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Original Article

Tooth brushing behavior and its influencing factors among middle school students in Chongqing, China

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Abstract: To analyze tooth brushing behavior and its influencing factors among middle school students in Chongqing city, and make a basic understanding of oral health related knowledge and attitudes of middle school students, and provide reference information and scientific basis for the development of oral preventive health care activities in Chongqing city. A systematic random sampling design was applied in 12-15-year-old middle school students of urban and rural areas in Chongqing to obtain oral health knowledge, attitude and behavior through questionnaires. The average correct rate of oral health knowledge was 58.9%. While 88.6% of the children maintained a positive attitude to oral health. With 39.7% of the children having good tooth brushing behavior. The use rate of dental floss was 8.8%. The use rate of fluoride toothpaste was 7.5%. Stepwise logistic regression analysis found that the father's education, mother's education, and knowledge of the necessity of regular oral examinations were significantly correlated with tooth brushing behavior. Middle school students in Chongqing had good oral health behavior and attitude, but had poor oral health knowledge. For children with low-educated parents or lack of awareness of the need for oral examination, it was necessary to improve their oral health behavior.

Keywords: Middle school students, questionnaire, tooth brushing

Background

Oral health has been considered as important as general health [1]. In recent years, oral diseases are prevalent all over the world, and are one of the major public health problems. As the focus of dental diseases, dental caries has been listed as one of the top three non-communicable diseases after cardiovascular disease and cancer by World Health Organization [2]. In addition, oral diseases disease is also considered to be associated with other systemic diseases [3].

Health-related behaviors are initiatives to maintain and promote health [4]. Good oral health behavior can prevent oral diseases, including personal and professional oral care, such as tooth brushing, use of dental floss, seeing a dentist and healthy eating habits [5]. Tooth brushing and use of dental floss are the easiest and cheapest way to remove dental plaque and has been widely considered an important personal care strategy to prevent oral diseases [4]. Oral health attitudes are particularly important, and can predict the long-term health of an individual's mouth [6]. The promotion of public oral health knowledge can improve group oral health attitudes and behaviors [7, 8]. Some Chinese studies have concluded that oral health behavior is significantly correlated with oral health attitude, but is not significantly correlated with oral health knowledge [9]. To analyze the influence of oral health care knowledge and attitude on oral health behavior, this survey was analyzed accordingly.

Adolescence a critical age to start taking oral disease prevention seriously and plays an important role in oral health in the future [5]. Oral health-related behaviors, beliefs, and attitudes that affect one's lifelong oral care are formed at this stage. The oral health habits of adolescents are also easy to cultivate during this period. Moreover, the sooner it is developed, the longer the effect will last [1]. At pres-

ent, there are few conclusions about the influence of parents on adolescent oral health behavior. This benefits from a few studies based on sociological impact models [10, 11], suggesting that the influence of parents on oral health behavior cannot be ignored. However, a previous study does not fully agree [12]. Analyzing the influence of parents on adolescent oral health behavior is also one of the purposes of this oral epidemiological survey.

Past surveys found that the risk factors for adolescent oral health do not include oral health behavior except for tooth brushing, such as uses of dental floss and fluoride toothpaste [13]. This study mainly analyzed the tooth brushing behavior and influencing factors in middle school students, and made a basic understanding of oral health care knowledge and attitudes, which provided information and basis for planning and decision-making in oral health care in Chongqing.

Subjects and methods

Subjects

A systematic random sampling design was applied in two urban and two rural areas in Chongqing, *i.e.*, Shaqu, Yubei, Dazu, and Fuling. According to the results of Wang Lin's survey [14] and formula of $N = K \times P/Q$, the sample size is estimated. Three streets were randomly selected from each district. One middle school was randomly selected from each street. In total 330, 12-15-year-old students were selected from each middle school. The survey was conducted in grades one, two and three at the same rate for each age group. All participants took the principle of voluntary participation and signed informed consent.

