Periodontal health: a national cross-sectional study of knowledge, attitudes and practices for the public oral health strategy in China

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Clinical Relevance

Scientific rationale for study: Periodontal health knowledge, attitudes and practices (KAP) have important impact on periodontal disease. Despite consistent high prevalence of periodontal disease in China, information on periodontal health KAP in the general populations are lacking. This survey used a nationally representative sample to explore the specific characteristics of periodontal health KAP among Chinese adults to inform public oral health strategy.

Principal findings: There are significant deficits on specific aspects of periodontal health KAP among most Chinese adults.

Practical implications: Community based health strategies to improve periodontal health KAP among Chinese adults are needed.

Abstract

Aim: To assess the status of periodontal health knowledge, attitudes and practices (KAP) among Chinese adults.

Materials and Methods: A cross-sectional study was conducted in a nationally representative sample of adults (N=50991) aged 20 years or older from ten provinces, autonomous regions, and municipalities. Percentages of Chinese adults with correct periodontal knowledge, positive periodontal attitudes and practices were estimated. Multiple logistic regression analyses were used to examine the related factors.

Results: Less than 20% of Chinese adults were knowledgeable about periodontal disease. Very few (2.6%) of Chinese adults use dental floss ≥once a day and undergo scaling ≥once a year, and visit a dentist (6.4%) in the case of gingival bleeding. Periodontal health KAP was associated with gender, age, body-mass index, marital status, place of residence, education level, income, smoking status, and history of periodontal disease.

Conclusions: Periodontal health KAP are generally poor among the Chinese adult population. Community based health strategies to improve periodontal health KAP need to be implemented. Increasing knowledge of periodontal disease, the cultivation of correct practices in response to gingival bleeding, and the development of good habits concerning the use of dental floss and regular scaling should be public oral health priorities.

Introduction

Periodontal disease is a chronic inflammatory disease characterized by the destruction of tooth-supporting tissues (Page et al., 1997). Severe periodontal disease ultimately causes tooth loss (Durham et al., 2013, Patel et al., 2008) and has been associated with a number of conditions and systemic diseases, including chronic respiratory disease (Si et al., 2012), diabetes mellitus (Borgnakke et al., 2013), cardiovascular disease (Dietrich et al., 2013), ischemic stroke (Lafon et al., 2014), and preterm birth (Usin et al., 2016). Periodontal disease is highly prevalent among adults and is reported to be the second main cause of tooth loss among adults globally (Albandar, 2005). Global data shows that mild to moderate periodontitis affects most adults, and severe periodontitis is the sixth-most prevalent disorder worldwide (Dye, 2012). In developed countries, despite a declining prevalence of caries, tooth loss is increasingly attributed to periodontal disease due to its rising prevalence (Deinzer et al., 2009, Geyer et al., 2010, Holtfreter et al., 2009). Periodontal disease is also the main cause of tooth loss in China, accounting for 44% of all tooth extractions (Qi, 2008).

Prevention of periodontal disease is the cornerstone of periodontal health (Jin et al., 2011). During the past thirty years oral health education has been carried out annually in China. Unfortunately, this preventive measure has been unsuccessful as the prevalence of periodontal disease remains high. Results from the Third National Oral Health Survey in China showed that the prevalence of healthy periodontal status was only 14.5% for adults aged 35 to 44 years and 14.1% for older adults aged 65 to 74 years (Qi, 2008). Only one seventh of the middle-aged and older adult population in China had no gingival bleeding, deep pockets,

or attachment loss (AL) of <3 mm (Qi, 2008). Therefore, more effective preventive measures should be explored in order to reduce the incidence of periodontal disease in Chinese adults.

The prevention of periodontal disease is highly dependent on a person's periodontal health knowledge, attitudes and practices (KAP) (Holtzman et al., 2017, Stein et al., 2015, Wehmeyer et al., 2014). There have been studies that explored the oral health related KAP of Chinese adults (Lin et al., 2001, Zhu et al., 2005). It has been observed that some oral health attitudes, such as the attitude towards tooth loss, had improved during the period 1996-2005 (Lin et al., 2001, Zhu et al., 2005). In addition, four National Oral Health Surveys have been carried out in China between 1983 and 2015. Despite all this, the available information on periodontal health KAP is very limited. On the one hand, the National Oral Health Survey is based on index (special age group) populations. The only adults investigated were those between 35-44 years of age and 65-74 years of age, and these groups are not representative of the whole Chinese adult population. Because periodontal disease is a gradual process that progresses with age (Kassebaum et al., 2014), it is essential to understand the periodontal health KAP of all ages. On the other hand, the National Oral Health Survey focuses on data obtained primarily from clinical oral examinations. There are few questions about periodontal health KAP in the questionnaire, making it is difficult to obtain comprehensive information about periodontal health KAP. Thus, we conducted a large-scale epidemiological study on periodontal health KAP and included all ages of the adult population in China. We aimed to fully and accurately understand the distribution of periodontal health KAP in the whole adult population. We also explored the risk indicator of high prevalence of periodontal disease in China, with the hope that periodontal preventive measures can be targeted to both minimize the cost of public health and achieve satisfactory social and economic benefits.

Methods

Study design and participants

This is a population-based face-to-face cross-sectional survey among Chinese adults aged 20 years or older. Details of the design, methods, and participants in the study have been previously described (Wang et al., 2018). This study is a partial study of the China Pulmonary Health Survey conducted from June 2012 to

May 2015. A multistage stratified cluster sampling procedure was utilized to enroll a nationally representative sample. In the first stage, ten provinces, autonomous regions, and municipalities stratified by geographical regions were selected. In the second stage, a large city, a midsize city, an economically developed county, and an underdeveloped county were randomly selected from each of the ten regions. In the third stage, two urban districts from each city and two townships from each county were randomly selected. In the fourth stage, two urban residential communities or rural village communities (about 1000-2000 households) from the urban districts or rural townships, respectively, were randomly selected. In the final stage, we selected at random individuals aged 20 years or older from the selected communities. We stratified the final sampling by sex and age distribution based on 2010 China census data (National Bureau of Statistics of China, 2013). We randomly selected only one participant from every household according to the Household Registration System, without replacement. A telephone appointment of the participants for the investigation was made by general practitioner or community physicians. Investigators were trained together on uniform survey procedures and divided into several teams to interview the participants. All on-site interviews and screenings were done in examination centers at local health stations or community clinics in the participants' residential area. Only permanent residents, who lived at the current residence for at least one year, were included in the sampling frame.

There is no prior information on the prevalence of periodontal health KAP of Chinese adults. Based on available data from previous study (Zhu et al., 2005), 16% of participants knew that tooth brushing and flossing can prevent periodontal diseases and 61% of the respondents declared that dental check-ups at least once a year was a good idea. The survey sample size calculation took into account the estimated prevalence of the different percentage of periodontal health KAP to be surveyed (varying between 0.16 and 0.61), the absolute error (varying between 0.01 and 0.10), a confidence level of 95%, costs of data collection, physical examinations, and laboratory tests. Given the final sample size of 57779, this study can ensure sufficient power of KAP prevalence estimation.

