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Association between Early Childhood Caries and Selected Feeding Practices among 3-5 Years Old Preschool Children of Beirut, Lebanon

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Abstract **Original Research Article**

The purpose of this study is to assess the impact of selected dietary determinants on the prevalence and severity of Early Childhood caries (ECC), among a group of Lebanese preschool children. A total of 500 preschool children, age 3 to 5 years were chosen with stratified random sample technique with proportional allocation of the subjects, into different strata. Out of the 500 students chosen, 409 complied and returned the questioner and hence were included in the study. The study was performed in six schools distributed in different areas of Beirut, 3 private and 3 public schools. Every child was examined using a disposable plastic dental mirror under an adequate source of light. Early childhood caries was diagnosed as present when one or more decayed (non cavitated or cavitated lesions), missing (due to caries), or filled tooth surface on any primary tooth in children up to 71 months of age [1] was detected. The severity of ECC was classified according to Whyne AH (1999) [2] Type 1 ECC (mild to moderate); Type 2 ECC (moderate to sever); Type 3 ECC (sever). All eligible children were given a questionnaire to be filled at home by parents, and were returned by a specific date. Infant feeding practices included in the questionnaire were; history and duration of breast feeding, history and duration of bottle feeding, contents and frequency of bottle feeding, history of bottle feeding to sleep at night, history of bottle sipping during day, age of commencement at cup drinking, age of commencement of solids. The data were collected, tabulated and statistically analyzed, using package for social science "SPSS" version 13. The age of the study sample ranged from 3- 5 years with a mean 4.0 ± 0.9. About half of the sample was males (49.1%). The majority of children were in public schools (60.9%). Breast feeding was used for nursing 92.4% of the examined children while 77.3% of the children were bottle fed. About half of the children (54.7%) used the bottle for milk, 34.8% used it to drink water and10.4% used it to drink juice. No carbonated beverages were reported to be taken in the bottle. Night feeding by bottle was reported by 33.7%, while 45.7% reported using the bottle during daytime. More than half the sample (57%) used the bottle for less than 18 months. About two thirds (64.8%) were breast fed for less than a year. By that age, 48.9% of them started using the cup to drink. Weaning by introducing non-milk food started by 4-6 months for 61.1% of the sample. One third of the examined children were caries free (29.6%). Of those who had caries, 38.9% had mild caries, 27.1% had moderate caries while only 4.4% had severe caries. The mean age increased significantly (P<0.0001) with increasing severity of caries (for no caries, mild, moderate and severe caries, mean ages= 3.7 ± 0.8, 4.1 ± 0.9, 4.3 ± 0.8 and 4.4 ± 0.7 respectively). No significant difference was observed between males and females in caries severity (P= 0.87). More children in public school had severe caries compared to children in private schools (6.8% and 0.6% respectively). Similarly, more children in private schools were caries free compared to children in public schools (49.4% compared to 16.9% respectively). The difference between children in public and private schools in caries severity was statistically significant (P<O.0001). No significant difference was noticed between children who were breast fed and those who were not, in caries severity (P= 0.59). More children who were not bottle fed were caries free than those who were bottle fed (62.4% and 19.9% respectively, P<0.0001). Less children who were breast fed < 3 months or > or equal 13 months were caries free than those who were breast fed 3-6 months or 7-12 months (28.3%, 18%, 35.7% and 37.6% repectively, P=0.04). No significant association was observed between caries severity and bottle content although more children who used the bottle for milk and water were caries free compared to those who used it for juice (24.3%, 16.4% and 9.1% respectively, P=0.36). No association was observed between bottle use at night or during day time and caries severity (P= 0.54 and 0.33 respectively). Similarly, no association was observed between caries severity and duration of bottle feeding (P=0.37). Significantly more children who began using the cup for drinking between 13-18 months were caries free compared to children who did so at 19 months or at 12 months (38.8%, 34% and 22.5% respectively, P=0.03). On the other hand, no association was observed between caries severity and age food started (P= 0.23). These findings deserve further investigation among Lebanese preschool children.

Keywords: Early childhood caries, Dietary habits, feeding habits.

