Assessment of Iron Content of Breast Milk in Preterm and Term Mothers in Enugu Urban

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Abstract

Background: *It is commonly assumed that preterm babies are malnourished and this has led to all forms of micronutrient supplementation including iron.*

Objective: *The aim of the study is to compare the iron content in breast milk of mothers who had preterm and term babies.*

Methods: *Ninety six (96) lactating mothers who delivered their babies at term and 68 lactating mothers who had preterm deliveries were recruited for the study. The mothers were attending the postnatal clinic of one secondary and two tertiary healthcare facilities in Enugu. Breast milk iron concentration was determined by Atomic Absorption Spectrophotometer.*

Results: *The differences in the mean values for the iron concentrations in preterm and term breast milk were statistically significant (39.06±10.78 versus 32.79±14.17 µmol/L, P =0.02). In both groups, the breast milk iron concentration gradually decreased as lactation progressed. (P <0.0001).*

Conclusion: *The iron content of breast milk from mothers who had preterm babies is higher when compared to mothers who had term babies. It may thus be needless to introduce exogenous iron during lactation.*

Key words: Iron concentration; breast milk; preterm mothers; term mothers; infants.

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Introduction

The World Health Organization (WHO) and American Academy of Paediatrics (AAP) unequivocally recommend that breastfeeding is the ideal nutrition for infants and is sufficient to support optimal growth for the first six months of life.[1, 2] Breast milk is a composite fluid, loaded in nutrients and non-nutritional bioactive

components. It contains all the nutrients needed by the newborn baby during the first few months of life.[3] Furthermore breast milk also contains non-nutritional components that may support infant health, growth, and development, and protects infants against certain diseases, infections and allergies.[4]

Preterm milk refers to the breast milk of mothers who delivered their babies earlier than the 37th week of gestation while term milk is when the baby is delivered at term (>37th week of gestation). The existence of differences in the nutrient composition of preterm and term breast milk has been demonstrated.[5] The baby needs the perfect nutrients found in breast milk such as fat, protein, and iron[6] to replenish nutritional stores. Iron, in conjunction with zinc, copper, selenium and fluorine remains the key mineral element found in breast miik.[7] The iron content in breast milk is bound to proteins, which makes it available to the baby only, thus preventing potentially harmful bacteria (like *E.coli, Salmonella, Clostridium, Bacteroides, Escherichia, Staphylococcus*) from utilising it for metabolism.[8] Although cow milk and infant formula may contain more iron than breast milk, the human milk iron is absorbed more efficiently by the baby.[6, 8] The composition of breast milk is not uniform, and the concentrations of many of its constituents change during the lactation period and differ between individual mothers. Specifically the factors regulating breast milk iron and lactoferrin levels are incompletely understood.[9]

The adequacy of breast milk in maintaining optimum iron status of breastfed babies and, the relationship between the iron concentration in preterm and term breast milk have remained areas of controversy. The WHO has expressed concern that some exclusively breastfed infants may become iron deficient.[1] As a result various recommendations have been advocated. While some researchers recommend drops of iron for breastfed infants with birth weights between 2500 g and 3000 g, [10] others recommended that breastfed infants should be given supplemental iron from 4 months, [11] 6 months [12] and 12 months of age, [13] respectively.

The iron content of a mother's breast milk is very vital for the optimal survival of the newborn baby, term or preterm. In our environment, preterm delivery is not uncommon, [5] and this has led to wild spread suggestions that routine micronutrient supplementation (including iron) should be the rule. Parents of preterm babies often panic, to the extent of administering iron supplements even without prescription. This supposition has led to the arbitrary importation, into the Nigerian market, of numerous and varied micronutrient compositions. Regrettably, there is diminutive literature on term and preterm breast milk iron composition in our environment. Consequently, all the formulations were based on unscientific assumptions that are very strange to our peculiar socioeconomic situation. The purpose of the present study was to establish the baseline iron concentrations, compare the iron concentrations in preterm and term breast milk of our mothers during early lactation.

Subjects and Methods

Subjects

The subjects used in the study were in two groups (I and II). Group I subjects were made up of 96 lactating mothers who delivered their babies at term (37 completed weeks). Group II subjects were 68 lactating mothers who gave birth preterm (less than 37 completed weeks). Both groups of subjects

had uncomplicated singleton normal vaginal deliveries and were attending the postnatal clinic of one private secondary and two government tertiary healthcare facilities in Enugu. The selection was based on lucky dip of "YES" or "NO". The exclusion criteria included; women on iron supplementation, primigravidas and grand multiparous women, twin or more deliveries, obstetric haemorrhage, established pre- and postnatal anaemia and deliveries by caesarean section. Other exclusions include fever, HIV positive patients, sickle cell disease, diabetes mellitus, hypertension and any other diagnosed medical condition in pregnancy. The subjects were of the same socio-economic status (class III) [14] and were similar in terms of level of education and other socio-demographic factors. All the subjects are of Ibo extraction, resident in Enugu metropolis and within the age range of 22-42 years. Informed written consent and ethical clearance was obtained before the commencement of the study. Personal history, history of present pregnancy and delivery, past obstetric history, past medical history, family and social history and review of systems were obtained.

