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RESEARCH ARTICLE
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Study Of Cord Blood Zinc Levels in Low and Normal Birth Weight Neonates and Correlate with Their Mother's Serum Zinc Levels

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ABSTRACT

Background: Zinc is a divalent cation first isolated in 1509 and since then its importance has been increasingly recognised in human health and nutrition. Women are at increased risk of zinc deficiency during pregnancy because of high fetal requirements for zinc. Severe maternal zinc deficiency has been associated with poor fetal growth, spontaneous abortion and congenital malformations, whereas milder forms of zinc deficiency have been associated with low birth weight (LBW), intrauterine growth retardation, and preterm delivery. Birth weight is the single most important marker of perinatal and neonatal outcome. We conducted this study to know and compare the cord blood zinc levels in normal and low birth weight neonates and correlate these with their mother's serum zinc levels.

Aim: To study and compare the cord blood zinc levels in normal and low birth weight neonates and correlate these with their mother's serum zinc levels.

Material and Methods: This study is a comparative study conducted in a tertiary care hospital.All inborn newborns with birth weight >2.5 kg to 4kg's and their mothers were labelled as 'Group 1' and 'Group 1 mothers' respectively. All inborn newborns with a birth weight of <2.5kg and their mothers were labelled as 'Group 2' and 'Group 2 mothers' respectively. Serum zinc was measured by using zinc reagent in semi-auto biochemistry machine. After delivery, baby's weight was measured within 1 hour after birth with no clothing on electronic weighing scale.

Statistical Analysis: The statistical analysis was done with SPSS software. Mean, Mode, Medians of various quantitative variables were calculated to study the central tendency of the parameters, while standard deviations of the parameters were calculated to study their extent of dispersion. Parametric test such as students t-test was used to study association between two quantitative parameters. Non-parametric test such as Chi-square test was applied to study the association between two qualitative parameters. A p value <0.05 was taken as significant.

Results: In normal birth weight group 1 mean cord blood zinc level was 97.07±8.13µgm/dl whereas in low birth weight group 2 the mean cord blood zinc level was 83.73±10.18µgm/dl. On comparing mean cord blood zinc level in normal birth weight to low birth weight, the difference was statistically significant. The mean maternal zinc level in normal birth weight group 1 was 97.32±9.65 µgm/dl, whereas in low birth weight group 2 it was 88.42±14.56 µg/dl. The results show a significant association between maternal zinc levels and birth weight.

Conclusion: Present study showed the maternal serum zinc level in normal birth weight group neonates was significantly higher compared to maternal serum zinc levels of low birth weight group. The mean cord blood zinc levels in the normal birth weight group neonates were significantly higher compared to low birth weight group of neonates.

Keywords: *Birth weight, Zinc, Comparative study, Pregnancy*

INTRODUCTION

Zinc is a divalent cation first isolated in 1509 and since then its importance has been increasingly recognised in human health and nutrition. Zinc is known as one of the life's essential elements because of its vital role in a wide range of biological activities. Though severe zinc deficiency is now considered rare, mild-to-moderate zinc deficiency may be relatively common throughout the world. Women are at increased risk of zinc deficiency during pregnancy because of high fetal requirements for zinc.[1-4] Severe maternal zinc deficiency has been associated with poor fetal growth, spontaneous abortion and congenital malformations, whereas milder forms of zinc deficiency have been associated with low birth weight (LBW), intrauterine growth retardation, and preterm delivery. Importantly, milder forms of zinc deficiency have also been related to complications of labour and delivery, including prolonged or inefficient first-stage labour and protracted second-stage labour, premature rupture of membranes (PROM), and the need for assisted or operative delivery. These complications in turn impair maternal and perinatal health because they lead to increased risk of maternal infections, fetal distress, stillbirth, neonatal asphyxia, and neonatal sepsis. Many enzymes and growth hormones required for fetal growth need zinc during pregnancy. Zinc is one of the elements which has an essential role in the living system. Since its discovery as an important micronutrient, it was found to affect many processes, such as the nucleic acid metabolism, enzyme function, apoptosis and cell signalling. Lipid metabolism, growth and development of immune and brain function all require Zinc as an important element[(5)].The World Health Organization (WHO) (2020) prioritized minimizing zinc deficiency in developing nations as part of the Millennium Development Goal to eradicate extreme poverty and hunger. Positive effect of zinc supplementation in pregnancy at primary care level is a cost effective intervention for reducing incidence of Low birth weight babies in developing countries. Most pregnant women in developing countries seek health services at primary health care level only and there is opportunity to address zinc deficiency in pregnant women at primary health care level by giving combination of iron and zinc rather than iron alone[(6)]. There is an increasingly global concern about the weight of babies at birth, as low birth weight is an important factor determining infant mortality and morbidity . Low zinc concentrations in the cord blood of low birth weight newborns have been noted in a number of settings and birth weight has been shown to be highly correlated with cord zinc concentration.[(7)] We conducted this study to examine the relationship between maternal zinc level and birth weight. Serum zinc level in LBW neonates was also examined and compared with that in normal birth weight (NBW) infants.

