



Feeding Practices, Nutritional and Socioeconomic Status Impact on Caries Experience among Group of Sudanese Children

Rabab M. Abd Elhakam¹, Mohammed Abou el Yazid², Nayera E. Hassan³, Nancy A. Fakhry⁴ and Tamer M. Abd Elwahab⁵

¹Assistant Researcher, Orthodontics and Pediatric Dentistry Department, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.

² Prof. of Pediatric Dentistry, Head of Orthodontics and Pediatric Dentistry Department, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.

³ Prof. of Biological Anthropology, Head of Biological Anthropology Department, National Research Centre, 33 El Buhouth St., 12622 Dokki, Giza, Egypt.

⁴ Prof. of Physical Anthropology, Anthropology Department, Faculty of African Postgraduate Studies, Cairo University, Egypt.

⁵Lecturer of Physical Anthropology, Anthropology Department, Faculty of African Postgraduate Studies, Cairo University, Egypt.

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ABSTRACT

Background: According to the WHO, "breastfeeding is the normal way of providing young infants with the nutrients they need for healthy growth and development. Exclusive breastfeeding is recommended up to 6 months of age, with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond". However, several studies have reported prolonged and unrestricted breastfeeding as a potential risk factor for primary tooth caries. Understanding the role that breast feeding and bottle-feeding play in the development of dental caries during childhood is essential in helping dentists and parents and care providers prevent the disease, and also for the development of effective public health policies. However, the issue is not yet fully understood. **Aim:** to evaluate the impact of feeding practices, nutritional status and socioeconomic status on caries experience. **Methods:** A cross-sectional study was conducted in the Sudanese nurseries and schools in Cairo, Egypt. A total 320 child of both sex were examined, they aged from 1 to 4 years. Feeding practice data were collected from them through a face-to-face interview. Dental examination was done using the dmft index according to the WHO criteria. Nutritional assessment was assessed by recording patient's anthropometric measures (weight and height). Socioeconomic status assessment was done using **Fahmy** modified index that was designed for evaluation of the social status of families, to be used in health research in Egypt. **Results:** Breastfed children had experienced caries more than bottle fed ones. 91.8% of the children who experienced caries were fed on need (irregular feeding). A moderate positive significant correlation was found between dmft and age ($r=0.41$); the older the child the more caries occurrence. A weak negative significant correlation was found out between dmft & nutritional status ($r=-0.28$), a weak positive significant correlation between dmft & socioeconomic status ($r=0.31$) as most of the children who experienced caries were high and medium SES. **Conclusion:** Children who experienced caries were breastfed and were weaned at age of 2 years. The higher the socioeconomic status of a child, the more caries experience. Increased frequency of feeding practice may increase the risk of dental caries.

Keywords: feeding practice, breast feeding, bottle feeding, caries, nutritional status, socioeconomic status, nocturnal feeding.

1. Introduction

According to the WHO, "breastfeeding is the normal way of providing young infants with the nutrients they need for healthy growth and development. Exclusive breastfeeding is recommended up to 6 months of age, with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond". However, several studies have reported prolonged and unrestricted breastfeeding as a potential risk factor for primary tooth caries (Paglia, 2015).

Understanding the role that breast feeding and bottle-feeding play in the development of dental caries during childhood is essential in helping dentists and parents and care providers prevent the disease, and also for the development of effective public health policies. However, the issue is not yet fully understood (Avila *et al.*, 2015).

Dental caries is an infectious, transmissible, bacterial disease affecting children and adults of all races, ethnicities and socio-economic levels. It is a major public health problem both within the U.S. and around the world, and has devastating effects including pain, infection, nutritional insufficiencies, learning and speech problems, and even death (Kierce *et al.*, 2016)

An individual's socioeconomic status (SES) is one of the most important determinants in children's oral health. Previous studies found out that children with low SES, including low household income, low mother's education and living in socially disadvantaged families, were more likely to have higher prevalence of dental caries and greater dental pain experience (Zhang *et al.*, 2021).

Nutritional assessment can be defined as the interpretation from dietary, laboratory, anthropometric, and clinical studies. It is used to determine the nutritional status of individual or population groups as influenced by the intake and utilization of nutrients (Gibson, 2005).

