Risk Factors of Early Childhood Caries among Young Children in Hong Kong: A Cross-Sectional Study

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Objective: *Early childhood caries (ECC) was prevalent in Hong Kong. Children with ECC risk should be identified early for prevention. This study aimed to identify common risk factors of ECC in Hong Kong 3-year-old children.* ***Study design:*** *Sample size calculation showed at least 6,321 of 3-year-old children should be invited in this study. A consent form and a questionnaire enquiring the children's oral health behaviours and social-economic background were distributed to their parents. Children with parental consent were examined by a trained dentist. Caries status was recorded in dmft index. Chi-square test and logistic regression analysis were performed to identify the risk factors of ECC.* ***Results:*** *A total of 5,167 children from the 6,331 children invited were examined. Among them, 1,130 children (22%) had ECC (dmft>0). Logistic regression analysis found age of starting tooth brushing, snack-intake frequency, dental visit experience, birthplace, family monthly income, primary caretaker, and mother's education level were factors associated with ECC of the children.*

Conclusions: *Children who started tooth brushing later, had higher snack-intake frequency, were not born in Hong Kong, and whose family monthly income was lower, mother's education level was lower, primary caretaker was not domestic helper, had a statistically significant higher chance of having ECC.*

Key words: *early childhood caries, risk factor, logistic regression*

INTRODUCTION

According to American Academy of Pediatric Dentistry, early childhood caries (ECC) is the presence of one or more decayed, missing due to caries, or filled tooth surfaces in primary tooth in a child at 71 months old or younger [1]. ECC causes pain and infection, and advanced caries will progress into the tooth pulp to eventually form a dental abscess [2]. If cases remain untreated, they lead to tooth loss, which affects dentition. In addition, children may have fever and pain because of systemic infection. ECC also adversely affects eating, growth, speech, social development, learning capacity, and quality of life of children. With pain and disinclination to eat, children with severe ECC may be underweight, or even grow in a slower pace than caries-free children [3]. Poor general health can also influence the school life. Millions of students were absent of school each year due to dental caries [4]. ECC not only affects the child, it also indirectly affects the parents and can even create a significant burden to the society. Dental caries is a preventable disease. However, a substantial amount of hospital resources was spent treating dental caries of children in the hospital-based emergency department [5]. In the United States, dental caries was the most common reason (50%) for more than 215,000 hospital-based emergency visits that related to dental condition in 2008 [5].

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ECC still remains as a major health problem among children all over the world, although people's knowledge of oral health has been generally improved, and various preventive methods are available in clinic [6]. In 2010, 621 million children were affected by ECC worldwide [7]. And there were significant variations in ECC prevalence and incidence between different regions and countries. In the United States, 50% children aged 5-9 suffered from dental caries, which is the most common chronic disease among children [8]. Another study reported that the prevalence of dental caries was 37% among Brazilian preschool children [9]. The situation is more unsatisfactory in Southeast Asia. According to a recent review [10], the caries prevalence of 5-6 year-old children in Cambodia, Philippines and Laos was around 90%. Hong Kong is a Special Administrative Region of China, with a population of more than 7 million. The water supply is fluoridated at 0.5 ppm and fluoride toothpastes are readily available. However, half of the 5-year-old children in Hong Kong suffered from ECC, and most of the dental caries were left untreated [11].

Resources for ECC treatment including manpower are not readily available or affordable in many countries. Therefore, the pattern for solving the problem of dental caries should be shifted from a traditionally curative model to a more salutogenic approach, which focuses on prevention of dental caries and promotion of good oral health [4]. According to an unpublished pilot study, the prevalence of dental caries is already 20% among 3-year-old children in Hong Kong. For young children, all primary teeth usually erupt before 36 months. It would be beneficial if health-care takers can identify the caries risk factors when children are in their early age for caries prevention. Parents and their children at caries risk can receive oral health education and reinforcement to establish and sustain good oral-health related habits. In addition, target-oriented preventive programmes such as fluoride therapy and dental sealant can be provided. Therefore, the aim of this study is to identify the common risk factors of ECC among 3-year-old children in Hong Kong.

MATERIALS AND METHOD

This cross-sectional study was conducted from 2014 to 2015 in Hong Kong. Ethics approval was obtained from the Institutional Review Board of the University of Hong Kong (UW 13-569). The study protocol and reporting procedure followed the statement of strengthening the reporting of observational studies in epidemiology (STROBE) [12].

