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Original Article

Obstetrics and Gynaecology Section

Effect of Maternal Anaemia on Different Macronutrients of Breast Milk in the Rural Population of India: An Observational Cross-sectional Study

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ABSTRACT

Introduction: Anaemia during pregnancy is a major public health problem throughout the world, particularly the developing countries. Maternal anaemia affects the major macronutrients contents of breast milk.

Aim: To analyse the major nutrients and components of transitional milk in anaemic mothers and healthy non anaemic mothers.

Materials and Methods: This was an observational cross-sectional study conducted from January 2018 to June 2019 for a period of 18 months, included 180 lactating mothers who were divided into two groups: Anaemic {Haemoglobin (Hb) <11 gm/dL} and Non anaemic (Hb >11 gm/dL) based on their antenatal haemoglobin status. Anaemic group patients were further subdivided according to severity as recommended by the Indian Council of Medical Research. Breast milk samples (15-20 mL) were collected from postpartum patients on day 4 to 14. The sample was collected in the morning 1 hour after the previous breastfeeding and instilled into a milk analyser and compared the following major components (fat, lactose, protein) in both the groups. The data was coded in Microsoft excel sheet and was analysed by using Statistical Package for the Social Sciences (SPSS) version 24.0 software. Analysis of the component of transitional milk was done.

Results: There were 90 cases in each group, with total 180 lactating mothers. The mean age of the anaemic group was 26.18±2.89 and non anaemic group was 26.03±3.43 (p-value=0.792) were statistically similar. The mean parity of both the group (p-value=0.039) were significant. Study shows that anaemia grossly affects the protein and lactose content of the breast milk but there is no significant change in fat content. In severe anaemia, there was significant difference present in all the 3 components, fat, protein, and lactose (p-value=0.012, p-value=0.051, p-value= 0.001 respectively).

Conclusion: Maternal anaemia particularly of severe type adversely affects all the macronutrients of breast milk in terms of protein, fat, and lactose.

Keywords: Breastfeeding, Deficiency, Mother, Transitional milk

INTRODUCTION

Anaemia is a global public health problem affecting both developing and developed countries [1]. In India, National Family Health Survey shows that 54% of women in rural and 46% of women in urban areas are anaemic [2]. The World Health Organisation (WHO) estimated that 56% of all pregnant women in developing countries are anaemic, about 75% are from Southern Asia and 88% from India [3]. In the rural part of India, marriage in early age followed by repeated pregnancies without antenatal visits and medical guidance are common, leads to a progressive increase in the prevalence of anaemia day-by-day despite of so many health policies made by the Government of India.

Human milk mainly consists of macronutrients such as protein, fat, lactose, and micronutrients including vitamin A, B1, B2, B6, B12, D, and iodine. It is recommended by WHO that upto six months baby should be exclusively fed on breast milk [4]. Development of infants initially depend upon the breast milk, most of the new born of anaemic mothers are either anaemic itself, preterm or growth-restricted [5]. Due to this, it is important to know the composition of the major component of breast milk in anaemic mothers. For this, comparison of breast milk of anaemic mother from their normal non anaemic counterpart is necessary to rule out the deficiency of the macronutrient in breast milk. If there is a deficiency of macronutrients in the breast milk of the anaemic mother present, we can supplement it from outside for better development of the new born.

For the present study, as it was difficult in rural areas to council the postpartum patients to get back in hospital for follow-up after two weeks for a mature milk examination, therefore authors had planned the study on transitional milk composition. The aim of this study was to find out if there were differences exists in transitional milk of anaemic and non anaemic mothers in terms of different components and macronutrients present in transitional milk.

MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted for a period of 18 months from January 2018 to June 2019, after taking Ethical Clearance from the Institutional Ethical Committee. A total of 180 postnatal patients were enrolled in this study.

Inclusion and Exclusion criteria: The study included postnatal patients on day 4 to day 14, all cases with singleton pregnancies, postnatal patients with term deliveries, both primigravida and multigravida cases. Patient with a history of blood transfusion within the last one month, patients with certain medical conditions like hypertensive disorders, Tuberculosis (TB), diabetes mellitus, thyroid disorder, leukaemia and bleeding diathesis, chronic renal disease, Human Immunodeficiency Virus (HIV) infected, patient on chemotherapy, postnatal patients with preterm deliveries, patients with multiple pregnancies, postnatal cases with a history of Postpartum Haemorrage (PPH) following their deliveries and with postpartum pyrexia and sepsis were excluded from the study.

