Dietary Habits and Dental Caries Occurrence Among Young Children: Does The Relationship Still Exist?

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ABSTRACT

Introduction: The role of diet in the aetiology of dental caries occurrence has been questioned recently. **Aim:** This cross-sectional study was conducted to determine the relationship between dietary habits and dental caries among 105 children aged 2 to 5 years old in Kuala Lumpur. **Methodology:** Subjects were selected using convenient sampling method. Their body weight and height were measured and their dental check-up was performed by qualified dental nurses. A Structured questionnaire and 3-day food diaries were distributed to their parents/caretakers to obtain socio-demographic data, oral health practice and dietary habits of the subjects. The dft (decayed, filled teeth) score was used to describe dental caries incidence. **Results:** Caries was found in 36.6% subjects with mean dft score of 1.95±3.59 (range: 0-16). Energy (r=-0.334, p=0.008), carbohydrate (r=-0.353, p=0.005), fat (r=-0.325, p=0.01), protein (r=-0.264, p=0.038), and calcium (r=-0.470, p<0.001) intake were significantly correlated with dft score. The negative association between frequency of milk consumption and dental caries was lost after other confounding factors were considered. Dental caries incidence was associated with age of subjects started brushing their teeth (Adjusted OR=5.46, 95% CI=1.74 – 17.17). There was no relationship between frequency of daily meals (p=0.800) and sugary food/drinks consumption (p=0.489) with dental caries occurrence. **Conclusion:** Dental caries is prevalent among young children and related with dietary factors and oral health practices. Therefore, healthy dietary habits and oral health practice should be integrated in the oral health promotion targeted to parents/caregivers and young children in order to improve their dental health status.

Keywords: Dental caries, dietary habits, sugary foods, sugary drinks, young children

INTRODUCTION

Dental caries also known as tooth decay is a common disease among children all over the world particularly in developing countries[1]. It occurs with the presence of dental plaque as the result of enamel demineralization process which is stimulated by organic acids produced by oral bacteria such as *Streptococcus Mutans* and *lactobacilli*[2, 3]. These bacteria metabolised carbohydrate from the diet as substrate to produce organic acids that will lower the dental pH plaque and form biofilm structure which attached itself to the teeth structure[4, 5].

Various factors contribute to the occurrence of dental caries; they include condition of saliva (buffer capacity, composition, flow rate)[3, 5], fluoride exposure[3], oral health practice[6], biological/maternal factor[7], diet[4] (amount, composition, frequency)[5], fermentable carbohydrates[3, 5] and also socio-demographic (education level, income)[7]. In the 1900's, diet was one of the main factor blamed for dental caries. After World War 2, caries data among caries-free children had increased as a result of wartime diets[8]. Diet is one of caries aetiological factor through various sugary foods and drinks[9-11]. The theory of diet and caries occurrence was proven by the legendary Vipeholm study (1945-1954) where sugar consumption was found significantly related to dental caries occurrence[12]. In young children, their dietary habits were linked to caries development through several ways such as frequent consumption of sugary foods and drinks, prolonged bottle feeding and pacifier usage[13, 14]. However, for the last 40 years, the relationship between diet and risk of dental caries has been debateable as the decline of caries prevalence was observed among children in industrialized countries[15]. In some parts of the world, water fluoridation programmes and usage of fluoride-tooth paste were reported as the preventive factors which contributed to the declining trend in dental caries[8, 16, 17]. However, certain groups of the population are still suffering from dental caries and the prevalence is increasing in some of the

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developing countries that experienced changes in dietary practice[1, 16, 18].

In Malaysia, data on incidence of dental caries and its link to dietary habits among children less than 5 years of age is limited as compared to older age groups. The National Oral Health School Survey in 1995 reported that 87.1% of 5-year old children had dental caries[19]. The latest Oral Health National Survey conducted in 2005 showed that 76.2% of the children of the same age had dental caries[20]. Nevertheless, contributing factors particularly dietary habits as explaination of the high prevalence of dental caries among young children in Malaysia has not been reported. Hence, the aim of this study was to determine the relationship between dietary habits and dental caries among children aged 2 to 5 years old in Kuala Lumpur. It was hypothesized that dietary habits were related to dental caries among children aged 2 to 5 years.

