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Associations of social and behavioural factors with early childhood caries in Xiamen city in China

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Background. Early childhood caries (ECC) is the presence of caries in primary teeth in children 71 months of age or younger. Despite a decreasing prevalence of caries in China, ECC and related risk factors in China have not been well studied.

Aims. This study aimed to investigate the status of ECC in children living in Xiamen city in China and to analyse the associated social and behaviour determinants.

Design. A stratified random sample consisted of 1523 children with normal birth records. Clinical examination was performed to record caries at the surface level. Parents filled in questionnaires regarding eating habits, family status, childcare provider, and oral intervention.

Results. Prevalence of ECC in studied child population was 56.8–78.31%, with an increasing tendency with age. The following factors were found to be significantly associated with ECC: age, candy, carbonated drink, bedtime eating, late start of brushing, low education of parents, private childcare, increased number of siblings, rural residence, and lack of oral health knowledge. Using a stepwise forward logistic regression analysis, a prediction model was established.

Conclusion. Early childhood caries in children living in Xiamen city was strongly associated with eating habits, family- and childcare-related factors and tooth-brushing. The ECC-high-risk group is children in rural private childcare facilities.

Introduction

Dental caries affects humans of all ages in all regions of the world and is also the most common oral disease of children. According to American Academy of Pediatric Dentistry (AAPD), early childhood caries (ECC) is the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a child 71 months of age or younger[1]. Untreated ECC may result in detrimental outcomes. First, tooth structure disintegration, as well as chewing and nutrient absorption, may affect maxillofacial growth and development[2]. In addition, children with ECC are more likely to develop further dental problems as they age[3,4]. Furthermore, caries-related toothache, infection and other morbidities may interfere with children's concentration and school participation and peer interaction, which can negatively influence children's psychological and emotional conditions[5]. Finally, because of the profound impact of ECC on children's quality of life and their future psychosocial health, such as effective communication and self-confidence, is considered as a part of child neglect if ECC is left untreated[6]. Currently, prevention and control of ECC is widely recognized and emphasized by dental caregivers.

Encouragingly, with the increase of ECC awareness and efforts by governments, care providers and family to control the disease, the general prevalence of caries in preschool has been decreasing world wide over the past several years. In China, the dental caries rate of 5-year-old children also shows a remarkable drop over the past several decades, as indicated by the over 10% difference of

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dental caries rate from a National Epidemiological Survey for oral health between 1995 and 2008, (76.55% and 66.0%, respectively)[7]. Nonetheless, China is still a region with a high prevalence of ECC in the world. Comprehensive investigation for ECC and analysis of its risk factors are crucial to screening the childhood population with high risk and helping public health officials and workers to develop dental health programs to promote prevention and early intervention.

Early childhood caries has a complex aetiology and is considered to be a multi-factorial disease[8]. In developed countries, it was found that ECC is closely associated with nursing habits, including prolonged bottle use, feeding at night and sweetened beverages with syrups, fruit juices and other solutions containing fermentable carbohydrates. In the developing world, it is also associated with malnutrition-related enamel hypoplasia and neglected oral hygiene. In addition, *Streptococcus mutans*, maternal education, family structure, and social status have been shown to play roles as well[2,9,10].

At the early-stage research of ECC, we focused on the bacteriological factors[11–13]. Nonetheless, little information is known about the nonbiological factors. In this study, on the basis of clinical examination and a questionnaire survey for 16 variables, we investigated the status of ECC and analysed the relationship between ECC and six factors including age, gender, eating habits, family, childcare provider, and oral intervention.

Materials and methods

Sample selection

A multi-stage, stratified, systemic sampling method was used to collect samples. Specifically, according to the ratio of populations in urban and rural areas in Xiamen City, four urban districts (Tongan, Helen, Siming, and Huli) and two rural districts (Jimei and Xiang'an) were selected. Next, three villages from each district were randomly selected. Children, 3–6 years of age, were randomly selected from public or private daycares. All children enrolled in this study are participants of the Xiamen Oral Health Program, which provides routine dental services. Moreover, each eligible child had a normal birth record, that is, on which it was written down that born at full term, normal birth weight and nature labour without foetal distress. Also, the eligibility spectrum for the mothers included healthy, in age of 25–35 at delivery, without any infection or hospitalization during pregnancy and having a normal process of delivery. A total of 1650 children, including 897 boys and 753 girls, were enrolled in this study. None of them has systematic disorders. Written informed consent was obtained from all families in this study, which was approved by the appropriate ethics committee. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki.