Sample size calculation and recruitment of participants

Shieh-O'Brien approximation method was used for the sample size calculation. From an unpublished pilot study, we estimated the prevalence of ECC among 3-year-old Hong Kong children was 20%. Proportion 0.3/0.7 was set as the test predictor. With type I error being set as 0.05, type II error being set as 0.1 (power of the study should be 90%), and the tested odds ratio being set as 1.3, at least 4,741 children needed to be recruited for this study. When the response rate was estimated as 75%, at least 6,321 children should be invited to participate in this study. A quota sampling method was used and 29 kindergartens were selected to meet the required number of children. All children aged 3 in those kindergartens were invited to join this study. An invitation letter explaining the purpose and procedures of this study was sent to the parents. Written parental consent was obtained before clinical examination. Children who were uncooperative, had significant systemic diseases, such as congenital heart disease, were excluded.

Questionnaire survey

A questionnaire adapted from a previous study was distributed to the parents with the parental consent through kindergarten [11]. English and Chinese version were validated by two independent investigators to make sure the content was the same in both languages. Pilot test was conducted in several non-dental background people, to make sure the content in the questionnaire was understandable. Parents were asked to complete the questionnaire if they agreed to let their children participate in this study. The questionnaire included two parts: a) oral-health related behaviours (bottle feeding before sleep, age of starting tooth brushing, daily tooth brushing frequency, assistance of tooth brushing, dental visit experience, snack-intake yesterday, and snack-intake frequency); b) social-economic backgrounds (gender, birthplace, parental condition, family monthly income, education level of parents, and primary caretaker).

Clinical examination

One trained dentist conducted dental examination for the participating children in the classroom of kindergarten. Dental caries status was accessed by using a 0.5mm ball-end Community Periodontal Index probe and an intra-oral LED light with disposable dental mirror. Diagnostic criteria recommended by the World Health Organization (WHO) were used for the assessment of dental caries [13]. A tooth was recorded as decayed (dt) when a lesion had an unmistakable cavity, undermined enamel, or detectably softened floor or wall. A tooth was record as missing (mt) when it was extracted because of caries and as filled (ft) when it was permanently filled without caries. Duplication examinations were performed on 10% of the children and the Kappa value was calculated to assess the intra-examiner agreement.

Data entry and analysis

The data were entered into a personal computer separately by two independent investigators. The two sets of data were compared using Excel to detect error in data entry. Any inconsistency found was cross-check with the original record. Missing data was input as "999" to be recognized. Data analysis was performed using Statistical Package for Social Science version 22.0 (SPSS Inc., Chicago, Illinois, USA). Children were divided into caries-free group (dmft=0) and ECC group (dmft>0). Chi-square test was conducted for preliminary analysis of the independent variables studied according to caries-free group and ECC group. Binary logistic regression analysis (using backward stepwise method) was used to study the significant variables. The statistical significance level for all tests was set as 0.05.

RESULTS

A total of 6,331 children attending the first year of 29 kindergartens were invited for this study. Parental consent and questionnaire were distributed. A total of 5,351 children agreed to join this study, and 5,167 children were clinically examined. The response rate was 82% (5,167 / 6331). Sixty children who were absent from school on the examination day and 124 uncooperative children were excluded

from the study (Figure 1). ECC was found in 1,130 children (22%) and 4,037 children (78%) had no caries experience (dmft=0). One fifth (20%) of the children had caries in their anterior teeth and this was associated with the presence of caries in their posterior teeth ($p < 0.001$). The intra-examiner agreement (Kappa value) was 0.954.

According to the clinical examination, the mean dmft score of ECC group was 4.25 ± 3.36. Within the children who had ECC, 90% of them had caries on anterior teeth. The distribution of dental caries in primary dentition was shown in Figure 2. ECC was most frequently found in maxillary incisors. Maxillary

