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International Journal of Clinical Biochemistry and Research

Journal homepage: www.ipinnovative.com

Original Research Article

Assessment of serum zinc levels among rural pregnant women in Chengalpettu district, Tamil Nadu

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ARTICLE INFO

Article history:
Received 23-06-2020
Accepted 01-07-2020
Available online 28-09-2020

Keywords:
Zinc deficiency
Pregnancy
Dietary intake

ABSTRACT

Context: Zinc is a micronutrient which is required as a coenzyme for the metabolism of carbohydrates, lipids and proteins. Zinc deficiency is more common in pregnancy especially in developing countries like India. Prevalence studies on zinc levels in pregnant women in south Indian population are scanty and needs to be evaluated.
Aims: The aim of this study is to assess the serum zinc levels during pregnancy and its association with their dietary intake and demographic characteristics.
Settings and Design: This cross sectional study was conducted in a tertiary care hospital in rural area of Chengalpettu District, Tamil Nadu.
Materials and Methods: A total of 54 healthy pregnant women were included in the study population. Detailed obstetric history was obtained by using a proforma. Serum zinc levels was estimated by colorimetric method and their average daily dietary intake in terms of zinc was assessed by using a weekly standardized food frequency questionnaire.
Statistical Analysis used: Statistical analysis was performed by using SPSS software.
Results: Mean serum zinc levels were 112.35±121.21 μg/dL. Almost 37% of the study participants had zinc deficiency (<60 μg/dL). Average daily dietary intake of zinc of the study participants were in the range of 0-2mg/day against the recommended dietary allowance (RDA) of 20mg/day which was 12.5% of the RDA.
Conclusions: High prevalence of zinc deficiency is due to deficient dietary intake of zinc. Persons on vegetarian diet are more prone for zinc deficiency. Larger studies are required to understand the magnitude of zinc deficiency during pregnancy in India.

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1. Introduction

Micronutrients are vitamins and minerals that are needed by the body in very small quantities, but they are important for normal functioning, growth and development. Deficiency of micronutrients during pregnancy may give rise to complications in growth and development of foetus. Hence, adequate nutrition during pregnancy is important for the development of the placenta, for a healthy delivery and successful lactation. Some epidemiological studies indicate that foetal nutrition may influence foetal growth, development and the risk of developing various diseases later in life.[1]

Deficiencies in micronutrients such as folic acid, iron, zinc, vitamin A, B6, B12, C, E, riboflavin are highly prevalent and may occur concurrently among pregnant women.[2] Causes for deficiencies include poor diet, mal-absorption syndromes, and diseases such as malaria or infestation by intestinal parasites.[3] Also, women who want to become pregnant, are prone to develop severe

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https://doi.org/10.18231/j.ijcbr.2020.069
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deficiencies in micronutrients, with multiple or closely spaced pregnancies.[4] Few observational studies suggest that consumption of micronutrient supplements in pregnancy is associated with higher birth weight and better outcomes.[5] Multiple micronutrient deficiencies are generally found in low socio-economic population.[6]

Zinc is an essential micronutrient which is required for normal growth, reproduction and lactation during pregnancy. It is required by 300 metalloenzymes in the body. e.g. carbonic anhydrase, alkaline phosphatase, alcohol dehydrogenase. It is involved in the synthesis, stabilization of DNA, RNA and proteins. It takes part in the renal regulation of pH. It is essential as an antioxidant as it forms a part of the enzyme superoxide dismutase. It is also present in gusten which is a salivary protein important for the taste sensation.

Diet is a main factor that determines the zinc status in our body. Dietary sources of zinc includes meat, fish, nuts, legumes, eggs, milk. Zinc found in cereals is not fully absorbed in our body. Absorption of zinc takes place in the duodenum and the transport protein metallothionine facilitates its absorption. Recommended dietary intake for adults is 10-15mg/day and during pregnancy, it is 20 mg/day. Supplementation of zinc in the diet has also increased the bioavailability of iron and iodine.[7]

Various studies conducted over the years suggest that zinc deficiency is a public health problem. It has been estimated that 82% of the pregnant women worldwide are suffering from zinc deficiency.[8] It is one of the ten significant factors contributing to burden of the disease in developing countries. World health organization has developed the millennium development goal: 1 by supplementing zinc in the developing nations for eradicating extreme poverty and hunger.[9] UNICEF advocates the use of multiple micronutrient supplementation in the form of iron, folic acid and zinc to improve the nutritional status of women in developing countries.[10]

Maternal zinc deficiency can cause infertility, prolonged labour, intrauterine growth retardation, preterm birth and low birth weight. It also causes growth retardation, delayed immune system development, congenital malformation, pregnancy induced hypertension, increased risk of abortions, miscarriages and still births. It also leads to premature rupture of membranes, placental abruption, haemorrhage, infections, increased neonatal morbidity and mortality, abnormal Neurobehavioural development.[11,12]