Examination of caries

According to the diagnostic standards for caries established in the third Chinese National Epidemiological Survey Programs of Oral Health[7], dental caries was identified with visual–tactile method. Briefly, the criteria includes: obvious cavities, sub-face enamel lesion, demineralization of dentine or localized enamel breakdown or noncavitation enamel damage on pits and fissure, and smooth surface (contacting surface, facial, and lingual surface), or definite soft cave bottom or tunnel wall. All examinations were carried out by two professional dental doctors and recorded by another doctor from Maternal and Child Health Hospital of Xiamen. Plain mouth mirror, wooden tongue spatula and gauze piece on an upright chair with artificial light supply were used. Examiners were calibrated and consistence test showed a Kappa value >0.85.

Studied factors and variable assignment

Based on the aetiology of caries and risk factors reported in the literature, we designed a questionnaire that contained 16 variables, covering six aspects of the studied subjects, including age, gender, eating habit, family, childcare provider, and oral intervention (Fig. 1).

Serial No. _____

Child 's Name_____ **Gender** ☐ Boy ☐ Girl

Childcare facility_____

Address_____

1. You are the child's ☐ Father ☐ Mother

2. How many children are there in your home? (please write down the number) _____

3. Which of the following does the child eat for dessert and how many times a week? (each item for one choice)

	>3	1–3	Seldom
Candy (sweets, chocolate)	☐	☐	☐
Carbonated drink	☐	☐	☐

4. How often does your child drink pure milk or diary products?

☐ Everyday ☐ Each week ☐ Seldom

5. Does the child eating before sleep without toothbrush?

☐ Frequently ☐ Occasionally ☐ Never

6. How old was the child when beginning to brush tooth?

☐ younger than 3 years old ☐ 3 years old ☐ older than 3 years old

7. How many times a day does the child brush tooth?

☐ more than twice ☐ 1–2 ☐ Seldom

8. Which type of toothpaste the child uses?

☐ Fluoride ☐ Non fluoride ☐ No clear

9. Which of the following is the highest lever of education you have achieved?

☐ Elementary ☐ Middle school ☐ College

10. Into which of the following income groups does the whole family fall? (RMB, million/year)

☐ less than 0.1 ☐ 0.1–0.2 ☐ more than 0.2

11. How do you think of the following statements? (each item for one choice)

Statement	Yes	No	Do not know
1). Rinsing of mouth after meals aids in caries prevention.	☐	☐	☐
2). Bacteria always present in our mouth.	☐	☐	☐
3). Bacteria are responsible for dental caries.	☐	☐	☐
4). Excessive sugar and candy can cause dental caries.	☐	☐	☐
5). Tooth brushing prevents caries.	☐	☐	☐
6). Sharp objects can damage our gums.	☐	☐	☐
7). Visiting a dentist every 6 months is essential for oral health.	☐	☐	☐
8). Tooth brush should be changed regularly.	☐	☐	☐
9). Pit and fissure sealing can work on the prevention of caries.	☐	☐	☐
10). Time of toothbrush is not less than 3 minutes.	☐	☐	☐
11). Caries should be treated timely.	☐	☐	☐
12). Children should start brushing teeth as soon as eruption of the first tooth.	☐	☐	☐
13). Fluoride can protect teeth from caries.	☐	☐	☐
14). Untreated caries may result in nutrient absorption or maxillofacial growth and development.	☐	☐	☐
15). Primary teeth have a direct effect on permanent teeth.	☐	☐	☐
16). Choose soft brushes with small head made special for children use.	☐	☐	☐
17). Brushing teeth every day and night.	☐	☐	☐
18). Children should not eat anything after brushing teeth in the night.	☐	☐	☐

Thanks For Your Cooperation

Fig. 1. Questionnaire to the parents of children examined for dental caries study.

