

The Prevalence and Risk Factors of Dental Caries of Permanent Teeth among 12-year-old Students in Guangdong, South China

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Abstract

Background: Analyses of factors related to dental caries in the population have been reported in some cities and provinces of China. However, large-scale field data evaluation at a provincial level is lacking. The aim of this study was to explore the factors related to caries in the permanent dentition of 12-year-old students in Guangdong province.

MATERIALS/METHODS: Equal-sized groups of urban and rural students (960 of each) in Guangdong were selected by stratified, multistage random sampling with a gender ratio of 1:1. All participants were required to undergo an oral health examination. Information concerning the subjects' family background, dietary habits and relevant oral health behaviour was collected in a structured questionnaire. Logistic regression analysis was used to study the factors related to dental caries. The independent variables included gender, residence, socio-economic status, dietary factors, and oral health measures, among others.

RESULTS: Multivariate conditional logistic regressions showed that rural residence (odds ratio (OR)=1.676, 95% confidence interval (CI): 1.350-2.080, $P < 0.001$), female gender (OR =1.377, 95%CI: 1.115-1.701, $P = 0.003$), frequent consumption of sugary snacks (\geq once a day vs. $<$ once a day) (OR=1.484, 95%CI: 1.123-1.962, $P = 0.006$), and calculus (OR =1.391, 95%CI: 1.122-1.724, $P = 0.003$) were risk factors for dental caries, while the father's education level (>9 years vs. ≤ 9 years) (OR=0.796, 95%CI: 0.638-0.993, $P = 0.043$) was a protective factor.

CONCLUSION: Rural residence, female gender, poor oral hygiene and frequent consumption of sugary snacks were the main risk factors for caries of the permanent teeth in 12-year-old students.

Background

Although the mean severity of caries in China is at a very low level (decayed, missing and filled permanent teeth (DMFT) <1.2), it has increased by 0.32 in the past 10 years [1]. The severity of caries in 12-year-old students in Guangdong Province is above the national average; this concern calls for further attention. Dental caries is associated with several variables such as social and demographic factors, oral health behaviours, sugar consumption habits, the status of dental service utilization, and pit-and-fissure sealant history, and this condition has both immediate and long-term impacts in terms of pain, suffering, loss of school time and economic burden of the family [2].

Dental caries is a multifactorial disease that results from the interplay among oral microflora, fermentable carbohydrates such as sugary snacks, susceptible teeth, and time [3]. Dental health is associated with child growth and development, both physical and psychological. A longitudinal study reported that caries in the primary teeth has an influence on caries in the permanent teeth [4]. Parents constituted the main influence on oral health behaviours among adolescents, while peers have an increasing impact on behaviour with maturity [5]. Given that both diet and [dentition](#) change as students progress through school and the young permanent teeth are vulnerable to caries in the age range,

prevention measures are of great importance [6]. Preventive measures can be highly effective in improving students' oral hygiene is well exhibited for students, if more effective prevention measures are taken. Guangdong, located in southern China, has always been a bellwether of the Chinese economy since the Opening of China and has made remarkable achievements in economic and social development. This province is rich in medical resources relative to other provinces. However, the caries prevalence and DMFT among 12-year-old students in Guangdong remained relatively high during the national oral health epidemiological surveys in 1995 and 2005. In addition, caries in rural areas was more serious than in urban areas in Guangdong [7, 8], in contrast to reports from other provinces [9]. The trend of serious caries among rural residents became clear starting in the fourth national oral health epidemiological survey. Some epidemical data concerning factors related to dental caries in the population have been reported in other cities and provinces of China [10–12]. However, these studies may have been insufficient to support the findings due to their small sample sizes. In contrast, the present study included large-scale samples at the whole-province level.

This survey was conducted in 2015–2016 within Guangdong Province at the request of the government to collect updated and detailed information on oral health status and related factors for the development of realistic and effective policies on dental caries prevention.

Methods

Ethical consideration

The Oral Health Survey scheme was approved by the Stomatological Ethics Committee of the Chinese Stomatological Association (Permit Number: 2014-003), and all of the parents of the respondents signed informed consent forms.

