

ORIGINAL RESEARCH

Self-reported oral health habits, knowledge and conditions of schoolchildren and adolescents in mainland China

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Abstract

To determine the oral health habits, knowledge and conditions of students in China and investigate the impact of associated factors. A self-reported online questionnaire was distributed through social networks in mainland China to assess the oral health habits, knowledge, and conditions of students aged 6–20 years attending primary, middle, and high schools. Factors potentially associated with oral health, such as oral health habits of their parents, family education level, and economic regions, were analyzed using McNemar's and Chi-square tests. Within one month, 5561 valid questionnaires were retrieved from all 31 provinces or equivalent regions in mainland China. The results showed that 46.9% of students suffered from bleeding when brushing their teeth, while only 11.8% reported professional teeth cleaning at a dental clinic. Soda beverages were widely consumed among them (75.4%). A significant minority of students brushed their teeth less than twice daily (22.8%) and for about 2 minutes each time (19.3%). Only 21.9% of the students had preventive oral health care. Students' toothbrushing habits and knowledge about interdental cleaning tools were associated with parental habits ($p < 0.001$). Overall, students from families with higher educational backgrounds and eastern China had better oral health habits, knowledge, and conditions. There is a need to pay more attention to gingival health and caries prevention among schoolchildren and adolescents in mainland China. Improving parental oral hygiene habits could have a positive impact on the oral health of students. Further research on oral health among students is needed in the middle and western regions of China.

Keywords

Children; Adolescents; Oral health; China

1. Introduction

The maintenance of oral health of the younger generation is a primary concern for dental professionals. Data from the fourth national oral health survey in China indicates that 15-year-old Chinese adolescents have a high prevalence of dental caries (44.2%) and gingival bleeding (64.7%) [1, 2]. Worthington *et al.* [3] and Vanobbergen *et al.* [4] reported that proper toothbrushing routines and limitations on sugar intake significantly lowered the risk of oral health problems among children and adolescents. In addition, it is important to establish good oral health behaviors during the growth period of young students [3] because long-term follow-up studies have shown that proper oral health habits established during childhood were well-maintained into adulthood [5, 6].

The use of interdental cleaning tools, such as floss, interdental brushes, wooden sticks, rubber/elastomer sticks and oral irrigators, can significantly benefit oral hygiene [7], and it is encouraging to note that the popularity of these tools is increasing in China. However, despite this trend, the prevalence

of gingival bleeding in adolescents has increased from 59.1% to 61.3% over the past decade, according to two nationwide investigations [2]. Unfortunately, studies examining the usage of interdental cleaning tools and associated factors among Chinese students remain limited.

Several studies have demonstrated the crucial role of the family on the oral health of students [8, 9]. Adolescents' oral health habits are reported to be closely related to parental educational background, family structure and household incomes [10]. A previous study found significant similarities between children's and parents' toothbrushing habits and consumption of sugary foods [11]. Baskaradoss *et al.* [12] found that caregiver oral health literacy is linked to a lower incidence of caries in children, particularly in rapidly urbanizing countries like China over the past decades [13–15]. In addition, lifestyle changes and child-rearing practices can have a significant impact on the oral health of students.

Unlike more developed countries, unbalanced economic growth in China is remarkable. Previous research found that socio-economic factors could impact oral health [16, 17]. Offi-

cial documents and statistical data showed that it is possible to distinguish two types of economic regions in mainland China [18, 19]. The eastern region, which developed earlier and boasts a higher economic aggregate, serves as a model for other regions. In contrast, although the middle and western regions of China started later, the current growth rate is high. An investigation found significant discrepancies in the prevalence of dental caries between students living in Shanghai (an eastern coastal city) and Lichuan (an inland city) [20]. The impact of these two different economic growth types on students' oral health warrants further research.

Since it is not uncommon to encounter a significant number of young patients suffering from oral health problems and facing difficulties in adhering to professional health advice [21, 22], this present research aimed to assess the oral health habits, knowledge and conditions of schoolchildren and adolescents in mainland China and identify associated factors to provide guidance for future interventions.

