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Original Research Article

A study of zinc level in cord blood of neonates and its relationship with antropometric measurements in the neonates: a descriptive cross-sectional study

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ABSTRACT

Background: During pregnancy, fast growth and cell differentiation takes place in both mother and foetus. Maternal nutritional factors play an important role in the growth of the neonate. Among the micronutrient zinc is an important micronutrient whose deficiency is associated with poor pregnancy outcomes. The objective the current study was to evaluate the relationship of serum zinc concentration of the maternal blood and the neonatal cord blood with that of the infant's anthropometric measurements.
Methods: A descriptive cross-sectional study was performed under the Department of Neonatology, Saveetha medical college. Duration of the study was from April 2017 to June 2018. The study included 82 singleton mother baby dyads born in Saveetha medical college. Anthropometric measurements such as birth weight, head circumference, neonate length apart from other clinical features of both the mother and neonates were recorded for statistical analysis. Serum zinc levels were estimated using 2-(5-bromo-2-pyridylazo)-5-(N-Propyl-N-sulfopropylamino)-phenol (5-Br-PAPS) protocol.
Results: The mean maternal age of the study population is 25.3±2.3 years. Majority of the mother had natural mode of delivery (57%). The mean cord serum zinc level was found to be 94.0±1.6microgram /dl and the mother's serum zinc level was 93.8±30.7microgram /dl (range from 49 to 171microgram /dl) which was not found to be statistically significant. Serum zinc levels of the cord was compared with the child anthropometrics and mother's serum zinc levels to assess for the significance, but there was no correlation observed between the umbilical cord, and the birth weight (r=0.03), length of the child (r=-0.02), head circumference (r=-0.07) and mothers serum zinc levels (r=-0.002).
Conclusions: According to our results authors were unable to establish a relationship between Neonates growth parameters and zinc levels in neonates cord blood and zinc levels in the mother. Further studies with a larger sample size and prospective design would establish a causal relationship between zinc and growth parameters in the neonate.

Keywords: Anthropometry, Birth weight, Cord blood zinc levels, Zinc deficiency

INTRODUCTION

Intra-partum period of growth is an important determinant of the future growth and development of a neonate as put forward by the barker's hypothesis. It is during pregnancy that fast growth and cell differentiation takes place in both mother and foetus. During this period, both the mother and foetus are susceptible to dietary deficiencies particularly to those of the essential micronutrients. These micronutrients or trace elements are involved in maintenance of the normal homeostasis.[1] They perform the key role of catalytic functions in

various chemical reactions apart from structural formation of various proteins like enzyme and hormones.[1] Modifications in the concentrations or alterations in homeostasis of these essential micronutrients in the human body are responsible for several of congenital disorders and diseases. A healthy pregnant woman with normal reproductive physiology and who is free from disease or nutritional deficiencies will result in a healthier infant and good pregnancy outcome. The normal growth progression will be based on the genetic potential and it will consist of changes in weight, height and head circumference that matches with the given population standards.[2] In short, overall health and nutritional status of the mother is an important determinant of foetal growth apart from genetic factors.[2]

Deficiencies of major nutrients like folic acid, vitamin B12 have been linked to development of neural tube defects. Calcium and phosphorus are essential for normal functioning of several enzymatic reactions and for growth and development. Similarly, other nutrients like selenium, copper, manganese, magnesium are required for a healthy pregnancy outcome. Zinc is needed for the functioning of many enzymes starting from cell division to the translation process involved in genetics. It is the major element involved in the formation of many proteins. It is mainly involved in the process of cellular metabolism deficiency of zinc manifest in fast growing or dividing cells and is liked with diseases of skin, gastrointestinal tract, respiratory system, reproductive and skeletal system There is a clear association between micronutrient deficiencies and foetal growth and development.

The growth of the foetus is determined by the anthropometric measurements at birth which include weight, length and head circumference, which serve as surrogate markers of the wellbeing of the foetus and the intrauterine growth. This association between maternal zinc and fetal growth has been studied previously with conflicting reports. The influence of maternal zinc on newborns growth parameters in developing countries like India need to be studied further since almost one-fourth of the low birth weight morbidity of the world is from India. Further supplementation of these micronutrients could possibly be studied in future as a solution to the problem of low birth weight if a causal relationship is established. The objective of this study was to demonstrate the association between zinc levels in cord blood in the neonates and the birth weight of the neonate. Other objectives were to demonstrate the association between serum zinc level in mother and the incidence of low birth weight among neonates and to demonstrate the association between cord blood zinc level in neonate and length, head circumference of the neonate.

