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Original Article

Prevalence of periodontal disease in middle-aged and elderly patients and its influencing factors

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Abstract: Objective: To explore the prevalence of periodontal disease in middle-aged and elderly patients and analyze its influencing factors. Methods: A total of 521 patients admitted to the Department of Stomatology of Fuyang District Chinese Medicine Hospital of Hangzhou from January 2019 to January 2022 were retrospectively collected as study subjects, including 176 patients aged 35-44 years old, 175 patients aged 45-64 years old, and 170 patients aged 65-74 years old. Community Periodontal Index (CPI) probe was used to detect gingival bleeding, periodontal pockets and attachment loss, and the prevalence of periodontal disease and its influencing factors were analyzed. Results: In the age group of 35-44, gingival bleeding was detected in 165 (93.75%) cases and dental calculus was detected in 176 (100.00%) cases; in the age group of 45-64, gingival bleeding was detected in 163 (93.14%) cases and dental calculus was detected in 161 (92.00%) cases; in the age group of 65-74, gingival bleeding was detected in 150 (88.24%) cases and dental calculus was detected in 162 (95.29%) cases. There were statistically significant differences in the detection rates of shallow periodontal pockets, deep periodontal pockets, and loss of periodontal attachment among the three groups ($P<0.05$). There wasalso asignificant difference in the detection rate of periodontitis among the three groups ($P<0.05$). Univariate analysis showed that gender, age, place of residence, smoking, alcohol consumption, brushing frequency, and dental cleaning in the past year were all associated with the occurrence of periodontitis ($P<0.05$). Logistic multi-factor regression analysis showed that age was a risk factor for the development of periodontitis in middle-aged and elderly patients ($P<0.05$). Conclusion: The prevalence of periodontal disease in middle-aged and elderly individuals is high, with a high prevalence of gingival bleeding and shallow periodontal pockets. Age is an influencing factor on the incidence of periodontitis in middle-aged and elderly individuals.

Keywords: Middle-aged and elderly patients, periodontal disease, influencing factors, periodontitis

Introduction

Oral health has been proposed as one of the hallmarks of modern human civilization [1], and reflects the health and well-being of a person throughout life [2]. At present, studies have clearly found that oral diseases are closely related to cardiovascular diseases, diabetes mellitus, kidney diseases and other systemic diseases [3, 4]. However, oral health of middle-aged and elderly population in China is still not optimal, and three national epidemiological surveys conducted in 1983, 1995 and 2005 showed that the incidence of dental caries and dental fluorosis is relatively high in the middle-aged and elderly population in China [5, 6].

With the rapid socioeconomic development in China, great changes have taken place in the lifestyle and dietary habits of the residents. On the one hand, the trend of aging has significantly increased the proportion of middle-aged and elderly population, and on the other hand, the above changes have also affected the dental health of the residents. Data show that the current prevalence of periodontal disease in the elderly is as high as 55.7%, and the percentage of completely edentulous elderly reaches 6.9%, and the research has pointed out that periodontal disease not only brings greater economic burden to the patients themselves, but also becomes a risk factor for a variety of cardiovascular diseases [7]. Currently, periodontal

diseases are treated in a variety of ways, including conservative treatment, and surgical intervention. Timely and effective treatment has positive significance in improving the periodontal health of patients [8]. Compared to young individuals, middle-aged and elderly individuals are more likely to develop periodontal disease due to multiple factors such as education level, living environment, and economic conditions, and that middle-aged and elder groups generally pay less attention to periodontal health. Therefore, it is necessary to investigate the periodontal disease in middle-aged and elderly population, so as to clarify the prevalence of periodontal disease in this population, formulate targeted intervention measures, and lay a good foundation for improving the dental health of the residents.

Materials and methods

Target population

Five hundred and twenty-one patients who attended the Department of Stomatology of Fuyang District Chinese Medicine Hospital of Hangzhou from January 2019 to January 2022 were retrospectively collected as study subjects, including 176 patients in the age group of 35-44, 175 patients in the age group of 45-64, and 170 patients in the age group of 65-74. The study was approved by the ethics committees of Fuyang District Chinese Medicine Hospital of Hangzhou (No. NCT01258634), and the study data were also used with informed consent of the patients.

