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Original Article

Nutritional status and early childhood caries among preschool children in Pasir Mas, Kelantan, Malaysia

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Abstract This is a cross-sectional study in a representative sample of preschool children from 12 preschools (TADIKA KEMAS) Pasir Mas, Kelantan, Malaysia. Data on socioeconomic status and sources of water supply at home were collected through interview with mothers. Children's anthropometric data (height and weight) and body-mass-index-for-age (BMI-for-age) was calculated. Oral examinations of ECC status was based on the dmft index (WHO, 1997). The results showed mean carious teeth were very high (dmft 11.1±4.8) and almost every preschool child was affected with ECC (prevalence 98.1%). The majority were in "high caries" category (i.e. dmft $\geq$7) and about 51.4% of preschoolers was underweight and only a few was overweight/obese. Preschool children with high caries mostly were underweight and normal of BMI. The BMI-for-age, household income and household expenditure for food were significant correlation with ECC experience (p<0.05). However, logistic regression showed only family income was a significant factor to ECC.

Keywords: Early childhood caries; nutrition; oral health; preschool children.

Introduction

Early childhood caries (ECC) is a serious public health problem especially in disadvantaged communities in both developing and industrialized countries (Davies, 1998). Drury *et al*. (1999) defined ECC as the presence of one or more decayed (non-cavitated caries and cavitated lesions), missing teeth (due to caries) or filled tooth surfaces in any primary tooth in a preschool-age child between birth and 71 months of age. Children who are suffering from ECC may experience pain, chewing difficulties, speech problems, general health disorders and psychological problems (Mattos-Graner *et al*., 1998; Berkowitz, 2003). In fact, chronic dental pain may cause avoidance of foods and lead to malnutrition. In addition, treatment of ECC is expensive because it may require general anaesthesia for multiple extractions and new caries tend to occur (Tinanoff, 1998).

Thus diet, nutrition and ECC are inextricably linked however there was limited literature reported (Clarke *et al*., 2006). Palmer (2003) reported that malnourished children have been shown to have retarded maxillary growth and general delay in tooth development and eruption when compared to nutritionally normal

children. It is observed by Midda and Konig (1994) that children from the lower socioeconomic status group had more growth retardation, lower average weight and greater bone retardation. They also had some delays in tooth eruption while compared to children in higher socioeconomic status. Furthermore, Ogden *et al*. (2006) has also reported that children from low socioeconomic status tend to have high caries experience. It was supported by a study in Columbia (Ramos-Martinez *et al*., 2010) and in other developing countries (Cooper, 2002; Locker, 2000). However, in developed countries there was a strong association between high caries and high nutrition (overweight/obese) of body mass index (Hilgers *et al*., 2006; Willershausen *et al*., 2007). The high BMI was associated with high consumption of sugar beverages, candies, chips and cookies which also increased caries risk.

In addition, studies on nutritional status in relation to dental caries are very limited in Malaysia. To our knowledge, there were no previous studies exploring the relationships between nutritional status and ECC among preschool children. The objectives were to assess the nutritional status (i.e. BMI), to determine the prevalence of ECC and explore the association between ECC and selected variables such as BMI-for-age and socio-economic status.

Materials and methods

This was a cross-sectional study and was conducted in August 2009 - January 2010 (6 months). The study was performed at 12 randomly selected clusters of community preschools (called TADIKA KEMAS) in Pasir Mas, Kelantan, Malaysia. The inclusion criteria were all enrolled preschool children aged 5-6 years old who were residents in Pasir Mas district most of the time since birth. All children who met the inclusion criteria were recruited from the selected clusters until the number exceeded the minimum sample size needed to give a 95% confidence and 5% sampling error. The final sample size involved 294 preschool children and their parents. Informed consent was obtained from parents. The study protocol was approved by the Ethics Committee of University Malaya (DF 00801/022 P).

Anthropometric measurements taken were body weight and height. All measurements were done by one investigator to avoid inter-observer error and to maintain uniformity and accuracy in techniques. Height was measured by a stadiometer (SECA 220, Germany) to the nearest 0.1 cm. Weight was measured while the child was wearing minimum clothing recorded to the nearest 0.1 kg using a digital scale (TANITA HD319, Japan). All measurements were taken twice for each child and the average value was used. The body mass indices (BMI) for age were calculated and classified according to standard deviation unit tables of the WHO standard (Z-scores) (WHO, 2006).

The oral examination was carried out on a school chair. The light source was a battery operated torch light. A fresh set of batteries were replaced after five hours of use. Only mouth mirrors were used for examination. The subjects were first asked to brush their teeth before examination. The criterion used for ECC in this study was “any signs of decay involving the primary maxillary incisors” based on the definition of ECC as the “occurrence of any sign of dental caries on any tooth surface during the first 3 years of life”. The caries index used was dmft (WHO, 1997). The index was chosen because the subjects in this study were below 6 years old. So, any missing tooth was considered more likely to be due to caries unless other reasons such as trauma were implicated.

