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ORIGINAL STUDY

Effect of Exclusive Bottle Feeding on Infant's Serum Calcium and Serum Vitamin D3 and its Comparison with other types of Feeding in Diyala Governorate, Iraq

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Abstract

Background: The mixed feeding means that the infant gets bottle milk and breast milk. Bottle feeding serves as incomplete nutritional source for the first six months of infant's life because bottle feeding not contains all essential nutrients that necessary for the physiological growth and development of infants.

Objectives: The aim of this research is to determine impact of breastfeeding feeding other than formula feeding,, or a mixed feeding ,on serum calcium and blood vitamin D3 levels in infants.

Materials and Methods: Fifty patients were enrolled in this study. We collected the sample from the infants and children (first 2 years of life) that attended Al-Batool Teaching Hospital in the period from October 2022 to April 2023.

Results: Fifty patients were enrolled in this study. They were 27 males and 23 females with age ranged from less than one month to two years. There was significant association between type of feeding and risk of hypocalcaemia and decrease level of vitamin D3 in blood. The infants with exclusive bottle feeding more associated with hypocalcaemia and decrease level of vitamin D3 in blood than other type of feeding.

Conclusion: We concluded that there is a strong association between exclusive bottle feeding and risk of decrease serum calcium and level of vitamin D3. The infants with exclusive artificial feeding are more prone to hypocalcaemia and vit D3 deficiency.

Keywords: Calcium, Serum vitamin D3, Type of feeding

1. Introduction

The infants receive only formula milk and no other foods when exclusively bottle fed. Bottle feeding supplies a portion of an infant's nutrients for the first six months of life. The use of formula feed fails to give the essential vitamins and minerals that are required for an infant's physiological growth and development [1, 2]. Because they contain necessary proteins and fatty acids, nutrients that are essential for children's development of cognition and infant brain growth [1, 2]. Compared to bottle milks, breast milk provides

better nutritional and health benefits [3]. By breast-feeding exclusively for the first four months of life and longer, it is possible to reduce the risk of disorders such atopic dermatitis, asthma, and maybe allergic rhinitis in children up to two years old [4]. Infants are protected from diarrhea and acute respiratory illnesses during their first six months of life by exclusively or primarily breastfeeding [5]. The purpose of this study was to ascertain the effects of exclusive bottle feeding on infants' serum calcium and serum vitamin D3, compare it to other forms of feeding

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such as exclusively breastfeeding, formula feeding, or mixed feeding.

2. Materials and methods

2.1. Study design and patients

This study was done in Iraq's Diyala Governorate. In this study, fifty healthy, full-term infants were included. All infants had regularly attend Al-Battol Teaching Hospital for medical care and follow-up. Mothers of infants were questioned about if they only breastfed, only bottle-fed, or mixed-fed their infants during their initial 24 months of life. Infants who are exclusively breastfed only receive breast milk, infants who are solely bottle-fed only receive bottle milk, not breast milk, and infants who are mixed-fed receive breast milk, bottle milk and added food. Data collection techniques between October 2022 and April 2023, healthy infants were registered. At the time of child's visit to the hospital, the baby's serum calcium and vitamin D3 values were measured. The serum vitamin D3 levels of infants were evaluated using a 25 OH Quantitative Vitamin D Rapid Test utilizes the principle of Immunochromatography.

2.2. Statistical analysis

For collection and statistical analysis, the Statistical Analysis System- SAS (2018) program was used to detect the effect of difference factors in study parameters. T-test and Least significant difference -LSD test (Analysis of Variation-ANOVA) was used to significant compare between means. Chi-square test was used to significant compare between percentage (0.05 and 0.01 probability) in this study.

2.3. Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee (College of Medicine/University of Diyala ethical committee) according to the document number 876 (including the number and the date in 1/9/2022) to get this approval.

