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Assessment of Zinc Status Among Pregnant Women Attending a Tertiary Level Hospital of Sunsari District, Nepal

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ABSTRACT

Background: Zinc deficiency is one of the major public health problems especially in developing countries, with an estimation of over 80% of pregnant women to be zinc deficient worldwide. Maternal zinc deficiency elevates the risk of foetal growth restriction. This study aimed to assess zinc deficiency and to examine the factors associated with zinc status among pregnant women attending a tertiary level hospital in Sunsari district, province no. one, Nepal.

Methods: Pregnant women were selected by using time frame consecutive sampling at B. P. Koirala Institute of Health Sciences, Dharan from September to November 2018. Data on nutritional, socio-demographic and reproductive profiles were collected using a semi-structured questionnaire. Blood was collected from each pregnant woman to estimate serum zinc concentration by atomic absorption spectrophotometry. Association between serum zinc concentration and predictor variables were assessed using chi-square test.

Results: A total of 156 women participated in the study. The prevalence of zinc deficiency among the pregnant women was 22.6%. Our data did not show association of any of the socio-demographic, nutritional and reproductive variables with serum zinc status (p-value>0.05) in chi-square.

Conclusions: Zinc deficiency was found to be prevalent in our targeted population. However, community based studies need to be conducted for exploring more precise relationship between zinc status and other variables.

Keywords: Nepal; nutritional factors; pregnant women; zinc status.

INTRODUCTION

Zinc, an essential micronutrient, is known to play significant roles in cellular growth, differentiation, signalling and metabolism.[1] It is essential to maintain adequate zinc nutrition for normal pregnancy outcome and child growth, immune function and neurobehavioral development.[2] Low maternal zinc concentration has been associated with adverse pregnancy outcomes[3-5] such as spontaneous abortion, congenital malformation, low birth weight and preterm delivery.[6-8]

Globally, zinc deficiency (ZD) is estimated to account for 1% of all deaths and 4.4% of deaths in children aged 6 months to 5 years.[9] Women in low-income settings, such as in India, are at risk of inadequate zinc intake due to poor diet quality and low consumption of flesh foods rich in zinc.[10] In the current study, we aimed to estimate the prevalence and associates of zinc deficiency among pregnant women attending a tertiary level hospital of eastern Nepal.

METHODS

This was an institution based cross sectional study conducted between September and November 2018 at B. P. Koirala Institute of Health Sciences (BPKIHS), Sunsari district, Nepal. Pregnant women attending antenatal clinic at Department of Obstetrics/Gynaecology, BPKIHS were selected usingtime frame consecutive sampling. Inclusion criteria were all healthy women while those with zinc supplementation were excluded from the study. A sample size of 156 was calculated with input of 95% CI, expected prevalence of zinc deficiency=

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61%[11] non-response rate of 10% and 8% margin of error. A set of pre-tested questionnaire was administered to each participant to record their demographic, socio-economic, nutritional and reproductive information. Individual Dietary Diversity (IDD) for each pregnant woman was calculated by Women's Dietary Diversity (WDD) questionnaire developed by FAO.[12] IDD was determined by 24 hour Dietary Recall Method. The WDD questionnaire was extensively discussed with experts and few local food items were added in the questionnaire in order to represent local food diversity. The Dietary Diversity (DD) score was determined according to the method described by Kumera et al.[13] Briefly, respondents were asked if they had taken any food from the predefined 14 food categories during the previous day of survey. Accordingly, the DD score was calculated out of the score of 14. The mean DD score of the study subjects was calculated where any score less than or equal to the mean was designated as "low dietary diversity" and score more than the mean was designated as "adequate dietary diversity score".

Nutrition education (prenatal dietary advice) received by pregnant women was assessed with the help of a set of three questions adapted from Ethiopian National Nutritional Survey.[13] Briefly, the three questions used were whether she received following three advices from her health care providers: a. advised to eat balanced diet, b. advised to eat more, c. advised to eat fruits and vegetables during pregnancy. A value of 1 was assigned if she answered yes and 0 was assigned otherwise. The participant was considered to receive nutrition education if she answered "yes" to any two of the questions.