Childcare provider was assigned as public or private childcare facility in terms of the legal registration. In China, public childcare facilities refer to the official-run kindergartens of which the ownership was hold by government and which could get the local financial assistance, whereas the private childcare facilities refer to the ones of which the ownership was hold by individual or other social groups, and which bear all the expenses without any government subsidy. Compared with the private facilities, the public ones often had long history of running experience, good environment, and good management. Especially, the public facilities would take into account the occupation of parents and interview of children when recruiting.

A total of 1650 questionnaires were sent to parents of enrolled children, and 1523 were returned (sample lost <10%).

Statistical analysis

SPSS program for Windows (version 15.0; SPSS, Inc. Chicago, IL, USA) was used for statistical analysis. Chi-square analysis was used to determine whether a factor was related to the caries by comparing the caries distribution in its subcategories. The Kruskal–Wallis test was used for age, sweet food, carbonated drink, bedtime eating, milk or dairy products, parents' oral health care knowledge and education, number of children in the family, household income, age of initial brushing, brushing frequency, and toothpaste type. The Mann–Whitney *U* test was used for gender, residence location, childcare facility and topical fluoride. A stepwise forward logistic regression analysis was performed to establish the prediction model and potential two-way interactions were explored throughout the modelling process. The variance inflation factor was used to test multicollinearity of independent variables. Hosmer–Lemeshow test was used to assess the model goodness-of-fit.

Results

Baseline data of caries

A total of 1523 children were examined with returned questionnaires. Caries were found in

142 of 250 (56.8%) children at 36–47 months of age, 496 of 692 (71.7%) children at 48–59 months of age, and 455 of 581 (78.3%) children at 60–70 months of age. The prevalence of the caries in the three age groups showed a significant difference ($P < 0.001$). In the three age groups of children, the sum of the number of decayed, missing, and filled primary teeth (dmft) was 3.06 ± 4.12, 4.58 ± 4.63, and 5.54 ± 4.97, respectively (Table 1). In contrast, the sum of decayed, missing, and filled primary teeth surfaces (dmfs) was 4.22 ± 6.93, 6.86 ± 9.28, and 9.49 ± 11.05, respectively. These results indicate that increased age correlates with an increased prevalence and severity of caries.

Caries distribution in the dentition

Fig. 2 indicated that caries experience was most frequently registered in the occlusal surfaces of mandibular first primary molars (range: 38.0–38.4%), followed by the occlusal surface of mandibular second primary molars (range: 36.9–37.5%), distal surfaces of mandibular first primary molars (range: 36.7–37.3%), mesial surfaces of mandibular second primary molars (range: 34.1–34.7%), occlusal surfaces of maxillary second primary molars (range: 32.2–33.3%), mesial surfaces of maxillary second primary molars (range: 30.3–30.6%), occlusal surfaces of maxillary first primary molars (range: 21.3–23.7%) and distal surfaces of maxillary first molars (range: 19.6–20.1%). Moreover, approximal surfaces of maxillary incisors were also the position susceptible to caries, mesial surfaces of central incisors in particular.

In accordance with previous studies, the maxillary central incisors were the most commonly involved teeth in the three age groups, followed by mandibular first and second molars, maxillary second molars, maxillary first molars, maxillary lateral incisor, maxillary canine, mandibular canine, mandibular central incisors, and mandibular lateral incisor (Fig. 2).

Table 1. Dental caries experience of sample by age and sex.

Variable	Category	Sample, *n* (%)	Children with caries (prevalence, %)	dmft (mean ± SD_1*)	dmfs (mean ± SD_2**)	*P*-value
Age (month)	36–47	250 (16.4)	142 (56.8)	3.06 ± 4.12	4.22 ± 6.93	0.000
	48–59	692 (45.4)	496 (71.7)	4.58 ± 4.63	6.86 ± 9.28	
	60–70	581 (38.2)	455 (78.3)	5.54 ± 4.97	9.49 ± 11.05	
Gender	Boys	827 (54.3)	599 (72.4)	4.75 ± 4.71	7.42 ± 9.50	0.503
	Girls	696 (45.7)	494 (71.0)	4.64 ± 4.81	7.44 ± 10.24	
Total (%)	1523 (100)	1093 (71.8)	4.70 ± 4.75	7.43 ± 9.84		

*Standard deviance of dmft.
**Standard deviance of dmfs.