2. Methods

This cross-sectional study was conducted in mainland China from 08 October 2018, to 08 November 2018. A digital questionnaire (**Supplementary material**) was developed and distributed online through social networks to enhance economic efficiency and environmental sustainability by reducing paper waste.

Students from 6 to 20 years old in primary school, junior high school and senior high school were included in this investigation, and their parents were also invited to participate. Pupils over 14 years old, junior high school students less than ten years old, and senior high school students younger than 14 years old were marked as outliers. Due to the percentage of outlier values (0.1%) and missing values (2.4%) being relatively low (2.5%), they were excluded from the following analysis.

This structured questionnaire was designed on an online survey platform (Tencent, China) and consisted of 17 questions, including demographic information, oral health conditions, and oral hygiene knowledge of students. The oral health habits of the students and their parents were also collected. Participants shared necessary information about their current education level, age, location, and parental educational background. There were some questions related to oral health habits (teeth brushing frequency, teeth brushing time, the favored sodas, knowledge about dental floss, water flosser and interdental brush, usage of interdental cleaning tools) and oral health conditions (bleeding when brushing, professional tooth cleaning, preventive oral health care, and dental caries treatment). Those who reported receiving professional tooth cleaning also provided information on treatment frequency. In addition, parents' teeth brushing frequency and their usage of dental floss, water flosser and interdental brush were investigated. A "higher educational background" was defined as a bachelor's degree or above. The website recorded the finishing time and device used by participants (smartphone or computer) upon submission of the questionnaire.

Statistical analysis was performed using the SPSS v16 (IBM, Chicago, IL, USA) software. Descriptive statistics

were used to present the demographic information, oral health habits, knowledge and conditions of students across different age groups. Similarities between parent-student pairs were analyzed by McNemar's test. The Chi-square test was used to investigate the influence of family educational background and economic regions. Statistical significance was assumed at $p < 0.05$.

3. Results

A total of 5704 online questionnaires were completed from all 31 provinces or equivalent regions in mainland China within one month, among which 5561 contained valid responses. The participants' demographic information, such as region, age, and education level, are shown in Table 1. Of the 5561 valid respondents, 1877 were primary school students, 2081 were middle school students, and 1603 were high school students, ranging from 6 to 20 years old. Among them, 45.2% were from the east of China, while 54.8% were from the middle and west of China. Most parents were born in the 1970s (58.7%) and 1980s (34.7%), and 37.5% of them had a higher educational background, while 62.5% did not.

TABLE 1. The descriptive character of the schoolchildren, adolescents, and their parents included.

Variable	n (%)
Total	5561 (100.0%)
Region	
East	2515 (45.2%)
Middle and West	3046 (54.8%)
Students' education Level	
Primary school	1877 (33.8%)
Junior high school	2081 (37.4%)
Senior high school	1603(28.8%)
Students' age group	
6–9	1457 (26.2%)
10–12	991 (17.8%)
13–15	1764 (31.7%)
16–20	1349 (24.3%)
Parents' generation	
Born before 1970	287 (5.2%)
Born in the 1970s	3262 (58.7%)
Born in the 1980s	1932 (34.7%)
Born after 1990	80 (1.4%)
Parents' education Level	
Lower education	3476 (62.5%)
Higher education	2085 (37.5%)

TABLE 2. The oral health habits, knowledge, and conditions of school-aged children and adolescents categorized by age groups.

