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Original Research Article

Study of effect of maternal nutrition on breast milk trace elements in malnourished versus well-nourished mothers

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ABSTRACT

Background: Minerals and trace element content of human milk have been a matter of concern among nutritionist in relation to the availability of the essential elements to the new born. Mineral and trace elements occur in the body in a number of chemical forms, such as inorganic ions and salts, or as constituents of organic molecules, for example proteins, fats, carbohydrates and nucleic acids. There is a paucity of data on the effect of nutrition on the composition of trace elements in milk and its effect on the infant. Hence a comparison made between the trace element and mineral such as sodium, potassium, magnesium, iron, zinc, copper, calcium in milk of malnourished and well-nourished mothers in order to determine the effect of maternal nutrition on the quality of milk and its effect on the growth and physical development of the new-born.
Methods: Around 100 mothers were enrolled in the study after obtaining prior informed consent. They were divided into 2 groups-group I had 50 malnourished mothers and group II had 50 well-nourished mothers. The pre-fed milk sample which was collected was stored at - 20°C until it was processed. It was thawed and analysed for copper, zinc, iron, magnesium, sodium, potassium and calcium.
Results: The mean levels of trace elements (iron and zinc) and minerals (sodium, potassium, calcium, magnesium) were slightly more among well-nourished than malnourished women. Values of only copper were significantly higher in the colostrum of well-nourished as compared to that of the malnourished mothers.
Conclusions: The parameters of weight, height weight/height ratio and hemoglobin varied significantly between the well-nourished and malnourished mothers. The difference in milk content of malnourished and well-nourished mothers is not significant for sodium, potassium, calcium, iron, magnesium, zinc. However, copper levels were significantly higher in well-nourished mothers.

Keywords: Colostrum, Flame atomic absorption spectrophotometer, Malnourished, Well-nourished

INTRODUCTION

Malnutrition and undernutrition among mothers in developing countries is a major problem and is closely associated with impaired, maternal, foetal and infant health. The usual diet of women in India is found to be nutritionally inadequate. This state physiological stress during pregnancy may aggravate chronic dietary inadequacy, and thus adversely influence the course and outcome of pregnancy, foetal growth and composition of lactation.[1,2]

The question of composition and volume of breast milk produced by mother on different planes of nutrition at different phases of lactation is a major issue in paediatric public health in the world, especially in resource poor countries. Fundamentally, ultimate concerns are the nutritional adequacy of such milk for babies in relation to calories, proteins, vitamins and minerals.[3]

Minerals and trace element content of human milk have been a matter of concern among nutritionist in relation to the availability of the essential elements to the new born.[4] Mineral and trace elements occur in the body in a number of chemical forms, such as inorganic ions and salts, or as constituents of organic molecules, for example proteins, fats, carbohydrates and nucleic acids.[5] They serve a wide variety of essential psychological functions ranging from structural components of body tissue to essential component of many enzymes and other biologically important molecules. The trace elements and minerals found in the milk serves as the only source for development of an infant in initial 6 months of its growth.[6] There is now growing evidence of the importance of trace elements in human nutrition. It is well known that nutritional status and habitual dietary intake differ in different economic groups and it is possible, therefore, that there might be difference in the trace element profile of women belonging to different economic groups.[7-10]

It is important to determine the trace element composition of breast milk, since it provides information on the trace element intake of infants for the first 6 months of age who are dependent only on breast milk during this period.[11-13] However only a few studies conducted maternal status with milk composition and even fewer studies have addressed the issue of trace element and minerals of these women.[14-16] Such information would be valuable in assessing the effects of maternal nutritional intake, composition of breast milk and in assessing the effect of these on growth and development of new-born.

There is a paucity of data on the effect of nutrition on the composition of milk and its effect on the infant. Hence a comparison made between the levels of trace elements and minerals such as sodium, potassium, magnesium, iron, zinc, copper, calcium in milk of malnourished and well-nourished mothers in order to determine the effect of maternal nutrition on the quality of milk and its effect on the growth and physical development of the new-born.

