Early childhood caries among 3- to 5-year-old children in Hong Kong

Short title : Early childhood caries among Hong Kong preschool children

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Abstract

Objective: The aim of this study was to describe the prevalence of dental caries among 3- to 5-year-old children in Hong Kong and to investigate the factors associated with their dental caries statuses.

Methods: Seven kindergartens in Hong Kong were selected by using stratified random sampling. The 3- to 5-year-old kindergarten children were invited to join the study. The participants' parents were asked to complete a questionnaire regarding their children's demographic and socioeconomic backgrounds, their dental habits and their own dental knowledge. Dental caries experience was measured using the decayed, missing and filled primary teeth (dmft) index. The visible plaque index was adopted for recording oral hygiene. The relationships between caries experience and children's demographic backgrounds, dental habits, oral hygiene and parental dental knowledge were studied using a zero-inflated negative binomial (ZINB) regression analysis.

Results: Among the 1,204 participating preschool children, the overall prevalence of dental caries (dmft > 0) was 46%. The mean dmft score was 2.1±3.4. The prevalences of dental caries among the 3-, 4- and 5-year-old children were 38%, 43% and 55% respectively. ZINB regression analysis revealed that the study children who were boys, came from families with lower incomes, had dental visit experiences, had higher plaque scores and had parents with lower levels of dental knowledge had higher dmft scores (p < 0.05).

Conclusions: Dental caries is prevalent among preschool children in Hong Kong. The caries experiences of the study children are associated with gender, family income, parental dental knowledge, dental visit experience and oral hygiene.

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Introduction

Early childhood caries (ECC) is one of the most common chronic diseases in children. According to the report of the 2016 Global Burden of Disease Study, dental caries in primary teeth was ranked as the 12th most prevalent condition, affecting around 560 million children globally[1]. ECC is defined as the presence of one or more decayed (non-cavitated or cavitated) lesions, teeth missing due to caries, or filled tooth surfaces in any primary tooth among children younger than 6 years[2]. If it is left untreated, it will progress into the pulp tissue, possibly leading to a toothache and dental abscess. Subsequently, it causes difficulty in chewing, thus lowering the quality of life of the affected children[3].

The prevalence and severity of ECC varied among different regions and countries. In Southeast Asia, the overall situation of caries in preschool children was unsatisfactory. In Cambodia, Lao and the Philippines, their caries prevalences were approximately 90%[4]. In China, the latest national oral health survey revealed that 70.1% of the 5-year-old children had dental caries experiences[5]. Hong Kong is a special administrative region of China with an estimated population of 7.4 million in 2017[6]. Several dental public health measures have been implemented to promote oral health in Hong Kong. Water fluoridation was established in 1961. Later, the School Dental Care Service (SDCS) was developed in 1979 with the aim of providing free dental treatment for schoolchildren in Hong Kong[7]. As a result, caries prevalence and severity have declined significantly among schoolchildren and adolescents during the past few decades[8]. However, preschool children are not eligible to participate in the SDCS. Most of them seek dental treatment from private dentists at their own expense. Previous studies indicated that ECC remained a major dental problem in Hong Kong[9]. No improvement has been made in the oral health statuses of 5-year-old children during the past two decades. According to the results of the territories-wide oral health surveys, caries prevalence was 50.7% among 5-year-old children in 2011, similarly to that in 2001 (51.0%), but the extent of caries experience (mean dmft score) slightly increased from 2.3 in 2001 to 2.5 in 2011[10].