Variable	Total n (%)	6–9 n (%)	10–12 n (%)	13–15 n (%)	≥16 n (%)
Toothbrushing frequency per day					
<2	1270 (22.8%)	304 (20.9%)	247 (24.9%)	512 (29.0%)	207 (15.3%)
≥2	4291 (77.2%)	1153 (79.1%)	744 (75.1%)	1252 (71.0%)	1142 (84.7%)
Toothbrushing time					
<2 min	1074 (19.3%)	351 (24.1%)	210 (21.2%)	292 (16.6%)	221 (16.4%)
≥2 min	4487 (80.7%)	1106 (75.9%)	781 (78.8%)	1472 (83.4%)	1128 (83.6%)
Drinking sodas					
Dislike	1367 (24.6%)	430 (29.5%)	229 (23.1%)	394 (22.3%)	314 (23.3%)
Like	4194 (75.4%)	1027 (70.5%)	762 (76.9%)	1370 (77.7%)	1035 (76.7%)
Knowledge about oral hygiene tools					
Dental floss	3147 (56.6%)	807 (55.4%)	519 (52.4%)	896 (50.8%)	925 (68.6%)
Water flosser	1403 (25.2%)	335 (23.0%)	236 (23.8%)	482 (27.3%)	350 (25.9%)
Interdental brush	1048 (18.8%)	220 (15.1%)	180 (18.2%)	343 (19.4%)	305 (22.6%)
Do not know	1933 (34.8%)	560 (38.4%)	385 (38.8%)	654 (37.1%)	334 (24.8%)
The usage of interdental tools					
No	4001 (71.9%)	1088 (74.7%)	719 (72.6%)	1273 (72.2%)	921 (68.3%)
Yes	1560 (28.1%)	369 (25.3%)	272 (27.4%)	491 (27.8%)	428 (31.7%)
Bleeding					
No	2951 (53.1%)	1013 (69.5%)	506 (51.1%)	841 (47.7%)	591 (43.8%)
Yes	2610 (46.9%)	444 (30.5%)	485 (48.9%)	923 (52.3%)	758 (56.2%)
Teeth cleaning					
No	4906 (88.2%)	1376 (94.4%)	890 (89.8%)	1569 (88.9%)	1071 (79.4%)
Yes	655 (11.8%)	81 (5.6%)	101 (10.2%)	195 (11.1%)	278 (20.6%)
Teeth cleaning frequency per year					
<1	390 (7.0%)	44 (3.0%)	58 (5.9%)	113 (6.4%)	175 (13.0%)
≥1	265 (4.8%)	37 (2.5%)	43 (4.3%)	82 (4.6%)	103 (7.6%)
Prevention of caries					
Yes	1218 (21.9%)	419 (28.8%)	218 (22.0%)	309 (17.5%)	272 (20.2%)
No	3218 (57.9%)	849 (58.3%)	536 (54.1%)	1016 (57.6%)	817 (60.6%)
Do not know	1125 (20.2%)	189 (13.0%)	237 (23.9%)	439 (24.9%)	260 (19.3%)
Treatment of caries					
No	3725 (67.0%)	938 (64.4%)	671 (67.7%)	1284 (72.8%)	832 (61.7%)
Yes	1719 (30.9%)	498 (34.2%)	297 (30.0%)	432 (24.5%)	492 (36.5%)
Do not know	117 (2.1%)	21 (1.4%)	23 (2.3%)	48 (2.7%)	25 (1.9%)

TABLE 3. Numbers and percentages of parent-student pairs according to their oral health habits and knowledge.

	P+S ^a n (%)	P+S ^b n (%)	P-S ^c n (%)	P-S ^d n (%)	Similarity ^e (%)	<i>p</i> ^f
Brushing teeth twice a day	3971 (72.4%)	651 (11.9%)	592 (10.8%)	269 (4.9%)	83.2%	<0.001
Dental floss	1780 (28.7%)	186 (3.3%)	2228 (40.1%)	1553 (27.9%)	68.8%	<0.001
Water flosser	1046 (18.8%)	71 (1.3%)	4087 (73.5%)	357 (6.4%)	92.3%	<0.001
Interdental brush	221 (4.0%)	71 (1.3%)	4442 (79.9%)	827 (14.9%)	83.9%	<0.001

a. P+S+ (parent and students both give positive feedback);

b. P+S- (parent give positive and their children give negative feedback);

c. P-S- (parent and children both give negative feedback);

d. P-S+ (parent give negative and children give positive feedback);

e. Similarity = (P+S+) + (P-S-);

f. The *p*-value for McNemar's test between parent-student pairs.