Sampling design

A stratified, multistage random sampling design was used to select equal-sized samples of 12-year-old participants who were representative of the province's population (Fig. 1). To ensure that the objectives of the study could be met, we used the formula $N = \frac{deff \mu p(1-p)}{\delta^2}$ to calculate the required sample size. 'deff' was the sampling design efficiency; 'α' was the selected confidence level for statistical testing, 'p' was the expected prevalence; 'δ' was the allowable error. Considering the urban-rural and male-female stratification, the 'deff' was set to 4.5, and 'α' was set to 0.05, making $\mu_{\alpha/2}$ equal to 1.96; the prevalence (p= 28.9%) of dental caries in children was estimated based on the prevalence of caries in previous national oral health surveys [13, 14]. A theoretical sample size of at least 1891 participants was originally calculated. For ease of grouping and implementation, the actual sample size was adjusted to 1920. All participants were drawn from 24 schools selected from 8 districts using the probability proportional to size (PPS) sampling method. Half of the participants were from urban areas (Chancheng, Shunde, Yuexiu, and Jiangcheng), and the other half were from rural areas (Boluo, Lufeng, Raoping, and Luoding). The ratio of male to female participants was 1:1 in each school.

Oral health examination

A special investigation team was set up to complete all the on-site investigations, including 3 oral physicians and 3 recorders who had been engaged in clinical work for more than 3 years and had passed the training conducted by the Technical Guidance Group Of National Oral Health Epidemiological Investigation. The consistency of the diagnostic standard among the investigators was calculated using Cohen's kappa statistic (0.80-0.92). Oral examinations were performed in the classrooms under artificial light using dental mirrors and ball-tipped WHO examination probes.

Questionnaire survey

All participants were asked to complete a structured questionnaire personally during the clinical examination. The questionnaire 22 questions on family background: oral behaviour; knowledge, attitude, and dietary habits related to oral health; dental experience and self-assessment of general health and oral health. The items on the questionnaire have been described in detail elsewhere [10]. The participants were divided into several groups to be examined. Our investigator administered the question to each group by reading each question to the students in the classroom; to avoid influencing the students' answers, the investigator did not elaborate on the meanings of the questions. The education levels of participants' parents were dichotomized as >9 years or ≤9 years. Oral health knowledge and attitude scores were computed by counting the total number of correct or positive replies.

Statistical analysis

To reduce any data entry-related errors, we performed structured double data entry using Epidata 3.0 and applied validation and correction methods. All statistical analyses were performed using IBM SPSS Statistics 25.0. The prevalence of caries and the mean DMFT scores were compared between urban and rural areas and between females and males using the chi-squared test and the Wilcoxon rank-sum test. The factors related to permanent dental caries were analysed by unconditional univariate logistic regression analysis and multivariate logistic regression analysis. Accordingly, a forward stepwise multivariate logistic regression model was applied to examine the risk of dental caries in relation to the independent variables whose P-values were less than 0.15 in the bivariate analyses. Statistical significance was set at $P < 0.05$.

Results

A total of 1920 students aged 12 years were investigated in this study, 827 of whom were diagnosed with caries. The overall prevalence of dental caries was 43.07%, and the mean DMFT was 1.06 ± 1.721 . There were statistically significant differences in caries prevalence by residence location and gender. Female students showed a significantly higher DMFT score and prevalence of dental caries ($P < 0.001$) than male students, and those measures were also higher in rural areas than in urban areas ($P < 0.001$).

Whether male or female, students living in rural areas showed higher prevalence and mean DMFT scores than those living in urban areas. The prevalence of dental caries was evaluated in different groups divided by gender and residence (Table 1).

Table 1 Caries prevalence and Mean DMFT of permanent tooth among 12-year-old students in Guangdong

Demographic characteristic	the prevalence of caries			mean DMFT		
	n(%)	χ^2	P	$\bar{x}\pm s$	Z	P
Total	827(43.07)			1.06±1.721		
Male		34.663	0.001		-6.456	0.001
Urban	143(29.79)			0.58±1.173		
Rural	232(48.33)			1.16±1.638		
Total	375(39.06)			0.87±1.452		
Female		10.452	0.001		-3.523	0.001
Urban	201(41.88)			1.04±1.766		
Rural	251(52.29)			1.45±2.072		
Total	452(47.08)			1.25±1.935		

The results of univariate conditional logistic regression are shown in Table 2. The risk of dental caries was significantly associated with residence, gender, whether the child was an only child, parents' education level, snack frequency, oral health education, and calculus. Almost half of the students had good toothbrushing habits (\geq twice per day), while gingival bleeding or dental calculus could be found among approximately 50% of the students.