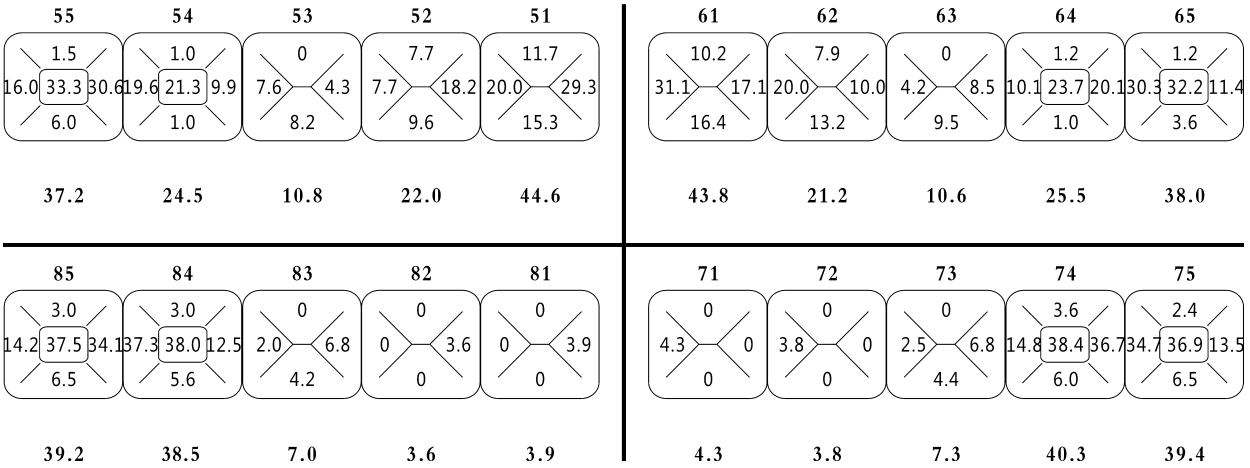

Fig. 2. Proportion (%) of surfaces with caries experience in studied group.

Analysis of caries and studied factors

The relationship between caries in children and the factors that were included in the questionnaire was analysed and is summarized in Table 2. Among the 16 studied factors, except gender, brushing frequency, toothpaste type and household income, the remaining factors including age, sweets, carbonated drinks, bedtime eating, milk or dairy products, age of initial bushing, education of parents, childcare provider, number of children, residence, parents' oral health care knowledge and topical fluoride showed significant relevance to caries ($P < 0.05$). The prevalence, dmft and dmfs show a similar increased correlation with higher frequency of sweet, carbonated drink, bedtime feeding, late start of initial brushing, low education of parents, private childcare giver, more children in the family, rural location of residence, lack of oral health knowledge, and foam topical fluoride.

Table 2. The prevalence and severity of caries in studied groups and corresponding factors.

