Research Article

Effect of Feeding Pattern on the Stage of Primary Dentition Eruption in Relation to Growth Parameters

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Abstract: Background: Feeding is a complicated process that involves the coordination of cardiovascular, respiratory, gastrointestinal (GI), and oropharyngeal mechanisms, with support from the musculoskeletal and craniofacial systems. The practice of feeding could be correlated with eruption stage and nutritional status in infants. Aim of the study: This study aimed to assess the relation of feeding patterns to a selected oral variable (stage of the eruption of primary teeth) and growth parameters among clinically healthy infants. Subjects and Methods: A cross-sectional comparative study on a sample of (300) infants aged between 6 and 18 months was performed in Karbala City, Iraq. The feeding pattern was investigated using an information sheet answered by parents. The stage of dental emergence was evaluated through intraoral examination. Growth parameters (height, weight, head circumference) were analyzed. Results: Bottle-fed infants had higher total tooth eruption incidence and nutritional status than the other feeding groups, but the difference was not statistically significant. Conclusion: Bottle-fed infants had the highest mean of erupted primary teeth and nutritional status.

Keywords: feeding, nutrition, eruption, growth parameters

Introduction

Feeding practices are crucial for healthy growth and development because they set the stage for the future development of an individual [1]. Mental and social development during infancy is closely linked to a child's motor development, which is often attained through appropriate nutrition and feeding practices during pregnancy and the early years of life [2,3,4].

Nursing is the best orthopedic intervention to achieve a mature individual's harmonic growth, which is essential for the proper growth of the complete craniofacial complex throughout the most critical period of an infant's life [5].

The primary tooth begins to erupt into the oral cavity after the sixth month of life through a complex and highly controlled process [6]. Breastfeeding is the best stimulus for the physiological development of the components of orofacial skeletal and muscular complexes [7,8]. Ahmadi–Motamayel et al. [15] found that infants fed with formula milk had earlier tooth eruption than those breastfed. Sahin et al. [17] compared the teething time of infants given formula milk with those breastfed and reported a positive association between the timing of tooth eruption and feeding patterns; formula-fed infants were more likely not to have a tooth by the sixth and ninth months of age. Folayan et al. [19] and Oziegbe et al. [20] failed to establish a link between eruption timing and breastfeeding duration. Viggiano et al. [21] found that breastfeeding is the ideal stimulus for the physiological development of the muscular and skeletal components of the orofacial complex. Clinicians used anthropometric measurements and assessment of typical growth patterns as a gold standard for evaluating a child's health. Height, weight, and head circumference are the three most often used metrics for assessing a child's growth. Accurate and serial anthropometric measures can be used to detect social, dietary, or medical issues in children. Further evaluation is warranted for abnormal anthropometric measurements, especially in the pediatric population [9,10,11].

Research question Is there a relation between feeding pattern with the stage of primary tooth eruption and growth parameters?

Null hypotheses: Feeding pattern is not related to primary tooth eruption and growth parameters.

Aim of study:

This study was conducted among infants aged 6–18 months to assess the following:

- Feeding pattern
- Relation of growth parameters to the feeding pattern
- Eruption stage of primary teeth in relation to the feeding pattern and growth parameters.

Materials and Methods

The study was approved by the Research Ethics Committee of the College of Dentistry, University of Baghdad in Iraq (approval number: 557322). Karbala Health Department/Center Sector in Karbala City approved the conduct of the study in the Primary Health Care Center (PHCC) (Immunization Unit) without impediments. The study complied with the Declaration of Helsinki. The parents and/or caretakers of every infant were informed of the design, aims, and possible benefits of the study as well as their right to quit whenever they desire. They signed an informed consent form before their participation. A total of 300 medically fit and healthy full-term infants of both genders aged 6–18 months were included in the study. Preterm infants with low birth weight (birth weight lower than 2,500 g) and those with inadequate or poor follow-up, poor compliance, congenital disorders, history of hospitalization, birth complications, detectable genetic disorders (infant and mother), major congenital anomalies, and admission to the newborn intensive care unit (NICU) were excluded.

Assessment of feeding pattern

An information sheet was utilized to collect demographic data, including date of birth, gender, number of siblings and rank in the family. Age of the parents at the time of birth, type of delivery (normal or

caesarian section), twining (yes/no; if yes, identical/not identical), feeding patterns (breast feeding/mixed feeding/bottle feeding), and time when the baby started eating semisolid and solid food were recorded after interviewing the parents. The birth weight of infants was obtained from the medical records to identify those who will be included. Parents answered the information sheets.

