Original Research Article

Comparative study on hypocalcemia and maternal serum calcium level in tertiary care hospital in Chennai

V. Ramya[1], Dunnuthala Sreenivasulu Reddy[2*], Shafath Ahmed[3]

[1]Post Graduate Resident, [2]Post Graduate Resident, [3]Professor
Department of Pediatrics, Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, India
[*]Corresponding author email: **drsreenivaspeds@gmail.com**

International Archives of Integrated Medicine, Vol. 5, Issue 11, November, 2018.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 15-10-2018 **Accepted on:** 20-10-2018
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: V. Ramya, Dunnuthala Sreenivasulu Reddy, Shafath Ahmed. Comparative study on hypocalcemia and maternal serum calcium level in tertiary care hospital in Chennai. IAIM, 2018; 5(11): 32-39.

Abstract

Background: Hypocalcemia occurs as a manifestation of nutritional deficiency of calcium and vitamin D. Deficiency of calcium in the diet has been identified as a leading cause of nutritional rickets. Infants less than 6 months are reliant on mothers for their daily calcium requirements. Calcium has a wide range of biological functions in both the ionized form as well as the bound complexes. It also plays an important role in skeletal mineralization.

Aim of the study: To rule out the prevalence of hypocalcemia in the mothers of the infants and to establish if there was an association between the infant and maternal serum calcium.

Materials and methods: Totally 50 children who were admitted in pediatric ward between Ages 1 Months to 6 months were assessed. A standard questionnaire was administered and venous blood samples collected from the mother-infant pairs. The samples were analyzed for calcium and albumin and corrected calcium levels calculated.

Results: A total of 93 mother-infant pairs were screened. 94(78.3%) of these gave samples which were analyzed. The mean age of the infants sampled was 3.5 months. The mean age of the mothers was 27.2 years with a standard deviation of 5.8 years. 78 (83%) infants were born at term and 16 infants (17%) were born preterm. 58 of 93 infants (62.4%) were exclusively breastfeeding whereas 35 of 93 infants (37.6%) were breastfeeding but not exclusive. Prevalence of hypocalcemia was 34% in the infants with 95% CI of 29.4-45%. Prevalence of hypocalcemia in the mothers of the infants was 39.4% with a 95% CI of 29.8. There was no statistically significant association between hypocalcemia in the mother and infants. OR 1.4 (95% CI 0.6-3.4) and P= 0.447.

Conclusion: There is a high prevalence of hypocalcemia in breastfeeding infants as well as in lactating women. However, there is no significant association between maternal and infant hypocalcemia. The recorded prevalence values .from the general population is quite high and were found to be due to dietary deficiency of both calcium and vitamin D. The values are much higher than those obtained during our study. The study population is ideal as it has taken into account the general population.

Key words

Hypocalcemia, Vitamin D, Nutritional Defects, Breast Feeding.

Introduction

Hypoparathyroidism leads to hypocalcemia by 2 mechanisms. First, the loss of PTH results in a failure of renal 1,25 dihydroxy vitamin D [1,25(OH)2D] production, with a resultant reduction in the ability to absorb dietary calcium. Second, PTH is a potent anticalcineurin agent in the distal convoluted tubule [1]. Therefore, its loss results in increases in renal calcium excretion Hypomagnesaemia with magnesium depletion causes impaired synthesis or secretion of parathyroid hormone. This impairment would account for the hypocalcemia observed in the hypomagnesemia state. Several factors may contribute to the hypocalcemia of acute renal failure. Among these are hyperphosphatemia, hypomagnesemia and magnesium depletion, hypoalbuminemia or alterations in calcium binding by serum proteins, failure of parathyroid gland function and skeletal resistance to the action of parathyroid hormone [2]. Ionized hypocalcemia has multifactorial causes in critically ill patients, especially with sepsis. This includes hypomagnesemia, elevated circulating cytokines leading to Hypoparathyroidism. Other causes include defective vitamin D absorption and activation [3]. There are several effects of hypocalcemia. Hypocalcemia is defined as a total serum calcium concentration of < 2.1 mmol/L in children, <2 mmol/L in term neonates and <1.75 mmol/L in preterm neonates. Measurement of ionized calcium is important to distinguish true hypocalcemia from a mere decrease in total serum calcium [4]. Total serum calcium can be affected by serum albumin levels as well as body pH. Calcium has a wide range of biological functions in both the ionized form as well as the bound complexes. It also plays an important role in skeletal mineralization. Calcium is an essential element that is only available to the body through dietary sources [5]. These include nutritional rickets which is associated with increased incidences of respiratory infection, of which pneumonia is included. Cardiac performance is demonstrably reduced by hypocalcemia, with decreased myocardial contractility and hence decreased left ventricular stroke work index, ejection fraction and cardiac index [6]. This can lead to reversible heart failure. Other cardiovascular effects include dilated cardiomyopathy and even cardiogenic shock. Acute hypocalcemia causes increased peripheral neuromuscular irritability. This can lead to mild symptoms such as paresthesia or muscle cramps to severe symptoms such as tetany and laryngospasms with stridor. Hypocalcemia is associated with various types of seizures including grand mal, petit mal and focal seizures [7].