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The results of the cumulative multivariate logistic regression are shown in Table 3. Only statistically significant associations are presented. Location, gender, father's education level, snack frequency, and calculus were significantly associated with dental caries. Rural residence (OR=1.676, 95%CI: 1.350-2.080, $P < 0.001$), female gender (OR =1.377, 95%CI: 1.115-1.701, $P = 0.003$), snack consumption at least once a day (OR=1.484, 95%CI: 1.123-1.962, $P = 0.006$), and calculus (OR =1.391, 95%CI: 1.122-1.724, $P = 0.003$) were risk factors for dental caries, while the father's education level (OR > 9 years=0.796, 95%CI: 0.638-0.993, $P = 0.043$) was a protective factor.

Table 3 Multivariate conditional Logistic regression about the factors of dental caries of permanent teeth

Variables	B	OR	95%CI	P
Residence(Rural)	0.516	1.676	1.350-2.080	0.001
Gender(Female)	0.32	1.377	1.115-1.701	0.003
Father's education level(≤ 9 years)	-2.28	0.796	0.638-0.993	0.043
Snack frequency(\geq once a day)	0.395	1.484	1.123-1.962	0.006
Calculus(Yes)	0.330	1.391	1.122-1.724	0.003

Discussion

Guangdong participated in the previous three national oral epidemiological surveys, but the fourth one had the largest sample size and the most extensive coverage, including 8 districts in this area. In this survey, DMFT in 12-year-old students in Guangdong (1.06) was very low according to the WHO dental caries severity criteria [15]. However, the caries prevalence and DMFT were relatively high compared to the nationwide averages over the past decade on the basis of the previous national Oral Health Survey. It is noteworthy that the results of this oral survey show an upward trend in dental caries, from 32.2% to 43.07% prevalence and 0.6 to 1.06 DMFT. Dental floss and fluoride toothpaste are rarely used among 12-year-old students in Guangdong, China. Moreover, almost 50% of students had good toothbrushing habits, while over half of them were diagnosed with gingival bleeding or calculus, which indicates that the majority of them did not know how to brush correctly and that more effective measures need to be taken on oral hygiene instruction (OHI) in Guangdong, China.

The effect of urbanization on caries prevalence varied in different parts of the world and within the same county or region. Located in southern China, Guangdong is a relatively prosperous region compared to northern China. The GDP of Guangdong reached 7.281 trillion RMB, increasing by 291.3 times from 1980 to 2015. This rapid growth has changed lifestyles and dietary habits; as a result, people need more medical care and must pay more attention to their physical, mental and oral health. Most residents in the Guangdong area prefer sweet and sticky snacks, which may be an underlying reason for the high prevalence of caries in these years.

In this study, we found that students in rural areas had a higher level of caries prevalence and a higher DMFT score compared with those from urban areas in Guangdong, which was in line with the national survey [16]. It remains us that more attention should be paid to rural students urgently. Generally, caries of residents in urban areas are more serious in developing countries. However, caries in rural areas are becoming an increasingly serious problem in China. Preschool children and older people in China and

Turkey have been similarly reported [17,18]. The difference between the urban and rural areas could be explained by dietary patterns and oral hygiene habits in some previous studies [19]. Rural residents face obstacles to recognizing the importance of oral health and obtaining timely treatment. These difficulties can be illustrated by a shortage of dental personnel, inadequate availability, and accessibility to oral health service [20], insufficient oral health knowledge and attitude [21]. Additionally, socio-economic factors such as low household income and low education level among the parents of children in rural areas might also account for this [22]. A recent study has reported that the utilization of a mobile dental vehicle can be a practical and positive strategy to support oral healthcare to rural populations to reduce inequalities to some extent [23]. The rationales behind these differences between urban areas and rural areas need more exploration in the future.

