Edward Chin-Man Lo[*]
BDS, MDS, PhD, FCDSHK (Community Dentistry), FHKAM (Dental Surgery)
Eva Kwok-Ying Loo[*]
BDS, MMedSc
Chun-Kei Lee[*]
BDS, MDS, MFGDP(UK), M Paed Dent RCS (Edin), FRACDS, FCDSHK (Paediatric Dentistry), FHKAM (Dental Surgery)

* Faculty of Dentistry, The University of Hong Kong, Hong Kong

ORIGINAL ARTICLE

Dental health status of Hong Kong preschool children

ABSTRACT

Objectives. To describe the dental health status of preschool children in Hong Kong, and to investigate the effects of selected socio-demographic factors and oral health–related behaviors on the dental health of the children. **Methods.** The study population was Chinese preschool children. The sampling frame was kindergartens with an enrolment of 70 children or more, located on Hong Kong Island. Through stratified random sampling, 12 kindergartens were selected. All children attending grades 1 and 2 in the kindergartens were invited. Children with parental consent were clinically examined in the kindergartens in March 2007 by one of two calibrated examiners using a disposable mouth-mirror attached to an intraoral LED light and a ball-ended probe. Diagnostic criteria for dental caries followed those recommended by the World Health Organization. A questionnaire on the child's socio-demographic background and oral health–related behaviors was completed by the parents. **Results.** A total of 1513 children were invited and 1343 (89%) were examined. Their mean (standard deviation) age was 3.9 (0.7) years and 51% were boys. Around one third (35%) of the children had experienced dental caries. The mean decayed, missing or filled teeth (dmft) score was 1.5, increasing from 1.2 at age 3 to 2.0 at age 5 (analysis of variance, P=0.016). Active decay (dt) accounted for 90% of the dmft score. Higher dmft scores were found in children who were born in Mainland China or came from lower socio-economic classes. Children who had poorer dietary or toothbrushing habits also had more dental caries. **Conclusion.** Prevalence of dental caries among the Hong Kong preschool children was not high but the severity of caries varied with the children's socio-demographic background, and their dietary and toothbrushing habits.

Key words: Asian continental ancestry group; Child; Data collection; Dental caries; Dentition, primary

Introduction

Prevalence and severity of dental caries in the permanent dentition of primary school children in Hong Kong is low. As reported by the Hong Kong Department of Health, the prevalence of caries experience among 12-year-old children in 2001 was 38% and their mean decayed, missing or filled teeth (DMFT) score was 0.8 [1]. According to the World Health Organization (WHO) criteria, Hong Kong is classified as a place with a very low dental caries level in the world [2]. However, the dental caries situation of the preschool children in Hong Kong is worse. In the oral health survey conducted in 2001 [1], it was found

Correspondence to:
Prof. Edward Chin-Man Lo
Faculty of Dentistry, The University of Hong Kong , 34 Hospital Road, Hong Kong

Tel : (852) 2859 0292
Fax : (852) 2858 7874
e-mail : edward-lo@hku.hk

that the prevalence of dental caries experience among the 5-year-old children was 51% and their mean dmft score was 2.3. Few surveys have been conducted in younger preschool children in Hong Kong; the latest one carried out in late 1997 reported a mean dmft score of 0.9 among the 4-year-olds surveyed [3].

There has been a decline in the prevalence and severity of dental caries experience among school children in most of the developed countries during the last three decades [2,4]. However, the decline may not continue when a low level of dental caries is reached [5]. The decline of dental caries in the developed countries has been attributed to a number of factors, including community water fluoridation, widespread use of fluoride toothpaste, changing lifestyles, and improved self-care practices [2,6]. In contrast to a clear picture of decline in dental caries in permanent teeth among school children and adolescents over the past 30 years, little information is available on the trends among preschool children. In fact, some observations indicate that caries prevalence in the primary dentition may have stabilized or is increasing slightly in some populations [7]. Thus, it is important to regularly conduct epidemiological surveys to monitor the dental caries situation of the preschool children in Hong Kong.