Materials and methods

In 2017, Totally 50 Children who were admitted in pediatric ward between Ages 1 Months to 6 months were assessed. A standard questionnaire was administered and venous blood samples collected from the mother-infant pairs. The samples were analyzed for calcium and albumin and corrected calcium levels calculated. Infants aged 1 to 6 months born preterm and term and currently breastfeeding Children were excluded if they had chronic systemic inflammatory diseases, degenerative neurological diseases, and primary or acquired immunodeficiency diseases, were on corticoid therapy, no steroidal anti-

inflammatories or antibiotics for more than 24 hours, had suffered traumas or burns or were in postoperative care.

Laboratory assay

Serum ionized calcium was estimated by ion-exchange method (Electrolyte Analyzer, Roche, Mannheim, Germany). The reference range for ionized calcium was 4-5 mg/dL (infants 10 days-2 years) and 4.7-5.2 mg/dL (adult women). Total serum calcium was measured by the colorimetric method and inorganic phosphate and alkaline phosphatase were measured by the photometric method (Randox Lab Ltd, UK). The reference range for total calcium was 8.410.8 mg/dL (infants 10 days-2 years) and 8.8-10.2 mg/ dL (adult women). Serum albumin was measured using Bromo-cresol green (BCG) dye method. The normal range of inorganic phosphate was 3.0 to 7.0mg/dL (infants) and 2.7 to 4.5 mg/dL (adults). The upper limit of normal for ALP in infants was 1076 IU/L while that in non-pregnant women was 240 IU/L.

Statistical analysis

Data were analyzed using SPSS software version 22 and MedCalc software version 15. Data were interpreted using descriptive and inferential statistics. The Chi-square test was used to test the statistical significance of the relationship between two variables.

Results

Social and demographic characteristics were as per **Table – 1**. Corrected calcium levels were as per **Graph – 1**. The mean calcium corrected calcium for the infant was 2.21mmol/L with a standard deviation of 0.279 (**Graph – 2**).

Table - 1: Social and demographic characteristics.