Inclusion criteria: (1) those who admitted to Fuyang District Chinese Medicine Hospital of Hangzhou and received periodontal treatments for gingivitis, periodontitis, periodontal atrophy and other periodontal diseases; (2) those with complete medical records.

Exclusion criteria: (1) those with concurrent mental or neurological disorders resulting in unconsciousness; (2) those with concurrent hearing, visual, and speech system dysfunction; (3) those with concurrent serious medical diseases; (4) those with severe periodontal defects due to trauma or other causes; or (5) those with other oral diseases that affected the results of the study.

Investigation method

Sample size calculation: $n = [\frac{\mu\alpha}{\sin^{-1}\frac{\delta}{\sqrt{pq}}}]^2$ *α=0.05,* two-sided test, $U_{0.05}$=1.96; the positive rate was predicted by reviewing the literature (p=15%, q=1-p, error δ=2.5%). Through calculation, a sample size of about 384 was obtained. Considering the incomplete data, the sample size was increased by 20%, and finally the total number of subjects should not be less than 461.

Data collection: (1) General clinical data, including gender, age, place of residence (in the past year), smoking, alcohol consumption, frequency of tooth brushing, number of dental cleaning in the past year were collected. (2) Oral health examination. According to the examination standards of the Fourth National Oral Health Epidemiological Survey [9], the prevalence of calculus, shallow periodontal pockets, deep periodontal pockets, attachment loss, and periodontitis were examined. The periodontal health rate and incidence of periodontitis were calculated.

Quality control: The collected data were input into an Excel sheet by two researchers, who were specially trained in advance to master the requirements of data collection and entry process, to ensure that the data were error-free.

Statistical methods

The collected data were processed using SPSS 26.0 statistical software. The measurement data were analyzed using t-test and expressed as ($\bar{x} \pm s$). The count data were expressed as [n (%)], and the difference between the two groups and multiple groups were compared using χ^2 test. Logistic regression model was used to analyze the factors influencing periodontitis. $P<0.05$ indicated a significant difference [10].

Results

Baseline data

A total of 521 patients were investigated, including 176 (33.78%) patients in the age group of 35-44, 175 (33.59%) patients in the age group of 45-64, and 170 (32.63%) patients in the age group of 65-74. The average age of the examined population was (55.98±4.30)

Table 1. The detection rate of gingival bleeding and tartar [n (%)]

Age group	Subgroup	Number of subjects	Gingival bleeding	Dental calculus
35-44	Urban	89	85 (95.51)	89 (100.00)
	Rural	87	80 (91.95)	87 (100.00)
	Male	90	86 (95.56)	90 (100.00)
	Female	86	79 (91.86)	86 (100.00)
	Total	176	165 (93.75)	176 (100.00)
45-64	Urban	90	82 (91.11)	82 (91.11)
	Rural	85	81 (95.29)	79 (92.94)
	Male	87	80 (91.95)	78 (89.66)
	Female	88	83 (94.32)	83 (94.32)
	Total	175	163 (93.14)	161 (92.00)
65-74	Urban	89	78 (87.64)	86 (96.63)
	Rural	81	72 (88.89)	76 (93.83)
	Male	86	77 (89.53)	84 (97.67)
	Female	84	73 (86.90)	78 (92.86)
	Total	170	150 (88.24)	162 (95.29)
Total		521	478 (91.75)	499 (95.78)

