Original Article :

Effect Of Maternal Nutritional Status On The Human Milk Composition

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Abstract:

In a developing country like India, maternal nutrition and their health status has always been a point of concern. There are doubts regarding the quantity and quality of milk that they provide to their offsprings. Scanty data that we do have regarding this topic, is many decades old and might not hold true in today's age. This study compared the quality of breast milk on day 3, of mothers. This qualitative analysis of milk was then correlated to the maternal nutritional status. We found that, the breast milk composition is fairly constant and is not affected by maternal nutrition, or dietary intake.

Introduction:

Exclusive human milk feeding for the first 6 months of life, with continued breastfeeding for 1 to 2 years of life or longer, is recognized as the normative standard for infant feeding. It is now clearly established that breast milk composition is not constant, but rather evolves throughout lactation in response to the changing nutritional requirements of the neonate. Nearly every macronutrient in breast milk evolves in some way during the course of lactation, with perhaps the most striking changes occurring with proteins, lipids and energy. These variations are believed to respond to specific infant needs and have beneficial effects on growth and development both during infancy and later in life. There is great variability in the concentrations of energy-yielding nutrients in human milk, even within well-nourished populations. The composition of milk changes from preterm to term, at different stages of lactation, and also has diurnal variation. The protein content of human milk has often been assumed to be relatively constant in contrast to the fat content Hind milk, defined as the last milk of a feed, may contain two to three times the concentration of milk fat found in foremilk. There are very scanty recent Indian and Western data, regarding the composition of human milk and the effect of maternal nutritional status on its outcome. The existing data available is almost 2 decades old. This study aims to renew our data of human milk composition, in our population, and study the influence of maternal nutritional status on the milk that is secreted.

Materials and Methods:

63 Mothers from post-natal ward of a tertiary care hospital were included on day 3 post-delivery, in the study. They were divided in three (3) categories, depending on their Body Mass Index (BMI). Mother's pre-pregnancy weight was considered for calculating their BMI. First group of mothers were those with BMI less than 18.5kg/m^2, second group of mothers were with BMI between 18.5-25 kg/m^2, and third group of mothers were with BMI more than 25kg/m^2. 5ml of the total

breast milk expressed by mothers was taken, pre-feed at around 9am to 11am, and collected in sterile containers. These sterile containers were transported to the biochemistry lab, within 2 hours of collection. Protein levels were estimated by Biuret's test. Lactose levels were estimated by Benedict's quantitative assessment. Cholesterol, Triglyceride levels were reported by Auto-analyzer….

The values obtained were entered in CRF, and a master chart prepared. Statistical analysis was performed with the software SPSS 17.00.

Results:

63 mothers were included in the study with a mean age of 28 years. Their weights ranged between 34kgs to 66kgs, with a mean weight of 48kgs. BMI of all these mothers ranged between 17.8kg/m^2 to 31.39kg/m^2, with a mean of 22.57kg/m^2.

Lactose content of the milk ranged between 4.2gm/dl to 9.7gm/dl, with a mean of 6.47gm/dl. Protein content was ranging from 0.6gm/dl to 7.1gm/dl, with a mean of 2.4gm/dl. Cholesterol had a wide range with a minimum of 4.8mg/dl to a maximum of 99.4mg/dl, with a mean of 32.3mg/dl. Triglycerides had a mean value of 8.4gm/dl, values ranging from 1.9 to 34.1gm/dl.

Table 1

Group, Mean (±SD)	Weight(kg)	Height(m)	BMI(kg/m2)
Group 1 (n=21)	40(±2.9)	1.48(±0.05)	18.18(±0.2)
Group 2 (n=21)	48.19(±5.62)	1.46(±0.06)	22.56(±1.79)
Group 3 (n=21)	55.19(±5.73)	1.43(±0.07)	26.97(±1.42)
All (n=63)	47.8(±7.91)	1.46(±0.06)	22.57(±3.84)

Comparing All 3 groups:

Baseline characteristics of the study population is shown in table 1. Mothers in group 1, had a mean BMI of 18.18kg/m^2, compared to a mean BMI of 22.56kg/m^2 in group 2, and a mean BMI of 26.97kg/m^2 in group 3.The mean pre-pregnancy weight of mothers in group 1, group 2 and group 3was 40kg, 48.19kg, and 55.19 kg respectively.

Lactose, Protein, Cholesterol and Triglyceride levels are shown in table 2.Lactose content in the 3 groups were similar, with no statistically significant difference in the 3 groups. Mean lactose level in group 1 was 6.31gm/dl, 6.66gm/dl in group 2, and 6.43gm/dl in group 3.