MATERIAL AND METHODS

Aim

To study and compare the cord blood zinc levels in normal and low birth weight neonates and correlate these with their mother's serum zinc levels.

Inclusion criteria

Inborn Term newborns with normal birth weight. Inborn Term low birth weight newborns. Low Birth weight newborns including late preterm without any birth asphyxia, congenital malformations, and hemorrhage. Mothers of these newborn.

Exclusion criteria

Mothers on drugs (diuretics, anticonvulsants, anticoagulants).Mothers with clinical illness known to affect mineral metabolism such as severe malnutrition, severe anemia (hemoglobin <10gm %), oligohydramnios, polyhydramnios, diabetes mellitus, gastrointestinal diseases, chronic renal disease, endocrinal disorders. Newborns with congenital anomalies, birth asphyxia, life threatening complications like hemorrhages.

Study Design

This study is a comparative study conducted in Maternity ward in KIMS Hospital, Karad, Maharashtra over a period of 18 Months (MARCH 2021 TO AUGUST 2022). We choose 50 low birth weight and 50 normal birth weight neonates and their mothers. All inborn newborns with birth weight >2.5 kg to 4kg's and their mothers, were labelled as 'Group 1' and 'Group 1 mothers' respectively. All inborn newborns with a birth weight of <2.5kg and their mothers were labelled as 'Group 2' and 'Group 2 mothers' respectively. Venous blood samples (2 ml maternal blood) were collected as soon as mother enters labour. Cord blood samples (5 ml cord blood) were collected before delivery of placenta. Zinc (µg/dl) levels were analysed in both maternal and cord blood samples. Serum zinc was measured by using zinc reagent in semi-auto biochemistry machine. After delivery, baby's weight was measured within 1 hour after birth with no clothing on electronic weighing scale with accuracy up to 5gms.

Statistical Analysis

The data was collected using a standard, pre-validated, semi-structured case record proforma and was analysed by statistician using SPSS software. Mean, Mode, Medians of various quantitative variables were calculated to study the central tendency of the parameters, while standard deviations of the parameters were calculated to study their extent of dispersion. Parametric test such as students t-test was used to study association between two quantitative parameters. Non-parametric test such as Chi-square test was applied to study the association between two qualitative parameters. A *p* value <0.05 was taken as significant.

RESULTS

In this comparative study from March 2021 to August 2022, 50 low birth weight and 50 normal birth weight neonates and their mothers were included. Majority of mothers i.e 47% belonged to the age group 21-25 years. Most of the babies (i.e 79) were born between 37- 40 weeks of gestation out of them 42 babies were normal birth weight babies and 37 babies were low birth weight babies. Out of 100 babies 46 babies were females and 54 babies were males. The mean birth weight of normal birth weight group 1 was 3.13±0.35 kg, whereas in low birth weight group 2 it was 2.12±0.18 kg.

