The Prevalence and Associated Factors of Periodontal Disease among 35 to 44-year-old Chinese Adults in the 4th National Oral Health Survey

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Objective: *To assess the current periodontal status of 35 to 44-year-olds from the Chinese population and to analyse potential influence factors on periodontal disease.*
Methods: *The data of subjects were collected from both urban and rural areas of all 31 provinces, autonomous regions and municipalities of the mainland of China, as part of the 4th National Oral Health Survey. All subjects were aged 35 to 44 years old. In total, 4,410 subjects were enrolled in the present study. Each subject was asked to undergo a professional oral examination and to fill in a questionnaire. Periodontal health status was evaluated by probe bleeding, calculus, periodontal pocket depth and clinical attachment loss. The data were analysed using the chi-square test and binary logistic regression analysis.*
Results: *The prevalence of probe bleeding and calculus was 87.4% and 96.7% respectively among the 35 to 44-year-old population. Prevalence of shallow pockets (4 mm ≤ PD < 6 mm) and deep pockets (PD ≥ 6 mm) was 45.8% and 6.9% respectively among 35 to 44-year-old people. In addition, prevalence of clinical attachment loss (CAL > 3 mm) was 33.2%. Gender, educational level, smoking, teeth brushing frequency, dental floss and toothpick use were found relevant to periodontal condition.*
Conclusion: *Periodontal disease was highly prevalent among 35 to 44-year-old Chinese adults. Gender, educational level, smoking, teeth brushing frequency, toothpick and dental floss use could be potential influence factors of periodontal health status.*
Key words: *associated factors, periodontal disease, prevalence, 35 to 44-year-old*
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Periodontitis is an inflammation of the periodontal tissues resulting in the loss of connective tissue attachment, destruction of alveolar bone and formation of pathological pockets around diseased teeth[1]. It is one of the most common diseases affecting oral health status and can even cause tooth loss in severe cases, especially in the elderly[2].

Throughout the world the prevalence of periodontal diseases varies from country to country. In Germany, the prevalence of moderate periodontal pockets (≥ 4 mm) was 76.9% among 35 to 44-year-olds[3]. Meanwhile the prevalence of CAL (≥ 3 mm) was 95.0% (35 to 44 years). In the USA, the total prevalence of periodontitis in adults aged 30 years and older was 47.2%, prevalence of mild, moderate and severe periodontitis was 8.7%, 30.0% and 8.5% respectively[4]. According to the Brazilian Ministry of Health[5], 19.4% (2011) and 9.9%

(2004) of 35 to 44-year old people have a periodontal probing depth of ≥ 4 mm.

China is a developing country whose population accounts for one third of the Asian and one fifth of the global population. However, reliable data on periodontal status is scarce. Within the past three decades, only few studies have provided comprehensive and representative results on the national population's periodontal status[6-8]. Wang et al reported that 12.8% participants have shallow periodontal pockets and 2.1% have deep pockets[6]. According to the report of the 3rd nationwide survey[7], the national population's prevalence of clinical attachment (over 3 mm) was up to 30% (rural) and 19% (urban) among the 35 to 44 years age group. Therefore, it is necessary to know about the situation of the current prevalence of chronic periodontitis in this part of the Chinese population because this can help us analyse the trend of this kind of disease in China. Additionally, this can be useful and helpful for providing a theoretical basis for promoting public oral health awareness and presenting preventive strategies.

The aim of this cross-sectional study was to collect data regarding periodontal condition, indices of periodontal disease, oral health habits and lifestyle to analyse the current 35 to 44-year-old Chinese population's periodontal health status and potential associated factors of periodontal disease.

Materials and methods

The study protocol was approved by the Ethics Committee of the Chinese Stomatological Association (Approval no. 2014-003).

