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Serum Total Calcium and Inorganic Phosphate are Higher in Exclusively Breast Fed Infants than Infants on Mixed Diet.

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Abstract:

Complementary feeding is gradually replacing traditional exclusive breast-feeding of infants in most parts of Nigeria. This study assessed comparatively, the serum total calcium and inorganic phosphate concentrations in exclusively breast fed infants and those on mixed diet.

Blood sample were collected from 200 infants aged between 3 and 6 months, made up of 100 exclusively breast fed infants (EBFI) and 100 infants on mixed diet (MDI). Serum total calcium and inorganic phosphate were determined spectrophotometrically. The EBFI has significantly higher serum levels of total calcium and inorganic phosphate compared to the MDI ($P < 0.01$, $P < 0.001$) respectively. There were statistically significant decreases in the concentrations of serum total calcium and inorganic phosphate with increase in the ages of both the EBFI and MDI ($P < 0.01$, $P < 0.05$) respectively. An age adjusted comparison of the serum total calcium and inorganic phosphate levels between the EBFI and MDI, showed significantly higher concentrations in the EBFI than the MDI ($P < 0.05$). Serum total calcium and inorganic phosphate may be higher in EBFI than MDI. This may result from hormonal changes in the mothers which ensure a sufficient supply of calcium and inorganic phosphate to the breast milk and the low bioavailability of calcium and phosphorous in complementary foods used in developing countries.

Key Words: Calcium, inorganic phosphate, infants, Nigeria.

Introduction:

The offspring of mammalian specie is naturally dependent on the mother's milk during the early part of life. The breast milk helps the baby to gradually develop immunological and physical dependence and also provide the baby's special nutritional requirement (1). Calcium and inorganic phosphate are macronutrients essential for the development of teeth and bone in infants. Their requirement in children are relatively higher than in adults because of the increasing demand for the growing skeletal size of the children and bones which are poorly calcified at birth (2,3). A direct relationship has been noted between daily dietary intake of calcium and phosphorous and their serum concentrations (4). It has also been noted that low calcium and chronic hypophosphataemia may lead to different pathological conditions like rickets (4,5).

Exclusive breast fed infants are infants given breast milk only as food during the first 6 months of life, while non-exclusive breast fed infants are,

in addition to breast milk, given other foods prepared from cereals, commercially prepared milk, etc. Jelliffe documented that exclusively breast-fed infants stand the chance of not suffering from any pathological condition in bone and internal organs (6). This study is designed to compare the serum levels of calcium and inorganic phosphate in Nigerian infants placed on exclusive breast feeding with those on mixed diet.

Materials and Methods:

Subjects: The study was approved by the management of the Saminaka Comprehensive Health Centre, Kaduna State, Nigeria. Informed consent was obtained from the parents of the infants used for this study. Two hundred (200) infants aged 3-6 months for post-natal care at the Health Centre between June 2002 to June 2003 were studied. Hundred (100) serum samples were from exclusively breast fed infants, while another 100 were from infants on mixed diet.

Collection of blood samples: Venous blood sample was collected from each baby using a 2ml sterile syringe and

needle. They were allowed to clot, after which serum samples were separated and analyzed for calcium and inorganic phosphate within 12 hours.

Methods: The cresolphthalein complexone method of Appleton et al and the Gomorri colorimetric method were used for determination of serum total calcium and inorganic phosphate respectively (7,4). Kits Supplied by Randox Laboratories, UK were employed.

Statistical analysis: The data collected were analyzed with student's t-test and analysis of variance (ANOVA). Values for $P < 0.05$ were considered statistically significant.

Results:

The mean serum total calcium and inorganic phosphate levels in the exclusively breast fed infants (EBFI) were significantly higher than in the mixed diet infants (MDI) ($P < 0.01$ and $P < 0.001$ respectively; Table 1).

There was statistically significant progressive decrease in the mean serum total calcium concentration with increase in the ages of infants ($P < 0.01$; Table 2). However, the decrease in the mean serum inorganic phosphate level with age was not progressive in both the EBFI and MDI ($P < 0.01$ and $P < 0.05$ respectively; Table 2) .