Variable	Category	Sample, *n* (%)	Children with caries (prevalence, %)	dmft (mean ± SD_1)	dmfs (mean ± SD_2)	*P*-value
Age (month)	36–47	250 (16.4)	142 (56.8)	3.06 ± 4.12	4.22 ± 6.93	0.000
	48–59	692 (45.4)	496 (71.7)	4.58 ± 4.63	6.86 ± 9.28	
	60–70	581 (38.2)	455 (78.3)	5.54 ± 4.97	9.49 ± 11.05	
Gender	Boys	827 (54.3)	599 (72.4)	4.75 ± 4.71	7.42 ± 9.50	0.053
	Girls	696 (45.7)	494 (71.0)	4.64 ± 4.81	7.44 ± 10.24	
Candy (times per week	>3	259 (17.0)	199 (77.0)	5.29 ± 5.31	9.26 ± 12.98	0.030
	1–3	528 (34.7)	381 (72.1)	4.74 ± 4.65	7.49 ± 9.45	
	Seldom	736 (48.3)	513 (69.7)	4.29 ± 4.68	6.65 ± 9.31	
Carbonated drink	>3	116 (7.6)	94 (81.1)	5.90 ± 4.79	9.43 ± 10.33	0.000
(times per week	1–3	402 (26.4)	308 (76.5)	5.22 ± 4.89	8.47 ± 10.47	
	Seldom	1005 (66.0)	691 (68.1)	4.19 ± 4.66	6.65 ± 9.79	
Bedtime eating	Frequently	161 (10.6)	121 (75.2)	5.71 ± 5.46	9.76 ± 12.76	0.000
	Occasionally	961 (63.1)	706 (73.5)	4.81 ± 4.76	7.72 ± 9.92	
	Never	401 (26.3)	266 (66.3)	3.53 ± 4.31	5.25 ± 8.50	
Milk or dairy products	Everyday	926 (60.8)	606 (65.4)	4.00 ± 4.52	6.26 ± 9.14	0.000
	Each week	366 (24.0)	279 (76.3)	5.05 ± 4.84	7.88 ± 9.65	
	Seldom	231 (15.2)	208 (90.0)	6.17 ± 5.13	10.65 ± 12.75	
Parents' oral health care	Comprehensive	926 (60.8)	636 (68.7)	4.32 ± 4.68	6.74 ± 9.37	0.000
knowledge	Moderate	532 (34.9)	407 (76.5)	5.25 ± 4.82	8.52 ± 10.55	
	Lack	65 (4.3)	50 (76.9)	5.49 ± 4.77	8.32 ± 9.69	
Education of parents	Elementary	93 (6.1)	80 (85.6)	7.55 ± 5.49	14.12 ± 15.02	0.0
	Middle school	684 (44.9)	542 (79.2)	5.17 ± 4.94	8.40 ± 10.72	00
	College	746 (49.0)	471 (63.2)	3.66 ± 4.26	5.38 ± 7.69	
Number of children	1	1255 (82.4)	887 (70.7)	4.36 ± 4.62	6.79 ± 9.38	0.029
	2	238 (15.6)	182 (76.3)	5.82 ± 5.40	10.18 ± 12.38	
	>2	30 (2.0)	24 (80.0)	4.88 ± 4.67	8.54 ± 12.18	
Residence	Rural	350 (23.0)	312 (89.0)	7.86 ± 5.36	14.15 ± 13.55	0.000
	Urban	1173 (77.0)	781 (66.6)	4.08 ± 4.23	6.00 ± 7.83	
Household income	<0.1	1285 (84.4)	935 (72.8)	5.48 ± 5.68	8.01 ± 10.49	0.346
(RMB, million, per year)	0.1–0.2	163 (10.7)	106 (65.2)	3.76 ± 4.12	5.90 ± 8.24	
	>0.2	75 (4.9)	52 (69.8)	3.65 ± 4.10	5.42 ± 8.02	
Childcare facility	Private	816 (53.6)	686 (84.1)	6.25 ± 4.98	10.33 ± 11.23	0.000
	Public	707 (46.4)	407 (57.6)	3.44 ± 4.05	5.03 ± 7.57	
Age of initial brushing	<3	535 (35.1)	357 (66.7)	4.18 ± 4.56	6.37 ± 8.96	0.000
	3	524 (34.4)	357 (68.2)	4.12 ± 4.44	6.42 ± 8.34	
	>3	464 (30.5)	379 (81.7)	5.49 ± 5.18	9.13 ± 11.58	
Brushing frequency	>2	425 (27.9)	285 (67.1)	4.22 ± 4.56	6.80 ± 9.56	0.149
(times per day)	1–2	859 (56.4)	618 (72.0)	4.86 ± 4.89	7.69 ± 10.09	
	Seldom	239 (15.7)	190 (79.5)	4.39 ± 4.63	7.02 ± 9.84	
Tooth paste type	Fluoride	880 (57.8)	670 (76.1)	5.40 ± 5.68	7.88 ± 10.55	0.413
	Nonfluoride	503 (33.0)	326 (64.9)	3.97 ± 4.39	6.10 ± 8.42	
	No clear	140 (9.2)	97 (69.3)	4.10 ± 4.40	6.53 ± 9.80	
Topical fluoride	Foam	917 (60.2)	709 (77.3)	5.53 ± 5.00	9.02 ± 10.81	0.000
	Vanish	606 (39.8)	384 (63.4)	3.44 ± 4.05	5.03 ± 7.57	

Establishment of prediction model for caries

Table 2 demonstrates the variables that are significantly associated with ECC, but the possible confounding influence of other variables is not taken into account. To determine the independent association between household- and neighbourhood-based socioeconomic measures and ECC, the above 11 factors (except ''topical fluoride'') with statistical significance were assigned to predict caries as a dependent variable. To construct the prediction model, a stepwise forward logistic regression analysis was performed. As shown in Table 3, residence, childcare facility, carbonated drink, bedtime feeding, milk or dairy products and age (month) have an independent impact on ECC. The odds ratio for children who live in a rural area was 2.187, representing an increase of caries risk com-

Table 3. Factors associated with primary caries and predictive risk of early childhood caries.