TABLE 1 : Distribution of cord blood zinc levels in normal birth weight group 1 & low birth weight group 2

	group	N	Mean cord blood zinc levels in µg/dl	Std. Deviation	Std. Error Mean	P value
cord blood zinc	Normal birth weight group 1	50	97.07	8.13	1.150	0.0
	Low birth weight group 2	50	83.73	10.18	1.446	

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In normal birth weight group 1 mean cord blood zinc level was 97.07±8.13µgm/dl whereas in low birth weight group 2 the mean cord blood zinc level was 83.73±10.18µgm/dl, on comparing mean cord blood zinc level in normal birth weight to low birth weight, the difference is statistically significant with p value- 0.0

TABLE 2 : Correlation of maternal zinc levels with their babies birth weight

	GROUP	N	Mean mothers zinc levels in µg/dl	Std. Deviation	Std. Error Mean	P value
mother zinc	Normal birth weight group 1	50	97.32	9.647	1.378	0.001
	Low birth weight group 2	50	88.42	14.559	2.059	

The mean maternal zinc level in normal birth weight group 1 was 97.32±9.65 µgm/dl, whereas in low birth weight group 2 it was 88.42±14.56 µg/dl, on comparing this the difference is statistically significant as P value is 0.001

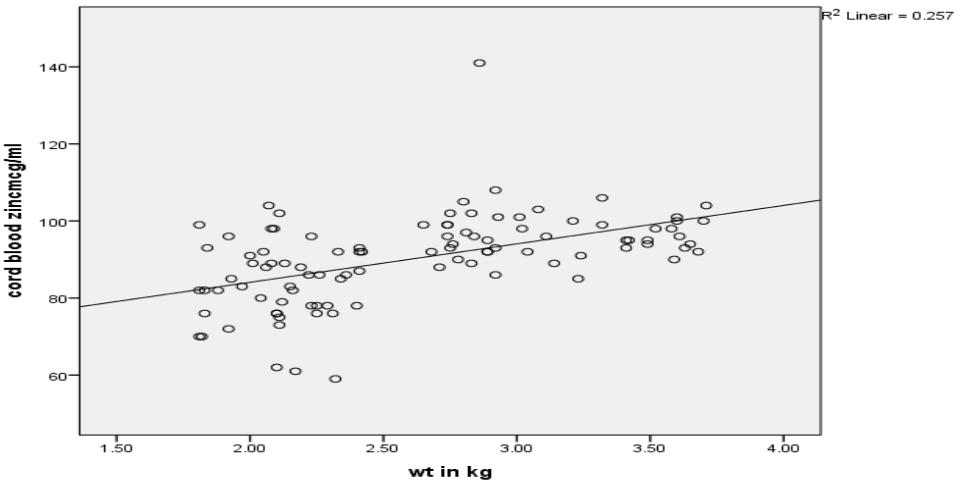

FIG 1: Association of cord blood zinc levels with birthweight of babies

Fig 1 shows Association of cord blood zinc with birthweight of babies, on regression analysis, there is positive association between baby birth weight with the cord blood zinc, however this association is mild association with R square 0.257

DISCUSSION

One of the most important causes of low birth weight in India is maternal malnutrition. Children with low birth weight are at considerable risk of morbidity. Long term effects of birth weight affect not only the perinatal period but also childhood and adulthood. While lot of importance is being given to protein and energy deficits micronutrients other than iron are often forgotten. It has been argued that micronutrient deficiency during pregnancy can lead to LBW.

In our study, the mean birth weight of normal birth weight group 1 was 3.13±0.35 kg, whereas in low birth weight group 2 it was 2.12±0.18 kg. Low birth weight has been defined by WHO as weight at birth of < 2500 grams. Normal birth weight has been defined as birth weight from 2500 grams to 4000 grams.

In the present study, In normal birth weight group 1, 42 babies were from 37-40 weeks of gestation, 6 babies were in 34 to <37 weeks of gestation and 2 babies were more than 40 weeks of gestation, whereas in low birth weight group 2, out of 50 babies 7 babies were born less than 37 weeks of gestation, 37 babies were in the range of 37-40 weeks of gestation, whereas 6 babies were more than 40 weeks of gestation and on comparing there is non- significant difference. **Ismail Mohamed et al.**[8] study shows a statistically significant correlation was found between cord zinc and gestational age. This may be due to fetal zinc accretion increases with gestational age with 60–70% of zinc occurring in the third trimester. Furthermore, a progressive increase in mean zinc levels with increasing gestational age was clearly depicted with the very preterm neonates having the lowest values and term babies having the highest. **Abass R M et al.**[9] Study shows there were significant direct correlations between cord zinc levels and gestational age. zinc is a vital nutrient that cannot be synthesized in the human body. Zinc is important component for transcription factors and function as catalytic cofactors for enzymes regulating cell differentiation and maturation. Zinc is important trace elements that are necessary for optimum human growth and development. Zinc is protective against free radicals and is involved intracellularly in cell division and nucleic acid synthesis. The maternal mineral status during gestation is essential for growth and develop. Since preterm infants are born prior to the time of rapid intrauterine fetal growth, they are vulnerable to deficiencies of essential nutrients for brain development, including zinc.