METHODS

A descriptive cross-sectional study was performed at the Department of Neonatology, Saveetha Medical College and Hospital. Study was performed with all singleton mother and neonate dyad delivered at Saveetha medical college and hospital, Thandalam from November 2017 to January 2018. All mother and neonatal dyads delivered during the above period fulfilling the inclusion criteria was be included in the study.

Inclusion criteria

- All singleton mother and baby dyad delivered in Saveetha medical college and hospital.

Exclusion criteria

- Multiple gestation
- Preterm gestation
- Mother with severe anaemia, chronic illness, placental abnormalities.

Statistical analysis

Data was expressed as mean±standard deviation (SD) and SPSS software was used for analysis. Correlation graph was obtained used SPSS**.**

The study was initiated after presentation of proposal and obtaining clearance from institutional review board of Saveetha medical college and hospital, all mothers who were admitted prior to labour pain were screened and if they fulfilled the eligibility criteria they were requested to participate in the study after obtaining a written consent form.

All mothers and neonates fulfilling the inclusion criteria and consenting to be a part of the study were included in the study. Venous blood sample was collected from the mother for the serum zinc level estimation on admission for confinement, prior to onset of labour. Cord blood sample was collected at the time of delivery and sent for zinc level estimation within one hour of collection demographic data was collected from the mother and included her obstetric history, risk factors and anthropometric data.

Examination of the neonates was done immediately after birth in case of babies shifted to mother side and after stabilization in case of babies admitted in NICU using electronic weighing scale with an accuracy of 5g, length by infantometer and head circumference by using non-stretchable measuring tape with an accuracy of 0.1cm.

Sample collection and estimation of zinc

Zinc levels were analyzed by atomic absorption spectrophotometry with air acetylene fuel. The blood samples were allowed to stand for roughly about thirty (30) minutes in order to facilitate the clot formation and the collected serum was subjected to serum zinc estimation using 2-(5-bromo-2-pyridylazo)-5-(N-Propyl-N-sulfopropylamino)-phenol (5-Br-PAPS) protocol.

RESULTS

A total of 82 mother baby dyads were included in the study and cord zinc levels and serum zinc levels from the mother were obtained. The mean maternal age was 25.3±2.3. The mother's maternal age ranged from 19 to 29 years. Majority of the mother had natural mode of delivery (57%). Higher percentage of mothers had multi (63%) parity. The mean gestational age of the mother was 38.4±0.9 weeks. The median gestational week was 38 weeks. Majority of the mother had male child (54%). The child's mean birth weight was found to be 3.0±0.3kg. The birth weight ranged from 2.3 to 3.8kg. The median birth weight was 2.9±0.04 kg. The mean child length was 50.7±2.2cm. The median child length was 50.7±2.2cm. The child length differed from 46 to 54cm. The mean circumference of the child's head was 34.8±1.6cm. The median head circumference was 35±0.2cm.

Table 1: Baseline characteristics of the total study population (n=82).

Parameters	Study population (n=82) Mean±SD (percentage)	P value
Maternal age (years)	25.3±2.3	
Parity of mother		
Multi	52 (63%)	0.0009
Primi	30 (37%)	
Mode of delivery		
Labour natural	47 (57%)	0.0739
LSCS	35 (43%)	
Gestational age (weeks)	38.4±0.9	
Baby's gender		
Male	44 (54%)	0.3071
Female	38 (46%)	
Mean birth weight (g)	3.0±0.3	
Length (cm)	50.7±2.2	
Head circumference (cm)	34.8±1.6	
Cord serum zinc level (microgram/dl)	94.0±1.6	P>0.05
Mother's serum zinc level (microgram/dl)	93.8±30.7	

The head circumference varied from 31 to 38.5cm. The mean umbilical cord serum zinc level was found to be 94.0±1.6microgram /dl and the mother's serum zinc level was 93.8±30.7microgram /dl. The serum umbilical cord zinc level varied from 61 to 139microgram/dl. The median was 94microgram /dl. The mother's serum zinc level was found to be varied from 49 to 171microgram /dl. The median was at 92. There is no statistical difference between the umbilical and mother's serum zinc levels.

