The prevalence and risk factors of Early Childhood Caries among 3-year-old children in Wenzhou

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Research article

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Abstract

Background This study aimed to investigate the prevalence and risk factors of Early Childhood Caries (ECC) among 3-year-old children in Wenzhou China. **Methods** Kindergarten children aged 3 were recruited using a stratified cluster sampling method. Dental examinations were conducted by one trained dentist, and oral health-related data were collected. Examinations were surface-specific for dental caries, following World Health Organization (WHO) criteria. Bivariate tests and logistic regression models were used to assess the association between ECC and different risk factors. **Results** A total of 693 children were recruited for the study, and 445 completed the dental examination. Among the 445 children, the prevalence of ECC was 59.8%. The mean decayed, missing, and filled primary teeth (dmft) was 2.9, and of the total dmft, only 6.3% were filled. The mean decayed, missing, and filled primary surface (dmfs) was 4.9. Logistic regression analyses identified age and parents' oral health knowledge level were associated with the experience of ECC ($P < 0.05$). **Conclusions** A higher prevalence of ECC was observed and most of the carious teeth were untreated. The experience of ECC was related to age and parents' oral health knowledge level.

Background

Dental caries (cavitated or non-cavitated) of primary teeth in children under age of 72 months, or what is known as Early Childhood Caries [ECC] [1]. Dental caries with a negative impact on the oral health-related quality of life (OHQoL) of children is one of the most common childhood disease [2, 3].

Dental caries decline has been observed in the developed countries during last three decades [4]. In contrast, because of the easy availability of refined sugars than earlier, compromised dental care and prevention, very few programs to eradicate the disease and poor public knowledge about the disease, dental caries in China has become a new threat and been on the rise [5, 6], affecting a considerable proportion of young children [5, 7, 8]. The Third National Oral Health Survey in China showed that the prevalence of ECC was 66% and the mean decayed, missing, and filled primary teeth (dmft) score was 3.5 in a 5-year-old age group [7]. This finding of high prevalence of caries exist in a population of young China children is alarming.

ECC is a chronic, infectious, and multifactorial disease. There are a number of factors found to be associated with ECC, including low socioeconomic statuses [9, 10], high consumption of sugar snacks or beverages [10, 11], nutritional problems, improper bottle use [12], poor oral hygiene [9, 12], and higher levels of *Streptococci mutans* bacteria [10]. A systematic review revealed that breastfeeding in infancy may protect against dental caries [13]. In contrast, children who were breastfed beyond 12 months had an increased prevalence of dental caries [13]. Because of different study designs, statistical analysis techniques, definitions of dependent and independent variables, children's ages, and presence of confounders, the risk factors differ in part [14]. There is no organized dental care available for preschool children in Wenzhou. It has been revealed that the prevalence of 3 years old children in Wenzhou was very high from former report [15]. However, the risk factors of ECC in Wenzhou remained unknown, in where

cultures, living styles, and child-rearing practices are markedly different. This study assessed the relationships between the visible caries experience and several behavioral risk factors (dietary and oral hygiene practices), demographic risk indicators and socio-economic factors in a high caries risk population.

Methods

Selection of children and sample size

The study was conducted in the city of Wenzhou from Zhejiang Province in southeast China. A stratified cluster sampling method was used to select the study population. Firstly, the whole geographic area was divided into three districts. Secondly, every district was stratified into developed and developing areas based on the economic income. Thirdly, one kindergarten was randomly selected from the developed and developing areas of different districts, respectively. In the end, in the selected 6 kindergartens, three classes were sampled from Grades 1. In Wenzhou, children can attend kindergarten from 3 years on. In the 2005 survey, the prevalence of ECC was 66% in the 5-year-old age group in China. The sample size after calculation was found to be 92. Because the age of participants was 3-4 years old, it was suspected that the corresponding prevalence of dental caries would be less than 66%. Then, larger sample size was required. Eventually, 693 children aged 3–4 in the selected kindergartens were recruited into the study. The inclusion criterion of this study was generally healthy children. The ethical authorization for the study was taken from the Institutional Ethics Committee of Wenzhou Medical University. During the parents meeting at the beginning of the semester, the aim of this study was explained and the details of the study, including relevant risks, compensation, confidentiality, and contact information, in a printed form were sent to all parents or legal guardians. Written informed consents was obtained individually from them.