Mid-upper arm circumference (MUAC) was measured on the unclothed left arm following a standard procedure using MUAC tape following procedure described by Katz et al.[14] Measurement was made at the mid-point of the upper arm two times by two enumerators. An average of the two measurements was recorded as MUAC value for the woman.MUAC value less than 23 was defined as malnourished and more than or equal to 23 was considered normal nutritional status.[15]

Definition of educational classification, income level and distance to nearest tertiary level hospital:Educational classification was based on Nepalese educational system.[16] Participant was classified as illiterate if she was unable to read and write. They were asked about their highest level of formal education attained and accordingly categories were made.Income levels of the participants were classified based on the Nepal Living Standard Survey.[17] For income calculation, average monthly household income of the participant was asked and it was converted to annual income. The distance between the participant's residence and BPKIHS (BPKIHS is the tertiary level hospital for our study) was calculated using Google map. Briefly, each woman was asked about her place of residence and average distance from her residence to BPKIHS was calculated. Ethical approval was taken from Institutional Review Committee of BPKIHS (Code no: IRC/1278/018). Written consent was obtained from each pregnant woman prior to enrolling them in study.

Three ml of blood was withdrawn from each woman by venepuncture. The blood sample was centrifuged at 3000 rpm and serum was stored in a trace metal free vial at -20ºc for zinc estimation. Zinc was determined in serum by flame atomic absorption spectrometry (Thermo Elemental UK) following the method of Jian-Xin.[18] Serum was thawed and mixed gently by inverting the vial before analysis. All test tubes for zinc analysis were thoroughly acid washed (0.1% HNO_3) and rinsed with double distilled deionized water. The serum sample was diluted to its double volume with double distilled deionized water. Zinc working calibrators were used to establish the calibration curve and zinc concentrations were calculated from the absorbance values by interpolation of the calibration curve. The zinc analysis was carried out at the laboratory of Nepal BatabaraniyaSewaKendra, Biratnagar, Nepal. Serum zinc concentration cut offs were adopted from Kumeraet al.[13] to define zinc status in our study.According to this criterion, a serum zinc concentration less than 50μg/dl is considered zinc deficient or low and more than or equal to 50μg/dl as adequate. Criteria for classification of anaemia was taken from the WHO guideline.[19]

Categorical variables were expressed in frequency and percentage, and continuous variables were expressed in mean and standard deviation. Association between serum zinc status and predictor variables were determined by using chi-square test (SPSS ver. 25). All p-values <0.05 were considered statistically significant.

RESULTS

A total of 156 pregnant women (n=156) were enrolled in the study. They were in second and third trimester of their gestational period. Nearly 78% of them were between the ages of 20-30 years. Most of the participants were housewife and none of them involved in any income generating work. Measurement of MUAC revealed that 10% of the women were malnourished. Majority of them were non-vegetarian while about half had adequate dietary diversity. The mean serum zinc concentration was 108.6±72.85μg/dL. Based on our data and cut off criteria, the prevalence of zinc deficiency (ZD) among our study population was found to be 22.6%. The descriptive data are presented in Table 1-3.

Table 1. Demographic and socio-economic profiles of pregnant women (n=156)

Variables	Frequency (%)
Age	
Less than 20 years	8(5.1)
20-30 years	121(77.6)
More than 30 years	27(17.3)
Ethnicity	
Brahmin and Chhetri	60(38.5)
Indigenous (Janajati)	79(50.6)
Madhesi	10(6.4)
Others	7(4.5)
Education level	
Illiterate (not able to read and write)	7(4.5)
Up to secondary schooling	73(46.8)
Higher secondary	46(29.5)
Bachelor and above	30(19.2)
Occupation	60(38.5)
Housewife/not working	137(87.8)
Business/Jobs	16(10.3)
Farming	3(1.9)
Annual family income (NRs)	
<200,000	59(37.8)
200,000-500,000	65(41.7)
>500,000	32(20.5)
Distance to nearest tertiary level hospital	
Within 5 km	54(34.6)
6-30 km	66(42.3)
More than 30 km	36(23.1)

Table 2. Nutritional profile of the pregnant women (n=156).