Variable	Regression coefficient	*P*-value	AOR*	95% CI**
Residence				
Rural	0.783	0.006	2.187	(1.252, 3.822)
Urban	1.000***			
Childcare facility				
Private	0.730	0.001	2.076	(1.345, 3.205)
Public	1.000***			
Candy (times per week)				
>3	—	—	—	—
1–3	—	—	—	—
Seldom	—	—	—	—
Carbonated drink (times per week)				
>3	0.521	0.001	1.594	(1.017, 2.289)
1–3	—	—	—	—
Seldom	1.000***			
Milk or dairy products				
Everyday	−0.532	0.041	0.588	(0.353, 0.978)
Each week	—	—	—	—
Seldom	1.000***			
Bedtime eating				
Frequently	0.882	0.003	2.417	(1.327, 4.400)
Occasionally	0.532		1.703	(1.191, 2.435)
Never	1.000***			
Age of initial brushing				
<3	—	—	—	—
3	—	—	—	—
>3	—	—	—	—
Education of parents				
Elementary	—	—	—	—
Middle school	—	—	—	—
College	—	—	—	—
Age (month)				
36–47	−0.922	0.000	0.398	(0.244, 0.648)
48–59	−0.480		0.619	(0.437, 0.876)
60–70	1.000***			
Parents' oral health care knowledge				
Comprehensive	—	—	—	—
Moderate	—	—	—	—
Lack	—	—	—	—
Number of children				
1	—	—	—	—
2	—	—	—	—
>2	—	—	—	—
Constant	1.799	0.036	6.043	

*Adjusted odds ratio, adjusted for all other factors listed in the table.
**95% confidence interval.
***Reference category.
—Nonsignificant covariate not included in the model.

pared with children living in an urban area (95% CI: 1.252–3.822). In terms of babysitter, children in a private facility were more likely to be susceptible to caries than in public ones, with a 2.076 × risk factor (95% CI: 1.345–3.205). Regarding the variables about dietary habits, carbonated drinks consumed more than three times a week (OR = 1.594, 95% CI: 1.017–2.289), drinking milk or dairy products everyday (OR = 0.588, 95% CI = 0.353–0.978), and bedtime eating (OR = 2.417, 95% CI: 1.327–4.400 for frequent group, and OR = 1.703, 95% CI: 1.191–2.435 for occasional group), were significantly associated with ECC. Among children with different age, the likelihood of experiencing caries was greater for those who were older. Compared to children of 60–70 months of age, the odds ratio of caries for a child of 3 years of age and 4 years of age were 0.398 (CI: 0.244–0.648) and 0.619 (CI: 0.437–0.876), respectively.

Throughout the modelling process, potential two-way interactions were explored. The results did not reveal interaction among these factors ($P > 0.05$), suggesting that the effects of these factors were independent. Using Hosmer–Lemeshow goodness-of-fit statistic, we also tested the fitness of the logistic regression model. The *P*-value was 0.784, suggesting the validity of this model in predicting caries.

Discussion

This study involved a random sample of 3- to 6-year-old children with normal birth records and confirmed nonbiological risk factors related to ECC. Despite earlier studies reporting a dramatic decrease in caries prevalence in China, ECC was diagnosed in 71.8% of the children. Caries may occur shortly after the eruption of primary teeth, in 2–3 years of age. The incidence continues increasing with age and reaches a peak in children 5–6 years of age[14]. Consistently, the incidence of caries in this study also showed a significant correlation with age, but not with gender. The difference of caries incidence in three age groups of children was significant. In addition, the severity of caries, as reflected by the values of dmft and dmfs, was increased with age. This may be explained by two reasons. First, with young children, more diversified food and sweetened drinks may be consumed. If a proper oral hygiene is not followed, this diet change may result in the accumulation of substrate for bacteria. In addition, if the caries-inducing factors are persistently present in affected children, the accumulative effect may also results in an increase of the severity of caries with age.