Dental examination and diagnostic criteria

The oral health examinations were carried out for all eligible subjects in the kindergarten by one dentist. The examination was carried out under natural light by using a World Health Organization probe (no. 621) and a dental mirror. The examiners evaluated caries experience by using decayed, filled and missing primary teeth (dmft) index and decayed, filled and missing primary surfaces (dmfs) following the World Health Organization criteria^[16] for dental caries diagnosis. Dental caries was detected by visual inspection, and cavitation stage was recorded as dental caries. No radiographs were taken on the children. All examinations were performed by one dentist. 10% of children were re-examined to monitor the intra-examiner reproducibility. Kappa statistics on tooth status was 0.96.

Data collection

Parents or other caregivers were asked to complete follow-up questionnaires. Data were collected with the use of structured questionnaires. It mainly collected information included dietary factors (e.g. frequent exposure to snacks and drinks, nighttime meals and drinks), and feeding habit (night-time nursing bottle use), oral hygiene practices (e.g. age brushing started and toothbrushing frequency), parental oral health

behavior, utilization of dental services, and socio-demographic characteristic (e.g. educational attainment of parents, household income). Information on parental oral health knowledge was collected through four true/false statements on the causes and prevention of tooth decay. Parents were asked to indicate their answers to four statements. Each correct answer ended a score of 1 and thus a dental knowledge score was computed as sum of score of four statements which ranged from 0 to 4, with a higher score indicating better oral health knowledge level.

Statistical analysis

The collected data were entered into Epidata software, version 3.1, and analyzed using SPSS version 19. The analysis first resulted in the reporting of descriptive statistics. Bivariate analyses were performed using the chi-square and Wilcoxon rank sum tests. We performed a t-test to test the differences in mean age between the children with and without caries. The risk factors associated with dental caries were founded out with the help of a multivariable logistic regression model which was used for adjusting the probable confounders. To present these conclusion, 95% CI, odd ratio (OR), and a p-value < 0.05 were considered for significance of the study.

Results

Caries experiences

A total of 693 children from six kindergarten were recruited for the study. 445 completed the dental examination, while the rest 248 children not examined as they were absent (often repeatedly) on the day of examination for undetermined reasons or of dental phobia.

Of the examined 445 children (mean age was 3.4 years), 206 (46.3%) were girls, and 239 (53.7%) were boys. The prevalence of ECC was 59.8%. The mean dmft score was 2.9 (standard deviation [17] = 3.7); the dmfs score was 4.9 (SD = 9.0). Prevalence of ECC in boys was 59.0%, while in girls was 60.7% (P=0.72). The mean dmft was 2.95 and was 2.74 in boys and girls (P=0.54).

The percentage of untreated carious teeth in 3 years old children in this study was 93.7%. Approximately 30 percent (31.2%) of the children had four or more teeth with caries experience, consist of 80 percent of the decay.

The reliability of the questionnaire was also tested. Questionnaires were completed by the majority of parents (95%). No significant difference was found between ECC group and caries-free group.

Bivariate analysis

The relationship between ECC and dietary factors and oral hygiene practices were presented in Table 1. Out of the total sample, 38.8% children were breastfed, 37.1% children were formula fed, and 24.1% children were mixed with breastfed and formula fed; the prevalence of ECC of each group was 57.9%, 61.1%, and 59.8% respectively (P=0.84). Approximately 18% children had a history of sleeping with

bottles. Dietary information collected showed that 13%, 57.9%, and 26.7% of the children consumed carbonated beverage, sweet snacks and candies/chocolate at least once a day. Out of the total sample, 17% children started toothbrushing before the age of 2; 74.2% children started toothbrushing when they were 2 to 3 years old; 8.7% children never have their teeth brushed. Approximately 50 percent (48.3%) children had their teeth brushed at least once a day.

Table 2 showed the relationship between ECC and parental oral health behavior, socio-demographic factors and parents' oral health knowledge level. Out of total sample, 22% children brushed teeth under supervision every day; 69.7% children brushed teeth under supervision sometimes; 8.3% children performed unaided brushing; the prevalence of ECC of each group was 51.6%, 61.7%, and 62.9% respectively ($P=0.14$). Over 50 percent of children were from families with annual incomes of less than ¥100000, and 71 percent of mothers had no more than a high school education. No significantly difference was observed in different groups ($P=0.21$).