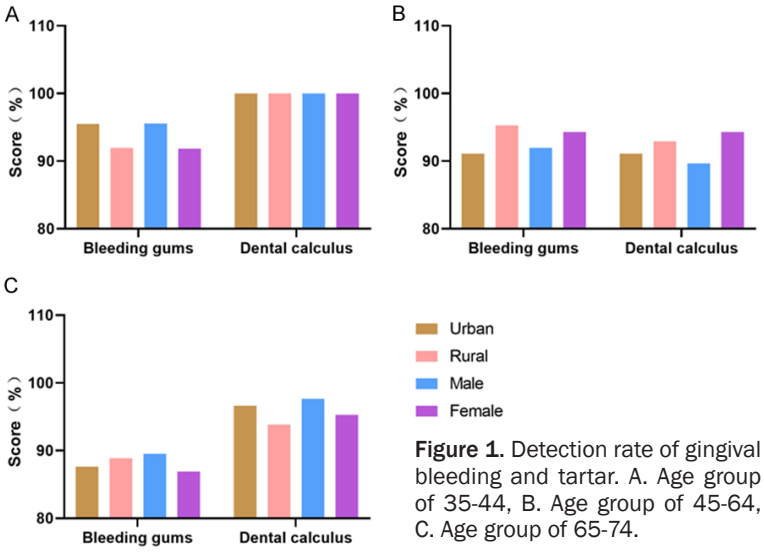

Figure 1. Detection rate of gingival bleeding and tartar. A. Age group of 35-44, B. Age group of 45-64, C. Age group of 65-74.

years old, and 263 (50.48%) patients were males and 258 (49.52%) were females (**Table 1**).

Periodontal disease statistics

The detection rate of gingival bleeding and dental calculus: Among the middle-aged and elderly patients, there were 165 (93.75%) cases of gingival bleeding and 176 (100.00%) cases of dental calculus in the age group of 35-44; there were 163 (93.14%) cases of gingival bleeding and 161 (92.00%) cases of dental calculus in the age group of 45-64; and there were 150 (88.24%) cases of gingival bleeding and 162 (95.29%) cases of dental calculus in the age group of 65-74. The detection rate of gingival bleeding and dental calculus among the three groups showed no significant differences (all $P>0.05$) (**Table 1** and **Figure 1**).

Detection rate of periodontal pockets and periodontal attachment loss: In the 35-44 age group , there were 67 (38.07%) cases of shallow periodontal pockets, 4 (5.97%) cases of deep periodontal pockets, and 56 (31.82%) cases of periodontal attachment loss; in the 45-64 age group, there were 108 (61.71%) cases of shallow periodontal pockets, 20 (11.43%) cases of deep periodontal pockets, and 132 (75.43%) cases of periodontal attachment loss; in the 65-74 age group, there were 89 (52.35%) cases of shallow periodontal pockets, 15 (8.82%) cases of deep periodontal pockets, and 149 (87.65%) cases of periodontal attachment loss. There were significant differences among the three groups in the detection rate of shallow and deep periodontal pockets as well as periodontal attachment loss. (χ^2=19.914, P<0.001; χ^2=11.274, P=0.004; χ^2=131.305, P<0.001). A pairwise comparison showed that the detection rate of deep periodontal pockets was higher in urban than in rural areas in the 35-44 age group, and the detection rate of shallow periodontal pockets were higher in men than in women in the 55-64 age group (all P<0.05) (**Table 2**).

Periodontal health and periodontitis detection rates: The detection rate of periodontitis and periodontal health rate was 3.41% and 13.64% in the 35-44 age group, 1.71% and 53.14% in

Table 2. The detection rate of periodontal pockets and periodontal attachment loss [n (%)]

Age group	Subgroup	Number of subjects	Shallow periodontal pockets	Deep periodontal pockets	Loss of periodontal attachment	χ^2	*P*
35-44	Urban	89	32 (35.96)	4 (4.49)*	29 (32.58)	2.659	0.004
	Rural	87	35 (40.23)	0 (0.00)	27 (31.03)		
	Male	90	36 (40.00)	1 (1.11)	30 (33.33)	0.698	0.215
	Female	86	31 (36.05)	3 (3.49)	26 (30.23)		
	Total	176	67 (38.07)	4 (5.97)	56 (31.82)	-	-
45-64	Urban	90	54 (60.00)	9 (10.00)	70 (77.78)	0.894	0.265
	Rural	85	54 (63.53)	11 (12.94)	62 (72.94)		
	Male	87	68 (78.16)#	14 (16.09)	78 (89.66)#	3.264	<0.001
	Female	88	40 (45.45)	6 (6.82)	54 (61.36)		
	Total	175	108 (61.71)	20 (11.43)	132 (75.43)	-	-
65-74	Urban	89	46 (51.69)	10 (11.24)	81 (91.01)	0.115	0.685
	Rural	81	43 (53.09)	5 (6.17)	68 (83.95)		
	Male	86	48 (55.81)	8 (9.30)	76 (88.37)	0.698	0.451
	Female	84	41 (48.81)	7 (8.33)	73 (86.90)		
	Total	170	89 (52.35)	15 (8.82)	149 (87.65)	-	-
Total		521	264 (50.67)	39 (7.49)	337 (64.68)	-	-