Dental examination

A dental examination was performed using a disposable dental check-up kit (China) under daylight. The study was conducted between January and April 2022. The eruption stage of dentition was determined by grading each tooth according to the method of Swami et al. [12]. The stages were as follows:

- Stage 0: The tooth is not visible in the oral cavity.
- Stage 1: At least one cusp is visible in the oral cavity.
- Stage 2: The entire occlusal surface/mesiodistal width of the tooth is visible.
- Stage 3: The tooth is in occlusion or at the occlusal level if the antagonistic tooth has not fully erupted.

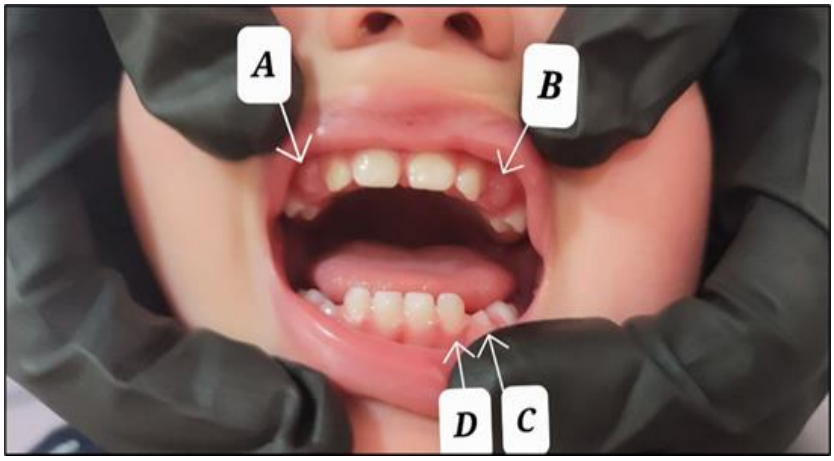

Figure 2: Stages of Tooth Eruption: (A) Stage 0, (B) Stage 1, (C) Stage 2, and (D) Stage 3.

Anthropometric Measurements

Standardized techniques and equipment were used to weigh children and measure their height and head circumference.

➢ Each child was weighed to the nearest 0.1 kg by a digital weighing scale (Kinlee/China). During weighing, the child wore light clothes, had no head covers and shoes, and did not touch anything.

➢ Height was measured using a horizontal scale (China) while the infant was lying down (recumbent position).

➢ Head circumference was measured using a flexible 1M measurement tape (China) placed through the supraorbital ridge to the occiput.

Infants were categorized by their BMI for age. Infant visits and birthday dates were recorded as day/month/year. Height and head circumference were recorded in centimeters and kilograms, respectively. Data were transferred to the World Health Organization calculator (WHO ANTHRO v3.2.2, Geneva, Switzerland). Z score was calculated using W/H, H/age, W/age, and head circumference/age and classified as follows: <5% (underweight), 5%–85% (normal), 85%–95% (at risk of overweight), and >95% (overweight or obese). [13]

Statistical Analysis

Statistical Package for Social Science (SPSS version 21) was used to describe, analyze, and present data. Statistical analyses were categorized into two classes:

Descriptive statistics: mean, standard error (SE), frequency and percentage

Inferential statistics:

A. Pearson correlation is a parametric test used to measure the linear correlation between two quantitative variables.

B. Levene's test is used to test the homogeneity of variance among groups.

C. Pearson Chi-square is used to test the association of distribution between two qualitative variables if the expected count of the cells is below 5 (less than 20%).

D. One-way ANOVA is used to test the difference between K independent groups through Hochberg GT2 (equal variance and unequal sample size).

The probability of error (P-value) was established at 5%.

Results

This cross-sectional comparative study consisted of 300 infants aged 6 to 18 months, with a median age of 10 months; infants younger than 10 months were the most common. Among the infants, 204 were breastfed (68%), 31 were bottle fed (10.33%), and 65 were mixed fed (21.67%). Most of the infants were males, delivered naturally, and were either first or second child. In addition, most of the infants started to eat at the age of 6 months. Breast-fed infants recorded a higher percentage in terms of gender, type of delivery, child's rank, and age of eating than the other groups, but the association was not significant (Table 1).

In Table 2, infants were categorized based on existing feeding practices and the mean score of tooth eruption. The mean scores of total tooth eruption and eruption at stages 1 and 2 were higher among bottle-fed infants, followed by those breast fed and mixed fed. The mean score of tooth eruption at stage 3 was higher in breast-fed infants than in the other groups. The differences were not significant.

