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# Exploring the Link Between Cord Blood Lipid Profile and Neonatal Anthropometric Characteristics

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**Abstract**

Background: The purpose of this study was to look into the connections between the lipid profiles of cord blood and the anthropometric measurements, gender, and delivery mode of newborns.

Methods: Lipid profiles were examined after 300 infants' cord blood samples were taken. For every infant, anthropometric measures, gender, and delivery method were noted. The relationships between the lipid parameters found in cord blood and the features of newborns were investigated using correlation analysis and t-tests.

Findings: Total cholesterol (TC) was significantly connected with birth weight and head circumference, while triglycerides (TG) was positively correlated with neonatal length. The research also showed substantial relationships between cord blood lipid parameters and anthropometric data. Nonetheless, no appreciable variations in the lipid profiles of the cord blood were identified between neonates born vaginally and through cesarean section, or between male and female neonates.

Conclusion: In conclusion, the results underscore the significance of lipid metabolism in promoting ideal fetal development and point to a possible relationship between cord blood lipid profiles and newborn growth. Further research is necessary to clarify the underlying mechanisms and long-term implications of cord blood lipid profiles on metabolic health outcomes, even though gender and mode of delivery did not significantly affect cord blood lipid profiles in the population under study.

Keywords: Cord blood, Lipid profile, Neonatal, Anthropometric characteristics, Triglycerides

## Introduction

Neonatal health is a critical aspect of public health, as it sets the foundation for an individual's lifelong well-being. Understanding the factors that influence neonatal growth and development is essential for identifying early markers of health and disease. One such factor

of increasing interest is the lipid profile present in cord blood, which may play a significant role in shaping neonatal anthropometric characteristics and metabolic health [1-3].
Birth weight, length, and head circumference are common anthropometric measures that are used to determine the growth and nutritional status of newborns. These parameters act as indicators of future health outcomes, such as the likelihood of developing metabolic syndrome, cardiovascular disease, and obesity in later life, in addition to reflecting intrauterine development [1]. Neonatal anthropometry is therefore extremely important from a clinical and epidemiological standpoint.
Lipids are fundamental components of cellular membranes and play vital roles in various physiological processes, including energy storage, hormone synthesis, and cell signaling. During pregnancy, lipids are transported across the placenta to meet the growing demands of the developing fetus. Cord blood, the blood collected from the umbilical cord at birth, provides a window into the fetal environment and reflects the lipid milieu to which the fetus is exposed during gestation [2]. Therefore, analyzing cord blood lipid profiles can offer valuable insights into fetal metabolic programming and neonatal health [3-6].
According to recent studies, anomalies in newborn growth patterns and metabolic function may be caused by disruptions in prenatal lipid metabolism. For example, macrosomia, a disorder marked by abnormal fetal growth and higher birth weight, has been linked to elevated levels of triglycerides and low-density lipoprotein cholesterol (LDL-C) in cord blood [3]. On the other hand, low HDL-C levels have been associated with a number of unfavorable newborn outcomes, such as intrauterine growth restriction and premature birth [4]. These results highlight how crucial it is to comprehend the complex interactions between lipid metabolism and the health of newborns.
Despite growing evidence linking cord blood lipid profiles to neonatal outcomes, many questions remain unanswered. The mechanisms underlying the observed associations are not fully elucidated, and conflicting findings have been reported in the literature. Factors such as maternal diet, genetics, and environmental exposures may influence fetal lipid metabolism and subsequently impact neonatal anthropometric characteristics [5]. Moreover, the long-term implications of altered cord blood lipid profiles on childhood and adult health outcomes warrant further investigation [5-9].
Given the complex interplay between cord blood lipid profiles and neonatal anthropometric characteristics, there is a pressing need for comprehensive research in this field. Understanding how lipid metabolism influences neonatal growth and development may inform strategies for early intervention and prevention of metabolic disorders later in life. Therefore, this study aims to explore the link between cord blood lipid profiles and neonatal anthropometric characteristics, contributing to our understanding of fetal metabolic programming and neonatal health.

**Materials and Methods:**
Study methodology: The association between cord blood lipid profiles and neonatal anthropometric traits was examined in this study using an observational, cross-sectional methodology. The study was designed to allow for thorough data collecting and analysis. It was carried out over a 24-month period.
Study Location: Krishna Hospital in Karad, which acts as a referral facility for maternity and newborn healthcare services, is the name of the tertiary care facility where the study was carried out.
Study Subjects: During the study period, newborns born at Krishna Hospital were included in the study. Neonates who met the 1-minute Apgar evaluation score threshold of >7 and whose parents gave their informed consent were considered for inclusion. Neonatals with congenital abnormalities, perinatal infection, or perinatal hypoxia met the exclusion criteria.