MATERIAL AND METHODS

Data collection

This cross-sectional study was carried out amongst 105 Malay children aged 2-5 years from five kindergartens around Kuala Lumpur. The kindergartens and the subjects of the study were selected by convenience sampling. Based on the sample size calculation[21] and with the assumption of 10% rejection rate, 106 subjects were required. Prevalence of dental caries in a previous study among 565 children aged 12-38 months in Jakarta Indonesia was used in the formula[1]. Prior to data collection pre-visits were arranged to the selected kindergartens to meet up with the teachers and the teachers' assistants. An invitation letter to participate in the study was sent out to parents/caregivers of all children aged 2-5 years. The inclusion criteria included: All children aged 2-5 years with parental/guardian consent. Children with any chronic diseases; physical or mental disabilities or being non-Malaysian were excluded.

Ethical approval was obtained from the Medical Research Ethics Committee of Universiti Kebangsaan Malaysia Medical Centre while approval to conduct this study was granted by the respective kindergartens and the Kuala Lumpur City Council. The information sheet about the study was distributed to parents/guardians and their consents were obtained.

Anthropometric Measurements

Height and weight of participants were measured in minimal indoor clothing and without shoes. Body weight was measured to the nearest 0.1 kg using a digital weighing scale (Tanita 318, Japan). Height without shoes was measured to the nearest 0.1cm using a SECA portable body meter (SECA 206, Germany). The anthropometric status of the subjects was classified based on the World Health Organization Growth Reference [22].

Questionnaire and Food Diary

Questionnaires on socio-demographic data and oral health practice together with the 3-day food diaries were distributed to the parents/guardians. Teachers in the selected kindergartens assisted in distributing the questionnaires to the parents/guardians and re-collecting them. The structured questionnaire was designed based on previous studies[23, 24]. Then, the questionnaire was translated into Malay Language and pilot-tested for face and content validity among 15 Malay parents with children of similar age around Selangor. The value of cronbach obtained was 0.77. Amendments to the questionnaire were then made accordingly.

The questionnaire was divided into four sections: Socio-demographic profile, health status, dietary habits and oral health practices of the children. Parents/guardians were required to record their children's food intake in the food diary on two weekdays and one weekend. In order to guide parents/guardians in filling up the food diary, detailed and easy-to-understand instructions were attached with the food diary. In addition, a complete example of one day food diary was also attached with the instructions. Food intake by subjects on two weekdays at the kindergarten were recorded in a form by the teachers and supervised by the researcher. Data from food diaries and food records were used to analyse the energy and nutrient intake, average daily frequency of meals, consumption of sugary food and drinks. The 3-day food diary method was also applied in previous studies[13, 24, 25] to determine the frequency consumption of sugary foods and drinks. Nutritionist Pro TM 2003 software was used to perform the dietary analysis.

The frequency of food/drink consumption was calculated as one 'episode' when the food/drink was taken at one same time or consumed within a 30-minute interval after the previous food/drink intake. Calculation of the food and sugary drinks frequency per day was also based on the same method[25].

Dental Check-ups

The dental check-up of the subjects was performed by qualified dental nurses from the Department of Dental Public Health, Faculty of Dentistry, Universiti Kebangsaan Malaysia. The check-up involved a dental probe and mouth mirror under consistent illumination. The position of nurse and the children during the examination was in line with the

recommendation by WHO (1997)[26]. The dft (decayed, filled teeth) index was used to describe the incidence of dental caries.