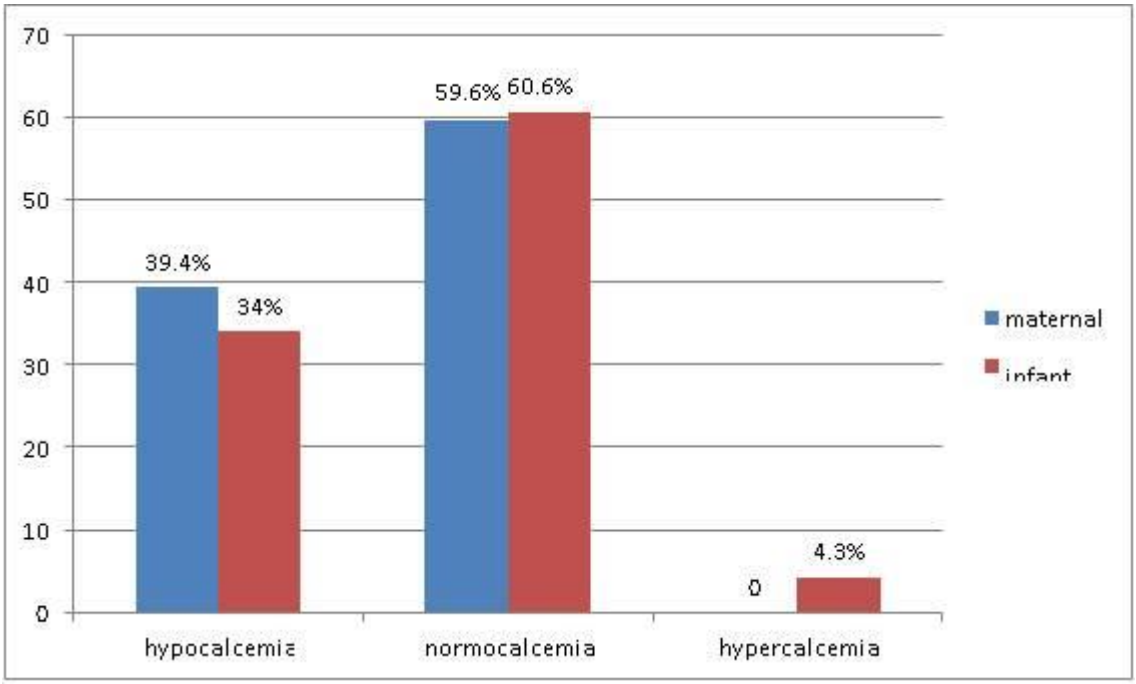
Characteristic	Frequency (%) or mean (SD)
Infant's age (months)	3.5 (1.8)
Gestation age of the child at birth Term	78 (83.0)
Preterm	16 (17.0)
Maternal age (years)	27.2 (5.8)
Level of maternal education	
None	2 (2.1)
Primary	37 (39.4)
Secondary	31 (33.0)
Tertiary	24 (25.5)
Maternal symptoms in preceding 3 months	
Numbness around the mouth	8 (8.5)
Twitching	0 (0.0)
Muscle spasms	5 (5.3)
Number of household occupants	4.1 (1.4)

The mean corrected calcium for the mother was 2.22 mmol/L with a standard deviation of 0.138 (**Graph – 3**).

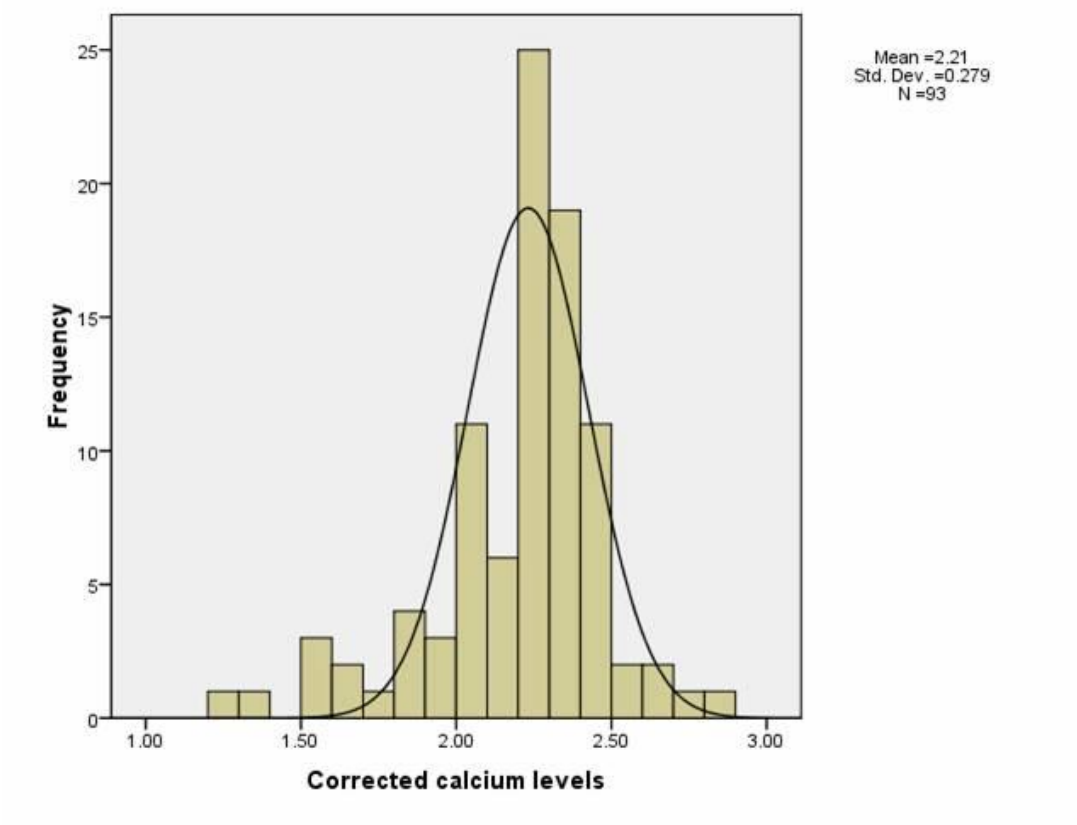
Of the infants recruited, 7 out of the 16 infants born preterm (44%) had hypocalcemia compared to 15 out of 78 of the infant's born term (32%). P = 0.37 Odds Ratio 1.65 with a 95% confidence interval 0.55-4.94. Of the 32 infants with hypocalcemia, 7 (21.9%) were born preterm and 25 (78.1%) were born term (**Graph – 4**).