Determining the Sample Size: Taking into account an 11% prevalence, the sample size was determined using the Cochrane formula. In order to guarantee sufficient statistical power and representativeness, a total sample size of 150 neonates was established.
Sampling Procedure: Regardless of the mode of birth, all neonates who met the inclusion criteria were included in the study. To reduce selection bias and guarantee the findings' generalizability, newborns were chosen at random.
Anthropometric Data Collection: Trained healthcare practitioners used standardized methodologies to gather anthropometric measurements. An electronic weighing scale with a 5 gram precision was used to measure birth weight (BW). Head circumference (HC) was measured with a non-stretchable tape, and length was measured with an infantometer. Applying a non-stretchable tape around the umbilicus allowed for the measurement of the abdominal circumference (AC). The formula used to compute the Ponderal Index (PI) was Weight (g)/Length (cm3) × 100.
Assessment of Gestational Age: The Ballard score or the mother's menstrual history were used to calculate gestational age. Based on predicted fetal weight percentiles, neonates were classified as tiny for gestational age, appropriate for gestational age, or large for gestational age.
Biochemical Approximations: After delivery, cord blood was extracted by clamping the umbilical cord. The cord blood lipid profile was examined for total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and high-density lipoprotein (HDL). For precipitation-based estimation techniques, modified polyvinyl sulfonic acid (PVS) and polyethylene glycol methyl ether (PGME) were employed.
Statistical Analysis: Information was gathered via paper-based case report forms, which were then imported into Microsoft Excel 2016. IBM SPSS Version 20 was used to conduct the statistical analysis. The Pearson correlation coefficient was utilized to examine the association between the anthropometric information and the lipid profile of cord blood. To provide an overview of continuous variables, such as means, standard deviations, and ranges, descriptive statistics tables were created. The averages were compared using ANOVA and independent sample T-tests, with a significance threshold of $p < 0.05$. Bar graphs and pie charts have been used to construct visual representations of data distribution.

**Results**

**Table 1: Cord Blood Lipid Profile**

Table 1 presents the lipid profile of cord blood in 150 neonates, indicating notable variability in lipid parameters. The mean values with standard deviations were as follows: Total Cholesterol (TC) at 83.40 mg/dl ± 25.04, Triglycerides (TG) at 55.39 mg/dl ± 13.84, High-Density Lipoprotein (HDL) at 25.22 mg/dl ± 4.17, Low-Density Lipoprotein (LDL) at 59.49 mg/dl ± 14.30, and Very Low-Density Lipoprotein (VLDL) at 9.42 mg/dl ± 2.97. These findings underscore significant diversity in lipid profiles among neonates, reflecting individual variations in lipid metabolism during early life.

**Table 2: Anthropometric Data**

Table 2 displays anthropometric data of the neonates, revealing a range of measurements. Birth weight exhibited a mean of 2688.92 grams with a standard deviation of ± 441.32, ranging from 1860 to 3650 grams. Head circumference (HC) averaged at 33.37 cm (SD ± 2.32), ranging from 30 to 37 cm, while abdominal circumference (AC) averaged 30.02 cm (SD ± 2.70), ranging from 26 to 35 cm. Neonatal length averaged 48.61 cm (SD ± 2.41), ranging from 45 to 53 cm. These measurements provide valuable insights into the physical characteristics of the neonatal population, facilitating assessments of growth and development during infancy.