Efforts have been made to improve the oral health statuses of Hong Kong preschool children. The department of health set up the oral health education unit, aiming to promote oral health and to provide free oral health education materials to schools and parents. The oral health

95 programme 'Brighter Smiles for the New Generation' was launched to help children to
96 establish good oral health–related habits[11]. Another program called "Brighter Smiles Playland"
97 was developed to help kindergarten classrooms to teach children about tooth brushing, tooth-
98 friendly diets and dental visits through interactive games and activities. Besides the provision
99 of oral health education programs, changes in immigration guidelines and economic growth
100 may possibly affect the general and oral health of the Hong Kong population. Following the
101 World Health Organization (WHO) recommendation, periodic surveys should be conducted at
102 five-year intervals to assess the oral health status of a community and to evaluate the
103 effectiveness of the preventive population-based measures taken in the community[12]. As the
104 last population-wide oral health survey among 3- to 5-year-old children was conducted in
105 2009[9], an updated child oral health status is required for dental practitioners and policy makers
106 in planning and monitoring target-oriented preventive measures for kindergarten children in
107 Hong Kong.

108

109 The aim of this study was to describe caries prevalence and the extent of caries
110 experience among 3- to 5-year-old kindergarten children in Hong Kong and to investigate the
111 risk factors associated with their dental caries statuses.

112

Materials and Methods

114 The Institutional Review Board of the University of Hong Kong/ Hospital Authority
115 Hong Kong West Cluster (IRB UW 16-180) approved the current study. Written consent was
116 sought from the parent of each participating child. The study was conducted in full accordance
117 with ethical principles, including the World Medical Association Declaration of Helsinki. This
118 oral health survey was conducted in 2016.

119

Sample selection

121 Almost 95% of preschool children attend kindergarten in Hong Kong. The unit of
122 sampling was a kindergarten. A stratified cluster random sampling proportionate to the size of
123 the subpopulations among the three geographical areas was adopted. The three geographical
124 areas in Hong Kong are the new territories (NT), Kowloon (KL) and Hong Kong Island (HK)[6].
125 The number of preschool children residing in three main geographical areas in Hong Kong was
126 as follows: 89,000 children in the NT, 50,000 in KL and 29,000 on HK. The ratio of invited
127 schools in the NT, in KL and on HK was 4:2:1, following the ratio of the populations of the

128 NT, KL and HT[6]. Registered kindergartens in each area were numbered sequentially. Four

129 kindergartens in the NT, two kindergartens in KL and one kindergarten on HK were selected

130 through a simple random sampling method using a list of computer-generated random numbers.

131 All seven selected kindergartens agreed to participate in the survey. All children in the selected

132 kindergartens were invited. The inclusion criteria were children aged 3 to 5 years old with

133 written parental consent. Children with special needs or severe chronic diseases were excluded.

134

135 *Sample size estimation*

136   Based on the Hong Kong Census in 2016, the population of Hong Kong preschool

137 children was approximately 168,000[6]. The sample size estimation was based on the previous

138 caries prevalence (approximately 50%)[9].The confidence interval was set at 5% (CI: 45% to

139 55%) with a 95% confidence level. The sample size of each age group (3-, 4- and 5-year-old

140 children) was 383, or 1149 children in total were required. With an estimated response rate of

141 80%, the total number of the study children to be invited would be at least 1436.

142

143 *Questionnaire survey*

144   A self-completed questionnaire and parental consent form were sent to all parents in

145 the selected schools. The questionnaire featured four sections[13]: 1) demographic background:

146 sex, age, place of birth, parenthood status and main caregiver; 2) socioeconomic status: parents'

147 education levels and family income; 3) oral health–related habits: bottle feeding habits,

148 snacking habits, tooth brushing habits and dental visit experience; and 4) parental dental

149 knowledge. Twenty-one questions about the etiology of dental caries and caries prevention

150 were modified from the previous study[9]. One mark was given for each correct answer, whereas

151 no mark was given for each incorrect answer. Thus, the marks (0 to 21) were categorized into

152 one of three levels as follows: high (15-21 marks), moderate (8-14 marks) and low (0-8 marks).

153 Missing and inappropriate answers on the returned questionnaire were checked and followed

154 up by phone.