Statistical analysis

SPSS version 18 was used for data analysis. Descriptive statistics (mean (sd), median (IQR)) was reported for numerical variables; and frequency and percentages for categorical variables. The independent t-test was used to see the difference

between with early childhood caries (numerical) and BMI-for-age (numerical). For BMI-for-age (categorical) and caries (categorical), the chi-square test was used. Pearson's correlation was used to analyze the correlation between nutritional status (BMI-for-age) (numerical) and selected variables with ECC (numerical). Logistic Regression was used for uni- and multivariate analysis to see the factors of ECC with independent variables. The dependent variable was caries (dmft) while nutritional status (BMI-for-age) and socio economic indicators (parent's level of education, parent's age, parent's occupation, household size, household income, allocated money to buy food sources, type of household water supply) were independent variables. The significance level was set at $p<0.05$.

Results

Table 1 shows the socio economic background of the family. The mean age of mothers and fathers was about 36 and 40 years respectively. Mean family members were 6.12 and median monthly household income was RM600 (IQR=8200). It was noted that the income range was very large i.e. from RM300 to RM8500. Of the total family income, about 34.8% was spent on food (mean RM471.2, sd 544.8) (Table 1). There were slightly more female (54%) than male children (46%). All subjects involved in this study were from the Malay ethnic group. Most of the mothers and fathers studied up to secondary level which is equivalent to about 11 years of formal education (67% mothers; 62% fathers). Most of the mothers in this study were housewives (71%). Nearly all fathers (99.0%) were employee and only one percent was employer. About one-half (49.0%) of the sample used the well as their main source of water supply at home followed by piped water (44%).

Table 2 the mean number of carious teeth was about eleven per child (dmft 11.1 $\pm$ SD 4.8). We noted that the range was very big i.e. from zero to a maximum of 20. The majority of children who had caries (80.6%) were in the "high category" (dmft $\geq$7) followed by "moderate" (11.6 %) and very few (7.8%) in the "low" caries category. In fact no child was caries free. The percentage of girls in the high caries category (i.e. dmft $\geq$7) was higher in girls (43.9%) as compared to boys (36.7%). While, there was no significant different between gender and caries experience (t=0.422, $p>0.05$). The prevalence of over- or under nutrition among the preschool children here based on anthropometric measurements (BMI-for-age) according to the WHO (2006) classification. Just over one-half (55.8%) had normal BMI-for-age, while about 5.5% were overweight and 2.7% obese. The total combined obesity/overweight children in the sample were 8.1%. However, quite a large proportion ie more than one-third (36.1%) were underweight (thin). By gender, there were more overweight/obese girls (8.8%) than boys (7.4%). Similarly, the proportion of underweight/severely thin boys (37.8 %) was more than girls (34.6%). However, there was no significant different between gender and BMI-for-age (t= -0.683, $p>0.05$).

Table 3 shows the distribution of early childhood caries severity category against nutritional status. The majority of those with high caries (i.e. dmft $\geq$7) are either underweight (thin / malnourished) or in the normal weight category. Only a few of the preschool were overweight and high caries. The Pearson correlation of early childhood caries, BMI-for-age and socioeconomic factors showed in Table 4. There were significant correlation between early childhood caries with BMI-for-age (r= -.097, $p<0.05$), household income (r= -.214, $p<0.01$), monthly household expenditure for foods (r= -.121, $p<0.05$). While, for the logistic regression, only household income was the significant factor of early childhood caries. Preschool children from low family income has the odds 1.0 times to have caries (95% CI, 1.38-36.75) as compared to those who from high family income.

Table 1 Socioeconomic status (SES) of sample (n=294)

Socioeconomic background	Mean	SD	Min.	Max.
Mothers age	35.8	6.4	19	56
Fathers age	39.7	6.8	25	60
Family members	6.12	1.9	3	13
Monthly household expenditure for food (RM)	471.2	544.8	100	6580
Monthly household income (RM)	Median	IQR	Min.	Max.
	600	8200	300	8500
SES indicators	**n (%)**			
Sex (preschool)				
Male	135 (45.9)			
Female	159 (54.1)			
Ethnicity				
Malay	294 (100)			
Level of education	Mothers	Fathers		
Primary	37 (12.6)	41 (13.9)		
Secondary	198 (67.3)	181 (61.6)		
Tertiary	59 (20.1)	729 (24.5)		
Jobs	Mothers	Fathers		
Housewives/ unemployed	208 (70.7)	0		
Employee	51 (17.3)	291 (99.0)		
Employer	35 (11.9)	3 (1.0)		
Source of water supply at home				
Well	144 (49.0)			
Rain	1 (0.3)			
Others	19 (6.5)			
Piped water	130 (44.2)			

Table 2 Prevalence of early childhood caries and nutritional status of preschool children

ECC prevalence		
Caries experience:		
	Mean	(sd)
Overall dmft	11.1	4.8
Decayed teeth (dt)	11.0	4.8
Missing teeth (mt)	0.06	0.4
Filled teeth (ft)	0.03	0.4
Caries experience category:		
	n	(%)
Caries free (dmf 0)	0	0
Low (≤3)	23	7.8
Moderate (4-6)	34	11.6
High (≥7)	237	80.6
Nutritional status		
BMI-for-age	Mean	(sd)
	14.6	2.2
BMI-for-age category:		
	n	(%)
Obese	8	2.7
Overweight	16	5.4
Normal	164	55.8
Underweight	106	36.1
Total	294	100

