Original Article

A comparative study of serum zinc levels in small for gestational age babies and appropriate for gestational age babies in a Tertiary Hospital, Punjab

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Abstract

Introduction: Zinc deficiency is very much prevalent among pregnant women in developing countries. Zinc is required to maintain normal structure and function of multiple enzymes including those that are involved in foetal growth. Zinc deficiency increases risk of baby being born preterm, low birth weight, small for gestational age (SGA). **Aims and Objectives:** To compare serum zinc levels in small for gestational age babies with respect to appropriate for gestational age (AGA). **Material and Methods:** Out of total 200 newborn, hundred SGA newborn comprised the study group and hundred AGA newborn comprised the control group. Cord blood sample was collected immediately after birth and zinc levels were determined by atomic absorption spectrophotometry method. **Results:** The mean (±SD) serum zinc levels of study and control groups were 56.8 ± 40.6 µg/dl and 107.4 ± 72 µg/dl respectively and difference between two groups were found to be statistically significant. The mean serum zinc levels of preterm SGA group and term SGA group were 46.26 ± 22.54 µg/dl and 63.35 ± 47.47µg/dl respectively. Statistically significant difference was found in mean serum zinc levels between the two groups. **Conclusion:** SGA neonates have significant zinc deficiency as compared to AGA neonates. This zinc deficiency is even more pronounced in SGA newborns that are born preterm. This warrants the future investigation and necessary intervention on zinc supplementation during pregnancy and to preterm and SGA babies for better maternal and child health outcomes.

Keywords: Appropriate for gestational age, newborn, serum zinc, small for gestational age

Introduction

Low birth weight (LBW) is major risk factor for increased mortality and morbidity in infancy and childhood in developing countries. Most of these LBW newborns are small for gestational age. (SGA)/IUGR (intrauterine growth restriction).[1] Maternal micronutrient deficiency is one of the contributing factors for higher incidence of IUGR/SGA babies. Zinc deficiency is one of the most common micronutrient deficiencies among pregnant women in developing countries.[2,3] Pathak *P* reported that 73.5% pregnant women suffer from zinc deficiency among rural population of Haryana.[4] SGA infants have higher rates of diarrhea, respiratory infections, septicemia and malnutrition and zinc supplementation is associated with lower morbidity and mortality in SGA infants.[5,6] UNICEF is already promoting antenatal use of multiple-micronutrient supplementation, including zinc, in developing countries.[7] The World Health Organization (WHO) prioritized minimizing zinc deficiency in developing nations as part of the Millennium Development Goal 1: to eradicate extreme poverty and hunger.[8] 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

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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.

Many studies have shown positive association between newborn zinc status and birth weight, suggesting that zinc might be an independent factor influencing the birth weight. A very few studies have been done to study specifically the relation between weight for gestational age and zinc status of newborn in India. The present study was carried out to compare the serum zinc levels in SGA with respect to AGA babies in our local population.

Materials and Methods

The present study was conducted on newborns delivered in department of Obstetrics and Gynaecology and admitted to neonatal section of Department of Paediatrics, Govt. Medical College Patiala. Total duration of the study was 2 years and conducted during June 2012–June 2014. Ethics clearance was taken from the institutional ethical committee (Approval was taken from institutional review board on 10 Jan 2012 as it was a part of thesis dissertation). The present study is an unmatched case-control study.

Study population

Hundred newborns who were small for gestational age (whether term or preterm) comprised the study group and 100 newborns who were appropriate for gestational age (whether term or preterm) comprised control group. Newborns were included irrespective of their period of gestation and weight, sex, parity, mode of delivery. Gestational age was calculated using mother's date of last menstrual period. To classify the infant as to whether was appropriate or small for gestational age, Battaglia and Lubchenco birth weight for gestational age standard graphs were used.[9] Based on ponderal index SGA infants were classified as symmetrical SGA (PONDERAL INDEX <2) or asymmetrical SGA (PONDERAL INDEX >2). All first 200 newborn born during the study period that fitted to the inclusion criteria were constituted the study group. Cord blood sample was collected immediately after birth and zinc levels were determined by atomic absorption spectrophotometry method. Five milliliters (ml) of cord blood was drawn using a 5 ml disposable plastic syringe with stainless needle. The blood was put into a zinc-free uncontaminated EDTA polyethylene tube (vacutainer) labeled with infant's details. Normal zinc levels for the study were 60–120 μg/dl.

Inclusion criteria

All SGA babies whether term (37–41 weeks) or preterm (<37 weeks) were included as test and AGA babies (both term and preterm) were taken as controls after taking informed written consent from the newborn parents.