Table 1: Distribution of Feeding Pattern by Age and Gender

Vars.		Feeding pattern								Total	
		Breast		Bottle		Mixed					
		N.	%	N.	%	N.	%	Chi square	P value	N.	%
Child's age (m)	<=10	113	55.39	17	54.84	40	61.54	0.805	0.669	170	56.67
	10+	91	44.61	14	45.16	25	38.46			130	43.33
Gender	M	115	56.37	13	41.94	39	60.00	2.904	0.234	167	55.67
	F	89	43.63	18	58.06	26	40.00			133	44.33
delivery	Natural	115	56.37	11	35.48	27	41.54	5.456	0.051	153	51.00
	Caesarian	89	43.63	20	64.52	38	58.46			147	49.00
Child's rank	1st and 2nd	109	53.43	18	58.06	45	69.23	5.038	0.081	172	57.33
	3+	95	46.57	13	41.94	20	30.77			128	42.67
Age of eating (m)	2-5	60	29.41	10	32.26	15	23.08	4.666	0.323	85	28.33
	6	113	55.39	13	41.94	35	53.85			161	53.67
	6.1	31	15.20	8	25.81	15	23.08			54	18.00
	Total	204	68	31	10.33	65	21.67			300	100.00

Table 2: Descriptive and Statistical Test of Tooth Eruption Among Feeding Patterns.

Vars.	Breast		Bottle		Mixed		F	P value
	Mean	±SE	Mean	±SE	Mean	±SE		
S1	.814	.092	.968	.234	.723	.157	0.375	0.688
S2	2.054	.142	2.387	.414	1.954	.299	0.441	0.644
S3	1.804	.213	1.677	.565	1.538	.325	0.203	0.816
Total tooth eruption	4.672	.334	5.032	.847	4.215	.607	0.358	0.699

S= stage of tooth eruption

Table 3 shows that the mean Z score of nutritional status was higher among bottle-fed infants, followed by breast-fed and finally mixed-fed infants. However, mixed-fed infants had higher Z score for height/age, followed by breast-fed infants and then bottle-fed infants. All the differences, except for weight/length, were not significant.

Table 3: Descriptive and Statistical Test of Nutritional Status among Feeding Patterns.

Vars.	Breast		Bottle		Mixed				Total	
	Mean	±SE	Mean	±SE	Mean	±SE	F	P value	Mean	±SE
Weight\length	0.530	0.068	0.944	0.203	0.342	0.114	3.978	0.020*	0.532	0.057
Weight\age	0.109	0.065	0.368	0.203	0.051	0.136	1.157	0.316	0.123	0.057
Height\age	-0.523	0.085	-0.590	0.223	-0.265	0.200	1.079	0.341	-0.474	0.076
HC\age	-0.095	0.085	-0.088	0.265	-0.352	0.138	1.133	0.324	-0.150	0.071

*=significant; HC=head circumference

Table 4 shows the correlation between nutritional status and tooth eruption. Positive weak non-significant correlations were found between nutritional status and tooth eruption stage. Weak and non-significant correlations were found between weight and height and total tooth eruption in breast- and bottle-fed groups. In the mixed-fed group, positive weak significant correlations were found in weight and stage 1 and height and head circumference and stage 2.

Table 4: Correlation between Nutritional Status and Tooth Eruption

Feeding pattern		Weight		Height		Head Circumference	
		r	p	R	P	r	p
Breast	**Total tooth eruption**	-0.024	0.630	0.080	0.233	0.074	0.294
	S1	0.073	0.233	0.127	0.078	0.034	0.632
	S2	-0.081	0.390	0.028	0.690	0.137	0.051
	S3	-0.058	0.500	0.060	0.394	0.010	0.884
Bottle	**Total tooth eruption**	0.090	0.621	0.225	0.223	0.265	0.149
	S1	-0.015	0.885	0.016	0.942	0.006	0.976
	S2	0.150	0.417	0.250	0.178	0.317	0.082
	S3	0.050	0.880	0.151	0.417	0.163	0.380
Mixed	**Total tooth eruption**	0.267	0.040*	0.335	0.005**	0.244	0.050
	S1	0.270	0.042*	0.178	0.162	-0.048	0.703
	S2	0.180	0.151	0.338	0.024*	0.280	0.030*
	S3	0.199	0.111	0.179	0.153	0.225	0.071

Discussion

The results can be considered logical and explainable despite the "dearth of literature" and the limitations faced. In general, this study aimed to assess the feeding pattern and its relation to the eruption stage of the primary teeth and growth parameters among clinically healthy infants.