On admission, detailed patient history was taken and clinical examination was done. Cases were divided into two groups, namely anaemic (Hb less than 11 gm/dL) and non anaemic (Hb more than 11 gm/dL), based on their antenatal haemoglobin status after checking the inclusion and exclusion criteria, anaemic patient

further subdivided into very severe anaemia (less than 4 mg/dL), severe anaemia (4 mg/dL-6.9 mg/dL), moderate anaemia (7 mg/dL-9.9 mg/dL), and mild anaemia (10 mg/dL-10.9 mg/dL) [6]. Tests like renal function test, blood sugar (random, fasting and postprandial), thyroid profile (T3, T4, Thyroid Stimulating Hormone (TSH)), bleeding time, clotting time, viral markers were also done to exclude other chronic diseases.

Breast milk samples (15-20 mL) were collected from postpartum patients from day 4 to 14. Samples were collected in the morning one hour after the previous breastfeeding after that milk was frozen for extended periods and repeatedly thawed. Breast milk was expressed by hand or manual pump and collected into plastic containers. The collected samples were instilled in a milk analyser (Model- Julie Z9 Fulmatic), which was fully automatic. It measures the following important parameters in breast milk such as fat, density, lactose, Solid Not Fat (SNF), protein, and added water.

STATISTICAL ANALYSIS

Data was coded in Microsoft Excel sheet and was analysed by using Statistical Package for the Social Sciences (SPSS) version 24.0 software. Results were presented in form of percentage and proportion. Suitable tables were made and relations between different factors were established by an appropriate statistical test. Tests used in our study were the Analysis of Variance (ANOVA) test, Chi-square test, Independent t-test. A p-value <0.05 was considered statistically significant.

RESULTS

In this study, 180 cases were enrolled to analyse the composition of transitional milk in postnatal cases who fulfil the inclusion criteria and divided into two groups with 90 cases in each group. The mean age of the anaemic group (26.18±2.89) and non anaemic group (26.03±3.43) were statistically similar (p-value=0.792). The mean parity of both the group (p-value= 0.039) were significant. As present study was done in the rural area of India, the number of women belonging to rural background was more in comparison to urban, but in this study, the difference was statistically insignificant (p-value=0.612). The mean gestational age of both groups (p-value= 0.296) was insignificant. This suggests that the difference in the mean gestational age of delivery between the two groups was found to be statistically insignificant [Table/Fig-1].

Variable	Anaemic	Non anaemic	p-value
Age (Mean age±SD)	26.18±2.89	26.03±3.43	0.792
Parity (Mean parity±SD)	2.81±1.20	2.36±1.33	0.039
Residence			
Urban	32 (35.5%)	24 (26.6%)	0.612
Rural	58 (64.5%)	66 (73.4%)	
Gestational age (Mean±SD)	38.26±0.84	38.46±1.30	0.296

[Table/Fig-1]: Demographic details of patients.

Mean protein content shows a significant reduction in the anaemic group than the non anaemic group (p-value=0.001). The mean lactose component showed a significant increase in the anaemic group (p-value=0.003) [Table/Fig-2].

Variable	Anaemic (mean±SD)	Non anaemic (Mean±SD)	p-value
Fat (%)	5.95±1.530	5.63±0.552	0.792
Lactose (%)	6.22±0.801	5.69±0.421	0.003
Protein (%)	0.88±0.191	1.20±0.161	0.001
Density (gm/mL)	24.32±0.89	24.96±1.55	0.006
SNF (%)	6.96±0.17	6.84±0.26	0.076

[Table/Fig-2]: Comparison of milk component in anaemic and non anaemic mothers.
SNF: Solid not fat, p-value ≤0.05 is statistically significant, Independent t-test was used

Mean fat content in mild, and moderate anaemic mothers was insignificant. Changes in mean lactose and mean protein content were significant in the moderate, and severely anaemic group. [Table/Fig-3] shows the variation in milk components according to the severity of anaemia and the p-values given in the table are calculated between different grades of anaemia with non anaemic groups.

Variable	Group	Value	Non anaemia	p-value
Fat	Mild anaemia (n=30)	5.38±1.39	5.63±0.552	0.641
	Moderate anaemia (n=35)	5.21±1.50		0.142
	Severe anaemia (n=25)	5.01±1.34		0.012
Lactose	Mild anaemia	6.01±0.693	5.69±0.421	0.021
	Moderate anaemia	6.14±0.79		0.010
	Severe anaemia	6.18±0.61		0.05
Protein	Mild anaemia	1.12±0.192	1.20±0.161	0.391
	Moderate anaemia	0.92±0.14		0.001
	Severe anaemia	0.76± 0.21		0.001

[Table/Fig-3]: Comparison of transitional milk component according to severity of anaemia.
p-values given in the table are calculated between different grades of anaemia with non anaemic groups using Analysis of Variance (ANOVA), p-value ≤0.05 is statistically significant

DISCUSSION

In rural areas of India, early marriage and childbearing are common. Repeated pregnancies and deliveries in the short intervals of the period without medical advice, lead to the progressive increase in the burden of anaemia day-by-day despite so many health policies by the government. A high percentage of women become anaemic at the time of pregnancy, however many of these women are anaemic at the time of conception only.