It is well-known that dental caries is a disease caused by acids produced by plaque bacteria, as a by-product of their metabolism of fermentable carbohydrates, which then diffuse into dental hard tissues and dissolve their mineral contents [8]. However, the explanation as to why some young children develop dental caries is a complex one. In a recent systematic review of epidemiological studies, over 50 risk factors were found to be related to caries prevalence or severity affecting the primary dentition of children below the age of 6 years [9]. The main culprits include socio-demographic factors such as family income and parental education level, dietary factors particularly a high frequency of between-meal sugar intake and the use of bottle feeding, oral hygiene factors such as frequency of toothbrushing and plaque level, and the use of fluorides. In fact, many of these factors are interrelated. For example, parental education level is related to the parents' oral health knowledge and how they look after the child's teeth such as feeding and oral hygiene practices. Family income may affect the child's utilization of dental care services and receipt of preventive measures. It is important to find out the main risk factors for dental caries in the preschool children in Hong Kong so that appropriate oral health promotion and caries prevention strategies can be developed.

The aims of this study were to describe the dental health status of preschool children in Hong Kong, and to investigate the effects of selected socio-demographic factors and oral health–related behaviors on the dental health of the children.

Methods

The study population and sampling

This study was approved by the institutional review board of The University of Hong Kong on human research ethics. The study population was Chinese preschool children in Hong Kong. The primary outcome estimate was the prevalence of children having dental caries experience in their primary dentition. It was estimated that this would be approximately 30%. A sample size of around 1500 would be needed to provide a high precision of the estimated true prevalence, with 95% confidence interval of plus or minus 2%.

A list of all registered kindergartens located on Hong Kong Island was obtained from the government website. Since the target study population was Chinese children, international kindergartens were excluded. To improve the efficiency of the survey procedures, kindergartens with a total enrolment of less than 70 children were also excluded. The remaining 67 kindergartens were numbered and grouped into two strata, those with 70-149 children (n=36) and those with 150 or more children (n=31). Six kindergartens in each stratum were selected by simple random sampling using computer-generated simple random numbers. Agreement to participate in the survey was obtained from the principal of the 12 kindergartens. All children attending grades 1 and 2 in the kindergartens were invited to participate. Letters explaining the purpose of the survey were sent to the parents through the kindergartens. Children with parental consent, of Chinese ethnic origin and in good general health were included in the survey. Children with major systemic diseases or syndromes, and those who were not cooperative and refused examination were excluded.

The study children were clinically examined in the

kindergartens in March 2007 by one of two calibrated examiners who used a disposable mouth-mirror attached to an intraoral LED light. Diagnostic criteria for dental caries followed WHO recommendations [10]. Active decay was detected at the cavitation level by careful visual inspection. A CPI probe with a 0.5-mm ball tip was used to remove plaque and food debris that obstruct inspection, and to confirm the presence of a carious cavity when necessary.

A questionnaire on the child's socio-demographic background and oral health–related behaviors was completed by the parents. The main questions included the child's gender, date and place of birth, use of nursing bottle, average intake of sugared food and drink per day, age at which the child started toothbrushing, frequency of toothbrushing, use of fluoride toothpaste, dental visit experience, monthly household income, and parental education level. To assess the dental knowledge of the parents, they were asked to indicate their answers to three true/false statements on the cause of tooth decay, and another three statements on the prevention of tooth decay. A score of 1 was given for each correct answer and thus the parental dental knowledge scores could range from 0 to 6.

The data collected were entered into a computer and analyzed using the Statistical Package for the Social Sciences (Windows version 16.0). The Chi squared test was used to assess the difference in the prevalence of caries experience between groups. Two-sample *t* test and analysis of variance (ANOVA) were used as appropriate to assess differences in mean dmft scores between groups. Pearson's correlation coefficient was used to assess the association between the child's dmft score and the parental dental knowledge score. To explore the influence of various factors on the dmft scores of the children, an analysis of covariance (ANCOVA) was carried out. Selected independent variables that had shown statistical significance at the 5% level in the bivariate analysis were entered into the model. The multivariate analysis was carried out using a backward stepwise procedure until only variables demonstrating a statistically significant association at the 5% level remained in the final model.

Results

A total of 1513 children were invited, of whom 98 (6%) declined to participate, 72 (5%) were absent from

kindergartens on the day of examination, and thus 1343 children (89%) were examined. The mean (standard deviation [SD]) age of those examined was 3.9 (0.7) years. Among them, 691 (51%) were boys.