Methods

Breast Milk Sample Collection

Breast milk sample collection was carried out on the 3rd, 6th, 9th, 12th and 15th day after delivery since lactation did not commence on the day of delivery for most of the mothers. Breast milk samples (5ml) were collected from the mothers by manual expression of the milk directly from the breast into sterile, iron-free, plastic sample containers. After collecting the first 2.5ml, the baby was breastfed for 15 minutes and thereafter, an equal volume of hind-milk from the same breast was collected. Samples were mixed thoroughly and were immediately stored and frozen at -20^{o}C prior to analysis. In other to avoid any possible diurnal changes, all milk samples were collected within the same period of the day (9.00 – 11.00 am).

Sample Analysis

Breast milk samples were digested in concentrated nitric acid and analysis done within two weeks of sample collection. Breast milk iron concentrations were determined by Atomic Absorption Spectrophotometer (AAS) method (Buck Scientific AAS/AES Model 205, United States of America).

Statistical Analysis

Statistical analysis was performed using SPSS software package version 15. Data were expressed as mean ± standard deviation. Test for significance was done using the student's t-test, one way Analysis of Variance (ANOVA) and the appropriate post hoc test where applicable. Values less than 0.05 were regarded as significant.

Results

The results of the survey show that the mean iron concentration in preterm breast milk was significantly higher than in the term breast milk (P =0.02). Table I.

Table I: **Mean Breast Milk Iron Concentration in Term and Preterm Mothers**

Subject Groups	Number (n)	Mean ± SD breast milk iron conc. (µmol/L)	Breast milk iron conc. Range (µmol/L)
Group I (Term)	96	32.79±14.17	18.59 - 47.86
Group II (Preterm)	68	39.06±10.78	26.48 - 54.12

At different days of early lactation period studied (0-15 days), the breast milk iron concentration gradually decreased significantly as lactation progressed in both term and preterm mothers $P < 0.001$, (Table 2). The higher levels of preterm breast milk iron were significantly maintained up until 9days post partum (P =0.044, 0.018 and 0.029 respectively), thereafter the increase became insignificant. (P = 0.062 and 0.167 respectively)

Table 2: **Mean Term Breast Milk Iron Concentrations (µmol/L) at Different Days of Postpartum/Lactation Period**

Days Postpartum	Preterm Breast milk	Term Breast milk	P values(t-test)
Day 0-3	47.33 ± 11.36^{a}	43.92 ± 10.19^{f}	0.044^{*}
Day 4-6	45.52 ± 8.94^{b}	42.58 ± 8.62^{g}	0.018^{*}
Day 7-9	39.94 ± 10.17^{c}	37.17 ± 6.95^{h}	0.029^{*}
Day 10-12	35.57 ± 9.06^{d}	32.80 ± 9.34^{i}	0.062^{ns}
Day 13-15	29.36 ± 8.23^{e}	27.63 ± 7.95^{j}	0.167^{ns}

ANOVA (a versus b versus c versus d, and e versus f versus g versus h), $P < 0.0001$.
T-test (* =significant, ns =not significant)

Discussion

Human breast milk is the ultimate form of nutrition for infants and offers the necessary requirements for newborns before they are able to eat and digest other foods.[15] The dilemma of iron nutritional imbalance is truly a global issue, and evidence now shows that it is a risk factor for a number of health problems especially in infants and lactating mothers. Correcting these imbalances, especially in these vulnerable groups, involves using new knowledge of iron nutrition and function in breast milk, in novel public health problems.[16] Indeed, there is incongruity about the capability of breast milk in sustaining optimal iron status of breastfed babies, as the adequacy of the iron concentration in preterm breast milk is still disputed.[17]

The present study showed that the mean breast milk iron levels were significantly higher in preterm mothers than those who gave birth at term. The result is consistent with the report that showed higher levels of breast milk iron in preterm mothers.[5] It also demonstrated a decrease in breast milk iron concentration (preterm and term) at successive stages of early lactation. This finding is

in concordance with previous studies.[17, 18] It has been stated that a healthy full term infant has ample iron stores at birth, enough to last for at least 6 months of life.[8, 20] Thus, it is rational to state that the possibly low iron stores in preterm babies may be compensated by the higher levels in the mother's breast milk. This is because the iron that would have been transferred to the preterm foetus in the third trimester is retained in the mother, and excreted in the breast. Since the breast milk iron concentrations (preterm and term) found in our report is within normal range, [4,7,20] exclusive breastfeeding (EBF) is adequate for both preterm and term babies, and infants, especially, for purposes of iron nutrient intake. It is suggested that the present indiscriminate administration of iron supplements in the preterm baby, in our environment should be discontinued to avoid overload.