155

156 *Clinical examination*

157   A single examiner (KJC) was trained and supervised by experienced dental

158 epidemiologists (LECM and CHC). The study children were positioned supine on small tables

159 in kindergartens. The clinical examinations were conducted using a ball-ended WHO

160 Community Periodontal Index (CPI)-probe and a disposable dental mirror with an intra-oral

161 light-emitting diode (LED) light attached. Dental caries was diagnosed at the tooth level. Caries

162   status was assessed according to the diagnostic criteria of the WHO[12]. A tooth was recorded as

163   decayed (dt) when a dentine lesion had an unmistakable cavity or when both a dentine carious

164   lesion and a restoration were present. A tooth was recorded as missing (mt) when it was

165   extracted as a result of caries. A tooth was recorded as filled (ft) when a permanent filling

166   without caries was present. No radiographs were taken. Approximately 10% of the study

167   children were re-examined on the same day. The duplicate examinations were conducted after

168   at least 30 children had been examined, so that the examiner could not remember the first

169   scoring. The intra-examiner kappa value was 0.98. Oral hygiene status was recorded using the

170   visible plaque index (VPI)[14]. The visible plaque of the buccal and lingual surfaces of six index

171   teeth (55, 51, 63, 71, 75 and 83) was recorded as the presence of visible plaque (score 1) or the

172   absence of visible plaque (score 0). The VPI score was then calculated as the percentage of the

173   number of surfaces with visible plaque to the total number of surfaces examined.

174

175   Approximately 10% of the participating children were randomly re-examined on the

176   same day as their examinations to assess the intra-reliability reproducibility. Following a

177   child's oral examination, his or her oral health report was sent to his or her parent. No

178   intervention was provided. Parents were advised to seek further treatment at their own expense

179   if necessary.

180

181   *Statistical analysis*

182   Data analysis was performed using IBM SPSS Statistics for Windows, Version 24.0

183   (SPSS Inc., Chicago, Illinois, USA) and STATA version 13.1 (StataCorp, College Station,

184   Texas, USA). The study children with missing data were excluded from the data analysis.

185   Statistical sample weights were performed. The intra-examiner agreement was assessed using

186   Cohen's Kappa statistics. A chi-squared test was used to test the association of caries

187   prevalence (yes/no) with various variables. The Mann-Whitney U test or Kruskal-Wallis H test

188   was adopted to study the distribution of dmft scores according to the variables studied. All

189   independent variables were studied as covariates in the regression model. The negative

190   binomial model, Poisson model, and zero-inflated models were taken into consideration to

191   investigate the association between the dmft scores and independent variables. Vuong's test

192   was adopted to indicate an appropriate statistical model. A backward stepwise procedure was

193   used to remove insignificant variables (p-value more than 0.05) from the regression model. The

194   final model contained only the remaining variables that were statistically significant. The level

195   of statistical significance for all tests was set at 0.05.

Results

A total of 1,700 kindergarten children in seven kindergartens were invited to participate in this survey. The response rate was 89% (1,514/1,700). The Cohen's Kappa value for the assessment of caries status was 0.97. Among the 1514 children with parental consent, 181 children were excluded because their ages were younger than 3 or older than 5, 102 failed to complete the questionnaire, 31 were absent from school on the examination day and two were uncooperative (more than one reason could be indicated). Thus, 1204 children with completed questionnaires were included in the study. Among these, 522 were in the NT, 453 were in KL and 229 were on HK. The ratio of participating children in the NT, in KL and on HK was 5:4:2, whereas the ratio of the Hong Kong population in 2016 was approximately 4:2:1[6]. Therefore, proportional sample weights were performed. The following descriptive data and further statistical analysis were weighted.