Methods

The Fourth National Oral Health Epidemiological Questionnaire (age 12-15) was used (Supplementary File 1). The main content includes basic information of the surveyed subjects, sweet food habits, oral health knowledge, attitude and behavior, toothache and medical experience. The questionnaire consists of single choices, multiple choices and fill in the blanks; totaling 22 questions. Trained questionnaire investigators were responsible for collecting the questionnaires.

Quality control

Before the research, the project leader organized the training to familiarize and unify the investigation methods. After investigation, any wrong and missing data in the returned questionnaires were identified by the investigators in time and filled in time. If all of the questions on the questionnaires were properly answered, the questionnaires were used for data analysis.

Data analysis

After verifying the findings in the questionnaire, all data were processed using Epidata software and then recorded using a double-data entry strategy. The data were compared and corrected in a timely manner. The statistical analysis was carried out with SPSS 21.0 software. The significance level was $\alpha = 0.05$. Mean, standard deviation are used to describe the score of oral health knowledge and attitude. Percentage is used to describe the score of the oral health behavior. Oral health knowledge and attitude were compared using *u* test. The univariate analysis of the effect of parental education and oral health knowledge and attitude on the frequency of brushing teeth was conducted using Chi-square test with row × column, multivariate analysis was performed by multiple logistic regression analysis.

Results

General conditions

In total, 3902 valid questionnaires were retrieved (effective ratio 99%) from 1953 boys and 1949 girls. With 1938 children in the urban area accounting for 49.7%, and 1964 in the rural accounting for 50.3%. Of which, 1779 were only children in families, accounting for 45.6%, and 2123 were children with siblings, accounting for 54.4%. Data were missing in four people, accounting for 0.1%.

Analysis of oral health knowledge

Oral health knowledge contained 8 questions, 1 point for each question, with an average score of 3.94 ± 1.17. The average correct rate of oral health knowledge was 58.9% (**Figure 1**). The *u* test revealed that no significant difference in the score was determined between

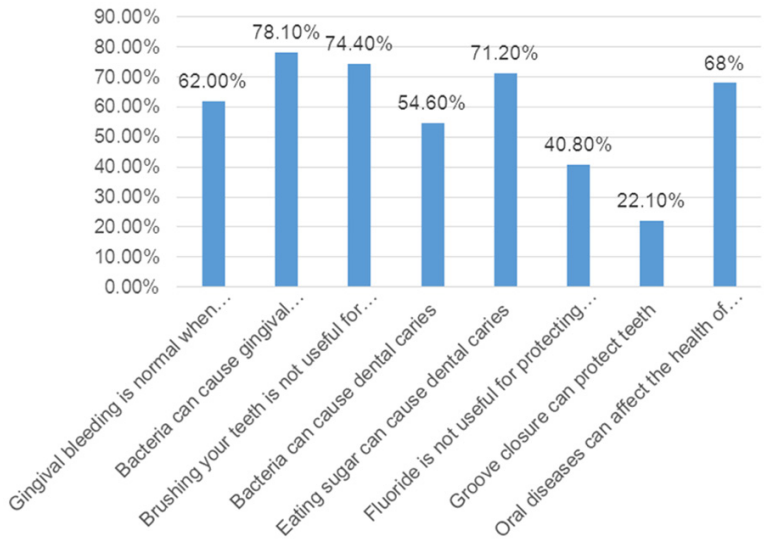

Figure 1. Correct rate of oral health care knowledge questions.

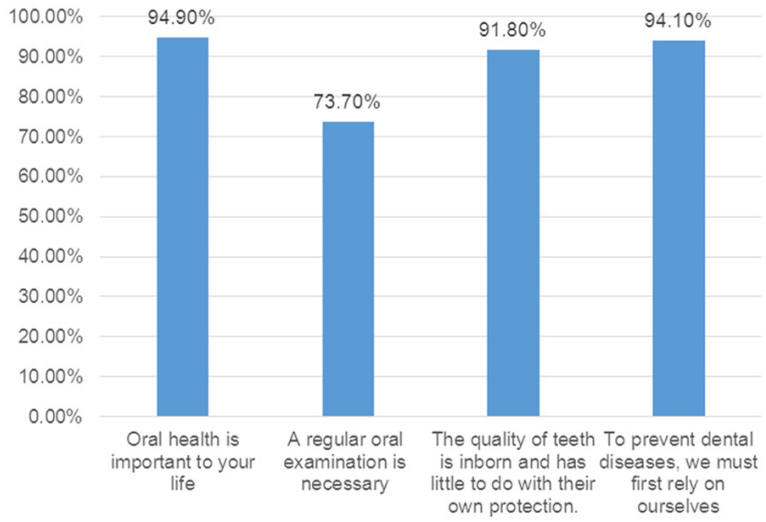

Figure 2. Correct rate of oral health care attitude questions.

