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The Effect of Adding Zinc To Zinc And Retinol Serum Levels At Postpartum In the Malnutrition Pregnant Women in Third Trimester

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Abstract

Zinc deficiency in pregnant women has been associated with various conditions in babies born, one of whom was an infant with low birth weight. Effect of zinc supplementation in pregnant women may increase serum zinc levels and high-doses vitamin A supplementation may increase serum retinol levels. The aim of this study is to examine the effect of zinc supplementation in the malnutrition pregnant women in third trimester to zinc and retinol serum levels when the mother had postpartum. The population in this study was all pregnant women in third trimester on study sites. Respondents were malnutrition pregnant women in third trimester with upper arm circumference less than 23,5cm (n=32). Data collected through questionnaire, blood sampling and laboratory tests. Samples were taken from the population with inclusion criteria. They were then placed into groups using random allocation.

At the end of the study, there was a significant difference in serum zinc levels (p<0,000) and no significant difference in serum retinol levels (p<0,624) in the trial group. Serum zinc levels increase after supplementation, but serum retinol levels decrease. These results suggest that zinc supplementation can increase serum zinc levels but needed adequate protein intake to increase serum retinol levels.

Keywords: Zinc supplementation; Serum zinc; Serum retinol; Postpartum women

Introduction

Maternal nutrition during pregnancy is essential for the growth of the fetus. The incidence of babies with low birth weight is higher in developing countries rather than developed countries. This is due to the low socio-economic circumstances affecting the mother's diet [1].

Women who suffer from malnutrition before pregnancy or during the first week of pregnancy tend to give birth to a baby who suffered brain damage and bone marrow because the central nervous system is very sensitive to the first 205 weeks. Malnutrition mothers during the last week of pregnancy will give birth to a baby with low birth weight (< 2500 g) because a lot of fat tissue deposited during 7 to 9 months of pregnancy [2].

Pregnant women who suffering from malnutrition especially chronic energy deficiency at risk of having a baby with low birth weight and impact on child growth and development, intellectual development and productivity in the future. Nutritional problems in pregnant women also have an impact on infant mortality. SKDI data in 2007 showed 34 infant deaths per 1,000 live births. Malnutrition in pregnant women will affect the growth and development of the fetus which at risk of low birth weight births. Data of low birth weight babies in 2002 showed 14%. Overview of the incident is an impact of low nutritional status in pregnant women [3].

Riskesdas data [4] showed that the prevalence of malnutrition pregnant women in 2007 estimated at 13.6%. Malnutrition pregnant women are at risk of having a baby with low birth weight [5]. Syarifuddin et al. [6] reported that a study conducted in Bantul, Central Java, 206 (69.1%) of 298 pregnant women who were respondents in his study suffer from chronic energy deficiency. From 149 pregnant women who gave birth to low birth weight, 124 people (83.2%) suffer chronic energy deficiency. Chronic energy deficiency is the biggest risk factor of low birth weight. Pregnant women with chronic energy deficiency have 3.95 times greater risk of having a baby with low birth weight than healthy pregnant women. If pregnant women suffering from chronic energy deficiency and anemia simultaneously, 75.53% predicted will give birth to babies with low birth weight.

In 2010, the prevalence of malnutrition pregnant women in East Java province was 9.3% and 11.3% in Bojonegoro. Then, it increases to 9.8% 12.3% and in 2011 [7]. These data showed that the prevalence of malnutrition pregnant women in Bojonegoro is higher than East Java province.

Pregnant women were also vulnerable to deficiency of other nutrients such as vitamin A, iodine, and zinc. Deficiencies of these nutrients together will bring more serious effects, both for mother who threatened her safety during pregnancy, childbirth, postpartum period and for fetuses [8].

Manifestations of zinc deficiency began from an increase of incidence and severity of infection and impaired growth and development of children and the presence of pregnancy complications, birth of a baby with low birth weight, premature rupture, prolonged labor, preterm birth and increase of prenatal mortality. Zinc deficiency will worsen clinical effects of vitamin A deficiency [9,10].

Bates et al. [11] suggest that zinc plays an important role in protein metabolism and very necessary for the maintenance of normal levels of proteins transport and support the possibility that zinc deficiency may change the network availability of other nutrients such as vitamin A or iron through its effect on transport by proteins.

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Repair or improvement of serum zinc levels are expected to increase the production of Retinol Binding Protein (RBP), which is required for vitamin A secretion from the storage in the liver into the plasma. High-dose vitamin A which given after childbirth is expected to be activated by the increased production of RBP then expected to increase serum retinol levels in postpartum mother. Increased serum retinol levels in postpartum mother is expected to increase the amount of vitamin A in mother's breast milk thereby reducing the impact of malnutrition during pregnancy which accompanied by deficiency of micronutrients in infants.

Methods

Study design and population

The study was an experimental research with Pre Test - Post Test Control Group Design by giving double-blind treatment [12]. Population of this study was all pregnant women in third trimester on study sites. Respondents were 32 malnutrition pregnant women in third trimester with upper arm circumference less than 23,5 cm. Samples were taken from the population with inclusion criteria then placed into groups using random allocation.

