

The Prevalence and Factors Associated with Complete Tooth Loss and Dental Visits in Menopausal and Non-Menopausal Women: Insights from the CHARLS

Huiyan Gong, Meihua Li

Department of Stomatology, The Second Hospital of Jilin University, Changchun, Jilin Province, People's Republic of China

Correspondence: Meihua Li, Email meihl_699@126.com; meihua@jlu.edu.cn

Purpose: To assess the incidence of complete tooth loss and dental visits in menopausal women and to identify relevant influencing factors in China.

Methods: This study analyzed data of 5,602 women sourced from the China Health and Retirement Longitudinal Study (CHARLS) during 2015. The incidence of complete tooth loss and dental visits in menopausal and non-menopausal women was explored. Univariate and multivariate logistic regression models evaluated the relationships between demographic background, health status and function, health care and insurance, blood data and complete tooth loss and dental visits in menopausal women. The results were expressed as odds ratios (OR) of 95% confidence intervals (CI).

Results: Risk factors for complete tooth loss in menopausal women included age (OR=1.09, 95% CI: 1.08–1.11), living in villages (OR=1.58, 95% CI: 1.29–1.93), smoke (OR=1.29, 95% CI: 1.01–1.65). Factors for dental visits in menopausal women included age (OR=0.99, 95% CI: 0.98–1.00), living in villages (OR=0.75, 95% CI: 0.64–0.88).

Conclusion: This study found that menopausal women have higher rates of complete tooth loss and dental visits. Age, place of residence, and smoking are major risk factors for complete tooth loss, while age and place of residence influence dental visits, indicating that menopausal women should pay more attention to their dental health, improve compliance with dental visits, and actively intervene to prevent tooth loss.

Keywords: complete tooth loss, dental visits, menopause, risk factors, CHARLS

Introduction

Menopause is the permanent cessation of menstruation in women, usually occurring between the ages of 45 and 56. Its essence is the loss of activity of ovarian follicles without any other pathological or physiological causes.¹ During the menopausal transition period, due to changes in the reproductive hormone environment, it can cause disease processes such as vasomotor symptoms, emotional disorders, temporary cognitive dysfunction, and urogenital system symptoms.² In addition, as the oral mucosa contains estrogen receptors, changes in hormone levels directly affect the oral cavity, leading to candidiasis, burning mouth syndrome, oral lichen planus, idiopathic neuropathy, dental caries, osteoporosis, periodontal disease and tooth loss.^{3–5} Oral health is closely related to overall health. The burden of oral diseases increases with age, often leading to a decline in the quality of life of the elderly.⁶ Menopausal women have a higher risk of oral health problems, and there is a close relationship between the two.⁷ Studies show that the rate of tooth loss among postmenopausal women is significantly higher than that among women with normal menstruation.^{8,9} Periodontal disease, hypertension, osteoporosis, etc. are all risk factors for tooth loss in postmenopausal women.^{10–13} Regular dental visits and dental treatment over time can reduce the incidence of tooth loss,^{14–16} It can play an important role in preventing tooth loss for menopausal women.

At present, the exploration of the risk relationship between total tooth loss and dental visits between menopausal and non-menopausal women is not thorough. This study analyzed the prevalence of complete tooth loss and dental visits among menopausal and non-menopausal women and related risk factors of complete tooth loss among menopausal women in China. It provides a basis for clinical prevention and treatment and has important clinical significance.

Materials and Methods

Study Participants

This study utilizes data from the China Health and Retirement Longitudinal Study (CHARLS) for analysis.¹⁷ It was initiated by Peking University's National Development Research Institute (NDRI) and implemented by Peking University's China Social Science Survey Center (CSSSC) and the Peking University Mission Committee (PUMLC). The national baseline survey began in 2011, with follow-up surveys in 2013, 2015 and 2018. The survey used a strict random sampling method to obtain comprehensive, high-quality data on the health status of people aged 45 years and older.