Among the study children, 650 (54.6%) were girls, and the mean age ($\pm$SD) was 4.6 ($\pm$0.8) years. The numbers of the included children aged 3, 4 and 5 years were 307 (25.8%), 427 (35.8%) and 457 (38.4%), respectively. Most of them (90.8%) were born in Hong Kong. A total of 552 (46.3%) children had caries experiences (dmft > 0). Approximately, 14.4% of them had five or more teeth with caries experiences. The mean dmft score ($\pm$SD) was 2.1 ($\pm$ 3.4). Untreated decayed teeth (dt = 2.0 $\pm$ 3.3) constituted 95% of the dmft score (Table 1). The mean number of filled (ft) or missing (mt) primary teeth was very small (ft = 0.1; mt = 0.01). A positively skewed distribution of the dmft score was found, with the skewness being 2.1. Maxillary incisors had the highest caries prevalence (29%), whereas mandibular incisors had the lowest (2%). However, maxillary molars had a lower caries prevalence compared with mandibular molars. Most of the children (66%) brushed their teeth at least twice daily, and 70% began brushing before the age of 2. However, 24% of the children still engaged in bottle feeding at bedtime, and the majority (82%) of them had never visited the dentist.

In the bivariate analysis, statistically significant differences were found in the prevalence of caries between gender and age of children (p < 0.001) (Table 1). Caries prevalence increased with increasing age during the preschool years (p < 0.001). Children born in Hong Kong had lower caries prevalences compared with those born in Mainland China or in other countries (p = 0.01) (Table 2). Children from families with high family incomes had

229 lower caries prevalences compared with those from families with low family incomes (p <
230 0.001). Children who had previously visited the dentist had higher caries prevalences compared
231 with those who had never visited the dentist (p < 0.001). Regarding parental dental knowledge,
232 children whose parents had low levels of dental knowledge had higher caries prevalences
233 compared with those whose parents had high levels of dental knowledge (p < 0.001). In the
234 Mann-Whitney U test and Kruskal-Wallis H test, a lower rank of the median dmft score was
235 observed among the study children who were born in Hong Kong, whose main caregivers were
236 domestic helpers, whose parents had tertiary-level (university) education or whose parents had
237 high levels of dental knowledge. Regarding oral health–related behaviors, children who had
238 sugary snacks once or less daily, had never visited the dentist, started tooth brushing before the
239 age of 2 years or brushed their teeth twice daily had significantly lower dmft scores (Table 2).
240

241   According to the results of Vuong's test, the ZINB model provided a better fit compared
242 with the Poisson distribution (p < 0.001). The output of final model comprised of two parts:
243 zero inflated part (in the logit model) and the negative binomial process (on the natural log
244 scale) in Table 3. The results from the final model of the zero-inflated part (dmft = 0) indicated
245 that seven variables, namely age, birthplace, parenthood, family income, frequency of
246 snacking, dental visit experience and visible plaque score, were significantly associated with
247 the chance of having 'no caries experience' (dmft = 0). Younger children who were born in
248 Hong Kong, came from single-parent families or high-income families, had sugary snacks once
249 a day or less, never visited the dentist and had lower plaque scores had an increasing probability
250 of having 'no caries experience' (p<0.05). In addition, the results of the final ZINB regression
251 model (dmft >0), with the five factors of gender, family income, dental visit experience,
252 parental dental knowledge and VPI score, revealed statistically significant associations with
253 the mean dmft score in the negative binomial part. Boys who had higher plaque scores, came
254 from lower-income families, had dental visit experiences and had parents with lower levels of
255 dental knowledge had significantly higher dmft scores (p < 0.05).
256

Discussion

258   Various preventive measures have been implemented to reduce the burden of ECC in
259 Hong Kong. As WHO Global Consultation suggested regarding ECC[15], subnational oral health
260 surveillance, including the assessment of modifiable risk factors, is required to monitor and
261 value intervention programs. Based on the results of the present oral health survey, ECC

262   remains prevalent and affects approximately half of the preschool children in Hong Kong. The

263   caries statuses of Hong Kong kindergarten children have not been improved during the past

264   two decades[8, 9]. In the present study, the mean dmft score of 3- to 5-year-old children, 2.1, was

265   similar to that obtained in previous research (2.2)[9]. Compared with Taiwan (89%)[16] and

266   Mainland China (70%)[5], Hong Kong has a much lower ECC prevalence (55%) among 5-year-

267   old children. However, when compared with developed countries, Hong Kong has a higher

268   ECC prevalence than the United States (23% in 2012)[17] or the United Kingdom (31% in 2013)[18]

269   does.