boys (3.92 ± 1.20) and girls (3.94 ± 1.14) (u = 0.72, P = 0.24). There was no significant difference between urban area (3.88 ± 1.13) and rural (3.89 ± 1.21) (u = 0.08, P = 0.47). The score was not significantly different between only children (3.96 ± 1.16) and children with siblings (3.91 ± 1.19) (u = 0.39, P = 0.35).

Analysis of oral health attitude

Oral health attitude contained 4 questions, 1 point for each question, with an average score of 3.55 ± 0.77. Of which, 88.6% of the children maintained a positive attitude to oral health. Correct rate of each question is listed in **Figure 2**. Significant difference in the score was determined between boys (3.48 ± 0.84) and girls (3.62 ± 0.69) (u = 5.69, P = 0.00). There was no significant difference between urban area (3.56 ± 0.77) and rural (3.54 ± 0.78) (u = 0.81, P = 0.21). The score was not significantly different between only children (3.55 ± 0.78) and children with siblings (3.55 ± 0.77) (u = 0.00, P = 0.50).

Univariate analysis of oral health behavior and tooth brushing behavior

Oral health behaviors include tooth brushing habits, use of dental floss and fluoride toothpaste. Brushing teeth twice a day or more was defined as a good brushing habits [2].

Results demonstrated that total prevalence of good tooth brushing habit was 39.7%. The total prevalence of using dental floss was 8.8%. The total prevalence of using fluoride toothpaste was 7.5%. Chi square test revealed that the habit of brushing teeth was better in girls than in boys (χ^2= 154.288, P = 0.00), in urban area than in rural (χ^2 = 7.978, P = 0.00), and in only children than in children with siblings (χ^2 = 11.247, P = 0.00). The uses of dental floss and fluoride toothpaste were not significantly different among children. The comparison of tooth brushing in each group is shown in **Figure 3**.

Chi square test revealed that the higher the father's education is, the better the child's tooth brushing behavior is (χ^2 = 41.319, P = 0.00). The higher the mother's education is, the better the child's tooth brushing behavior is (χ^2 = 51.559, P = 0.00) (**Table 1**).

Chi-square test with row × column was used to analyze the effects of oral health knowledge and oral health care attitude on the frequency

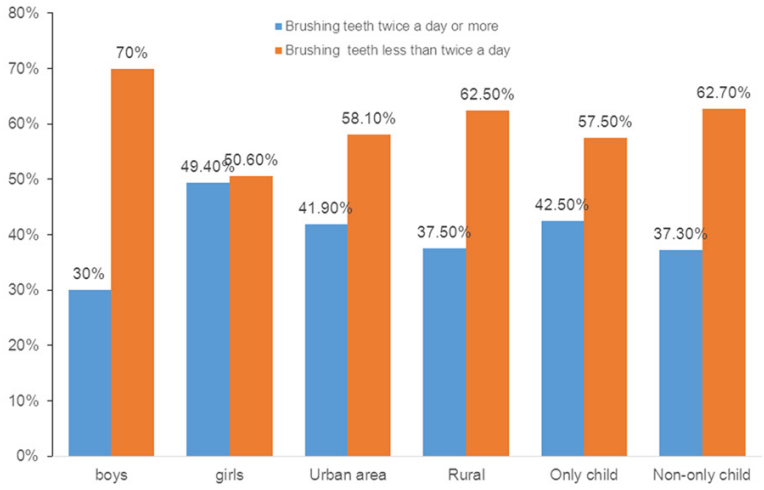

Figure 3. Proportion of good tooth brushing habits among different groups.

of tooth brushing. The test results are summarized in **Table 2**. The results showed that the correct rate of each question had a significant effect on the frequency of tooth brushing.