Exclusion criteria

All newborns whose mothers were not sure about date of last menstrual period, having features of chorioamnionitis, antepartum hemorrhage, intrauterine infections, toxemia of pregnancy, Diabetes mellitus, hepatitis, smokers and all birth-asphyxiated babies, newborns of multiple pregnancies, and congenital malformation.

A detailed antenatal, perinatal, obstetrical, personal, past history, and present complaints were taken to rule out other causes that can affect zinc levels in babies. A thorough physical and systemic examination of every newborn recruited into the study was carried out.

Statistical analysis

We combined and analyzed data with SPSS version 20 (IBM Corp., Armonk, NY, USA). Percentages, means, and standard deviation (SD) were used. Difference between two means was evaluated by students *t*-test by calculating the standard of error of difference. The level of significance was fixed at <0.05.

Results

The male and female percentage of newborn babies in the study group was 55% and 45% and in the control group was 56% and 44%, respectively. The mean birth weight in the study group was 2030 ± 411.45 grams and in the control group was 2598 ± 416.32 grams. The mean gestational age in the study group was 37.13 ± 2.33 weeks and 36.82 ± 2.50 weeks in the control group. The maximum numbers of cases in both the groups were in the

Table 1: Socio-demographic characteristics of the study population (*n*=100)

Socio-demographic characteristics	Study Group	Control Group
Gender		
Male	55	56
Female	45	44
Birth weight (in grams)		
1500-1999	39	6
2000-2499	45	33
2500-2999	16	41
3000-3499	0	20
>3500	0	0
Mean gestational age (in weeks)		
32-35	28	30
35-38	38	40
38-41	34	30
Mode Of Delivery		
Vaginal Delivery	66	59
Caesarean Section	34	41
Parity		
1	50	35
2	31	39
3	19	26

39th week period of gestation Statistical analysis showed that birth weight of both the groups was not comparable ($P < 0.05$) whereas gestational ages were comparable between both the groups ($P > 0.05$). Mode of delivery distribution was same in both the groups, but groups were not comparable parity wise [Table 1].

The mean (±SD) serum zinc levels of the study and the control groups were 56.8 ± 40.6 μg/dl and 107.4 ± 72 μg/dl respectively. Statistically highly significant difference was found in the mean serum zinc levels between the two groups. These results show that newborn with lower zinc levels in their blood are more at risk of being born SGA as compared to newborns with sufficient zinc levels [Table 2].

The mean serum zinc levels of the preterm SGA group and term SGA group were 46.26 ± 22.54 μg/dl and 63.35 ± 47.47 μg/dl respectively. Statistically significant difference was found in the mean serum zinc levels between the two groups. These results show that babies born preterm as well as IUGR are more vulnerable to further zinc deficiency. This indicates transfer of micronutrients more in the last trimester causing lesser values in preterm babies [Table 3].

Infants who are born SGA can be symmetrical SGA or asymmetrical SGA. Infants with growth restriction affecting the later parts of pregnancy have normal head circumference, some reduction in length and more reduction in weight are asymmetrical SGA. Infants whose restriction begins early in pregnancy have proportionately small head circumference, length and weight are symmetrical SGA. No data in literature is available comparing zinc levels between the symmetrical and asymmetrical SGA. Statistically no significant difference was found in the mean serum zinc levels between the two groups. Thus, it indicates that zinc levels in SGA babies were not different irrespective of the time of gestation during which growth of fetus was affected in utero [Table 4].

Table 2: Comparison of Serum zinc levels in Study (SGA) and control (AGA) group

Group	No.	Mean±SD* (μg/dl)	"t" value	"*P*" value	Sig†.
Study (SGA)	100	56.8±40.6	-6.1	0.001	Sig.
Control (AGA)	100	107.4±72			

*:SD: standard deviation, †:Sig.: significant

Table 3: Comparison of serum zinc levels in preterm and term SGA newborns

Group	No.	Mean±SD* (μg/dl)	"t" value	"*P*" value	Sig†.
Preterm SGA	38	46.26±22.54	2.07	0.05	Sig.
Term SGA	62	63.35±47.47			

*:SD: standard deviation, †:Sig.: significant

Table 4: Comparison of serum zinc levels in symmetrical and asymmetrical SGA newborns

Group	No.	Mean±SD* (μg/dl)	"t" value	"*P*" value	Sig†.
SGA symmetrical	55	46.26±22.54	-0.253	>0.05	Not Sig.
SGA asymmetrical	45	58.00±28.34			