The development of caries is promoted by multiple factors including host susceptibility, oral cariogenic bacteria, appropriate substrate, and sufficient time[15]. Previous studies have shown that children with bedtime eating habits have higher risk. Obviously, this habit provides two critical caries-promoting conditions: a large volume of substrates (sucrose, glucose, and fructose) and sufficient time for bacteria to produce the acid products. While the accumulation of the acid products damages the teeth directly, it also facilitates the adhesion of bacteria on the teeth surface and the interaction between bacteria as well. In addition, owing to the change of the permeability of bacterial plaque, the buffering capacity of saliva is weakened or diminished. Ultimately, a prolonged exposure of the teeth in the acidic environment causes the teeth etching and caries[8,14,15]. The results of this study also support the hypothesis that eating habits constitute an important factor for caries development, as the incidence and severity of caries are associated with the frequency of sweet foods, carbonated drinks, and bedtime eating. In contrast, milk and dairy product appears to play a protective role. It has been suggested that milk contains a similar composition to saliva, including calcium, phosphorus and a variety of proteins that mediate anti-caries and anti-demineralization effects[16,17].

As home and childcare facilities are the two primary living places for most kids, we also investigated the influences from family and caregivers. Instead of using socioeconomic status (SES) as a single index for family impact as many other studies did, we examined the family impact with several specific variables such as parents' education and oral knowledge, family income, number of children and rural or urban residence. It has been shown that the family SES is closely related

to the occurrence of caries[18]. In this study, we found that family income was not associated with the incidence of caries, whereas low education and less oral knowledge of parents, more number of children in the family, and rural residence were significantly related to the occurrence of caries, which is consistent with other studies[19,20]. In addition, we also found that the incidence of caries was significantly higher in private childcare providers than in public ones. We did not further study the reasons behind the two different types of childcare providers. Nonetheless, it is speculated that the availability of milk and dairy products in the diet, as well as the higher education of childcare workers in public childcare facilities, may contribute to the reduction of caries. Collectively, it is suggested that the awareness of the caries prevalence and active intervention is one important control point for public health officials to design a preventive strategy[21,22]. Furthermore, the focus should be on those from rural areas of lower education, more poverty and less access to medical care at the time of making policies for health insurance.

Tooth-brushing and topical application of fluoride are two effective methods to prevent caries[23]. We determined the relationship between the caries incidence and age of initial brushing, frequency of brushing, the type of toothpaste, and topical application of fluoride. Our results indicated that the brushing frequency and type of toothpaste is not significant, but the earlier starting time of brushing and topical application of fluoride is significantly associated with less caries[24].

Limitations of the study

In this study, with a large, nationally representative sample of preschool-aged children, we assessed the integrated effects of multi-faceted dental behaviour with multiple statistical analysis methods. In the meantime, there are a few weaknesses in this study. One is due to the use of a cross-sectional design to assess indicators of caries. In addition, we were unable to ascertain the level of parental bias in responding to self-reported questions. Another limitation lies in the variations of sample such as individual body mass index and oral microorganism. Finally, due to absence of baseline data on dmft/dmfs of the group, we were unable to compare the effectiveness of two types of topical fluoride interventions.

What this paper adds?

- The present survey would be the first literature that explored systematically the link between early childhood caries (ECC) and household- and neighbourhood-based social determinants in a large representative sample of preschool children in the city of Xiamen in Fujian province in southeast China that enjoys a relatively high economic status compared with other regional cities.
- The status of ECC in Xiamen City was studied, which provides an important reference for dental care providers, daycare providers and families.
- This comprehensively determined the risk factors of ECC on environmental–behavioural reasons, which may help to screen the high-risk children population in need of treatment.
- From the perspective of public health, the results of this study can be helpful for public health policy-makers to design dental programs to prevent and treat ECC.

Why this paper is important to paediatric dentistry?

- The results of our study support the American Dietetic Association's dietary guideline for children: discouragement of soft drinks[25] and encouragement of milk as an alternative[26].
- In addition, to prevent ECC, the following factors should also be emphasized: avoidance of bedtime eating, enhancement of parents and caregivers' oral knowledge, and encouragement of teeth-brushing at a very young age.

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