**Table 3: Maternal and Neonatal Characteristics**
Table 3 outlines maternal and neonatal characteristics observed in the study. The mean maternal age was 26.17 years (SD ± 4.59), with ages ranging from 18 to 38 years. The majority of mothers (60.67%) were in the age group of 20-30 years. About 56.67% of neonates were male, while 43.33% were female. The study also recorded the mode of delivery, with 54.67% of neonates delivered vaginally and 45.33% delivered via cesarean section. These findings contribute to a comprehensive understanding of the demographic and delivery-related factors influencing neonatal health outcomes.
**Table 4: Correlation Between Cord Blood Lipid Profile and Anthropometric Measurements**
Table 4 presents the correlation coefficients between cord blood lipid profile parameters and anthropometric measurements of neonates. The analysis revealed significant correlations between certain lipid parameters and anthropometric variables. Specifically, Total Cholesterol (TC) showed a positive correlation with birth weight ($r = 0.412$, $p < 0.05$) and head circumference ($r = 0.368$, $p < 0.05$). Triglycerides (TG) exhibited a positive correlation with birth weight ($r = 0.284$, $p < 0.05$) and neonatal length ($r = 0.256$, $p < 0.05$). These findings suggest potential associations between lipid metabolism and neonatal growth parameters, highlighting the interplay between metabolic health and physical development during the early stages of life.
**Table 5: Comparison of Cord Blood Lipid Profile Between Male and Female Neonates**
Table 5 compares the lipid profiles of cord blood between male and female neonates. The analysis revealed no significant differences in Total Cholesterol (TC), Triglycerides (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), or Very Low-Density Lipoprotein (VLDL) levels between male and female neonates ($p > 0.05$ for all parameters). These findings indicate that gender does not appear to exert a significant influence on cord blood lipid profiles in the studied population, suggesting similar metabolic characteristics between male and female neonates at birth.
**Table 6: Comparison of Cord Blood Lipid Profile Between Vaginal and Cesarean Delivery**
Table 6 compares the lipid profiles of cord blood between neonates delivered vaginally and via cesarean section. The analysis revealed no significant differences in Total Cholesterol (TC), Triglycerides (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), or Very Low-Density Lipoprotein (VLDL) levels between neonates delivered vaginally and via cesarean section ($p > 0.05$ for all parameters). These findings suggest that the mode of delivery does not significantly impact cord blood lipid profiles in the studied population, indicating similar metabolic profiles regardless of the delivery method.

**Discussion:**
The present study investigated the relationship between cord blood lipid profiles and various neonatal characteristics, including anthropometric measurements, gender, and mode of delivery. The findings shed light on the metabolic status of neonates at birth and provide valuable insights into the factors influencing lipid metabolism during early development.
**Cord Blood Lipid Profile and Anthropometric Measurements:**
The correlation analysis revealed significant associations between cord blood lipid parameters and anthropometric measurements of neonates. Specifically, Total Cholesterol (TC) exhibited positive correlations with birth weight and head circumference, while Triglycerides (TG) showed positive correlations with birth weight and neonatal length. These findings suggest a potential link between lipid metabolism and neonatal growth, highlighting the intricate interplay between metabolic health and physical development during the early stages of life [1-5].

The positive correlation between TC and birth weight is consistent with previous studies demonstrating associations between lipid levels and birth weight in newborns. High birth weight has been linked to increased adiposity and altered lipid metabolism, potentially predisposing individuals to metabolic disorders later in life. The positive correlation between TC and head circumference further underscores the influence of lipid metabolism on neurodevelopment during the perinatal period. Lipids play crucial roles in brain development, and alterations in lipid levels may impact neurodevelopmental outcomes in neonates [4-6].

Similarly, the positive correlation between TG and birth weight suggests a potential role of triglycerides in fetal growth and adiposity. Triglycerides serve as a major energy source during fetal development and are essential for adipose tissue accumulation. The positive correlation between TG and neonatal length further highlights the involvement of triglycerides in overall growth and development. These findings emphasize the importance of lipid homeostasis in supporting optimal fetal growth and development [7-10].

**Gender Differences in Cord Blood Lipid Profile:**

Contrary to expectations, the analysis revealed no significant differences in cord blood lipid profiles between male and female neonates. This finding suggests that gender does not exert a significant influence on lipid metabolism at birth in the studied population. While previous studies have reported gender differences in lipid metabolism and adiposity in adults, the present findings indicate similar metabolic characteristics between male and female neonates at birth [6-10].

The lack of gender differences in cord blood lipid profiles may reflect the influence of prenatal factors such as maternal lipid status and intrauterine environment. Maternal lipid levels can influence fetal lipid metabolism through placental transfer, and alterations in maternal lipid metabolism may affect neonatal lipid profiles regardless of gender. Additionally, genetic and hormonal factors may contribute to the observed similarities in lipid metabolism between male and female neonates [9-11].

**Impact of Mode of Delivery on Cord Blood Lipid Profile:**

The comparison between neonates delivered vaginally and via cesarean section revealed no significant differences in cord blood lipid profiles. This finding suggests that the mode of delivery does not significantly impact lipid metabolism at birth in the studied population. While previous studies have reported associations between cesarean delivery and altered metabolic outcomes in offspring, the present findings indicate similar metabolic profiles regardless of the mode of delivery [11-13].

The lack of differences in cord blood lipid profiles between vaginal and cesarean deliveries may be attributed to various factors, including prenatal care, maternal health status, and neonatal care practices. Adequate prenatal care and monitoring can help mitigate potential metabolic differences associated with mode of delivery. Additionally, advancements in neonatal care and feeding practices may contribute to the normalization of lipid metabolism in neonates delivered via cesarean section [11-15].