This study is based on the 2015 CHARLS database survey of total tooth loss and dental visit rates. It is a secondary analysis of CHARLS data. We first analyzed the incidence of complete tooth loss and dental visits among menopausal and non-menopausal women, and then further focused on identifying factors associated with complete tooth loss and dental visits specifically in menopausal women. The data for this study included demographic background, health status and function, health care and insurance and blood data.¹⁸ The dataset is available at <http://charls.pku.edu.cn/>. All individuals who agreed to participate in the CHARLS survey signed an informed consent form, and ethical authorization was obtained from the BGSU Institutional Review Board (IRB) for all CHARLS surveys (authorization number: IRB00001052-11,015). An independent IRB license was obtained for all biomarker collection (IRB00001052-11,014). After review by the Ethics Committee of the Second Hospital of Jilin University, this study has been determined to meet the criteria outlined in item 1 and 2 of Article 32 of the Measures for Ethical Review of Life Science and Medical Research Involving Human Subjects dated February 18, 2023, China, obtained exemption from ethics review (Approval No.: 2,025,015).

Definition of Menopause in This Study

Menopausal status was determined through self-reporting by respondents, based on their response to the questionnaire item: "Have you started menopause?" Respondents who answered "Yes" were classified as menopausal.

Investigation Content Relevant to This Study

The information collected from all study participants includes demographic backgrounds (age, residence, marital status), health status and functioning (sleep time, nap time, pain, smoking status), and blood data (white blood cell, hemoglobin, hematocrit, mean corpuscular volume, platelets, triglycerides, creatinine, blood urea nitrogen, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, total cholesterol, glucose, uric acid, cystatin C, C-reactive protein, glycated hemoglobin). To ensure the accuracy and completeness of the study, sample sizes with missing values for any variables were excluded in this study.

Pain status was determined through self-reporting by respondents, based on their response to the questionnaire item: "Are you often troubled with any body pains?" Respondents who answered "Yes" were classified as experiencing pain. Smoking status was determined through self-reporting by respondents, based on their response to the questionnaire item: "Have you ever chewed tobacco, smoked a pipe, smoked self-rolled cigarettes, or smoked cigarettes/cigars?" Respondents who answered "Yes" were classified as having a history of smoking. Complete tooth loss was determined through self-reporting by respondents, based on their response to the questionnaire item: "Have you lost all of your teeth?" Respondents who answered "Yes" were classified as having complete tooth loss. Dental visit was determined through self-reporting by respondents, based on their response to the questionnaire item: "In the past year, have you seen a dentist for dental care, including dentures?" Respondents who answered "Yes" were classified as having had a dental visit in the past year.

Statistical Analyses

In this study, continuous variables were expressed as medians and interquartile ranges, and rank-sum tests were used to compare between groups. Categorical variables were expressed as percentages, and χ^2 -tests or Fisher's exact tests were used for group comparisons. Demographic characteristics and covariates were compared for the presence or absence of complete tooth loss and for the presence or absence of dental visit in menopausal women and non-menopausal women. The test level $\alpha=0.05$, $P<0.05$ indicates that the difference is statistically significant. A univariate logistic regression analysis was initially used to determine the factors associated with complete tooth loss and dental visit in menopausal women. Variables with p-values <0.05 in the univariate logistic regression analysis were then included in the multivariate logistic regression analysis. The significance level was set at 0.05 to examine the factors associated with complete tooth loss and dental visit in menopausal women. Odds ratios (OR) and corresponding 95% confidence intervals (CI) were calculated. R software (version 4.2.3) was used for all analyses in this study.

Results

Participants Characteristics

In total 5602 patients were included after excluding covariates with missing values in this study, 4724 were menopausal women, and 878 were non-menopausal women (Figure 1). Detailed information is provided in Table 1.