Multivariate analysis of tooth brushing behaviors

The Forward LR method was used to select independent variables from the variables with statistically significant differences (sex, region, only child, father's education, mother's education, oral health knowledge and attitude) in above univariate analysis of chi-square test. Inclusion criteria was $P \leq 0.05$, and exclusion criteria was $P > 0.1$. Results showed that father's education, mother's education, and whether the necessity of regular oral examination is known, were significantly correlated with good tooth brushing behavior. The higher the father's education, the higher the child's tooth brushing frequency (OR = 3.271). The higher the mother's education, the higher the child's tooth brushing frequency (OR = 4.324). The tooth brushing behavior in children knowing the necessity of oral examination is better than those who do not know (OR = 6.061; **Table 3**).

Discussion

Tooth brushing is considered to be the most effective way to maintain oral hygiene and to prevent oral diseases [15]. A previous study has shown that the most influential factor for the number of decayed, missing, and filled teeth in school-age children is whether they have good brushing behavior [16]. Therefore, the promotion of good tooth brushing habits among middle school students should be one of the important goals of oral care intervention. A total of 39.7% of 12-15-year-old middle school students of Chongqing city had good tooth brushing behavior, which was better than that of 12-year-old group (31.9%) from The Fourth National Oral Health Epidemiological Questionnaire [17]. This is quite similar to Sichuan Province in the same western region [18]. However, it is quite different from Guangzhou city in the coastal area [2] and some European countries (more than 50%) [19, 20].

The tooth brushing habits of girls are better than that of boys. This is in line with the findings of other epidemiological surveys [21-23]. Oral health attitudes are worse in boys than in girls [24]. This leads to differences in oral hygiene behaviors and attitudes. In addition, tooth brushing habits in urban students are better than in the rural. Previous research also found that there were regional differences in oral hygiene behaviors and speculated that this was due to the fact that the city was prone to organize oral health education activities, as well as differences in socioeconomic conditions and differences in healthy living habits [25]. In this study, the only children have better tooth brushing behavior than children with siblings. The number of siblings in the family is associated with children's oral hygiene [25]. The oral health behavior, dietary structure, and living conditions of the only children are better than that of children with siblings, resulting in a relatively high prevalence of dental caries in permanent teeth of children with siblings [26, 27].

In addition to sociological demographic factors, this survey found that the higher the parental education, the better their children's tooth brushing behavior was. This may be because highly educated parents represent a better family economic level. A previous study confirmed that high socioeconomic status of the family is associated with tooth brushing twice or more

Table 1. Relationship between parents' educational background and children's tooth brushing frequency

	Brushing teeth twice a day or more	Daily tooth brushing less than twice	χ^2	*P*
Father's education			41.319	0.00
Junior high school and below	829 (35.5%)	1509 (64.5%)		
High school, secondary school, college	631 (41.8%)	878 (58.2%)		
Bachelor and above	106 (58.9%)	74 (41.1%)		
Mother's education			51.559	0.00
Junior high school and below	913 (36.3%)	1603 (63.7%)		
High school, secondary school, college	429 (48.4%)	457 (51.6%)		
Bachelor and above	70 (54.3%)	59 (45.7%)		

Table 2. Effect of oral health knowledge and oral health attitude on the frequency of tooth brushing

	χ^2	*P*
Oral health knowledge		
Gingival bleeding is normal when brushing your teeth	21.890	0.009
Bacteria can cause gingival inflammation	24.261	0.004
Brushing your teeth is not useful for preventing inflammation of the gums	19.514	0.021
Bacteria can cause dental caries	21.130	0.012
Eating sugar can cause dental caries	34.439	0.000
Fluoride is not useful for protecting teeth	30.461	0.000
Groove closure can protect teeth	31.805	0.000
Oral diseases can affect the health of the whole body	21.379	0.011
Oral health attitude		
Oral health is important to your life	43.731	0.000
A regular oral examination is necessary	134.937	0.000
The quality of teeth is inborn and has little to do with their own protection	34.499	0.001
To prevent dental diseases, we must first rely on ourselves	37.568	0.000