Note: Compared to the same age group of females, #*P*<0.05; compared to the same age group of rural residents, *P<0.05.

the 45-64 age group, and 4.71% and 47.06% in the 55-64 age group, exhibiting significant differences among the three groups (χ^2=54.756, *P*<0.001). A pairwise comparison showed that the detection rate of periodontitis was higher in urban than in rural areas in the 55-64 age group, and was higher in men than in women in the 65-74 age group (*P*<0.05) (**Table 3** and **Figure 2**).

Analysis of factors influencing periodontitis: Univariate analysis showed that gender, age, place of residence, smoking, alcohol consumption, frequency of brushing, and dental cleaning in the past year were all associated with the occurrence of periodontitis (*P*<0.05) (**Table 4**).

Logistic regression analysis of influencing factors related to periodontitis: Based on the sample size of 521 patients in this study, presence of periodontitis was used as a dependent variable (0= no periodontitis, 1= periodontitis), and factors with P<0.1 in the univariate analysis were used as independent variables (including gender, age, place of residence, smoking, alcohol consumption, frequency of brushing, and dental cleaning in the past year) (**Table 5**). Logistic regression analysis models were developed. The analysis showed that age was an independent risk factor influencing the development of periodontitis in the middle-aged and elderly population (*P*<0.05) (**Table 6**).

Discussion

Oral diseases are common diseases affecting human health [11], and survey data show that the prevalence of dental caries is as high as 67.0% in children, the prevalence of permanent pressure caries reaches 59.9% in the middle-aged group, and about 7% of adults over 65 years old are edentulous. The detection rate of gingival teeth and dental calculus is also high in various age groups, suggesting that overall oral health is generally poor [12, 13]. Influenced by traditional concepts, Chinese people pay less attention to oral health, but in recent years, with the improvement of the overall quality of life and living standards, the demand for oral health has been increasing, and oral health has become a more prominent health issue of public concern at this stage [14, 15].

In this study, the prevalence of periodontal diseases was analyzed by including 521 middle-aged and elderly individuals, and the results found that the total prevalence of gingival bleeding among the 521 middle-aged and elderly individuals was 91.75%, the total prevalence of calculus was 95.78%, and the total

Table 3. The periodontal health and periodontitis detection rate in middle-aged and elderly population

Age group	Subgroup	Number of subjects	Periodontal health		Periodontitis		χ^2	*P*
			Number of cases	Detection rate (%)	Number of cases	Detection rate (%)		
35-44	Urban	89	4	4.49	15	16.85	1.583	0.208
	Rural	87	2	2.30	9	10.34		
	Male	90	5	5.56	14	15.56	0.576	0.448
	Female	86	1	1.16	10	11.63		
	Total	176	6	3.41	24	13.64	-	-
45-64	Urban	90	1	1.11	60*	66.67	13.609	<0.001
	Rural	85	2	2.35	33	38.82		
	Male	87	2	2.30	58#	66.67	12.707	<0.001
	Female	88	1	1.14	35	39.77		
	Total	175	3	1.71	93	53.14	-	-
65-74	Urban	89	5	5.62	45	50.56	0.920	0.337
	Rural	81	3	3.70	35	43.21		
	Male	86	4	4.65	47*	54.65	4.027	0.045
	Female	84	4	4.76	33	39.29		
	Total	170	8	4.71	80	47.06	-	-
Total		521	17	3.26	197	37.81	-	-

Note: Compared to the same age group of females, #*P*<0.05, compared to the same age group of rural residents, **P*<0.05.

