ORIGINAL ARTICLE

Hospital Based Study on Estimation of Breast Milk Sodium Levels in Mothers Delivering Term and Preterm Babies

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ABSTRACT

Introduction: Breastfeeding is crucial for maternal and infant health, offering complete nutrition. Sodium levels in breast milk naturally fluctuate during lactation, with a gradual decline in the first two weeks of a newborn's life, which is considered a normal physiological process. **Objectives:** This study aimed to determine if there is a difference in sodium levels in breast milk produced by mothers of preterm infants compared to those of full-term infants. Additionally, it sought to observe any postnatal changes in the sodium content of breast milk during the first week after birth for both groups of mothers. **Methodology:** The study was a retrospective, time-bound hospital-based investigation carried out at a tertiary care hospital in central Karnataka from January 2019 to September 2020. A total of 70 newborns were included. Breast milk samples were collected from the mothers daily from Day 1 to Day 7 postpartum, and sodium levels were analyzed. **Results:** On the seventh day postpartum, the mean sodium concentration in the breast milk of mothers of term infants was 19.9±2.8 mEq/L, while for mothers of preterm infants, it was 20.1±3 mEq/L. The difference in sodium concentrations between the two groups was not statistically significant. **Conclusion:** This study concludes that there was no statistically significant difference in sodium concentrations in the breast milk of mothers of preterm versus term infants. Additionally, the variation in sodium levels over the first week postpartum was also found to be insignificant.

KEY WORDS: Breast milk, Lactation, Term, Preterm, Sodium, Breastfeeding.

Introduction

Breastfeeding is crucial for the health of both infants and mothers, providing all the necessary nutrients. The volume of human milk consumed daily by a newborn varies based on the duration and frequency of feeding. Typically, newborns feed every 2-4 hours, consuming 10-70 ml per feed over 5-20 minutes.[1–3] Newborns often lose 5-10% of their birth weight within the first week, regaining it by the tenth day.[1,2] Various factors can disrupt normal breastfeeding patterns, potentially leading to complications like neonatal hypernatremic dehydration (NHD).[2]

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Human milk contains a consistent mineral composition, including calcium, sodium, chloride, potassium, phosphorus, magnesium, and trace elements like zinc, iron, copper, selenium, manganese, and iodide.[4] Sodium levels in breast milk change during lactation, generally decreasing, which may not meet the needs of premature newborns.[5] Research indicates that milk from mothers of premature infants has higher concentrations of proteins, lipids, fatty acids, vitamins, calcium, sodium, and energy in the first four weeks than milk from mothers of term infants. Therefore, milk from milk banks may be nutritionally inadequate for preterm infants.[6]

Sodium concentrations in breast milk normally decrease over the first two weeks of life.[7] Colostrum sodium levels in the first five days are around 22 ± 12 mmol/l, reducing to 13 ± 3 mmol/l in transitional milk from days 5 to 10 and 7 ± 2 mmol/l in mature

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milk after 15 days.[7] Inadequate breastfeeding in the first week can prevent this normal decline in sodium levels.[8] Some studies suggest that lower sodium intake in the first days of life may reduce hypernatremia risk.[9,10] This study aims to compare sodium content in breast milk from mothers of preterm and term babies and correlate these findings with existing literature and newborn weight changes in the first week of life. This study also examines the temporal variations in sodium concentrations in breast milk over the initial seven days postpartum for both study groups.

Materials and Methods

This retrospective analytical study was conducted in the Department of Pediatrics at a tertiary care hospital in Central Karnataka from January 2019 to September 2020. The study involved a total of 70 newborns who were delivered at this institution during the study period. The research included all healthy preterm and full-term infants. Babies admitted to the NICU were excluded from the study.

To evaluate the biochemical parameters, approximately 2 ml of breast milk was collected through manual expression beginning on day 1, from the same breast each morning at the same time, for seven days (covering the first week of the babies' lives). Additionally, the newborns' weights were measured daily at the same time for the first week of life.

Results

In this study, there were 55.7% female and 44.3% male newborns and among the seventy newborns, equal proportions of term and preterm neonates were included.

On assessing the gestational age at delivery of the newborns there were 25 newborns (35.7%) who were born during 36-36 weeks + 6 days of gestation, 23 (32.9%) were born during 38-38 weeks + 6 days of gestation, 8 (11.4%) were born during 35-35 weeks + 6 days of gestation, 6 (8.6%) were born during 37-37 weeks + 6 days of gestation, 5 (7.1%) were born during 39-39 weeks + 6 days of gestation, 2 (2.9%) during 34-34 weeks + 6 days of gestation and 1 (1.4%) was born at more than 40 weeks of gestation.