Protein content was significantly lower in milk of mothers from group 1.Mean protein content in group 1, was 1.5gm/dl, compared to 3.3gm/dl in group 2. This difference is statistically significant, with a p value of 0.015. Mean protein level in group 3 was 2.58gm/dl. Protein content in group 1, was also found to be lower with statistical significance when compared to group 3, with a p value of 0.001.

Mean cholesterol levels are in the range of 28-36 mg/dl in the 3 groups. Mean cholesterol level in group 1 was 28.4 mg/dl, 36.6mg/dl in group 2, and 32mg/dl in group 3. There was no statistically significant dif-ference in cholesterol levels, in the 3 groups.

Mean triglyceride levels are in the range of 7-10gm/dl in the 3 groups. Mean triglyceride level in group 1 was 7.4gm/dl, 10.7gm/dl in group 2, and 7gm/dl in group 3. There was no statistically significant differ-ence in triglyceride levels, in the 3 groups.

Table 2

Group, Mean (±SD)	Lactose (gm/dl)	Proteins (gm/dl)	Cholesterol (mg/dl)	Triglycerides (gm/dl)
Group 1 (n=21)	6.31(±1.41)	1.51(±0.48)	28.4(±23.5)	7.43(±5.62)
Group 2 (n=21)	6.66(±1.55)	3.29(±1.27)	36.61(±22.59)	10.73(±8.54)
Group 3 (n=21)	6.43(±1.44)	2.58(±1.15)	32.03(±17.61)	7.08(±2.28)
All (n=63)	6.47(±1.45)	2.46(±1.25)	32.35(±21.33)	8.41(±6.18)

Discussion:

Protein

Human milk contains a wide variety of proteins that contribute to its unique qualities. Many of these proteins are digested and provide a well-balanced source of amino acids to rapidly growing infants. But in areas where protein-calorie malnutrition is common, there has been a concern about the protein content of breast milk from under-nourished women. Our study also points out that poorly nourished mothers, in group 1, had significantly lower protein content (1.5gm/dl), when compared to well-nourished mothers, in group 2, (3.29gm/dl) with a statistical significance (p value = 0.015). Similarly, Garg et al. found significantly higher protein concentrations in the colostrum of well-nourished than undernourished mothers (6.0 and 4.5 g/dl respectively). Karmarkar and Ramakrishnan found a significant relation between protein in the diet and milk protein concentration, with (as for fat)an apparent threshold effect at daily protein intakes of around 40 g to 50 g. Other authors have reported low protein concentrations in the milk of undernourished women from several countries including India and Guatemala.

However in a study of poorly nourished women from Karachi, Pakistan, the 'true protein content' determined by exchange chromatography after acid hydrolysis was similar to those obtained by like techniques in Sweden, Belgium and Japan presumably using milk from well-nourished mothers. In an early study of low income Yoruba women, in Ibadan, Jelliffe found the protein content of the milk to be similar to values obtained for well-nourished western women, with no apparent fall on prolonged lactation. In addition, Brown et al. found no relationship between anthropometric measurements of Bangladeshi women and the nitrogen concentration of the milk.

A study in Davis, California examined the association between maternal characteristics and the composition of human milk macronutrients and found that the macronutrient concentrations of human milk are associated with one or more of the following factors: Maternal body weight for height, protein intake, parity, return of menstruation, and nursing frequency. This study also found that mothers who produce higher quantities of milk tend to have lower milk concentrations of fat and protein but higher concentrations of lactose. Protein concentration in different studies is shown in figure 2.

Figure 1:

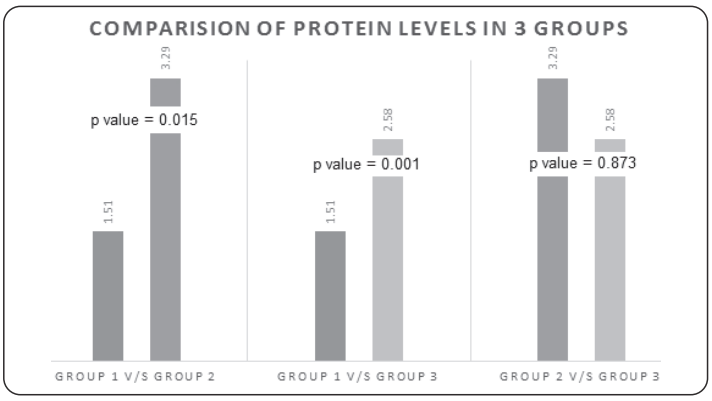
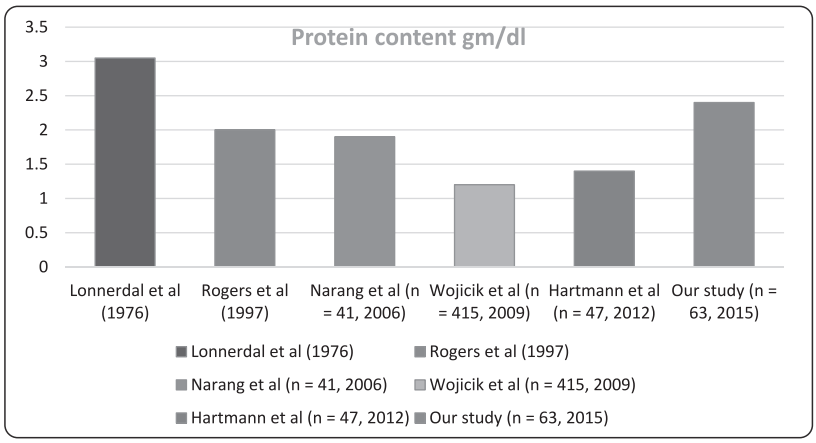