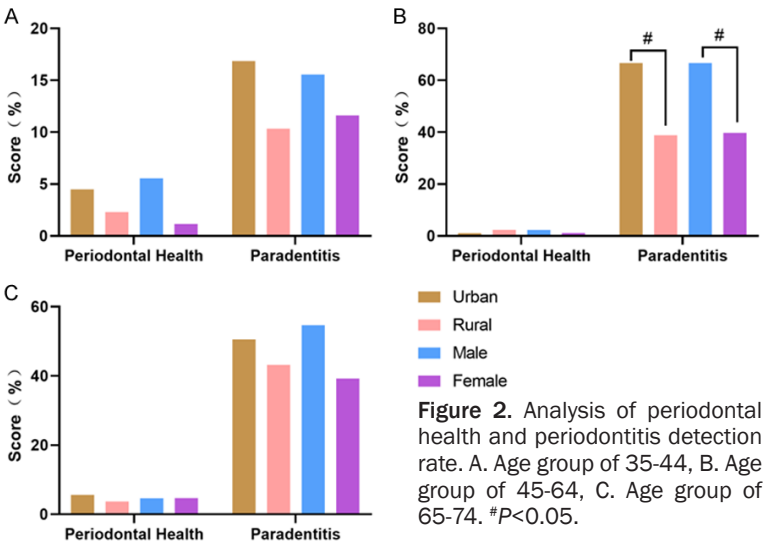

Figure 2. Analysis of periodontal health and periodontitis detection rate. A. Age group of 35-44, B. Age group of 45-64, C. Age group of 65-74. #*P*<0.05.

prevalence of shallow periodontal pockets was 50.67%; the total prevalence of deep periodontal pockets was 7.49%, and the total prevalence of periodontal attachment loss was 64.68%; the total prevalence of periodontitis was 37.81%, and the periodontal health rate was only 3.26%. A survey on the periodontal health status of 328 middle-aged and elderly patients from January 2017 to July 2017 showed that 71.04% of 328 patients were periodontal unhealthy individuals, and the main indicators of periodontal unhealthiness included gingival bleeding, periodontal pockets, attachment loss, and tooth loss [16]. A stratified, multistage, equal-volume random sample of 447 residents found that the prevalence of gingival bleeding and dental calculus as well as the proportion of periodontal attachment loss were 98.7%, 98.0%, and 76.5%, respectively [17]. The results of the present study were partially similar to those of the above two studies. For example, the main types of periodontal diseases in the investigated population were gingival bleeding, periodontal pockets, and attachment loss, and some of the differences may be related to differences in the geographical environment and dietary habits of the investigated population.

In addition, by grouping the investigated population according to age, place of residence and gender, some indicators had significant differences, such as the prevalence of shallow periodontal pockets, periodontal attachment loss

Table 4. Results of univariate analysis of periodontitis

Health status		Number of people (n=521)	Periodontitis (n=197)		χ^2	*P*
			Number of cases	Detection rate (%)		
Gender	Male	263	119	45.25	12.486	<0.001
	Female	258	78	30.23		
Age	35-44	176	24	13.64	67.419	<0.001
	45-64	175	93	53.14		
	65-74	170	80	47.06		
Place of residence	Urban	268	120	44.78	11.383	0.001
	Rural	253	77	30.43		
Smoking	Yes	356	154	43.26	14.181	<0.001
	No	165	43	26.06		
Alcohol consumption	Yes	213	123	57.75	60.89	<0.001
	No	308	74	24.03		
Frequency of brushing	<1 time per day	332	164	49.40	52.242	<0.001
	≥1 time per day	189	33	17.46		
Dental cleaning in the past year	Yes	120	67	55.83	21.534	<0.001
	No	401	130	32.42		

Table 5. Assignment of independent variables

Independent variable	Assignment 0	Assignment 1	Assignment 2
Gender	Male	Female	
Age	35-44	45-64	65-74
Place of residence	Urban	Rural	
Smoking	No	Yes	
Alcohol consumption	No	Yes	
Brushing frequency	<1 time per day	≥1 time per day	
Tooth cleaning in the past year	No	Yes	