This study reported that 17.3% of the children had a previous visit to a dentist. Over 80 percent of children had never visit to a dentist in a year.

Bivariate analyses relating to the caries experience at 3 years found six factors (age, the main caretaker, consumption of candies/chocolate, age toothbrushing started, parental check after toothbrushing, and parental dental knowledge levels) significantly related at $P<0.15$.

Multivariable logistic regression analyses

Following the initial assessment of the relationship between the presence of caries and the above mentioned factors, multivariable logistic regression was used to evaluate the multiple independent factors related to the experience of caries. The final multivariable logistic regression analyses revealed age and parental dental knowledge levels were associated with the experience of ECC ($P<0.05$) (Table 3).

Discussion

The present study shows the prevalence of dental caries among 3-year olds children in Wenzhou was 59.8%; it was higher than the prevalence of ECC in 3-4 years old in Beijing (49%)[8]. On average, the occurrence of dental caries among 3 years old children in China was 50.8%[6]. In Asian countries, such as India[18] and Singapore[19], the prevalence of dental caries in preschool children was found to be 47.3% and 49% respectively. The prevalence of dental caries among 3 years old children in Japan was 14.7% [20]. In some developed countries, the prevalence was low which was largely attributed to increasing awareness about the oral hygiene practices, increasing access to fluoridation for prevention of dental caries, and parental concern about the dental health[18].

It has been estimated that 80 percent of the decay was found in just 25 percent of children [21], and that 80 percent of decay experience by low-income children aged 2 to 5 years remains untreated. Similarly, this study reported that approximately 30 percent (31.2%) of the children had four or more teeth with

caries experience, which consists of 80 percent of the total decay detected. The percentage of untreated carious teeth in 3 years old children in this study was 93.7%. This may be attributed to the lack of public knowledge about primary prevention and preventive programs. Meanwhile, pediatric dentist is often under-staffed and cannot meet the extensive needs of the community.

This study depicted that increase in child's age were more vulnerable to develop dental caries. A similar type of study conducted in Tanzania[22] and Nigeria[23] showed that increase in age of the children was associated with dental caries. This could be explained by several plausible mechanisms such as age-related causes, caries progression due to early caries experience, and caries susceptibility [24]. Caries experience measures the cumulative effects of dental caries in life time of a particular dentition. Therefore, older children are likely to have caries.

Our study showed a negative association between parental dental knowledge levels and the experience of ECC. Similarly, Chen et al found that children whose parental dental knowledge levels were moderate had higher dmft scores [25]. Parents play a crucial role as decision makers in making important health-related choices for their children. Positive attitude and knowledge of parents toward a healthy lifestyle have significant links to their child's quality of life [26].

This study depicted that age toothbrushing started and parental check after toothbrushing would be predictors of dental caries, while it was unable to found the association between frequency of toothbrushing and dental caries. A longitudinal prospective study has shown an incremental association between a decreasing frequency of toothbrushing at age 2 and higher chances of dental decay at age 5[27]. In this study, the effect of twice daily tooth brushing was probably in part attenuated because of unaided toothbrushing. Collett et al stated that parents' child behavior management skills and the duration of parent-led toothbrushing were associated with better child oral health[28].

This study was unable to found the association between breastfeeding and dental caries. However, some authors have stated that bottle feeding is a risk factor for dental caries[29],[#12973] while another authors have not found such an association[22]. Tham et al stated that children exposed to longer duration of breastfeeding up to age 12 months (more versus less breastfeeding), had a reduced risk of caries, while children breastfed > 12 months had an increased risk of caries when compared with children breastfed < 12 months[13]. The relationship between breastfeeding and development of ECC is still a contentious issue and further investigations are needed.

However, there are some potential limitations of this study, such as recall bias and social desirability bias existed. In addition, the study has not assessed other potential indicators, including oral counts of mutans streptococci; maternal oral health status; and the numbers of people in the household. Further prospective studies are needed which would give a better insight into the complex multi-factorial etiology of dental caries.

Conclusions

The prevalence of ECC among Wenzhou 3-4 years old children was very high and most of the carious teeth were untreated. There appears to be a relationship between consumption of candies/chocolate, the age at which toothbrushing was started, whether parents supervised to brush or not, and parents' oral health knowledge level and ECC.

