PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 6 (6): 672-675, 2007
ISSN 1680-5194

Iron and Zinc Nutritional and Biochemical Status and Their Relationship among Child Bearing Women in Marand Province

Z. Paknahad[1], R. Mahdavi[2], S. Mahboob[2], S.J. Ghaemmaghami[2], N. Omidvar[3], M. Ebrahimi[2], A. Ostadrahimi[2] and Sh. Afiat Milani[2]
[1]Faculty of Health, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Faculty of Health and Nutrition, Tabriz University of Medical Sciences, Tabriz, Iran
[3]Shahid Beheshti University of Medical Sciences, Iran

Abstract: Iron and zinc are essential micronutrients for human health. Deficiencies in these 2 nutrients remain a global problem, especially among women and children in developing countries. Many studies indicate the low zinc intakes among premenopausal women and avoidance of meat intake is characterized as one of the main causes. However, it seems dietary zinc reduces iron biochemical indices including ferritin, Hct, Hb, MCV, Transferrin Saturation. This study is an analytical cross-sectional survey and the sample concluded 170 premenopausal women and was a subgroup of the population that was studied in "Evaluation of intervention methods to preventing of Iron deficiency Anemia Research". The data on demographic and food consumption were gathered by related questionnaire. Serum zinc was measured by atomic absorption and other iron related biochemical parameters were measured by their specific related kits. Data was analyzed by food processor 2 and SPSS 10 Softwares. Mean of dietary intake of iron and zinc was 24.51 and 3.45 mg/day respectively. Mean of daily calory intake was 1708.55 Kcal among subjects. Serum zinc was significantly correlated with hematocrit and hemoglobin (P was 0.027 and 0.02 respectively). Analysis of regression between serum zinc and dietary factors including calory, protein, iron, fiber, zinc, vitamin C also showed the significant correlation between serum zinc and dietary vitamin C ($r = 0.30$, $p = 0.026$). Among the iron biochemical indices, hematocrit and hemoglobin were significantly correlated with dietary zinc (p was 0.03 and 0.02 respectively). Mean of serum zinc was significantly different between anemic and non anemic groups, but normal, anemic and iron deficient anemic groups did not show significantly difference about serum zinc. Our results indicated that mean of dietary zinc is lower than RDA among the women and this is confirmed by the NHANESII results. At the other hand, the significant relationship between zinc and Hb, Hct, vitamin C would explain the role of vitamin C in enhancing their bioavailability.

Key words: Iron, zinc, dietary intake, anemia, premenopause

Introduction

Although zinc was recognized as a dietary essential in rats in 1934, it was not until 1961 that a zinc deficiency in humans was recognized (Guthrie, 1986; Anderson, 2004). Zinc deficiency associated with iron deficiency anemia was apparently first recorded by Prasad *et al.* in that year (Nishiyama *et al.*, 1998). Clinical findings included growth stunting, hypogonadism, anemia, low serum iron and plasma zinc levels, low urine, sweat and hair zinc levels (Guthrie, 1986; Yokoi *et al.*, 1994).

Iron and zinc nutrition are often associated. Red meat is the most important common dietary source of bioavailable iron and zinc. Phytate inhibits iron and zinc retention (Yokoi *et al.*, 1994). Consequences of these association were first described by Prasad, Halsted and their associates in Egyptian and Iranian adolescents whose diets were nearly devoid of meat and were based on bread prepared from whole grain wheat flour rich in phytate (Yokoi *et al.*, 1994).

NHANES* -II found that many premenopausal women consume less than two thirds of the Recommended Dietary Allowance for iron and zinc (Katsuhiko *et al.*, 2003).

Avoidance of red meat appears to be one cause of NHANES-II findings. Comparison of zinc requirement with NHANES-II findings suggests that premenopausal women are at risk of zinc deficiency (Katsuhiko *et al.*, 2003).

Vegetarians represent a group of particular interest, their dietary intakes being restricted in animal products, especially flesh foods, which are important sources of readily available iron and zinc. Instead, vegetables, whole grain cereals, legumes and nuts are their major food sources of these trace elements. However, these same foods also contain high levels of phytic acid and dietary fiber; components that may interfere with the absorption of iron and zinc, thus leading to decreased bioavailability (Anderson *et al.*, 1981; Shan *et al.*, 2003). These such studies, indicates an urgent need to assess the prevalence of zinc deficiency in representative samples of at risk populations with use of direct indicators of zinc status, so we studied zinc nutritional