Table 2 displays the self-reported oral hygiene habits, knowledge and conditions of the students, which were divided into four age groups. Most Chinese students knew that they should brush their teeth twice daily (77.2%) for at least 2 minutes each time (80.7%), while 29% from the 13 to 15 years old group did not maintain this frequency. Drinking sodas was popular among the Chinese students (75.4%), especially in the age groups above 10 years old. In regard to students' knowledge of interdental cleaning tools, dental floss was the most widely known tool (56.6%), while the interdental brush was the least known (18.8%). Although water flosser was a relatively new product in China, 25.2% of students were aware of it. The knowledge of these tools seems to increase with age. Gingival bleeding when brushing teeth was common among the students (46.9%), with up to 56.2% of high school students reporting having this symptom. However, only a few of them (11.8%) had dental visits for professional teeth cleaning. Adolescents above 16 years old had the highest ratio of teeth cleaning (20.6%), while only 7.6% of them underwent treatment more than once a year. Preventive oral health care was still at a relatively low level (21.9%), and 30.9% of the students reported dental visits for caries treatment.

Table 3 shows the oral health habits and knowledge among parent-student pairs. A significant similarity was observed in the frequency of twice-daily toothbrushing between parents and children ($p < 0.001$). Also, the parents' usage of interdental cleaning tools was associated with students' knowledge about these devices ($p < 0.001$).

Additional analyses on the influence of parents on the oral health of their children are presented in Table 4. Children and adolescents from families with higher education levels were more likely to have better toothbrushing habits. Significant differences were found between students from lower and higher-education families in the knowledge of dental floss ($p < 0.001$), water flossers ($p = 0.002$), and usage of these interdental cleaning tools ($p < 0.001$). A higher incidence of gingival bleeding during brushing was reported in families with lower educational backgrounds (50.5%) than higher educated ones (41%, $p < 0.001$). In addition, compared with lower educational backgrounds families, students in higher educated families had higher percentages of dental visits for professional teeth cleaning (13.2% and 10.9%, $p = 0.009$),

prevention (25.9% and 10.8%, $p < 0.001$) and caries treatment (41.1% and 24.6%, $p < 0.001$). Nonetheless, some similarities were still observed between these two groups, such as the favor of sodas ($p = 0.148$), knowledge of interdental brush ($p = 0.118$), and maintaining regular teeth cleaning habits ($p = 0.829$).

Economic region was identified as another factor associated with students' oral health (Table 4). A higher percentage of students in the eastern regions of China were aware of dental floss compared to those in the middle and western regions of China (71.5% and 44.3%, $p < 0.001$), and these students were more likely to use these tools to improve oral health compared to others (32.2% and 24.6%, $p < 0.001$). Moreover, prevention and treatment for caries were more common in students from the eastern regions of China ($p < 0.001$). Bleeding during brushing was slightly more common in the middle and western regions compared to the eastern regions of China (49.2% and 44.2%, $p < 0.001$). However, no significant difference was found regarding professional teeth cleaning ($p = 0.882$) and the favor of sodas ($p = 0.766$) between the two economic regions.

4. Discussion

According to our study, the prevalence of gingivitis and dental caries among Chinese students was still high, which is consistent with the research results of many scholars [23–25]. Meanwhile, dental visits for caries prevention and gingival health were low. Thus, more attention should be provided to students' oral health, especially gingival health.

It is widely known that caries preventive treatment is helpful for dental health [26, 27]. Pit and fissure sealant therapy may reduce the prevalence of dental caries from 11% to 51% [28]. However, we found that only 21.9% of the Chinese students had dental visits for caries prevention. In light of the data that 79.6% of American children had preventative dental health care in 2015, more preventative dental visits should be encouraged in China [29]. Moreover, we noticed that students in the youngest age group (28.8%) had the best preventive oral health care records, which might be attributed to the growing concerns about caries prevention in recent years.

