Original Article

Monitoring of Zinc Level in Milk of Breastfeeding Mothers at First Month of Delivery

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Abstract

Introduction: Zinc plays a vital role in various biological functions and physical growth. More than 300 enzymes in body need zinc for proper function. In this study, the concentration of the zinc micronutrient in breast milk was evaluated and analyzed at the first month of breastfeeding.

Materials and Methods: This was a descriptive study of 150 breastfeeding mothers in the 2014 that had given birth in Yazd and were sampled in a simple way. Sampling was done exclusively in the health and treatment centers in the city, in the spring of 2014. 10- 20 ml samples of breast milk were taken manually in the morning and before infants' feeding, in 3 times of 5, 15 and 30 days after delivery, to measure the micronutrient of zinc. The concentration of zinc was measured by atomic absorption spectrophotometer. Data obtained by questionnaires and atomic absorption was analyzed by ANOVA test.

Results: The average age of mothers was 27.40 ± 4.67 years. The average level of zinc in breast milk was 2.60 ± 0.35 mg/l. The zinc concentration of breast milk was at the bottom of the standard range of zinc in breast milk. There was no significant relationship between zinc averages in milk with education, age, BMI and mothers' job. But, there was a direct relationship between zinc levels of breast milk with mothers' BMI.

Conclusion: According to the results of this study, it seems that addition of zinc to the diet of breastfeeding mothers helps to prevent zinc deficiency in mothers' blood serum as well as children's nutrition.

Keywords: Zinc level, breastfeeding, Milk, delivery, Yazd

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Introduction

The World Health Organization has recommended exclusive breast feeding for infants up to 6 months [1]. Breast milk is a complex biological fluid and a mixture of micronutrients and macronutrients which is considered as a perfect food for baby feeding [2]. Minerals are one of the micronutrients of milk, essential for growth and development and maintaining the health of tissues. Several factors such as genetic features, mothers' nutrition and the stage of breastfeeding affect breast milk composition and the concentration of its components [3]. Also, minerals concentration in various regions is different and the socio-economic conditions can be effective in the amount of minerals [4].

Today, the findings of the researches show that there is a relationship between malnutrition during the embryonic period and breastfeeding with chronic diseases in adulthood; for this reason, prevention from embryos and newborns' malnutrition is necessary. Therefore, breastfeeding, rich in micronutrients, during infancy has a positive impact on new born and children's growth and development and prevents many diseases in future. Zinc is one of the effective micronutrients in growth and development which it must be sufficient in newborns and children nutrition. Children under one year need 5 mg of zinc each day [5], so that the relative deficiency of zinc can cause physical, behavioral and cognitive defects [6]. Total body zinc content is 5.1 to 5.2 g that plays a vital role in proteins synthesis and helps cells regulation of immune system. Zinc is mainly found in the strong muscles of the body and particularly in the red blood cells, white blood cells, retina, skin, liver, kidney, bones, and pancreas. Zinc is a component of hydroxyl apatite that makes the bone matrix strong and hard. Therefore, zinc deficiency can lead to weak and brittle bones. Zinc plays a vital role in various biological functions such as reproduction, controlling diabetes, stress, appetite, odor, taste and physical growth. More than 300 enzymes in body need zinc for proper function [7]. For this reason, zinc deficiency affects many body systems, especially the tissues with high rate of cell division and turn over such as immune system and gastrointestinal tract which are affected more than other tissues [8].

Epidemiological studies have shown that average daily intake of zinc in all people, regardless of race, age, and gender is about 50% of daily recommended amounts [3,9]. Although, pregnant women, children and elderly people are the main groups at risk of zinc deficiency, lack of it can affect the entire population [7,10]. In the study conducted in Yazd, zinc concentration in breast milk of mothers who did not take zinc supplement, in the fourth month of breastfeeding was 1.29± 57 mg/l less than the recommended range (3- 5 mg/l) [9]. In this regard, several studies were conducted about the potential benefits of prescribing zinc supplement to breastfeeding women that led to the increase in breast milk quality and quantity and improvement of children's growth and development, and it was recommended to add zinc in newborns and mothers' diet. Shrimpton et al. added 15 mg of zinc to the breastfeeding mothers' diet and observed that children' height and weight of these mothers increased more than the children of the mothers in control group [11]. In a conducted study by Lira, 5 mg of zinc was added to newborns' diet; this study showed more increase in newborns' height and weight, who received additional zinc, than control group that did not receive additional zinc.