Bullet Points

Why this paper is important to paediatric dentists

The prevalence of ECC varies from population to population, this study provide the prevalence of ECC in Wenzhou China. Because of different study designs, statistical analysis techniques, definitions of dependent and independent variables, children's ages, and presence of confounders, the risk factors of ECC differ in part. Partial risk factors are still a contentious issue and further investigations are needed.

Abbreviations

Dmfs: Decayed, missing, and filled surfaces; dmft: Decayed, missing, and filled teeth; ECC: Early childhood caries; SD: Standard deviation; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate:

This study was approved by the institutional review board of School and Hospital of Stomatology, Wenzhou Medical University. The aim of this study was explained and the details of the study, including relevant risks, compensation, confidentiality, and contact information, in a printed form were sent to all parents or legal guardians of participants. Written informed consent was obtained from the parents or legal guardians of participants.

Consent for publication:

Not applicable

Availability of data and materials:

The datasets analyzed during the current study will not be publicly available to protect patient confidentiality.

Competing interests:

The authors declare that they have no actual or potential conflicts of interest.

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Author's contributions:

LM designed the studies, carried out the dental examination and drafted the manuscript; ZW performed the statistical analysis and participated in its design; QL collected data, performed data analysis and made the charts in the manuscript; and XW carried out the studies, collected data, and helped to draft the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1: Relationship between ECC and dietary factors and oral hygiene practices

Variable(n)	Caries experience		p-value
	Yes(%)	No(%)	
Breastfeed or not			
almost bottle feed(157)	61.1	38.9	0.84
mixed feed (102)	59.8	40.2	
almost breastfeed(164)	57.9	42.1	
Slept with bottles			
never(348)	60.1	39.9	0.741
sometimes(39)	53.8	46.2	
always(36)	61.1	38.9	
Consumption of carbonated beverage			
<1 time/day (368)	57.9	42.1	0.183
1 time/day (37)	70.3	29.7	
≥1 time/day (18)	72.2	27.8	
Consumption of sweet snacks			
<1 time/day (178)	57.9	42.1	0.561
1 time/day (200)	59.5	40.5	
≥1 time/day (45)	66.7	33.3	
Consumption of candies/chocolate			
<1 time/day (310)	56.8	43.2	0.14
1 time/day (91)	68.1	31.9	
≥1 time/day (22)	63.6	36.4	
Sugary snack/drinks at night			
never(66)	53.0	47.0	0.37
sometimes(278)	59.7	40.3	
always(79)	64.6	35.4	
Age Toothbrushing started			
< 2 years (72)	50.0	50.0	0.14
2-3 years (314)	60.8	39.2	
never (37)	67.6	32.4	
Frequency of Toothbrushing			
≥2 time/day (51)	56.9	43.1	0.881
1 time/day (153)	60.8	39.2	
< 1 time/day (219)	59.4	40.6	

Table 2: Relationship between ECC and parental oral health behavior, socio-demographic characteristics and parents' oral health knowledge level

Variable(n)	Caries experience		p-value	
	Yes(%)	No(%)		
Help with toothbrushing				
once a day (93)	51.6	48.4	0.206	
sometimes (295)	61.7	38.3		
never (35)	62.9	37.1		
Check after toothbrushing				
once a day (66)	50.0	50.0	0.14	
sometimes (302)	60.3	39.7		
never (55)	67.3	32.7		
Annual family income				
¥50000 or less (42)		66.7	33.3	0.209
¥50000 to ¥100000 (187)		55.1	44.9	
¥100000 to ¥200000 (135)		65.2	34.8	
more than ¥200000 (59)		55.9	44.1	
Mother' education level				
less than high school(95)		62.1	37.9	0.176
high school or GED (222)		62.2	37.8	
attended college (106)		51.9	48.1	
Parents' oral health knowledge				
Good (79)		51.9	48.1	0.095
Medium level (202)		58.9	41.1	
Poor (142)		64.8	35.2	

Table 3: Multiple logistic regression analysis for the risk of the caries experience at 3 years

Characteristic	Coefficient	P-value	OR	95%CI
Age	0.083	0.001	1.086	[1.032-1.143]
Consumption of candies/chocolate	0.314	0.099	1.369	[0.942-1.990]
Age toothbrushing started	0.376	0.08	1.457	[0.957-2.218]
Parental check after toothbrushing	0.335	0.09	1.398	[0.949-2.06]
Parent's oral health knowledge level	0.294	0.044	1.341	[1.008-1.785]