The mean value of the relationship between feeding pattern and primary tooth eruption was higher among bottle-fed infants than in infants with other feeding patterns, but the difference was not statistically significant. Ahmadi–Motamayel et al. [15] found that infants fed with formula milk in Iran had earlier tooth eruption than breast-fed infants, consistent with the present results. However, Holman and Yamaguchi [16] and Aziz [18] reported contradicting results in Kerbala. Viggiano et al. [21] found that breastfeeding is the ideal

stimulus for the physiological development of the muscular and skeletal components of the orofacial complex. Although breastfeeding is imperative for the good development of the entire craniofacial complex [5], the eruption process depends on many other factors, such as breast milk composition, which was found to be positively related to maternal BMI and adiposity [22].

Based on the relation between feeding pattern and nutritional status, bottle-fed infants had the best nutritional status, followed by breast-fed infants and mixed-fed infants; the results were not significantly different among the groups, except for the weight/length z score (a parameter of overweight risk). Infant feeding practices have a major role in determining a child's nutritional status [23]. Mothers who bottle-fed their infants are less sensitive to infant cues for feeding interactions, leading to a higher risk for overfeeding and use of more controlling feeding practices and pressuring feeding style increasing the risk for weight gain [30].

The European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition (2017) recommended exclusive or complete breastfeeding for at least four months and exclusive breastfeeding or predominant breastfeeding for approximately six months as a desirable goal [31]. High rates of undernutrition may be due to the mothers' poor socio-economic status and knowledge about feeding practices and low educational level [32].

Related studies were conducted by Koletzko et al. (2009) and Luque et al. (2015); the latter suggested that a higher protein intake through infant formula increased certain circulating essential amino acids, which stimulate the secretion of insulin and insulin-like growth factor 1 (IGF-1). These anabolic hormones promote weight and fat gain in formula-fed infants [24,25]. Yang et al. (2019) reported that formula feeding is a risk factor for rapid weight gain during the first six months of an infant's life [26]. These results agree with the present findings, but the data were not statistically significant. By contrast, Khan et al. (2022) indicated that growth was more rapid and accomplished sooner in infants who were breastfed for a longer duration with fewer intervals between feeds [27]. Golley et al. (2013) and Perrine et al. (2014) found that breastfeeding is associated with more positive dietary behavior during childhood, and longer durations of breastfeeding have been associated with more frequent fruit and vegetable consumption, less frequent sugar-sweetened beverage consumption, and reduced risk for obesity [28,29].

Conclusion

This study reported the highest mean score for the relationship of erupted primary teeth and nutritional status in bottle-fed infants. However, the results were not significant from a statistical point of view.

Conflict of interest: None

Author contributions

DHMH, SMA and BAY; study conception and design. DHMH; data collection. DHMH; Methodology. DHMH; statistical analysis and interpretation of results. DHMH; original draft manuscript preparation. DHMH; Writing - review & editing. Supervision; SMA, BAY and SR. All authors reviewed the results and approved the final version of the manuscript to be published.

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Informed consent

Informed consent was obtained from all individuals or their guardians included in this study.

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تأثير نمط التغذية على مرحلة ثوران الأسنان الأولية بالنسبة لمعلمات النمو

الباحثون: ضي حيدر محمد حسن , شهباء منذر الجوراني , بيداء احمد ياس , سمانة رازقي

المستخلص:

الخلفية: لتقييم علاقة نمط التغذية بمتغير الفم المختار (مرحلة بزوغ الأسنان الأولية) ومعايير النمو بين الرضع الأصحاء سريريًا الذين تتراوح أعمارهم بين 6-18 شهرًا. المواد والطريقة: أجريت دراسة مقارنة مقطعية في مدينة كربلاء ، العراق ، لعينة قوامها (300) رضيع تتراوح أعمارهم بين 6-18 شهرًا. أوضحت الدراسة نمط التغذية من خلال استبيانات أجاب عليها الوالدان ومرحلة ظهور الأسنان من خلال الفحص داخل الفم ومعايير النمو (الطول والوزن ومحيط الرأس). النتائج: الاتجاه هو أن يكون للرضع الذين يرضعون بالزجاجة اندفاعًا كليًا للأسنان والحالة التغذوية أعلى من مجموعات التغذية الأخرى. ومع ذلك ، لم تظهر هذه النتائج أي دلالة إحصائية. الخلاصة: في هذه الدراسة ، أشارت النتائج إلى أن أعلى متوسط للأسنان الأولية المنفجرة والحالة التغذوية وجد بين الأطفال الذين يرضعون بالزجاجة.