Serum zinc levels of the umbilical cord was compared with the child anthropometrics and mother's serum zinc levels to assess for the significance, but there was no correlation observed with the birth weight (r=0.03), length of the child (r=-0.02), head circumference (r=-0.07) and mothers serum zinc levels (r=-0.002) as enlisted in the Table 2 with the respective correlation plot (Figure 2 and 3).

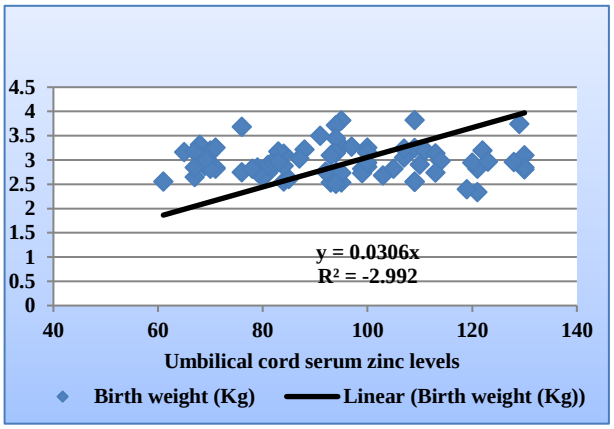

Figure 1: Correlation plot the serum zinc levels of the umbilical cord with the child's birth weight.

There was no correlation observed between the serum levels of the zinc (mothers) with the anthropometric measurement of the child.

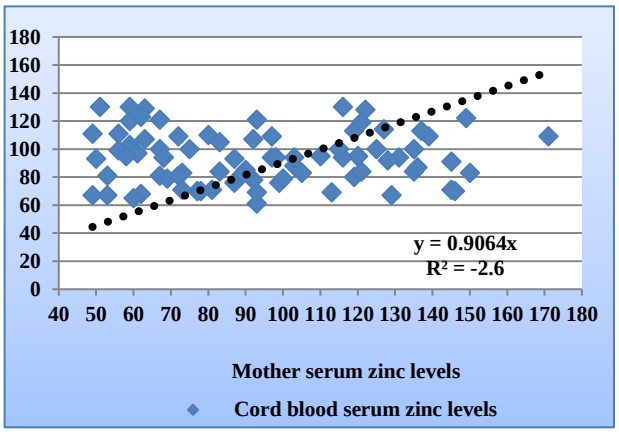

Figure 2: Correlation plot the serum zinc levels of the umbilical cord with their mother's serum zinc levels.

Mothers serum zinc levels does not find to have any relationship with the birth weight (r=-0.06), length of the child (-0.13) and head circumference (-0.2) as shown the respective Table 3 and their Figure 2 and 3.

Table 2: Correlation between zinc levels of the umbilical cord, anthropometric of the child and mother's serum zinc levels.

Parameter	Correlation co-efficient	P value
Birth weight	0.03	0.79
Length of the child	-0.02	0.84
Head circumference	-0.07	0.5
Mothers serum zinc levels	-0.002	0.99

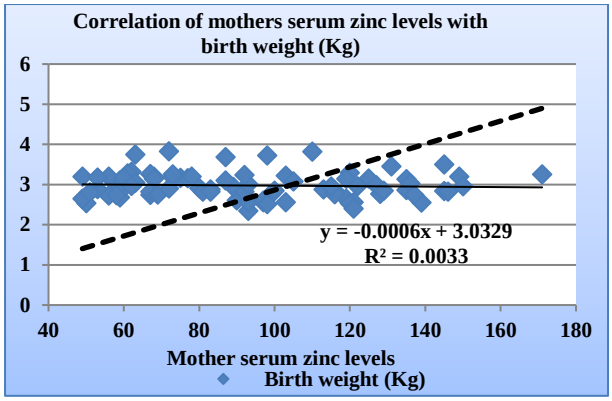

Figure 3: Correlation plot the mother's serum zinc levels and child's birth weight.