Cases of gingival bleeding in puberty have been widely reported [30]. Our results showed that the incidence of bleeding

TABLE 4. Schoolchildren's and adolescents' oral health habits, knowledge, and conditions in relationship with economic regions and parents' education level.

	East	Middle and West	<i>p</i>	Lower education	Higher education	<i>p</i>
Toothbrushing frequency per day						
<2	429 (17.1%)	841 (27.6%)	<0.001	934 (26.9%)	336 (16.1%)	<0.001
≥2	2086 (82.9%)	2205 (72.4%)		2542 (73.1%)	1749 (83.9%)	
Toothbrushing time						
<2 min	517 (20.6%)	557 (18.3%)	0.033	610 (17.5%)	464 (22.3%)	<0.001
≥2 min	1998 (79.4%)	2489 (81.7%)		2866 (82.5%)	1621 (77.7%)	
Drinking sodas						
Dislike	623 (24.8%)	744 (24.4%)	0.766	832 (23.9%)	535 (25.7%)	0.148
Like	1892 (75.2%)	2302 (75.6%)		2644 (76.1%)	1550 (74.3%)	
Dental floss						
Don't know	718 (28.5%)	1696 (55.7%)	<0.001	1847 (53.1%)	567 (27.2%)	<0.001
Know	1797 (71.5%)	1350 (44.3%)		1629 (46.9%)	1518 (72.8%)	
Water flosser						
Don't know	1820 (72.4%)	2338 (76.8%)	<0.001	2648 (76.2%)	1510 (72.4%)	0.002
Know	695 (27.6%)	708 (23.2%)		828 (23.8%)	575 (27.6%)	
Interdental brush						
Don't know	2057 (81.8%)	2456 (80.6%)	0.271	2843 (81.8%)	1670 (80.1%)	0.118
Know	458 (18.2%)	590 (19.4%)		633 (18.2%)	415 (19.9%)	
Do not know oral hygiene tools above						
Don't know	585 (23.3%)	1348 (44.3%)	<0.001	1471 (42.3%)	462 (22.2%)	<0.001
know	1930 (76.7%)	1698 (55.7%)		2005 (57.7%)	1623 (77.8%)	
The usage of oral hygiene tools						
No	1704 (67.8%)	2297 (75.4%)	<0.001	2669 (76.8%)	1332 (63.9%)	<0.001
Yes	811 (32.2%)	749 (24.6%)		807 (23.2%)	753 (36.1%)	
Bleeding						
No	1403 (55.8%)	1548 (50.8%)	<0.001	1721 (49.5%)	1230 (59.0%)	<0.001
Yes	1112 (44.2%)	1498 (49.2%)		1755 (50.5%)	855 (41.0%)	
Teeth cleaning						
No	2217 (88.2%)	2689 (88.3%)	0.882	3097 (89.1%)	1809 (86.8%)	0.009
Yes	298 (11.8%)	357 (11.7%)		379 (10.9%)	276 (13.2%)	
Teeth cleaning frequency per year						
<1	180 (60.4%)	210 (58.8%)	0.682	227 (59.9%)	163 (59.1%)	0.829
≥1	118 (39.6%)	147 (41.2%)		152 (40.1%)	113 (40.9%)	
Prevention of caries						
Yes	789 (31.4%)	429 (14.1%)	<0.001	413 (11.9%)	805 (38.6%)	<0.001
No	1393 (55.4%)	1825 (59.9%)		2164 (62.3%)	1054 (50.6%)	
Don't know	333 (13.2%)	792 (26.0%)		899 (25.9%)	226 (10.8%)	
Treatment of caries						
No	1533 (61.0%)	2192 (72.0%)	<0.001	2522 (72.6%)	1203 (57.7%)	<0.001
Yes	944 (37.5%)	775 (25.4%)		855 (24.6%)	864 (41.4%)	
Don't know	38 (1.5%)	79 (2.6%)		99 (2.8%)	18 (0.9%)	

gums increased with age, which might be related to prolonged exposure to risk factors and inflammation associated with hormonal changes [31]. However, less than one-fourth of adolescents suffering from gingival bleeding underwent professional teeth cleaning. This might be due to a limited understanding of gingivitis and misconceptions about non-surgical periodontal treatment. Therefore, improving education on gingival health could be an effective approach to address this issue.