Informed consent and ethical clearance

This study has obtained ethical clearance from the ethical committee of the Public Health Faculty of Airlangga University relating to the protection of human rights in medical research. Before the data were collected, selected sample was asked to sign an informed consent as evidence of the willingness to being respondents in the study.

Supplement

Zinc supplementation given to respondents, who are malnutrition pregnant women in third trimester.

Data collection

Data collection techniques were questionnaire, blood sampling and laboratory tests.

Biochemistry assessment

Blood samples were collected in the laboratory by medical analyst to know serum zinc level and serum retinol serum levels of respondents.

Statistical analysis

To analyze the differences each of the variables in two groups, independent samples T-test was used with SPSS. A p-value < 0.05 was considered statistically significant.

Result

Variables in this study are serum albumin, serum zinc levels and serum retinol levels. Homogeneity test result that there was homogeneity for all variables tested, so it was possible to assume that trial and control group came from sample population.

Serum albumin

Average of serum albumin in the trial group was 2.93±0.20 g/dl, minimum 2.50 g/dl and maximum 3.30 g/dl. Whereas in the control group average of serum albumin was 2.91±0.21 g/dl with minimum 2.50 g/dl and maximum 3.30 g/dl. There was no significant difference of serum albumin between trial and control groups (p<0.797) (Table 1).

Serum Albumin (g/dl)	Group	
	Trial	Control
Sample	16	16
Average	2.93	2.91
Standard deviation	0.20	0.21
Minimum	2.50	2.50
Maximum	3.30	3.30

Table 1: Serum albumin in trial and control group of malnutrition pregnant women in third trimester before supplementation in Bojonegoro in 2011.

Levels	Trial Group				p-value
	Pre-test		Post-test		
Zinc serum (µg/dl)	163.56 ±	14.07	226.51 ±	27.46	0.000
Retinol serum (µg/dl)	7.87 ±	4.05	7.07 ±	3.25	0.624

Table 2: Differences average of zinc and retinol serum levels in trial group between pre-test and post-test.

Levels	Control Group				p-value
	Pre-test		Post-test		
Zinc serum (µg/dl)	170.19 ±	17.30	203.73 ±	27.43	0.000
Retinol serum (µg/dl)	8.41 ±	6.60	6.16 ±	2.50	0.175

Table 3: Differences average of zinc and retinol serum levels in control group between pre-test and post-test.

Trial Group

Serum zinc levels: Average of serum zinc levels in pre-test is 163.56±14.07 µg/dl and 226.51±27.46 µg/dl in post-test. There is differences average of serum zinc levels in trial group before and after supplementation (p< 0.000) (Table 2).

Serum retinol levels: The average of serum retinol levels in the pre-test is 7.87±4.05 µg/dl and 7.07±3.25 µg/dl in post-test. There is no differences average of serum retinol levels in trial group before and after supplementation (p<0.624) (Table 2).

Control Group

Serum zinc levels: Average of serum zinc levels in pre-test 170.19±17.30 µg/dl and 203.73±27.43 µg/dl in post-test. Same in trial group, there are differences average of serum zinc levels in control group before and after supplementation (p<0.000) (Table 3).

Serum retinol levels: Average of serum retinol levels in the pre-test is 8.41±6.60 µg/dl 6.16±2.50 µg/dl in post-test. There is no differences average of serum retinol levels in control group before and after supplementation (p<0.175) (Table 3).

Discussion

The average of serum zinc levels after supplementation on post-test tends to increase in both groups; however, the trial's group increment was higher than the control's group increment. The average increase of serum zinc levels in the group that received supplementation is higher than those who not received zinc supplementation.

In the trial group, there were statistically significant differences in average of serum zinc levels between pre-test to post-test (p=0.000). This is consistent with Hafeez et al. research [13] that investigated the effects of zinc supplementation in pregnant women, that studied began from 10 to 16 weeks of pregnancy, supplemented with zinc sulphate containing 20 mg zinc element. The results of that study are pregnant women who are given zinc supplements showed an average increase of zinc serum 14.7 μg/dl ($p<0.002$). In the control group showed a decrease in serum zinc levels ($p<0.47$). It is also consistent with studies conducted by Goldenberg et al. [14], which concluded that concentrations of plasma zinc were significantly higher in the group who receiving zinc supplements.

Garg et al. [15] investigated the effects of zinc supplementation during pregnancy to outcome of pregnancy in 168 pregnant women in India who divided into 2 groups: the treatment group was given 200 mg of zinc sulfate (45 mg zinc element) orally per day in different trimesters of pregnancy and the control group did not receive any supplements. In the end of that study, zinc serum in grouped that receiving zinc supplementation significantly increased from 109.70 ± 3.23 μg/dl to 205.40 ± 4.47 μg/dl ($p<0.001$).

Average of serum zinc levels in the control group before supplementation is higher than the trial group (6.63 μg/dl) but statistically there was no difference ($p<0.336$). At post-test an increase in average of serum zinc levels (33.54 μg/dl) happened and statistically this increase shows difference average of serum zinc levels between pre-test and post-test in the control group. However, when compared with the trial group, the increase is greater in the trial group. An increase average of serum zinc levels in the pre-test and post-test accompanied by the statistical difference in the control group which showed a zinc intake of foods that affect serum zinc levels.