Nutritional assessment is the quantitative evaluation of nutritional status. A comprehensive nutritional assessment has five components:

-Dietary, medical and medication history

-Physical examination

-Growth, anthropometric and body composition measurements (Phillips and Jensen, 2019).

Dietary choices affect oral health as well as general health and well-being. Establishment of a dental home by 12 months of age allows the institution of individualized caries-preventive strategies, including dietary recommendations and appropriate oral hygiene instruction, as the primary teeth begin to erupt (AAPD, 2017).

So, Aim of this study is to investigate the impact of feeding practices, nutritional and socioeconomic status on caries experience among a sample of Egyptian children aged 1-4 years.

2. Subjects and methods

A cross-sectional study was carried out. A total 320 Sudanese children (168 boys and 152 girls) were examined. Children aged 1 to 4 years and were recruited from four Sudanese schools and nurseries in Cairo Governorate. Accurate birthday was available from either the parent supported by birth certificates or from the school registrant (personal school chart for each child). Children were classified to 3 groups, group1 (from 12 to 23 months), group 2 (from > 23 to < 35 months) and group 3 (from 35 to ≤ 48 months).

I. Ethical consideration

The study was approved by The Ethical Committee of the National Research Centre (registration no. 18110).

The guardians (either the father or the mother) were asked to give written informed consent to participate in the study after explanation of the study aim and examination procedures. The data pertaining to the subjects were entered into the database with a numerical code only.

II. Anthropometric measures (Nutritional status assessment)

Weight and length were assessed using standardized equipment and follows the recommendation of international biological program (WHO, 2013).

• **Measurement of weight**

The Weight was measured to the nearest 0.1 kg by using a digital balance machine. The child weighted with minimum clothes, no shoes and without touching anything (Krishna *et al.*, 2017).

• **Measurement of length**

Length was measured to children < 2 years, while height is measured to children > 2 years. The length was measured by infantometer, while the height was measured to the nearest 0.1 cm using the ordinary measuring tape fixed at the wall and the child standing up after removing the shoes with feet parallel to each other and pointed forward and the back is straight in upright position. The knees must be straight and the head in position that Frankfort Plane must be horizontal (Krishna *et al.*, 2017).

Weight, height(length), age and, sex data were used to calculate Z-scores of the nutritional indicators (WHZ) in comparison to the published World Health Organization/National Center for Health Statistics (WHO/ NCHS) reference population using the WHO Anthro-Plus Software (Version 1.0.4) (WHO, 2009).

The nutritional status was classified according to the World Health Organization Classification of weight for height Z score (2007) as follows:

- Very thin: WHZ < -3 SD.
- Underweight: WHZ < -2 SD. Percentile: 0 < 3.
- Normal: WHZ \geq -2 and \leq +1 SD. Percentile: \geq 3 and \leq 85.
- Overweight: WHZ > +1 and \leq +2SD. Percentile > 85 and \leq 97.
- Obese: WHZ > +2 SD. Percentile > 97

III. Socioeconomic status assessment:

The Socioeconomic status of the participants was determined using Fahmy modified index (Fahmy *et al.*, 2015). This index was designed for evaluation of the social status of families, to be used in health research in Egypt.

Data were collected by the examiner, using an interview questionnaire that included the following updated social Questions:

- | | |
|----------------------------------|-----------------------------|
| 1. Mother's education. | 6. Per-capita income. |
| 2. Father's education. | 7. Family size. |
| 3. Working status of the mother. | 8. Crowding index. |
| 4. Working status of the father. | 9. Proper sewage disposal. |
| 5. Use of computer | 10. Proper refuse disposal. |

The examiner asked the questions to one /or both of the parents of each child and filled the index as well. School children, whom parents were not met, were telephoned interviewed.

The total score of the scale was 54, and according to the final score, the family was classified into: high, medium and low SES as the following:

High \geq 75% (40.5 points). Medium 50 to < 75% (< 40.5 > 27 points). Low < 50% (<27 points).