The mean dmft score of the surveyed children was 1.5 (Table 1); over 90% of the score was contributed by untreated decay (dt=1.4). The distribution of the children according to their dmft score is highly skewed (Figure). While most of the children (65%) were caries-free, 12% of the children had a dmft score of greater than 4, and 68% of the decayed, missing or filled teeth were found in these children.

There was no significant difference in the prevalence of caries experience or mean dmft score between the boys and the girls (Table 2). The proportion of children with caries experience increased from 31% among the 3-year-olds to 42% among the 5-year-olds (P=0.018). The corresponding

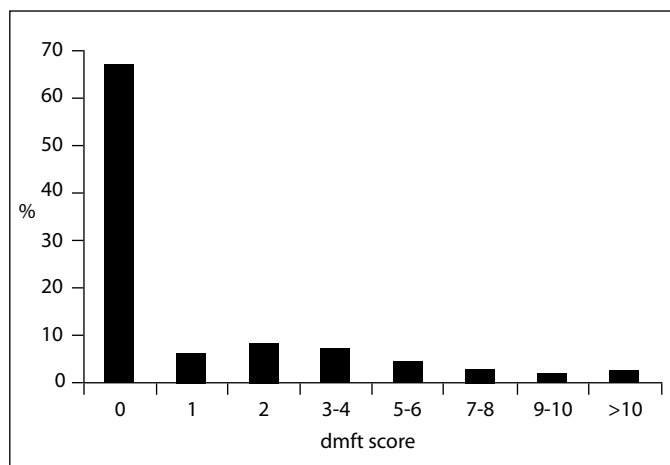| Table 1	Dental status of the study children	
	Children affected	**Mean score (standard deviation)**
Decay teeth (dt)	34.5%	1.4 (2.8)
Teeth missing due to caries (mt)	0.3%	<0.1 (0.1)
Filled teeth (ft)	5.1%	0.1 (0.9)
dmft	35.3%	1.5 (3.0)

Figure   Distribution of the surveyed children according to their dmft score

Table 2	Dental caries experience of the study children according to their socio-demographic background [*]				
	No.	% With dmft>0	P value	Mean (SD) dmft	P value
Gender					
Male	691	36	>0.05	1.6 (3.0)	>0.05
Female	652	35		1.5 (3.0)	
Age (years)					
3	368	31	0.018	1.2 (2.7)	0.016
4	747	36		1.5 (3.0)	
5	228	42		2.0 (3.4)	
Place of birth					
Hong Kong	1201	34	<0.001	1.4 (2.9)	<0.001
Mainland	52	65		3.6 (4.7)	
Others	61	31		1.8 (3.6)	
Father's years of education					
≤9	160	62	<0.001	3.1 (3.7)	<0.001
10-13	405	37		1.7 (3.3)	
≥14	691	29		1.1 (2.5)	
Mother's years of education					
≤9	168	61	<0.001	3.2 (4.1)	<0.001
10-13	486	36		1.5 (3.0)	
≥14	596	28		1.1 (2.5)	
Monthly household income (HK$)					
<10 000	124	53	<0.001	2.6 (3.7)	<0.001
10 000-19 999	219	52		2.5 (3.7)	
20 000-29 999	130	35		1.6 (3.1)	
≥30 000	757	28		1.1 (2.5)	

[*] Not all respondents answered every question; dmft denotes decayed, missing or filled teeth score, and SD standard deviation

Table 3	Dental caries experience of the study children according to their dietary and oral health–related behaviors [*]				
	No.	% With dmft>0	P value	Mean (SD) dmft	P value
Use of nursing bottle					
Yes	315	46	<0.001	2.6 (4.0)	<0.001
No	995	32		1.2 (2.6)	
Daily candy intake					
<Once	507	31	0.014	1.3 (2.9)	>0.05
Once to twice	494	36		1.7 (3.2)	
More than twice	314	40		1.7 (2.8)	
Daily consumption of soft/sweet drinks					
<Once	676	32	0.006	1.4 (2.9)	>0.05
Once to twice	439	36		1.6 (3.2)	
More than twice	196	40		1.9 (3.1)	
Daily consumption of cake/sweet snacks					
<Once	491	33	0.019	1.4 (3.0)	0.027
Once to twice	558	34		1.4 (2.9)	
More than twice	263	43		2.0 (3.3)	
Age to start tooth-brushing (months)					
6-12	352	28	<0.001	1.1 (2.4)	0.001
13-18	338	36		1.6 (3.1)	
19-24	268	33		1.5 (3.1)	
>24	350	43		2.0 (3.3)	
No. of times of toothbrushing per day					
<Once	61	57	<0.001	2.5 (3.4)	<0.001
Once	328	45		2.0 (3.5)	
Twice or more	926	31		1.3 (2.8)	
Ever visited a dentist					
Yes	351	43	<0.001	2.4 (3.8)	<0.001
No	965	32		1.2 (2.6)	

