

## Relationship between Zinc deficiency in pregnancy and infant anthropometric indicators

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### Abstract

**Introduction:** Minerals and trace elements like zinc have a significant effect on the growth and development of the fetus and newborn. The purpose of this study was to determine the relationship between zinc deficiency during pregnancy and neonatal anthropometric indicators.

**Materials & Methods:** This study is a cross-sectional study and done on the women admitted for delivery in Ahvaz Imam Khomeini hospital. Sampling was available. 120 women who had all characteristics of the study were enrolled. The data was collected by Questionnaires and information lists, spectrophotometer, centrifuge, balance and centimeter. The collected data was analyzed with statistic T absolute, Squire and SPSS 17 software.

**Results:** The mean serum zinc level in mothers was 76.57 mg/dl. Average weight, length and head circumference at birth in infants of mothers with normal serum zinc level respectively: 3229 g, 50.32 cm, 34.73 cm and in the group with abnormal serum zinc level: 3092.17 g, 50.10 cm, 34.48 cm.

**Conclusion:** The results of this study showed that only birth weight has been associated with serum zinc level in maternal ( $p=0.07$ ).

**Keywords:** Anthropometry, Pregnant woman, Zinc.

### Introduction

One factors of infant survive and health is nutrition of mother during pregnancy (1). Birth weight is the most important survival factor for infants in developing countries. Annually over 20 million babies are born with low birth weight. Low birth weight is more common in developing countries. It is associated with poor health outcomes (2).

As an essential element, zinc plays an important role in human growth and development and is involved in many biological functions such as protein synthesis and amino acid metabolism (4). In a study

conducted by Parasad et al in 1990 in Iran, zinc deficiency was identified as the cause of stunted growth and delayed puberty (5). The physiological role during the rapid growth emphasizes its importance during pregnancy and fetal growth. Regardless of the problems of measuring the zinc status, it is estimated that probably about 82% of all pregnant women in the world are receiving inadequate zinc (6).

The recommendation to receive zinc for pregnant women in the second and third trimester of pregnancy may be at least 3 mg per day. 1-2 mg of zinc is daily taken by

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pregnant women in developed countries, while the consumption is lower in developed countries, and it ranges, for example, from 6.2 to 7 mg per day in Malawi and Brazil (6). Reference value of plasma levels for zinc is 70-120 micrograms per deciliter (7). The concentration of zinc in fetal plasma significantly depends on the zinc level in maternal plasma (8). Maternal zinc deficiency causes a zinc deficiency in the fetus and serious consequences, which include low birth weight, intra uterine fetus retardation, prematurity, spontaneous abortion, low birth weight compared to the weight at gestational age, impairment of the central nervous system and cognitive development disorder in children in the first 6 months of life (9). Pregnancy is associated with an increased need for micronutrients, including zinc; and the material, if reduced, can affect the prognosis of the pregnancy. In human studies, the reduction of leukocytes and zinc concentration in pregnant women has increased in the risk of low birth weight amongst infants, which can be suggestive of a reduction in the fetal growth in the case of zinc deficiency in the mother (10).

Several studies in this case have reported conflicting results, and the relationship between zinc deficiency in maternal serum and the anthropometric indices of birth is not clearly understood. Given the importance of the anthropometric indices of the infant at birth and also the importance and the prevalence of zinc deficiency in the population and the contradictory relationship between these two indices in previous studies, in this study, the researcher intended to examine the relationship between zinc deficiency during pregnancy and the anthropometric indices of

neonates in Ahvaz's Imam Khomeini Hospital.

### Materials and Methods

This study was a cross-sectional analysis that was conducted, over three months in the emergency room, maternity ward of Imam Khomeini Hospital, Ahvaz, in 2010. ۱۸۶ samples were taken during this period. ۱۳۰ people who had the characteristics of the study subjects and had a prenatal record before 12 weeks were selected with a simple, accessible and purposeful non-randomized method and entered the study, but in the end, 120 persons, including 60 people with abnormal serum zinc level and 60 people with abnormal serum zinc level, remained in the study.

۱۰ people were excluded from the study due to the birth of infants with anomalies (1 case), defects in the records (4 cases), severe neonatal asphyxia (2 cases) and the likelihood of contamination of the sampling tube (8 cases).

