A Study of Cord Blood Zinc Levels in Term Small for Gestational Age and Term Appropriate for Gestational Age Neonates

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ABSTRACT

Zinc deficiency is the most common micronutrient deficiency in the developing countries. Maternal zinc deficiency is associated with foetal growth retardation and other adverse foetal outcomes. This study aimed to determine Cord blood zinc level between the term SGA and AGA babies, as well as the relationship between the Cord blood zinc and maternal zinc levels. The Present study includes the serum zinc levels in the Cord blood of term-small for gestational age neonates and term appropriate for gestational age neonates and to study the correlation between Cord blood serum zinc levels and birth weight in term- small for gestational age neonates. The Present study focuses on the correlation between maternal zinc levels and Cord blood zinc levels.

Key words: Zinc, Low birth weight, Cord blood zinc, Maternal zinc

INTRODUCTION

Birth weight is the vital factor of perinatal and neonatal outcome. A newborn baby weighing less than 2.5 kg at birth irrespective of the gestational age is termed as a low-birth-weight baby. Low birth weight babies can be term SGA or preterm babies. In India, the incidence of low-birth-weight babies is around 28%1. About two third of the low-birth-weight babies are term-small for gestational age babies and one third are preterm babies. Most of the low-birth-weight babies weigh between '2kg to 2.49kg' 2. out of which zinc is an important one. Zinc level has positive correlation with birth weight 5. LBW babies have lower levels of zinc, which might be an independent factor influencing the birth weight 5. Zinc is an important component of cell function and architecture. It has an important role in gene transcription. Zinc plays the main role in protein-DNA or protein –RNA interactions 6. It is required for process of growth.

Mothers who are zinc deficient may have an adverse pregnancy outcomes like spontaneous abortion, congenital malformations, preterm birth and low birth weight leading to poor weight gain, growth retardation, and infection6.This study is done to find if there is any association between Cord blood zinc level and birth weight in term SGA and AGA babies and their mothers. Several studies have been done on this subject, some of the studies have reported a positive correlation between zinc and birth weight, while some of the studies contradict such correlation [1-21].

MATERIALS AND METHODS

Study design

Prospective cross-sectional study.

Sample size

- 50 term SGA neonates and their mothers.
- 50 term AGA neonates and their mothers.

Study period

The period of study was one year from April 2017 to March 2018.

Study place

This study was carried out in the Department of Paediatrics at Sree Balaji Medical College and Hospital, Chennai.

Inclusion criteria

Cases: Term- small for gestational age neonates and their mothers.

Controls: Term- appropriate for gestational age neonates and their mothers.

Exclusion criteria

- Neonates born to multiple gestation.
- Neonates with features of chromosomal abnormalities, intrauterine infection or with congenital malformations and Intra uterine growth restriction.
- Neonates of mothers with severe malnutrition (body mass index<18.5), severe anaemia. diabetes mellitus, gestational diabetes, pregnancy induced hypertension, chronic illness. teratogenic drugs, placental abnormalities.
- Neonates requiring admission to Neonatal intensive care unit.

Method

Our study included 50 term-small for gestational age neonates and their mothers and 50 term-appropriate for gestational age neonates and their mothers who satisfied the inclusion and exclusion criteria. Detailed maternal history was taken and thorough physical examination of the neonate was done. Birth weight was plotted against gestational age in Lubchenco growth charts to assess if they are small for gestational age or appropriate for gestational age. After obtaining informed consent from the parents, Cord blood sample for serum zinc was collected from term-SGA and term-AGA babies and 2ml of blood from the peripheral vein of their mothers immediately after delivery was collected respectively for serum zinc level estimation and sent to our central laboratory.

