Article

Serum Zinc and Copper in Iron Deficient Adolescents

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Abstract

Background: Adolescents are vulnerable to iron deficiency. Deficiency of iron may be associated with deficiency of zinc and high copper level. **Objectives:** To observe serum zinc and copper status in iron deficient anemic adolescents. **Methods:** This observational study was conducted in the Department of Physiology, BSMMU, between January and December 2007. For this, total 60 adolescents of both sexes aged 11-18 years were selected. Of them,on the basis of hemoglobin and serum Ferrtin level 15 iron deficient male adolescents (Hb<13g/dl, SF<30ìg/L) and 15 iron deficient female adolescents (Hb<11.5g/dl, SF<22ìg/L)were included into study group as group $B_1$and B_2 respectively. Age and sex matched apparently healthy 15 male and 15 female subjects without iron deficiency were taken as control(group A_1, A_2). Serum zinc and copper status were assessed by measuring serum zinc and copper levels by atomic absorption spectrophotometric method and | serum ferritin and serum iron levels by micro particle enzyme immunoassay method. Data were analyzed by un paired student t test. **Results:** In both male and female iron deficient adolescents, mean serum zinc level was significantly ($p<0.01$) lower and serum copper level was significantly higher($p<0.01$) than those of their respective healthy control. No statistically significant differences of these values were observed between A_1 vs A_2 and B_1 vs B_2. In this study, hypozincemia and hypercupremia were observed in both male and female iron deficient adolescents **Conclusion:** Therefore, from this study concludes that deficiency of iron may be associated with hypozincemia and hypercupremia in anemic adolescents and the supplementation of zinc along with iron is suggested for the correction of iron deficiency anemia especially in adolescents when their metabolic demand is high.

Key Words: Copper; Zinc; Adolescence

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Introduction

In adolescence, the requirements for energy and nutrients per Kg body weight including essential trace elements are higher than adult[1]. Physiological processes during puberty are particularly linked to increased requirements for iron and zinc to meet the increased demand for erythropoiesis as well as high growth rate [2]. Changes in micronutrient levels like zinc and copper have important role in the development of iron deficiency [3]. Zinc plays an important role in cell division, protein synthesis and body growth and therefore, specially important for adolescents [4]. Zinc deficiency is associated with iron deficiency anemia [5-7]. This deficiency of zinc may occur due to inadequate dietary intake and decreased intestinal absorption[6]. An increased concentration of copper is associated with iron deficiency anemia. This increased copper concentration may occur due to excessive gastrointestinal copper absorption as grain products are major source of dietary copper [6].

In our country, many people are suffering from anemia. Along with iron, copper and zinc may have some role in contributing deficiency of iron, where copper overload and zinc deficiency may be the associated findings in iron deficiency anemia. In Bangladesh, data regarding serum copper and zinc are not available in iron deficiency anemia. Therefore, the present study was undertaken to observe serum zinc and copper status in iron deficient adolescents.

Methods

The present cross sectional study was carried out in the Department of Physiology, BSMMU, Dhaka from January to December, 2007. In this study, a total number of 60 subjects with the age range 11 to 18 years of both sexes were included and all of them belonged to lower socioeconomic status .Among them, 30 were apparently healthy without iron deficiency and 30 were iron deficient anemic adolescents. All the subjects were selected randomly from resident of different area of Dhaka city and belonged to lower middle socioeconomic status. On the basis of Hb concentration [8] and serum ferritin level (SF)[9] the subjects were divided into control groupA (iron non deficient) and study group B(iron deficient). On the basis of sex, they were further subdivided into A_1 (male) havingHb>13g/dl and SF>30ìg/L A_2(female) having Hb>11.5g/dl and SF>22ìg/L and B_1(male) with Hb<13g/dl, SF<30ìg/L,B_2(female) with Hb<11.5g/dl, SF<22ìg/L. Each sub group was consisted of 15 subjects. Protocol of this study was approved by the ethical review committee of the department of Physiology BSMMU.The subjects with history of blood transfusion and iron therapy during the last three month, any history of kidney diseases, liver diseases were excluded from the study. After selection of the subjects, the aim and objectives of the study were explained giving emphasis to the benefits the would obtain to ensure voluntary participation. All ethical norms were maintained. After they have agreed for participation, their written informed consents were taken. Detail personal, dietary, medical, family, socio economic, occupational history were taken and a thorough clinical examination were done and all information were recorded in a standard prefixed questionnaire. During the study period, all the subjects were asked to attend the department on day of their visit. Blood samples were taken from each subject in the morning at 9 AM. Serum was prepared and send to the laboratory of Atomic Energy Commission for estimation of serum copper and zinc level. Serum zinc and copper levels were measured by spectrophotometric method. The statistical analysis was done by unpaired Student's 't' test.

Results

Anthropometric data of the subjects are presented in TableI. This table shows that all the subjects were almost similar regarding their height,weight and BMI.