Table 3: Correlation between mother's serum zinc levels and anthropometric of the child.

Parameter	Correlation co-efficient	P-value
Birth weight	-0.06	0.61
Length of the child	-0.13	0.24
Head circumference	-0.2	0.08

DISCUSSION

Zinc deficiency is a common problem in pregnancy, especially in developing countries. A study from India reported 73.5% Zn deficiency among rural pregnant women.[3] This zinc deficiency can be due to several factors like expanded blood volume, increased demands and poor intake or bio-absorption. Zinc deficiency during pregnancy is shown to be associated with various feto-maternal complications including spontaneous abortion, congenital malformations, IUGR, and preterm births Zinc deficiency during pregnancy may lead to growth retardation in infants by affecting the development of body's immune system. It has been shown to regulate IGF-I activity and regulates the bone growth. Many enzymes and growth hormones, which play important role in post-natal growth, require zinc during pregnancy for e.g. placental alkaline phosphatase which stimulates DNA synthesis and cell proliferation in pregnancy requires zinc.

But there have been conflicting reports about role of zinc and its effect on growth parameters in neonate like the prospective study (scope study) which concluded that lower zinc concentration was related with less risk of pregnancy complications than higher zinc levels.[4]

Reports from few Indian studies by Jyostana et al and other studies by Gomez et al, Hanachi et al and Nanbakhsh et al who have demonstrated higher serum zinc levels in mothers of normal birth weight newborns compared to mothers of LBW infants. These studies establish a positive relationship between maternal serum zinc level and neonatal birth weight.[5-8] Similarly studies by Abass et al and Malathi et al showed association between maternal zinc and newborns birth weight.[9] Abass et al reported that there exists a relationship between the maternal zinc concentrations with the low birth weight infants than with the normal weight.[9]

In a study by Lorena Bermúdez et al, it was shown association was practically non-existent between anthropometric parameters and, As, Co, Cr, Fe, Se, and Zn in both umbilical cord and maternal blood.[10] Similar to this study a review of literature done by Roohani N et al to assess the association of dietary zinc intake and the circulating levels of zinc in the pregnant mother with pregnancy complication.[11] It was concluded that there was a no link established between maternal zinc levels and the complications such as spontaneous preterm birth; preeclampsia, low birth weight (LBW); and gestational diabetes (GDM). Further the study confirmed the negative association of maternal zinc concentration and the pregnancy outcome with a demand for further validation of the future studies. Reasons to explain these discrepancies between these studies are not clear, but it may be related to the diversity of unknown factors that could contribute to foetal development, heterogeneity in populations, and non-uniformity in the study designs and techniques used.

Present study was an observational study with a small sample size, and authors did not study the effect of maternal zinc supplementation on birth weight. Birth weight is dependent on number of other factors such as gender, gravidity, parity, race, body mass index, and maternal weight gain during pregnancy. Present study has other limitations also. First, the sample included pregnant women coming to a semi urban hospital in the outskirts of Chennai thus the outcomes might not be representative of the whole population of pregnant women in south India. To ideally prevent this, authors would need to conduct a larger multicenter study. Second, Intrauterine growth depends on many other factors such as gravidity, parity, body mass index, and maternal weight gain during pregnancy. In addition, authors did not control for the above factors and also other factors that have an influence on the growth parameters of the neonate which includes quality of mother's sleep and stress and other life style-related factors. Ideally a multiple regression analysis should have been conducted to check for all of these factors. Moreover, food intake and the role of other micronutrients and vitamins during pregnancy were found to correlate with growth parameters as demonstrated in previous studies which were not considered in present study. Most importantly present study had a cross-sectional design, which does not provide us with information about changes during pregnancy, and thus, it does not allow exploring causal relationship. Future studies should consider exploring life style factors, food intake quality, and role of other micronutrients which could influence the growth parameters in detail.

CONCLUSION

Authors were unable to establish a relationship between neonate's growth parameters and zinc levels in neonates cord blood and zinc levels in the mother. Similar reports have been documented in literature previously. The limitation of present study included the cross-sectional nature of the design, smaller sample size, inability to counter for other confounding variables. Further studies with a larger sample size and prospective design would establish a causal relationship between zinc and growth parameters in the neonate.

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