A gender difference in oral health has been widely documented over time and across cultures [24]. Female students have a higher risk of caries than male students, as reported in this survey, which has been well documented in epidemiological studies of dental caries in living human populations. Exceptions exist but are not common. Some reports attributed the gender difference to the earlier eruption of teeth in girls, gender-based dietary preferences, and saliva osmotic pressure. A foreign study of clinical and experimental caries research confirms the impact of hormonal fluctuations [24,25], which make the oral environment significantly more cariogenic for women than for men during puberty, pregnancy, and menstruation. Caries aetiology is complex, and the quantity and quality of saliva constitute an important dimension in its occurrence and progress. Changes in saliva composition have been used to predict the susceptibility to caries. Females showed low salivary pH and similar flow rates compared to males [26,27], whereas other studies turned out just the opposite [28]. The difference in salivary levels of oral bacteria (*S. mutans*) has been reported in Sudanese adults [29]. These findings revealed the complex and dynamic influences of physiological, behavioural, and environmental factors on gender differences in caries incidence. A gender-based approach put forward by Arantes R to prevent dental caries might be taken into consideration later in the future [30].

Parents guide children's dietary habit and pass on oral health knowledge, attitudes and behaviour. A systemic review has shown that it is increasingly acknowledged that parents and the family act as moderators on children's oral health behaviours [31]. A qualitative study provided detail regarding parental views on the influences on children's OHB [32]. More highly educated parents are more willing to spend time and money on the exhibition of children's good oral habits [33]. In this survey, the high educational level of the father was a dominant risk factor, which indicated that the students whose father was in high educational status were relatively not easily infected with caries. This differed from some views of students in domestic and overseas related studies [34]. Nevertheless, the design of sampling and survey methods were not quite the same in these studies, which was insufficient to make a point. There has been little discussion about the impact of fathers' education background on students' caries. Interestingly, there was no significant difference between different maternal educational levels in the multivariate logistic regression model. There might be a strong correlation between maternal and paternal education. Once other factors (diet, gender, etc.) are considered, mothers' influence gradually fades away. To date, most research has focused on the association between caries and mothers' education

background, with few studies discussing fathers' attributes, holding a point of view that mothers spent more time on accompanying and have more influence on students' exhibition of behaviour. A previous study had shown that sugar consumption had some relationship to the mother's education as an indirect representation of family socio-economic status indirectly [35]. This needs further study in future research to explore the influence of parental education on children's caries.

Caries and periodontal diseases are associated with each other and share the common risk of factor-added sugar consumption [36,37]. Numerous cross-sectional epidemiological studies document the significant correlation between dental caries and sugar intake in diet [38,39], whether in longitudinal studies or cross-sectional studies. Recently, an increasing series of studies has reported that added sugar, especially the high frequency of consumption, is associated with periodontal disease[37]. Periodontal and dental status appears to correlate with nutritional habits, which are multifactorial diseases that follow similar risk patterns and develop from an interaction between chronic conditions originating early in life[40]. In our study, the high frequency of added sugar consumption (snack) was represented as a risk factor of caries among 12-year-old students in Guangdong province. In addition, a new risk factor found in the survey was calculus, which has not been assessed before. Consequently, some relationship existed between dental caries and oral hygiene. It is suggested that an assessment of sugar intake followed by appropriate changes in the diet seems appropriate in clinical efforts to reduce the extent of caries. The mean daily added sugar varied in children, teenagers, and adults. In the UK, the recommendation for sugar consumption among the total population is below 60 g/d, while in Irish adults, the frequency of intake of added sugar intake four times per day corresponded to a mean added sugar intake of 9%, but for children and teenagers, this exceeded the WHO recommendation [39]. Hence, a rational limitation on sugar consumption should be set up according to the daily energy consumption of Chinese people. To satisfy the desire for sweets and reduce energy intake, substitute sweeteners would be helpful; these additives have been demonstrated to have no untoward effect on general health [41]. Furthermore, clear and accurate labelling for added sugar-containing packaged foods could be a useful way to remind one's awareness of limiting sugar consumption. A school-based method limiting the type of food in the school canteens is worthy of putting into effect [42].