Carrier proteins are essential for the transport of these elements from the maternal circulation to the placenta. The fetus is dependent on its own synthesis of these transport proteins for delivery of minerals to all organs of its body, but it is not well known to what extent these carrier proteins are present late in gestation and at birth. Since the absolute amount of nutrients, vitamins and trace elements transported across the placenta increases as gestation progresses, potential nutritional deficiencies may be critical in premature fetus if the transfer of essential elements from mother to fetus has not kept pace with the needs of the fetus. Such insufficiencies may result in a reduced accumulation of these elements in storage organs of the fetus. Therefore, the neonatologist is faced with the challenge of providing adequate nutrition in the early neonatal period, especially to the premature infant, whose possible specific mineral deficiencies at birth are not well determined.

Though zinc is needed only in small quantity, it has several vital functions in our human body. As zinc requirements are small, its adequacy must be checked carefully and moreover many of the trace elements have interactions with each other. Thus, their needs have to be adequately met with a concern over their interactions, safety and toxicity.

In the present study, in normal birth weight group mean cord blood zinc level was 97.07±8.13µgm/dl whereas in low birth weight group the mean cord blood zinc level was 83.73±10.18µgm/dl, on comparing mean cord blood zinc level in normal birth weight group to low birth weight group, the difference is statistically significant. **Abdellatif et al.**[10]Study shows the mean cord serum zinc level in full-term neonates was 88 ± 18 µg/dl, whereas in pre terms was 73 ± 13 µg/dl. Few study also shows non-association of cord blood zinc with birth weight like study by Iqbal, *et al*. and Gomez *et al*, the probable reason mentioned in study by **Nisha gupta et al**[11] is it might be due to delay in separation of plasma and collection of blood sample, or different sample size and different food habits of the countries.

In the present study, the mean maternal zinc level in normal birth weight group was 97.32±9.65 µgm/dl, whereas in low birth weight group it was 88.42±14.56 µgm/dl, on comparing the difference is statistically significant. **Abdellatif et al.** [10] Study shows the mean serum zinc level in mothers of full term neonates was 109 ± 15 µg/dl, whereas in the mothers of preterms was 96 ± 15 µg/dl. Maternal zinc deficiency can lead to an adverse pregnancy outcome, such as intrauterine growth retardation, pregnancy-induced hypertension, and LBW deliveries. Maternal zinc deficiency in late pregnancy could be a determinant for newborn birth weight. The zinc is an important carrier of nutrients from the mother through the placenta to the fetus. Low zinc levels impair transport of nutrients to the fetus with consequences of fetal malnutrition and arrested growth. Also maternal zinc deficiency may affect birth weight though shortening the

duration of pregnancy leading to premature delivery and hence LBW. The influence of maternal zinc on newborns growth parameters in developing countries like India is important since almost one-fourth of the low birth weight morbidity of the world is from India.

CONCLUSION

Present study showed the mean cord blood zinc levels in the normal birth weight group neonates were significantly higher compared to low birth weight group of neonates.

The difference between mean cord blood zinc levels in normal birth weight group and low birth weight group was statistically significant.

The maternal serum zinc level in normal birth weight group neonates was significantly higher compared to maternal serum zinc levels of low birth weight group. This difference was statistically significant.

LIMITATIONS

- Sample size was small and is from a single Tertiary Hospital.
- Socioeconomic status and type of diet of the mother was not taken into consideration.
- Correlation of maternal weight and maternal serum zinc was not studied in this study.

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