Variables	Frequency (%)
MUAC	
<23	16(10.3)
≥23	140(89.7)
Nutrition education(prenatal dietary advice received)	
Yes	153(98.7)
No	2(1.3)
Iron/folic acid/calcium supplementation	
Yes	149(96.8)
No	5(3.2)
Dietary pattern	
Vegetarian/vegan	6(3.9)
Non-vegetarian	149(96.1)
Dietary diversity score	
Low dietary diversity (≤7)	74(47.4)
Adequate dietary diversity(>7)	82(52.6)
Serum zinc concentration	
Low serum zinc concentration	35(22.6)
Adequate serum zinc concentration	120(77.4)
Anaemia status	
Non-anaemic	116(82.9)
Anaemic	24(17.1)

Table 3. Reproductive profile of pregnant women.

Variables	Frequency (%)
Gestational period	
Second trimester	63(40.4)
Third trimester	93(59.6)
Contraceptive use in last 12 months	
Yes	26(17.3)
No	124(82.7)
Parity	
0	81(55.5)
≥1	65(44.5)

The independent variables included were age, ethnicity, education, occupation, family income, distance to nearest tertiary level hospital, MUAC, level of nutrition education, iron/folic acid/calcium supplementation, haemoglobin status, dietary pattern, dietary diversity, gestational period, contraceptive use in last 12 months and parity. Chi square test results showed no association between serum zinc status and aforementioned variables (Tables 4-6).

Table 4. Association of serum zinc status with socio-demographic variables (n=156).

Variables	Serum zinc status		p value
	Adequate (n%)	Low (n%)	
Age			
Less than 20 years	7(4.5)	1(0.6)	
20-30 years	93(60.0)	27(17.4)	0.727
More than 30 years	20(12.9)	7(4.5)	
Ethnicity			

Brahmin and Chhetri	42(27.1)	18(11.6)	0.257
Indigenous (Janajati)	65(41.9)	13(8.4)	
Madhesi	7(4.5)	3(1.9)	
Others	6(3.9)	1(0.6)	
Education level			
Illiterate	6(3.9)	1(0.6)	0.860
School level	56(36.1)	17(11.0)	
High secondary	36(23.2)	9(5.8)	
Bachelor and above	22(14.2)	8(5.2)	
Occupation			
Housewife/not working	108(69.7)	29(18.7)	0.162
Business/Jobs	9(5.8)	6(3.9)	
Farming	3(1.9)	0(0)	
Annual family income (NRs)			
<200,000	45(29.0)	14(9.0)	0.564
200,000-500,000	52(33.5)	12(7.7)	
>500,000	23(14.8)	9(5.8)	
Distance to nearest tertiary level hospital			
Within 5 km	41(26.5)	13(8.4)	0.946
6 to 30 km	51(32.9)	14(9.0)	
More than 30 km	28(18.1)	8(5.2)	

Table 5. Association of serum zinc status with nutritional and dietary factors (n=156).