Figure 1: Survey flowchart

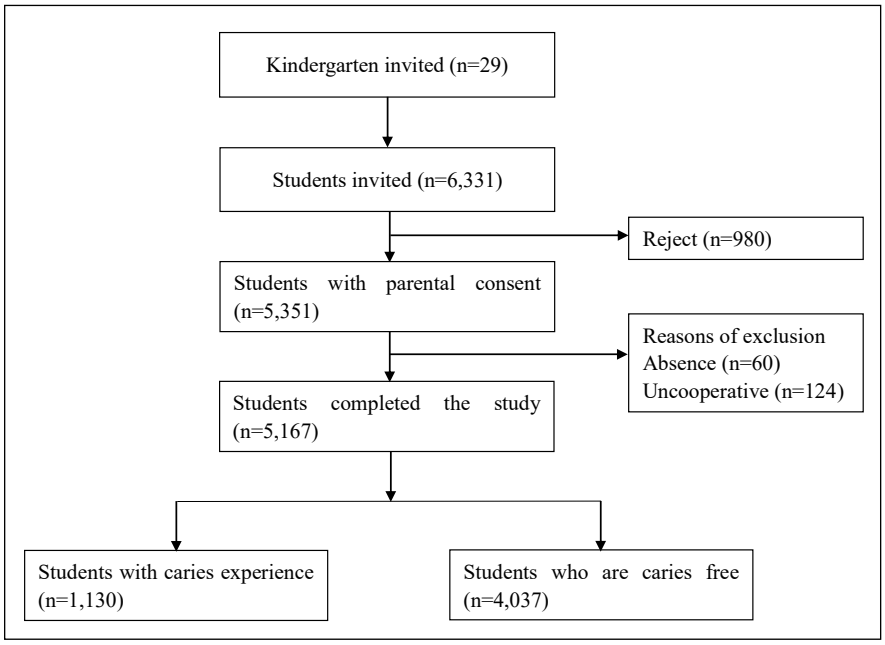
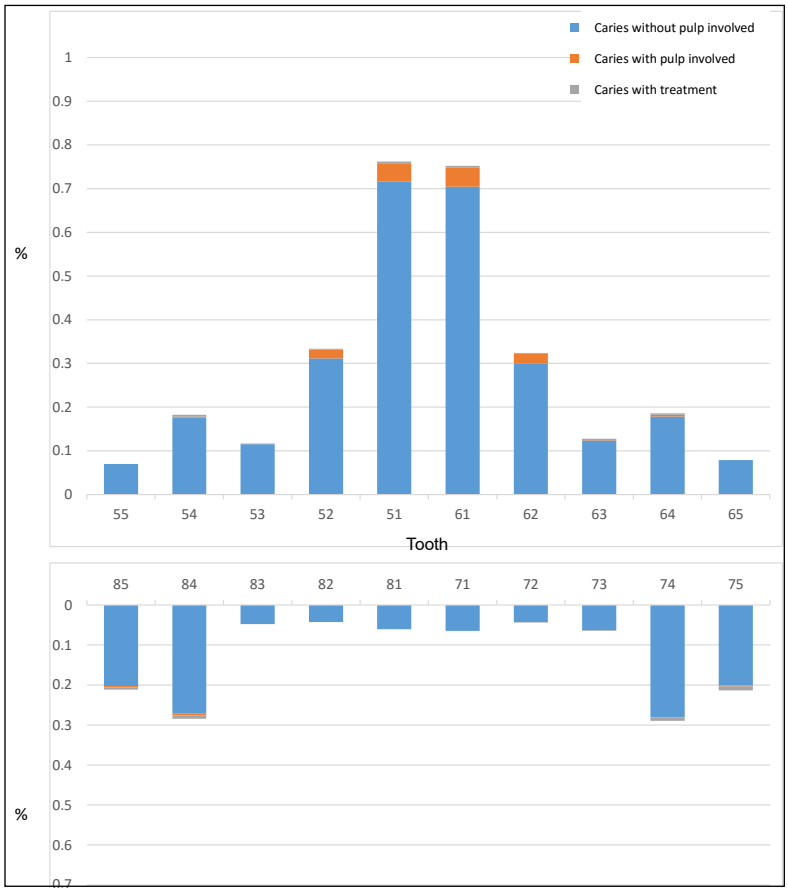


Figure 2: Caries distribution in early childhood caries group



central incisors were the most common carious teeth (70%). The maxillary lateral incisors were the second commonest teeth with caries (30%), followed by mandibular first molars (27%). Among the untreated caries, 3.4% of them had local infection in form of fistula or abscess. The infection was associated predominantly with maxillary incisors (89%).

The result of Chi-square test for oral-health related behaviors of the children and caries experience was shown in Table 1, and the Chi-square test result of their social-economic background and caries experience was shown in Table 2. Age of starting tooth brushing, daily tooth brushing frequency, snack-intake yesterday, snack-intake frequency, dental visit experience, birthplace, primary caretaker, parents' education level and family monthly income were significantly associated with dental caries experience. Results of binary logistic regression showed that the age of starting tooth brushing, snack-intake frequency, dental visit experience, birthplace, family monthly income, primary caretaker, and mother's education level were risk factors associated with ECC (Table 3). Children who had tooth brushing after 24 months, higher frequency of snacking, lower monthly family income, and those were not born in Hong Kong (water fluoridated area) had higher caries risk. Moreover, children whose mother's education level was lower and primary caretaker was not domestic helper also had a higher caries risk.