IV. Dental examination

Dental examination of the children was carried out by the dentist using torch light, disposable mirror, and explorer. Dental caries was measured using the decayed (d), missing (m), and filled (f) teeth (dmft) index according to the WHO criteria. Teeth missing (m) or filled (f) contributed to the overall dmft score only if teeth were missing or filled because of dental caries. After dmft calculation; two dmft groups were obtained; with caries group (dmft = or > 1) and caries free group (dmft = 0).

- Young children (1 to 2 years) were examined using knee-to-knee examination.
- Older children (2 to 4 years) were seated on a small chair during the dental examination.

V. Statistical analysis

All Data were collected, tabulated and subjected to statistical analysis. Statistical analysis was performed with SPSS 20®1, Graph Pad Prism®1, and Microsoft Excel 20163. All quantitative data presented as mean & standard deviation, while qualitative data were presented as frequency & percentages, all data presented in tables & figures. Comparisons two different groups were performed

by using Independent t-test. All comparisons in qualitative data were performed by using Chi square test. Spearman's correlation coefficient was performed to evaluate all correlations. Results is significant when p-value < 0.05.

3. Results

The study sample consisted of 320 children aged from 1 to 4 years (168 boys and 152 girls). For each child: dmft was recorded, weight and length were measured, and nutritional status and SES were assessed.

Frequency and percentages of dmft (caries free and with caries) among different age group are shown in table (1). Comparison between caries and no caries in different age groups revealed significant difference as $P < 0.05$ (caries free higher than with caries), as presented in table (1). Also, correlation was calculated by using Spearman's correlation coefficient which revealed moderate positive significant correlation between dmft & age ($r = 0.41$).

Table 1: Comparison and correlation between frequency & percentages of dmft categories among different age groups:

Age Group (months)	Total	dmft				P value	r
		No Caries		With Caries			
		N	%	N	%		
12 to > 24	73	73	100.0	0	0.0	0.0001*	0.41 *
24 to > 36	100	95	95.0	5	5.0	0.0001*	
36 to > 48	147	89	60.5	58	39.5	0.006*	
Total	320	257	80.3	63	19.7	0.0001*	

Frequency & percentages of dmft (caries free and with caries) among sex is shown in table (2). Comparison between dmft (caries free and with caries) among sex revealed insignificant difference in (with caries) as $P > 0.05$, while revealed significant difference in (caries free) as $P < 0.05$, as presented in table (2).

Table 2: Comparison between Frequency & percentages of dmft categories distribution among sex:

dmft	Total	Gender				P Value
		Boys		Girls		
		N	%	N	%	
Caries free	257	142	55.3	115	44.7	0.01*
With Caries	63	26	41.3	37	58.7	0.06

Frequency & percentages of dmft (caries free and with caries) among different nutritional statuses (thin and underweight, normal, overweight and obese) is shown in table (3). Comparison between 4 categories of nutritional status in both dmft categories was performed by using Chi square test which revealed significant difference between them as $P < 0.05$ in both categories of dmft. Normal was significantly the highest in both dmft categories while (Thin and underweight) was significantly the lowest in (no caries) & (Obese) in (with caries), as presented in table (3). Also, correlation was calculated by using Spearman's correlation coefficient which revealed weak negative significant correlation between dmft & nutritional status ($r = - 0.28$).

Table 3: Comparison and correlation between Frequency & percentages of dmft categories among different nutritional statuses:

dmft	Total	Nutritional status								P Value	r
		Thin and underweight		Normal		Overweight		Obese			
		N	%	N	%	N	%	N	%		
Caries free	257	11	4.2	194	75.6	26	10.1	26	10.1	0.001*	-
With Caries	63	21	33.3	37	58.7	0	0.0	5	8.0	0.001*	0.28*

Frequency & percentages of dmft (caries free and with caries) among different socioeconomic status (low, medium and high) is shown in table (4). Comparison between 3 categories of

socioeconomic standard in both dmft categories was performed by using Chi square test which revealed significant difference between them as $P < 0.05$. (Medium) was significantly the highest while (Low) was significantly the lowest in both dmft categories, as presented in table (4). Also, correlation was calculated by using Spearman's correlation coefficient which revealed weak positive significant correlation between dmft & socioeconomic status ($r = 0.31$).