The dft (decayed, filled teeth) and DMFT (decayed, missing and filled teeth) index are the indicators of dental caries for primary and permanent dentition respectively[27]. The dft index was applied for preschool children as they do not experience tooth loss caused by dental caries. The calculation of the dft and DMFT index involved the counting of teeth that has been affected with decay (decayed), loose tooth (missing) or teeth filling (filled). Zero dft/DFMT index shows that a person is caries-free whereas higher dft/DFMT signifies the incidence of caries[28, 29].

Subjects were regarded as having dental caries if there is a decay or dental filling even on only one tooth[29, 30]. The dental check-ups were followed by an oral health education session which also included demonstration on brushing of teeth by the dental nurses.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences software (SPSS) version 17.0. Data were presented as means, standard deviations and ranges. The normality of the data was assessed using Kolmogorov-Smirnov test. The Mann-Whitney test was performed to compare continuous and categorical variables while Chi square test was applied to test the different of two categorical variables. The association between continuous data was analysed by using the Spearman's Correlation test. The occurrence of dental caries was dichotomised by presence or absent of caries (Yes/No) and the quantitative data of dft index. Further analysis was carried out using binary logistic regression to calculate adjusted odd ratio (AOR) with the inclusion of confounding factors such as gender, parents' educational status and parents' income. P values of less than 0.05 were considered statistically significant.

RESULTS

Approximately 280 invitation letters and information sheets were distributed to the parents/guardians in the selected kindergartens. A total of 146 children were eligible to participate in this study but the final number of subjects included

Table 1.   Prevalence of Dental Caries and dft index and the associations with Socio-demographic characteristics

Characteristics	Total n (%)[†]	Had Caries n (%)	p value[a]	dft index (mean±S.D)	p value[b]
Gender					
Boys	59 (56.2)	22 (59.5)	0.64	1.82±3.11	0.79
Girls	46 (43.8)	15 (40.5)		2.11±4.17	
Total	105 (100.0)	37 (36.6)		1.95±3.59	
Age					
2-3 years old	36 (35.7)	4 (10.8)	<0.001	0.61±2.70	<0.001
4-5 years old	69 (64.3)	33 (89.2)		2.69±3.82	
Mother's education level					
Attend schools/Others	40 (39.6)	19 (51.4)	0.07	2.37±3.30	0.07
Diploma/Degree/Master/PhD	61(60.4)	18 (48.6)		1.67±3.78	
Father's education level					
Attend schools/Others	40 (41.2)	15 (42.9)	0.81	2.15±3.30	0.56
Diploma/ Degree/Master/PhD	57 (58.8)	20 (57.1)		1.75±3.80	
Mother's income (RM 1= USD 0.33)					
<RM 2000	44 (43.6)	19 (51.4)	0.30	1.86±3.13	0.30
RM 2000-3000	31 (30.7)	8 (21.6)		1.13±2.43	
> RM 3000	26 (25.7)	10 (27.0)		3.08±5.06	
Father's income (RM 1= USD 0.33)					
<RM 2000	34 (34.3)	11 (30.6)	0.83	1.09±1.85	0.64
RM 2000-3000	36 (36.4)	14 (38.9)		1.94±3.46	
> RM 3000	29 (29.3)	11 (30.6)		2.79±4.86	

[a]Chi Square test between socio-demographic characteristics and dental caries occurrence
[b]Spearman's correlation test for the association between socio-demographic characteristics and dental caries occurrence
[†]Total number of subject in some sections are inconsistence due to incomplete information from some of parents/guardians.

in the study was 105, giving a response rate of 72%. The remaining subjects did not return completed questionnaires and food diaries. Nonetheless, some parents did not answer some of the questions. The data were analyzed based on those who responded.

The socio-demographic characteristics and Body Mass Index (BMI) of subjects are shown in Table 1. Out of 105 subjects, 56.2% were boys and 43.8% of girls. The mean age of the subjects was 3.90 ± 1.05 years. A total of 35.7% of the subjects aged 2-3 years and 64.3% aged 4-5 years old. Most of the parents/caregivers had completed their education level at Diploma/Degree/Master/PhD. There were 43.6% of mothers and 34.3 % of fathers who had monthly income of less than RM 2000.