Estimation of zinc

Serum zinc levels were estimated by end point nitro PAPS dye binding colorimetric method. The principle of the method is, nitro-PAPS reacts with zinc in alkaline solution to form a purple-coloured complex, the absorbance of which is measured at 575nm (interference from copper and iron are virtually eliminated by ph and chelating additives). Reference value of serum zinc is 70 -150 micrograms/ decilitre. The linearity can go up to 1000 micrograms/ decilitre. The sensitivity of detection is 5micrograms/ decilitre. The data collected was analysed using SPSS 21 version. Qualitative data like maternal age, parity, mode of delivery, sex of the baby was analysed by Pearson chi square.

Does this study include human subjects or animals?

Only human subjects are included.

Study definition

Term baby

A baby whose gestational age falls between 37 completed weeks and 41 weeks 6/7 days.

Small for gestational age

SGA is defined as a baby whose birth weight falls 'below the 10th percentile' in the Lubchenco growth chart.

Appropriate for gestational age

AGA is defined as a baby whose birth weight falls 'between 10th and 90th centile' in lubencho growth chart.

RESULTS

A prospective cross-sectional study was done on 50 term SGA neonates and their mothers and 50 term AGA neonates and their mothers for a period of 1 year in Sree Balaji Medical College and Hospital. The mean maternal age in AGA was 24.22 and in SGA was 23.88. The above tabular column shows that there is no statistical significance in the maternal age between AGA and SGA groups (Table 1). The primiparous mother was 46% and 58% in AGA and SGA respectively, whereas in multiparous it was 54% and 42% in AGA and SGA, respectively. The above results shows that there is no statistical significance in the parity of mother between AGA and SGA groups (Table 2).

Table 1: Maternal age–AGA vs. SGA.

	AGA	SGA
Mean	24.22	23.88
SD	4.258	3.858
Minimum	17	17
Maximum	34	35
P-Value=0.677		

Table 2: Parity–AGA Vs. SGA.

	AGA	SGA	Total
Primi	23 (46%)	29 (58%)	52
Multi	27 (54%)	21 (42%)	48
Total	50 (100%)	50 (100%)	100
P-Value=0.229			

In LSCS group, AGA babies were 44% and SGA were 40% whereas in NVD group, AGA babies were 56% and SGA babies were 60 %. Thus, the above results shows that there was no statistical significance in the mode of delivery between AGA and SGA groups (Table 3). The male babies were 52% and 50% in AGA and SGA,respectively. The female babies were 48% and 50% in AGA and SGA respectively (Table 4). The tabulation shows that there is no statistical significance in the sex of the baby between AGA and SGA groups.

Table 3: Mode of delivery AGA vs. SGA.

	AGA	SGA	Total
LSCS	22 (44%)	20 (40%)	42
NVD	28 (56%)	30 (60%)	58
Total	50 (100%)	50 (100%)	100
	P-Value=0.685		

Table 4: Sex of the baby AGA vs. SGA.

	AGA	SGA	Total
Male	26 (52%)	25 (50%)	51
Female	24 (48%)	25 (50%)	49
Total	50 (100%)	50 (100%)	100
	P-Value=0.84		

The mean Cord blood zinc level in AGA was 97.15 and 90.89 in SGA. The values shows that there is statistical significance in the Cord blood zinc level between AGA and SGA groups (Table 5). In table 6, The mean maternal zinc level in AGA and SGA were 101.1 and 92.47,respectively. The results show that there is a statistical significance in the maternal zinc between AGA and SGA groups.

Table 5: Cord blood zinc- AGA vs. SGA.

	AGA	SGA
Mean	97.15	90.89
SD	8.26	17.62
Minimum	85.3	57.9
Maximum	140.1	140.4
	P=0.025	

Table 6: Maternal zinc level–AGA vs. SGA.

	AGA	SGA
Mean	101.1	92.47
SD	14.61	19.88
Minimum	68.9	56
Maximum	138.1	136
	P value=0.015	

Correlation coefficient: "r value"–0.431 with the P VALUE of 0.002 shows significant correlation between maternal zinc and Cord blood zinc levels (Table 7).