The Ethics Review Committee of the Beijing Capital Medical University approved the protocol of the study. Written informed consent was obtained from all participants prior to participation in the study.

Survey Questions and Measures

A structured questionnaire was designed to collect information on demographic characteristics, smoking status, periodontal health KAP, and history of periodontal disease. The demographic characteristics included name, gender, date of birth, place of residence, marital status, education, and household income level. Household income was determined by questions on family income and number of persons in the household and was classified into three classes: low income class, middle class, and high class. We defined a current smoker as an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes. We defined a former smoker as an adult who has stopped smoking for at least 24 hours.

The periodontal health KAP of participants was assessed by 13 questions, which were developed from previous study of our team (Liu et al., 2012) and The Third National Oral Health Survey in China (Qi, 2008). The detailed questions and answer choices are shown in Supplementary Table 1. The periodontal health knowledge section focused on the basic knowledge of risk factors, symptoms, and preventive and therapeutic measures of periodontal disease. In order to assess participants' awareness of risk factors for periodontal disease, the term risk factor was initially defined as a factor linked to a faster emergence or a more severe course of periodontal disease. The periodontal health attitude section mainly examined the participants' attitude on the necessity of regular dental visit, tooth loss for older adults, and periodontal health affecting general health. The periodontal health practice section assessed the self-care practices of tooth brushing, flossing, mouth rinsing in recent one year, scaling in recent five years, and how to alleviate gingival bleeding if there is. History of periodontal disease was determined by patient self-reporting based on previous diagnoses. Based on our pilot study experience, nearly 85% of the participants could understand all the items in the questionnaire. To help create a more comprehensive understanding of the questionnaire items, such as periodontal disease, gum, subgingival scaling, anti-inflammatory drugs, an instruction or description using local common language and words of the unfamiliar words were allowed to introduce during the interview.

Interview Process and Quality Control

All on-site interviews and physical examinations were conducted at local community health centers or community clinics. All investigators underwent training on survey procedures to ensure accurate and consistent data collection. Investigators took a qualification test at the end of training; only those who passed the exam received a certificate allowing entry to the survey site. The inter-rater reliability was up to 95%. In the areas where dialect was used, local investigators were

enrolled to provide language assistance. Before the interview, all participants were informed of the importance of answering questions honestly and confidentially. Quality controllers checked 100% of the completed questionnaires after each interview. Anthropometric data were collected using standard measurements. All data were entered into an online database within a week of the interview and double-entered data were checked for consistency prior to statistical analysis.

Data Analysis

For each question about periodontal health knowledge, participants who provided one or more correct answer were classified as "aware" of the corresponding topic of periodontal health knowledge. For the questions about periodontal health attitudes, participants' responses which were more "positive" were categorized as positive, and those more "negative" or "not sure" were categorized as negative. Answer "agree" or "almost agree" were regarded as "Yes"; answer "disagree" or "almost/somewhat disagree" were regarded as "No"; and answer "do not know" or "not sure" were regarded as "Not sure". For the questions about periodontal health practices, answer choices were selected based on the participants' practices within the time frame. In addition, we excluded respondents who didn't answer all the questions in their results section before the final statistics in view of the fact that study participants may choose to respond to some items while refusing to respond to others.

All analyses were conducted using SUDAAN (version 11.0; Research Triangle Institute, Research Triangle Park, NC, USA) and SAS version 9.4 (SAS Institute, Cary, NC, USA) software based on stratified cluster sampling. All calculations were weighted by gender, age groups, administrative regions, place of residence (rural or urban area) according to China's National Population Census in 2010 (National Bureau of Statistics of China, 2013), and the study sampling scheme to ensure that the sample was representative of the entire adult population ($\geq$20 years old) of China. We accounted for several features of the survey, including oversampling for women, non-response, and other demographic differences between the sample and the total population. Our analysis used all participants for whom the variables of interest were available, and missing data were not imputed. We used a technique appropriate for the complex survey design to calculate SEs. The percentages of participants with correct periodontal health knowledge, positive periodontal health attitudes and practices were estimated. The potential related factors of poor periodontal health KAP, including gender, age, marriage, body-mass index (BMI), residence place, education

level, income level, smoking status, and history of periodontal disease, were explored using a multiple logistic regression model. Odds ratios (ORs) and 95% confidence intervals (CIs) were computed to examine the association between periodontal health KAP and the selected variables. Results were considered significant when P≤0.05. Due to the large sample size of this study most of the observed differences may be statistically significant; however, whether or not differences are of substantive or practical significance is a separate issue.

Results

The surveys were completed by 50991 of the 57779 targeted individuals, yielding an excellent survey response rate of 88.3%. There was also no significant difference of the demographic factors between non-response subjects and that of respondents. The sample consisted of 21446 (42.1%) males and 29545 (57.9%) females, with a mean age of 49.4 years (SD13.9). More respondents lived in urban areas (64.5%) than in rural areas (35.5%). The proportions of the respondents with an education level of primary school, middle/high school and college were 25.0%, 57.2% and 17.8%, respectively. Smoking status was grouped as never-smokers (71.4%)，current smokers (23.0%) and former smokers (5.6%). The detailed distributions of the participants are shown in Table1.

Knowledge on periodontal health

Among the general Chinese population aged 20 years or older, 63.7% of them had never heard about periodontal disease. A small part of the population were aware of the risk factors associated with oral hygiene (poor/faulty tooth brushing [8.2%], plaque bacteria [12.8%], and dental calculus [3.8%]), but 81.1% of them were unable to identify a single risk factor. More than 75% of the population did not know any of the symptoms associated with periodontal disease. With regard to preventive measures, 78.6% of the population was unaware of any preventive measures; a small part of the population indicated that oral hygiene was necessary for prevention of periodontal disease (tooth brushing [15.4%], dental flossing [1.9%], mouth rinsing [5.3%]); and only 4.8% of them indicated that regular scaling or check-ups are necessary. As to therapeutic measures, 83.3% of the population stated that they did not know of any therapeutic measures; and only 5.3% and 1.5% of them mentioned scaling and sub-gingival scaling, respectively. Table 2 shows the percentages for awareness of periodontal disease and its

associated risk factors, symptoms, prevention, and therapy. This data is categorized by basic characteristics and shows that being male, poorly educated, from a rural area, or without a history of periodontal disease makes one more likely to lack awareness of periodontal disease.