Table 1: Biochemical variables related to Iron and zinc status

	Hb (g/dl)	Ferritin (µg/l)	TS (%)	Iron (µg/dl)	Zn (µg/dl)	MCV (fl)	Hct (%)
X±SEM	13.25±0.15	20.19±2.30	28.33±2.12	9.93±5.17	83.185±1.39	83.19±0.83	39.75±0.4

Table 2: Means of daily calory, iron, zinc, vitamin C, fiber and protein intake

	Energy (Cal)	Zn (mg)	Protein (g)	Iron (mg)	Vit C (mg)	Fiber (gr)
X±SEM	170.8.55±46.55	3.45±0.41	55.83±1.53	24.51±0.9	46.98±2.58	14.12±0.53

Table 3: Comparison of serum Zinc between different groups of Iron Status*

Group	X±SEM	P-Value
1) anemia (n=28)	3.24±72.8	0.043
2) Non anemia (n=130)	1.55±80.68	
1) Iron deficiency (n=65)	3.69±77.29	N.S**
2) Non Iron deficiency (n=80)	76.75±1.57	
1) Iron deficiency Anemia (n=31)	70.61±3.62	N.S
2) normal (n=75)	76.92±13.9	

*Anemia: Hb<12gr/dl, Iron deficiency: Two or more of these: ferritin<12, TS<16, MCV<80, Fe<60, Iron deficiency Anemic: Co existence of Anemia and iron defeciency (10), **non significant

status and its relationships with iron biochemical indices in premenopausal women.

Materials and Methods

This study is an analytical cross-sectional survey and the sample concluded 170 premenopausal of 15-49 years old women (non pregnant-nonlactatings) and was a subgroup of the population that was studied in "Evaluation of intervention methods to preventing of Iron deficiency Anemia Research". Clustering sampling Method suggested for The eastern Mediterranean was used (Bennett *et al.*, 1991).

Data collection done was in 3 steps

a) Demographic Data was collected by questionnaire.
b) Biochemical Data by collecting fasting blood sample and determining Hb, Hct (Auto Analyzer), Fe and TIBC[1] (colorimetry), ferritin (ElISA)[2], zn (Atomic absorption).

Hemolyzed sample or samples belongs to thalassemic cases were outed, so we actually assessed 170 cases.

Dietary Intake: Estimation of food consumption was done by interviewing a 2-days dietary recall questionnaire (Bennett *et al.*, 1991). The answers were analyzed by food processor 2 and their energy and nutrient were estimated.

Results are expressed as means±SEs. Data were analyzed by t-test, Regression and ANOVA by using $SPSS_{10}$ software.

Results

a) General characteristics: Mean of age was 30.26±0.68, BMI[3] was 22.59±0.71, Height was 155.71±0.46 and weight was 59.86±0.97.

b) Biochemical Data: As Table 1, means of Hb, Hct,TS[4], MCV[5], Iron and zinc are at normal range.

c) As the Table 2 describes, the subjects had Zinc intake lower than RDA[6], but Iron intake was adequate

Statistical analysis

Regression: Regression Analysis indicated that only correlation between serum zinc, Hb and Hct was significant (r = 0.8 and 0.17 respectively and p = 0.02).

Regression Analysis of serum zinc and dietary factors showed a significant relationship between serum zinc and dietary vitamin C (r = 0.16 and p was 0.02 and 0.03 respectively).

For assessing effect of dietary zinc on biochemical iron status indices, regression analysis was introduced. Only Hb and Hematocrit was significantly correlated with dietary zinc (r = 0.16, p = 0.02 and 0.03 respectively).

T- test: Dietary zinc classified to two groups (lower or higher fifty percent of RDA) and mean of serum zinc and biochemical iron indices compared.

Serum zinc was compared in 2 different groups (according to anemia status), Table 3. It did not show significant difference between iron deficient and anemic subjects or normal subjects. However means of serum zinc was significantly different between anemic and nonanemic subjects (p = 0.043).

Analysis of variance (ANOVA): Subjects were classified to three groups (Anemic, Iron deficiency Anemic and Normal). Means of serum zinc between them were not significantly different (p = 0.09).

Mean of serum zinc between different age and BMI groups were compared (p = 0.01), ANOVA show significant difference between BMI groups (Table 4).

Discussion

Means of serum zinc and Intake zinc showed that zinc status of women appeared adequate inspite their lower intake than RDA (Anderson, 2004). It is similar to NHANES-II (Katsuhiko *et al.*, 2003) results that premenopause women consume lower that two third Recommended Dietary Allowances of zinc and iron.

Ahrary and calleague reported elderly diets poor of zinc (Ahrari and Kimiagar, 1997). This point demonstrated in Yokoi survey and calleague reported elderly diets poor of zinc (Yokoi *et al.*, 1994). In Anderson *et al.* (1981) study about zinc and iron status in women, Although iron and zinc was provided from plant resources, means of serum zinc and related indices to iron were in normal range (Anderson *et al.*, 1981). In our study there isn't significant relationship between dietary and plasma zinc.