Sampling method

The cross-sectional study was carried out from August 2015 to December 2016. A multistage stratified sampling of civilians aged 35 to 44 from 31 provinces, autonomous regions and municipalities of the mainland of China who had lived for more than 6 months in sampling areas (including urban and rural areas) were collected. The size of sample was calculated to have a prevalence rate (86%) of periodontal diseases of 2005 and a 10% acceptable margin of error. The final sample consisted of 4410 subjects.

Figure 1 shows the sampling process of this survey. Two districts and two counties were selected by Probability-Proportional-to-Size (PPS) Sampling from all 31 provinces, autonomous regions and municipalities of the mainland of China, totally 124 sampling sites, comprising 62 districts and 62 counties. From each district (county), three streets (towns) were selected by PPS sampling and from each street (town) one neighbourhood committee (village committee) was chosen. Twelve adults from the 35 to 44-year-old group were then selected in each neighbourhood (village) committee.

Clinical examination

All the examinations were performed using a CPI probe and periodontal status was recorded in four indexes: probe bleeding, calculus, probing depth and clinical attachment loss. Probe bleeding is the indicator of gingivitis, calculus represents oral hygiene, periodontal pocket is one of the most important pathological changes, clinical attachment loss reflects the accumulative periodontal destruction. A full mouth examination was performed, whereby the probe is "walked around" along gingival crevices with a force of no more than 20 gm to measure the probe bleeding, calculus, periodontal pocket depth and clinical attachment loss at one time, before each tooth was scored according to severity. Probe bleeding and calculus were scored as 0 (absence of condition), 1 (presence of condition), 9 (tooth excluded) and X (tooth not present). Periodontal pockets depth was scored as 0 (absence of condition), 1 (pocket 4 to 5 mm), 2 (pocket 6 mm or more), 9 (tooth excluded) and X (tooth not present). The extent of loss of attachment was recorded as 0 (0-3 mm), 1 (4 to 5 mm), 2 (6 to 8 mm), 3 (9 to 11 mm), 4 (12 mm or more), 9 (tooth excluded) and X (tooth not present). Finally, healthy periodontal condition was defined as probing bleeding, PD ≥ 4mm and clinical attachment loss were scored 0, by which a periodontal healthy rate was calculated.

All the examination and face-to-face interviews were performed by three assigned dental practitioners including an examiner, a recorder and a questionnaire investigator. The examiners were qualified dental practitioners who had been working for at least 3 years and the recorder and investigator were clinicians or nurses with relevant clinical experience. Before the field investigation, examiners accepted theoretical and clinical training and every examiner and a reference examiner carried out the examination on 10 to 15 pre-subjects to assess the consistency. The statistical κ value was calculated and was more than 0.6, which suggested good reliability.

Interview

A questionnaire was conducted during a face-to-face interview, to collect relevant information including

demographic data, educational level, income levels, dietary habit, smoking status, alcohol consumption, brushing habits, dental care history, scaling history and attitude to oral health.

Statistical analysis

Data from the paper questionnaire and clinical examination was entered into a computer using IBM SPSS Statistics Version 21. For further descriptive analysis, prevalence and mean teeth number with probe bleeding, calculus, pocket depth ≥ 4mm and clinical attachment loss > 3mm was calculated and the level of statistical significance was set at 0.05.

The Chi-square test was performed to test the association between periodontitis and selected relevant variables. Logistic regression was performed to evaluate the odds ratio of relevant variables on clinical attachment loss. The dependent variables were defined as CAL > 3 mm. All independent variables that were significant in the chi-square analysis were entered as candidates and included in the binary logistic regression analysis. Odds ratio was calculated with 95% confidence intervals to evaluate the connection between the dependent variables and the potential risk indicators, and statistical significance was defined as $P < 0.05$.