Attitudes towards periodontal health

The overall percentages of Chinese adults with positive attitudes toward periodontal health (necessity of regular dental visit, tooth loss for older adults, and periodontal health affecting general health) were 56.5%, 28.4%, and 53.8%, respectively. Table 3 shows the percentages of the population with positive attitudes towards three important issues pertaining to periodontal health. Individuals that were female, young, well-educated, wealthy, or positive for a history of periodontal disease were inclined to have regular dental visits. Young adults and former-smokers were more likely to have a positive attitude toward tooth loss for older adults, but overweight or obese people tended to have a more negative attitude. Females, the unmarried, and the well-educated tended to have a positive attitude toward periodontal health affecting general health, while those that are under-weight are more likely to have a negative attitude.

Practices towards periodontal health

The overall percentages of Chinese adults who exhibited the proper/positive practice of tooth brushing, dental flossing, mouth rinsing, scaling, and relieving gingival bleeding were 95.9%, 2.6%, 10.3%, 2.6%, and 57.1%, respectively. Up to 90.1% of the population reported never using dental floss. A small number of people go for scaling only once every two years (0.9%) or once in more than two years (7.6%), while 88.8% of the population have never undergone scaling. Only 6.4% of them sought a dentist in the case of gingival bleeding; a small minority chose at least one measure to control gingival bleeding by themselves (careful tooth brushing [7.5%], mouth rinsing [49.5%], and using medicine [5.3%]); while 5.4% of them claimed that they would not brush the bleeding gum and 37.3% of them neglected to take care of the bleeding. Table 4 shows the percentages, categorized by basic characteristics of study participants, for tooth brushing ≥once a day, dental flossing ≥once a day, mouth rinsing after meals ≥once a day, scaling ≥once a year, and having positive practice toward gingival bleeding. Higher education was associated with all five good practices for periodontal health. A history of periodontal disease was associated with the good practices of dental flossing, mouth rinsing after meals, and scaling at least once a year. Females and higher income individuals tended to brush their teeth once a day or more,

while younger individuals and people with higher income were more likely to have scaling performed at least once a year. Females, the well-educated, and adults with a history of periodontal disease were more likely to have positive practice toward gingival bleeding.

Discussion

Our study is the first to report data on the specific characteristics of periodontal health KAP of all adults in China. The age continuity of the sampling population and the strict sampling design ensured the best representativeness of samples. The validity and reliability of our study findings were ensured through a rigorous sampling design and stringent quality-control processes. First, results from this study reveal the extent of knowledge of periodontal disease among Chinese adults, including its risk factors, symptoms, and preventive and therapeutic measures; remarkably, more than 75% of Chinese adults exhibit knowledge deficits. Second, we show that although approximately half of Chinese adults hold positive attitudes towards gingival bleeding, most choose not to seek medical treatment under these circumstances. Finally, although the practice of daily brushing has gained popularity throughout China, most adults continue to not use dental floss or receive regular scaling.

A previous study by Wang et al. investigated 1590 subjects over 25 years of age from the northwest, southwest, northeast and east regions of China in 2007 (Wang et al., 2007). Their survey results showed that most Chinese adults have no knowledge of common periodontal prevention and treatment strategies. Many people were unfamiliar with scaling, and only a few had regular oral examinations. Our study estimated that more than 75% of Chinese adults lack knowledge of the risk factors, symptoms, preventive strategies, and therapeutic measures of periodontal disease, while 97.4% of Chinese adults did not have regular scaling between 2012 and 2015. Although the methods of these two studies are not entirely comparable, their findings indicate that public awareness of periodontal health in the Chinese population has not significantly improved over the years while the public health strategies concerning periodontal health in China remain insufficient.

Age is a well-established risk factor for periodontal disease (Kassebaum et al., 2014). With the exception of daily brushing, our data show that knowledge of periodontal health and practices among adults of all ages is poor; this suggests that periodontal health education should encompass all age groups in adults.

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Moreover, the elderly tend to have poorer periodontal health knowledge and decreased interest in or ability to perform oral hygiene practices compared to young adults (El-Qaderi and Quteish Ta'ani, 2004, Kiyak et al., 1998). This may be due to the elderly having less participation in social communication and activities, which consequently limits their access to periodontal health knowledge. China is now an ageing society due to the reduced fertility rate and an increasing life expectancy (Gong et al., 2012, Peng, 2011). Although the elderly have a higher morbidity of periodontal disease, many fail to seek proper medical treatment; unfortunately, this is even true when patients experience symptoms of periodontal disease or tooth loss (Qi, 2008). Therefore, professionals and policy makers need to explore individualized and easily acceptable forms of periodontal health education for the elderly. For example, family health instruction for oral health care can be carried out in communities. Prevention and intervention measures initiated by family members may help elderly people gradually understand periodontal health knowledge and develop correct periodontal health practices.

Our results also suggest that rural residents, adults with low education, and adults with low income are at a higher risk for having poor periodontal health KAP, a finding that is in line with results from former studies conducted in China (Lin et al., 2001, Zhu et al., 2005), Germany (Deinzer et al., 2009), Jordan (El-Qaderi and Quteish Ta'ani, 2004), and Sweden (Martensson et al., 2006). Despite overall rapid economic and educational development in China during the past thirty years, there remains a vast imbalance of development in urban and rural areas that needs to be addressed (Liu, 2017). In addition, our results suggest that a considerable number of urban residents, high-income level individuals, and people with high educational backgrounds also lack knowledge and practices of periodontal disease. These findings reflect professional periodontal health education not being popularized to the public. At present, daily periodontal health education in China predominantly comes from dentists in hospitals or clinics; this explains why people with a history of periodontal disease usually have better periodontal health KAP. Education from dentists can only have an indirect effect on the oral health care of family members. Therefore, we need community based periodontal health education for the general population.

According to the survey results, only 2.6% of Chinese adults use dental floss ≥once a day and undergo scaling ≥once a year, and only 6.4% of adults visit a dentist in the case of gingival bleeding; interestingly 20.2% of adults are aware that gingival bleeding is a symptom of periodontal disease. Gingival bleeding is usually the only symptom of gingivitis, a precursor to periodontitis (Lang et al., 2009). Such a low visiting percentage of Chinese adults in case of gingival

bleeding indicates that health education on the early symptoms of periodontal disease is urgently needed. Data from a survey conducted in 2009 revealed that 25.3% to 41.5% of German adults, aged 20 years or older, reported the daily use of either dental floss or interdental brushes (Deinzer et al., 2009). This rate was much higher than that reported from our survey. A 2005 survey of 4398 Chinese adults showed that nearly 15% of those surveyed would visit a dentist if they experienced bleeding from the gums (Zhu et al., 2005). A 2007 survey of 1590 Chinese adults showed that 19.5% of adults visited a clinic when they experienced bleeding gums, while only 2.8% would go to a dental clinic for regular scaling (Wang et al., 2007). Our findings suggest that the percentage of Chinese adults receiving regular scaling has not risen in the past decade. In fact, our results indicate that the rate of seeking a dentist when experiencing bleeding gums has decreased. Due to the better sample representativeness in this survey, our data provide a more accurate reflection of the current situation. The negative periodontal health practices mentioned above reflect a serious lack of periodontal health knowledge in Chinese adults. Healthcare policy makers must also pay attention to the need for a periodontal health promotion strategy. Dental care is offered on a fee-for-service basis and the related medical insurance does not cover all the population in China. Moreover, even with general medical insurance, the cost of periodontal treatments is still partly or totally paid for by the patient. This may negatively affect the dental care-seeking practice of patients. Consequently, an effective social insurance system for dental health may be a helpful measure towards the improvement of periodontal health practice.