Table 4: Comparison of serum zinc Among different groups based on Age, BMI, Iron status, Delivery Number

Serum zinc group	X±SEM	n	p
a) iron nutritional status:			
Anemic	82.5±6.43	7	N.S
Iron deficiency Anemic	70.61±3.74	31	
Normal	79.926±1.63	75	
b) BMI:			
<20	79.59±4.53	21	P = 0.01
20-24.99	75.25±1.78	83	
25-25.99	83.28±2.93	45	
>30	87.09±4.29	21	
c) Age:			
<19	78.42±4.41	19	N.S
20-25	84.29±2.99	37	
25-30	82.92±3.65	33	
30-35	74.72±3.01	31	
35-49	75.41±2.32	52	
d) delivery number:			
0	93.31±9.19	8	P = 0.009
1-2	81.62±3.43	32	
3-5	78.12±2.81	44	
>6	72.36±2.04	48	

Sian *et al.* (1996) also did not observe any correlation ship between serum zinc and dietary zinc (lower than 5 mg). However Kogirima *et al.* found a positive correlation between zinc intake and serum zinc levels in elderly subjects (Kogirima *et al.*, 2007).

Payette and colleague found significant relationship between serum zinc and intake zinc in elderly (Payette and Gray-Donald, 1991). But Baily *et al.* (1997) found no relationship between Zn intake and either plasma Zn concentration which was consistent with our observation, they believed that plasma zinc did not able to predict long and short periods of zinc nutritional status (Baily *et al.*, 1997).

However the serum zinc concentration is not considered to be a reliable indicator to diagnose mild or moderate zinc deficiency in individual persons. Serum zinc is fairly maintained within a normal range during short term zinc depletion because of homeostatic mechanisms and therefore may show measurable changes only when zinc depletion is prolonged or severe (Hotz *et al.*, 2003). Hamidge *et al.* believed this marker may have utility for the detection of potentially toxic intakes (Hambidge, 2003).

Fall in plasma zinc may be a part of homeostatic mechanisms to maintain critical level of zinc in tissues most susceptible to zinc depletion (King *et al.*, 2000).

Homeostatic regulation of iron and zinc metabolism is achieved by iron absorption from the diet and for zinc, by regulation of daily basal losses and secretion of endogenous reserves. Suboptimal iron and zinc nutrition develops when Homeostasis disturbed because of increased physiological and/or excessive losses and inadequate dietary supply (Gibson *et al.*, 2002). It is suggested that probably adaptation in zinc and iron absorption was occurred during long time. In our study regression analysis of data showed significant relationship between serum zinc with Hemoglobin and dietary vitamin C. At the other hand zinc is clearly involved in several aspects of normal hematopoiesis by virtue of its role in many enzyme systems involved with DNA synthesis including thymidine kinase and DNA polymerase (Nishiyama *et al.*, 1998). Probably vitamin C enhances zinc absorption by increasing its solubility and bioavailability.

This study didn't show relationship between ferritin, serum iron, transferrin saturation with serum zinc, at the other hand comparison of iron deficiency and non-iron deficiency did not show significant difference about serum zinc.

Yokoi suggested that nonspecific absorption of zinc increases with iron deficiency (Katsuhiko *et al.*, 2003), but in their study there is not absorption increasing and plasma zinc level increasing as its result.

Our study showed a weak significant relation between serum zinc and age in different age groups. Linderman (1971) findings showed results similar to our study (Linderman *et al.*, 1971). But Anderson and colleague didn't find any relationship between serum zinc and age (Anderson *et al.*, 1981). Other researchers also did not find any relationship between serum zinc and age (Villalpando *et al.*, 2003). Relation between serum zinc and delivery number wasn't significant that was similar to Anderson *et al.* findings (Anderson *et al.*, 1981).

BMI increases with age with age, analysis of variance and regression analysis showed significant relationship between serum zinc and BMI. Plasma zinc represents <0.1% of whole body zinc (Gibson *et al.*, 2002). Plasma zinc is metabolically active and fluctuates in response to dietary intake and physiological factors (Anderson, 2004). It is confirmed that at low nutritional intake, zinc is released from tissues, this can describe the indirect relation between BMI and serum zinc.

Recommendations

1) According to prevalence of dietary zinc deficiency, additional studies are necessary.
2) According to prevalence of iron deficiency, iron supplementary programme and decreasing zinc availability with organic iron dosages, suggested that pay attention to zinc intake and zinc deficiency indices in women.
3) Use of more indicators in next studies, for better judgment about nutritional zinc status.