The most obvious limitation of this study is the retrospective rather than prospective design, which introduced potential recall bias. An additional limitation is the lack of water fluoride concentration in the area tested, which has a dominant impact on the prevalence of one district. Finally, the questionnaire of this study is self-reported and might contain several potential sources of partiality, especially the participant's memory bias.

In conclusion, the prevalence of permanent teeth dental caries among 12-year-old students in Guangdong was not optimistic, especially in rural areas, female students and those who frequently consumed sugary food. Therefore, the relevant departments should modulate the direction of preventive and treatment strategies on the risk factors according to this survey. More attention should be paid to female students and rural students.

Abbreviations And Acronyms

CI = confidence interval

CPI = community periodontal index

DMFT = decayed, missing and filled permanent teeth

GDP = gross domestic product

OR = odds ratio

OHB = oral hygiene behaviour

OHI = oral hygiene instruction

PPS = probability proportional to size

Declarations

All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. There are no conflicts of interest to declare.

Ethics approval and consent to participate

The protocol was approved by the Ethics Committee of the Chinese Stomatological Association, and all of the parents of the respondents signed informed consent forms. (Permit Number: 2014–003)

Consent for publication

All authors are informed consent for the publication.

Availability of data and material

We declared that materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The paper was drafted by Linmei Wu. The survey was conducted by Jianbo Li, Yueshan Zhou and Yihao Liang. The corresponding author was Shaohong Huang. The statistics were collected and analyzed by all authors. All authors have read and approved the final manuscript.

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References

- 1.Wang X, Feng XP, Li ZX: *The fourth national oral health epidemiological survey report*. Beijing: People's Medical Publishing House; 2018.
- 2.Jackson SL, Vann WF, Kotch JB, Pahel BT, Lee JY: *Impact of Poor Oral Health on Children's School Attendance and Performance*. *AM J PUBLIC HEALTH* 2011, *101*(10):1900.
- 3.Fan MW, Zhou XD: *Endodontics*. 4th ed. Beijing: People's Medical Publishing House; 2014.
- 4.Hall-Scullin E, Whitehead H, Milsom K, Tickle M, Su TL, Walsh T: *Longitudinal Study of Caries Development from Childhood to Adolescence*. *J DENT RES* 2017, *96*(7):762–767.
- 5.Hall-Scullin E, Goldthorpe J, Milsom K, Tickle M: *A qualitative study of the views of adolescents on their caries risk and prevention behaviours*. *BMC ORAL HEALTH* 2015, *15*(1):141.
- 6.Wright JT: *The Burden and Management of Dental Caries in Older Children*. *PEDIATR CLIN N AM* 2018, *65*(5):955–963.
- 7.Zhang SN, Huang SH: *Sampling Survey Report on Permanent Dental Caries in Urban and Rural Population of Guangdong Province*. *Journal of Dental Prevention and Treatment* 1999, *7*(1):3–6.
- 8.Wong MCM, Lo ECM, Schwarz E, Zhang HG: *Oral Health Status and Oral Health Behaviors in Chinese Children*. *J DENT RES* 2016, *80*(5):1459–1465.
- 9.Wei SH, Shi Y, Barmes DE: *Needs and implementation of preventive dentistry in China*. *Community Dent Oral Epidemiol* 1986, *14*(1):19–23.