Inclusion criteria were: age 35-18 years, more than 145 cm tall, weighs more than 45 kg before pregnancy, no smoking, no alcohol and drug addiction, initiated prenatal care before 12 weeks of gestation, singleton pregnancy, number of pregnancies (1-3), the number of deliveries (1-2), not being in active phase of delivery, and no abnormal infants, the gestational age of 42-37 weeks based on the exact date of the last regular menstrual periods or based on ultrasound at 16-18 weeks of gestation, supplementation with folic acid and iron, the lack of a vegetarian diet, the absence of any underlying and chronic disease such as differences in thyroid, kidney disorders, diabetes, mal absorption syndrome, known

digestive problems, as well as types of infection, etc.

Two study groups were selected matched in terms of socioeconomic, racial, nutritional status, history of low birth weight, anemia, prenatal care, weight gain during pregnancy, education level and age. Information from the demographic and midwifery questionnaire was completed by the researcher who asked questions verbally. Then, 3 ml of venous blood were taken from each sample by the researcher, whose serum was separated by a professional colleague in the laboratory in order to be sent to the Jihad Daneshgahi Laboratory for the serum measurement. Before sampling, the test tubes were rinsed with deionized water so that it is devoid of trace elements, and after a 10-minute centrifugation (1000 cycles per second) of the serum in acid-wash polyethylene pipes, they were collected and stored at  $-20^{\circ}\text{C}$  until analysis. Analysis of the serum zinc level in the biochemistry division of the Jihad Daneshgahi Laboratory in Ahvaz was performed using an atomic absorption spectrophotometer with air-acetylene fuel.

The anthropometric factors of neonates, including weight by Seca scale, Length by stadiometer and head circumference with a tape measure were measured.

Data analysis was performed using the software SPSS 17.

Data analysis was performed using descriptive statistics, chi-square and t tests; and ANOVA was used to compare the dual-mode and multimode qualitative variables and compare the quantitative variables after examining the normality. A stepwise multiple regression model was used to control confounding factors such as gender of the

infant. A significance level of  $p = 0.007$  was considered.

### **Ethical considerations**

In this study, the objectives were first explained to each sample; and written consent to participate in the study was obtained from all of them. This study was confirmed by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran. At the end of the study, the women with micronutrient deficiencies were referred for follow-up and, if necessary, treatment.

### **Results**

This study was conducted on 120 pregnant women and their neonates. The mean age of the study samples was  $24.51 \pm 0.5$  years in the group with normal serum level and  $24.51 \pm 0.52$  years in the group with abnormal serum zinc level.  $33.4\%$  of mothers in the group with normal serum level and  $35.0\%$  of mothers in the group with abnormal serum zinc level were educated at the diploma level. The majority of women in both groups were housewives. Subjects who lived in the city includes  $80\%$  and  $75\%$  of mothers in the group with normal serum zinc level and in the group with abnormal serum zinc level, respectively. The average number of pregnant women was  $1.53 \pm 0.09$  in the group with abnormal serum zinc level and  $1.55 \pm 0.09$  in the group with normal serum zinc level. The current mean gestational age was  $271.30 \pm 0.58$  days in the group of mothers with normal serum zinc level and  $271.46 \pm 0.68$  in the group of mothers with abnormal serum zinc level.

The two groups were matched in terms of age, education, number of pregnancies,

number of deliveries, gestational age, and socioeconomic status. The mean serum zinc level in all mothers surveyed was 76.57 mg dl.

The results indicate that the mean weight of infants was  $3229 \pm 38.76$  g in the group with normal serum zinc level and  $3092.17 \pm 30.82$  in the group with abnormal serum zinc level; and the statistical test of t-test showed significant differences between the two study groups ( $p = 0.007$ ). Maximum frequency of infants (46.7 percent) in the group with normal serum zinc level was related to the weight range of 3210-3600 g, and maximum

frequency of infants (43.4 percent) in the group with abnormal serum zinc level was related to the weight range of 2810-3200 g (Table 1).

Average height and head circumference of infants at birth in the group of mothers with normal serum zinc level were 50.32 cm and 34.73 cm, respectively; while in the group of mothers with abnormal serum zinc level, they were 50.01 cm and 34.48 cm. The difference between the two groups was not statistically significant (Table 2).