INTRODUCTION

Oral health is one of the most significant components in the normal development of a child. Oral health problems or illnesses can unfavorably influence quality of life and have a direct or an indirect impact on general health and future development of a child [3]. Dental caries which is untreated in deciduous teeth was the tenth most common condition, influencing 621 million youngsters around the world [4].

All carious lesions including those associated with early childhood caries are produced from the interaction of 3 variables, (1) Cariogenic microorganisms (mutans streptococci) in the mouth; (2) fermentable carbohydrates(substrate), that the microorganism metabolize to organic acids; (3) susceptible tooth surface/host. Given the proper time these variables induce incipient carious lesions that continue to progress [5]. Child oral health-care behavior ,feeding and cleaning behavior are associated with ECC among children; night time bottle feeding and frequent consumption of cariogenic food; late commencement of child tooth brushing and irregular brushing habits [6, 7]. Streptococcus mutans (SM) and Streptococcus sobrinus are the most common microorganisms associated with ECC. Lactobacilli also participate in the development of caries lesions and play an important role in lesion progression, but not its initiation [8]. Colonization of the oral cavity with SM in children is generally the result of transmission of these organisms from the child's primary caregiver usually the mother, suspected to be due to close maternal- child contact and sharing of food and utensils [9]. Infants and toddlers whose mothers have high levels of SM, a result of untreated caries, are at a greater risk of acquiring the organism than children whose mothers have low levels [10]. The Actinomyces species and specifically Actinomyces gerencseriae were also associated with deep caries initiation [11], Bifidobacterium species was associated with deep caries lesions [12]. The carbohydrate component of the diet is associated with the formation of dental caries. Certain carbohydrates are utilized by oral microorganisms, especially SM to form a sticky plaque matrix that enables the microorganisms to adhere to the teeth surface. The carbohydrates also serve as metabolites in the production of organic acids that demineralize the teeth [13]. Sucrose, has been considered to be the most cariogenic sugar in the human diet. Also studies have demonstrated the erosive effects of fruit drinks on the enamel and erosion may be the primary enamel change preceding the dental caries [14]. Studies have shown that cow milk has minimal cariogenicity due to its mineral content and low lactose level [15, 16]. Breast feeding and its duration were independently associated with an increased risk for ECC among 2- to 5-year-old children [17]. A systematic review revealed that breast feeding up to 1 year of age is associated with significantly lower ECC experience compared to not breast fed at all or breastfeeding extended beyond 12 months [18].

MATERIALS AND METHODS

The present study was conducted to access the impact of dietary determinants on the prevalence and severity of ECC among a group of Lebanese preschool children. Its a descriptive, cross sectional study that included various public and private pre-schools in Lebanon. Disposable plastic mirrors were used for screening after drying the area to be examined and before deciding the presence and severity of ECC. The examination was conducted in each school in a prepared room with a suitable source of light for screening, were the child was seated on an ordinary straight back chair. A total of 500 preschool children, age 3 to 5 years were chosen with the stratified random sample technique with proportional allocation of the subjects, into different strata. Out of 500 students chosen, 409 complied and returned the questioner and hence were included in the study. The study was performed in schools distributed in different areas of Beirut. The students in these schools came from different areas in Lebanon. And, hence the results obtained could be generalized on all Lebanese pre- school children. The selected schools where three private and three public schools.

As for the private schools the students in the study sample were distributed as follows:

1. The first school with 54 students.
2. The second school with 45 students.
3. The third school with 61 students.

The students in the public schools were distributed as follows:

4. The forth school with 128 students.
5. The fifth school with 55 students.
6. The sixth school with 66 students.

Intra-examiner calibration was done before starting the survey where ten children were examined under the supervision of the main supervisor in order to make sure that the investigator achieved optimally uniform examination and to minimize variations which might affect the judgment of the examiner and hence the diagnosis.

Every child was examined using a disposable plastic dental *mirror* with an adequate source of light. Early childhood caries was diagnosed as present when one or more decayed (non cavitated or cavitated lesions), missing (due to caries), or filled tooth surface on any primary tooth in children up to 71 months of age [1] was detected.

The severity of ECC was classified according to Whyne AH (1999) [2]:

Type 1Early Childhood Caries (mild to moderate): The existence of isolated carious lesion(s) involvi ng molars and / or incisors.