This will also enable us to ascertain whether a child exclusively breastfed by a malnourished mother is more prone to specific nutritional deficiencies or to infections. In such cases she may then have to seek other options, such as elevating maternal nutritional status or providing supplements to the infants.

METHODS

The study was conducted at the Human Milk Bank and Research Centre, Department of Neonatology in a Tertiary Care Hospital.

About 100 mothers were enrolled in the study after obtaining prior informed consent. The study protocol was approved by the Institutional Ethical Committee. They were divided into 2 groups.

- Group I had 50 malnourished mothers.
- Group II had 50 well-nourished mothers.

Mothers were considered well or malnourished depending on the following criteria:

- Criteria for malnourished mothers was, W/H ratio less than 0.3 in (group I),
- Criteria for well-nourished mothers was, W/H ratio more than 0.3 in (group II).

Inclusion criteria

- Mothers who have undergone full term normal vaginal delivery of normal neonate
- Mothers with well babies on breast-fed.
- No major detectable medical or obstetric illness diagnosed in the mother (other than malnutrition).

Exclusion criteria

- Operative/instrumental delivery
- Medical/obstetric disease in mother
- Mother on medication.

Detailed maternal and neonatal history was recorded on a printed proforma, following information were noted.

- Maternal- age, parity, haemoglobin %, weight, height, W/H ratio. And nutritional status.
- The weight of the mothers was recorded by weighing scale. (Libra)
- The height of the mothers was recorded by the height chart.
- Haemoglobin concentration was determined by Sahli's method.

Analysis of trace elements from milk samples

Method of milk collection

Colostrum milk samples were collected from 100 mothers (50 malnourished and 50 well-nourished) who were delivered in Hospital. 10ml of milk sample were collected at 3rd day after delivery in acid cleansed test tube with special care by manual expression.[17-19]

Precautions

In the present study, all laboratory wares used in sample ashing, analysis and storage were soaked in 10% nitric acid (HNO_3) for several days and then rinsed thoroughly with distilled and double distilled water, respectively before use.

Pre-treatment of colostrum milk samples

For the complete digestion of 2ml milk $2\,{}^{1}/_{2}$ ml nitric acid (HNO3) and $1\,{}^{1}/_{2}$ ml perchloride acid (HCIO4) were required. Acid blank was taken along with each batch of milk sample through the same procedure throughout the analysis.

Determination of Copper, zinc, iron, magnesium, sodium, potassium and calcium in digested colostrum samples were carried out by flame atomic absorption spectrophotometer (GBC, 904) At environmental assessment division, BARC Hospital.

Statistical analysis

In this study each parameter of both the group mean and standard deviation were calculated by using SPSS software package. To compare the significance difference between two groups "student unpaired t test" was used.

RESULTS

Mothers delivering at hospital were selected as per inclusion criteria and were classified into two groups of 50 each: Group (I) malnourished mothers, and Group (II) well-nourished mothers.

Table 1: Maternal demographic profile.

Parameter	Well-nourished (n=50)	Malnourished (n=50)
Age of mothers (years)	@22.8±2.99	22.72±3.43
Weight of mothers (weight)	*50.4±5.91	41.5±3.17
Height of mothers (cm)	*152.34±5.54	149.94±4.17
Weight/height ratio (kg/cm)	*0.33±0.032	0.27±0.018
Haemoglobin (g%)	*10.37±1.03	9.64±0.75

*p <0.05 significant and p >0.05 not significant.

The two groups were matched in age. The parameters of weight, height, weight/height ratio and haemoglobin varied significantly between the well-nourished and malnourished mothers while the change was not significant with respect to the age.

Above data reveals that mean level of trace elements (Copper, Iron and Zinc) and minerals (Sodium, Potassium, Calcium, Magnesium) were slightly more among well-nourished than malnourished but difference was not significant.

Mean levels of copper were significantly more among well-nourished mothers i.e. 0.70 as compared to only 0.58 in malnourished.