Table I: Mean ±SD Height, Weight and BMI distribution in different groups (n = 60)

Sub groups	Height (cm)	Weight (Kg)	BMI (Kg/m^2)
A_1 (n=15)	155.00 ± 14.76	46.53 ± 12.02	19.01 ± 1.65
A_2 (n=15)	152.23 ± 6.57	44.06 ± 5.20	18.92 ± 0.90
B_1 (n-15)	151.26 ± 13.32	43.40 ± 8.62	18.63 ± 1.05
B_2 (n=15)	146.26 ± 4.07	38.26 ± 3.69	17.84 ± 0.84

Statistical analysis:

	P value		
A_1 vs B_1	0.411^{ns}	0.371^{ns}	0.437^{ns}
A_1 vs B_2	0.044*	0.019*	0.024*
A_2 vs B_1	0.758^{ns}	0.766^{ns}	0.318^{ns}
A_2 vs B_2	0.004**	0.003**	0.007**
A_1 vs A_2	0.551^{ns}	0.497^{ns}	0.859^{ns}
B_1 vs B_2	0.232^{ns}	0.081^{ns}	0.083^{ns}

n = Total number of subjects. ns = Not significant. ** = Significant at p<0.01.* = Significant at p<0.05.

Control group A: Apparently healthy subjects of sexes.
A_1 = M ale
A_2 = Female
Study group B: Iron deficient anemic adolescents.
B_1 = M ale
B_2 = Female

Mean serum zinc level was significantly ($p<0.01$) lower and mean serum copper level was significantly ($p<0.01$) higher in iron deficient group B_1 ,B_2 in comparison to their respective healthy control group A_1 and A_2. No statistically significant differences of these levels were observed between A_1 vs A_2 and B_1 vs B_2. (Table II).

Table II: Mean ±SD serum Zinc and Copper levels in different groups (n = 60)

Sub groups	Zinc (mg/dl)	Copper (mg/dl)
A_1	107.46 ± 14.03	108.60 ± 20.92
(n=15)	(80 - 126)	(82 - 139)
A_2	102.80 ± 16.84	118.13 ± 15.57
(n=15)	(80 - 125)	(82 - 139)
B_1	80.80 ± 14.20	140.53 ± 18.63
(n-15)	(60 - 107)	(97 - 165)
B_2	80.26 ± 18.23	150.06 ± 22.59
(n=15)	(57 - 120)	(106 - 191)

Statistical analysis:

	P value	
A_1 vs B_1	0.001**	0.001**
A_1 vs B_2	0.000***	0.000***
A_2 vs B_1	0.004**	0.005**
A_2 vs B_2	0.001**	0.001**
A_1 vs A_2	0.288ns	0.101ns
B_1 vs B_2	0.930ns	0.258ns

Results are expressed as Mean ± SD. Statistical analysis was done by unpaired Student's t test. Figures in parentheses indicate ranges. n = Total number of subjects. ns = Not significant. *** = Significant at $p<0.001$. ** = Significant at $p< 0.01$.

Control group A: Apparently healthy subjects of both sexes. A_1 = Male A_2 = Female

Study group B: Iron deficient anemic adolescents. B_1 = M ale B_2 = Female

Discussion

In this study, mean serum zinc level was nearer to the lower limit and mean serum copper level was nearer to the upper limit of the reference values in iron deficient adolescents of both sexes. Serum zinc level was significantly lower and serum copper level was significantly higher in both sexes of iron deficient adolescents in comparison to their respective healthy control. Similar observations were also made by others [6,7,10]. However, no statistically significant differences were observed in serum zinc and copper levels between two non deficient and also between two iron deficient male and female groups.

Various investigators suggested that lower level of serum zinc may be due to its low dietary intake, increased body demand, malabsorption, increased urinary excretion and impaired utilization [11]. Grain products, having rich fiber and phytate contents are known to decrease the availability of zinc by decreasing its absorption [12]. Moreover, some investigators suggested that lower zinc concentration is usually associated with high level of copper in blood[13,14].

Grain products are a major source of dietary copper which may lead to increased copper absorption and thereby may results in high copper concentration in blood[6]. Some researchers suggested that iron and copper shares with the same metal transporter. Therefore, copper exhibits competitive antagonism with iron for uptake into enterocyte during iron deficiency[15,16].

In the present study, poor socio background of the study subjects indicates that the observed hypozincemia is most likely due to its low dietary intake which is evident from their dietary history. Increased body demand during adolescence period is also likely to be an additional factor responsible for this hypozincemia in the subjects of the present series. In addition, increased dietary intake of grain may be attributed to hypercupremia as all the subjects of the present study had history of high dietary intake of cereals. Therefore, this study revealed that deficiency of iron may be an important factor for development of hypozincemia and hypercupremia especially in adolescents.

Conclusion

From this study it may be concluded that deficiency of iron alone usually does not occur and it is usually associated with hypozincemia and hypercupremia. Therefore supplementation of iron along with zinc should be given to correct deficiency of iron especially in adolescents when their demand is high.

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