Table 4: Comparison and correlation between Frequency & percentages of dmft categories among different socioeconomic status:

dmft	Total	Socioeconomic status						P Value	r
		Low		Medium		High			
		N	%	N	%	N	%		
Caries free	560	53	20.6	131	51.0	73	28.4	0.001*	0.31*
With Caries	110	5	7.9	16	25.4	42	66.7	0.001*	

Comparison between frequency and percentages of dmft categories among different answers regarding feeding practice questions

Frequency and percentages of dmft (caries free and with caries) among different types of feeding practices (breast feeding, bottle feeding and combination) is shown in table (5). There was a significant difference between all answers in both categories of dmft, in both categories (breast feeding) was significantly the highest while (bottle feeding) was significantly the lowest in (no caries) category while in (with caries) category there was insignificant difference between (bottle feeding) & (combination).

Table 5: Comparison between frequency and percentages of different answers regarding the question what was the type of feeding practice?

Sudanese dmft	Total	Question 1 what was the type of feeding practice?						P Value
		Breast feeding		Bottle feeding		Combination		
		N	%	N	%	N	%	
Caries free	257	141	54.8	58	22.6	58	22.6	0.001*
With Caries	63	53	84.1	0	0	10	15.9	0.001*

Frequency & percentages of dmft (caries free and with caries) in different weaning timing (one year, two year and still feeding) is shown in table (6). Comparison between different answers revealed significant difference between them as $P < 0.05$ in (with caries) while there was insignificant difference between them in (no caries). (Two years) was significantly the highest while there was insignificant difference between (one year) & (still feeding) in both dmft categories, as presented in table (6).

Table 6: Comparison between Frequency & percentages of different answers regarding the question when was the time of weaning?

dmft	Total	Question: when was the time of weaning?						P value
		One year		Two years		Still feeding		
		N	%	N	%	N	%	
Caries free	257	79	30.7	99	38.6	79	30.7	0.06
With Caries	63	0	0.0	63	100.0	0	0.0	0.0001*

Frequency and percentages of dmft (caries free and with caries) and frequency of feeding (every 2-3 hours and on need) is shown in table (7). Comparison between different answers revealed significant difference by using Chi square test in both categories of dmft as $P < 0.05$, (on need) answer was significantly higher than (Every 2-3 hours) in both categories, as presented in table (7).

Frequency and percentages of dmft (caries free and with caries) among different types of feeding at bedtime (breast feeding, bottle feeding and combination) is shown in table (8). Comparison between different answers revealed significant difference by using Chi square test in both categories of dmft as $P < 0.05$, (breast feed) was significantly the highest, while (combination) was significantly the lowest in both categories, as presented in table (8).

Table 7: Comparison between Frequency & percentages of distribution of dmft regarding the question how many times do you feed your child?

dmft	Total	Question: how many times do u feed your child?				P value
		Every 2 to 3 hours		On need		
		N	%	N	%	
Caries free	257	21	8.2	236	91.8	0.0001*
With Caries	63	21	33.3	42	66.7	0.002*

Table 8: Comparison between Frequency & percentages of distribution of dmft regarding the question what was the type of feeding at bedtime?

dmft	Total	Question: at bedtime what was the type of feeding?						P value
		Breast feed		Bottle feed		Combination		
		N	%	N	%	N	%	
Caries free	257	147	57.1	68	26.6	42	16.3	0.001*
With Caries	63	58	92.0	5	8.0	0	0.0	0.0001*

Grading Standards	Correlation Degree
$\rho = 0$	no correlation
$0 < \rho \leq 0.19$	very week
$0.20 \leq \rho \leq 0.39$	weak
$0.40 \leq \rho \leq 0.59$	moderate
$0.60 \leq \rho \leq 0.79$	strong
$0.80 \leq \rho \leq 1.00$	very strong
1.00	monotonic correlation

4. Discussion

Feeding practices during infancy play a major role in causation of ECC because teeth are more vulnerable for caries immediately after eruption. Night feeding during sleep provides fermentable carbohydrates. This, along with diminished salivary flow at night, increases the risk of ECC. There is evidence in the medical literature to conclude night feeding with formula milk, adding sugar to formula milk and excessive consumption of sweets will promote ECC (Perera *et al.*, 2014).