The strengths of this survey are its strict sample scheme and large sample size, which together ensure the best sample representativeness of Chinese adults. The use of trained interviewers in face-to-face interviews helps participants avoid being overwhelmed by the high number of answer choices in the questionnaire. In addition, the range of periodontal health KAP information investigated in this study was far more comprehensive compared to previous studies (Lin et al., 2001, Zhu et al., 2005).However, there are also limitations of this study. First, women were oversampled because many men (migrant workers) were working outside of their permanent residential regions. Oversampled of women may result in the overall percentage biased towards women and periodontal health KAP overestimated, which may also limit the representativeness of the sample. However, all estimates were weighted to correct for oversampling and non-responses in the study. Second, all the data collected were self-reported by the participants, which is therefore subject to potential bias (including social desirability and recall bias). The recall bias may result in periodontal health KAP underestimated. Third, this study did not utilize an international standardized questionnaire on

periodontal health KAP, as none had been developed as of the date of this study. We did not test the validity and reliability of the questionnaire, which may affect the accuracy and authenticity of the conclusions to some extent. We also did not list the "refused to respond" response as an answer choice in the questionnaire. However, due to the large sample size and strict sampling design, we can still capture the characteristics and distribution in some specific aspects of periodontal KAP of Chinese adults. Finally, the nature of cross-sectional data limits the ability to determine the causality of the relationships between periodontal health KAP and socio-demographic variables.

Summarizing, this study assessed the periodontal health knowledge, attitudes and practices of Chinese adults aged 20 years or older using a large community based representative sample. Our data indicate that periodontal health KAP deficits are widely distributed across age, residence, education, and income groups. Community based periodontal health strategies need to be implemented throughout the adult population rather than within specific target groups, even though the elderly, rural residents, less educated and low-income adults seem to be somewhat more in need. Increasing knowledge concerning the risk factors, symptoms, prevention, and therapeutic measures of periodontal disease, the cultivation of correct practices in response to gingival bleeding, and the development of habits comprising the proper use of dental floss and regular scaling should all be public oral health priorities in China aimed at reducing the morbidity of periodontal disease.

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Table 1. Distribution of different characteristics by gender in periodontal health KAP sample

Characteristics	Total		Male		Female		P for difference
	n	%[c]	n	%[c]	n	%[c]	
Age							
20-44	18229	35.8	8129	37.9	10100	34.2	<0.0001
45-64	25761	50.5	10098	47.1	15663	53.0	
≥65	7001	13.7	3219	15.0	3782	12.8	
Marriage							
Unmarried	3764	7.39	2163	10.1	1601	5.42	<0.0001
Married	44563	87.5	18615	86.9	25948	87.9	
Divorced	766	1.50	290	1.35	476	1.61	
Death of a spouse	1845	3.62	351	1.64	1494	5.06	
Body-mass index, kg/m^{2a}							
Under-weight (<18.5)	2055	4.03	814	3.80	1241	4.20	<0.0001
Normal weight (18.5-23.9)	24825	48.7	9743	45.4	15082	51.1	
Overweight/obesity (≥24)	24111	47.3	10889	50.8	13222	44.8	
Residence							
Urban	32879	64.5	13572	63.3	19307	65.4	<0.0001
Rural	18112	35.5	7874	36.7	10238	34.7	
Education							
Primary school and lower	12755	25.0	3930	18.3	8825	29.9	<0.0001
Middle and high school	29170	57.2	12732	59.4	16438	55.6	
College and higher	9066	17.8	4784	22.3	4282	14.5	
Household income level[b]							
Low	15768	31.5	6207	29.4	9561	33.1	<0.0001

Middle	17272	34.5	7300	34.6	9972	34.5	
High	16971	33.9	7577	35.9	9394	32.5	
Cigarette smoking status							
Never smoker	36429	71.4	7842	36.6	28587	96.8	<0.0001
Current smoker	11724	5.57	10978	51.2	746	2.52	
Former smoker	2838	23.0	2626	12.2	212	0.72	
History of periodontal disease							
No	44215	87.5	18623	87.6	25592	87.4	0.44
Yes	6317	12.5	2628	12.4	3689	12.6	

[a] Body-mass index is the weight in kilograms divided by the square of the height in meters and refers to China's classification standards ; [b] Household income level means annual per capita income of family; [c] Number and percentages are unweighted.

Table 2. Knowledge on periodontal health

Characteristics		Awareness of periodontal disease		Awareness of periodontal disease risk factor		Awareness of periodontal disease symptom		Awareness of periodontal disease prevention		Awareness of periodontal disease therapy	
		Percentage (%, 95% CI)	AOR (95% CI)	Percentage (%, 95% CI)	AOR (95% CI)	Percentage (%, 95% CI)	AOR (95% CI)	Percentage (%, 95% CI)	AOR (95% CI)	Percentage (%, 95% CI)	AOR (95% CI)
Gender	Male	36.8 (28.9-45.5)	**0.75 (0.62-0.91)** [*]	15.1 (11.4-19.8)	**0.77 (0.62-0.95)**[*]	20.0 (15.0-26.1)	**0.74 (0.59-0.92)** [*]	16.4 (11.9-22.0)	**0.76 (0.64-0.92)** [*]	14.3 (10.9-18.6)	**0.75 (0.60-0.94)** [*]
	Female	37.9 (26.9-50.3)	1.00 (reference)	17.7 (12.3-24.9)	1.00 (reference)	22.6 (15.6-31.7)	1.00 (reference)	19.3 (13.0-27.7)	1.00 (reference)	16.8 (11.7-23.4)	1.00 (reference)
Age	20-44	41.3 (32.5-50.6)	1.00 (reference)	19.9 (15.0-25.9)	1.00 (reference)	24.4 (18.3-31.7)	1.00 (reference)	21.3 (15.6-28.4)	1.00 (reference)	18.0 (13.5-23.6)	1.00 (reference)
	45-64	34.1 (23.7-46.4)	0.99 (0.84-1.16)	12.8 (8.6-18.6)	0.94 (0.82-1.08)	18.4 (12.6-26.2)	0.99 (0.87-1.13)	14.2 (9.3-21.3)	0.97 (0.81-1.16)	13.1 (9.1-18.5)	1.02 (0.82-1.26)
	≥65	27.3 (15.6-43.2)	0.93 (0.69-1.26)	10.0 (5.2-18.2)	0.95 (0.69-1.30)	14.5 (7.8-25.2)	1.02 (0.77-1.36)	11.5 (6.0-20.9)	1.05 (0.82-1.33)	10.5 (6.1-17.6)	1.09 (0.83-1.42)
Marriage	Unmarried	49.8 (41.2-58.4)	0.99 (0.79-1.23)	28.8 (22.6-35.9)	1.16 (0.85-1.59)	31.5 (24.4-39.6)	0.98 (0.72-1.34)	29.6 (22.2-38.1)	1.05 (0.78-1.41)	24.7 (19.2-31.2)	1.05 (0.78-1.42)
	Married	35.6 (26.2-46.2)	1.00 (reference)	14.6 (10.3-20.4)	1.00 (reference)	19.9 (14.1-27.4)	1.00 (reference)	16.2 (11.2-22.8)	1.00 (reference)	14.2 (10.3-19.3)	1.00 (reference)
	Divorced	42.8 (31.8-54.6)	1.11 (0.76-1.62)	17.4 (11.0-26.4)	1.10 (0.64-1.91)	22.0 (13.3-34.0)	0.89 (0.58-1.36)	17.7 (11.2-26.7)	0.95 (0.51-1.76)	17.1 (10.4-26.8)	1.01 (0.66-1.54)