270

271   Although the department of health has organized several oral health promotion

272   activities, no improvement has been made in preschool child oral health. This may be due to

273   the unsatisfactory participating rate of kindergartens and parents[19]. Possibly, these prevailing

274   preventive measures may be ineffective or inaccessible. Factors affecting parental involvement

275   and school administrators' decision to participate in this program should be further explored.

276   The present study affirms that untreated decay in primary teeth is a widespread phenomenon

277   in Hong Kong, as almost all decayed teeth (95%) were left untreated. This denotes that dental

278   service use among preschool children remained low. The majority (75%) of the 5-year-old

279   children had never visited the dentist according to the previous oral health survey, and the

280   parents who did take their children did so in an effort to alleviate their children's dental pain[10].

281   The present survey revealed that one in seven children (14%) had severe ECC with multiple

282   carious lesions (dmft > 5). Oral health education alone without clinical preventive and curative

283   measures may not be able to manage the burden of tooth decay, particularly among those with

284   severe ECC.

285

286   In the present study, the distribution of dmft scores was positively skewed. Because the

287   standard assumption of normality was unmet, the use of multiple linear regression models

288   would not be suitable[20]. Poisson regression can be considered for handling non-negative integer

289   count data. However, the dmft data were over-dispersed (the variance was larger than the

290   mean), so the negative binomial regression model used in this study would be more appropriate

291   compared with the Poisson regression model. According to the result of the final ZINB model,

292   several significant, factors, including demographic and socioeconomic backgrounds and oral

293   health–related behaviors were associated with the prevalence and severity of ECC. The present

294   results indicated that the occurrence of caries in young children is a complex interaction. A

295   well-established link existed between lower economic status and higher ECC prevalence and

296   severity in the present study. Similarly to the previous results [9, 21], a social gradient in young

297   children is obvious in Hong Kong: the higher the household income, the better the dental status

298   of the child. Thus, children living in poverty should be prioritized if oral health resources are

299   limited. Our study indicated that parental dental health knowledge is significantly associated

300   with their children's caries experiences. The need exists to raise parental dental knowledge and

301   literacy as well as to reinforce positive attitudes with active parental involvement. To achieve

302   this, pregnant women should be advised to seek family-oriented oral health counseling during

303   pregnancy. The first dental visit is recommended by 12 months of age to assess caries risk and

304   to provide early intervention if needed[22]. Contradictorily, Hong Kong preschool children who

305   had previously visited the dentist had a higher chance of having caries prevalence and higher

306   dmft scores compared with those without dental visit experiences. This implies that they sought

307   dental treatment due to having already encountered oral health problems. Despite the fact that

308   ECC prevention programs are offered, their effectiveness in achieving the goal of obtaining a

309   significant reduction in ECC has not yet been proved. Our results suggest the need to revise

310   preventive programs to reduce oral health disparities among Hong Kong preschool children.

311   At present, several oral health schemes have been implemented. Water fluoridation is one of

312   the cost-effective measures in reducing ECC in Hong Kong. Caries prevalence had declined

313   remarkably from 97.5% in 1960 to 77.5% in 1987[8], and to approximately 50% in the 1990s[23].

314   This is in accordance with the results of the Cochrane systematic review that the introduction

315   of water fluoridation resulted in children having approximately 35% fewer caries experience[24].