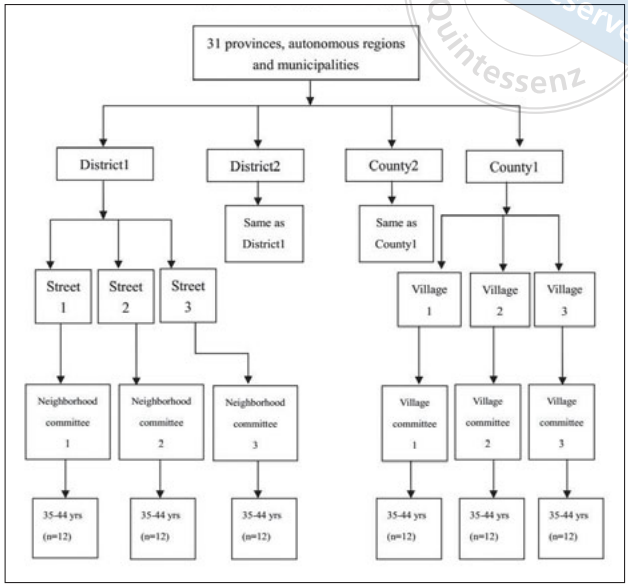

Fig 1 Sampling process diagram.

Fig 2 Percentage of subjects with healthy periodontal condition.

Results

Subjects were randomly selected from a permanent population of urban and rural communities in 31 provinces, autonomous regions and municipalities. There were 2,239 (50.8%) subjects from the urban population and 2,171 (49.2%) from the rural population. Sociodemographic information such as health maintenance behaviour and medical history was obtained by the questionnaire. A total of 4,410 participants were included in final analysis. The sample was 49.8% male (2,197 subjects) and 50.2% female (2,213 subjects).

Figure 2 shows that the percentage of subjects with a healthy periodontal condition in the 35 to 44-year-old group was 9.1%. And the result of the general periodontal health conditions is shown in Tables 1 to 3. Among the age groups, prevalence rate of probe bleeding, calculus, pocket depth ≥ 4 mm and clinical attachment loss > 3 mm was 87.4%, 96.7%, 52.7% and 33.2% respectively. The prevalence of deep pockets (PD ≥ 6 mm) was 6.9% among the 35 to 44-year-old group. The personal mean number of teeth (SD) with the situation of probe bleeding, calculus, pocket depth ≥ 4mm and clinical attachment loss in the 35 to 44-year-old group were 13.77 (10.44), 20.09 (9.21), 3.38 (5.72) and 1.73 (4.00) ($P < 0.05$).

Table 4 presents associations between the prevalence of clinical attachment loss and selected variables. The results of our study indicated that gender, location, number of cigarettes smoked per day, educational level, tooth brushing frequency, use of dental floss, toothpick use in the past year, and drinking alcohol can be correlated with clinical attachment loss ($P < 0.05$).

In this study, logistic regression (Table 5) was used to evaluate high-risk behaviour of periodontal disease,

Table 1 Percentage of subjects and mean number of teeth with probe bleeding and calculus among 35 to 44-year-old Chinese adults.

	N	Bleeding		Calculus	
		Mean ± SD	%	Mean ± SD	%
Gender					
Male	2,197	14.63 ± 10.70	88.0%	21.99 ± 8.61	98.0%
Female	2,213	12.93 ± 10.11	86.8%	18.20 ± 9.39	95.5%
Area					
Urban	2,239	13.26 ± 10.42	86.3%	19.16 ± 9.50	95.8%
Rural	2,171	14.30 ± 10.44	88.5%	21.05 ± 8.79	97.7%
Total	**4,410**	**13.77 ± 10.44**	**87.4%**	**20.09 ± 9.21**	**96.7%**

Table 2 Percentage of subjects and mean number of teeth with periodontal pockets among 35 to 44-year-old Chinese adults.

	N	PD = 4 to 5 mm		PD ≥ 6 mm	
		Mean ± SD	%	Mean ± SD	%
Gender					
Male	2,197	4.06 ± 6.07	49.1%	0.23 ± 1.06	9.6%
Female	2,213	2.39 ± 4.40	42.5%	0.10 ± 0.74	4.3%
Area					
Urban	2,239	3.07 ± 5.18	44.8%	0.19 ± 1.00	7,7%
Rural	2,171	3.38 ± 5.54	46.8%	0.14 ± 0.82	6.1%
Total	**4,410**	**3.22 ± 5.36**	**45.8%**	**0.16 ± 0.92**	**6.9%**

Table 3 Percentage of subjects and mean number of teeth with CAL among 35 to 44-year-old Chinese adults.