	Widowed	23.3 (11.4-41.7)	0.82 (0.55-1.23)	6.8 (3.6-12.4)	0.72 (0.50-1.05)	10.3 (5.5-18.6)	**0.70 (0.52-0.95)** [*]	7.9(3.7-15.7)	**0.72 (0.55-0.96)** [*]	7.7 (4.3-13.3)	0.77 (0.52-1.16)
BMI (kg/m^2)	Under-weight (<18.5)	40.2 (29.8-51.5)	0.95 (0.76-1.19)	22.7 (15.9-31.4)	1.13 (0.88-1.45)	25.5 (18.2-34.3)	1.00(0.77-1.30)	23.7 (16.3-33.1)	1.09 (0.85-1.40)	19.2 (13.1-27.3)	0.99 (0.70-1.42)
	Normal weight (18.5-23.9)	38.2 (29.0-48.4)	1.00 (reference)	17.7 (12.9-23.7)	1.00 (reference)	22.3 (16.2-29.9)	1.00 (reference)	18.8 (13.3-25.9)	1.00 (reference)	16.4 (12.1-21.8)	1.00 (reference)
	Overweight/obesity (≥24)	35.8 (26.1-46.9)	0.95 (0.88-1.03)	14.1 (9.9-19.7)	0.85 (0.71-1.02)	19.5 (13.6-27.2)	0.90 (0.75-1.08)	15.9 (10.8-22.8)	0.90 (0.76-1.08)	14.0 (9.9-19.5)	0.92 (0.75-1.12)
Residence	Urban	51.8 (45.0-58.6)	1.00 (reference)	24.0 (20.0-28.5)	1.00 (reference)	31.3 (26.3-36.8)	1.00 (reference)	26.7 (21.8-32.3)	1.00 (reference)	22.9 (19.6-26.5)	1.00 (reference)
	Rural	21.8 (15.6-29.6)	**0.41 (0.26-0.65)** [*]	8.3 (5.6-12.3)	**0.51 (0.32-0.80)** [*]	10.6 (7.4-14.8)	**0.45 (0.30-0.68)** [*]	8.3 (5.4-12.5)	**0.45 (0.28-0.72)** [*]	7.7(5.0-11.6)	**0.50 (0.30-0.80)** [*]
Education	Primary school and lower	13.7 (9.6-19.1)	1.00 (reference)	3.0(2.0-4.6)	1.00 (reference)	4.5 (3.0-6.6)	1.00 (reference)	2.8 (1.6-4.7)	1.00 (reference)	3.0 (1.8-5.1)	1.00 (reference)
	Middle and high school	36.7 (28.0-46.4)	**2.68 (2.20-3.28)** [*]	13.5 (10.0-18.0)	**3.61 (2.57-5.09)** [*]	19.1 (14.3-25.1)	**3.73 (2.83-4.91)** [*]	14.8 (10.6-20.3)	**4.46 (3.47-5.73)** [*]	13.2 (10.0-17.1)	**3.70 (2.85-4.81)** [*]
	College and higher	60.0 (53.8-65.8)	**5.57 (4.10-7.58)** [*]	34.5 (30.6-38.7)	**9.24 (7.00-12.2)** [*]	41.0 (36.4-45.7)	**8.68 (6.61-11.4)** [*]	37.7 (33.2-42.4)	**12.1 (8.54-17.0)** [*]	31.7 (28.7-34.9)	**9.44 (6.81-13.1)** [*]
Household income	Low	24.8 (19.3-31.2)	1.00 (reference)	8.8 (6.3-12.1)	1.00 (reference)	11.6 (8.3-16.0)	1.00 (reference)	9.1 (6.1-13.3)	1.00 (reference)	8.7 (5.9-12.6)	1.00 (reference)

	Middle	36.4 (26.4-47.7)	1.12 (0.90-1.38)	16.4 (11.6-22.7)	1.26 (0.98-1.63)	21.4 (15.7-28.4)	1.31 (1.07-1.60)	17.7 (12.6-24.3)	1.31 (0.99-1.74)	15.6 (11.5-20.8)	1.21 (0.93-1.58)
	High	51.0 (42.6-59.3)	1.34 (0.99-1.80)	24.2 (20.2-28.8)	1.33 (0.93-1.91)	31.2 (25.6-37.5)	1.40 (1.04-1.89)	27.1 (22.0-32.8)	1.41 (0.95-2.10)	22.5 (18.9-26.6)	1.20 (0.85-1.68)
Smoking	Never smoker	38.1 (28.2-49.1)	1.00 (reference)	18.0 (13.0-24.4)	1.00 (reference)	22.8 (16.3-30.8)	1.00 (reference)	19.7 (13.7-27.5)	1.00 (reference)	16.9 (12.2-22.8)	1.00 (reference)
	Current smoker	35.5 (27.7-44.1)	1.11 (0.92-1.34)	12.9 (9.7-17.0)	0.84 (0.68-1.03)	17.7 (13.2-23.3)	0.90 (0.74-1.09)	13.6 (10.0-18.1)	0.77 (0.63-0.92)	12.4 (9.2-16.5)	0.86 (0.68-1.07)
	Former smoker	36.5 (25.6-49.0)	1.27 (1.00-1.62)	13.5 (9.1-19.5)	1.00 (0.74-1.35)	20.0 (13.8-28.0)	1.15 (0.88-1.49)	14.7 (9.4-22.2)	0.95 (0.70-1.27)	13.5 (9.4-19.0)	1.02 (0.70-1.49)
History of periodontal disease	No	33.6 (25.2-43.2)	1.00 (reference)	14.4 (10.6-19.5)	1.00 (reference)	18.2 (13.2-24.5)	1.00 (reference)	15.5 (10.9-21.5)	1.00 (reference)	13.1 (9.6-17.6)	1.00 (reference)
	Yes	72.7 (66.3-78.3)	**4.41 (3.56-5.45)** [*]	34.9 (29.1-41.2)	**2.57 (2.22-2.98)** [*]	50.5 (44.6-56.4)	**3.80 (3.20-4.50)** [*]	39.6 (33.1-46.5)	**2.87 (2.41-3.42)** [*]	38.4 (34.7-42.2)	**3.34 (2.88-3.88)** [*]