316   However, no further caries reduction has been observed in the recent two decades.

317

318   Our findings indicated that both non-modifiable (socioeconomic background) and

319   modifiable risk factors (oral health related knowledge and habits) were significantly related

320   with ECC. Poor oral hygiene, low parental dental knowledge and high frequency of snacking

321   are the most important modifiable factors which are needed to be addressed. Primary

322   prevention program should encourage changes in behaviors and lifestyles to forestall this

323   impending epidemic of ECC. The health promoting school initiatives can be used as examples

324   of the most effective and sustainable ways to modify these factors. In Scotland, a school-based

325   supervised brushing program was found to be very successful in reducing dental caries among

326   5-year-old children [25]. Sodium fluoride, which is a simple and effective treatment for caries

327   prevention, can be used in an outreach dental care. In addition, silver diamine fluoride can also

328   be incorporated in a school-based health program for arresting cavitated dentine caries due to

329   its effectiveness, safe and simplicity to use[26]. However, since dental caries is influenced by the

330   same modifiable risk factors of other non-communicable diseases, rather than taking

331   individualistic approaches, a common risk approach such as the food policy development

332   should be adopted to address both the oral health problem and the general health problem[27].

333

334   Some limitations of the present study should be addressed. The study children were

335   selected based on the unit of kindergarten. Using the cluster sampling method could help with

336   reducing the cost and time and increasing the operational efficiency of conducting a survey in

337   a large area. However, a sampling error may occur if the limited number of included clusters

338   leaves off a significant proportion of the population that is not sampled. Due to the nature of

339   the cross-sectional study, our results could identify only the association between risk factors

340   and ECC. Further cohort research will be essential for determining the predictors of ECC.

341   Nevertheless, the present study has several strengths, such as obtaining a high response rate

342   (89%), sufficient sample size (more than 1,200 children) and high intra-reliability (Kappa value

343   0.97). The participating children also came from a broad socioeconomic background, and their

344   gender distribution was as estimated, representing kindergarten children in Hong Kong.

345

346   In summary, ECC is prevalent among 3- to 5-year-old kindergarten children in Hong

347   Kong. Untreated ECC is a common phenomenon. Caries prevalence dramatically increases

348   with increasing age among kindergarten children. The caries experiences of the study children

349   were significantly associated with gender, family income, parental dental knowledge, dental

350   visit experience and oral hygiene.

351

352   **Conflict of interest**

353   All authors declare no conflict of interest.

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361

Table 1 Prevalence and severity dental caries of the study children according to age and gender

Independent factors	N	Caries prevalence (dmft > 0)	p-value	Mean dmft (SD)	Mean d (SD)	Mean m (SD)	Mean f (SD)	p-value
All children	1191	46.3%		2.1 (3.4)	2.0 (3.3)	0.01 (0.2)	0.1 (0.6)	
Gender			<0.001[a]					<0.001[b]
Female	650	42.4%		1.8 (3.1)	1.7 (3.0)	0.02 (0.2)	0.1 (0.5)	
Male	541	51.0%		2.5 (3.7)	2.3 (3.6)	0.01 (0.1)	0.1 (0.6)	
Age			<0.001[a]					<0.001[c]
3	307	37.5%		1.4 (2.9)	1.3 (2.8)	0.01 (0.1)	0.02 (0.2)	
4	427	43.1%		1.9 (3.2)	1.8 (3.1)	<0.01 (0.1)	0.1 (0.4)	
5	457	55.4%		2.7 (3.8)	2.5 (3.7)	0.02 (0.3)	0.2 (0.8)	