Type 2 Early Childhood Caries (moderate to severe): Labiolingual carious lesions affecting maxillary incisors, with or without molar caries, and unaffected mandibular incisors.

Type 3 Early childhood caries (severe): Carious lesions affecting almost all the teeth including the lower incisors.

All eligible children were given a questionnaire to be filled at home by the parents and was returned by a specific date. Out of 500 students given the questionnaire, 409 returned the filled questionnaire on the specific date.

Infant feeding practices included in the questionnaire are, History and duration of breast feeding, History and duration of bottle feeding, Contents and frequency of bottle feeding, History of bottle feeding to sleep at night, History of bottle sipping during day time, Age of commencement of cup drinking, Age of commencement of solids. Descriptive statistics were calculated in the form of frequencies and percents for qualitative variables and mean and standard deviation or medians for quantitative variables. Relation between caries severity and quantitative variables was analyzed using analysis of variance while chi square was used for analysis of association between caries severity and qualitative variables. Significant associations in these bivariate analyses were used to build an ordinal regression model to predict factors affecting caries severity. In all cases, significance was set at the 5% level. Statistical analysis was performed using SPSS version 13.

RESULTS

In order to study the impact of feeding and dietary habits determinants on the prevalence and severity of ECC, this epidemiologic survey was conducted among 409 preschool children in Lebanon. The data were collected, tabulated and statistically analyzed, using package for social science "SPSS" version 13. And since we have a responsibility, as researchers, to insure and defend the credibility of our work, intra-examiner consistency has been assessed before collecting the data.

Table 1 shows the types of nursing of the study sample. Breast feeding was used for nursing 92.4% of the examined children while 77.3% of the children were bottle fed.

Table 1: Types of nursing of the study sample

Variables	Categories	N (%)
Breast feeding	No	31 (7.6)
	Yes	378 (92.4)
Bottle feeding	No	93 (22.7)
	Yes	316 (77.3)

Table 2 shows the bottle feeding habits of the study sample. About half of the children (54.7%) used the bottle for milk, 34.8% used it to drink water and 10.4% used it to drink juice. No carbonated beverages were reported to be taken in the bottle. Night feeding by bottle was reported by 33.7%, while 45.7% reported using the bottle during daytime. More than half the sample (57%) used the bottle for less than 18 months.

Table 2: Bottle feeding habits of the study sample

Variables	Categories	N (%)
'Bottle contents	Milk	173 (54.7)
	Water	110(34.8)
	Juice	33 (10.4)
	Carbonated beverages	-
Use of bottle at night	No	178 (43.5)
	Yes	138 (33.7)
Use of bottle during daytime	No	129 (31.5)
	Yes	187 (45.7)
Duration of bottle feeding	12 months	133 *(42.l)*
	13- 18 months	47 (14.9)
	19- 24 months	57 (18.0)
	25- 36 months	79 (25)

Table 3 shows the duration of breast feeding and feeding habits of the study sample. About two thirds (64.8%) were breast fed for less than a year. By that age, 48.9% of them started using the cup to drink. Weaning by introducing non-milk food started by 4-6 months for 61.1% of the sample.

Table 3: Duration of breast feeding and feeding habits of the study sample

Varlables	-Categorjes	N (%)
Duration of breast feeding	< 3 months	60 (15.9)
	3- 6 months	84 (22.2)
	7- 12 months	101 (26.7)
	13 months	133 (35.2)
Age of using cup to drink	12 months	200 (48.9)
	13- 18 months	103 (25.2)
	19 months	106 (25.9)
Age food started	3 months	48 (11.7)
	4- 6 months	250 (61.1)
	7 months	111 (27.1)

Table 4 shows caries prevalence and severity in the study sample. One third of the examined children was caries free (29.6%). Of those who had caries, 38.9% had mild caries, 27.1% had moderate caries while only 4.4% had severe caries.

