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Effect of Zinc and High-Dose Vitamin A Supplementation to Retinol and Zinc Levels of Breast Milk in the Malnutrition Pregnant Women in Third Trimester

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Abstract

Zinc and high-dose vitamin A supplementation in the malnutrition pregnant women in third trimester could increase retinol and zinc levels in breast milk. This research applied an experimental design of double blind randomized tests (pre-test and post-test) on two groups (trial and control groups) to analyze the effect of zinc and high-dose vitamin A supplementation. Variables of interest were measured two times, pre-test and post-test. Data were collected through questionnaire-based interviews, laboratory tests of blood samples and breast milk. Based on the inclusion criteria, 32 malnutrition pregnant women were selected as samples. The sample was randomly assigned to two groups, trial and control groups. Based on t-tests, the effects of supplementation were analyzed. The results showed that there was no significant differences of zinc ($p < 0.386$) and retinol levels ($p < 0.948$) of breast milk between pre and post-tests within control group and trial group. The conclusion is there was no difference on zinc and retinol levels of breast milk between the control and trial groups. These results suggested that zinc and high-dose vitamin A supplementation has no effect to retinol and zinc levels of breast milk in the control and trial groups.

Keywords: Zinc supplementation; High-dose Vitamin A; Breast milk retinol; Breast milk zinc

Introduction

During pregnancy mother should pay attention to the food consumed by eating nutritious foods which are foods that contain power, builder substances and regulators in accordance with nutritional needs. Nutritious food is required to fulfill fetus needs and increase breast milk production. Nutritional needs during pregnancy have a direct impact on the journey of pregnancy and the baby to be born. Capacity and development of the embryo to survive, poor nutrition during pregnancy affects fetal growth [1].

According to the Depkes [2] upper arm circumference measurements in women of childbearing age group is one of the easy early detection and can be implemented by common people, to determine risk groups of malnutrition. Chronic energy deficiency in pregnant women is malnutrition in pregnant women which last long (several months or years) [3]. Risk of malnutrition is a state where girls/women have a tendency to suffer from malnutrition with upper arm circumference less than 23.5 cm [4]. Malnutrition in pregnant women have an impact on the health of the mother and child in the womb, such as increasing risk of babies with low birth weight, miscarriage, premature birth and mortality in mothers and newborn baby.

In another study by McLaren [5] which get the result that children aged 6 months or more tend to decrease mortality. Greater mortality happened in children who less than 2 years old. Children aged less than 3 months requires 100,000 IU dose of vitamin A and 50,000 IU dose will be useful for babies aged over 3 months. For a larger dose about 300,000 IU indispensable in pregnant women to improve the content of vitamin A in breast milk, serum retinol in breast-fed babies will reduce infant mortality by about 30%.

Zinc is an essential element that makes up more than 200 enzymes which involved in the metabolism of carbohydrates, lipids and protein and synthesis and degradation of nucleic acid [6]. Therefore, zinc is important for some functions, including growth and development, reproduction, immunity and sensory function, antioxidant protection and membrane stability [6]. Zinc is one of essential minerals that must consumed by mother. Diets low in zinc will increase the risk of fetal prematurity, low birth weight and congenital defects. Zinc is considered able to increase birth weight and head circumference [7]. Enzyme deficiency in pregnant women will greatly affect fetus immune function; it will stay after the fetus born and also during his/her lifetime. Therefore, it is important to consume zinc in pregnant women.

Vitamin A deficiency is closely associated with increased morbidity and mortality in infants [8]. Vitamin A status in most newborn babies are marginal and postpartum mothers who do not get enough vitamin A is at risk for experiencing vitamin A deficiency. Women who breastfeed are at risk of vitamin A deficiency due to a number of vitamin A that comes out will be entered into the breast milk. Intake of vitamin A which are not sufficient to replace the vitamin A that secreted and transferred to the baby through breast milk will reduce vitamin A reserves in the mother, thus the mother will experience depletion and quality of vitamin A in her breast milk will reduced [9].