Correlation coefficient: "r value"–0.472 with the P VALUE of 0.001 shows significant correlation between maternal zinc and Cord blood zinc levels (Table 8).

In table 9& figure2, Among the 50 study participants of SGA groups, 10, 24, 14 and 2 were belonging to less than 20, 21 to 25, 26 to 30 and more than 30 years of maternal age, respectively. In majority of maternal age group, the zinc level was ranging from 95.1 to 110. The result shows that there is no statistical significance between Cord blood zinc and maternal age in SGA group.

Table 7: Correlation of maternal zinc and Cord blood zinc levels in AGA.

|		Maternal Zinc	Cord Zinc
Maternal Zinc	Pearson Correlation	1	0.472**
	Sig. (2-tailed)		0.001
	N	50	50
Cord blood Zinc	Pearson Correlation	0.472**	1
	Sig. (2-tailed)	0.001	
	N	50	50
**Correlation is significant at the 0.01 level.			

Table 8: Correlation of maternal zinc and cord blood zinc levels in SGA.

		Maternal Zinc	**Cord Zinc**
Maternal Zinc	Pearson Correlation	1	0.472**
	Sig. (2-tailed)		0.001
	N	50	50
Cord blood Zinc	Pearson Correlation	0.472**	1
	Sig. (2-tailed)	0.001	
	N	50	50

Table 9: Cord blood ZINC vs. maternal age in SGA.

Zinc (mcg/ml)		**Maternal age in years (SGA)**				
		<=20	**21-25**	**26-30**	**>30**	**Total**
	55-65	1	3	2	0	6
	65.1-80	2	3	1	1	7
	80.1-95	3	6	5	1	15
	95.1-110	4	8	6	0	18
	110.1-125	0	2	0	0	2
	125.1-140	0	1	0	0	1
	>140	0	1	0	0	1
P value-0.064		10	24	14	2	50
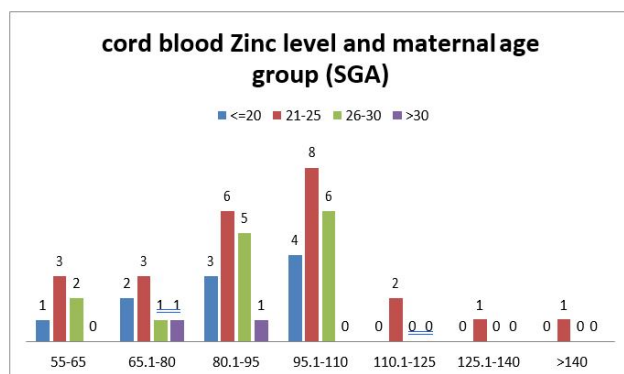
Figure 1: Cord blood Zinc level and maternal age group (SGA).

DISCUSSION

Infant mortality rate of India is 41 per 1000 live births According to NFHS 4 (2015 -2016) which is mainly contributed by the high neonatal mortality rate of 32 per 1000 live births. India contributes around 25% of world's neonatal deaths8. One fourth of the world's total death occurs in India.

Low birth weight including preterm accounts for around 60-80% of the total neonatal death. Incidence of low-birth-weight babies in India is 28% 1. One of the most important cause 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 12. 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 LBW13. Zinc deficiency is associated with abnormal conditions during pregnancy including congenital malformation (anencephaly) and abortion.

Though zinc is needed only in small quantity, they have several vital functions in our human body. As their requirements are small, their 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 and toxicity.

Among several micronutrients, iron stands first whose importance have been extensively studied and practised. Next lies zinc whose importance is slowly brought into light by several research trials and studies. Hence this study of serum zinc levels in the Cord blood of term SGA babies & their mothers and term AGA babies & their mothers was done.

In our study the mean maternal age in AGA was 24.22 and in SGA was 23.88, which shows that there is no statistical significance in the maternal age between AGA and SGA groups. In a study conducted by Abass et al. [11] the maternal age of the control and cases were comparable. The average age of controls was 27.54 and that of cases were 27.5. Thus, the two groups were well matched in this study. Thus, the mean maternal age in the two groups were comparable similar to the study conducted by Abass et al [14].