Table 2.   Associations of dental caries occurrence with nutritional status of subjects

Variables	N (%)[†]	Had Caries n (%)	p[a] value	dft index (mean±S.D)	p[b] Value
BMI status [c¥]					
Thinness	8 (8.9)	3 (8.8)	0.91	1.95±3.92	0.91
Normal	45 (50.0)	16 (47.1)		2.04±3.52	
At risk of overweight, Overweight, Obese	37 (41.1)	15 (44.1)		2.87±4.32	
Height-for-Age [d¥]					
Normal	57 (63.3)	18 (54.5)	0.19	1.91±3.90	0.22
Stunting	33 (36.7)	15 (45.5)		2.45±3.55	
Weight-for-Age [e¥]					
Normal	75 (83.3)	28 (84.8)	0.77	1.96±3.60	0.85
underweight	15 (16.7)	5 (15.2)		2.87±4.57	

[a] Chi Square test between nutritional status and dental caries occurrence
[b] Spearman's correlation test for the association between nutritional status and dental caries occurrence
[c] Z scores: Obese (>+3 SD); Overweight (+2 SD) – (>+3 SD); Risk of overweight (+1 SD – (+2 SD); Normal (-1 SD – (+1 SD); Thinness (-2SD) – (-1 SD); Severe thinness (<-3 SD), these categories were re-grouped for purpose of statistical analysis
[d] Z scores: Stunting (<-2 SD) height-for-age
[e] Z scores: Underweight (<-2 SD) weight-for-age
[¥] World Health Organization Growth Standard (2006)
[†] 15 subjects (14.3%) were not measured anthropometrically; 6 subjects did not attend the kindergarten during the measurement days and 9 subjects had left the kindergarten.

Table 3.   The correlation between the mean nutrients intake with dft score

Variables	Mean±S.D	r value	p[a] value
Nutrients/Energy Intake			
Energy Intake (EI) (kcal)	1163±427	-0.334	0.008
% of RNI	128	-0.473	<0.001
Carbohydrate (g)	145±57	-0.353	0.005
Fat (g)	47±19	-0.325	0.010
Protein (g)	41±13	-0.264	0.038
% of RNI	184	-0.355	0.005
Calcium (mg)	657±400	-0.470	<0.001
% RNI	132	-0.494	<0.001

[a]Spearman's correlation test for the association between variables

Table 4. The correlation between the mean nutrients intake with dft score

Dietary Habits	Had caries n (%)	No Caries n (%)	Total n (%)†	p[a]	OR (95% CI)
Frequency of meal consumption in 24 hours					
1-4 times	10 (27.0)	12 (18.8)	22 (21.8)	0.332	0.62
>4 times	27 (73.0)	52 (81.3)	79 (78.2)		(0.24-1.63)
Sucking pacifier for the past 7 days					
Yes	8 (21.6)	11 (17.5)	19 (19.0)	0.383	0.77
No	29 (78.4)	52 (82.5)	81 (81.0)		(0.28-2.12)
Frequency of juice/milk consumption and during bedtime					
Almost every time	22 (59.5)	39 (60.9)	61 (60.4)	0.884	1.06
Seldom/Never	15 (40.5)	25 (39.1)	40 (39.6)		(0.47-2.43)
Consumption of Pre-chewed food					
Yes	1 (2.9)	5 (8.1)	6 (6.2)	0.307	2.98
No	34 (97.1)	57 (91.9)	91 (93.8)		(0.33-26.61)
Frequency of milk formula consumption in bottle/cup					
Seldom	7 (23.3)	4 (7.1)	11 (12.8)	0.032	0.25
Often	23 (76.7)	52 (92.9)	75 (87.2)		(0.07-0.95)
Consumption of milk before bed time					
Yes	6 (26.1)	8 (21.6)	14 (23.3)	0.691	0.78
No	17 (73.9)	29 (78.4)	46 (76.7)		(0.23-2.64)
Given sweets as reward					
Yes	8 (22.9)	10 (16.7)	18 (18.9)	0.458	0.68
No	27 (77.1)	50 (83.3)	77 (81.1)		(0.24-1.91)

[a] Chi Square test between dietary habits and dental caries prevalence
† Total number of subject in some sections are inconsistence due to incomplete information from some of parents/guardians.