	N	CAL > 3 mm		0 ≤ CAL ≤ 3 mm	4 ≤ CAL ≤ 5 mm	6 ≤ CAL ≤ 8 mm	9 ≤ CAL ≤ 11 mm	CAL ≥ 12 mm
		Mean ± SD	%	%	%	%	%	%
Gender								
Male	2,197	2.27 ± 4.70	38.8%	61.1%	28.2%	8.9%	1.2%	0.5%
Female	2,213	1.20 ± 3.05	27.6%	72.4%	22.8%	3.9%	0.6%	0.2%
Area								
Urban	2,239	1.62 ± 4.04	30.4%	69.6%	22.5%	6.4%	1.1%	0.4%
Rural	2,171	1.85 ± 3.95	36.1%	63.8%	28.6%	6.4%	0.7%	0.4%
Total	**4,410**	**1.73 ± 4.00**	**33.2%**	**66.8%**	**25.5%**	**6.4%**	**0.9%**	**0.4%**

and the results demonstrated that men were more susceptible to clinical attachment loss (CAL) than women, and subjects with a higher education level have less chance of CAL. In addition, smokers or former smokers are more likely to have CAL than non-smokers. Subjects who brush their teeth less than twice a day and who scarcely use dental floss are more likely to suffer from periodontal diseases. Periodontal diseases are more likely to occur among subjects who use toothpicks rather than those who do not.

Discussion

The present study showed that periodontal disease was very serious among 35 to 44-year-old Chinese adults. The percentage of subjects with healthy periodontal conditions was below 10%. The prevalence of PD ≥ 4 mm was 52.7%. Regarding CAL ≥ 3 mm, it came to 33.2%. However, it is noteworthy that this prevalence was higher than that reported by Wang et al in another Chinese study of the 35 to 44-year-old group (14.9%) in 2002[6]. Meanwhile, the results showed that the prevalence of periodontal disease was higher than that reported in oth-

Table 4 The relationship between CAL and associated factors among 35 to 44-year-old Chinese adults

	N	N (CAL > 3 mm)	Prevalence (%)	*P* value
Gender				*P* < 0.001
Male	2,197	853	38.8%	
Female	2,213	610	27.6%	
Area				*P* < 0.001
Urban	2,239	680	30.4%	
Rural	2,171	783	36.1%	
Smoking status				*P* < 0.001
Current (former)	1,458	594	40.7%	
Never	2,952	869	29.4%	
Cigarettes per day				*P* = 0.016
≤ 10 per day	463	167	36.1%	
< 10 per day	768	331	43.1%	
Educational level				*P* < 0.001
≤ Elementary	953	415	43.5%	
Junior high	1,349	475	35.2%	
≥ Senior high	2,108	573	27.2%	
Brushing frequency				*P* < 0.001
≥ twice per day	2,110	566	26.8%	
< twice per day	2,300	897	39.0%	
Use of dental floss				*P* < 0.001
No	4,179	1,415	33.9%	
Yes	230	47	20.4%	
Drinking alcohol				*P* = 0.011
Daily	206	78	37.9%	
Weekly	374	143	38.2%	
Scarcely/never	3,712	1,195	32.2%	
Ceased	115	47	40.9%	
Use of toothpick				*P* < 0.001
No	2,397	716	29.9%	
Yes	2,013	747	37.1%	

er countries such as Hungary. Hermann et al[9] reported that prevalence of PD ≥ 4 mm was 27.4% among 35 to 44-year-olds. However, our results were in accordance with that reported in some other countries, i.e. Denmark, as Krustrup et al[10] reported that more than 42% of 35 to 44-year-old participants had pockets of 4 to 5 mm or deeper.

