https://doi.org/ 10.33472/AFJBS.6.Si2.2024.419-426

AFJBS African Journal of Biological Sciences
Journal homepage: http://www.afjbs.com

Research Paper Open Access

# Comparative Analysis of Cord Blood Zinc Levels in Normal and Low Birth Weight Neonates: Correlation with Maternal Serum Zinc Levels

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Article History

Volume 6,Issue Si2, 2024

Received:26 Feb 2024

Accepted : 02 Apr 2024

doi: 10.33472/AFJBS.6.Si2.2024.419-426

**Abstract**

Objective: The purpose of this study was to evaluate the link between maternal serum zinc levels and the zinc levels in the cord blood of low birth weight and normal weight newborns.

Methods: During the course of 18 months, a comparative study was carried out at a tertiary care hospital. Included were newborns born at the hospital throughout the study period. Samples of the mother's serum were taken throughout labor, and samples of the cord blood were taken upon birth. The amounts of zinc were assessed using common biochemical tests. To evaluate associations and compare zinc levels between groups, statistical analysis was done.

Findings: The study comprised 100 newborns in total, 50 in each group representing normal and low birth weights. When comparing low birth weight neonates to normal birth weight neonates, the mean cord blood zinc level was considerably higher in the former group (97.07 µg/dl vs. 83.73 µg/dl, $p < 0.05$). Neonatal cord blood zinc levels and mother serum zinc levels showed a favorable connection ($r = 0.65$, $p < 0.001$).

Conclusion: Our results imply that the zinc status of the mother affects the amounts of zinc in neonates, with lower levels seen in neonates with low birth weights. Optimizing newborn zinc levels and improving birth outcomes may be possible with routine evaluation of the mother's zinc status during pregnancy and focused therapies. To clarify the underlying mechanisms and investigate the possible advantages of zinc supplementation during pregnancy, more research is required.

Keywords: maternal serum, low birth weight, neonates, cord blood, and zinc levels

## Introduction

Birth weights under 2500 grams, or low birth weights, or LBWs, continue to be a major global public health concern [1]. Infants born before full term (LBW) are more likely to experience respiratory distress syndrome, metabolic problems, and cognitive abnormalities [2]. Maternal factors that affect fetal growth and development include age, nutrition, socioeconomic situation, and medical issues. This makes the etiology of LBW multifaceted [3].

Maternal diet is a crucial factor that can influence fetal development, especially if vital micronutrients like zinc are consumed. Numerous physiological functions, such as cellular development, DNA synthesis, and immunological function, depend on zinc, an important trace element [4]. Maternal zinc needs rise throughout pregnancy in order to sustain the fast fetal development and growth that takes place during the gestational period [5].

Preterm birth, congenital abnormalities, and LBW are only a few of the negative pregnancy outcomes that have been linked to zinc deficiency [6]. These results could be caused by a number of processes, such as compromised fetal tissue development, changed fetal nutrition transport, and compromised placental function [7]. Furthermore, a higher risk of intrauterine growth restriction (IUGR), a disorder marked by decreased fetal growth and development in utero, has been associated with maternal zinc insufficiency [8].

On the other hand, optimal maternal zinc status during pregnancy has been linked to better delivery outcomes, such as smaller birth weights and a lower chance of low birth weight (LBW) [9]. In contexts with limited resources, zinc supplementation during pregnancy has been demonstrated to improve birth weight and lower the incidence of low birth weight [10]. Additionally, since zinc is essential for immunological response and neurodevelopment in the early years of life, a mother's zinc status may have an impact on the health of her newborn after birth [11].

The link between maternal zinc levels and newborn outcomes—particularly with regard to cord blood zinc levels in LBW neonates—has not received much attention, despite the relevance of maternal zinc status in fetal growth and development being widely acknowledged. Clarifying the role of zinc in fetal metabolism and its possible effects on neonatal health requires an understanding of the differences in cord blood zinc levels between normal and LBW neonates as well as the association between these changes and maternal serum zinc levels.

Thus, the purpose of this study is to examine the relationship between mother serum zinc levels and cord blood zinc levels by comparing the levels in newborns who are LBW and normal. This study advances our knowledge of the function of maternal nutrition in fetal growth and development and may provide guidance for measures aimed at enhancing the health of both mothers and newborns by clarifying the connection between maternal zinc status and neonatal outcomes.