3. Results

Fifty patients were enrolled in this study. They were 27 male and 23 females with age ranged from less than one month to two years. There was significant association between type of feeding and risk of

hypocalcaemia and decrease level of vitamin D3 in blood. The first group consist of (19) patients with breast feeding of both gender, 11 were males and 8 were females. The second group consist of (23) patients with bottle feeding of both gender, 11 were males and 12 were females. The third group consist of (8) patients with mixed feeding of both gender, 5 were males and 3 were females (Table 1).

According to age and gender distribution, the first group consist of (19) patients with breast feeding of both gender, 11 were males and 8 were females. The second group consist of (23) patients with bottle feeding of both gender, 11 were males and 12 were females. The third group consist of (8) patients with mixed feeding of both gender, 5 were males and 3 were females Tables 2 and 3.

The (S. Ca) showed increase level in breast feeding group with mean (9.21 mg/dl) as compared to bottle feeding with mean (8.93 mg/dl) and mixed feeding with mean (8.97 mg/dl). On the other hand, bottle feeding group shows a decreased level of (S. Ca) as compared to breast feeding and mixed feeding as Fig. 1.

Serum vitamin D3 (S. vit D3): As shows in Table 4, level of (S. vit D3) in breast feeding group with mean (37.77 ng/ml) was increase as compared with bottle feeding with mean (27.87 ng/ml) and mixed feeding groups mean (23.95 ng/ml). In contrast, the mixed feeding group has a lower level of (S. vit D3) than the breast and bottle feeding groups, as seen in (Table 5).

4. Discussion

The current study examined the effects of various infant feeding practices, including exclusive formula feeding (EFF), mixed feeding, and exclusive breast feeding (EBF), on infants' serum calcium and vitamin D amounts through their initial two years in the Diyala Governorate. Participation rates for EBF, mixed feeding, and EFF were 38%, 16%, and 46%, respectively. These rates roughly correspond to research done in Bagdad. The rates of EBF, mixed feeding, and EFF had been found to be 48%, 41%, and 11%, respectively [6].

The serum calcium showed increase level in breast feeding group compared to bottle feeding and mixed feeding were also reported by Martin and Dror DK [7, 8]. On the other hand, bottle feeding group shows a decreased level of serum calcium as compared to breast feeding and mixed feeding were also reported by Challa *et al.* [9]. However, some other researchers said the study's findings showed greater calcium absorption from breast milk than the mixed-fed infants [10].

Table 1. Age and gender distribution of the samples.

Age in months	Male No.	%	Female No.	%	Total No.	%	P-value
<1 months	4	8%	5	10%	9	18%	0.902
1-6 months	10	20%	4	8%	14	28%	0.194
7-12 months	6	12%	5	10%	11	22%	0.897
1-2 years	7	14%	9	18%	16	32%	0.673
Total	27	54%	23	46%	50	100%	0.349
P-value	0.0647		0.155		0.0378		—

