Prevalence of zinc deficiency among rural women during childbearing age in Peshawar, Pakistan

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Abstract: Zinc deficiency is a commonly reported health problem throughout the world. This cross sectional survey was conducted in rural Peshawar with an aim to estimate the prevalence of zinc deficiency in women of child bearing age and find its association with age, marital, pregnancy status and parity. Data was collected from 353 women age 15-45 years. EPI INFO version 6.04 was used for data analysis. Overall 98 (27.8 %) women were zinc deficient (≤80 µg/dl) while 31 (8.8%) had severe zinc deficiency (<50µg/dl.). Mean zinc level was found to increase gradually with the increase in the age up to 40 years and then starts decreasing significantly beyond this age. A significant decrease ($p<0.03$) in zinc concentration was found in married as compared to unmarried women. Out of 31 female with severe zinc deficiency, 23 (74.2%) were pregnant. Pregnant women in second (OR (CI) 3.36 (1.52-7.44) $p<0.0008$) and third ((OR (CI) 3.73 (1.91-7.30) $p<0.00002$) trimester were 3.4 & 3.7 times, respectively more zinc deficient as compared to control women. Mean zinc levels were significantly lower in women having no children versus women with 1-5 numbers of children. This study concludes that severe zinc deficiency especially prevalent in pregnant women needs urgent correction through food supplementation.

Keywords: Zinc levels, women of child bearing age, marital status, pregnancy, rural Peshawar.

INTRODUCTION

Zinc is one of the essential trace metals for many physiological functions and plays an important role in growth and reproduction (Cho *et al*., 2010; Pathak *et al*., 2004). It also acts as membrane stabilizer and is essential for the integrity of immune system (Sharif *et al*., 2011; Darnton *et al*., 2005). Many enzymes require it as a cofactor and is believed to be involved in the storage and release of insulin, tissue repair and protein synthesis. It is also needed in bones formation, synthesis of prostaglandin and thyroid hormones (Prasad, 1993; Hands, 1999).

In a study reported by (Yokoi *et al*., 1994) Zinc deficiency is found to be associated with growth stunting, hypogonadism, anemia, low serum iron and plasma zinc levels, low urine, sweat and hair zinc levels. Red meat is the most important common dietary source of bioavailable iron and zinc. Phytate present in cereal protein inhibits iron and zinc retention (Yokoi *et al*., 1994).

Zinc deficiency is a commonly reported health problem throughout the world (De-Regil *et al*., 2011; Gibson *et al*., 1989). Low income family's children in Pakistan are reported to exhibit low zinc level (Ahmad *et al*., 1988) and accredited to low dietary intake of zinc besides other confounding factors such as education, socio-economic condition, dietary habits and poor absorption. All these need proper evaluation to be considered. As data on the subject is scare particularly in the women of Pakistan in this age group. Therefore this study is designed to assess the magnitude of the problem of zinc deficiency as hypnotized in the most vulnerable cross section of our population i.e. the women of childbearing age (WCBA).

METHODS

A cross sectional study was conducted on 353 females of child bearing age (CBA) in village Palosi, District Peshawar, Khyber Pakhtunkhwa (KPK) Province Pakistan. The selection of study subjects was done through simple random sampling method. Ethical clearance for the study was taken from the PMRC local ethical review committee. Informed consent was taken from the respondents after explaining the objectives of the study.

Data on demographic characteristics and other factors hypothesized to be associated with zinc deficiency among females of child bearing age were collected on a well designed questionnaire. These included age, marriage age, socioeconomic/educational and marital status. Height, weight and blood pressure of selected individuals was recorded by using standard methods. Random blood

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samples were taken to measure serum zinc level. Atomic Absorption Spectrophotometer (Shimadzu) was used to measure zinc levels at a wavelength of 213.9 nm by utilizing an air acetylene flame and hollow cathode lamp as a light source. Zinc deficiency was defined as mild to moderate (Ferguson *et al*.,1993) for serum zinc levels 50-80 µg/dl and severe zinc deficiency (Prasad; 1998) for levels below 50µg/dl.

According to the revised criteria for Asian population overweight and obesity was defined as a Body Mass Index (BMI) of 23 kg/m^2 or greater and obesity as a BMI of 27 kg/m^2 or greater (WHO, 2000)

STATISTICAL ANALYSIS

EPI INFO version 6.04 was used to design data entry program to make the questionnaire, record and check files for statistical analysis. The frequencies, means and their standard deviations were obtained, as appropriate. In uni-variant analysis, unadjusted association of each of the independent variable, with zinc estimation test status of females either as abnormal or normal were evaluated with odds ratio (OR) and its corresponding 95% confidence interval (C.I).

RESULTS

A total of 353 women in child bearing age were screened for their zinc deficiency status in rural Peshawar, KPK province. General characteristics of the female population surveyed are represented in table 1. Mean of age of women was 24.07 (±6.48) years, height 153.96±7.89 cm, weight 51.14±9.84 kg and mean BMI was 21.5±9.2. Nearly eighty percent of women were married and 20% were unmarried. Mean age at marriage was 16.2 years. Out of 284 married women, 115(40.5%) were pregnant. Majority of females belonged to poor families and 310 (87.8%) of them were living below poverty line with total income less than Rupees 5000/- per month. A vast majority 323 (91.5%) of females were illiterate.