Prevalence of malnutrition in Indonesia according to RISKESDAS in 2007 is 13.6% for women of childbearing age who suffer from malnutrition, while in East Java by 15.9%. Report from Health Department of Bojonegoro in 2010 showed that pregnant women in Bojonegoro who suffer malnutrition are 11.3%, while in 2011 increased to 12.3%.

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Zinc deficiency, vitamin A deficiency and malnutrition actually related to each other like a chain. If body suffer of zinc deficiency, serum retinol also decreased and resulting in vitamin A deficiency. Zinc deficiency can also lead to disruption of protein metabolism so malnutrition also occurs. Zinc deficiency can also reduce immunity, whereas malnutrition and low immunity was also interrelated.

Methods

Study design and population

This research applied an experimental design of double blind randomized tests (pre-test and post-test) on two groups (trial and control groups). Based on the inclusion criteria, samples of this study are 32 malnutrition pregnant women in their third trimester. The sample was randomly assigned to two groups, trial and control groups.

Informed consent and ethical clearance

This study has obtained ethical clearance from ethical committee of the Public Health Faculty of Airlangga University. Any woman who is the subject of this study has been agreed to completing a written informed consent form.

Supplement

Zinc and high-dose vitamin A supplementation were given to respondents who are malnutrition pregnant women in their third trimester.

Data collection

Data were collected through questionnaire-based interviews, laboratory tests of blood samples and breast milk.

Biochemistry assessment

Blood samples and breast milk were collected by medical analyst to know retinol and zinc levels in the breast milk of respondents.

Statistical analysis

To analyze the differences each of the variables in two groups, independent samples T-test was used for ratio data scale. Normality of data distribution was tested with Kolmogorov-Smirnov test.

Result

The results of this study showed that average of serum albumin in trial group was higher (2.93 ± 0.20 µg/dl) with minimum 2.50 µg/dl and maximum 3.30 µg/dl than control group (2.91 ± 0.21 µg/dl) with minimum 2.50 µg/dl and 3.30 µg/dl as maximum value. Test results using the Kolmogorov-Smirnov statistic showed p-value > 0.05 which means that data distribution is normal, data in both group is homogeneous. Based on T-test results with p-value < 0.797 concluded that there was no difference of serum albumin between trial group and control group (Table 1).

Based on the Table 1, we showed that average retinol levels of breast milk in trial group was higher (6.72±7.07 µg/dl) with minimum 0.67 µg/dl and maximum 22.33 µg/dl than control group (6.57 ± 3.83 µg/dl) with minimum 2.25 µg/dl and maximum 14.73 µg/dl. After statistical test using T- test to see the difference, it can be concluded that there was no difference retinol levels of breast milk between the trial and control groups (p < 0.948) (Table 1).

Variable	Group		p-value
	Trial	Control	
Albumin (µg/dl)	2.93 ± 0.20	2.91 ± 0.21	0.797
Retino breast milk (µg/dl)	6.72 ± 7.07	6.57 ± 3.83	0.948
Zinc breast milk (µg/dl)	35.70 ± 10.60	39.41 ± 10.64	0.386

Table 1: Albumin, retinol and zinc levels of breast milk in trial group and control group in Bojonegoro.

The average zinc levels of breast milk that obtained from this research are: in the trial group 35.7 ± 10.60 µg/dl with minimum value of 20.92 µg/dl and 52.74 µg/dl as maximum value whereas in the control group, the average was 39.41 ± 10.64 µg/dl with minimum value of 24.55 µg/dl and maximum value of 64.80 µg/dl. Different with albumin and retinol level, zinc levels of breast milk in trial group is lower than control group. Result of T-test showed that there was no difference in zinc levels of breast milk between the trial and control groups (p < 0.386) (Table 1).

Discussion

Albumin

Result of t-test showed that there was no difference of serum albumin between the trial group and the control group (p < 0.797). Foodstuffs that contain a lot of albumin from animal sources such as beef, fish, chicken, eggs and milk containing high levels of protein. While nuts and vegetables have a lower level of protein.