As attention to nutrition and eating various foods during the pregnancy is very important, these attentions should be also considered during the

breastfeeding. After delivery, about 800 ml of milk is made daily in the mothers' body that can cause severe changes in the micronutrients concentration in the body. Therefore, monitoring each micronutrient during the breastfeeding helps community health. In this study, the concentration of the zinc micronutrient in breast milk was evaluated and analyzed at the first month of breastfeeding.

Materials and Methods

All chemicals used in this study, were of analytic grade to prevent the effects of impurities on the results. Double distilled water was used for washing the lab equipment before measuring and for preparation of solutions. The chemicals were measured by laboratory digital scale, the model of Mettler (Switzerland), with the precision of ±0.0001 g. The concentration of zinc was measured by model 20AA Varian (Spain) atomic absorption spectrophotometer, in the instrumental analysis laboratory at the School of Public Health.

This was a descriptive study of 150 breastfeeding mothers who had given birth in Yazd and were sampled in a simple way. Sampling was done exclusively in the health and treatment centers in the city, in the spring of 2014. Lack of receiving the micronutrient supplements, being the mothers with children exclusively breastfed and being the mothers without a history of the chronic diseases, were the requirements for the volunteers for inclusion in the study. After consent of the volunteers, the questionnaires containing personal, career and educational information were completed by interviewing. Hereby, breastfeeding mothers' personal information was collected by the questionnaires. 10- 20 ml samples of breast milk were taken manually in the morning and before infants' feeding, in 3 times of 5, 15 and 30 days after delivery, to measure the micronutrient of zinc. The breast milk samples were collected in the metal- free plastic tubes washed and sterilized beforehand by 10% nitric acid and distilled water; all samples were stored in a -20°C freezer until the time of testing. After being thoroughly mixed, the collected samples, first, were mixed with 15 ml of acid mixture (20% sulfuric acid and 10% nitric acid) and then with 10 ml of toluene in a separating funnel. The mixture was vigorously shaken for 15 minutes and remained for 20 minutes unchanged in the same condition to separate two phases, completely [12]. The aqueous phase was separated from the mixture and zinc concentration in breast milk was measured at wave length of 232nm and in the air- acetylene flame 4.0 to 1.7 ml/min by Atomic Absorption Spectrophotometer (AAS).

Data obtained by questionnaires and atomic absorption was saved in a data file of the SPSS software version 16 and was analyzed by ANOVA test. All test results were considered significant, with p- value less than 0.05.

Results

The age range of mothers was 18- 43 years and the average age was 27.40 ± 4.67 years. The education level was 24.67% academic, 52.00% diploma and 23.33% below diploma. Minimum and maximum amount of zinc in breast milk was 1.31 and 3.86 mg/l. The average level of zinc in breast milk was 2.60 ± 0.35 mg/l. Also, the obtained data was analyzed according to the parameters of mothers' age, education and job that were shown in Table 1.