Variables	Serum zinc status		p value
	Adequate (n%)	Low (n%)	
MUAC			
<23	11(7.1)	5(3.2)	0.360
≥23	109(70.3)	30(19.4)	
Nutrition education (prenatal dietary advice received)			
Yes	117(76.0)	35(22.7)	0.440
No	2(1.3)	0(0.0)	
Iron/folic acid/calcium supplementation			
Yes	116(75.8)	32(20.9)	0.308
No	3(2.0)	2(1.3)	
Dietary pattern			
Vegetarian/vegan	4(2.6)	2(1.3)	0.619
Non-vegetarian	115(74.7)	33(21.4)	
Dietary diversity score			
Low dietary diversity(≤7)	53(34.2)	20(12.9)	0.185
Adequate dietary diversity (>7)	67(43.2)	15(9.7)	
Anaemic status			
Non-anaemic	90(64.7)	25(18.0)	0.922
Anaemic	19(13.7)	5(3.6)	

Table 6. Association of serum zinc status with reproductive related factors (n=156)

Variables	Serum zinc status		p-value
	Adequate (n%)	Low (n%)	
Gestational period			
Second trimester	52(33.5)	11(7.1)	0.244
Third trimester	68(43.9)	24(15.5)	
Contraceptive use in last 12 months			
Yes	3(2.0)	3(2.0)	0.196
No	32(21.5)	32(21.5)	
Parity			
0	61(42.1)	19(13.1)	0.904
≥1	49(33.8)	16(11.0)	

DISCUSSION

There is scarce amount of information on zinc status among pregnant women in province no. 1, Nepal. In this light, we explored zinc status and its associated factors among pregnant women attending tertiary health facility of province no.1, Nepal. Our findings showed that 22.6% of the pregnant women were zinc deficient while none of the variables tested were significantly associated with zinc deficiency. At present, only few published papers highlight zinc status among pregnant women and women of reproductive age in Nepal.[11,20] These studies reported more than 60% of the pregnant women under study as zinc deficient while our finding is considerably less. Recent data from nationwide survey in Nepal[21] showed overall national prevalence of 24%, quite similar to our finding. According to the guidelines of International Zinc Nutrition Consultative Group (IZiNCG), ZD is considered as public health alarm when its prevalence reaches more than 20%.[2] The prevalence of ZD from our study along with other studies conducted in Nepal over 10 years, hence, highlight that the target population of pregnant women are at risk ofZD.

A study by Kumera et al.[13] established significant association of plasma zinc levels with inadequate dietary diversity. Association of DD with serum zinc status in the Ethiopian study[13] but not in our case could be due variation in dietary pattern between Nepalese and the latter setting.

Zinc concentration in maternal serum decreases as gestation progresses possibly due to increase in blood volume and higher demands by developing foetus. Therefore, comparisons between studies which enrolled pregnant women of different gestational periods should be carefully interpreted.[22]

Moreover, seasonal variation might affect serum zinc concentration. The months of September-October in Nepal lie towards middle of the annual calendar in which our study was carried out. These months represent the transition phase between summers and winter seasons in Nepal. Furthermore, cut offs for ZD used by various studies varied from 50µg/dL to 71µg/dL. Our study considered 50µg/dL as criteria to define ZD while a study from Vietnam[23] defined less than 71µg/dL as zinc deficient. An Indian study, however, utilized 66µg/dL as criteria to classify ZD.[24] Thus, we could observe variation in cuff off values and consequently differences in prevalence across countries. These data suggest the necessity of developing more suitable and valid criteria for defining ZD. In addition, several techniques of serum zinc estimation are used by various studies which might affect interpretation of zinc prevalence data.

Our study has some limitations. First, due to cross sectional design, bias could result as seasonal variation may occur in dietary diversity among the target population. Second, sample size is not large enough to represent the whole pregnant women population in eastern region of Nepal. Third, setting is hospital based, and therefore, those pregnant women who do not attend the hospital could have been missed. Fourth, we could only recruit pregnant women from second and third trimester. Therefore, the conclusion derived from this study might not be generalized to pregnant women of all trimesters.

CONCLUSIONS

The pregnant women in the current study were at risk of zinc deficiency in spite of the fact that no nutritional, socio-economic, demographic and reproductive variables were associated with serum zinc status. Our study recommends further community based researches including assessment of dietary zinc intake and multivariate analysis.

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