- 10.Hu JH, Jiang W, Lin XL, Zhu HH, Zhou N, Chen YD, Wu WZ, Zhang DH, Chen H: *Dental Caries Status and Caries Risk factors in Students Ages 12–14 Years in Zhejiang, China. MED SCI MONITOR* 2018, 24:3670–3678.
- 11.Lin WH, Chen PY: *Correlative factors of 12-year-old Children in Guangzhou. Journal of Dental Prevention and Treatment* 2010, 5(18):247–250.
- 12.Dai JN, Ding XB, Lv XY, Y J: *Muti-level analysis of oral health and its influencing factors in 12-year-old Children in Chongqi. Academic Journal of Second Medical University of Second Military* 2016, 11(37):1426–1430.
- 13.Huang SH, Li JB, Fan WH, Zhao WH: *A sampling survey of permanent teeth caries in 12–15-year-old population in Guangdong Province (2015–2016). Journal of Prevention and Treatment for Stomatological Diseases* 2017, 11(25):697–701.
- 14.Qi XQ: *The third national oral health epidemiology survey report*: Beijing: People's Medical Publishing House; 2008.
- 15.WHO: *Oral health surveys: Basic methods – 5th ed. Geneva*; 2013.
- 16.Quan JK, Wang XZ, Sun XY, Yuan C, Liu XN, Wang X, Feng XP, Tai BJ, Hu Y, Lin HC et al: *Permanent Teeth Caries Status of 12- to 15-year-olds in China: Findings from the 4th National Oral Health Survey. Chin J Dent Res* 2018, 21(3):181–193.
- 17.Yin W, Yang YM, Chen H, Li X, Wang Z, Cheng L, Yin QD, Fang HZ, Fei W, Mi FL et al: *Oral health status in Sichuan Province: findings from the oral health survey of Sichuan, 2015–2016. INT J ORAL SCI* 2017, 9(1):10–15.
- 18.Gökalp SG, Doğan BG, Tekçiçek MT, Berberoğlu A, S U: *National survey of oral health status of children and adults in Turkey. Community Dent Health* 2010, 27(1):12–17.
- 19.Okoye LO, Ekwueme OC: *Prevalence of Dental Caries in a Nigerian Rural Community: A Preliminary Local Survey. Annals of Medical & Health Sciences Research* 2011, 1(2):187–195.
- 20.Zhou XD, Xu X, Li JY, Hu DY, Hu T, Yin W, Fan YJ, Zhang XD: *Oral health in China: from vision to action. INT J ORAL SCI* 2018, 10(1):1.
- 21.Varenne B, Petersen PE, Ouattara S: *Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. INT DENT J* 2006, 56(2):61–70.
- 22.Petersen PE: *The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme. COMMUNITY DENT ORAL* 2003,

31(s1):3–24.

23.Gao S, Yon M, Chen K, Duangthip D, Lo E, Chu C: *Utilization of a Mobile Dental Vehicle for Oral Healthcare in Rural Areas. INT J ENV RES PUB HE* 2019, *16(7)*:1234.

24.Lukacs JR: *Sex differences in dental caries experience: clinical evidence, complex etiology. CLIN ORAL INVEST* 2011, *15(5)*:649–656.

25.Lukacs JR, Largaespada LL: *Explaining sex differences in dental caries prevalence: Saliva, hormones, and "life-history" etiologies. AM J HUM BIOL* 2006, *18(4)*:540–555.

26.Galvao-Moreira LV, de Andrade CM, de Oliveira J, Bomfim M, Figueiredo P, Branco-de-Almeida LS: *Sex Differences in Salivary Parameters of Caries Susceptibility in Healthy Individuals. Oral Health Prev Dent* 2018, *16(1)*:71–77.

27.Kedjarune U, Migasena P, Changbumrung S, Pongpaew P, Tungtrongchitr R: *Flow rate and composition of whole saliva in children from rural and urban Thailand with different caries prevalence and dietary intake. CARIES RES* 1997, *31(2)*:148–154.

28.Eliasson L, Birkhed D, Österberg T, Carlén A, Institutionen FO, Institute OO, Sahlgrenska A, Göteborgs U, Gothenburg U, Sahlgrenska A: *Minor salivary gland secretion rates and immunoglobulin A in adults and the elderly. EUR J ORAL SCI* 2006, *114(6)*:494–499.

29.Darout IA, Albandar JM, Skaug N, Ali RW: *Salivary microbiota levels in relation to periodontal status, experience of caries and miswak use in Sudanese adults. J CLIN PERIODONTOL* 2002, *29(5)*:411–420.

30.Arantes R, Santos RV, Frazão P, Coimbra CEA: *Caries, gender and socio-economic change in the Xavante Indians from Central Brazil. ANN HUM BIOL* 2009, *36(2)*:162–175.

31.Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N: *Parental influence and the development of dental caries in children aged 0–6 years: A systematic review of the literature. J DENT* 2012, *40(11)*:873–885.