The percentage of subjects with dental caries was not statistically significant between genders. However, a significantly greater percentage of subjects in older age group had dental caries (89.2%) compared to the younger age group (10.8%). A slightly higher percentage of caries incidence were observed in the subjects whose parents had lower education level (51.4%) compared with their counterparts whose mothers had higher level of education (48.6%). However, this difference was not statistically significant.

Results from the anthropometric assessments show that half of the subjects (50%) had normal BMI-for-age while 41.1% was at risk of overweight, overweight and obese (Table 2). Only 8.9% was classified as moderately thin. More than one-third (36.7%) of the subjects were stunted and 16.7% of subjects were underweight. Lower dft scores were observed among thin subjects compared to their counterparts who were normal, at risk of overweight, overweight or obese. However, this difference was not statistical significant.

The nutrient analysis shows that subjects of this study had adequate nutrients intake as recommended by Recommended Nutrients Intake of Malaysia (RNI)[31] for energy and selected nutrients (Table 3). There were significant associations in the mean intake of all nutrients with dft score. Energy and calcium intake were strongly associated with dft score.

Dietary habits and Dental Caries Occurrence

Table 4 shows the prevalence of dental caries occurrence according to dietary habits of the subjects. The majority of subjects (78.2%) had daily meals more than four times a day and about less than a quarter (21.8%) of them had less than four times a day (Table 4). Almost 19% of subjects were given pacifier and 60.4% of subjects were put to bed with bottle of juice/milk at most bed times. Only 6.2% were given pre-chewed food by their parents/caregivers and 85.7% had stopped being breastfed. A total of 18.9% of subjects received sweets as rewards from their parents/guardians.

There were no associations between these dietary practices with dental caries. However, the frequency of formula milk consumption was positively associated with dental caries occurrence (p=0.032). Caries free subjects were more likely to report often consumed milk (91.9%) compared with of their counterparts with caries (76.7%). The odds of having caries experience was lower (OR=0.25, 95% CI=0.07-0.95) among subjects who consumed milk more frequently. Almost 10% of subjects consumed sugary food/drinks more than 4 times a day. The average of daily frequency of sugary food/drink consumption was not significant between subjects with and without caries (p=0.489) (Figure 1).
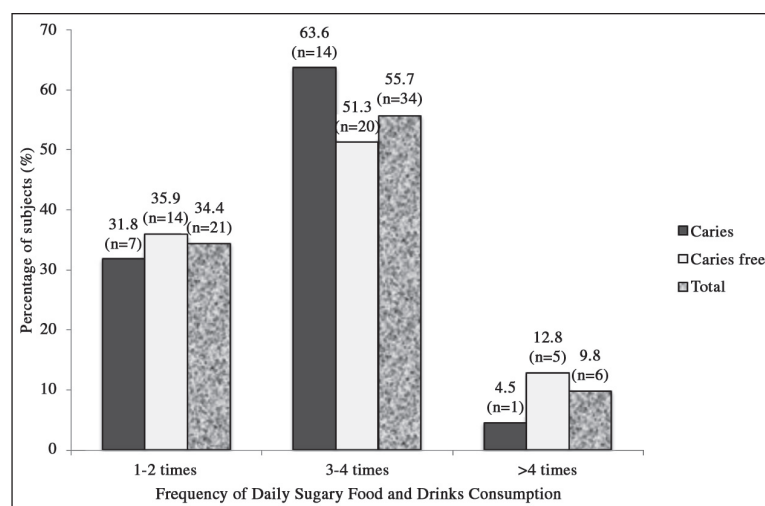