## Materials and Methods

The Krishna Hospital in Karad, Maharashtra, served as the site of this comparison study for eighteen months, from March 2021 to August 2022. The study's focus was on the moms of the newborns born at the hospital. Inborn term babies with normal birth weight, inborn term low birth weight babies, and low birth weight newborns—including late preterm babies without congenital abnormalities, bleeding, or asphyxia—as well as their mothers were included in the study. However, newborns with congenital defects, birth asphyxia, or potentially fatal complications including hemorrhages were not allowed to participate in the study, nor were moms taking specific medications or suffering from clinical disorders known to impact mineral metabolism.

Participants were divided into two groups: Group 1 was made up of inborn babies and their mothers weighing between >2.5 kg and 4 kg, while Group 2 was made up of inborn babies and their mothers weighing less than 2.5 kg. As soon as labor started, pregnant women's venous blood samples were taken in the delivery room, and cord blood samples were taken prior to placental delivery. An electronic weighing scale was used to measure the baby's weight within an hour of delivery, and a semi-auto biochemistry machine was used to measure the serum zinc levels.
With a minimum of 62 neonates (31 with low birth weights and 31 with normal birth weights) and their mothers as the primary aim, the sample size was determined using data from an earlier study. Ultimately, though, 100 neonates from each group were selected in order to increase the study's power. SPSS software was used to execute the statistical analysis, and the results were shown in tables and graphs for the frequency analysis. For quantitative variables, measures of central tendency and dispersion were computed; for qualitative characteristics, non-parametric tests like the Chi-square test were utilized, and parametric tests like the Student's t-test were employed to evaluate correlations between quantitative and qualitative parameters. A statistically significant p-value of less than 0.05 resulted in the null hypothesis being rejected.

**Results**

Table 1: Infant Distribution by Birth Weight

According to the distribution of babies by birth weight, the mean birth weight in the group of babies with normal birth weight was 3.1288 kg, with a standard deviation of 0.34606. On the other hand, with a standard deviation of 0.18314, the mean birth weight in the low birth weight group was significantly lower, at 2.1168 kg. This result shows that the two groups' birth weights were clearly different, with the low birth weight group showing noticeably lower birth weights than the normal birth weight group.

Table 2: Mothers' Age Distribution

The study's participant mothers' age distribution revealed differing percentages in each age group. There were 47 mothers in the age group of 21–25 years, which comprised the majority of moms (47%) in this category. Furthermore, it was found that 14 moms were under the age of 20, 32 were between the ages of 26 and 30, 6 were between the ages of 31 and 35, and only one mother was older than 35. These results offer information about the demographic makeup of the study's maternal population.

Table 3: Baby Distribution by Gestational Age

The proportions of infants across various gestational age ranges were highlighted by the distribution of babies based on gestational age. Thirteen of the hundred kids were born between 34 and 37 weeks gestation prematurely, eight babies were delivered after 40 weeks, and the remaining seventy-nine babies were born between 37 and 40 weeks gestation. This distribution shows that only a lesser percentage of the study's babies were preterm or postterm, with the majority born at term.

Table 4: Mothers' Distribution by Parity and Delivery Mode

The distribution of mothers according to birth mode and parity revealed details about the makeup of the maternal population. Of the moms, 49 were primigravida, meaning they were pregnant for the first time, and 51 were multigravida, meaning they had previously given birth. Furthermore, there was variation in the delivery method; 47 mothers gave birth via Lower Segment Cesarean Section (LSCS) and 53 mothers gave birth naturally (Normal Vaginal Delivery, NVD). The variety of pregnancy histories and delivery styles among mothers is highlighted by these data.

Table 5: Baby Distribution by Gender

There was an equal amount of male and female newborns in the study, according to the distribution of neonates by sex. Fifty-six of the one hundred newborns were female, and 54 were male. There is no discernible variation in the sex ratio among the babies taking part in the study, according to this balanced distribution.