**Clinical Implications and Future Directions:**

The findings of this study have several clinical implications for maternal and neonatal care. Understanding the relationship between cord blood lipid profiles and neonatal characteristics can help identify infants at risk of metabolic disorders and inform early intervention strategies. Monitoring lipid levels in neonates may aid in the early detection of metabolic abnormalities and facilitate targeted interventions to promote optimal health outcomes [11,12].

Moreover, the lack of gender differences in cord blood lipid profiles suggests that metabolic screening and monitoring should be conducted regardless of gender. Early identification of metabolic risk factors in neonates can guide personalized interventions and preventive measures to mitigate the long-term health consequences associated with metabolic disorders [5,8].

Future research directions may include longitudinal studies to examine the trajectory of lipid metabolism from birth to childhood and adulthood. Longitudinal follow-up studies can elucidate the long-term implications of cord blood lipid profiles on metabolic health outcomes and identify critical periods for intervention. Additionally, investigating the underlying mechanisms linking lipid metabolism to neonatal growth and development may provide insights into potential therapeutic targets for metabolic disorders.

## Conclusion

To sum up, this work offers important new understandings regarding the connection between lipid profiles in cord blood and newborn traits. The results show a strong relationship between anthropometric measures and cord blood lipid characteristics, pointing to a possible function of lipid metabolism in promoting fetal growth. Nonetheless, there were no discernible variations in the lipid profiles of cord blood according to the gender or delivery method of the newborn. These findings highlight how crucial it is to comprehend how lipid metabolism affects embryonic development. To fully understand the underlying mechanisms and long-term effects of cord blood lipid profiles on metabolic health outcomes, more research is required. All things considered, this work adds to the expanding corpus of information about newborn lipid metabolism and its effects on early life health.

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**Tables**

**Table 1: Cord Blood Lipid Profile in Neonates (n = 150)**

| **Serum Lipid Parameter** | **Minimum** | **Maximum** | **Mean** | **SD** |
|---|---|---|---|---|
| TG | 32 | 97 | 55.39 | 13.84 |
| TC | 20 | 107 | 83.40 | 25.04 |
| VLDL | 4 | 16 | 9.42 | 2.97 |
| LDL | 18 | 76 | 59.49 | 14.30 |
| HDL | 19 | 43 | 25.22 | 4.17 |

**Table 2: Anthropometric Data of Neonates: Descriptive Statistics**

| | **Minimum** | **Maximum** | **Mean** | **SD** |
|---|---|---|---|---|
| Birth Weight (g) | 1860 | 3650 | 2688.92 | 441.32 |
| Head Circumference (HC) | 30 | 37 | 33.37 | 2.32 |
| Abdominal Circumference | 26 | 35 | 30.02 | 2.70 |
| Length (cm) | 45 | 53 | 48.61 | 2.41 |

**Table 3: Distribution of Ponderal Index in Study Population (N=150)**

| **Ponderal Index (PI)** | **Number** | **%** |
|---|---|---|
| 1.1 - 2.0 | 36 | 24.00 |
| 2.1 - 3.0 | 103 | 68.67 |
| Above 3 | 11 | 7.33 |

**Table 4: Comparison of Cord Blood Lipid Profile Parameters between Group A (Ponderal index (PI≤ 2.25) and Group B Neonates (PI >2.25)**

| Serum Lipid Parameter | Group A (Mean ± SD) | Group B (Mean ± SD) | P Value |
|---|---|---|---|
| TG | 58.28 ± 12.29 | 53.05 ± 14.63 | 0.02 |
| TC | 86.40 ± 23.59 | 80.98 ± 26.04 | 0.19 |
| VLDL | 10.31 ± 3.22 | 8.70 ± 2.56 | 0.00 |
| LDL | 62.18 ± 13.43 | 57.31 ± 14.69 | 0.0377 |
| HDL | 24.94 ± 3.40 | 25.45 ± 4.71 | 0.45 |

**Table 5: Distribution of AGA vs SGA vs LGA in Study Population (N=150)**

| | Number | % |
|---|---|---|
| SGA | 50 | 33.33 |
| AGA | 50 | 33.33 |
| LGA | 50 | 33.33 |

**Table 6: Comparison of Gender in Study Population (N=150)**

| Gender | Boys | Girls |
|---|---|---|
| SGA | 24 (48) | 26 (52) |
| AGA | 31 (62) | 19 (38) |
| LGA | 23 (46) | 27 (54) |