32.Duijster D, de Jong-Lenters M, Verrips E, van Loveren C: *Establishing oral health promoting behaviours in children – parents' views on barriers, facilitators and professional support: a qualitative study. BMC ORAL HEALTH* 2015, *15(1)*:157.

33.Berendsen J, Bonifacio C, van Gemert-Schriks M, van Loveren C, Verrips E, Duijster D: *Parents' willingness to invest in their children's oral health. J PUBLIC HEALTH DENT* 2018, *78(1)*:69–77.

34.Bakhurji E, El Tantawi MM, Gaffar BO, Al-Khalifa KS, Al-Ansari AA: *Carious lesions of permanent molars and oral health practices of parents and peers in Saudi male adolescents. SAUDI MED J* 2017, *38(7)*:748–754.

35. Ahmed NAM, Astrøm AN, Skaug N, Petersen PE: *Dental caries prevalence and risk factors among 12-year old schoolchildren from Baghdad, Iraq: a post-war survey. INT DENT J* 2007, 57(1):36–44.
36. Carmo CDS, Ribeiro MRC, Teixeira JXP, Alves CMC, Franco MM, França AKTC, Benatti BB, Cunha-Cruz J, Ribeiro CCC: *Added Sugar Consumption and Chronic Oral Disease Burden among Adolescents in Brazil. J DENT RES* 2018, 97(5):508–514.
37. Lula EC, Ribeiro CC, Hugo FN, Alves CM, Silva AA: *Added sugars and periodontal disease in young adults: an analysis of NHANES III data. The American Journal of Clinical Nutrition* 2014, 100(4):1182–1187.
38. Moynihan P, Petersen PE: *Diet, nutrition and the prevention of dental diseases. PUBLIC HEALTH NUTR* 2004, 7(1a):201–226.
39. Joyce T, McCarthy SN, Gibney MJ: *Relationship between energy from added sugars and frequency of added sugars intake in Irish children, teenagers and adults. BRIT J NUTR* 2008, 99(5):1117–1126.
40. Kesim S, Cicek B, Asim Aral C, Ozturk A, Mustafa Mazicioglu M, Kurtoglu S: *Oral Health, Obesity Status and Nutritional Habits in Turkish Children and Adolescents: An Epidemiological Study. BALK MED J* 2016, 33(2):164–172.
41. Gupta M: *Sugar Substitutes: Mechanism, Availability, Current Use and Safety Concerns-An Update. Open Access Macedonian Journal of Medical Sciences* 2018, 6(10):1888–1894.
42. Zadka K, Pałkowska-Goździk E, Rosołowska-Huszcz D: *Family factors Associated with Selected Childhood Nutrition Aspects in Central Poland. INT J ENV RES PUB HE* 2019, 16(4):541.

Table

Table 2 Univariate conditional Logistic regression about the factors of dental caries of permanent teeth

Variables	DMFT=0(%)	DMFT>0(%)	OR	95%CI	P
Residence					
Urban	616(64.17)	344(35.83)	1.000		
Rural	477(49.69)	483(50.31)	1.813	1.510-2.177	0.001
Gender					
Male	585(60.94)	375(39.06)	1.000		
Female	508(52.92)	452(47.08)	1.388	1.158-1.664	0.001
Single child					
Yes	272(65.54)	143(34.46)	1.000		
No	821(54.55)	684(45.45)	1.585	1.264-1.987	0.001
Father's education level					
≤9 years	504(35.14)	443 (64.86)	1.000		
>9 years	400(53.22)	240(46.78)	0.683	0.556-0.838	0.001
Mother's education level					
≤9 years	605(54.75)	500(45.25)	1.000		
>9 years	311(62.45)	187(37.55)	0.728	0.586-0.904	0.004
Snack frequency					
Seldom	316(60.42)	207(39.58)	1.000		
Sometimes	460(58.01)	333(41.99)	1.105	0.882-1.384	0.384
Frequently	317(52.48)	287(47.52)	1.382	1.090-1.752	0.007
Soft drink frequency					
Seldom	540(56.90)	409(43.10)	1.000		
Sometimes	422(58.86)	295(41.14)	0.923	0.758-1.123	0.424
Frequently	131(51.57)	123(48.43)	1.240	0.939-1.636	0.129
Milk,tea,coffee with sugar					
Seldom	512(56.64)	392(43.36)	1.000		
Sometimes	342(56.91)	259(43.09)	0.989	0.803-1.218	0.918
Frequently	239(57.59)	176(42.41)	0.962	0.760-1.217	0.745
Tooth brushing frequency					
≥2 times per day	513(56.07)	402(43.93)	1.000		
≤once a day	552(57.44)	409(42.56)	0.946	0.788-1.135	0.548
Use of fluoride toothpaste					
Yes	87(57.62)	64(42.38)	1.000		
No	82(67.21)	40(32.79)	0.663	0.403-1.090	0.105
Unknown	887(55.79)	703(44.21)	1.077	0.769-1.510	0.665
Use of dental floss					
Yes	109(56.19)	85(43.81)	1.000		
No	984(57.01)	742(42.99)	0.967	0.717-1.304	0.826
Oral health education					
Yes	80(65.57)	42(34.43)	1.000		
No	960(55.85)	759(44.15)	1.506	1.024-2.214	0.037
Gingival bleeding					