Figure 1.   Frequency of Daily Sugary Food and Drinks Consumption
and Dental Caries occurrence, % (n)

Table 5.   The prevalence of dental caries among the subjects according to their oral health practices

Oral health practices	Had caries n (%)	No Caries n (%)	Total n (%)†	p[a]	OR (95% CI)
Brush own teeth					
Yes	29 (78.4)	47 (78.3)	76 (78.4)	0.996	1.00
No	8 (21.6)	13 (21.7)	21 (21.6)		(0.37-2.70)
Age of started tooth brushing (years)					
< 1 - 2	18 (56.3)	49 (84.5)	67 (74.4)	0.030	4.24
After 2	14 (43.8)	9 (15.5)	23 (25.6)		(1.56 - 11.47)
Frequency of tooth brushing per day					
Once	12 (32.4)	17 (27.4)	29 (29.3)	0.596	0.79
Twice or more	25 (67.6)	45 (72.6)	70 (70.7)		(0.32 - 1.91)
Duration of brushing of teeth					
One minute or less	24 (64.9)	40 (64.5)	64 (64.6)	0.972	0.99
More than 1 minute	13 (35.1)	22 (35.5)	35 (35.4)		(0.42-2.31)
Use toothpaste during brushing teeth					
Yes	36 (97.3)	60 (95.2)	96 (96.0)	0.612	0.56
No	1 (2.7)	3 (4.8)	4 (4.0)		(0.06-5.54)

[a] Chi Square test oral health practices and dental caries prevalence
†Total number of subject in some sections are inconsistence due to incomplete information from some of parents/guardians

Oral Health Practices and Dental Caries Occurrence

Data on oral health practices by subjects are shown in Table 5. The majority of the subjects (78.4%) brushed their teeth on their own. About three-quarters of the subjects (74.4%) had started brushing their teeth at less than 2 year of

age and a quarter (25.6%) did so after 2 years. More than half (70.7%) brushed their teeth twice or more a day while 29.3% only once a day. Subjects who were caries-free were more likely to brush their teeth at an early age i.e. less than 1 year – 2 (84.5%) compared with those with caries (56.3%) (p=0.030). More than half (64.6%) of the subjects spent one minute or less brushing their teeth. Almost all of the subjects (96.0%) used tooth paste to brush their teeth. There was significant association between the age of subjects when they started brushing their teeth, with dental caries risk even after gender, parents'/guardians' educational level and income were taken into consideration (Table 6). Those who brushed their teeth later had 5.46 times more risk to have dental caries (OR=5.46, 95% CI=1.74 – 17.17) than those who did so earlier. After adjustment of confounding factors, binary logistic regression analysis shows that the risk of dental caries occurrence was not significant with frequency of milk consumption (Table 6).

Table 6.   Binary Logistic Regression Model for amount of dietary habits and oral health practice

Parameter	Crude OR	(95% CI)	Adjusted OR^a	(95% CI)
Frequency of milk formula consumption in bottle/cup	0.25	(0.07-0.95)	0.65	(0.23 – 1.84)
Age of tooth brushing started (years)	4.24	(1.56 - 11.47)	5.46	(1.74 – 17.17)

^{a}Adjusted OR for gender, parents educational status and parents/guardians income.

DISCUSSION

The present study has yielded important information on the dietary habits and other factors that are related to dental caries occurrence among children aged 2 to 5 five years. This study shows that more than a third of the subjects had dental caries experience with mean dft index of 1.95±3.59. The percentage of subjects with dental caries in the present study was lower compared to previous studies. A recent study conducted by Zahara *et al*. [28] among children aged 5 to 6 years in Kuala Lumpur showed 62% of subjects had caries with dft score of 3.72. In Thailand, 95.4% of 2-12 years old children had dental caries with dmft (decay, missing, filling primary teeth) score of 7.4±4.6 [6]. This difference may be due to subjects recruited in the current study were younger. Similar trend was observed in the study of which the older age group were more likely to experience dental caries compared to the younger age group. Previous studies in Hong Kong[32] and Nigeria[33] also found similar results. Colonization of oral bacteria i.e. *Streptococcus Mutans* is high as the age increases which contributes to higher risk of dental caries [34]. Children with high colonization of *Streptococcus Mutans* are more prone to experience dental caries than children with lower level of *Streptococcus Mutans* [35].