The finding of our study indicated that most Chinese students had a good toothbrushing habit. Similar to the results in our research, Ji *et al.* [11] revealed that the percentage of brushing teeth more than twice a day and more than 2 minutes each time was 72.9% and 89.0% among students in large Chinese cities. However, it is possible that this behavior is not as widespread as reported. Another investigation revealed that only 32.6% of teenagers had similar brushing frequency

[1]. Moreover, our study revealed that interdental cleaning tools were widely accepted by these students. A previous study reported that 91.4% of 12 to 14 years old in Zhejiang province did not use dental floss [25], and 71.9% of students in our study reported not having any other oral hygiene tools besides a toothbrush.

We found significant associations between students and parents in toothbrushing and interdental cleaning habits. Additionally, students from higher educational background families had better oral health habits and knowledge. A Japanese study reported that the toothbrushing habits of mothers and fear of dentists were positively correlated with children's brushing habits [32]. Mannaa *et al.* [33] similarly found that families' education level, snack consumption and toothbrushing habits impacted their kids' oral health. Although students could receive oral health education from schools or communities, families still play an essential role, and more attention should be given to families with lower educational backgrounds. Interestingly, we also found that children tended to respond more positively than their parents about dental floss, water flosser and interdental brush (27.9%, 6.4%, and 14.9%, respectively). Meanwhile, less than 3.3% of families reported that parents knew more about these interdental cleaning tools than children. This may be a good trend as more people in the new generation are learning how to clean interdental areas effectively. Thus, the popularities of dental floss, water flosser and interdental brush are likely to continue growing in China.

Socio-economic factors have been associated with oral health [29, 34]. Students from the eastern regions of China had better oral health knowledge and dental care records than their peers in the middle and western regions. Besides, the difference in economic development and an uneven distribution of medical resources might have also played an important part in these findings. Thus, since human resources are more concentrated in the eastern than in the middle and western regions [35], raising public oral health awareness and strengthening the local medical force could help narrow this gap.

Based on the popularity of social networks, our website recorded up to 19,605 visits and 5561 valid questionnaires were collected within a month. Of them, 97% were submitted *via* smartphones. In addition to data collection, our website also helped promote awareness of oral health among the public, focusing on children's oral health. However, there were several limitations associated with this present study. First, since the survey was self-reported, the reliability of certain variables might be weak, which restricted us from collecting more data concerning oral health conditions [36]. Second, although we received questionnaires from all 31 provinces and equivalent regions in mainland China, due to Internet users being more concentrated in cities, the response rate in rural areas was relatively low, suggesting that the present data was more representative of urban residents.

5. Conclusions

Chinese schoolchildren and adolescents were found to have poor gingival health, limited dental visits for professional teeth cleaning, and insufficient caries prevention. Improving

parental oral health routines, such as teeth brushing habits and the use of interdental cleaning tools, could positively impact their children's oral health. Further efforts to address oral health among students should be concentrated in the middle and western regions of China.

AVAILABILITY OF DATA AND MATERIALS

The data are contained within this article (and supplementary material).

AUTHOR CONTRIBUTIONS

HL, LL—designed the research study. SJW, LTW—performed the research. TYT, RY—analyzed the data. TYT and RY—wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee of Nanjing Stomatological Hospital (approval number 2018NL-035). Before filling out this anonymous questionnaire, all participants were informed that personal questions would be included and assured that their privacy would be protected. Participants were given the option to proceed or decline after reading this notice.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at <https://oss.jocpd.com/files/article/1635564249523601408/attachment/Supplementary%20material.docx>.

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