On comparing the mean number of feeds taken per day by each newborn, term newborns were found to have 10.7±0.8 feeds per day whereas preterm newborns had 10.5±0.9 feeds per day. The mean difference in the number of feeds taken by the term and preterm neonates in this study was found to be statistically insignificant with p value of 0.374.

When comparing the average sodium concentrations in breast milk between preterm and term mothers, it was found that preterm mothers had a mean sodium level of 19.5±3.0 mEq/L, while term mothers had a mean level of 19.8±2.9 mEq/L. The statistical analysis revealed no significant difference between the two groups, with a p-value of 0.678, indicating that the sodium levels in breast milk are similar regardless of whether the infant is preterm or term.

Mean breast milk sodium levels on different days were reported as 19.6±3.2 mEq/L on day 1 of life, 19.4±3.1 mEq/L on day 2 of life, 19.4±2.4 mEq/L on day 3 of life, 19.5±2.5 mEq/L on day 4 of life, 19.5±2.9 mEq/L on day 5 of life, 19.6±3.0 mEq/L on day 6 of life, 19.5±2.3 mEq/L on day 7 of life.

Table 1: Comparison of breast milk sodium levels in the first week of life among term & preterm neonates

Day of life	Breast milk sodium values		p value
	Term (mEq/L)	Preterm (mEq/L)	
Day 1 of life	19.7±3.9	19.4±2.8	0.702
Day 2 of life	19.8±3.1	19.5±2.8	0.716
Day 3 of life	19.8±2.9	19.5±3.0	0.690
Day 4 of life	20.1±2.8	19.8±3.2	0.681
Day 5 of life	19.6±2.9	19.4±3.0	0.747
Day 6 of life	19.7±3.0	19.6±2.9	0.753
Day 7 of life	19.9±2.8	20.1±3.0	0.719

Table 2: Comparison of weight in the first week of life of term & preterm neonates

Weight of neonates (kgs)	Term (kgs)	Preterm (kgs)	p value
Day 1 of life	2.9±0.8	2.6±0.4	0.051
Day 2 of life	2.9±0.6	2.5±0.5	0.003
Day 3 of life	2.8±0.4	2.4±0.8	0.010
Day 4 of life	2.8±0.5	2.4±0.5	0.001
Day 5 of life	2.7±0.4	2.3±0.2	0.000
Day 6 of life	2.7±0.7	2.3±0.5	0.004
Day 7 of life	2.7±0.4	2.3±0.3	0.000

Discussion

Breastfeeding undoubtedly provides the complete nutrition which is required for the healthy life of

infant as well as mother. The amount of human milk consumed daily by a newborn commonly depends on the duration and frequency of feeds. Normal neonatal feeding is done based on the demand basis commonly every 2-4 hours, with 10-70 mL per feed over a period of 5-20 minutes.

On comparing the average weight on the first week of life among term and preterm babies, preterm babies were found to have a mean weight on the first week of life of 2.5±0.3 kgs & the term babies had a mean weight on the first week of life of 2.77±0.5 kgs. The difference in average weight on the first week of life among the term and preterm neonates was found to be statistically significant with p value of 0.007, in this study.

The comparison of breast milk sodium levels between term and preterm mothers over the first week of life showed no statistically significant differences. On day 1, term mothers had a mean sodium level of 19.7 mEq/L, while preterm mothers had 19.4 mEq/L. On day 2, the levels were 19.8 mEq/L for term and 19.5 mEq/L for preterm mothers. By day 3, the sodium levels remained similar, at 19.8 mEq/L for term and 19.5 mEq/L for preterm. On day 4, term mothers had 20.1 mEq/L and preterm 19.8 mEq/L. On day 5, term mothers had a mean sodium level of 19.6 mEq/L compared to 19.4 mEq/L for preterm mothers. On day 6, both groups maintained close levels, with 19.7 mEq/L for term and 19.6 mEq/L for preterm. By day 7, the sodium levels for term mothers were 19.9 mEq/L, and preterm mothers had 20.1 mEq/L. Throughout the week, the sodium content in breast milk for both groups remained consistently close, with no significant statistical variation observed between term and preterm mothers at any point.