*:SD: standard deviation, †:Sig.: significant

Discussion

The present study was undertaken with an aim to evaluate the association of low birth weight with zinc levels in the body. The study found out lower zinc levels in SGA newborns as compared to AGA newborns indicating that maternal zinc levels causing intrauterine growth restriction which reflects in the serum zinc levels of SGA born newborns. Bahl L. found significantly lower zinc levels in term and preterm SGA babies (58.2 ± 13.4, 51.2+/- 51.7 micrograms/dl) as compared to term and preterm AGA babies (79.6 ± 17.8, 81 ± 25.2 μg/dl).[10] Elizabeth *et al.* found the statistically significant lower zinc level in preterm and term LBW babies (70.25 ± 24.5 μg/dl, 78.09 ± 18.39 μg/dl) as compared to term babies (92.24 ± 19.4 μg/dl), these results are consistent to present study.[11] Ashraf *et al.*, also showed that zinc level has positive correlation with birth weight and LBW babies had lower levels of zinc.[12] Ozdemir *et al.* also reported significantly lower zinc levels (<100 μg/dl) in the SGA neonates as compared to the AGA (150 μg/dl) neonates similar to our study.[13] Rwebembera *et al.*, reported that newborns with low zinc levels were 2.8 times more at risk of being LBW.[14] Another study done by Jyotsna *et al.* concluded that LBW neonates and their mothers have significant zinc deficiency as compared to term AGA neonates and their mothers and this deficiency is correlated with zinc deficiency in mothers of these LBW neonates.[15] Jeswani *et al.*, also found positive correlation between neonatal weight and zinc status of the newborns.[16] In a recent case control study done by Abass RM *et al.* it was found that maternal zinc were lower in LBW newborns than in those with normal weight.[17] Negandhi PH also found significant association of low birth weight with maternal low zinc intake in a recent study done in Indian urban settings.[18]

Contrary, to these findings, there are also studies that found no relationship between infant birth weight and zinc status. Iqbal, *et al.* and Gomez *et al.*, found no significant relationship between infant birth weight and zinc status.[19,20] This 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.

Randomized Control trials to study the effect of prenatal zinc supplementation on birth weight have reported different results whereas Goldenberg *et al.* and Iannotti *et al.* found positive effect of zinc supplementation in pregnant women on infant birth weight and newborn growth parameters respectively,[21,22] Osendarp *et al.* and Danesh A *et al.* found no significant effect of zinc supplementation in pregnant women on infant birth weight or gestational age.[23,24] A Cochrane review done by Haider BA *et al.* concludes that multiple micronutrient supplementation reduced the number of low birth weight and small for gestational age babies when compared with supplementation with iron and folic acid supplements alone.[25] But Mori R and Chaffee BW

et al. failed to found any significant association between prenatal zinc supplementation and delivery of low birth weight babies in reviews done by them.[7,26] As per these reviews, although, zinc supplementation lowers risk of preterm births, but does not affect any other parameters of fetal growth like birth weight, length, or head circumference at birth. The authors have suggested that it might be due to the confounding bias, difference in method used in assessment and interpretation of zinc levels in various studies and difference in the underlying zinc status of the populations studied. Though most of the trials were carried out on women from lower income groups in developing countries, none of the review included trials on Indian population. Participant noncompliance is also an issue in field settings. The other reason might be related to the bioavailability of the zinc supplement as absorption of zinc can be inhibited by iron and phytates and zinc used in conjunction with iron may dilute the effect of supplementation. Moreover, presence of other concurrent nutrient deficiencies in the studied populations might have influenced the results. Also, besides zinc deficiency various other maternal and biosocial factors also influence birth weight. These factors should also be duly considered while studying the effect of zinc-based interventions in pregnancy. However in a recent meta analysis done by Wilson *et al.* a definite relationship between maternal zinc deficiency and infant birth weight was noticed and further such studies in zinc deficient populations were recommended.[27] This study demonstrates the importance of zinc in child development, particularly in utero, and implementing supplementation at primary health care level will help in reducing preventable causes of infant mortality.

Conclusion

The present study demonstrates that SGA neonates have significant zinc deficiency as compared to AGA neonates. There is a relationship between birth weight of newborn and infant zinc levels.

Recommendation

Preventing zinc deficiency by improving dietary intake and considering zinc supplementation during pregnancy at primary health care level can improve prenatal growth which thus translates into greater improvements in postnatal growth and decreased risk of mortality and morbidity in infancy. However, more community-based studies are required to initiate zinc-based interventions in pregnancy.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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