The mechanism underlying the developmental defects in severe zinc deficiency can be attributed to the impairment of several metabolic functions. There is abnormal synthesis of proteins and nucleic acids, impaired cellular growth, morphogenesis, abnormal polymerization of tubulin with reduction in cellular motility and development, chromosomal defects and excessive lipid peroxidation of cellular membranes occurs in severe zinc deficiency and leads to the Teratogenic effects.[13]

Although zinc deficiency is considered as a major health problem in developing countries like India, there is no precise data available about zinc deficiency in rural pregnant women in South India with reference to their dietary intake. This study was done to assess the maternal serum zinc levels in rural pregnant women of Chengalpettu District and its association with their dietary intake, socioeconomic status, parity and intake of animal food sources.

2. Materials and Methods

This cross sectional study was conducted on 54 healthy pregnant women attending tertiary care hospital in rural area in Chengalpettu District, Tamil Nadu. All the patients referred to the laboratory after applying inclusion and exclusion criteria were enrolled in the study. Duration of the study was 3 months (Mar – May 2020). Informed consent was obtained from all the study participants. Institutional ethical committee approval was obtained.

Inclusion criteria included healthy antenatal women attending the OPD of a tertiary care hospital in rural area in Chengalpettu District, Tamil Nadu and also women who were not taking Zinc supplements during pregnancy. Exclusion criteria includes subjects with severe anaemia (Hb < 7g/dl), twin pregnancies, pre-eclampsia, eclampsia, antenatal bleeding, diabetes mellitus, chronic hypertension, seizure disorders, malignancies, infections, infestations, alcohol and drug abuse.

Serum sample was collected from all the study participants. Serum sample was centrifuged at 3000 rpm for 5 minutes and the serum was analysed for zinc by colorimetric method using Nitro – PAPS according to manufacturer's instructions. Patient's age, obstetric profile, Socioeconomic status along with co-morbidities were collected using a proforma and the average dietary intake per day was calculated[14] using a validated food frequency questionnaire for a week.

2.1. Statistical analysis

Statistical analysis was performed by using SPSS software. Results were reported as Mean± Standard deviation for quantitative variables. Chi square test was used to evaluate the significance of difference between the two groups. P Value <0.05 was considered as a statistically significant difference.

3. Results

Table 1 shows the demographic characteristics of pregnant women with reference to age, gestational age, parity, socioeconomic status and type of dietary intake. Majority of the women belonged to age group of 20-25 years, gestational age of 27-37 weeks, parity of 1, lower socioeconomic status and non-vegetarian diet. Table 2

Table 1: Distribution of demographic characteristic among the study participants (n=54)

S. No.	Variable	Frequency	Percentage
1	Age		
	20-25	28	51.9
	25-30	22	40.7
	30-35	4	7.4
2	Gestational age		
	1-12 weeks	4	7.4
	13-26 weeks	23	42.6
	27-37 weeks	25	46.3
	$\geq$ 38 weeks	2	3.7
3	Parity		
	0	4	7.4
	1	41	75.9
	2	9	16.7
4	SES		
	Low	30	55.6
	Lower middle	19	35.2
	Middle	5	9.3
5	Type of diet		
	Veg	23	42.6
	Non-veg	31	57.4

Table 2: Frequency distribution of serum zinc levels according to the reference range (n=54)

S. No	Serum zinc levels (μg/dl)	Frequency	Percentage	Mean±SD	Range
1	< 60 μg/dl	20	37		
2	60-120 μg/dl	25	46.3	112.35±121.21	24-514
3	>120 μg/dl	9	16.7		

Table 3: Distribution of average daily dietary intake of zinc according to the recommended dietary allowance (n=54)

S.No.	Daily dietary intake (mg/day)	Frequency	Percentage (%)	Mean±SD	Range
1	< 20	54	100	.70±0.60	0-2
2	> 20	-	-		