The sample population was distributed in different age groups as <20, 20-30, 31-40 and >40 years and their zinc levels analyzed. It was found that mean zinc level increases gradually with the increase in the age up to 40 years and then starts decreasing significantly ($p<0.001$) beyond this age (fig. 1). Overall 27.8 % female in the age group of 15-45 years were zinc deficient. Severe zinc deficiency <50 µg/dl was found in 31(8.8%) female in the child bearing age. Out of 31 female with severe zinc deficiency, 23 (74.2%) were pregnant (table 2). Serum zinc levels in pregnant and non pregnant woman during different trimesters of pregnancy is shown in table 3. Mean zinc concentration was decreasing with the progress in the gestation period. A highly significant difference has been noted in second (unadjusted OR (95% CI) 3.36 (1.52-7.44), $p<0.0008$) and third trimester (unadjusted OR (95% CI) 3.73 (1.91-7.30), $p<0.00002$) when compared with the non pregnant women as a control.

It has been observed that mean zinc levels were significantly lower ($p<0.05$) in women having no children as compared to women having 1-5 numbers of children (table 4).

Table 5 represents association between different variables with zinc cut off levels as normal (>80 µg/dl) and zinc deficiency (≤80 µg/dl) in women of child bearing age. A significant association has been found only in married and unmarried women and women having children and no children.

DISCUSSION

Zinc deficiency is documented as a serious health problem, especially in developing countries (Prasad; 1998). In our study overall prevalence of zinc deficiency in women of child bearing age was 27.8%, of whom 8.8% women were severe zinc deficient. As majority of families studied were from low income group, therefore less use of red meat appears to be one cause of low zinc concentration. Instead they may be using more whole grain cereals, which contains high levels of phytic acid and dietary fiber; components that may interfere with the absorption of iron and zinc, thus leading to decreased bioavailability (Shan *et al*., 2003).

A study from Iraq (Dhia *et al*., 2005) reported prevalence of severe zinc deficiency in 2.2% and mild to moderate deficiency in 55.7% of sample population age one month to 85 years. Several studies documented that mean serum zinc concentration is age dependent. It is lower in infants, children and elderly (Dhia *et al*., 2005; Hotz *et al*., 2003). In present study we found that mean zinc levels increased with the increase of age and dropped significantly ($p<001$) at age greater than 40 years. Similar results have been reported by studies from Baghdad (Dhia *et al*., 2005), Iran (Paknahad *et al*., 2007) and analysis of zinc data from NHANES II, United States of America (Hotz *et al*., 2003). Data from New Zealand reports (De-Jang *et al*., 2001) that zinc status in women of older age is suboptimal.

Maternal zinc provides an indirect role in the physiological stress by pregnancy and labour (Dura-Trava *et al*., 1984). According to a study in Wad Medani hospital, central Sudan (Bushra M *et al*., 2010), 45.0% of pregnant women had zinc deficiency (≤80 µg/ml). In the present study 51 (44.3%) pregnant women were zinc deficient as compared to 36 (21.3%) non pregnant women. Out of 31 female with severe zinc deficiency, 74.2% pregnant women were found to have severe zinc deficiency of <50 µg/dl as compared to 19.4% non pregnant women. Serum zinc concentration was

significantly reduced in second and third trimester as compared to control women. This decrease may also be attributed to vomiting during early phase of pregnancy leading to overall deficiency including that of zinc as reported by Breksin *et al*., 1983. Similar decline in serum zinc levels during pregnancy is reported by others (Dhia *et al*., 2005; Tianan *et al*., 2005; Sharma *et al*., 1991). Different hypothesis include, changes in protein level (Girouse *et al*., 1976) secondary to physiological adoption, hormonal effect (Brigger *et al*., 1971), expansion of plasma volume and maternal fetal transfer of zinc (Swanson *et al*., 1987). A common finding during pregnancy is Hypoalbuminea (Girouse *et al*., 1976) and high levels of estrogens (Brigger *et al*., 1971), which may be associated with low concentration of zinc. Low zinc levels in first trimester may reflect underlying hormonal changes in the trophoblast which may even contribute to toxemia in third trimester (Zimmerman *et al*., 1984). In our study 22(44%) of nuliparious women were zinc deficient as compared to 41% reported by Pathak *et al* (2003) among nulliparous non pregnant women in a rural community of Haryana State, India.

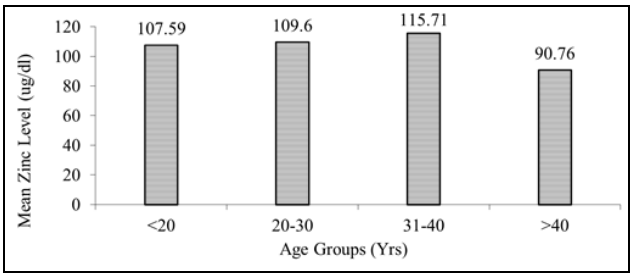

Fig. 1: Comparison of mean serum zinc concentration among female of different age groups.