Table 6. Logistic regression analysis of influencing factors related to periodontitis

Variable	β	SE	Wald	95% CI	Exp (B)	*P*
Age	2.156	0.452	22.705	3.558-20.964	3.558	<0.001
Gender	1.025	0.698	5.124	0.954-1.125	2.112	0.064
Place of residence	1.098	0.445	4.125	0.698-1.041	1.658	0.451
Smoking	1.521	0.625	3.012	0.598-0.654	0.685	0.065
Alcohol consumption	1.001	0.987	1.569	0.695-0.874	0.559	0.078
Brushing frequency	1.265	0.8859	1.663	0.623-0.984	0.625	0.061
Tooth cleaning in the past year	1.712	0.698	1.332	1.012-1.652	0.698	0.071

and periodontitis was significantly higher in men than in women in the age group of 55-64, the prevalence of periodontitis was significantly higher in urban than in rural areas, and the prevalence of deep periodontal pockets was significantly higher in urban than in rural areas in the age group of 35-44, which were similar to the findings of other study [18]. A survey on the periodontal health status of middle-aged and elderly population in a central urban area pointed out that there were significant differences in periodontal health rates among the individuals of different ages, and it showed that with an increase of age, individuals pay less attention to oral health, which may be one of the reasons for the high prevalence of periodontal diseases

in the elderly population [19]. Another study has shown that individuals with higher education and cleaner living environment pay more attention to oral health, suggesting that living environment may affect individuals' concern for oral health [20].

The study conducted univariate and multifactorial logistic regression analyses regarding the risk factors affecting the development of periodontitis in middle-aged and elderly population, and the results showed that gender, age, place of residence, smoking, alcohol consumption, frequency of brushing, and dental cleaning in the past year were all associated with the development of periodontitis, and age was an independent risk factor affecting the development of periodontitis in middle-aged and elderly population. Abou El Fadl et al. [21] conducted a health survey on 5954 adults age over 20 years old, and found that the prevalence of periodontitis were significantly higher among the elderly, illiterate, smokers and rural residents, and further analysis conducted by the researcher revealed that advanced age and history of diabetes were the main factors leading to tooth loss. Humagain and Adhikari [22] conducted an assessment of periodontal status among people in the Chepang Hill district of Nepal, and noted a significant increase in loss of attachment and Community Periodontal Index (CPI) with the increase of age, suggesting that interventions should be intensified for the elderly population. We believed that gender, place of residence, smoking, alcohol consumption, frequency of brushing, and dental cleaning habits in the past year would have an impact on the oral health condition, with smoking and alcohol consumption, for example, disrupting the oral microbial balance of patients, leading to the suppression of probiotic bacteria and increasing the chance of periodontal inflammation [22, 23]. We found that age was an independent risk factor for the development of periodontitis, and the reasons might be: (1) age increases the incidence of local plaque, calculus, and food impaction in the oral cavity, along with decreased metabolic capacity and immune capacity, thus increasing the incidence of periodontal inflammation [24]; (2) age can affect habits that are beneficial to oral health, such as forgetting to brush teeth and rinse mouth after meals; and (3) the elderly have low acceptance of oral health knowledge and poor compliance with treatment.

In conclusion, the condition of periodontal disease in middle-aged and elderly population is not good, and the prevalence of gingival bleeding and shallow periodontal pockets is high. Age has a significant impact on the incidence of periodontitis in middle-aged and elderly population, and oral prevention and health care should be strengthened for them. The innovation of this study lies in the analysis of the current prevalence of periodontal disease and its influencing factors in middle-aged and elderly population by including middle-aged and elderly groups, which provides detailed data support for the improvement of periodontal health in middle-aged and elderly population. The limitation of this study is that the patients included were from a single center, Fuyang District Chinese Medicine Hospital of Hangzhou, which may cause bias. It is proposed to conduct a multicenter study at a later stage to improve the accuracy of the data.

Disclosure of conflict of interest

None.

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