Feeding habits, particularly during the first year of life, involve numbers of simultaneous and interrelated behaviors, such as breastfeeding, bottle-feeding and the introduction of complementary foods (Feldens *et al.*, 2018). The World Health Organization (WHO) recommended that mothers should breastfeed babies exclusively for the first 6 months and then continue breastfeeding along with other weaning foods for up to 2 years or later (WHO, 2021).

This study was designed to evaluate the impact of feeding practice, nutritional status and socioeconomic status on caries experience. Also to assess sex differences in caries experience. A total 320 child aged from 1 to 4 years (168 boys and 152 girls) was examined.

Caries free children were 80.3% of the total examined children; 54.8% were breast fed. Our findings is consisted with some studies that we reviewed showed no effect of Breast feeding on dental caries (Nunes *et al.*, 2012 and Kramer *et al.*, 2009).

Children who had experienced caries were 19.7% of the sample; 84.1% were breastfed and 15.9% were on combination. Breastfed children had experienced caries more than bottle fed ones that goes with Perera *et al.* (2014) who also revealed an increased risk of ECC among children exclusively breast fed up to six months, but the increase was not statistically significant. In contrast to our findings, the results of two other systematic reviews showed that any breastfeeding, in general, is protective against dental caries compared to children who never received breast milk (Avila *et al.*, 2015; Cui *et al.*, 2017). In contrast to Al Dashti *et al.* (1995) in Kuwait who found that children on combination (breast and bottle) were less caries experienced than bottlefed.

It was found out that caries experience is significantly positive correlated with age ($r= 0.41$); the older the child the more caries occurrence; this finding is consisted with Chanpum *et al.* (2020) in Thailand, Elamin *et al.*, (2018) in United Arab Emirates and Ferreira *et al.*, (2007).

Our findings showed that there is significant difference between boys and girls in caries free group where 80.3% of the children were caries free. 55.3% were boys and 44.7% were girls. Boys

were significantly higher than girls in caries free group; and that was in contrast with Abu Hamila, 2013 who found out that ECC significantly affects males more than females.

While 19.7% of the sample was experiencing caries; 41.3% were boys while 58.7% were girls with no significant differences and that were consistent with Ferreira *et al.* (2007). Also a study was done by Bafti *et al.* (2015) in Iran who found out that dmft was higher in boys compared to girls.

Exploring the relation between nutritional status and dental caries is controversial (Edalat *et al.*, 2014). Undeniably, it is likely that not a single common risk factor plays a role in the relationship between ECC and BMI but rather a complex interface of dietary pattern, oral hygiene practices, and genetic aspects that determine both caries and alterations in BMI. We found out a weak negative significant correlation between dmft & nutritional status ($r = -0.28$); and that was similar to studies done by Krishna *et al.* (2017) in India and Ambarkova and Bakracevska, (2015) in Republic of Macedonia.

75.6% of the caries free children were normal nutritional status. While 58.7% of the children who experienced caries were normal nutritional, 33.3% were thin and underweight. In contrast to Ahmed and Abuaffan, (2015) in Sudan who found out that higher prevalence of dental caries in primary teeth were found in underweight groups. Also Koksall *et al.*, 2011 in Turkey who found out those children with low body weight have a higher risk of developing dental caries than overweight-obese children. He also found out that maximum number of children were underweight, which might be due to the social class difference among children and study setting done in schools (Public and private).

We found out a weak positive significant correlation between dmft & socioeconomic status ($r = 0.31$); 51% of the caries free children were medium SES, 28.4% high SES, and 20.6% low SES. While 66.7% of the children who experienced caries were high SES, 25.4% were medium and 7.9% were low SES. Most of the children who experienced caries were high SES and that was similar to a study conducted by Prasanth *et al.* (2011) where a greater number of caries was found in private school group people who are from upper socioeconomic status. It could be because soft drinks and chocolates, which are promptly open, and oftentimes devoured, speak to high sugar source that may add to the potential for dental caries.