The male infants had significantly higher mean serum levels of total calcium and inorganic phosphate than the females ($P < 0.05$; Table 3).

Table 1 Serum total calcium and inorganic phosphate levels in the infants

	EBFI (n = 100)	MDI (n = 100)	P value
Total calcium (mmol/L)	2.40 + 0.44	2.20+ 0.27	< 0.01
Inorganic phosphate (mmol/L)	1.45+ 0.19	1.30 +0.19	< 0.001

Key: Values are mean + SD, SD = Standard deviation, EBFI = Exclusive breast fed Infants, MDI = Mixed diet infants, n = Number of subjects.

Table 2: Serum total calcium and inorganic phosphate levels in relation to the ages of the infants Age distribution (months)

Parameter		3-4	4-5	5-6	P value
n:	EBFI	72	20	8	
	MDI	10	52	38	
Total Calcium: (mmol/L)	EBFI	2.64+ 0.36	2.31+ 0.29	2.02+ 0.33	< 0.01
	MDI	2.21+ 0.34	1.99+0.25	1.64+0.27	< 0.01
	P value	< 0.01	< 0.01	< 0.05	
Inorganic phosphate: (mmol/L)	EBFI	1.48+ 0.27	1.21+ 0.12	1.34+ 0.17	< 0.01
	MDI	1.26+ 0.24	1.24+ 0.16	1.39+ 0.23	< 0.05
	P value	< 0.05	> 0.05	> 0.05	

Values are mean + SD.

Table 3: Serum total calcium and inorganic phosphate levels of infants in relation sex.

		Male (n = 72)	Female (n = 128)	P value
Total calcium (mmol/L)	EBFI	2.43 + 0.04	2.39+ 0.12	< 0.05
	MDI	2.26+ 0.29	2.13 +0.34	< 0.05
Inorganic phosphate (mmol/L)	EBFI	1.46+ 0.23	1.27 + 0.14	<0.05
	MDI	1.30+0.16	1.25+ 0.11	<0.05

Values are mean + SD

Discussion:

Serum calcium and inorganic phosphate concentrations may vary depending on the physiological, biochemical and pathological variations

in humans (8). Data from this present study indicate that there were significantly higher concentrations of total calcium and inorganic phosphate in exclusive breast fed infants (EBFI) than

those on mixed diet (MDI). This may be as a result of the hormonal changes in the mother which ensure a sufficient supply of calcium and inorganic phosphate through the breast milk to the infants (9). It was also reported that complementary foods offered before 6 months of age tend to displace breast milk (10). Further more, the complementary food used in most developing countries do not meet the required bioavailability for calcium (50-75%) and phosphorous (75-100%) (11,12).

An age and sex adjusted study of the infants show that the males have significantly higher serum total calcium and inorganic phosphate concentrations than the females. This may be due to the higher activity including feeding associated with male babies. Our observations in the levels of serum calcium in relation to sex differed with previous reports (13,14). However, the relationship between variations in sex with serum inorganic phosphate is in consonance with the observations of Xu and colleagues (14). Significant decreases in serum total calcium and

slightly in inorganic phosphate levels with increase in age of both the EBF and MDI were observed in this study, with the decrease being more significant in the MDI than the EBF. This may result from the increasing demand for calcium and inorganic phosphate for the development of bone and teeth in the babies with increase in age. Furthermore, an age adjusted study of the serum total calcium levels show that there were significantly higher concentrations of calcium in the EBF than the MDI. This may be associated with the higher availability of calcium and inorganic phosphate in breast milk than in the complementary food used in developing countries (9,11).

From this study, it could be concluded that in developing communities, serum calcium and inorganic phosphate concentrations are significantly higher in exclusively breast fed babies than in those on mixed diet. Hence, this study calls for an exclusive breast feeding of infants aged less than 6 months in developing economies to ensure adequate growth. There is the need also for a detailed study of the nutrient

adequacy and improvement possibilities for complementary foods for infant feeding in our local communities.

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