The periodontal conditions between males and females is obvious from the result of all measurement indices. Similar results can be found in different studies from other countries. For instance, Bourgeois et al[11] reported that prevalence of male subjects with attachment loss was significantly higher than that in female subjects in all degree of clinical attachment loss. Hermann et al[9] also reported that 34% of males vs 28% of females recorded a high CPI score. This is possibly because women did better than men in many aspects of oral health awareness, e.g. smoking frequency, number of cigarettes smoked, brushing frequency and so on.

Clinical attachment loss and periodontal pocket depth are used as key parameters to identify periodontitis, both in clinical work and epidemiological investigation; CAL especially is considered a direct indicator of periodontitis. Therefore, CAL was chosen in the study

Table 5 Binary logistic regression analyses of odds ratio for CAL among 35 to 44-year-old and older Chinese adults.

	P-value	OR	95% CI	
			Lower	Upper
Gender	$P < 0.001$			
Male				
Female		0.672	0.569	0.794
Educational level	$P < 0.001$			
≤ Elementary				
Junior high		0.701	0.588	0.835
≥ Senior high		0.539	0.454	0.641
Smoking status	$P = 0.039$			
Current (former)				
Never		0.835	0.704	0.991
Brushing frequency	$P < 0.001$			
< twice per day				
≥ twice per day		0.736	0.642	0.845
Use of dental floss	$P = 0.005$			
No				
Yes		0.619	0.442	0.866
Use of toothpicks	$P < 0.001$			
No				
Yes		1.345	1.182	1.530

as the index to analyse participants' periodontal health high-risk behaviour. This was in accord with studies in other countries[4,12,13]. In the current study, educational levels were found to be highly relevant with clinical attachment loss and the result showed that the higher educational level people achieve, the less opportunity they have of CAL. The odds ratio for educational level of senior high school was 0.539 compared with educational level of below elementary school. The result is in accordance with previous studies[4,14]. Eke et al[14] reported that subjects with an educational level higher than high school had a lower prevalence of PD and CAL than those with a high school or lower than high school education.

Smoking is considered a highly associated factor which greatly affects periodontal health. Our results showed that people who have never smoked had more chance of having a better periodontal status (odds ratio was 0.835) , which is consistent with previous studies[15-17]. Do et al[16] and Thomson et al[17] reported that smoking has a significant impact on periodontal health. Besides, some studies have found that stopping smoking can be conducive to improve the effects of periodontal treatment[18,19], which means quitting could still be helpful for restoring periodontal health.

Use of dental floss and toothpicks was also found to be associated with CAL among this study population. In the present study, using dental floss could be a protective factor (odds ratio was 0.619) for periodontal disease, while using toothpicks was shown to be a risk factor (odds ratio was 1.345). This is consistent with some previous studies. Hermann et al[9] reported that those using dental floss have a 0.71 (men) and 0.72 (women) odds ratio for a CPI score ≥ 3. But toothpick users have a 1.45 (men) and 1.12 (women) odds ratio of having a CPI score ≥ 3. It is probably because wrongful use of toothpicks could increase the risk of periodontal damage.

Conclusion

Periodontal disease was highly prevalent among 35 to 44-year-old Chinese adults. Besides gender, education, smoking, tooth brushing frequency, and use of toothpicks and dental floss could also be potential influence factors of periodontal health status.

Conflicts of interest

The authors reported no conflicts of interest related to this study.

Author contribution

Dr Hao Yun SUN contributed to data analysis and manuscript writing; Drs Han JIANG, Min Quan DU contributed to data analysis; Drs Xing WANG, Xi Ping FENG, De Yu HU, Huan Cai LIN, Bo WANG, Shu Guo ZHENG, Xue Nan LIU, Wen Sheng RONG, Wei Jian WANG and Bao Jun TAI, trained the investigators, designed and supervised the survey. Dr Bao Jun TAI revised the manuscript.

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