Table 4: Caries prevalence and severity

Variables	N (%)
No caries at all	121 (29.6)
I (mild)	159 (38.9)
II (moderate)	111 (27.1)
III (severe)	18 (4.4)

Table 5 shows the relation between caries severity and dietary habits. No significant difference was noticed between children who were breast fed and those who were not in caries severity (P= 0.59). More children who were not bottle fed were caries free than those who were bottle fed (62.4% and 19.9% respectively, P<0.0001). less children who were breast fed <3 months or 2: 13 months were caries free than those who were breast fed 3-6 months or 7- 12 months (28.3%, 18%, 35.7% and 37.6% respectively, P=0.04). No significant association was observed between caries severity and bottle content although more children who used the bottle for milk and water were caries free compared to those who used it for juice (24.3%, 16.4% and 9.1% respectively, P=0.36). No association was observed between bottle use at night or during daytime and caries severity (P= 0.54 and 0.33 respectively). Similarly, no association was observed between caries severity and duration of bottle feeding (P=0.37). Significantly more children who began using the cup for drinking between 13- 18 months were caries free compared to children who did so at 19 months or at 12 months (38.8%, 34% and 22.5% respectively, P= 0.03). On the other hand, no association was observed between caries severity and age food started (P= 0.23).

Table 5: Relation between caries severity and dietary habits

variables	Categories	Caries				Total	chi square P value
		No caries	I (mild)	II (moderate)	III (severe)		
Breast feeding	No	12 (38.7)	9 (29)	9 (29)	1 (3.2)	31 (100)	1.93 0.59 NS
	Yes	109 (28.8)	150 (39.7)	102 (27)	17 (4.5)	378 (100)	
Bottle feeding	No	58 (62.4)	18 (19.4)	16 (17.2)	1 (1.1)	93 (100)	62.92 <0.0001 *
	Yes	63 (19.9)	141 (44.6)	95 (30.1)	17 (5.4)	316 (100)	
Duration of breast feeding	< 3 months	17 (28.3)	26 (43.3)	14 (23.3)	3 (5)	60 (100)	17.83 0.04*
	3- 6 months	30 (35.7)	34 (40.5)	17 (20.2)	3 (3.6)	84 (100)	
	7- 12 months	38 (37.6)	32 (31.7)	29 (28.7)	2 (2)	101 (100)	
	2: 13 months	24 (18)	58 (43.6)	42 (31.6)	9 (6.8)	133 (100)	
	Milk	42	73	51 (29.5)	7 (4)	173	6.60

Bottle contents		(24.3)	(42.2)			(100)	0.36 NS
	Water	18 (16.4)	51 (46.4)	34 (30.9)	7 (6.4)	110 (100)	
	Juice	3 (9.1)	17 (51.5)	10 (30.3)	3 (9.1)	33 (100)	
	Carbonated beverages	-	-	-	-	-	
Use of bottle at night	No	36 (20.2)	83 (46.6)	48 (27)	11 (6.2)	178 (100)	2.17 0.54 NS
	Yes	27 (19.6)	58 (42)	47 (34.1)	6 (4.3)	138 (100)	
Use of bottle during daytime	No	20 (15.5)	59 (45.7)	41 (31.8)	9 (7)	129 (100)	3.46 0.33 NS
	Yes	43 (23)	82 (43.9)	54 (28.9)	8 (4.3)	187 (100)	
Duration of bottle feeding	12 months	18 (13.5)	61 (45.9)	44 (33.1)	10 (7.5)	133 (100)	9.74 0.37 NS
	13- 18 months	9 (19.1)	21 (44.7)	14 (29.8)	3 (6.4)	47 (100)	
	19- 24 months	15 (26.3)	23 (40.4)	17 (29.8)	2 (3.5)	57 (100)	
	25- 36 months	21 (26.6)	36 (45.6)	20 (25.3)	2 (2.5)	79 (100)	
Age of using cup to drink	12 months	45 (22.5)	83 (41.5)	62 (31)	10 (5)	200 (100)	13.89 0.03*
	13- 18 months	40 (38.8)	33 (32)	28 (27.2)	2 (1.9)	103 (100)	
	19 months	36 (34)	43 (40.6)	21 (19.8)	6 (5.7)	106 (100)	
Age food started	3 months	7 (14.6)	24 (50)	16 (31.3)	2 (4.2)	48 (100)	8.05 0.23 NS
	4- 6 months	84 (33.6)	92 (36.8)	64 (25.6)	10' (4)	250 (100)	
	7 months	30 (27)	43 (38.7)	32 (28.8)	6 (5.4)	111 (100)	

Table 6 shows the result of ordinal regression analysis to predict factors affecting caries severity. Factors with significant effect on caries severity were, bottle feeding (P= 0.004), duration of breast feeding (P= 0.001).