Figure 2:



Lactose

The principal sugar of human milk is the disaccharide lactose. The concentration of lactose in human milk is the least variable of the macronutrients, but higher concentrations of lactose are found in the milk of mothers producing higher quantities of milkv. Many reports have shown that maternal malnutrition, or, conversely, energy supplementation has little effect on lactose concentration in milk, and it has been stat-ed that of all nutrients in human milk, lactose is the nutrient least likely to be affected by maternal nutri-tion . A single report of low lactose levels in milk from strictly vegetarian mothers is difficult to evalu-ate, since the method used for lactose analysis was not given, no control women were studied, and the values were about 40-50 % of those in all other studies. Similarly, we see in our study, there was no statis-tical difference, in the lactose levels of milk in all the 3 groups. Harzer et al reported that lactose in milk increased when the diet was changed from low fat, high carbohydrate to high fat, low carbohydrate. When the order of the diets was reversed, a decrease in lactose was observed. Only a few women partici-pated in this study, and it is not known whether the effects were transitory.

The other significant carbohydrates of human milk are the oligosaccharides, which comprise approxi-mately 1g/dL in human milk, depending on stage of lactation and maternal genetic factors . The oli-gosaccharides are among the non-nutritive bioactive factors. Lactose content in a study from Denmark were 6.4 to 7.6gm/dl, which is similar to our results . Different studies over different regions, and dif-ferent time period have shown a similar levels, as shown in figure 4. None of these studies showed any statistically significant difference in lactose levels in milk,

Figure 3 :

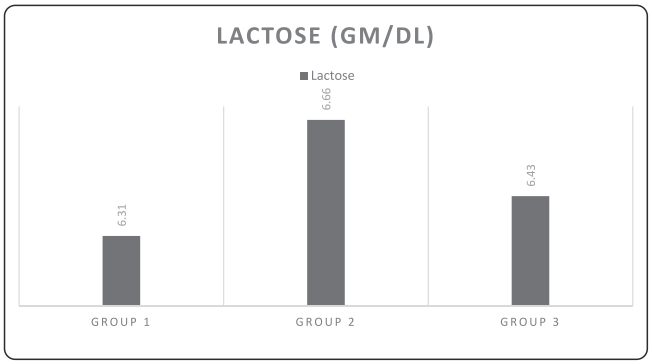
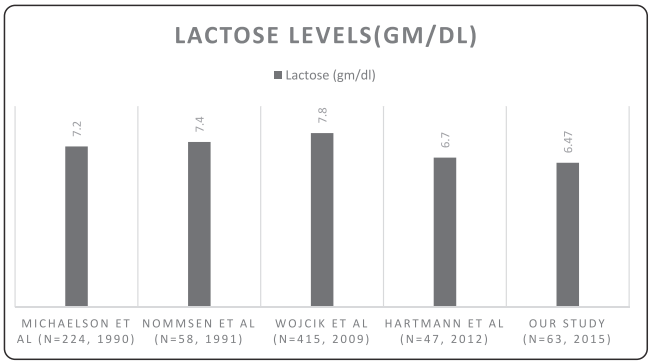


Figure 4 :



Fat

Fat is the main source of energy in human milk and appears to be the most variable of the macronutrients, both within and between individuals and in response to maternal nutrition. The total fat content of breast milk is low at the beginning of each feed, and depends on the extent to which the breast was emptied during the previous feed. As the feed proceeds the fat content rises and can increase as much as four-fold. It also varies according to the time of the day, and with each individual mother and is affected by the type of food she eats. It also depends on maternal nutritional status, dietary practices, volume of feeds, diurnal variation. Fat content is lower in morning and night feeds, whereas it is significantly higher in afternoon and evening feeds . In our study, samples were taken in the morning hours, and not much difference was found in fat content of different groups.