[*]$P \leq 0.05$; Complex weighted computation was used in the statistical analysis based on Chinese population census data in 2010. AOR: Adjusted odds ratios (All co-variables listed were included in the model simultaneously); BMI: Body-mass index; CI: confidence interval

Table 3. Attitudes towards periodontal health

Characteristics		Positive attitude to visiting dentist		Positive attitude to tooth loss		Positive attitude to effect on general health	
		Percentage (%, 95%CI)	AOR (95% CI)	Percentage (%, 95%CI)	AOR (95% CI)	Percentage (%, 95%CI)	AOR (95% CI)
Gender	Male	54.8 (51.2-58.3)	**0.76 (0.65-0.89)** [*]	27.8 (22.9-33.3)	0.91 (0.73-1.15)	53.4 (45.9-60.9)	**0.79 (0.64-0.97)** [*]
	Female	58.4 (53.8-62.9)	1.00 (reference)	28.9 (25.0-33.2)	1.00 (reference)	54.2 (48.1-60.2)	1.00 (reference)
Age	20-44	63.7 (59.4-67.8)	1.00 (reference)	33.7 (28.7-39.2)	1.00 (reference)	59.5 (50.6-67.9)	1.00 (reference)
	45-64	50.0 (44.6-55.3)	**0.77 (0.66-0.91)** [*]	22.9 (19.2-27.0)	**0.65 (0.48-0.88)** [*]	48.9 (42.4-55.6)	0.92 (0.68-1.23)
	≥65	41.0 (36.9-45.2)	**0.67 (0.55-0.81)** [*]	18.0 (13.6-23.6)	**0.49 (0.28-0.87)** [*]	40.1 (33.6-46.9)	0.80 (0.56-1.15)
Marriage	Unmarried	72.8 (68.7-76.6)	1.17 (0.93-1.46)	36.4 (32.8-40.1)	1.02 (0.8-1.3)	71.3 (66.0-76.1)	**1.40 (1.07-1.84)** [*]
	Married	54.5 (50.6-58.3)	1.00 (reference)	27.5 (22.8-32.7)	1.00 (reference)	51.5 (44.9-58.0)	1.00 (reference)
	Divorced	55.1 (46.2-63.7)	0.92 (0.61-1.37)	20.6 (14.6-28.3)	0.69 (0.46-1.03)	50.5 (39.4-61.6)	0.89 (0.61-1.31)

	Widowed	38.2 (30.8-46.2)	0.85 (0.65-1.11)	17.1 (12.4-23.2)	0.84 (0.67-1.07)	36.8 (28.4-46.0)	0.86 (0.65-1.13)
BMI (kg/m^2)	Under-weight (<18.5)	59.3 (52.6-65.6)	0.87 (0.66-1.14)	31.3 (25.5-37.8)	0.90 (0.74-1.09)	52.3 (41.4-63.1)	**0.77 (0.64-0.93)** [*]
	Normal weight (18.5-23.9)	58.1 (53.9-62.1)	1.00 (reference)	31.2 (25.7-37.3)	1.00 (reference)	54.6 (46.9-62.1)	1.00 (reference)
	Overweight/obesity (≥24)	54.4 (50.6-58.2)	0.97 (0.88-1.08)	24.5 (21.5-27.8)	**0.76 (0.62-0.93)** [*]	53.1 (47.2-58.8)	1.04 (0.88-1.22)
Residence	Urban	60.8 (56.4-64.9)	1.00 (reference)	27.3 (24.2-30.7)	1.00 (reference)	61.8 (57.8-65.7)	1.00 (reference)
	Rural	52.1 (45.4-58.8)	1.16 (0.80-1.68)	29.4 (21.8-38.5)	1.32 (0.89-1.97)	45.3 (35.5-55.4)	0.77 (0.48-1.23)
Education	Primary school and lower	37.0 (30.7-43.7)	1.00 (reference)	24.0 (15.1-35.9)	1.00 (reference)	32.7 (24.5-42.2)	1.00 (reference)
	Middle and high school	55.5 (52.4-58.5)	**1.93 (1.60-2.33)** [*]	26.8 (22.5-31.6)	1.09 (0.67-1.78)	53.6 (48.5-58.6)	**2.01 (1.46-2.75)** [*]
	College and higher	76.6 (73.8-79.2)	**4.16 (2.99-5.79)** [*]	35.5 (32.4-38.7)	1.47 (0.81-2.69)	73.3 (71.1-75.4)	**3.72 (2.48-5.57)** [*]
Household income	Low	46.9 (41.4-52.5)	1.00 (reference)	26.2 (19.1-34.8)	1.00 (reference)	43.3 (34.4-52.7)	1.00 (reference)
	Middle	58.8 (54.3-63.2)	**1.26 (1.00-1.58)** [*]	29.0 (24.2-34.3)	1.06 (0.82-1.37)	55.7 (49.9-61.4)	1.22 (0.94-1.59)

	High	65.0 (61.8-68.0)	**1.33 (1.04-1.72)** [*]	30.2 (26.9-33.7)	1.10 (0.90-1.35)	63.2 (58.7-67.5)	1.28 (0.99-1.66)
Smoking	Never smoker	58.7 (54.9-62.4)	1.00 (reference)	28.8 (24.6-33.5)	1.00 (reference)	54.9 (48.6-61.0)	1.00 (reference)
	Current smoker	53.4 (49.7-57.0)	0.93 (0.80-1.07)	27.5 (23.3-32.1)	0.98 (0.80-1.19)	52.4 (45.2-59.6)	1.05 (0.87-1.27)
	Former smoker	44.8 (38.2-51.7)	0.84 (0.68-1.03)	26.6 (19.3-35.4)	**1.21 (1.02-1.44)** [*]	47.2 (37.0-57.7)	1.08 (0.79-1.48)
History of periodontal disease	No	55.5 (51.9-59.1)	1.00 (reference)	28.3 (23.9-33.3)	1.00 (reference)	53.0 (46.3-59.6)	1.00 (reference)
	Yes	66.9 (62.3-71.3)	**1.49 (1.27-1.74)** [*]	28.8 (23.8-34.3)	1.10 (0.87-1.40)	61.4 (55.4-67.2)	1.16 (0.94-1.44)