Table 6: Ordinal regression model to predict factors affecting caries severit

Variables	Wald chi square	P value
Age	0	0.99 NS
School	8.97	0.003*
Bottle feeding	8.33	0.004*
Duration of breast feeding	10.12	0.001*
Age of using cup to drink	2.46	0.12 NS

*: Statistically significant
NS: Not statistically significant

Table 7 shows the relation between caries severity and personal characteristics. The mean age increased significantly (P<0.0001) with increasing severity of caries (for no caries, mild, moderate and severe caries, mean ages= 3.7 ± 0.8, 4.1 ± 0.9, 4.3 ± 0.8 and 4.4 ± 0.7 respectively). No significant difference was observed between males and females in caries severity (P= 0.87). More children in public school had severe caries compared to children in private schools (6.8% and 0.6% respectively). Similarly, more children in private schools were caries free compared to children in public schools (49.4% compared to 16.9% respectively). The difference between children in public and private schools in caries severity was statistically significant (P<O.0001).

Table 7: Relation between caries severity and personal characteristics

Variables	Categories	Caries				Total	Test P value
		No canes at all	I(mild)	II(moderate)	III(severe)		
Age	Mean ± SD	3.7 ± 0.8	4.1 ±0.9	4.3 ± 0.8	4.4 ± 0.7	-	12.70<0.0001 *
Gender	Male	62(30.8)	75(37.3)	56 (27.9)	8 (4)	201(100)	0.70
	Female	59(28.4)	84(40.4)	55 (26.4)	10 (4.8)	208(100)	0.87 NS
School	Public	42(16.9)	97(39)	93 (37.3)	17 (6.8)	249(100)	67.76<0.0001 *
	Private	79(49.4)	62(38.8)	18 (11.3)	1 (0.6)	160(100)	

*Statistically significant
NS: Not statistically significant

DISCUSSION

This study was undertaken primarily to determine the possible association of certain dietary and feeding practices, on the prevalence and severity of ECC among a group of Lebanese preschool children.

Student's age ranged from 3-5 years, this age group was carefully chosen since at this age children have a complete primary dentition, hence, this factor is standardized. In addition to that, many children keep on using the bottle for feeding till the age of 5 years [19].

The data showed the personal characteristics of the study sample. The severity of caries increased significantly with increased age ($p<0.0001$). This finding was in agreement with many studies [20-22]. A possible explanation might be that the longer the teeth subjected to certain dietary and behavioral attitudes the more liable they were to decay. Therefore, the severity of caries increased as the age increased from 3 to 5 years [20].

More children in public schools had severe caries, compared to those in private schools. Similarly, more children in private schools were caries free compared to those in public schools. The difference between children in public and private schools in caries severity was statistically significant ($p<0.0001$). These results came in agreement with many studies in Europe [23-27] and Middle East [28] which demonstrated the powerful effect of social class on oral health status. Lower socioeconomic classes in poor areas in Lebanon usually place their children in public schools with minimum fees contrary to higher socioeconomic classes which place their children in expensive private schools. Social class may influence caries risk in several ways. Individuals from lower socioeconomic status experience financial, social and material disadvantage, that compromise their ability to care for themselves, obtain professional health care services and live in a healthy environment [29], all of which lead to reduced resistance to oral and other diseases [30] .

As for the gender no significant difference was observed between males and females in caries severity ($p=0.87$). This result agrees with a study [31] and disagrees with another study [32], were boys showed a significantly higher ECC severity index compared to girls ($p=0.01$).

Concerning caries severity; no significant difference was noticed between children who were breast fed and those who where not ($p=0.59$). More children who were not bottle fed were caries free than those who were bottle fed ($p<0.0001$). This agrees with a study conducted in Kuwait [33]. Duperon has suggested that ECC associated with misuse of feeding bottles occurs in lower socioeconomic status families. Whereas ECC associated with improper breast feeding practices tends to occur in children of well-educated parents who believe that breast-feeding imparts a sense of closness and well-being and facilitates the transfer of passive antibodies in their offspring [34].

