

Iron And Zinc Status Of Anemic Adolescent Girls Before And After Iron And Zinc Supplementation

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ABSTRACT

Nutrition in adolescent has not received adequate attention. Aside from anemia due to iron deficiency, chronic malnutrition and other micronutrient deficiencies such as zinc deficiency may also affect adolescent girls.

Double blind, community trial was carried out to investigate whether iron-zinc supplementation would improve iron and zinc status among anemic adolescent girls 10–12 years old.

Subjects (n=133) with hemoglobin concentration <120 g/L were randomized to receive 60 mg iron (iron group), or 30 mg iron and 15 mg zinc (iron/zinc 2:1 group), or 60 mg iron and 15 mg zinc (iron/zinc 4:1 group) for 12 weeks daily supplementation. Hemoglobin, serum ferritin, serum transferrin receptor, zinc protophorphyrin and serum zinc were determined for the iron and zinc status.

Supplementation with iron or with iron and zinc significantly improved iron and zinc status. The changes of hemoglobin were 9.6 g/L in iron group, 6.6 g/L in iron/zinc 2:1 group and 3.4 g/L in iron/zinc 4:1 group. The changes of serum zinc were 2.7 µmol/L in iron group, 4.1 µmol/L in iron/zinc 2:1 group and 3.5 µmol/L in iron/zinc 4:1 group. In iron/zinc 2:1 group, no one subjects suffered from iron deficiency anemia and zinc deficiency by the end of supplementation.

It was concluded that iron supplementation alone improved iron and zinc status effectively, while adding zinc protected the adverse effect of iron on decreasing zinc absorption. Therefore, it is timely to establish iron-zinc supplementation program targeted to adolescent girls.

Key Words: Iron, Zinc, Anemia, Adolescent, Girls

INTRODUCTION

Nutrition in adolescent has not received adequate attention. Aside from anemia due to iron deficiency, chronic malnutrition and other micronutrient deficiencies such as zinc deficiency may also affect adolescent girls¹. Zinc deficiency has been linked with stunting, decreased appetite and impaired immune function.

The Indonesian National Household Health Survey in 2001 showed that 30% of adolescent girls (10-19 yrs) were anemic (Hemoglobin level < 120 g/l)². This figure was not far different from other smaller studies showing the anemia prevalence between 22% and 44%^{3,4,5}, indicating that anemia is a public health problem in Indonesia. In areas where iron deficiency is a problem, zinc deficiency is likely to be a problem as well⁵. Information about the magnitude of zinc deficiency problem among adolescent girls in Indonesia is limited. The occurrence of zinc deficiency problems in Indonesia was revealed only recently that around 72% of pregnant women in East Nusa Tenggara⁷, suffered from zinc deficiency.

OBJECTIVES

A double blind community trial was carried out to investigate the effect of daily iron-zinc supplementation on the iron and zinc status among anemic adolescent girls 10 – 12 years old.

METHODS

Initially, 1358 girls aged 10-12 years old from 34 elementary schools in two sub-districts of the rural coastal area of Teluk Naga and Kosambi Sub-districts, Tangerang District, Banten Province, Indonesia were screened for hemoglobin using Hemocue from finger prick. Those who had hemoglobin concentration <115 g/L (n=238) were given anti-helminthic drug (a single dose of 500 mg mebendazole). One week after deworming a second blood drawing (at this time venous blood) was carried out and those who had hemoglobin concentration <120 g/L^{8,9} (n=133) were entered into the study. The subjects were randomized to receive 60 mg iron (n = 45), or 30 mg iron and 15 mg zinc (n = 45), or 60 mg iron and 15 mg zinc (n = 43) for 12 weeks daily supplementation. Iron in the form of FeSo₄ and

zinc as ZnSO₄. Intake of supplementation was supervised, and two (2) subjects refused for taking blood at the end of supplementation.

Subjects were enrolled in the study after their mothers or fathers signed the written informed consent. The protocol was approved by the Ethical Committee of the Faculty of Medicine, University of Indonesia and the Local Government of Tangerang District.

KEY RESULTS

Iron and zinc status

Table 1 shows that most variables of iron and zinc status increased significantly by the end of supplementation, whether the subjects took iron alone or iron-zinc supplements with ratio of iron/zinc 2:1 or iron/zinc 4:1. In particular, the mean of serum ferritin and serum zinc concentration reached normal ranges by the end of supplementation. The improvement in iron status was the highest among subjects who took iron alone compared to those who took iron-zinc supplementation, but taking iron alone also improved zinc status. The increment of hemoglobin concentration among subjects who took iron alone (9.6 g/L) was the highest and significantly higher ($P < 0.05$) compared to those who took iron/zinc 4:1 supplements (3.4 g/L).

Proportion of iron deficiency anemia and zinc deficiency

All three groups had similar iron status at the end of supplementation, and the proportion of subjects suffered from iron deficiency anemia was significantly ($P < 0.01$) reduced among all groups, whether they received iron or iron/zinc supplementation. The proportion of subjects who had low serum zinc concentration was significantly reduced ($P < 0.01$) among subjects who took iron/zinc 2:1 group, but not significantly reduced in iron and iron/zinc 4:1 groups. By the end of supplementation, around 50% subjects were still suffered from anemia (Figure 1).