*P≤0.05; Complex weighted computation was used in the statistical analysis based on Chinese population census data in 2010. AOR: Adjusted odds ratios (All co-variables listed were included in the model simultaneously); BMI: Body-mass index; CI: confidence interval

Table 4. Practices towards periodontal health

Characteristics		Tooth brushing ≥once a day		Dental flossing ≥once a day		Mouth rinsing after meals ≥once a day		Scaling ≥once a year		Positive practices to gingival bleeding treatment	
		percentage(%, 95%CI)	AOR (95% CI)	percentage(%, 95%CI)	AOR (95% CI)	percentage(%, 95%CI)	AOR (95% CI)	percentage(%, 95%CI)	AOR (95% CI)	percentage(%, 95%CI)	AOR (95% CI)
Gender	Male	94.6 (90.0-97.2)	**0.37 (0.26-0.51)**[*]	2.7 (1.9-3.9)	1.24 (0.88-1.75)	10.5 (7.3-14.8)	0.95 (0.72-1.25)	2.8 (1.9-3.9)	1.16 (0.80-1.69)	55.6 (51.9-59.2)	**0.85 (0.74-0.99)**[*]
	Female	97.2 (94.4-98.7)	1.00 (reference)	2.4 (1.5-4.1)	1.00 (reference)	10.2 (6.7-15.2)	1.00 (reference)	2.5 (1.3-4.8)	1.00 (reference)	58.5 (53.0-63.9)	1.00 (reference)
Age	20-44	97.3 (93.2-99.0)	1.00 (reference)	2.9 (1.7-4.8)	1.00 (reference)	10.8 (7.3-15.8)	1.00 (reference)	3.5 (2.2-5.5)	1.00 (reference)	57.2 (52.1-62.1)	1.00 (reference)
	45-64	95.6 (91.5-97.7)	0.70 (0.38-1.29)	2.3 (1.6-3.2)	0.93 (0.53-1.63)	10.6 (7.0-15.6)	0.97 (0.77-1.22)	1.8 (1.0-3.1)	**0.71 (0.61-0.82)**[*]	57.4 (53.1-61.5)	1.04 (0.84-1.28)
	≥65	90.2 (80.8-95.2)	0.42 (0.15-1.15)	1.9 (0.9-3.6)	0.81 (0.37-1.76)	7.1 (5.0-10.0)	0.70 (0.48-1.02)	0.9 (0.4-1.8)	**0.42 (0.29-0.61)**[*]	55.1 (48.5-61.5)	0.95 (0.60-1.49)
Marriage	Unmarried	97.9 (95.4-99.0)	1.02 (0.46-2.24)	3.6 (2.5-5.2)	1.06 (0.58-1.92)	11.1 (7.3-16.5)	0.96 (0.73-1.25)	5.1 (3.1-8.2)	1.12 (0.76-1.64)	59.2 (53.5-64.7)	0.96 (0.77-1.19)
	Married	95.9 (91.7-98.0)	1.00 (reference)	2.4 (1.5-3.8)	1.00 (reference)	10.3 (6.9-15.1)	1.00 (reference)	2.3 (1.4-3.6)	1.00 (reference)	56.5 (51.9-61.1)	1.00 (reference)

	Divorced	97.0 (89.6-99.2)	1.21 (0.22-6.66)	6.1 (2.0-17.4)	2.58 (0.88-7.56)	16.3 (11.0-23.4)	**1.71 (1.01-2.92)**[*]	5.2 (2.6-10.3)	**2.29 (1.39-3.79)**[*]	52.9 (42.9-62.7)	0.75 (0.54-1.03)
	Widowed	87.6 (76.8-93.8)	0.49 (0.31-0.78)	0.9 (0.4-1.9)	0.51 (0.25-1.02)	5.1 (3.0-8.6)	0.66 (0.40-1.10)	0.9 (0.3-2.5)	1.03 (0.59-1.78)	60.6 (47.7-72.2)	1.29 (0.78-2.12)
BMI (kg/m2)	Under-weight (<18.5)	97.0 (94.9-98.2)	1.17 (0.71-1.94)	2.5 (1.5-4.2)	1.01 (0.55-1.86)	8.2 (5.2-12.6)	0.79 (0.48-1.28)	4.2 (2.0-8.8)	1.31 (0.84-2.04)	60.8 (54.7-66.5)	1.07 (0.79-1.45)
	Normal weight (18.5-23.9)	95.8 (92.0-97.8)	1.00 (reference)	2.4 (1.7-3.5)	1.00 (reference)	10.1 (6.9-14.7)	1.00 (reference)	2.7 (1.6-4.7)	1.00 (reference)	56.9 (52.1-61.7)	1.00 (reference)
	Overweight/obesity (≥24)	96.0 (91.7-98.1)	1.10 (0.87-1.39)	2.8 (1.5-4.9)	1.19 (0.73-1.95)	10.8 (7.3-15.8)	1.11 (0.94-1.31)	2.4 (1.5-3.7)	0.97 (0.62-1.53)	56.7 (51.6-61.7)	1.04 (0.81-1.32)
Residence	Urban	96.5 (88.2-99.0)	1.00 (reference)	3.5 (2.5-5.0)	1.00 (reference)	12.1 (7.5-19.0)	1.00 (reference)	3.8 (2.5-5.9)	1.00 (reference)	61.4 (57.0-65.5)	1.00 (reference)
	Rural	95.4 (92.4-97.2)	1.68 (0.50-5.63)	1.5 (0.9-2.7)	0.62 (0.31-1.25)	8.4 (5.2-13.2)	0.69 (0.38-1.24)	1.4 (0.9-2.0)	0.64 (0.37-1.10)	52.1 (47.4-56.8)	0.81 (0.62-1.05)
Education	Primary school and lower	92.1 (86.6-95.4)	1.00 (reference)	1.2 (0.6-2.3)	1.00 (reference)	7.1 (4.1-12.1)	1.00 (reference)	0.4 (0.2-0.6)	1.00 (reference)	50.3 (45.3-55.2)	1.00 (reference)
	Middle and high school	96.5 (92.1-98.5)	**1.83 (1.37-2.44)**[*]	2.3 (1.5-3.5)	1.42 (0.78-2.56)	10.7 (7.0-15.9)	**1.45 (1.02-2.06)**[*]	1.9 (1.2-3.1)	**3.03 (1.57-5.85)**[*]	56.1 (51.7-60.4)	1.19 (0.91-1.55)
	College and higher	98.3 (95.6-99.4)	**2.54 (1.73-3.72)**[*]	4.5 (2.9-7.0)	**2.13 (1.01-4.48)**[*]	12.5 (8.1-18.6)	**1.89 (1.15-3.13)**[*]	6.2 (4.4-8.6)	**6.18 (3.39-11.3)**[*]	63.0 (58.4-67.4)	**1.54 (1.09-2.17)**[*]
Household income	Low	92.6 (86.1-96.2)	1.00 (reference)	1.8 (1.2-2.8)	1.00 (reference)	10.6 (6.8-16.2)	1.00 (reference)	1.1 (0.7-1.9)	1.00 (reference)	53.6 (48.5-58.6)	1.00 (reference)