The burden of zinc deficiency in rural women of reproductive age in this population is evident and needs regional guidance to the control of this important micronutrient deficiency early in pregnancy and throughout the reproductive years by zinc supplementation. More studies are needed to define the parameters for measurement of zinc deficiency in women of child bearing age and especially in pregnancy.

Table 1: Main characteristics of women of childbearing age in rural Peshawar

Characteristics	No	Mean (± SD)	Min-Max
Sample Size	353		
Age (years)		24.07 (6.48)	15-45
Height (cm)		153.96 (7.89)	130-176
Weight (kg)		51.14 (9.84)	30-85
Mean BMI (Kg/m^2)		21.54 (9.2)	17.8-47.3
Systolic Blood Pressure (mmHg)		106.09 (12.13)	70-180
Diastolic Blood Pressure (mmHg)		71.77 (9.27)	50-110
Married	284 (80.4%)		
un married	69 (19.6%)		
Marriage age	284	16.23 (2.57)	11-30
Pregnant women	115(40.5%)		
Non pregnant	169(59.5%)		
Literate	30 (8.5%)		
Illiterate	323 (91.5%)		
Family size		7.35 (3.21)	2-12
Monthly income < Rs: 5000 > RS:5000	 310 (87.8%) 43 (12.2%)		

Table 2: Frequency of zinc deficiency (<50 (severe deficiency) 50-80 (Zn deficiency), and >80 (normal Zn) in women of child bearing age (15-45 years) and comparison between pregnant and non-pregnant women in rural Peshawar.

Zinc status (ug/dl)	Overall (n=353)					
	Frequency	(%)	Pregnant (n=115)		Non Pregnant (n=169)	
			N	%	N	%
< 50	31	8.8	23	74.2	06	19.4
50-80	67	19.0	28	41.8	30	44.8
> 80	255	72.2	64	25.1	133	52.2

Table 3: Serum zinc levels in non-pregnant and pregnant women during different trimesters.

Status	S. Zinc Mean ± SEM	S. Zinc≤ 80 µg/dl		S. Zinc > 80 µg /dl		Unadjusted OR (95% CI)	χ^2	P value
		N	(%)	N	(%)			
Non-pregnant	117.2± 3.2	36	21.3	133	78.6	-	Referent	
Pregnant 1st trimester	113.1±9.51	3	17.6	14	82.4	0.80 (0.17-3.2)	0.11	0.73
2nd trimester	89.04±6.19	18	47.4	20	52.6	3.36 (1.52-7.44)	11.21	0.0008
3rd trimester	89.75±5.69	30	50	30	50	3.73 (1.91-7.30)	18.25	0.00002

Table 4: Association between number of children and zinc levels in women of childbearing age in rural Peshawar

Number (children)	Number (mothers)	Mean ± SEM	S. Zinc ≤ 80 µg/dl N (%)	S. Zinc > 80 µg/dl N (%)	Un adjusted OR (95% CI)	χ^2	P-value
0	50	96.66± 5.67	22 (44%)	28 (56%)	-	-	-
1-2	62	114.1± 5.54	14 (22.6%)	48 (77.4%)	2.75(1.13-6.75)	6.09	0.01
3-5	102	110.76±4.46	29 (28.4%)	73 (71.6%)	2.00(0.93-4.31)	3.80	0.05
≥ 6	70	108.10±5.32	22 (31.4%)	48 (68.8%)	1.71(1.71-3.90)	1.98	0.16

Table 5: Association between different variables with zinc levels in women of childbearing age in rural Peshawar

Variables	S. Zinc levels				Un adjusted OR (95% CI)	χ^2	P value
	≤ 80 µg/dl		> 80 µg/dl				
	N	%	N	%			
Age							
< 20 yrs	32	29.6	76	70.4	1.14 (0.87-1.95)	0.15	P>0.69
≥ 20 yrs	66	26.9	179	73.1	-	-	-
Married	86	30.3	198	69.7	2.31 (1.07-5.12)	4.71	P< 0.03
Un-married	11	15.9	58	84.1	-	-	-
Age at marriage							
< 17 yrs	58	32.7	119	67.3			
≥ 17 yrs	28	26.2	79	73.8	1.36 (0.78-2.40)	1.04	P>0.307
Children							
Yes	65	27.7	169	72.3	0.52(0.27-1.02)	3.63	P< 0.057
No	21	42.0	29	58.0	-	-	-
BMI							
< 23 Kg/m^2	68	28.3	172	71.7	1.08(0.64-1.86)	0.03	P> 0.86
≥ 23 Kg/m^2	30	26.8	83	73.5	-	-	-
Literate	9	33.3	18	66.6	0.75(0.3-1.90)	0.20	P> 0.653
Illiterate	89	27.3	237	72.7I	-	-	-

ACKNOWLEDGMENTS

The authors are thankful to the Pakistan Medical Research Council for funding of this project. Thanks are due to the child bearing age women for their time and participation in this study. PMRC staff is acknowledged for data collection, biochemical and statistical analysis.

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