The main feed of the infants recruited was exclusive breastfeeding. 58 out of 93 infants (62.4%) were on exclusive breastfeeding. 14 out of 93 infants (15.1 %) were on breast milk and formula and 20 out of 93 infants (21.5%) were already on complementary feeds.

Graph - 1: Corrected calcium levels.

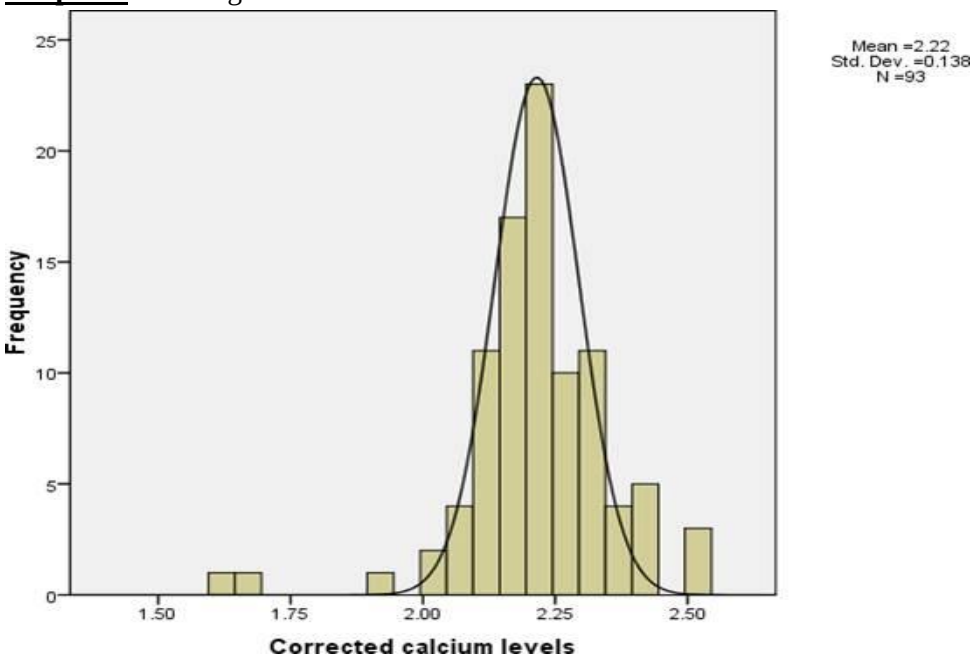


Graph - 2: Normogram of corrected calcium in infant.