Table 2: Comparison of trace elements and minerals of colostrum between well-nourished and malnourished mothers.

	Mean±SD	
Parameters	Well-nourished (n=50)	Malnourished (n=50)
Sodium (µg/ml)	220.32±78.80	214.25±56.65
Potassium (µg/ml)	566.83±194.5	553.56±178.13
Calcium (µg/ml)	259.31±75.66	250.22±61.55
Iron (µg/ml)	0.43±0.32	0.39±0.13
Magnesium (µg/ml)	22.43±8.16	20.12±4.05
Zinc (µg/ml)	9.86±2.85	9.56±2.61
Copper (µg/ml)	0.70±0.32	0.58±0.23

*p <0.05 significant and p >0.05 not significant.

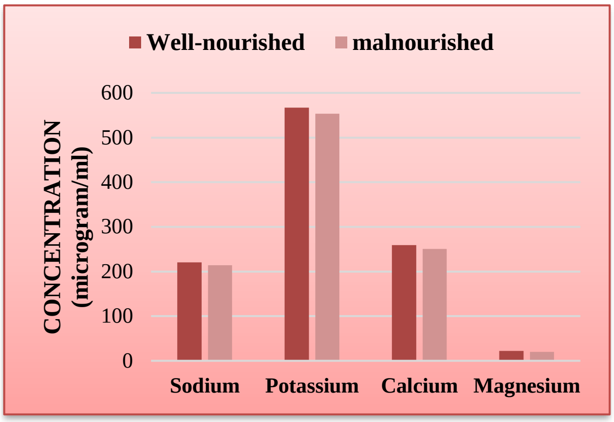

Figure 1: Comparison of minerals of colostrum between well-nourished and malnourished mothers.

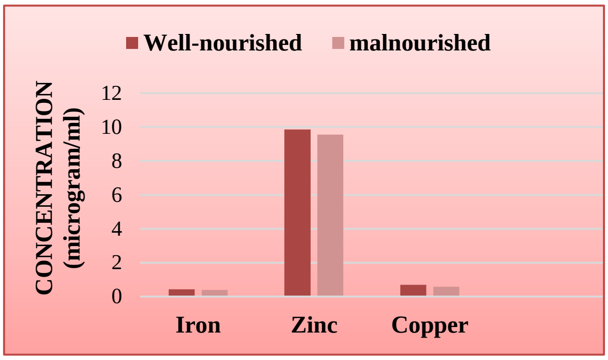

Figure 2: Comparison of trace elements of colostrum between well-nourished and malnourished mothers.

DISCUSSION

The question of composition and volume of breast milk produced by mothers on different planes of lactation is a major issue in paediatric public health in the world, especially in resource poor countries. Fundamentally, ultimate concerns are the nutritional adequacy of such milk for young infants in relation to calories, proteins, vitamins and minerals.[20,21]

Pregnant women and nursing mothers constitute a vulnerable group because of their special needs. Maternal nutritional status is also known to influence the condition of the offspring. In view of these considerations, the nutritional problems of pregnancy and lactation assume importance.[22,23]

This perspective study was conducted at postnatal ward and outpatient neonatal centre. It included 50 well-nourished and equal number of malnourished women. The milk composition of these two groups was compared for mineral and trace elements in milk -sodium, potassium, calcium, iron, magnesium, zinc and copper concentration was also compared between two groups.

Demographic profile

Table 1 reveals the demographic profile of the mothers in the two groups for age, weight, height, weight/height ratio and haemoglobin concentration.

The weight (kg)/height (cm) ratio in study group was 0.27±0.018 in malnourished and 0.03±0.032 in well-nourished respectively. The criterion for maternal malnutrition in this study was weight/height ratio less than 0.3.

The mean weight of the mothers in the malnourished group was 4.15±3.17(kg) and the mean of the mothers in well-nourished group was 50.44±5.9 (Table1).

The mean height of the mothers in malnourished group was 149.94±4.17(cms) and the mean height of the mothers in well-nourished group was 152.34±5.54(cms) (Table1).