Many investigations have attempted to correlate poor maternal nutrition with the total concentration of milk fat .In several studies, low fat concentrations were found in milk from poorly nourished women compared to published values from Western societies, but methodological differences cannot be excluded. The general lack of an effect of diet on total milk fat could, of course, arise from the use of de-pot fat to synthesize milk fat. However, there is also a high degree of variation in milk fat among individ-uals, during each nursing (in the same individual), during the day, and between days as reviewed by Lammi-Keefe and Jensen . These large variations make it difficult to detect significant differences.

Figure 5

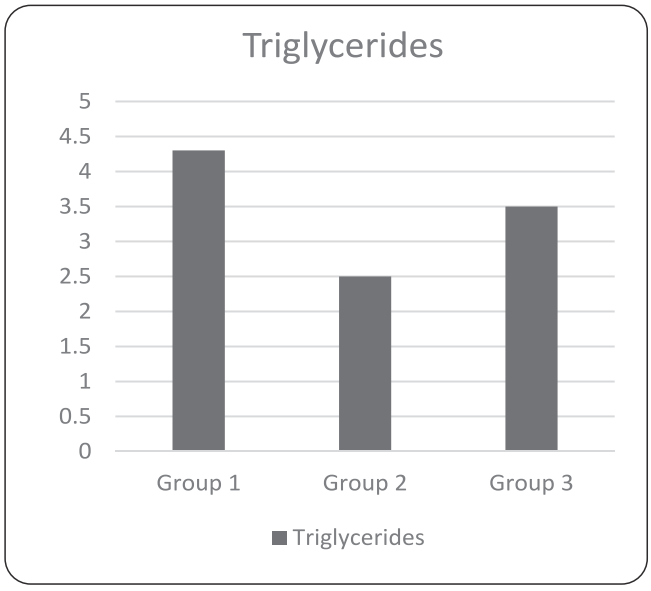
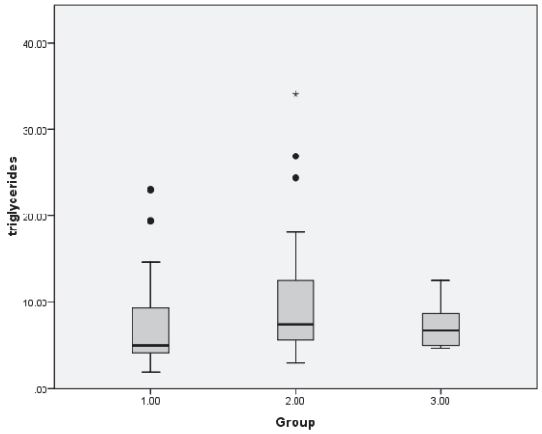
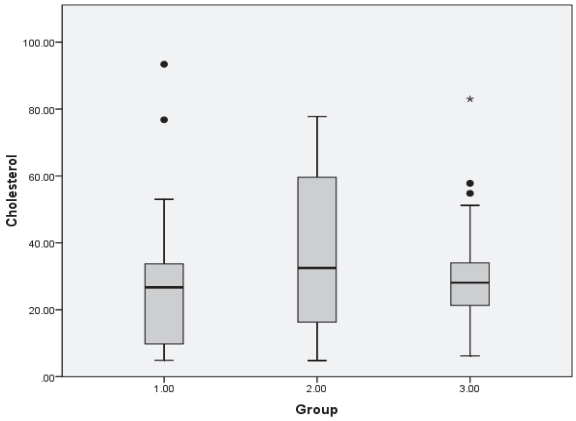


Figure 6





Conclusion:

Breast milk composition is fairly constant and is not affected by maternal nutrition, or dietary intake. The only significantly lower levels of protein, were still in the acceptable range, and would meet the infant's requirement. The slightly higher values of protein, can be explained by the fact, that this estimation was done for milk expressed on day 3, post-delivery. Protein con-tent is known to be higher in the first week post-partum, and gradually lowers to a constant level, by second week.

However, nutrition during pregnancy is an area of concern. Various health programs in India are contributing to it, but maybe they need more focused approach. Poorly nourished mothers and its impact on the milk for its offspring should be conveyed to the mothers and family members. Nutrition should be taken care of in all women of child-bearing age.

Author contribution - *Nakul Kothari - Data collection, Write-up,Jayshree Mondkar - Con-cept, Guidance,Pankhuri Kothari - Statistical Analysis*

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