[*] Not all respondents answered every question; dmft denotes decayed, missing or filled teeth score, and SD standard deviation

mean dmft scores also increased with age, from 1.2 at age 3 to 2.0 at age 5 (ANOVA, P=0.016).

Both the prevalence and the severity of caries experience were higher among children who were born in Mainland China than those born in Hong Kong or other places (P<0.001). Higher mean dmft scores were also found among children whose parents had a lower education level and those coming from families with a lower household income (P<0.001).

Table 3 shows the relationship between the caries situation of the children and their oral health–related behaviors. Children who used a nursing bottle during sleep when they were young had a higher mean dmft score than those who did not (2.6 vs 1.2, P<0.001). Frequent intake

of cakes or sweet snacks, more than twice daily, was also associated with a higher dmft score (P=0.027).

Lower dmft scores were found among children who started to brush their teeth at an earlier age (P=0.001) and among those who brushed their teeth more frequently (P<0.001).

Only 26% of the study children had visited a dentist and in over one third of these children, the reason for the visit was for treatment such as a filling. A higher mean dmft score was found among these children compared to those who had never visited a dentist (2.4 vs 1.2, P<0.001).

The mean (SD) dental health knowledge score of the parents was 4.7 (1.7). There was a negative correlation between the parents' dental health knowledge score and the dmft score of their children (Pearson's coefficient $r=-0.15$, P<0.001). This relationship was found both for the knowledge on the causes ($r=-0.14$, P<0.001) and the knowledge about

the prevention ($r=-0.14$, P<0.001) of tooth decay.

To build a multivariable model using ANCOVA, 10 independent variables that were found to have a statistically significant association with the children's dmft score in the bivariate analysis were entered. These were: child's age, place of birth, mother's education level, father's education level, monthly household income, use of nursing bottle, daily intake of sweet snacks, parental dental knowledge, age at which toothbrushing started, and the frequency of toothbrushing. Four of these factors had strong correlations with other independents factors; they did not make a statistically significant contribution, and were therefore removed from the final model in the variable selection process.

In the final model of the ANCOVA, the six significant independent factors were: child's age, use of nursing bottle, daily intake of sweet snacks, mother's education level, parental dental knowledge, and household income (Table 4). Higher dmft scores were found in children who were

Table 4	Relationship between dmft scores of children and selected independent variables (ANCOVA final model) [*]			
Independent variable	**Estimate**	**95% Confidence interval**	**P value**	**Bonferroni's multiple comparison**
Use of nursing bottle				
Yes	1.48	1.11 to 1.85	<0.001	
No [†]				
Daily consumption of cake/sweet snacks				
(a) More than twice	0.56	0.12 to 0.99	0.015	a>b
(b) Once to twice	-0.04	-0.39 to 0.32		a>c
(c) <Once [†]				
Mother's years of education				
(a) ≤9				
(b) 10-13	1.33	0.67 to 2.00	<0.001	a>b
(c) ≥14 [†]	0.08	-0.33 to 0.49		a>c
Monthly household income (HK$)				
(a) <10 000				
(b) 10 000-19 999	0.50	-0.19 to 1.19	0.013	b>d
(c) 20 000-29 999	0.88	0.35 to 1.40		
(d) ≥30 000 [†]	0.38	-0.20 to 0.96		
Age of children (years)	0.38	0.14 to 0.61	0.002	
Dental knowledge score of parents	-0.22	-0.35 to -0.10	<0.001	
(Intercept)	0.26	-0.95 to 1.47	>0.05	

[*] F value=18.14; df=10, 1191; P<0.001. dmft denotes decayed, missing or filled teeth, and ANCOVA analysis of covariance
[†] Reference category

older, who had used a nursing bottle during sleep, who had more frequent intake of sweet snacks, and in those whose mothers had a lower education level, whose parents had poorer dental health knowledge, and who came from families with lower incomes.