Table 3 Distribution of ECC according to BMI-for-age

BMI-for-age category		Caries category			Total
		Low (Below 3)	Moderate (4-6)	High (>7)	
Obesity	Count	0	0	8	8
	% within BMI category	0%	0%	100.0%	100%
	% within caries category	0%	0%	3.4%	2.7%
Overweight	Count	2	2	12	16
	% within BMI category	12.5%	12.5%	75%	100.0%
	% within caries category	8.7%	5.9%	5.1%	5.4%
Normal	Count	15	24	125	164
	% within BMI category	9.1%	14.6%	76.2%	100.0%
	% within caries category	65.2%	70.6%	52.7%	55.8%
Underweight	Count	6	8	92	106
	% within BMI category	5.7%	7.5%	86.8%	100.0%
	% within caries category	26.1%	23.5%	38.8%	36.1%
Total	Count	23	34	237	294
	% within BMI category	7.8%	11.6%	80.6%	100.0%
	% within caries category	100%	100%	100.0%	100.0%

χ^2= 7.157, df=6, p>0.05

Table 4 Association between ECC with BMI-for-age and socio-economic factors

Indicators	Early childhood caries (ECC)
BMI-for-age	-0.097*
Mothers age	-0.027
Fathers age	-0.006
Family members	0.074
Monthly household income (RM)	-0.214**
Monthly household expenditure for food (RM)	-0.121*

* Level of significant was set at 0.05
** Level of significant was set at 0.01

Discussion

The source population was Pasir Mas district in Kelantan where the majority was from the lower socio-economic category and had poor access to piped water supply. The preschools involved (TADIKA KEMAS) were partially funded by the federal government and attended by children aged 4-6 years old from the nearby communities with a minimum monthly payment by the parents or the guardians. From the socioeconomic distribution of the sample population (Table 1), although there was an occasional high income parent in the sample, most of families with large family members (mean 6.12); average income just over the poverty line; more than one-third of income were spent on food; most had only basic secondary education and many relied on wells for their main water supply.

The present study found a large proportion of underweight preschool children despite the problem of increasing obesity in urban areas in Malaysia and most developed countries. This finding indicates the inequity in the distribution of health, wealth and disposable incomes between groups (rich and poor) whereby pockets of groups living below the poverty line can affect health outcomes. Thus, the control of underweight should be made a priority towards children should have special nutritional needs because of their extensive growth and development (Blössner *et al.*, 2006).

The present study showed that the problem of ECC in this population was

indeed very serious and acute based on 99% was affected by caries. In fact, the majority (80.6%) of them were categorized as “high caries” (i.e. dmf>7) and every child had an average of eleven rotten teeth each. Compared to other populations, for example In the Commonwealth of Independent States, the mean dmft of 5 year old children ranged from 4.4 in Lithuania and 7.4 in Belarus (Blinkhorn and Davies, 1996). In five urban areas in China, the mean dmft ranged from 3.7 to 7.6 (4) and in Ulaanbaatar Mongolia, children aged 4.5 years old had mean dmft of 6.5 (Karvonen *et al*., 2003).

However, the prevalence in present study (80.6%) was slightly lower than the 90% caries prevalence among 4 year old children in northern Philippines (Cariño *et al*., 2003). If at all there was any evidence of improvement in Pasir Mas, an earlier study in 2005 involving 279 preschool children aged 4-6 years, reported an even higher mean dmft of 12.2 (Badariah, 2005). In other words there was some evidence of a decline of mean dmft of about 11.6 from 2005 to 2010 which is however has to be further improved.

This study found that low body mass index was associated with caries. Kanchanakamol *et al*. (1996) showed that there was relationship between malnutrition (PEM), enamel hypoplasia and primary dentition caries. Other cross-sectional study showed increased primary dentition caries levels in stunted children (Cleaton-Jones *et al*., 2000).

Many studies showed that socioeconomic status is an indicator of oral health (Sampaio *et al*., 2000). For example, the incidence and prevalence of oral disease decrease when socioeconomic status increases (Reisine and Psoter, 2001). The present study also showed that ECC was significantly associated with household income. These results are comparable with the findings of Marshall *et al*. (2007) and Casanova-Rosado *et al*. (2005). However, logistic regression analysis in the present study indicated that the body mass index was not a good factor of ECC. Similar result was reported by Chen *et al*. (1998) as there was no significant association in the dmf score of three-year-old children with their BMI. It was probable that three-year–old children had insufficient lead times to develop the full caries experience and body mass index as compared to the six-year-old children in the present study. It must be noted that caries is a slow progressing disease that takes many years to progress from initial white spot to a frank cavity affecting dentine.

Conclusions

Thus we conclude that the present study found significant associations between early childhood caries (dmft) and household income (p<0.05). There was no significant association between ECC and body mass index. Evidence from the present study indicated that preschool children from low family income should be the prioritized group for intervention in order to reduce ECC in preschool children. The other factors that should be considered are large family size and type of water supply at home.

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