Table 3. Multivariate logistic regression analysis affecting the frequency of tooth brushing

Influencing factors	B	SE	Wald	P	OR	95% CI for OR	
Father's education	1.638	0.231	5.987	0.014	5.145	3.271	8.091
Mother's education	1.811	0.177	6.463	0.011	6.117	4.324	8.653
Knowing the necessity of oral examination							
Yes vs No	2.286	0.247	7.854	0.005	9.836	6.061	15.961

times a day [28]. The family is considered to be the most important aspect of the sociological influence of child behavior. Especially in adolescence, it is obvious that many children's health behaviors are influenced by parental behaviors, such as physical exercise, diet and smoking [29]. Among the many ways in which the children's oral health behavior is affected, the model role of parents is also the most important method. Therefore, parents' oral health behavior is often used as a predictor of their child's experience of dental caries and oral health behavior [10, 30]. Besides the guidance of oral health behavior needs to be strengthened in middle school students having low-educated parents, parental oral health behavior also has a positive impact on children.

Multivariate logistic regression analysis revealed that besides parental education, knowing the need for regular oral health examination is important for tooth brushing behavior, reflecting that good attitude to oral health has positive effects on oral health. The response rate of

this question in oral health attitude is lowest, which may be due to the correlation between children's oral health attention and the affected oral health degree [31].

Through multivariate analysis, this survey also found that the oral health behavior was obviously associated with oral health attitudes, but not significantly associated with oral health knowledge, which was consistent with a previous study [9]. The reason may be related to the general oral health knowledge found in the survey.

The proportions of dental floss and fluoride toothpaste used in this survey were 8.8% and 7.5%, respectively. All of them performed poorly. Especially the use rate of fluoride toothpaste being far lower than the 55% of the 12-year-old age group in The Fourth National Oral Health Epidemiological Questionnaire in China. The use of fluoride by evidence-based medicine can effectively reduce the prevalence of dental caries [32]. The low use rate of fluoride toothpaste in this questionnaire was in line with the low awareness of fluoride-containing anti-caries. It is estimated that this is caused by the lower awareness rate of oral health knowledge compared with the national level. It also reflects that the development of oral health education in Chongqing is inadequate. In this survey, 69.8% of the respondents did not know whether the used toothpaste contained fluorine, which may also be the reason for the low use rate of fluoride toothpaste.

In summary, compared with the results of The Fourth National Oral Health Epidemiological Questionnaire in China, 12-15 year-old middle school students in this study had relatively poor oral health care knowledge, overall positive attitudes, and good oral health behavior. Influencing factors for tooth brushing behavior need to be emphasized in the development of oral prevention in the future.

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Disclosure of conflict of interest

None.

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Supplementary File 1: The Fourth National Oral Health Epidemiological Questionnaire

Personal code: _____

School: _____

Grade: _____

Class: _____

Name: _____

Survey time: _____

1. Are you an only child?

(1) Yes

(2) No

2. What is your father's highest educational background?

(1) No schooling

(2) Primary school

(3) Junior middle school

(4) Senior high school

(5) Secondary technical school

(6) College

(7) Undergraduate

(8) Master or above

(9) Unclear

3. What is your mother's highest educational background?

(1) No schooling

(2) Primary school

(3) Junior middle school

(4) Senior high school

(5) Secondary technical school

(6) College

(7) Undergraduate

(8) Master or above

(9) Unclear

4. Do you brush your teeth?

(1) Yes

(2) Occasionally or never

5. How many times do you brush your teeth every day?

(1) Brush twice a day or more

(2) Brush once a day

(3) Brush not every day

6. Do you use toothpaste when brushing your teeth?

(1) Yes

(2) No

(3) I don't know

7. Do you use fluoride toothpaste when brushing your teeth?

(1) Yes

(2) No

(3) I don't know.