Discussion

The surveyed children in this study were selected through a random sampling procedure and the response rate was high. They came from a wide socio-demographic background, and their gender and age distribution was as expected, representing the younger preschool children attending kindergartens in Hong Kong. However, since the sampling frame was kindergartens located on Hong Kong Island, the estimate of dental caries experience of the surveyed children was subjected to a sampling bias. In the 2006 population by-census, it was found that the median monthly income of households in Hong Kong Island was approximately 30% higher than that of all the households in Hong Kong [11]. Since in this survey, the children from higher-income households had a lower dental caries experience, our estimates of overall prevalence may be lower than the true values.

The prevalence and severity of dental caries experience in the preschool children surveyed in this study fall between those of the children at the same age surveyed by Chu et al. [3] in 1997 and those surveyed by the Hong Kong Department of Health in 2001 [1]. There was no clear trend of a change in the dental caries situation of the preschool children in Hong Kong over the past decade; notably over 90% of the decayed teeth still remain untreated. Although there has been an increase in oral health education activities for local preschool children in the recent years, there has not been any major change in the provision of clinical dental services for this population group in the private or public sectors.

Our results show that although most of the preschool children in Hong Kong were caries-free, more than 10% had many primary teeth with caries experience (dmft>4). It is important that a strategy to identify preschool children at high caries risk be developed and appropriate preventive measures be provided. Financial support and human resources should be sought to conduct oral health screening of young children attending nurseries and kindergartens, followed by topical fluoride treatment for those at high risk,

and provision of advice for their parents.

The factors found to be associated with the dental caries experience in preschool children in this study were similar to those of other studies in Hong Kong [3] and in other places [9].

In this study, a number of socio-demographic indicators for identifying preschool children with a high chance of having dental caries experience in Hong Kong were found. These are similar to those found in an earlier study in Hong Kong [3]. One of these indicators was the child's place of birth. Lack of fluoridated water in China (except Hong Kong) may explain why children born on the Mainland experienced more caries than those born in Hong Kong. Another reason is that immigrant children from China usually come from the lower socio-economic classes. There was a positive correlation between the education level of the parents and the household income, and that these factors were negatively associated with the dental caries experience of the preschool children. This information is useful for identifying the children with high caries risk, and focusing resources and efforts on them when conducting oral health promotion activities.

The finding that parents' dental health knowledge is associated with the child's caries experience highlights the importance of involving and educating the parents in caries prevention programs for preschool children.

Sugar in the diet is a known important factor in the causation of dental caries, and controlling its consumption plays an important part in caries prevention [12,13]. With the widespread use of fluorides in developed countries in the recent years, the role of sugar consumption in dental caries development has become less prominent. However, the findings of this study show that even in a fluoridated community like Hong Kong, frequent intake of sweet snacks increases the risk of developing dental caries in young children. The use of a nursing bottle that usually contains milk or a sweet drink during sleep is particularly bad for the teeth of young children. In this study, frequent intake of sweet/sugared drinks during the day did not have a strong association with the children's caries experience; this was in agreement with a recent US study on diet and dental caries [14].

Although dental caries is caused by plaque bacteria

on the tooth surface [8], strong clinical evidence showing that toothbrushing per se is effective in caries prevention is lacking [15]. However, in this study, children who started toothbrushing at an earlier age and those who brushed their teeth more frequently experienced less caries. This finding is in agreement with a number of earlier studies in various child populations [9]. This is probably not just due to the mechanical removal of the cariogenic bacteria, but also to the anti-caries effect of fluoridated toothpastes which dominate the market in Hong Kong. The finding that these two factors did not remain in the final multivariate model shows that their influence on the caries experience of the study children was not as strong as that of other factors. Despite this, it is still probably important to promote good oral hygiene practices among young children in Hong Kong to reduce their caries risk.

From the results of this study, it is concluded that the prevalence of dental caries among the Hong Kong preschool children was not high and that the severity of caries varied with the children's socio-demographic background, and their dietary and toothbrushing habits.

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