This study serves as a baseline for the determination of iron requirements of neonates in our environment. Although women on iron supplements were excluded, the iron content of the foods eaten in the last 24 hours was not estimated and thus all the subjects may not have had approximately the same daily intake. Further large scale longitudinal will address this shortcoming.

Breast milk from mothers giving birth to preterm babies contains significantly higher levels of iron during the early lactation period when compared to mothers of term babies. Preterm babies may therefore not require iron supplementation.

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References

1. World Health Organization. The Optimal Duration of Exclusive Breastfeeding. 2001; [Assessed on Jun 10 2010]. Available from: http://www.who.int/inf-pr-2001/en/note2001-07.html.
2. American Academy of Pediatrics Work Group on Breastfeeding. Breastfeeding and the use of human milk. Pediatrics 1997; 100:1035-1039.
3. Prentice A. Constituents of Human Milk. Food Nutri Bull 1996; 17(4): 1-14.
4. Stehlin D. Food and Drug Administration: Feeding Baby: Nature and Nurture 2009; [Assessed on Jun 10 2010]. Available from: http://www.about.com/
5. Atinmo T and Omololu A. Trace element content of breast milk from mothers of preterm infants in Nigeria. Early Hum Dev 1982; 6(3):309-313.
6. All About Breast Milk. 2009; [Assessed on Jun 10 2010]. Available from http://www.mordernstork.com/
7. Nagin MK. Minerals in Breast milk. 2009; [Assessed on Jun 10 2010]. Available from http://www.about.com/
8. Bonyata K. Is Iron-Supplementation Necessary? 2010; [Assessed on Jun 10 2010]. Available from http://www.kellymom.com/index.html.
9. Raj S, Faridi MMA, Singh O and Rusia, U. Mother's iron status, breast milk iron and lactoferrin – Are they related? Eur J Clin Nutr 2006; 60:903-908.

10. Dewey KG, Cohen RJ, Rivera LL, and Brown KH. Effects of age of introduction of complementary foods on iron status of breast-fed infants in Honduras. Am J Clin Nutr 1998; 67:878-884.
11. Calvo EB Galindo AC and Aspres NB. Iron status in exclusively breast-fed infants. Pediatrics 1992; 90:375-379.
12. Owen GM, Garry PJ, Hooper EM, Gilbert BA and Pathak D. Iron nutriture of infants exclusively breastfed the first five months. J Pediatr 1981; 99:237-240.
13. McMillan JA, Landaw SA and Oski FA. Iron sufficiency in breastfed infants and availability of iron from human milk. Pediatrics 1976; 58:686-691.
14. Szreter SRS. 'The Official representation of Social Classes in Britain, the United States and France: The Professional Model and "Les Cadres"', Comparative Studies in Society and History, 1993. 35(2): 285-317.
15. O'Connor M. Anatomy and Physiology: Supplements for breastfed babies. 1998; [Assessed on Jun 10 2010]. Available from:http://www.breastfeedingbasics.org/cgi-bin/deliver.cgi/content/index.html.
16. King JC. Supplement: 11th International Symposium on Trace Element in Man and Animals. J Nutr 2003; 1429S-1430S.
17. Raj S, Faridi MMA, Rusia U and Singh O. A prospective study of iron status in exclusively breastfed term infants up to 6 months of age. Int Breastfeed J 2008; 3:3-8.
18. Feeley RM, Eitenmiller RR, Jones JB (Jr) and Barnhart H. Copper, Iron and Zinc contents of human milk at early stages of lactation. Am J Clin Nutr 1983; 37: 443-448.
19. News letter- Infact Canada: Breastfeeding and iron status. 1997; [Assessed on Jun 10 2010].Available at: http://www.infactcanada.ca/fall97.htm.
20. Lauber E, Reinhardt M. Studies on the quality of breast milk during 23 months of lactation in a rural community of the Ivory Coast. Am J Clin Nutr 1979; 32:1159–1173.