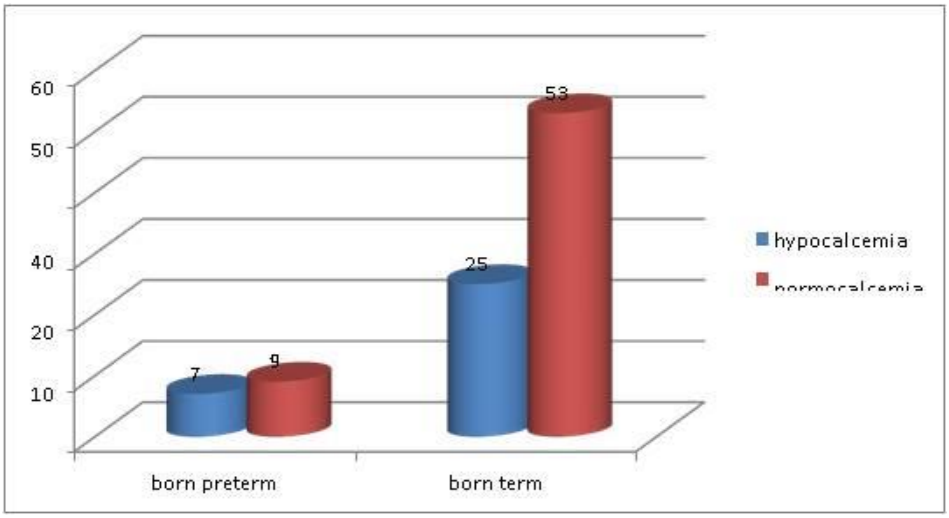


In the 24 hours dietary recall, only 50 (53.2%) of the mothers had taken milk in the 24 hours prior. Only 2 (2.1%) only had taken fish and 25 (26.6%) had taken eggs. Of the 93 mothers, 70 (74.5%) prepared their cereal by boiling before soaking and only 23(24.5%) soaked the beans before boiling. Milk intake by the mothers was such that 31.9% took milk daily, 33% took milk less than twice a month (**Graph – 5, 6**).

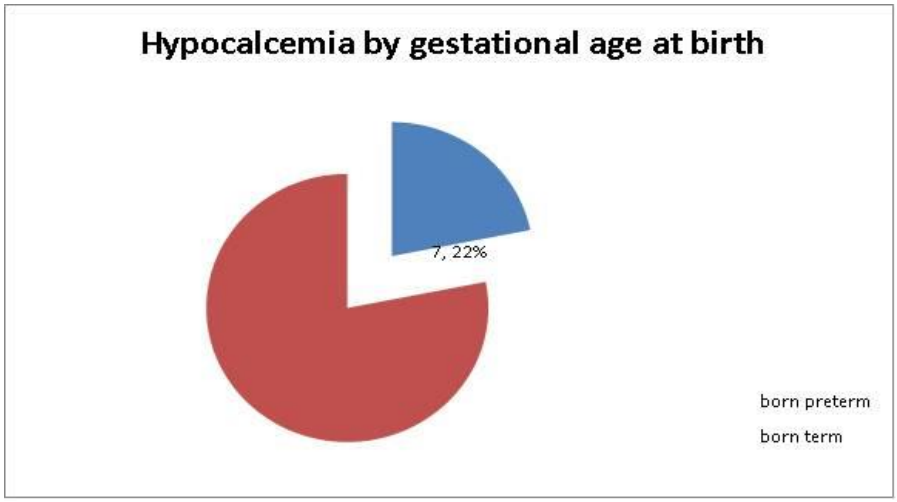
Graph - 3: Normogram of corrected calcium in mother.