More children who were breast fed 3-5 month or 7-12 month were caries free than those who were breast fed < 3 month and >13 month,($p=0.04$). This agrees with the study which related ECC to prolonged breast- feeding beyond l year of age [35], and other studies which also associated ECC with prolonged breastfeeding [36, 37]. A possible explanation might be that the human breast milk contains caries protective elements such as maternal immunoglobulins, enzymes, leucocytes and specific antibacterial agents [38, 39]. This caries protection afforded from breast feeding, diminishes progressively with depletion of these protective elements beyond 12 months of age [33, 40].

No significant association was observed between caries severity and duration of bottle feeding ($p=0.37$). This comes in agreement with a study undertaken in Greece [31] and with another study [41]. However, a study conducted was unable to relate ECC to length of time of breast or bottle feeding in South African children [42]. The highest concentration in infant formula is 2.6% lactose; human milk has a lactose concentration of about 7%. Milk may be less cariogenic than other sugar- containing liquids because lactose may be less cariogenic than sucrose and because it contains phosphoprotiens that inhibit enamel dissolution, and antibacterial factors that interfere with acid metabolisim. Milk also may facilitate enamel remineralization [43]. More children who used the bottle for milk and water were caries free compared to those who use it for juice ($p=0.36$). This is in consistence with a study which found that children who

consumed beverages containing sucrose in their baby bottle had levels of mutans streptococci (the bacteria most associated with ECC) four times the level of those who consumed milk in the bottle [44]. This also agrees with the study which showed that the improper use of natural fruit juices and particularly, sweetened fruit drinks, soft drinks, containing significant concentrations of sugar, in infant feeders, may cause dental decay [45]. It disagrees with a study which showed that children who frequently take a bottle with sweetened contents do not develop ECC [46]. The cause might be the prolonged contact between sugars in the consumed liquid and the cariogenic bacteria on the susceptible teeth [47].

As for the severity of caries, there was no significant association with bottle content and bottle use at night or during daytime. This finding is in accordance with many studies [48, 49]. While it disagrees with a study which states that the use of nursing bottles during sleep intensifies the risk of ECC, as oral clearance and salivary flow rate are decreased during sleep [50]. A possible explanation might be that the bottle use and its content has a role in ECC initiation and not in its severity. No association was observed between caries severity and age food started (p=0.23). This comes in agreement with many studies [48, 51].

While it disagrees with a study which showed that commencement of food solids between four to six months of age significantly reduced ECC prevalence and severity compared with later or earlier commencement of food solids in the infant diet [52].

These results may be due to the multifactorial nature of ECC or due to the inaccurate data on the weaning age, manner of baby bottle use, bottle content, bottle use during the day, and other diet habits [31].

More children who began using the cup for drinking between 13-18 month were significantly caries free compared to children who did so at 19 months or at 12 months (p=0.03). A study showed that earlier commencement of drinking from a cup did not affect ECC experience [32], while another study recommended the commencement of drinking cup as early and as often as possible [52]. A possible explanation might be that using the cup for drinking will reduce the time for contact between the consumed liquid and the susceptible teeth. Unlike using the baby bottle where the liquid pools all around the teeth, and the child might also sleep with the bottle in his mouth giving the required time factor for decalcification of teeth to take place.

CONCLUSION

The present study has contributed to knowledge about the ECC experience and selected dietary and feeding habits in a group of Lebanese pre-school children age 3 to 5 years, at private and public schools in Beirut. The results of this study showed that the prevalence of ECC was found to be (70.4%). As for the severity (38.2%) had mild early childhood caries, (27.1%) had moderate early childhood caries, while only (4.4%) had severe early childhood caries. ECC was not found in (29.6%), who were caries free. The findings showed that ECC and feeding habits are significantly associated since children who were breastfed were more caries free, than those who were bottle fed. And we could also conclude that caries severity had no significant association with duration of bottle feeding. Caries severity could be predicted from factors such as bottle-feeding practice and duration of breast feeding. In addition to healthy oral practice, oral health awareness programs, especially among parents and caregivers, should also high-light proper bottle-feeding practice and healthy diet in order to minimize prevalence and severity of ECC among preschool children.

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