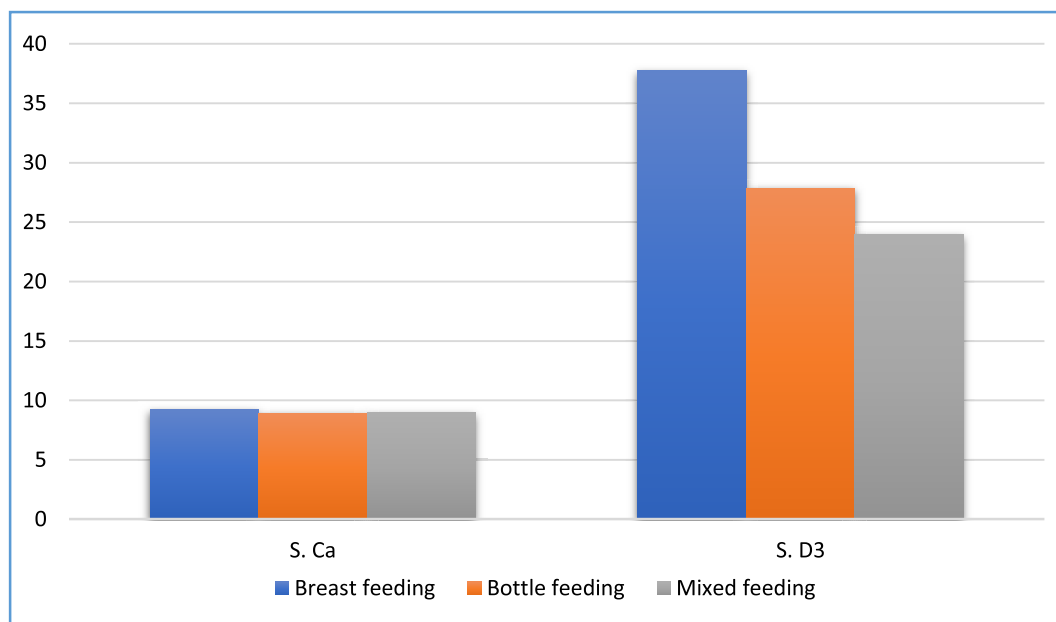


Fig. 1. Bar – charts of the studied mean's values of S. calcium (mg/dl) and S.vit.D3 (ng/ml) in different samples (Breast feeding, Bottle feeding and Mixed feeding).

Table 2. Descriptive statistics (Mean $\pm$ SD) of the studied (S. calcium) in different samples (breast feeding, bottle feeding, and mixed feeding).

Groups	S. Ca (mg/ dl)	LSD value (P-value)
Breast feeding		
No.	19	
Mean	9.21	
Std. Deviation	1.033	
Bottle feeding		1.872 (0.259)
No.	23	
Mean	8.93	
Std. Deviation	0.978	
Mixed feeding		
No.	8	
Mean	8.97	
Std. Deviation	0.749	

(S. Ca): Serum calcium

Several studies were compatible with this study that children's seizures are typically caused by hypocalcaemia. Compared to exclusively breastfed newborns, artificially fed infants are more likely to develop hypocalcaemia. Lack of breastfeeding and improper artificial feeding are two prominent causes of hypocalcaemia in infants may be to impropri-

ated milk preparation. Recent reports in the UK indicate an increased incidence of hypocalcaemia and vitamin D insufficiency in children and newborns without radiological signs of rickets. Recent data show that hypocalcaemia and vitamin D deficiency are becoming more common in kids and babies who don't have radiological symptoms of rickets [11]. If the serum 25OH vitamin D3 level was less than 10 ng/mL, a vitamin D deficit was determined. The serum vitamin D3 level in the breast-feeding group was higher than that in the bottle-feeding and mixed feeding groups [12]. According to Chandy DD et al., high-dose vitamin D was effective in raising 25(OH)D levels in breastfeeding moms to their highest levels without any evidence of harm. These other researchers disagree with this study. During the first four months, the breast milk's vitamin D3 and calcium levels declined independently of the mother's vitamin D intake and grade. The mother's vitamin D condition improved, while the baby's calcium level remained normal [13]. The exclusively bottle-fed group exhibits a lower level of (S. vitamin D3), which is contrary to some other researchers

Table 3. Descriptive statistics (Mean $\pm$ SD) with std. error of the studied (S. calcium) in different samples (breast feeding, bottle feeding and mixed feeding) distributed in gender.

Groups	Gender	No.	Mean (mg/dl)	Stander Deviation	T-test (P-value)
Breast feeding					
S. Ca	Male	11	8.81	1.089	1.055 (0.261)
	Female	8	9.75	0.690	
Bottle feeding					
S. Ca	Male	11	9	1.136	0.892 (0.477)
	Female	12	8.85	0.854	
Mixed feeding					
S Ca	Male	5	9.28	0.697	0.837 (0.307)
	Female	3	8.46	0.611	

S. calcium level in breast feeding infant (male 8.81 mg/dl, female 9.75 mg/dl) highly significant.

Table 4. Descriptive statistics (Mean $\pm$ SD) of the studied (S. Vitamin D3) in different samples (breast feeding, bottle feeding and mixed feeding).