To the best of our knowledge, the latest study on dental caries among children less 5 years in Malaysia was conducted by Chin *et al*. [36] among children aged 36 -71 months in Kelantan, Malaysia. They reported that a higher percentage of subjects with dental caries (88.7 %) with dft index of 7.3 ± 5.01. The majority of their subjects (53.6%) brushed their teeth once a day and 85.7% consumed sugary food/drink of more than 4 times per day. In contrast, this findings show that the majority of the subjects (70.7%) brushed their teeth more than twice a day and only 9.8% had sugar exposures of more than 4 times a day. Moreover, subjects recruited in their study were those who attended dental clinics and most likely had dental problems. These differences may explain a higher percentage of subjects with dental caries in the aforementioned study.

There was no significant difference between dental caries occurrence between genders. This finding is consistent with the finding of previous studies among children aged 3.9±0.7 years in Hong Kong [32] and children aged 3-5 years in Saudi Arabia [18]. Studies in the USA [37] and Australia [7] reported that dental caries prevalence was lower in children of more educated parents. We found a similar trend here but it did not reach a statistical significance (p=0.07) which may be due to the small sample size. Moreover, there wasn't any significant association between household income and dental caries occurrence. In contrast, Sugito *et al*. [1] reported that that children aged 12-38 months from families with higher socioeconomic levels in Indonesia generally had lower dental caries incidence than those from the lower socioeconomic levels. In the present study, we did not take into account the number of children/dependents in a family. This factor may affect the ability of families to provide a healthy diet and oral health care for their children.

In the present study, we observed that there is no statistical significant association between dft index and anthropometric status of the children. Findings from previous studies show the relationship between BMI and risk of dental caries were inconsistent [38-42]. Studies among children with primary dentition in the USA [40, 41] and China [42] show, no association between childhood obesity and caries experiences. However, studies in Brazil [43] and in Thailand [44] reported that malnourished preschoolers were more vulnerable to dental caries compared with their counterparts.

It was hypothesized that malnutrition compromised tooth integrity, thus increase risk for dental caries [45]. Studies in Finland [46] and Germany [47] suggested that obesity was a predicting indicator for caries experience. A longitudinal study with a bigger sample size is needed to investigate the association between nutritional status with primary and permanent dentition.

The results of the present study show significant negative correlations between energy, carbohydrate, fat, protein and calcium intake with the incidence of dental caries. These negative associations may be because most of the children in the present study consumed milk as their main food item in their diet. Based on the food diaries collected, most of the children drank milk twice or more per day. Full cream milk is rich in energy, carbohydrate, protein, fat and calcium [48]. Although milk contains carbohydrate i.e. lactose, it has protective factors against dental caries [13, 49]. Calcium is described as an important component in the process of repairing teeth and dental remineralisation process along with phosphate and fluorine [50]. Protein intake was also found to be negatively correlated with caries occurrence. Dietary protein has been associated with dental caries prevention by the mechanism of salivary polymorphic protein towards the binding capacity of bacteria induced-caries like *Streptococcus Mutans* [51].