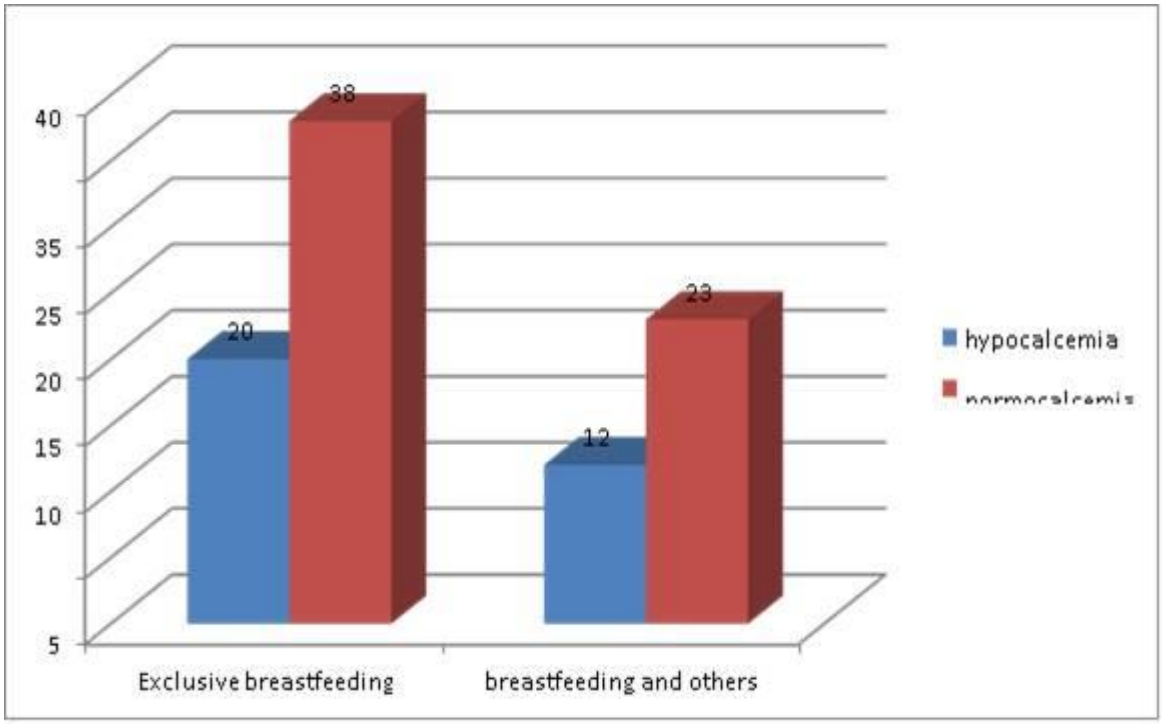
Graph - 4: Calcium levels of infants based on gestation age at birth.



Graph – 5: Hypocalcemia by gestational age at birth (N=32).



Graph - 6: Calcium levels based on infants feeds.



Discussion

In this study, we found a high prevalence of hypocalcemia using the laboratory ranges of 2.2-2.6 mmol/l. the prevalence in the infants was 34% with a 95% CI of 29.5- 45.5% with an equally high prevalence in the mothers of 39.4%. CI 29.8-50.5%.

The large confidence interval is attributed to using of a precision error of 8% which gave a smaller sample size but a larger confidence interval. As such the prevalence we found while not being very precise, gives us an idea of what the value is like [8]. Other factors that could contribute to high reported prevalence are the inclusion of preterm in the study sample. The infants born preterm contributed 17% of the study population. Preterms are a unique population prone to rickets of prematurity due to inadequate transfers of maternal vitamin D which mainly occurs in the 3rd trimester. Of the 32 children with hypocalcemia 7 of them (21.9%) were born preterm and 25(78.1%) were born term [9]. However, 7 of 16 born preterm (44%) compared to 25 of 78 born term (32%) had hypocalcemia which contributed to the high prevalence of hypocalcemia in the infants [10]. Inclusion of some sick infants at the pediatric emergency and pediatric outpatient clinic could also have contributed to the noted high prevalence. In as much as none of the children had a clinical diagnosis of rickets, it is likely that due to illness and derangement of hormonal balance, hypocalcemia was noted [10]. The recorded prevalence values from the general population are quite high and were found to be due to dietary deficiency of both calcium and vitamin D. The values are much higher than those obtained during our study. The study population is ideal as it has taken into account the general population. The infant feeding mode did not seem to affect calcium levels in the infants much. There was no significant difference in hypocalcemia between the infants who were exclusively breastfed and those who were not [11]. Although this presumption is prejudiced by the lack of power in the sample size of each. In the maternal dietary intake, we had a 24 hour dietary recall. Only 50 % of the mothers had taken a diet rich in calcium and only 2.1% had taken fish and 26.6% had taken eggs. This shown low dietary intake by the mothers of both calcium and vitamin D in the previous 24 hours [12]. Apart from that, the frequency of taking