No	609(56.39)	471(43.61)	1.000
Yes	484(57.62)	356(42.38)	0.951 0.793-1.141 0.589
Calculus			
No	678(59.42)	463(40.58)	1.000
Yes	415(53.27)	364(46.73)	1.284 1.069-1.544 0.008
Oral health knowledge			
≥4 score	762(57.12)	572(42.88)	1.000
≤4 score	331(56.48)	255(43.52)	1.026 0.844-1.249 0.795
Oral health attitude			
4 score	627(58.06)	453(41.94)	1.000
≤4 score	357(56.67)	273(43.33)	1.058 0.868-1.291 0.575

Figures

Fig. 1 The sampling process

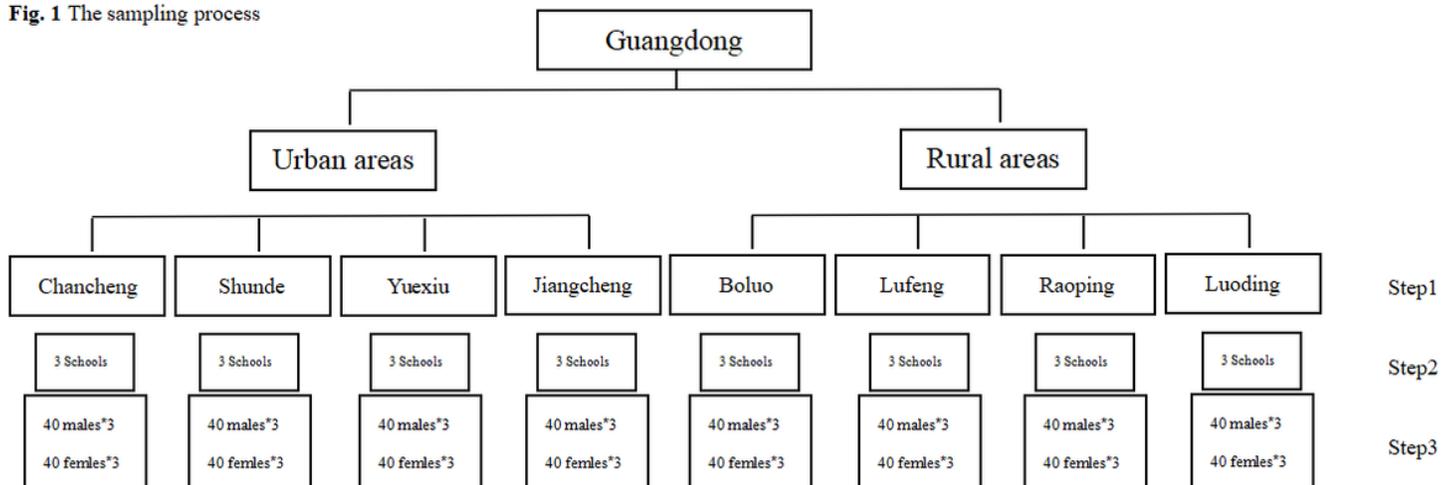


Figure 1

The sampling process