The comparison of neonatal weights based on maturity revealed significant differences between term and preterm neonates. On day 1, term neonates weighed 2.9±0.8 kgs, while preterm neonates weighed 2.6±0.4 kgs. On day 2, the weights were 2.9±0.6 kgs and 2.5±0.5 kgs, respectively. By day 3, term neonates weighed 2.8±0.4 kgs, and preterm neonates 2.4±0.8 kgs. On days 4 and 5, term neonates weighed 2.8±0.5 kgs and 2.7±0.4 kgs, while preterm neonates weighed 2.4±0.5 kgs and 2.3±0.2 kgs. On days 6 and 7, term neonates weighed 2.7 kgs, and preterm neonates 2.3 kgs (Table 2). The difference in all the mean weight values between term & preterm babies was found to be significant. Calcium, phosphorus & sodium were found to have no significant difference between the colostrum, transitional milk & mature milk in their study.[11]

Gross SJ study confirms previous report that protein, nitrogen & sodium are present in greater concentration in preterm as opposed to term milk.[12]

Gross SJ observed that breast milk from a mother with a preterm infant has a higher protein, energy & sodium content than a mother at term approximately more closely to the nutritional requirements of the preterm infant.[12]

The mean breast milk sodium was similar to the study done by Smith RG[13] and higher than as compared to studies done by Neville et al[14], Kulski et al[15] and Manganaro et al[16].

The negative correlation observed in the present study between mean sodium concentration, a constituent of colostrum, and newborn weight is in concordance with the findings of Krebs et al[17]& might reflect a compensation mechanism that contributes to faster weight gain in low weight infants.

In the present study, sodium levels did not exhibit significant differences between the groups, which can be attributed to multiple factors. Firstly, the small sample size and strict inclusion criteria might have limited the variability in sodium levels, thereby reducing the likelihood of detecting statistically significant differences. Additionally, the frequency of feeding patterns was relatively similar across all participants, which may have influenced sodium clearance. Frequent feeding has been shown to enhance sodium excretion through breast milk, leading to comparable sodium levels among the groups. Furthermore, maternal nutrition and hydration status were consistent across the study population. Since sodium levels are influenced by dietary intake and fluid balance, the uniformity in these factors likely contributed to the observed similarity in sodium concentrations. These findings suggest that external factors such as feeding frequency and maternal health status played a crucial role in maintaining stable sodium levels, despite potential physiological variations.

Limitations

This study was conducted over a short duration with a limited sample size. Additionally, strict inclusion criteria led to the exclusion of many NICU infants, which may have impacted the generalizability of the

Table 3: Comparison with other studies

Study	Sodium Levels (mEq/L)	Trend Over Time	Comparison with current study
Current study	- Term: 19.8 ± 2.9 mEq/L - Preterm: 19.5 ± 3.0 mEq/L	No significant variation over 7 days ($p = 0.678$)	
Smith RG[13]	Severe hypernatremia (197-198 mEq/L)	Sodium levels remained dangerously high until medical intervention	Extreme case of high sodium due to dehydration, unlike stable levels in current study.
Kulski JK, et al.[15]	Day 1: ~22 mEq/L - Day 5: ~13 mEq/L - Day 15: ~7 mEq/L	Gradual decline in sodium levels postpartum	Confirms normal decline in sodium, while current study reports no significant reduction over 7 days
Manganaro R, et al.[16]	Day 3 Mean: 23.05 ± 1.10 mEq/L	Higher sodium when lactation was suboptimal	Current study reports lower sodium levels compared to this study

findings. Future research should consider a larger sample size and broader inclusion criteria to enhance the applicability and robustness of the results.

Conclusion

Breastfeeding is crucial to infant health as it delivers essential nutrients and promotes growth and development. This study underscores the significance of monitoring sodium concentrations in breast milk, as these levels can impact infant nutrition. The findings of this study suggest that while breast milk sodium levels do not significantly vary between preterm and term mothers, there are notable differences in the weight of the infants during the initial week postpartum. This weight variation underscores the importance of monitoring and supporting the growth of preterm infants, who may require additional nutritional support to catch up with their term peers. Continued research and attention to these aspects can help enhance nutritional outcomes and overall well-being for preterm and term infants. This comprehensive approach to breastfeeding can ultimately contribute to better health trajectories and developmental progress in early life.

Disclosure

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- Conflict of Interest: Nil

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