	Middle	96.8 (93.6-98.5)	**2.05 (1.36-3.09)**[*]	2.0 (1.3-3.1)	0.84 (0.57-1.25)	11.5 (6.9-18.7)	0.88 (0.62-1.25)	2.2 (1.4-3.5)	1.25 (0.87-1.79)	60.6 (55.8-65.3)	1.18 (0.90-1.54)
	High	98.7 (97.5-99.3)	**5.05 (2.37-10.7)**[*]	3.9 (2.4-6.2)	1.27 (0.87-1.84)	8.7 (6.5-11.7)	0.54 (0.37-0.77)	4.5 (3.2-6.5)	**1.78 (1.19-2.65)**[*]	58.6 (53.1-63.9)	0.93 (0.69-1.26)
smoking	Never smoker	96.3 (92.4-98.3)	1.00 (reference)	2.8 (1.8-4.3)	1.00 (reference)	10.3 (7.2-14.5)	1.00 (reference)	2.9 (1.7-4.9)	1.00 (reference)	57.7 (53.0-62.3)	1.00 (reference)
	Current smoker	95.1 (91.5-97.2)	1.18 (0.84-1.66)	2.3 (1.4-3.6)	0.71 (0.44-1.15)	10.1 (6.6-15.1)	1.02 (0.76-1.36)	2.3 (1.7-3.1)	0.77 (0.55-1.07)	54.3 (48.0-60.5)	0.97 (0.76-1.25)
	Former smoker	94.8 (89.5-97.5)	1.51 (0.97-2.33)	1.7 (0.8-3.6)	0.58 (0.29-1.18)	11.9 (6.7-20.4)	1.32 (0.84-2.07)	1.6 (0.9-2.8)	0.67 (0.40-1.11)	60.4 (49.9-70.0)	1.40 (0.81-2.41)
History of periodontal disease	No	95.8 (91.9-97.9)	1.00 (reference)	2.2 (1.5-3.3)	1.00 (reference)	9.8 (6.7-14.1)	1.00 (reference)	2.1 (1.4-3.2)	1.00 (reference)	55.1 (50.9-59.4)	1.00 (reference)
	Yes	97.1 (93.7-98.7)	1.25 (0.90-1.74)	5.7 (3.5-9.2)	**2.07 (1.32-3.24)**[*]	15.0 (9.3-23.4)	**1.52 (1.12-2.06)**[*]	8.0 (5.2-12.1)	**3.43 (2.61-4.50)**[*]	69.2 (65.5-72.6)	**1.68 (1.43-1.98)**[*]

*$P \leq 0.05$; Complex weighted computation was used in the statistical analysis based on Chinese population census data in 2010. AOR: Adjusted odds ratios (All co-variables listed were included in the model simultaneously); BMI: Body-mass index; CI: confidence interval
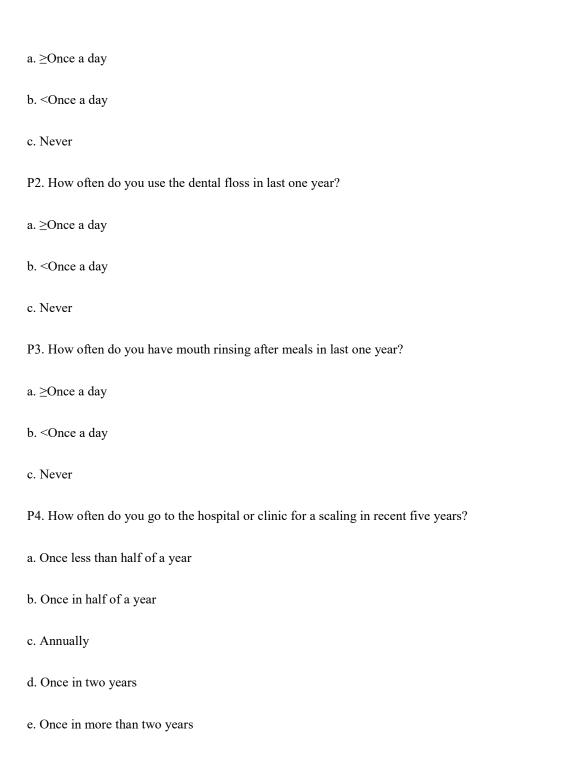
Supplemental Table

Table1. Questionnaire of periodontal health knowledge, attitudes, and practices in Chinese adults

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Periodontal health knowledge

K1.Do you know about the periodontal disease?

a. Yes

b. Don't know/unsure

K2. Do you know risk factors of periodontal disease?

a. Don't know/unsure

b. The microbial infection of periodontal tissue

c. Not brushing properly

d. Dental plaque in the tooth

e. Inheritance

f. Other reasons

K3. Do you know the symptom and representation of periodontal disease?

a. Don't know/unsure

b. Bleeding and swelling of gums

c. Loosening of tooth

d. Loss of tooth

e. Damage of alveolar bone

f. Weakness of chewing

g. Others

K4. Do you know how to prevent periodontal disease?

a. Don't know/unsure

b. Brushing properly

c. Using Mouth wash

d. Using Dental floss

e. Scaling regularly

f. Visiting a dentist Regularly

g. Others

K5. Do you know about therapeutic measures of periodontal disease?

a. Don't know/unsure

b. Scaling

c. Anti-inflammatory drug

d. Subgingival scaling

e. Tooth extraction

f. Others

Periodontal health attitudes

A1. Do you think that regular visit to the dentist is necessary?

a. Yes

b. No

c. Not sure

A2. Do you think that tooth loss is unhealthy for older people?

a. Yes

b. No

c. Not sure

A3. Do you think that periodontal health can affect general health?

a. Yes

b. No

c. Not sure

Periodontal health practices

P1. How often do you brush your teeth in last one year?

a. ≥Once a day

b. <Once a day

c. Never

P2. How often do you use the dental floss in last one year?

a. ≥Once a day

b. <Once a day

c. Never

P3. How often do you have mouth rinsing after meals in last one year?

a. ≥Once a day

b. <Once a day

c. Never

P4. How often do you go to the hospital or clinic for a scaling in recent five years?

a. Once less than half of a year

b. Once in half of a year

c. Annually

d. Once in two years

e. Once in more than two years

f. Never

P5. In the next one year, if you experience any gingival bleeding, what self-care measures would you likely take to make it stop/treat it?

a. Not brushing the bleeding gum

b. Brushing more carefully (positive)

c. Mouth rinsing (positive)

d. Using medicine (positive)

e. Visiting a dentist (positive)

f. Don't take measures/ unmindful/ neglectful