Digestibility of animal protein has the best quality compared with vegetable protein. Protein quality is determined by the type and proportion of the amino acids that it contains. High biological-value protein is a protein that contains all essential amino acids in proportions which adapted to the growth [10]. It is associated with low serum albumin in this study so that the content of protein source that has high biological value also decreases.

Retinol levels of breast milk

The statistical results showed that there was no difference in retinol levels of breast milk between the trial and control groups (p < 0.948). Vitamin A is needed by the baby and mother to reduce the mortality of children aged 6 months or more. This is because pregnant women need higher doses of vitamin A, i.e. 300,000 IU in order to improve the content of vitamin A in breast milk, serum retinol in breast-fed babies will lower the infant mortality of about 30% [5].

Retinol concentration in breast milk may be an indication when current status of mother's vitamin A suboptimal, breastfeeding mothers produces breast milk with decreased retinol levels. This condition illustrates the inadequacy of food intake during pregnancy and the insufficiency of vitamin A reserves in the body. Retinol concentration of breast milk can also be used for indirect indicators of vitamin A status of breastfed babies [11].

According to Miller et al. [12] during lactation period, mothers with good nutritional status provides approximately 750 µmol of vitamin A through breast milk that consumed as much as 130 L, with vitamin A in breast milk by 1.92 µmol/L. While the postpartum mothers in developing countries only give half of that number, because the content of vitamin A in breast milk is less than 1.05 µmol/L (Equivalent to 30 µmg/dL). The content of vitamin A in breast milk varies related to vitamin A status and lactation period. In a healthy mother, colostrum contains 151 µg/100 ml, breast milk in transition period contains 88 µg/100 ml and mature breast milk were 75 µg/100 ml [13]. Giving vitamin A in postpartum mothers expected can increasing the amount of vitamin A in breast milk which also

expected to have other potential that is increase immunity factors in breast milk.

Zinc levels of breast milk

The statistical results showed that there was no difference zinc level of breast milk between the trial and control groups. According to Krebs [14] study concluded that zinc supplementation has effect on zinc levels of breast milk after supplementation of 13 mg zinc/day for 6 months. But some studies have concluded that poor micronutrient intake and micronutrient status in mothers resulted in low levels of micronutrients in breast milk. In contrast, other studies concluded that there was no relationship of micronutrients intake in mothers to micronutrients levels in breast milk.

Various parts of the placenta actively participate in the transfer, processing and synthesize of nutrients in the influence of mother hormones, the fetus and placenta. Air and water diffuse freely through the placenta, but it is still unknown how it mechanical. Nutrients are not directly from the mother's blood to fetal blood, but from maternal blood to the placenta, where the proteins, enzymes and nucleic acids are synthesized. Conversion and next synthesis occurs in the fetal side of the placenta [15].

Carbohydrates are the main source for the fetus and obtained continuously from blood glucose transfer through the placenta. While fat is not the main energy source, only limited transferred in the form of fatty acids across the placenta. Fetal cell growth is the result of protein synthesis from amino acids which transferred through the placenta [15].

Consumption patterns of mother during pregnancy will determine the content of zinc in breast milk. Zinc is widely available on the animal side dish, vegetable side dishes, fruit, vegetables and cereals. However, in these foods also contain phytic acid so that zinc from food cannot be absorbed completely.

Based on the results of the study, zinc supplementation and high-dose vitamin A to retinol and zinc levels of breast milk in the malnutrition pregnant women in third trimester does not affect the increase of retinol and zinc level in breast milk between the groups which given zinc supplement with the group which not given zinc supplement. This is due to the lack consumption of animal protein which consumed by mother that would affect zinc levels in the body. Low consumption of animal protein will affect albumin concentration. Albumin is a tool transport of zinc. When albumin values are low, it will interfere synthesis of Retinol Binding Protein (RBP). This will disrupt the presence of retinol in breast milk.

Conclusion

At the end of study, there was no significant difference of zinc levels ($p < 0.386$) and retinol levels ($p < 0.948$) of breast milk between pre and post-tests within control group and trial group. These results suggested that zinc and high-dose vitamin A supplementation has no effect to retinol and zinc levels of breast milk in the control and trial groups.

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