eggs is relatively low. 10.6% of the sampled population took eggs only once a month and 43.6 took eggs at least once a week. As far as milk is concerned, most mothers made tea for the whole household and the majority used 1-2 packets of milk [13]. Each packet of milk is 500 mls and contains 212 mg of calcium/100ml. this leads to a low dietary intake of calcium. Also notable is 74.5% of the sampled mothers prepared their cereals without soaking. This means their meals had quite a high phytate content which leads to inhibition of calcium absorption [14]. Thus likely that there is a high prevalence of hypocalcemia in the mothers and infants due to lack of both calcium and vitamin D due to both dietary and physical habits of the mother. Despite these findings, in our study did not find any statistically significant association between hypocalcemia in the infant with any of the variables measured [15].

Conclusion

There is a high prevalence of hypocalcemia in breastfeeding infants and in lactating women. There is, however, no significant correlation between hypocalcemia in the mothers and in the breastfeeding infants. Advice to breastfeeding mothers to spend time in the sun as well as to ensure their infants spend time in the sun. Consider evaluating calcium and vitamin D supplementation in mothers and breastfeeding infants. In-depth studies to establish the local reasons for the high prevalence of hypocalcemia in the mothers and their infants.

Acknowledgments

The author would like to thank the whole team at the PICU and Paediatrics Department's Clinical and Experimental Research Centre of Sree Balaji Medical College and Research Center for helping with data collection and laboratory analyses.

References

1. Yogangi Malhotra. Pediatric hypocalcemia. Availabe from: https://emedicine.medscape.com/article/921844-overview
2. Munroe Peacock. Calcium Metabolism in Health Disease. Clin J m Soc Nephrol., 2010; 5: S23–S30.
3. Felix Bronner, et al. Nutritional aspects of calcium absorption. The Journal of Nutrition, 1999; 129: 9-12.
4. Frank Greer. Optimizing bone health and calcium intakes of infants, children, and adolescents. A clinical report. Pediatrics, 2006; 117: 578-585.
5. David Bushinky, et al. Calcium. Electrolyte content. The Lancet, 1998; 352: 305-311.
6. Bin Mohanna, et al. Prevalence of hypocalcemia in children in Yemen. Saudi Med J., 2005; 26: 457-459.
7. O.F Ogunkolo, et al. Prevalence of hypocalcemia in patients attending the Olabisi Onabanjo University Teaching Hospital, Sagamu, South Western Nigeria. Afr. J. Biotechnol., 2006; 5: 1675-1677.
8. Sunit C. Singi, et al. Hypocalcaemia in the Pediatric Intensive Care Unit. Journal of Tropical Pediatrics, 2003; 49: 298-301.
9. Kisangani JW. Prevalence and correlates of neonatal hypocalcemia in term neonates at Kenyata National Hospital. University of Nairobi research archive. [[cited 2011]]. Available from URL: http://erepository.uonbi.ac.ke/handle/11295/15748.
10. M. Horowitz, et al. Hypoparathyroidism: Is It Time for Replacement Therapy? J Clin Endocrinol Metab., 2008; 93(9): 3307–3309.
11. Se Moh Su. Pathogenesis of hypocalcemia in hypomagnesemia. Journal of clinical investigation, 1973; 52: 153-160.
12. S. Massey, et al. Divalent ion metabolism in patients with acute renal failure. Kidney International, 1974; 5: 437-445.
13. Zaloga G. Ionized hypocalcemia during sepsis. Critical Care Medicine, 2000; 28:

266- 268.

14. Nelson's textbook of pediatrics, 19th edition, Saunders, 2011.
15. Neumann C, Bwibo NO, et al. Intake of micronutrients. British Journal of Nutrition, 2006; 95: 379–390.