Groups	S. D3 (ng/ml)	LSD value (P-value)
Breast feeding		
No.	19	
Mean	37.77	
Std. Deviation	15.04	
Bottle feeding		
No.	23	
Mean	27.87	20.037
Std. Deviation	13.14	(0.261)
Mixed feeding		
No.	8	
Mean	23.95	
Std. Deviation	12.87	

Table 5. Descriptive statistics (Mean $\pm$ SD) with std. error of the studied (S. Vitamin D3) in different samples (breast feeding, bottle feeding and mixed feeding) distributed in Gender.

Groups	Gender	No.	Mean vit. D3 ng/ml	Stander Deviation vit.D3	T-test (P-value)
Breast feeding					
S. Vit D3	Male	11	31.6	12.87	17.32 (0.081)
	Female	8	46.27	14.25	
Bottle feeding					
S. Vit D3	Male	11	33.49	16.15	14.52 (0.266)
	Female	12	22.72	6.91	
Mixed feeding					
S. Vit D3	Male	5	28.98	13.30	16.02 (0.194)
	Female	3	15.59	7.64	

S. Vitamin D3 in breast feeding infant with mean (male 31.6 ng/ml, female 46.27 ng/ml) highly significant.

who concur with this study, like Choi *et al.* [14]. If a newborn is formula-fed, it cannot be assumed that the infant is receiving an adequate amount of vitamin D. The amount of formula you consume each day should be taken into account [14]. According to some other researchers who disagree with this study, including Hollis, Wagner *et al.* [16]. Healthy lactating women's milk typically isn't considered sufficient to prevent vitamin D deficiency in infants who are exclusively breastfed if sunlight exposure is insufficient [15]. Recent studies have also demonstrated that healthy lactating mothers who take vitamin D supplements of 4000 IU per day and 6400 IU per day can

increase the vitamin D concentration in milk to a level that provides an adequate amount of vitamin D for the breastfed infant, even though neither the mother nor the child received enough sunlight exposure [15, 16].

However, other researchers, such as Wagner and Greer, were incompatible with this study, since the majority of studies on the vitamin D concentration in human milk were published in North America and Europe more than two decades ago. The biological activity values of the vitamin D metabolite (25(OH)D) and the vitamin D in human milk were used to communicate the vitamin D content in the

milk as anti-rachitic activity (ARA) [10, 15]. In average, the mean ARA of human milk in healthy nursing mothers ranges from 10 to 80 IU/L with or without supplementing the existing recommended vitamin D intake. If human milk is the only source of vitamin D, these data point to poor vitamin D consumption in breast-fed infants compared to bottle-fed infants with the recommended intake of 400 IU/d of vitamin D [17, 18]. The main limitations for the study was the small size of the sample, and that we collected the data from only Al-Batool Teaching Hospital, Diyala Governorate, Iraq.

5. Conclusion

According to study results it is concluded there is a strong association between exclusive bottle feeding and risk of decrease serum calcium and level of vitamin D3. The infants with exclusive artificial feeding are more prone to hypocalcaemia & vit D3 deficiency.

Recommendation

We recommend to encouraging the mothers on exclusive breast feeding and avoiding the exclusive bottle feeding.

Ethical consideration

This study was done according to ethical standards for research involving the participants. All participants provided full information consent prior to participation. The Written informed consent was obtained from each participant that involved in research.

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Authors' contributions

Hailah Othman Habeeb: Selection of the title, writing the paper, method arrangement, data collection and analysis. Dr. Saif Hakeem Tofiq: Data collection, review and editing of the paper, statistical analysis and review of the result. Haider Jwad Dawod: contribution to statistical analysis and the methodology design, and final review of the paper.

Conflict of interest

Nil.

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