Adequate intake of zinc during pregnancy to fulfill the increased of physiological demands influenced by food and may be changes in fractional zinc absorption and / or excretion of endogenous zinc. Arrangement of zinc absorption in intestine and endogenous excretion is the primary tools to maintain zinc homeostasis at different levels of zinc intake [16].

Zinc status affects several aspects of vitamin A metabolism, such as absorption, transport and utilization of vitamin A. Two general mechanisms have been postulated to explain that there are some dependency relationship between zinc and vitamin A on 1) role of zinc to transport vitamin A which mediated through protein synthesis, and 2) conversion from retinol to retinal that requiring zinc-dependent enzyme, retinol dehydrogenase. However, evidence of the effect of zinc intake on vitamin A status that conducted in experimental animals is not convincing. Weight gain higher in control animals compared with zinc deficiency animal in these experiments, although it gets same meal, making it difficult to isolate the effects of general zinc deficiency in the state of protein-energy malnutrition. In humans, cross-sectional studies often show a weak relationship between vitamin A status and zinc. Randomized trials have failed to show a consistent effect of zinc supplementation on population [17].

In his study expressed a high dose vitamin A supplementation cannot repair the effects of zinc deficiency on the metabolism of vitamin A during pregnancy. Levels of vitamin A on plasma decreased, but there are increased levels of vitamin A in the liver on zinc deficiency conditions. This is an indication of a decline in the mobilization of vitamin A from the liver, which may be caused by low synthesis of zinc-dependent RBP.

In a cross-sectional study in pregnant Mexican teenager, did not find any differences concentrations of vitamin A serum among subjects with low zinc status and normal status. From these results we concluded that zinc supplementation did not improve vitamin A status.

In this study, serum zinc levels in respondents which increased after zinc supplementation in the trial group was not accompanied by an increase in serum retinol levels in the trial group. This is related to the metabolism of zinc.

Serum zinc levels in this study increased after zinc supplementation in the trial group was not accompanied by an increase in serum retinol levels. Adequate protein intake is needed as a tool for zinc transportation in circulation. Albumin is the main tool of zinc transportation. Albumin in plasma is a major determinant of zinc absorption. Zinc absorption decreases when the blood albumin decreased [18]. Intake of protein which contains essential amino acids and non-essential is needed. Essential amino acids, especially histidine and non-essential/conditionally essential especially cysteine is required for the formation of zinc finger protein. Zinc finger protein requires four amino acid residues as ligands i.e. two cysteine and two histidine [19].

The amount and level of protein consumption by respondents in this study is still below the RDA. From laboratory tests found the presence of albumin levels are below normal. Lack of protein intake for a long time caused low levels of albumin.

Zinc is mainly requires albumin (70%) to circulate in the systemic circulation to body tissues and the remainder binds to other proteins such as transferrin, ceruloplasmin and amino acids, especially histidine and cystine. With the low protein intake (under the RDA) can cause low levels of albumin in the blood. Consume less protein for a long time can cause low albumin levels, so zinc intake from food and supplements are not absorbed optimally. In this study, all respondents have low albumin levels (3.5-5 g/dL) before supplementation and otherwise, zinc deficiency also one of the factor that can affect serum albumin levels [20].

Consume enough protein and zinc needed to produce normal RBP. Therefore, zinc deficiency or protein malnutrition would interfere vitamin A function by preventing the release of vitamin A normally from its storage in the liver [21]. Thus low serum retinol levels in this study and the absence of increased levels of serum retinol average after zinc supplementation and high-dose vitamin A supplementation showed that albumin has an important role in the vitamin A metabolism. Zinc supplementation without being followed with normal albumin levels in serum cannot reach other networks with optimal. Similarly, high-dose vitamin A supplementation in this study did not increase retinol serum levels though found a significant difference in serum zinc levels after supplementation because RBP synthesis which needed to mobilize vitamin A from the storage in the liver requiring zinc and protein.

So in malnutrition pregnant women with low serum albumin levels, required supplementary feeding mainly containing protein and energy also zinc supplementation to optimize high-dose vitamin A supplementation program which is a government program. Besides, the increase in nutrition counseling is also needed to improve nutritional knowledge of pregnant women so although there is a limitation in the economy, pregnant women still able to choose good food, both in quality and quantity.

Conclusion

There are differences of serum zinc levels before and after zinc supplementation in the trial and control group, and increased of serum zinc levels were higher in the trial group. There is no difference of retinol serum levels between before and after zinc supplementation in both groups.

Based on the results of these discussions, it is known that zinc supplementation in the malnutrition pregnant women in third trimester may increase serum zinc levels but this increase was not accompanied by an increase of serum retinol levels. That is due to low intake of protein which is a zinc transportation tool to circulate in the systemic circulation into body tissues so zinc supplementation cannot synthesize RBP optimally which required to mobilize vitamin A from the liver.

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