**Table 1: Distribution of samples based on neonatal weight in both groups**

Neonatal weight(g) (p-Value = 0.007)	Normal zinc level(mg/dl) Number = 60		Abnormal zinc level (mg/dl) Number = 60	
	Percent	Frequency	Percent	Frequency
2400-2800	10	6	18.3	11
2810-3200	31.6	19	43.4	26
3210-3600	46.7	28	38.3	23
3610-4000	11.7	7	0	0
TOTAL	100	60	100	60
Maximum-Minimum	2450-3850		2650-3540	
Mean $\pm$ SD	$3229 \pm 38.76$		$3092.17 \pm 30.82$	

**Table 2: Statistical indices in neonatal anthropometric characteristics of the study samples in both groups**

Variable	Normal zinc level(mg/dl) Number = 60 Mean $\pm$ SD	Abnormal zinc level (mg/dl ) Number = 60 Mean $\pm$ SD	p-Value
Height (Cm)	$50.32 \pm 0.24$	$50.01 \pm 0.23$	T-Test(NS*)
Head Circumference(Cm)	$34.73 \pm 0.16$	$34.48 \pm 0.17$	T-Test(NS*)

\*NS: Not Significant

## **Discussion**

Many studies have been conducted worldwide on the anthropometric indices of neonates, in which several factors have been reported. Among these factors, the effect of various metals such as zinc, copper, lead can be mentioned.

The results showed that % 9.9 of the study samples had a serum zinc level less than 60 mg per dl, which represents a severe lack of zinc. Increased levels of estrogen and plasma volume are considered as factors reducing the level of zinc in plasma during pregnancy (11).

Various studies have also shown that high fiber and phytate in the diet decrease the intestinal absorption of zinc and thus gives rise to the prevalence of zinc deficiency (12).

The results of this study indicate that there is a positive correlation between the serum zinc level in the mother and the birth weight of infants. Although the difference in the mean weight of infants was significant in both groups, it was not so considerable and was very low. Therefore, we must consider the role of other important variables, except for zinc. In a study entitled "The Relationship between the Zinc Levels of Mothers and Infant Growth", which was conducted by Lannotti et al in 2008 in Peru, a significant relationship was found between the maternal zinc intake and the birth weight of the infant (13). The results are similar to those of studies by Goldenberg and Gary et al on American and African women (14, 15), whereas in the study of Mahmudian et al in 1387 and Hufeez et al in Pakistan in 2005, zinc supplementation to pregnant women had no effect on the fetal growth (weight and height) (16,17). The result of a study conducted by Domenech et al showed that the level of zinc in the mother

causes a 20% change in the infant's birth weight (18).

Another study showed that the zinc supplementation have created significant differences in height, weight and stillbirth (19). According to King in 2005, the need for zinc has been different in different periods of the life of mammals, and zinc deficiency is mostly seen during cell division as exists in the fetus (20). Important in this study is that infants with low weight at birth were seen only in the group of mothers with the serum zinc level below 70 micrograms per deciliter - the difference that is considerable though it was not statistically significant. The similar results in a study that was conducted on adolescent pregnant women in Chile, showed that zinc supplementation reduces the number of infants weighing less than 2500 grams and increases the birth weight (21). In this study, no significant difference was observed between the two groups in terms of neonatal height, head circumference and chest circumference, which in this respect, the study was consistent with the results of the study by West et al study, which was conducted in 2008 in Nepal (22). Also in the study of Negrez et al in the U.S. and also Asendarp et al in 2002 in Bangladesh, zinc had no effect on the fetal growth in terms of height at birth (23- 24).

Despite the positive effects on the fetal growth and development and given the evidence from trials conducted in developed and developing countries and from this study, there is still insufficient evidence for make routine the zinc supplementation during pregnancy. Thus, more research is needed in this field to complete the evidence. Given the importance of zinc in the growth and development, sufficient knowledge should be

available to gynecologists, pediatricians and other related groups so that they are able to make the necessary recommendations to their clients. In addition, given the contradictory results of studies in different areas on the prevalence of zinc deficiency, comprehensive reviews are recommended in this area, which in case of the shortages of this element, a planned program is required in order to raise awareness, modify the dietary pattern and add zinc supplements during pregnancy.

Limitations of the study include selected cases without risk factors for LBW as well as freshly prepared samples and rapid separation of serum .

### Conclusion

The results of this study showed that among the anthropometric indices measured, the birth weight of the infant has a direct correlation

with the serum zinc level in the mother. Thus, the mean birth weight of infants whose mothers were deficient in zinc was lower than the mean birth weight of infants whose mothers were not deficient in zinc. Given the importance of anthropometric indices of infants at birth, particularly birth weight, it seems that, to determine more precisely the effect of the shortage of the serum zinc level in pregnant women on the anthropometric indices of children in Ahvaz, studies with a larger sample size and with a controlled diet should be made to minimize the limitations of the study.

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