Table 6: Zinc Levels in Maternal Serum and Cord Blood

Analyses of mother serum zinc levels and cord blood zinc levels produced some intriguing results. The mean zinc levels in cord blood were significantly greater than those in mother serum in both the low birth weight and normal birth weight groups. On the other hand, there was no statistically significant variation in the mother serum zinc levels between the two groups. These results warrant additional research into the variables controlling zinc metabolism throughout pregnancy and neonatal development, since they point to a possible discrepancy between cord blood and mother serum zinc levels.

**Discussion**

This study's discussion section seeks to explore the data reported in the results section, analyze their ramifications, and place them in the context of previously published works. The relevance of cord blood zinc levels in both low birth weight and normal neonates, their relationship to mother serum zinc levels, and any possible ramifications for neonatal health will all be covered in this talk.

Zinc Levels in Neonates' Cord Blood

The results of this investigation showed that newborns with low birth weight and those with normal birth weight have significantly different zinc levels in their cord blood. Compared to their low birth weight counterparts, neonates with normal birth weights had mean cord blood zinc levels that were greater. This finding is consistent with earlier studies showing zinc's critical involvement in fetal growth and development, especially in the third trimester when fast fetal growth happens [1,3,11]. Zinc is a vital vitamin that is involved in many physiological processes, such as DNA synthesis, immune system function, and cell proliferation [12]. Consequently, adequate intrauterine zinc transfer may be the cause of the greater cord blood zinc levels seen in neonates with appropriate birth weights, which would promote ideal fetal growth and development.

On the other hand, low birth weight babies had lower amounts of zinc in their cord blood, which could indicate inadequate zinc availability from the mother during pregnancy or poor zinc transfer across the placenta. Maternal malnutrition, insufficient food consumption, and underlying medical disorders are some of the variables that can affect a mother's zinc status [13]. Preterm delivery and intrauterine growth restriction are two negative pregnancy outcomes that have been linked to maternal zinc deficiency [14]. Thus, the decreased zinc levels in the cord blood of low birth weight neonates could be a result of a zinc shortage in the mother during pregnancy, underscoring the significance of maternal nutrition and prenatal care in fostering fetal health.

Relationship with Zinc Levels in Mother's Serum

The link between maternal serum zinc levels and neonatal cord blood zinc levels is another significant conclusion of this study. The findings show a positive association between the zinc levels of the mother and the newborn, indicating that the zinc status of the mother may have an impact on the zinc accretion of the fetus. Low birth weight and poor fetal development are among the negative pregnancy outcomes associated with maternal zinc insufficiency [15]. Thus, for the best possible fetal growth and development during pregnancy, the mother's zinc status must be maintained.

The significance of maternal nutrition in guaranteeing sufficient fetal zinc supply is shown by the link found between maternal serum zinc levels and cord blood zinc levels. Certain zinc transporters carry zinc across the placenta, and the zinc status of the mother has a direct impact on the zinc accumulation of the fetus [11–13]. Consequently, nutritional counseling or dietary supplements targeted at enhancing the mother's zinc level may have an impact on the health and development of the newborn.

Clinical Consequences

The clinical implications of the study's findings for the care of mothers and newborns are numerous. First, monitoring a mother's zinc levels during pregnancy can assist detect those who are susceptible to zinc deficiency and allow for focused treatments to promote the health of both the mother and the fetus. To guarantee early identification and treatment of deficiencies, routine screening for maternal nutritional status, including zinc levels, should be included in prenatal care protocols [14,15].

Second, measuring the zinc levels in newborns' cord blood may be a useful way to determine the state of the fetus's growth and intrauterine zinc transfer. A mother's underlying nutritional inadequacies or metabolic diseases may be indicated by abnormalities in the cord blood zinc levels, such as excess or deficiency, necessitating additional testing and treatment. Consequently, adding cord blood zinc assays to standard newborn screening procedures may improve the early identification of neonatal health problems and enable prompt intervention.

Moreover, nutritional advice or dietary supplements targeted at improving the mother's zinc status may have long-term advantages for the health of the mother and the newborn. Preterm birth, low birth weight, and intrauterine development restriction have all been linked to adequate zinc consumption during pregnancy [7]. Thus, encouraging maternal zinc sufficiency through focused interventions may lessen the chance of unfavorable pregnancy outcomes and enhance the health of newborns.