It has been proposed that quantity and quality of breast milk and adversely affected by maternal under nutrition and the growth pattern of infants of these mothers is not satisfactory. It has been also indicated that maternal nutrition during pregnancy and lactation has little direct impact on birth weight and the infant growth.

Haemoglobin

The haemoglobin levels in malnourished women were 9.64±0.75gm% while those in the well-nourished women were 10.37±1.03gm%. This difference was found to be statistically significant.

Trace elements

Table 2 reveals the trace element and mineral content of well-nourished and mal nourished mother's milk for sodium, potassium, calcium, iron, magnesium and zinc and copper.

The difference in milk content of malnourished and well-nourished mothers is not significant for sodium, potassium, calcium, iron, magnesium, zinc. However copper levels were significantly higher in well-nourished mothers.

The mean levels of some micronutrient are less in the colostrum of the under nourished mother than in the colostrum, samples of well-nourished mothers. The iron content of breast milk is low but since the bio-availability of iron is high, iron deficiency anaemia is not seen in first six months in exclusive breast feed infants. No co-relation has been observed between the dietary intake of iron and its concentration in human milk.

Sodium and potassium in milk are of much importance in the feeding of young infants and clinical problems may arise if there is no excessive intake of these nutrients. They have believed to be present in the milk almost entirely as free ions. There is no relationship between maternal dietary sodium and potassium intake and the concentration of these electrolytes in milk.[24]

Calcium is responsible for number of regulatory functions such as maintenance of normal heartbeat, blood coagulation, hormone secretion, integrity of intracellular cement substance and membrane, nerve conduction and activation of enzymes. Consumption of dairy products is very important to achieve adequate calcium intake. The calcium content of human milk is considerably lower than that of cow's milk. There appears to be no co-relation between intake of calcium and calcium concentration in milk.[25,26]

Magnesium has an essential role in wide variety of physiological process including protein and nucleic acid metabolism, neuromuscular transmission, and muscle contraction and it acts as a co factor for many enzymes.[27] Dietary deficiency of magnesium is uncommon excepting condition of severe malnutrition and certain disease states. There is no relationship between milk magnesium concentration and dietary magnesium intake within the normal range of dietary intake.

Zinc is essential for growth and development, sexual maturation and wound healing and it may also be involved in the normal functioning of the immune system and other physiological process.[28,29] Zinc content in human milk is less than that of cow's milk. No significant correlation has been observed between zinc intake and zinc concentration in human milk.

The bioavailability of zinc from human milk is higher than the cow milk. It is likely that the lower concentration of zinc in human milk may be a contributory factor to the higher absorption efficiency from human milk in infancy.

Copper is required for iron utilization and a cofactor for enzyme involved in the metabolism of glucose and the synthesis of haemoglobin, connective tissue and phospholipid.[30,31] Dietary deficiency of copper is uncommon except in conditions of severe malnutrition.

There is no significant correlation between dietary copper intake and milk concentration.

The nutritional roles, requirements and metabolism and the quantitative relationship between dietary intake and the health for a number of the minerals and trace elements have been more clearly defined in recent years.

Reliable information is now available on the content, and the principal factor affecting it, of most of the trace elements on human milk. However, for some of the trace elements, there is still a wide variation in reported values in the literature, which is due at least in part, to analytical difficulties

Breast milk usually has adequate mineral and trace elements contents for feeding full term infants.

CONCLUSION

The present study has made an effort to find out the influence of maternal malnutrition on some of the important biochemical components and trace elements in the milk and its effect on the growth of newborn.

The parameters of weight, height weight/height ratio and hemoglobin varied significantly between the well-nourished and malnourished mothers.

The study reveals that mean level of trace elements (Iron and Zinc) and minerals (Sodium, Potassium, Calcium, Magnesium) were slightly more among well-nourished than malnourished but difference was not significant.

Amongst the trace elements, values of only copper were significantly higher in the colostrum of well-nourished as compared to that of the malnourished mothers.

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