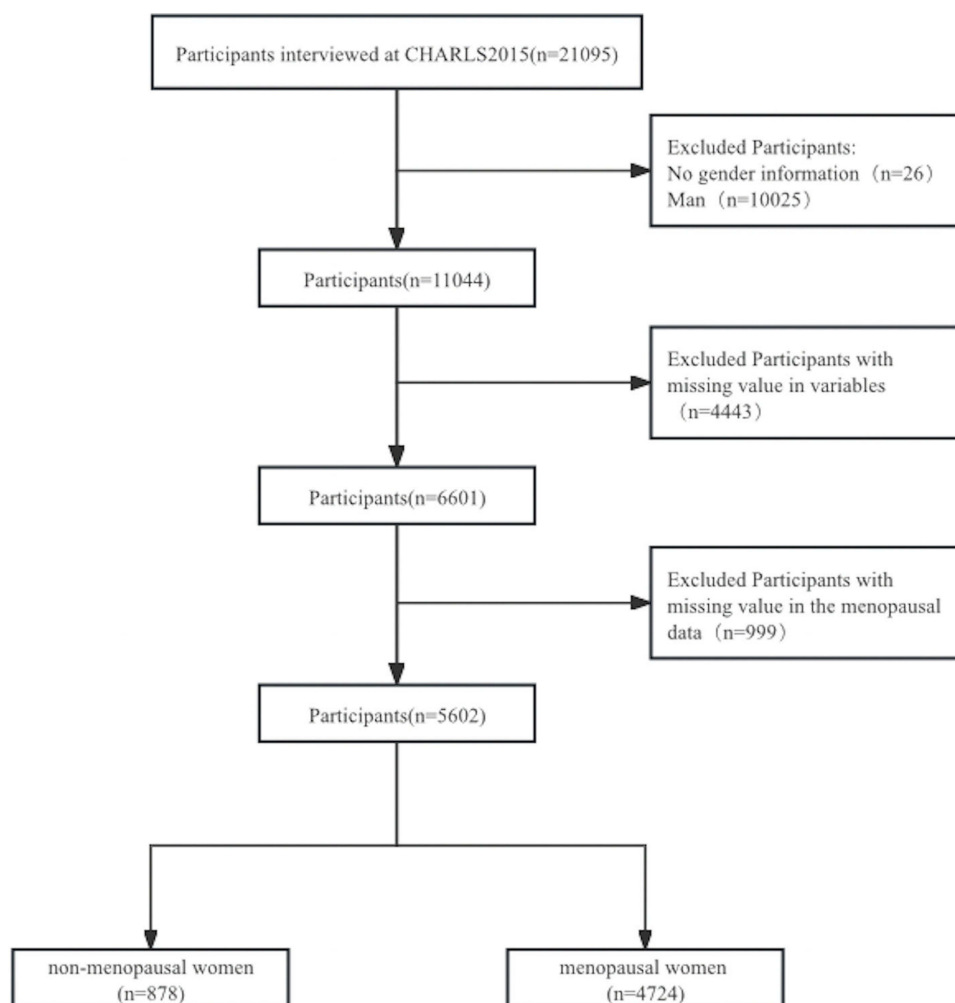


Figure 1 Study flowchart.