The WHO recommends Exclusive Breastfeeding (EBF) for the first six months of life to decrease the burden of infectious disease [4]. Breast milk composition varies by stages of lactation and between term and preterm infants. The effects of low maternal haemoglobin levels on the different macronutritional components (protein, fat, lactose) of breast milk at different maturation stages were not much reported in the literature. Analysis of the composition of macronutrients in breast milk is important because they are building blocks to the development in terms of structure and function of the new born. As breast milk is the only source of nutrients in the newborn for few months (EBF), any major change in the composition of macronutrients in the breast milk of anaemic mother adversely affects the health and development of the newborn. It is furthermore important to know the comparison of milk in anaemic mothers with their normal counterparts.

Corbitt M et al., conducted a cross-sectional study on 208 breastfeeding mothers in Northern Kenya and compare different levels of macronutrients in breast milk and their association with maternal anaemia and found significantly higher milk protein and lower milk fat in anaemic mothers in comparision to non anaemic mothers [5]. França EL et al., conducted a study to find out the relation between maternal anaemia and the immunological and nutritional components of breast milk [7]. Twenty five mothers with normal haemoglobin levels (control group) and 18 mothers with haemoglobin levels below 11 gm/dL (anaemia group) were included in this study. They reported higher total protein levels and low-fat content (non significant) in transitional milk of anaemic in contrast to the control group. Fujita M et al., performed a cross-sectional study to assess associations between milk macronutrients and maternal anaemia on 204 lactating mothers from Northern Kenya [8]. They found high protein levels and low-fat content in milk of anaemic mothers, however, alteration in lactose content was insignificant. In the present study, authors found a highly significant decrease in protein content (p-value=0.001) and significant decrease in density of transitional milk (p-value=0.006) in anaemic mothers. The lactose content was significantly increased (p-value=0.003). However, in

cases of severe anaemic mothers in present study, there was a significant decrease in all macronutrient level of breast milk i.e., fat (p-value=0.012) and protein (p-value=0.001) and lactose content (p-value=0.05).

There is no clear-cut consensus on how maternal anaemia effects in alteration of nutritional macronutrients in breast milk. One hypothesis suggested that fat and lactose in human milk primarily originated from maternal blood while protein content is made in the mammary glands [9,10]. Protein synthesis is easier to increase in anaemic mother than fat and lactose because fat and lactose levels depend upon the increased uptake and nutritional status of mothers. This alteration in milk macronutrient may be explained by the maternal buffering hypothesis, according to which macronutrients in human milk remain constant (buffered) from the effect of fluctuations in maternal nutrition [11-13].

In present study, there was no significant change in the protein content in cases of mild anaemia probably due to buffering of the macronutrients (protein) content of the breast milk. However, a mother suffering from severe anaemia and severe malnutrition may not be able to buffer the macronutrient contents of breast milk. This explains the decrease level of all macronutrients in the present study in cases of severe anaemia. This hypothesis must be investigated more to clarify this buffer theory. To access the magnitude of anaemia, ideally all antenatal women should be screened routinely, especially where the screening facility is available. It would help to identify the women at risk at an early stage and treat them before the deleterious effect of anaemia starts to appear in breast milk and adversely affect not only the mother but also the newborn.

Limitation(s)

The limitation of the present study was the small sample size and the mothers without any co-morbid conditions were included, maybe it is possible that anaemia with co-morbid conditions had a different composition of milk. Also, there was no information on milk volume, leading to limited knowledge about the total amount of macronutrients transferred to the newborn. The present study included the storage of breast milk for a longer duration and repeated freeze-thaw cycles at very low temperatures to analyse total protein, fat, and lactose content in breast milk. The effects of these procedures are insignificant on total protein and fat level but it is significant on the level of lactose may be leading to some biases [13].

CONCLUSION(S)

There was a significant association between low level of maternal haemoglobin and macronutrient contents (protein, fat, and lactose) in breast milk. Maternal anaemia particularly of severe and moderate type adversely affects the quality of breast milk in terms of protein and lactose content.

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