Restrictions and Prospective Paths

Notwithstanding the insightful information this study offered, a number of limitations need to be noted. First off, the small sample size of the study limited how broadly the results could be applied. In order to verify the reported relationships and investigate potential confounding factors, more research including bigger and more diverse cohorts is necessary.

Second, because of the cross-sectional design of the study, it is not possible to determine the temporal correlations or establish causation between the zinc levels in mothers and newborns. To clarify the underlying mechanisms and causal pathways, longitudinal studies monitoring the mother's zinc level during pregnancy and evaluating its effect on fetal development are required.

Additionally, the study ignored other potential factors that could influence fetal zinc accretion, such as placental function and zinc transporter activity, and instead concentrated only on cord blood zinc levels and maternal serum zinc levels. Subsequent investigations that encompass thorough evaluations of the dynamics between maternal and fetal zinc, encompassing placental zinc transport pathways and tissue zinc concentrations, should offer more profound understanding of the intricate relationship between maternal nutrition and fetal development.

**Conclusion**

As a result, this study highlights the crucial function zinc plays in fetal growth and development and clarifies the significance of maternal zinc status in regulating newborn zinc levels. The results underline the necessity of routinely assessing a mother's nutritional condition during her pregnancy and the possible advantages of measures meant to maximize her zinc status in order to improve the health of her unborn child. Healthcare professionals can minimize the risk of unfavorable pregnancy outcomes linked to zinc shortage and improve maternal and newborn health outcomes by addressing maternal nutritional deficits and guaranteeing an adequate fetal zinc supply.

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**Tables**

**Table 1: Distribution of Babies Based on Birth Weight**

| **Group** | **N** | **Mean (kg)** | **Std. Deviation** |
|---|---|---|---|
| Normal Birth Weight | 50 | 3.1288 | 0.34606 |
| Low Birth Weight | 50 | 2.1168 | 0.18314 |

**Table 2: Age Distribution of Mothers**

| **Mother's Age Group (Years)** | **Normal Birth Weight Group 1** | **Low Birth Weight Group 2** | **Total** |
|---|---|---|---|
| ≤20 | 5 | 9 | 14 |
| 21-25 | 25 | 22 | 47 |
| 26-30 | 19 | 13 | 32 |
| 31-35 | 1 | 5 | 6 |
| >35 | 0 | 1 | 1 |
| **Total** | 50 | 50 | 100 |

**Table 3: Distribution of Babies Based on Gestational Age**

| **Gestational Age (Weeks)** | **Normal Birth Weight Group 1** | **Low Birth Weight Group 2** | **Total** |
|---|---|---|---|
| 34-37 | 6 | 7 | 13 |
| >40 | 2 | 6 | 8 |
| 37-40 | 42 | 37 | 79 |
| **Total** | 50 | 50 | 100 |

**Table 4: Distribution of Mothers Based on Parity and Mode of Delivery**

| **Parity** | **Normal Birth Weight Group 1** | **Low Birth Weight Group 2** | **Total** |
|---|---|---|---|
| Multigravida | 28 | 23 | 51 |
| Primigravida | 22 | 27 | 49 |
| **Total** | 50 | 50 | 100 |
| **Mode of Delivery** | **Normal Birth Weight Group 1** | **Low Birth Weight Group 2** | **Total** |
| LSCS | 24 | 23 | 47 |
| NVD | 26 | 27 | 53 |
| **Total** | 50 | 50 | 100 |

**Table 5: Distribution of Babies Based on Sex**

| **Sex** | **Normal Birth Weight Group 1** | **Low Birth Weight Group 2** | **Total** |
|---|---|---|---|
| Female | 20 | 26 | 46 |
| Male | 30 | 24 | 54 |

| | | | |
|---|---|---|---|
| **Total** | 50 | 50 | 100 |

**Table 6: Cord Blood Zinc Levels and Maternal Serum Zinc Levels**

| **Group** | **Mean Cord Blood Zinc (µg/dl)** | **Mean Maternal Zinc (µg/dl)** | **P Value** |
|---|---|---|---|
| Normal Birth Weight | 97.07 ± 8.13 | 97.32 ± 9.56 | 0.88 |
| Low Birth Weight | 83.73 ± 10.18 | 88.42 ± 14.56 | 0.06 |