8. Do you use floss?

(1) No

(2) Occasionally

(3) Once a week

(4) Daily use

9. How do you usually eat the following foods or drinks?

(1) dessert (biscuit, cake, bread) and candy (chocolate, sugar gum)

- More than 2 times a day
- 1 time a day
- 2-6 times a week
- 1-3 times a month
- Very few/never

(2) Sweet drinks [carbonated drinks such as sugar water, cola, orange juice, apple juice, lemonade]

- More than 2 times a day
- 1 time a day

- 2-6 times a week
- 1-3 times a month
- Very few/never

(3) Sugared milk, yogurt, milk powder, tea, soy milk and coffee

- More than 2 times a day
- 1 time a day
- 2-6 times a week
- 1-3 times a month
- Very few/never

10. Do you smoke?

(1) Smoking Daily

(2) Smoking weekly

(3) Rarely or ever smoking and never smoking

11. How do you evaluate your general health?

(1) Excellent

(2) Good

(3) General

(4) Poor

(5) Terrible

12. How do you evaluate your teeth and oral condition?

(1) Excellent

(2) Good

(3) General

(4) Poor

(5) Terrible

13. Did your get dental trauma?

(1) Yes

(2) No

(3) Can't remember clearly

14. Where did your teeth get hurt?

(1) On campus

(2) Off campus

15. Have you had toothache in the past 12 months?

(1) Often

(2) Occasionally

(3) Never

(4) Unclear.

16. Have you visit a dentist before?

(1) Yes

(2) No

17. When was the last time you see a dentist?

(1) Within 6 months ago

(2) 6 months to 12 months ago

(3) More than 12 months ago

18. What was the main reason for your last dental visit?

(1) Consultation inspection

(2) Prevention

(3) Treatment and ignorance

19. Do you think the following statement is correct?

(1) Gingival bleeding is normal when brushing teeth

1 = correct

2 = incorrect

8 = do not know

(2) Bacteria can cause gingival inflammation

1 = correct

2 = incorrect

8 = do not know

(3) Brushing does not use to prevent gingival inflammation

1 = correct

2 = incorrect

8 = do not know

(4) Bacteria can cause dental caries

1 = correct

2 = incorrect

8 = do not know

(5) Eating sugar can lead to dental caries

1 = correct

2 = incorrect

8 = not knowing

(6) Fluoride does not protect teeth with

1 = correct

2 = incorrect

8 = do not know

(7) Fossa and fissure closure can protect teeth

1 = correct

2 = incorrect

8 = do not know

(8) Oral diseases may affect general health

1 = correct

2 = incorrect

8 = do not know

20. What do you think of the following statement?

(1) Oral health is very important to one's life

1 = agree

2 = disagree

8 = don't care

9 = don't know

(2) Periodic oral examination is necessary

1 = consent

2 = disagreement

8 = indifference

9 = not knowing

(3) The quality of teeth is innate, and the relationship with their own protection is not big

1 = consent

2 = disagreement

8 = indifference

9 = do not know

(4) Preventing dental disease depends first on oneself

1 = consent

2 = disagreement

8 = indifference

9 = not knowing

21. How much have oral problems affected you in the past six months?

(1) Eating

1 = serious effect

2 = general effect

3 = slight effect

4 = no effect

5 = unclear

(2) Pronunciation

1 = serious effect

2 = general effect

3 = slight effect

4 = no effect

5 = unclear

(3) Brushing and gargling

1 = serious

2 = general

3 = slight

4 = no

5 = unclear

(4) Doing housework

1 = serious impact

2 = general impact

3 = slight impact

4 = no impact

5 = unclear

(5) School

1 = serious

2 = general

3 = slight

4 = no

5 = unclear

(6) Sleep

1 = Serious Impact

2 = General Impact

3 = Mild Impact

4 = No Impact

5 = Uncertainty

(7) Open teeth smile

1 = serious effect

2 = general effect

3 = slight effect

4 = no effect

5 = unclear

(8) Easy to worry

1 = serious impact

2 = general impact

3 = slight impact

4 = no impact

5 = unclear

(9) Interpersonal interaction

1 = serious impact

2 = general impact

3 = slight impact

4 = no impact

5 = unclear

22. How many oral health lessons did you have in school last semester?