The negative correlations between nutrients intake and caries are consistent with the finding in this study that children who often consumed milk had lower incidence of caries compared to those who seldom did so. Milk has low cariogenic potential and contains cariostatic factors against dental caries [52]. Cariogenic potential can be defined as the foods' ability to drop plaque pH significantly, demineralise the enamel or can lead to more caries occurrence [49]. Many studies showed that milk has potential caries protective factor as it contains calcium, phosphorus and casein which are believed to inhibit the occurrence of caries [16, 49]. The mechanism of milk as caries protective factor can be explained by high buffering capacity characteristic which balances the demineralization and remineralisation process of saliva [5, 13]. Nonetheless, the cariogenicity potential should be considered along with the frequency and manner of consumption so that the 'effective cariogenicity' can be determined. In this study we did not ask the parents/guardians to record the duration of milk drinking neither to specify whether milk was taken in bottle or cup in the food diary. Drinking milk in cup is highly recommended for children starting from their first birthday as this can reduce the prolonged contact of children teeth with milk at the bottle pacifier [53]. The variability of milk consumption manner and other factors may interfere with the result of positive association between milk and dental caries occurrence [49]. This was proven when frequency of milk consumption did not show significant association with caries when other confounding factors were taken into consideration in the multivariate analysis.

The present study did not find any significant relationship between the frequency of daily meal and sugary food/drinks consumption with dental caries occurrence. This result is in line with the earlier study by Zahara *et al.* [28] which found no statistical significant relationship between frequencies of sugary food and drink consumption with dft score. The insignificant relationship between daily meal and sugary food/drinks consumption with dental caries occurrence can also be explained by the cross-sectional design of the study. Cross-sectional study may not reflect the true dietary habits of the children before dental caries occurred as dietary habits of several months earlier are responsible for the current caries development. The parents may also have changed the food served to their children due to the presence of dental caries on the children's teeth. Like other studies that require subjects or their parents to write down the diet intake, the result of food intake may suffer from biases as the parents may tend to report socially acceptable foods [54] and underreport cariogenic foods.

We found that the younger the age of the children when they started to brush their teeth, less likely were to experience dental caries. This finding is in agreement with previous studies conducted among children in different populations in Saudi Arabia [55] and Hong Kong [32]. This may be related with the effect of cariogenic bacteria removal during tooth brushing [32]. In addition, the American Academy of Pediatric Dentistry [53] recommends that oral hygiene measures in children should be no later than the time of eruption of the first primary tooth i.e. one year old. Parents should be educated on dental health as this will help them to inculcate good oral health practice among their children. They should be advised on the usage of fluoride tooth paste, dietary control (reduce consumption and frequency of cariogenic sugars in food and drinks), plaque control (by highly effective tooth brushing twice a day) and having oral examination more frequently than once a year [56].

The main limitation of this study is the study design employed which should be addressed. The nature of cross-sectional design is that it does not take into account the previous dietary habits and dental hygiene practices which may have been changed when the study was conducted. Oral health education is usually integrated as one of the activities in most kindergartens in Malaysia for example, dental checkups and demonstration of tooth brushing by dental nurses and tooth brushing routine at a designated area in kindergartens. It is more beneficial for future studies to apply longitudinal and cohort study designs so that the dietary and oral health practice habits of the subjects can be identified when dental caries incidence occur. Another limitation of this study is the small sample size recruited which only involved Malay children from five kindergartens in Kuala Lumpur, therefore, it limits the generalibility of our findings to the general population. Finally, there were parents/guardians who did not answer some of the questions in the questionnaire. Due to limited time for data collection, we did not contact them. It is possible that those who

completed the questionnaire had better dietary and oral health practices than those who did not. It would be beneficial to replicate this study with a larger sample size to determine risk factors of dental caries occurrence among young children. Parents/guardians should be contacted if their questionnaires are not completed.

CONCLUSIONS

This study has shown that more than a third of the young children aged 2 to 5 had dental caries. On the whole, the findings presented in this study suggest that several dietary habits and oral health practices are associated with dental caries occurrence. Thus, it is important for the parents or caretakers to enhance their oral health knowledge and inculcate good practices on dietary habits and oral health practices for their children in order to prevent dental caries at young age.

ACKNOWLEDGEMENTS

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