Table 1: Oral-health related behaviors of children with and without early childhood caries

	Caries free (n=4,037)	ECC (n=1,130)	p-value
Bottle feeding before sleep			0.113
Yes	43.8% (n=1,760)	46.4% (n=524)	
No	56.2% (n=2,262)	53.6% (n=605)	
Age of start tooth brushing			<0.001
1-24 months	66.5% (n=2,676)	56.1% (n=633)	
Over 24 months	33.5% (n=1,348)	43.9% (n=496)	
Tooth brushing frequency			<0.001
Less than once daily	7.1% (n=281)	10.1% (n=114)	
Once daily	39.2% (n=1,549)	44.6% (n=503)	
More than once daily	53.7% (n=2,125)	45.3% (n=512)	
Assistance of tooth brushing			0.947
No	16.8% (n=664)	16.7% (n=180)	
Yes	83.2% (n=3,285)	83.3% (n=896)	
Dental visit experience			<0.001
No	94.5% (n=3,798)	87.8% (n=989)	
Regular check-up	4.8% (n=192)	5.6% (n=63)	
Treatment due to caries	0.7% (n=29)	6.6% (n=74)	
Snack-intake yesterday			0.001
No	5.3% (n=214)	3.0% (n=34)	
Yes	94.7% (n=3,804)	97.0% (n=1,093)	
Snack-intake frequency (mean ± SD)	2.05 ± 1.24	2.21 ± 1.17	<0.001

Table 2: Social-economic background of children with and without early childhood caries

	Caries free (n=4,037)	ECC (n=1,130)	p-value
Gender			0.053
Male	52.0% (n=2,098)	55.2% (n=624)	
Female	48.0% (n=1,939)	44.8% (n=506)	
Birthplace			<0.001
Hong Kong	95.5% (n=3,834)	91.3% (n=1023)	
Mainland China	4.5% (n=180)	8.7% (n=97)	
Parental condition			0.568
Both parents	95.2% (n=3,827)	95.7% (n=1,078)	
Single parent	4.8% (n=191)	4.3% (n=49)	
Primary caretaker			<0.001
Father and/or mother	64.7% (n=2,625)	75.8% (n=854)	
Other relatives	24.3% (n=980)	19.4% (n=219)	
Maid	10.9% (n=440)	4.8% (n=54)	
Father's education level			<0.001
Mandatory education	20.8% (n=804)	28.4% (n=309)	
Higher education	79.2% (n=3,068)	71.6% (n=780)	
Mother's education level			<0.001
Mandatory education	21.3% (n=847)	32.9% (n=369)	
Higher education	78.7% (n=3,127)	67.1% (n=753)	
Family monthly income (HK$)			<0.001
Below 10,000	10.3% (n=404)	18.5% (n=207)	
10,001–20,000	30.1% (n=1,182)	39.3% (n=439)	
20,001–40,000	38.9% (n=1,527)	30.7% (n=343)	
Above 40,000	20.8% (n=816)	11.5% (n=129)	

Table 3: Logistic regression analysis of risk factors of early childhood caries

Independent variable	Group	B	S.E.	Sig.	Exp(B)	CI(95%) for Exp(B)	
						Lower	Higher
Mean daily snacking frequency		0.110	0.030	<0.001	1.116	1.053	1.183
Age of starting tooth brushing	Before 24 months	-0.308	0.077	<0.001	0.735	0.632	0.855
	After 24 months Reference						
Dental visit experience	Regular check-up	0.516	0.160	0.001	1.675	1.224	2.294
	Treatment due to caries	2.435	0.240	<0.001	11.417	7.131	18.279
	No Reference						
Birthplace	Hong Kong	-0.506	0.142	<0.001	0.603	0.457	0.795
	Other places Reference						
Monthly family income (HK$)	Below 10,000	1.112	0.150	<0.001	3.040	2.265	4.080
	10,001–20,000	0.672	0.126	<0.001	1.958	1.530	2.506
	20,001–40,000	0.328	0.119	<0.001	1.389	1.099	1.755
	Above 40,000 Reference						
Mother's education level	Mandatory education	0.306	0.088	0.001	1.358	1.142	1.614
	Higher education Reference						
Primary caretaker	Maid	-0.548	0.163	0.001	0.578	0.420	0.796
	Other relatives	-0.146	0.095	0.126	0.864	0.717	1.042
	Parents Reference						
Constant		-1.230	0.194	<0.001	0.292		