Table 1 Demographic and Clinical Characteristics of Participants

Variables	Overall (n=5602)	Non-Menopausal Women (n=878)	Menopausal Women (n=4724)	P-value
Age (years)	64.00 [56.00, 70.00]	53.00 [52.00, 55.00]	66.00 [60.00, 72.00]	<0.001
Residence (%)				<0.883
City or Town	1418 (25.3)	220 (25.1)	1198 (25.4)	
Village	4184 (74.7)	658 (74.9)	3526 (74.6)	
Marriage (%)				<0.001
Yes	4724 (84.3)	846 (96.4)	3878 (82.1)	
No	878 (15.7)	32 (3.6)	846 (17.9)	
Sleep_time	6.00 [5.00, 8.00]	7.00 [5.00, 8.00]	6.00 [5.00, 8.00]	<0.001
Nap_time	10.00 [0.00, 60.00]	17.50 [0.00, 60.00]	5.00 [0.00, 60.00]	0.281
Pain (%)				0.001
No	3530 (63.0)	599 (68.2)	2931 (62.0)	
Yes	2072 (37.0)	279 (31.8)	1793 (38.0)	
Smoke (%)				<0.001
No	5110 (91.2)	838 (95.4)	4272 (90.4)	
Yes	492 (8.8)	40 (4.6)	452 (9.6)	
WBC (1000)	5.56 [4.60, 6.62]	5.63 [4.65, 6.81]	5.54 [4.60, 6.60]	0.113
Hb (g/dl)	12.90 [12.10, 13.80]	12.80 [11.80, 13.70]	12.90 [12.10, 13.80]	<0.001
Hct (%)	39.40 [36.80, 42.00]	39.00 [35.92, 41.68]	39.50 [36.90, 42.00]	<0.001
MCV (fl)	91.00 [87.30, 94.60]	89.70 [84.50, 93.50]	91.30 [87.70, 94.80]	<0.001
PLT (10 ⁹ /L)	210.00 [167.00, 254.00]	228.00 [182.00, 271.00]	207.00 [165.00, 251.00]	<0.001
TG (mg/dl)	122.12 [89.38, 176.99]	109.73 [81.42, 166.15]	124.78 [91.15, 177.88]	<0.001
Cr (mg/dl)	0.68 [0.61, 0.76]	0.65 [0.59, 0.72]	0.68 [0.61, 0.77]	<0.001
BUN (mg/dl)	14.29 [12.04, 17.37]	12.89 [10.64, 15.41]	14.57 [12.32, 17.65]	<0.001
HDL (mg/dl)	51.35 [44.79, 58.69]	50.97 [44.79, 58.30]	51.35 [44.79, 58.69]	0.431
LDL (mg/dl)	104.63 [85.71, 123.84]	98.46 [81.47, 115.44]	106.18 [87.16, 125.10]	<0.001
TC (mg/dl)	188.03 [166.41, 212.74]	178.38 [158.30, 198.75]	190.35 [168.34, 214.67]	<0.001
GLU (mg/dl)	95.50 [88.29, 106.31]	91.89 [86.49, 100.90]	95.50 [88.29, 106.76]	<0.001
UA (mg/dl)	4.30 [3.60, 5.10]	4.00 [3.40, 4.80]	4.40 [3.70, 5.20]	<0.001
CysC (mg/l)	0.80 [0.69, 0.92]	0.67 [0.60, 0.77]	0.83 [0.72, 0.94]	<0.001
CRP (mg/l)	1.40 [0.80, 2.60]	1.10 [0.60, 2.20]	1.50 [0.80, 2.70]	<0.001
HbA1c (%)	5.80 [5.60, 6.20]	5.70 [5.40, 6.00]	5.90 [5.60, 6.20]	<0.001
Tooth_loss (%)				<0.001
No	4783 (85.4)	845 (96.2)	3938 (83.4)	
Yes	819 (14.6)	33 (3.8)	786 (16.6)	
Dental_visits (%)				0.018
No	4524 (80.8)	735 (83.7)	3789 (80.2)	
Yes	1078 (19.2)	143 (16.3)	935 (19.8)	

Abbreviations: WBC white blood cell, Hb hemoglobin, Hct hematocrit, MCV mean corpuscular volume, PLT platelets, TG triglycerides, Cr creatinine, BUN blood urea nitrogen, HDL high density lipoprotein cholesterol, LDL low density lipoprotein cholesterol, TC total cholesterol, GLU glucose, UA uric acid, CysC cystatin C, CRP C-reactive protein, HbA1c glycated hemoglobin.

Prevalence of Complete Tooth Loss in Menopausal Women

[Table S1](#) shows the prevalence of complete tooth loss in menopausal women. The incidence of complete tooth loss in menopausal women is 16.6% (786/4724). The two groups of participants in terms of age, place of residence, marital status, pain, smoke, hemoglobin, hematocrit, triglycerides, creatinine, blood urea nitrogen, cystatin C showed statistical differences ($P<0.05$).

Prevalence of Dental Visits in Menopausal Women

[Table S2](#) shows the prevalence of dental visits in menopausal women. The incidence of dental visits in menopausal women is 19.8% (935/4724). The two groups of participants in terms of age, place of residence, cystatin C showed statistical differences ($P<0.05$).

Prevalence of Complete Tooth Loss in Non-Menopausal Women

[Table S3](#) shows the prevalence of complete tooth loss in non-menopausal women. The incidence of complete tooth loss in non-menopausal women is 3.8% (33/878). The two groups of patients in terms of age, place of residence, cystatin C showed statistical differences ($P<0.05$).

Prevalence of Dental Visits in Non-Menopausal Women

[Table S4](#) shows the prevalence of dental visits in non-menopausal women. The incidence of dental visits in non-menopausal women is 16.3% (143/878). The two groups of patients in terms of pain, blood urea nitrogen showed statistical differences ($P<0.05$).

