Effect of iron and zinc supplementation on iron, zinc and morbidity status of anemic adolescent school girls (10-12 years) in Tangerang District

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Abstrak

Anemia is the main micronutrient deficiency problem among adolescent school girls in Indonesia. Anemia due to iron deficiency often coexists with zine deficiency. Iron and zinc have anlagonistic interaction. Therefore, it was appropriate ratio of iron-zinc supplementation.

Objective

The study was aimed to investigate the different ratios of iron-zinc supplementation Fe: Zn = 2: 1 and Fe: Zn = 4: 1 on improving the iron and zinc status and eventually reduction of the morbidity of anemic adolescent school girls compared to iron supplementation alone.

Methodology

A randomized, double blind community trial was conducted among anemic adolescent school girls (10-12 years old). Selection of subjects was conduted in two steps. Firstly, 238 girls (out of 1358 girls), with hemoglobin concentration level < 115 g/L using Hemocue were recruited and given antihelminthic drug (500 mg mebendazole as a single dose). Secondly, those who had hemoglobin concentration < 120 g/L using Cell Dyn from venous blood one week after deworming (n+133) were enrolled into the study.

The 133 subjects were assigned randomly to one of the three groups for daily iron-zinc supplementation for 12 weeks with: Group 1 (n=45): iron (60 mg/day), Group 2 (n=45): iron and zinc (30 mg and 15 mg/day) or group 3 (n=43): iron and zinc (60 mg and 15 mg/day).Supplement intake was supervised at base line, weight and height were measured and the available iron and zinc intake from diet was estimated using a model modified from WHO/FAO and Murphy, based on the data 24-hour Food Recall and Food Frequency Questionnare. Iron (hemoglobin/Hb, serum ferritin/SF, serum transferrin receptor/TfR, zinc protoporphyrin/ZPP, Mean Corpuscular Volume/MCV, Red-cell Distribution Width/RDW, body iron/BI) and zinc (serum zinc/SZ) status and supplementation. Morbidity status of diarrhea and Acule Respiratory Infection (ARI) were recorded weekly. The phagocytes cell and Cell-Mediated Immunity were measured only for 50% of the subjects.

Results and Discussion

By the end of the supplementation, most indicators of iron status were increased significantly in all subjects both they took iron supplementation with or without zinc, and the proportion of iron deficiency anemia reduced. Iron supplementation alone or iron-zinc improved zinc status. The proportion of zinc deficiency was sinificantly reduced only among subjects who took iron-zinc supplementation with the ratio of Fe: Zn =2: 1. which was significantly lower compared to the other two groups at the end of supplementation. In iron/zinc 2 : 1 group, no subject had iron deficiency anemia and zinc deficiency after 12 weeks of supplementation, which suggested that iron-zinc supplementation with the ration of Fe: Zn = 2 : 1 had reduced both iron deficiency anemia and zinc deficiency.

In this study, iron deficiency among anemic school girls was due to insufficiency of iron in red blood cell, and iron or iron-zinc supplementation for 12 weeks had less benefit to increase iron status. The possibility;

of hemoglobinopathies such as thalassemia trait affecting adolescent girls in this study should be considered as several studies indicated that the prevalence of tlinlassemia trait among the same population in Indonesia is high.

Iron deficiency also occurred at the storage level, which increased and reached the normal value with iron or iron-zinc supplementation. At the end of supplementation, the mean value of most indicators of iron status in all groups did not reach the normal value (such as Hb < 120 g/L, ZPP > 40 umol/mol heme, MCV <2 80 fL, RDW > l4%), perhaps the 12-weeks of iron supplementation was not long enough to fulfill iron for the 120 erythrocyte life cycle.

lt seems, that the competition between iron and zinc occurred both at the storage level and the erythrocyte formation, and iron-zinc supplementation with the ratio of Fe: Zn = 2: 1 had minimal interaction as the improvement of both iron and zinc status was higher compared to the other groups. Most anemic adolescent school girls in this study had low available iron and zinc intake from the diet, with low intake of enhancers and high intake of inhibitors, which is not enough to promote either iron or zinc absorption from the supplements.

The reduction of the proportion ol' subjects suffering from ARI was the highest among subjects who took either iron alone (3l.1% to 6.7%) compared to those who took iron- zinc supplement with ratio 2: 1 (1 7.3% to l1.l%) or iron-zinc supplement with ratio 4: 1(16.3 % to l4%), indicating that iron alone reduced morbidity status in tenn of Acute Respiratory Infection (ARI). However, adding zinc to iron supplements with ratio 2: 1 scents to improve the specific immune response of anemic adolescent school girls, as shown that the ratio of CD-4/CD-S was slightly increased among subjects who took iron-zinc supplement with the ratio of Fe: Zn= 2: 1.

Conclusions and Recommendations

lt was concluded, that both iron deficiency anemia (22%) and zinc deficiency (15.8%) were problems in the study area. Iron deficiency and hemoglobinopathies such as that assemia trait might be the causes of anemia among adolescent school girls. A daily 30 mg iron and 15 mg zinc supplementation among anemic adolescent schools girls for 12 weeks improved iron and zinc status and reduced iron deficiency anemia and zinc deficiency. Iron supplementation alone increased iron status, while adding zinc to iron supplementation protected the adverse effect of iron on decreasing zinc status.

The competition between iron and zinc might occur in the role of both nutrients for erythrocytes formation as well-as at storage level, and supplementation with the ratio of Fe: Zn = 2: 1 had minimal interaction on improving bot.h iron and zinc status. As most of the anemic adolescent school girls had inadequate iron and zinc intake from the diet, the deficiencies of other micronutrients such as; vitamin A, folic acid and vitamin B12 should also be considered as the causes of anemia.

Combined iron-zinc supplementation with the ratio of Fe: Zn = 2: 1 was appropriate on reducing the risk of anemic adolescent school girls suffering from Acute Respiratory Infection, however the mechanism of both iron and zinc on enhancing immune system could not clearly be shown from the results of this study.

It is recommended to establish an iron-zinc supplementation program with ratio of 2: 1 through the existing channel of school health program to alleviate iron de iciency anemia and zinc deficiency 'among adolescent girls. Research cum action prioritized is to explain the contribution of bioavailability iron and zinc intake from the diet including increase the enhancers and minimize the inhibitors to the absorption of iron-zinc supplementation with ratio of Fe: Zn = 2: 1. The possibility of hemoglobinopathies such as thalassemia trait, as the cause of anemia needs further investigations.