[a] Chi-squared test, [b] Mann-Whitney U test, [c] Kruskal-Wallis test

Table 2 Caries prevalence and mean dmft score of independent variables

Variables (number of children)	Caries prevalence	p-value[a]	Mean dmft (SD)	p-value
Birthplace		0.010		0.003[b]
Hong Kong (1081)	45.2%		2.1 (3.4)	
Others (110)	57.3%		2.4 (3.1)	
Parenthood		0.387		0.159[b]
Both parent (1087)	46.1%		2.0 (3.3)	
Single parent or others (104)	48.1%		2.6 (4.0)	
Main caregiver		0.004		0.004[c]
Parent (824)	48.1%		2.1 (3.3)	
Grandparent (211)	48.3%		2.4 (3.9)	
Helper or others (156)	34.0%		1.5 (2.9)	
Father's education		<0.001		<0.001[c]
Primary or below (71)	59.2%		3.3 (4.4)	
Secondary (697)	50.2%		2.2 (3.4)	
Tertiary or above (425)	37.9%		1.8 (3.2)	
Mother's education		0.001		<0.001[c]
Primary or below (101)	61.4%		2.6 (3.3)	
Secondary (684)	47.5%		2.2 (3.5)	
Tertiary or above (406)	40.6%		1.9 (3.2)	
Family income (HK$)		<0.001		<0.001[c]
Less than 15,000 (424)	59.4%		2.8 (3.9)	
15,001-30,000 (420)	47.4%		2.1 (3.2)	
More than 30,000 (347)	29.1%		1.1 (2.6)	
Bottle feeding duration		0.548		0.880[c]
24 months or less (456)	48.2%		2.1 (3.2)	
More than 24 months (453)	45.7%		2.1 (3.4)	
Still fed with bottle (282)	44.3%		2.1 (3.7)	
Frequency of daily snacking		<0.001		<0.001[b]
2 times or less (676)	41.7%		1.8 (3.2)	
More than 2 times (515)	47.6%		2.4 (3.6)	
Age when starting brushing		0.004		<0.001[b]
24 months or less (830)	43.6%		2.0 (3.4)	
More than 24 months (361)	52.6%		2.4 (3.4)	
Frequency of daily brushing		0.032		0.002[b]
2 times or less (410)	50.7%		2.4 (3.5)	
More than 2 times (781)	44.0%		2.0 (3.3)	
Dental visit experience		<0.001		<0.001[b]
Yes (214)	59.8%		3.7 (4.4)	
No (977)	43.3%		1.7 (3.0)	
Parental dental knowledge level		<0.001		<0.001[c]
Low (53)	64.2%		3.8 (4.7)	
Middle (647)	50.2%		2.3 (3.5)	
High (490)	39.2%		1.6 (2.9)	

[a] Chi squared test, [b] Mann-Whitney test, [c] Kruskal-Wallis test

368   **Table 3 Caries risk factors of the study children (ZINB regression)**

Zero-inflated portion (dmft=0)	Odd Ratio	95% CI[#]	p-value	Pairwise comparison
Age			<0.001	(1)>(2)>(3)
(1) 3*				
(2) 4	0.66	0.45-0.97		
(3) 5	0.42	0.28-0.63		
Birthplace			0.046	
(1) Hong Kong*				
(2) Others	0.54	0.30-0.99		
Parenthood			0.041	
(1) Both parent*				
(2) Single parent or other	1.82	1.03-3.22		
Family income (HK$)			<0.001	(3)>(2)>(1)
(1) Less than 15,000*				
(2) 15,001-30,000	1.94	1.29-2.92		
(3) More than 30,000	5.27	3.38-8.23		
Frequency of daily snacking			0.001	
(1) 2 times or less*				
(2) More than 2 times	0.60	0.44-0.82		
Dental visit experience			<0.001	
(1) Yes*				
(2) No	2.14	1.43-3.21		
Increase VPI score by 10%	0.87	0.73-0.98	0.017	

Negative Binomial Portion (dmft>0)	Incidence rate ratio	95% CI[#]	p-value	Pairwise comparison
Gender				
(1) Female*			0.008	
(2) Male	1.25	1.06-1.48		
Family income (HK$)			0.030	(1),(2) > (3)
(1) Less than 15,000*				
(2) 15,001-30,000	0.98	0.81-1.19		
(3) More than 30,000	0.73	0.57-0.93		
Dental visit experience			<0.001	
(1) Yes*				
(2) No	0.51	0.42-0.63		
Parental dental knowledge			0.023	(1),(2)>(3)
(1) Low*				
(2) Middle	0.84	0.60-1.17		
(3) High	0.68	0.48-0.96		
Increase VPI score by 10%	1.09	1.03-1.15	0.001	

369   * Reference group, [#]95% CI = 95% confidence interval
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