In our study the primiparous mother was 46% and 58% in AGA and SGA respectively, whereas in multiparous it was 54% and 42% in AGA and SGA respectively which shows that there is no statistical significance in the parity of mother between AGA and SGA groups which was similar to the study done by Zainab et al. 15.In our study, the LSCS were 42% and NVD were 58% which was not similar to a study conducted by Zainab et al. 15 were the LSCS were 54% and NVD were 46%.

In our study, the mean Cord blood zinc level in term AGA babies was 97.15 micrograms/decilitre and the mean Cord blood zinc level in term SGA babies was 90.89 micrograms/decilitre. There was statistically significant difference in zinc level between both the groups. In a study conducted by Abass et al [14], the mean Cord zinc level was 92.2 mcg/dl in term-AGA babies and 87.1mcg/dl in term SGA babies. Thus, in our study the mean zinc level in both term SGA and term AGA babies were higher than this study.

Similarly in a study by Elizabeth et al. [17], the mean zinc level was 70.25 ± 24.59 mcg/dl in term AGA neontaes and 78.09 ± 18.39 mcg/dl in SGA babies which showed that the mean zinc level of our study was higher than their study. However mean zinc value in AGA babies in our study was lower when compared to study done by croatia and Awadallah et al [19] with the zinc level of 114 ± 23 mcg/dl.

The mean maternal zinc levels in AGA babies in our study were 101.1mcg/dl and SGA babies were 92.47mcg/dl

and the p value are 0.015 which was significant. Whereas the mean maternal zinc levels in term AGA babies in Abass et al14 is 96.2 mcg/dl and term SGA babies is 62.9mcg/dl and the p value are 0.001which is also significant. Thus, this study supports our study results between both the groups. The correlation between the maternal and Cord zinc level of term AGA babies (p value-0.12) and term SGA babies (p value-0.15) in a study done by Abass et al. [14] is not significant, respectively. Our study shows significance between maternal and Cord blood zinc levels of term AGA babies (p value – 0.002) and term SGA babies (p value- 0.001). Hence our study is in contrast with their study.

Nanbakhsh F et al [16] studied the comparison of term SGA and term AGA with Cord blood zinc levels (p value-0.021) and maternal zinc levels (P value<0.017) shows significance and this finding agrees with our study. Our study results are in line with those of many studies conducted in different parts of the world showing a positive association between maternal zinc status and birth weight [8-10,17-20]. Jyotsna et al recognised that the rate of zinc deficiency was significantly higher in LBW babies and their mothers as compared to term NBW neonates and their mothers [21]. Gomez et al. found a significant positive association between serum zinc level and birth weight [25].

In our study both the term AGA and term SGA groups were comparable in the qualitative data like maternal age (p>0.05), parity of mother (p>0.05), mode of delivery (p>0.05), and sex of the baby (p>0.05) and was not statistically significant whereas in a study of Zainab et al [15] and Jyotsna et al. [21]. showed higher the parity of mother the lower their serum zinc levels which is contradicting our study.

CONCLUSION

The study concludes that there is a significant correlation in the Cord blood zinc level between the term AGA and term SGA neonates. Maternal zinc level influences the Cord blood zinc level.

Cord blood zinc level influences the birth weight of the baby. Thus, we conclude that zinc defiance can also be one of the reasons for low-birth-weight babies and providing zinc supplementation to the pregnant mothers can be recommended. The study concludes that there is a significant correlation in the Cord blood zinc level between the term AGA and term SGA neonates. Maternal zinc level influences the Cord blood zinc level. Cord blood zinc level influences the birth weight of the baby.

Thus, we conclude that zinc deficiency can also be one of the reasons for low-birth-weight babies and providing zinc supplementation to the pregnant mothers can be recommended.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

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