References

Ahrari, M. and M. Kimiagar, 1997. "Food intake and Body mass intake in the privately institutionalized elderly in Tehran", Int. J. Vitam. Nutr. Res., 67: 41-6.

Anderson, J.J., 2004. Minernls in "Krause's food, Nutrtion and Diet Therapy". 11th Edition, 2004, Saunders Publication, pp: 143-147.

Anderson, B.M., R.S. Gibson and J.H. Sabry, 1981. "The iron and zinc status of long-Term vegeterian women", Am. J. Clin. Nutr., 34: 1042-1048.

Baily, A.L., S. Maisy, A.J.A. Wright, P.M. Finglas and R.A. Fulcher, 1997. "Relationship between micronutrient intake and biochemical of nutrient adequacy in' Free living' elderly UK population": Br. J. Nutr., pp: 225-242.

Bennett, T. Woods, W.M. Liyamaga and D.L. Smith, 1991. "Simplified general method for cluster sample surverys of health in developing countries" World Health Quart., 44: 98-106.

Gibson, R.S., A.L.M. Heath and E.L. Ferguson, 2002. Risk of Suboptimal Iron and Zinc Nutriture Among adolescent girls in Australia and Newzeland Asia Pacific J. Clin. Nutr., 11: S543.

Guthrie, H.A., 1986. Introductory Nutrition, Times Mirror and Mosby College publishing, Toronto, pp: 269-274.

Hambidge Michael, 2003. Biomarkers of Trace mineral Intake and status, J. Nutr., 133: 948-955S.

Hotz, C., J.M. Peerson and K.H. Brown, 2003. Suggested Lower Cutoffs of Serum Zinc Concentrations for Assessing zinc status: Reanalysis of NHANESII (1976-1980), Am. J. Clin. Nutr., 78: 756-764.

Katsuhiko Yokoi, Norman G. Egger, V.M. Sadagopa Ramanujam, Nancy W. Alcock, Hari H. Dayal, James G. Penland and Harold H. Sandstead, 2003. Association between plasma zinc concentration and zinc kinetic parameters in premenopausal women Am. J. Physiol. Endocrinol. Metab., 285: E1010-E1020.

King, J.C., D.M. Shams and L.R. Woodhouse, 2000. Zinc Homeostasis in Humans, J. Nutr., 130; 1360S-1366S.

Kogirima, M., R. Kurasawa, S. Kubori, N. Sarukura, M. Nakamori, S. Okada, H. Kamioka and S. Yamamoto, 2007. Ratio of low serum zinc levels in elderly Japanese people living in the central part of Japan Eu. J. Clin. Nutr., 61: 375-381.

Linderman, R.D., L.C. Mervin and J.P. Colmore, 1971. Influence of Old Age and Sex on Plasma and red Cell zinc Concentration. J Gerontol., 26: 358-63.

Nishiyama, S., K. Irisa, T. Matsubasa, A. Higashi and I. Matsuda, 1998. Zinc status relates to Hematological Deficits in Middle aged Women: J. Am. College Nutr., 17: 291-295.

Payette, H. and K. Gray-Donald, 1991. "Dietary intake and biochemical indices of nutritional status in and elderly population with estimates of precision of the 7-d food record", Am. J. Clin. Nutr., 54: 478-48.

Shan, Ji Li, Jihye Kim, Hyojee Joung and Hee Young Paik, 2003. The Effect of Dietary Phytate Content on Iron Absorption and Status in Young Korean Women: Int. J. Human Ecol., 1: 35-44.

Sian, L., Y. Mingyan, L.V. Miller, L. Tong, N.F. Krebs and K.M. Hambidge, 1996. Zinc absorption and intestinal losses of endogenous zinc in young Chinese women with marginal zinc intakes. Am. J. Clin. Nutr., 63: 348-353.

Villalpando, Salvador, Garcia-Guerra Armando, Ramirezsilva and Claudia Ivonne, 2003. Iron, zinc and iodide status in Mexican children under 12 years and women 12-49 years of age: a probabilistic national survey. Salud pública Méx, pp: 520-529.

Yokoi, K., N.W. Alcock and H.H. Sadstead, 1994. Iron and zinc nutriture of premenopausal women. J. Lab. Clin. Med., 124: 852-61.

*Second National Health and Nutrition Examination Surveys
[1]Total Iron Capacity
[2]Enzyme linked immunosorbent assay
[3]BMI: Body mass index
[4]Transferrin saturation
[5]Mean corpuscular volume
[6]Recommended Dietary Allowances = 18mg