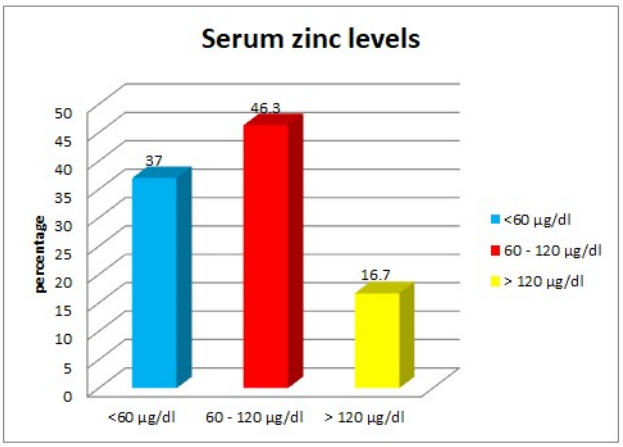

Fig. 1: Serum zinc levels

shows the distribution of serum zinc levels among the pregnant women in the study population. The serum zinc levels in 25 individuals accounting to 46.3% of the study population were in the normal range (60-120μg/dl). Serum zinc levels were found to be deficient (< 60μg/dl) in 20 antenatal women comprising of 37% of the total study participants. 9 of the study participants had levels > 120 μg/dl accounting to 16.7% of the study population. Mean levels of serum zinc were 112.35 $\pm$ 121.216 μg/dl in the study population. Figure 1 depicts the distribution of serum zinc levels in the study participants. Average daily dietary intake of zinc was found to be deficient in the total study population which is only 12.5% of the recommended dietary allowance of zinc which is around 20 mg/day (Table 3). Table 4 shows the association of serum zinc levels with demographic characteristics of the study population. There was no statistically significant (p value <0.05) association between serum zinc levels and age, gestational age, parity, socioeconomic status and type of diet.

Table 4: Association of serum zinc levels with demographic characteristics of the study participants (n=54)

S.No.	Variable	(<60 μg/dl) (n= 20)	(60-120μg/dl) (n=25)	(>120μg/dl) (n=9)	p value
1	Age				
	20-25	10 (50)	11 (44)	7 (77.8)	0.57
	25-30	8 (40)	12 (48)	2 (22.2)	
	30-35	2 (10)	2 (8)	0	
2	Gestational age				
	1-12 weeks	0	2 (8)	2 (22.2)	0.11
	13-26 weeks	12 (60)	8 (32)	3 (33.3)	
	27-37 weeks	8 (40)	14 (56)	3 (33.3)	
	$\geq$ 38 weeks	0	1 (4)	1 (11.1)	
3	Parity				
	0	0	2 (8)	2 (22.2)	0.24
	1	15 (75)	20 (80)	6 (66.7)	
	2	5 (25)	3 (12)	1 (11.1)	
4	SES				
	Low	8 (40)	15 (60)	7 (77.8)	0.25
	Lower middle	8 (40)	9 (36)	2 (22.2)	
	Middle	4 (20)	1 (4)	0	
5	Type of diet				
	Veg	10 (50)	17 (68)	4 (44.4)	0.32
	Non-veg	10 (50)	8 (32)	5 (55.6)	

4. Discussion

The present study was conducted to assess the serum levels of zinc and its association with the demographic parameters such as age, gestational age, parity, socioeconomic status and type of dietary intake. Average daily dietary intake of zinc was also calculated. Serum zinc levels were deficient in 37% of the study population with mean serum levels of zinc of 112.35$\pm$121.21 μg/dl in the study population. The average daily dietary intake of zinc was found to be deficient in the entire study population owing to the reduced intake of meat, fish, eggs, nuts etc. even among the non vegetarians. There was no statistically significant association between serum zinc levels with respect to age, gestational age, parity, socioeconomic status and dietary intake of the pregnant women in the rural area.

In a study done by Salimi et al, the prevalence of zinc deficiency was 49% in the pregnant women from Iran. There was a high consumption of fibre and little red meat intake in the study participants.[15] A study conducted among high school girl students in Zahedan showed the prevalence of zinc deficiency about 42.8%.[16]

Mahmoudi et al showed zinc deficiency of 65% in high school girl students in Tehran.[17] About 64.6% of the pregnant women with 28 weeks of gestation were deficient for zinc in a study conducted in Haryana, India.[18] A study conducted in Bangladesh showed lower serum zinc levels in pregnant women 47$\pm$24 μg/dL.[19] A study conducted in pregnant women of urban slums in Delhi showed lower serum zinc levels <60 μg/dL.[20]

The serum zinc levels mentioned in the present study is higher compared to the earlier studies conducted in pregnant women. Cause of zinc deficiency can be attributed to the low intake of zinc rich foods even among the non vegetarians and high intake of phytates in the diet which lowers the absorption of zinc. Low serum zinc levels in non vegetarians can be attributed to reduced frequency of consumption of non vegetarian food owing to higher costs of food stuffs. Poor nutritional status of adolescent girls is also a leading cause of zinc deficiency in the pregnant women. Larger studies have to be conducted in various parts of our country to estimate the prevalence and cause of zinc deficiency in antenatal women.

5. Conclusion

Multiple micronutrient supplementation in the form of iron, folic acid and zinc has to be emphasized to meet the overall requirements of micronutrients which are increased during pregnancy. Dietary counselling for the pregnant mothers regarding the increased consumption of animal food sources for non vegetarians and milk, nuts and legumes for vegetarians has to be advocated.

6. Source of Funding

Self funded study.

7. Conflict of Interest

None.

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Cite this article: Maheshwari K U, Kumar N A, Preethi S . Assessment of serum zinc levels among rural pregnant women in Chengalpettu district, Tamil Nadu. *Int J Clin Biochem Res* 2020;7(3):320-324.