In contrast to other studies that showed that children from lower SES families suffer from more severe dental pain, higher prevalence of dental caries and dental fluorosis (Zhou *et al.*, 2018 and Peres *et al.*, 2019). A study was done by Sukumaran *et al.* (2020) who found out that there was no correlation between dental caries, BMI, and SES among Private preschool children.

In contrast to our findings, Devenish *et al.* (2020) who did not observe an association between prolonged full or any breastfeeding for >12 months and increased caries risk. Also Victora *et al.*, 2016 who stated that breastfeeding in itself and of prolonged duration has been shown to be beneficial for many health outcomes, such as overweight, diabetes, and infections. We found out 38.6% of the caries free children were weaned at age of 2 years, 30.7% were weaned at 1 year and 30.7% were still feeding. While children who experienced caries; all were weaned at age of 2 years. Two studies found a significant association between being breastfed for > 12 or 24 months and dental caries (Feldens *et al.*, 2010; Chaffee *et al.*, 2014. Also Hong *et al.* (2014) Tanaka *et al.* (2013) had all shown an increase in dental caries with increased duration of breast feeding.

A study was done by Nirunsittirat *et al.* (2016) who observed a dose-response relationship between the frequency of sleeping while breast- or bottle-feeding and dmfs. Also higher frequency of any infant feeding may increase the risk of dental caries as stated by Feldens *et al.* (2018). We found out that 91.8% of the children who experienced caries were fed on need while 8.2% were fed regularly (every 2 to 3 hours). 66.7% of the children who experienced caries were fed on need and 33.3% were fed every 2 to 3 hours. increased the frequency, which points towards the theory that increased feeding frequency might be the major explanation for the observed association between prolonged breastfeeding and dental caries; which was proved by van Meijeren-van Lunteren *et al.* (2021) that the proportion of children with dental caries was clearly higher among infants who had been exposed to increased breastfeeding frequency at the age of 12 months. Also a study was done by Feldens *et al.* (2010) who stated that Daily breastfeeding frequency was associated with S-ECC in a previous study of Brazilian preschoolers, in which breastfeeding frequency, but not duration ≥ 12 months, maintained statistical significance in multi-variable models.

A study was done by Nakayama and Mori, (2015) who found out significant associations between ECC and nocturnal breastfeeding. We found out 57.1% of the caries free children were breastfed at bedtime, 26.6% were bottle-fed at bedtime and 16.3% were on combination at bedtime. 19.7% of the Sudanese patients were suffering from caries; 92% were breastfed at bedtime and 8% were bottle-fed at bedtime. Breastfed children at night experienced more caries than those bottle-fed ; that is may be clarified by the theory that during the night, the salivary flow is less, leading to decreased re-mineralization which increases the risk of developing caries lesions over time (Shelton *et al.*, 1977; Reisine and Psoter, 2001). In contrast to our findings, the results of 2 other systematic reviews showed that any breastfeeding, in general, is protective against dental caries compared to children who never received breast milk (Avila *et al.*, 2015; Cui *et al.*, 2017). Also van Meijeren-van Lunteren *et al.* (2021) who found that nocturnal bottle-feeding is related to an increased caries risk.

Limitations of the study:

The challenge we faced was data collection during the pandemic Covid-19 virus.

Conflict of interests

There was no conflict of interests in this study.

Conclusion

- 1- Children who experienced caries; Breastfed ones experienced caries more than other types feeding practices.
- 2- Increased frequency of feeding practice increases the risk of dental caries.
- 3- Children who experienced caries; were weaned at age of 2 years.
- 4- The older the child the more caries occurrence.
- 5- There was no sex differences in caries experience in caries group.
- 6- There was a positive correlation between SES and caries experience, the higher the socioeconomic status of a child, the more caries experience.
- 7- There was negative correlation between caries experience and nutritional status.

Recommendations:

- 1- Mothers with low levels of education may require special attention because their children are of greater risk of caries and would benefit most from preventive efforts.
- 2- The extent of oral health education and regular training of the mothers to perform cleaning of the teeth for their children by dentists and health care givers should be encouraged.

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