characteristics and anthropometric measurements. Neonatal mid-upper arm circumference and head circumference were found to significantly positively correlate with birth weight, suggesting that these straightforward anthropometric measurements accurately represent total foetal growth. Birth weight and the mother's eating habits were strongly correlated, with a poor diet greatly raising the risk of low birth weight babies. Additionally, there was a significant correlation between birth weight and the mode of delivery. These results emphasise the significance of healthy gestational practices and optimal maternal nutrition in enhancing neonatal outcomes. Reducing the burden of low birth weight and improving neonatal health may be achieved by strengthening prenatal nutritional counselling, encouraging balanced dietary intake, and early detection of at-risk pregnancies.

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