DISCUSSION

The WHO recommended reporting caries status in primary dentition (ECC) of children at 5-year-old. A survey in 2012 found the caries experience and prevalence of the 5-year-old children were 2.2 ± 3.5 and 49%, respectively [11]. It is not common to report the caries experience and prevalence of the 3-year-old children and is not the objectives of the study. The aim of this study is to identify common risk factors of ECC of children in Hong Kong at early age, so that appropriate and cost-effective preventive methods can be provided to these at risk children to minimise caries development. The questionnaire was used in two previous studies for kindergarten children in Hong Kong [11, 14]. It is simple and easy to answer, and hence is low-cost and quick for data collection for this study with more than 6,000 children.

The sample size calculation was based on binary logistic regression analysis on the primary outcome measurement (presence of ECC). The test predictor was set at a proportion 0.3 and 0.7 because the adherence for most of the common studied risk factors from a previous study was approximately 70% [14]. The large sample size chosen in this study was sufficient to detect an odds ratio higher than 1.3, which would be considered clinically significant. In addition, the sample size was more than sufficient for chi-square test. Results of the chi-square test would demonstrate that most of the studied risk factors were highly significant with a p-value less than 0.001.

Missing data was inevitable in questionnaire survey, although follow-up phone-calls were made to fill in the unanswered questions in this study. If the sample size is very large, the accumulating sum of the missing data would result in systematic error. This would also happen when a large number of variables were put into the regression analysis. To minimising the potential bias, the p-value for inclusion in this study was set as 0.05. Even though the p-value set for inclusion was 0.05, there were still 10 out of the 14 independent variables needed to be included into the binary logistic regression model for statistical analysis.

A review concluded that bottle feeding before sleep is a significant risk factor of ECC [15]. In this study, the percentage of children with bottle feeding before sleep in ECC group was higher than that in caries-free group, but the difference was not significant. Only one closed question (Yes/No) was asked about bottle feeding before sleep in this study. Reduction of data to simple yes or no answer would result in losing information. There was no information on contextual factors to help interpret the results or to explain variations in this behavior. Conceivably, it could not explore in depth the relationship of feeding habits and ECC. Another review reported that inappropriate breastfeeding can also be a reason for ECC [16]. More information about feeding habits such as feeding method, duration, tooth cleaning after feeding should be evaluated to study the relationship of feeding habit and ECC.

This study confirmed establishing tooth brushing early would reduce risk of ECC. However, caregiver-assisted tooth brushing was not a significant risk factor for ECC. This finding is consistent with previous studies [11, 17]. Again only one closed question was asked to caregiver-assisted tooth brushing. Information such as the frequency and the quality of the caregiver-assisted tooth brushing was not evaluated.

Social-economic status is another important factor affecting children's oral health. Most of the children included in this study were born in Hong Kong where the water supply is fluoridated.

Some children (5%) were born in Mainland China where there was no water fluoridation. This might be one of the main reasons that children born in Mainland China had a higher caries risk. Previous surveys found parental education level and family income were factors associated with ECC [11, 18, 19], which corroborated with the results of this study.

Mother's education level but not father's education level was found to be related to children's caries status. The reason might be female primarily take care of children in Hong Kong family [20]. Therefore, empowering mother to promote oral health of their children could be an effective strategy for caries prevention. This study also found children who were primarily cared by domestic helper had a lower caries risk. In general, family who had domestic helper had a better social-economic status and hence they have more resources allocated for their children's oral and general health. Children from low income family would have higher caries risk. This could be inferred by the results that 58% of the children in ECC group were from a family whose monthly income was lower than the median (HK$ 23,500, or about US$ 3,000) whereas only 40% of them were in the caries-free group.

This study confirmed that the young children who have poor oral health related behaviours and come from low socio-economic status or parents with low education will have a higher chance to suffer ECC. This results concurred with two previous studies on preschool children [11, 18]. In addition, this study demonstrated the success of using a simple questionnaire to identify children who are at risk of ECC for preventive care. Since resources are often limited, this strategy enables a cost-effective health promotion programme for young children.

CONCLUSION

In conclusion, the Hong Kong young preschool children who started tooth brushing later, had higher snack-intake frequency, were not born in Hong Kong, and whose monthly family income was lower, mother's education level was lower, primary caretaker was not domestic helper, had higher caries risk of ECC.

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