Table. 1. Mean concentration and standard deviation of zinc in the breastfeeding milk at different group

Factors	Groups	Number	Maximum*	Minimum*	Mean*±SD	p-value
BMI	Thin	2	2.02	1.78	1.90±0.17	0.36
	Medial	65	1.98	1.31	1.65±0.31	
	Fat	83	3.86	1.53	2.06±0.38	
Age	< 25 year	51	1.98	1.31	1.01±0.289	0.068
	25-30 years	63	1.68	1.51	1.59±0.26	
	>30 years	36	3.86	1.53	2.74±0.53	
Education	Under-diploma	35	1.51	2.63	2.07±0.28	0.49
	Diploma	78	1.55	3.86	2.75±0.25	
	Academic	37	1.31	2.68	1.99 ±0.53	
Job	Household	141	3.86	1.31	2.60±0.36	0.91
	Practitioner	9	2.45	1.57	1.91±0.28	
Total		150	1.31	3.86	2.60 ±0.35	

*Values is mg/l

Discussion

It is notable that the accumulation of metals such as zinc and magnesium in embryonic tissues increase during the second and third trimester, and transmission of these elements to the embryos can decrease the concentration of these elements in their maternal serum. In previous studies, a meaningful relationship between consuming zinc and zinc concentration in breast milk was not reported. Only, the results of the study conducted by Krebs et al. showed that zinc supplementation led to an increase in zinc amount in breast milk, but in another study which was conducted by the same researchers, with more samples, was reported the lack of effects of zinc supplementation on concentration of zinc in breast milk. Therefore, monitoring zinc level in mothers' milk during breastfeeding is of the particular importance and so, in this study, it has been investigated during the first month of breastfeeding.

In comparison with reported results of zinc concentration in mothers' milk, in different countries, in this study average zinc in breast milk (2.60 ± 0.35 mg/l) was less than the average zinc in mothers' milk in Australia (4.1 mg/l), Canada (3.24 mg/l) and Texas (2 mg/l) and was to the extent of zinc average in mothers' milk in the previously conducted study in Yazd [13].

The results showed that there was a direct relationship between zinc levels of breast milk with mothers' BMI, so that with an increase in body weight, the amount of zinc in milk increased. Also, in this division, minimum amount in medial people was equal to 1.31mg/l and the maximum amount in fat people was equal to 3.86 mg/l. Previous studies also showed that the reduction of zinc in body, in its early stages, could be associated with lack of proper weight gain [14,15] and the obtained results are consistent with this study.

There was no clear relationship between zinc averages in milk with education and mothers' job. Because it was observed that zinc level in breast milk of mothers with academic education was slightly lower than it in non- academic educated mothers. This represents the fact that zinc level in breast milk are directly proportional to the diet and using a variation diet can control the elements in people's blood serum and milk.

Mother's age is a factor affecting on the amount of nutrients in breast milk. Not many studies have been conducted on the effects of mother's age on metal concentration in breast milk. But a few animal studies have been conducted on the effects of age on minerals absorption and it has been shown that with increasing the age, zinc and copper absorption decrease in the intestine; possible changes in the expression of transporter proteins gene and the increase in cholesterol amount were mentioned as the reasons of absorption reduction [16]. The findings of this study showed a meaningful relationship between mothers' ages with amount of zinc in breast milk.

The results of this study showed that breast milk zinc concentration in the studied mothers was at the bottom of the standard range of zinc in breast milk. Since, first, breast milk is the only source of zinc for children in the first few months after birth and second, zinc concentration in breast milk decreases with continued breastfeeding and in the case of insufficient zinc intake by mothers, the amount of zinc in breast milk will not solve children's needs. According to the results of this study, it seems that addition of zinc to the diet of breastfeeding mothers helps to prevent zinc deficiency in mothers' blood serum as well as children's nutrition. In the conducted study by Shrimpton et al., the use of zinc supplement by breastfeeding mothers led to an increase in their children's weight compared to children in control group.

Conclusion

The results of these studies showed that there was no meaningful relationship between demographic parameters with zinc concentration in breast milk; however, a study with more samples, probably can offer clear results. Nevertheless, due to the low level of zinc in mothers' milk, it is recommended to consume the foods rich in essential nutrients for mothers' health and infants' better growth. Also, mothers' knowledge is a factor influencing the nutrients in breast milk; therefore, more studies with more numbers of volunteers and surveying the effects of different parameters in micronutrients concentration in breast milk seem necessary.

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