DISCUSSIONS AND CONCLUSIONS

Daily supplementation of 30 mg elemental iron and 15 mg elemental zinc for 12 weeks, which is equal to Indonesian RDA (MOH-RI, 2002)¹⁰, markedly reduced both iron deficiency anemia and zinc deficiency, and improved both iron and zinc status. This combination seems to be an appropriate ratio of iron zinc supplementation, as shown that the improvement in iron and zinc status was slightly

higher when compared to iron-zinc supplementation with 60 mg iron and 15 mg zinc. Further more, none of the subjects suffered from iron deficiency anemia and zinc deficiency after 12 weeks of supplementation suggesting that iron-zinc supplementation with ratio iron/zinc 2:1 had the largest benefit to alleviate both deficiencies. Iron supplementation alone (60 mg iron) for 12 weeks improved both iron and the zinc status, and it also reduced both iron deficiency anemia and zinc deficiency.

It is concluded that iron supplementation among anemic adolescent girls effectively increased iron status, while adding zinc to iron supplementation protected the adverse effect of iron on reducing the zinc status.

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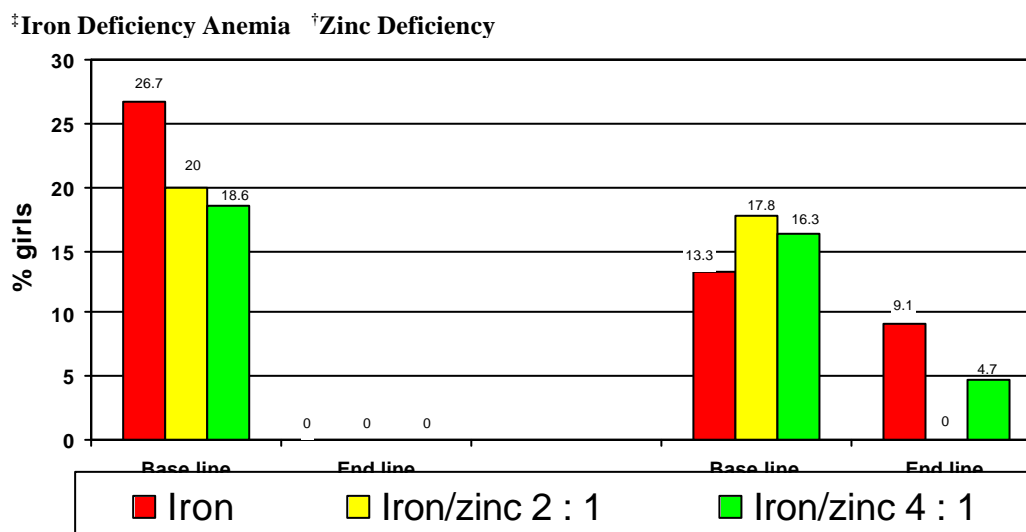
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Table 1. Iron and zinc status of anemic adolescent girls before and after supplementation

Changes of Iron and zinc status	Supplementation group:		
	Iron group (n=44)	Iron/zinc 2:1 group (n=44)	Iron/zinc 4: 1 group (n=43)
	(mean ± SD)		
Hemoglobin/Hb conc. (g/L):			
- Base line	109.1± 8.1	110.9 ± 7.0	110.7 ± 7.2
- End line	118.7 ± 14.6 ^{*)}	117.5 ± 12.0 ^{*)}	114.1± 13.8
- Difference:	9.6 ± 13.9 ^{a)}	6.6 ± 9.5	3.4 ± 13.7 ^{a)}
Serum Ferritin/SF conc. (mg/L) :			
- Base line	28.8 ± 18.8	24.9 ± 17.0	28.9 ± 22.6
- End line	91.3 ± 54.6 ^{*)}	78.7 ± 33.8 ^{*)}	82.3 ± 40.4 ^{*)}
- Difference	63.4 ± 59.8	53.7 ± 39.7	53.4 ± 45.8
Transferrin Receptor/TfR conc. (mg/L):			
- Base line	9.7 ± 5.8	9.2 ± 4.8	10.1 ± 5.1
- End line	7.0 ± 6.2 ^{***)}	5.8 ± 2.2 ^{*)}	6.7 ± 2.7 ^{*)}
- Difference	-2.7 ± 8.7	-3.4 ± 5.0	-3.5 ± 5.3
Zinc Protoporphyrin/ZPP value (mmol/mol heme):			
- Base line	69.1 ± 31.4	55.9 ± 20.0	60.1 ± 23.7
- End line	45.4 ± 21.1 ^{*)}	40.6 ± 14.9 ^{*)}	49.4 ± 19.5 ^{***)}
- Difference	-23.6 ± 26.3 ^{a)}	-15.2 ± 19.3	-10.8 ± 29.1 ^{a)}
Serum Zinc/SZ conc. (mmol/L):			
- Base line	12.1 ± 2.2	11.7 ± 2.4	12.0 ± 2.1
- End line	14.7 ± 4.2 ^{*)}	15.7 ± 2.9 ^{*)}	15.4 ± 3.3 ^{*)}
- Difference	2.7 ± 4.0	4.1 ± 3.2	3.5 ± 2.9

Sign. different within group at ^{*)} (P < 0.001), ^{**)} (P < 0.01) ^{***)} (P < 0.05) (Paired T test)

^{a)}Sign. different on delta Hb conc. & delta ZPP value between iron group and iron/zinc 4: 1 group at (P < 0.05) (ANOVA; Post Hoc Test: LSD).



[‡]Iron Deficiency Anemia : Hb conc. < 120 g/L, SF conc. <12 mg/L, TfR conc.> 8.5 mg/L and ZPP value > 40 mmol/mol heme;

[†]Zinc Deficiency: SZ conc. < 10.1 mmol/L

^{a)}Sign. difference between groups at (P < 0.05) (Likelihood ratio Chi-Square).

Figure 1. Iron Deficiency Anemia and Zinc Deficiency among anemic adolescent girls before and after supplementation