Influencing Factors of Complete Tooth Loss in Menopausal Women

Logistic regression analysis ([Table 2](#)) shows the influencing factors on complete tooth loss in menopausal women. Risk factors for complete tooth loss in menopausal women in the univariate regression analysis included age (OR=1.10, 95% CI: 1.09–1.11), living in villages (OR=1.52, 95% CI: 1.26–1.84), unmarried (OR=2.20, 95% CI: 1.84–2.62), pain (OR=1.20, 95% CI: 1.03–1.40), smoke (OR=1.62, 95% CI: 1.28–2.04), triglycerides (OR=1.00, 95% CI: 1.00–1.00), creatinine (OR=1.54, 95% CI: 1.17–2.03), blood urea nitrogen (OR=1.03, 95% CI: 1.02–1.05), cystatin C (OR=2.64, 95% CI: 1.93–3.61). Protective factors for complete tooth loss in menopausal women in the univariate regression analysis included hemoglobin (OR=0.91, 95% CI: 0.86–0.95), hematocrit (OR=0.97, 95% CI: 0.96–0.99). Risk factors for complete tooth loss in menopausal women in the multivariate regression analysis included age (OR=1.09, 95% CI: 1.08–1.11), living in villages (OR=1.58, 95% CI: 1.29–1.93), smoke (OR=1.29, 95% CI: 1.01–1.65). Detailed information is shown in [Figure 2](#).

Table 2 Univariate and Multivariate Logistic Regression Analysis of Risk Factors for Complete Tooth Loss in Menopausal Women

Variables	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Age (years)	1.10 (1.09–1.11)	<0.001	1.09 (1.08–1.11)	<0.001
Residence (%)				
City or Town				
Village	1.52 (1.26–1.84)	<0.001	1.58 (1.29–1.93)	<0.001
Marriage (%)				
Yes				
No	2.20 (1.84–2.62)	<0.001	1.07 (0.87–1.31)	0.543
Sleep_time	1.00 (0.96–1.03)	0.870		
Nap_time	1.00 (1.00–1.00)	0.674		
Pain (%)				
No				
Yes	1.20 (1.03–1.40)	0.021	1.12 (0.95–1.32)	0.169
Smoke (%)				
No				
Yes	1.62 (1.28–2.04)	<0.001	1.29 (1.01–1.65)	0.044

(Continued)

Table 2 (Continued).

Variables	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
WBC (1000)	0.97 (0.93–1.02)	0.205		
Hb (g/dl)	0.91 (0.86–0.95)	<0.001	0.98 (0.90–1.06)	0.586
Hct (%)	0.97 (0.96–0.99)	0.001	0.99 (0.96–1.02)	0.509
MCV (fl)	1.00 (0.99–1.01)	0.910		
PLT (10 ⁹ /L)	1.00 (1.00–1.00)	0.280		
TG (mg/dl)	1.00 (1.00–1.00)	0.005	1.00 (1.00–1.00)	0.106
Cr (mg/dl)	1.54 (1.17–2.03)	0.002	1.05 (0.74–1.51)	0.771
BUN (mg/dl)	1.03 (1.02–1.05)	<0.001	1.01 (0.99–1.03)	0.508
HDL (mg/dl)	1.01 (1.00–1.01)	0.060		
LDL (mg/dl)	1.00 (1.00–1.00)	0.277		
TC (mg/dl)	1.00 (1.00–1.00)	0.770		
GLU (mg/dl)	1.00 (1.00–1.00)	0.920		
UA (mg/dl)	0.95 (0.89–1.01)	0.129		
CysC (mg/l)	2.64 (1.93–3.61)	<0.001	1.05 (0.71–1.56)	0.810
CRP (mg/l)	1.00 (0.99–1.02)	0.667		
HbA1c (%)	1.03 (0.96–1.10)	0.385		

Abbreviations: WBC white blood cell, Hb hemoglobin, Hct hematocrit, MCV mean corpuscular volume, PLT platelets, TG triglycerides, Cr creatinine, BUN blood urea nitrogen, HDL high density lipoprotein cholesterol, LDL low density lipoprotein cholesterol, TC total cholesterol, GLU glucose, UA uric acid, CysC cystatin C, CRP C-reactive protein, HbA1c glycated hemoglobin.

Influencing Factors of Dental Visits in Menopausal Women

Logistic regression analysis (Table 3) shows the influencing factors on dental visits in menopausal women. Factors for dental visits in menopausal women in the univariate regression analysis included age (OR=0.99, 95% CI: 0.98–0.99), living in villages (OR=0.75, 95% CI: 0.64–0.88), cystatin C (OR=0.65, 95% CI: 0.46–0.93). Factors for dental visits in menopausal women in the multivariate regression analysis included age (OR=0.99, 95% CI: 0.98–1.00), living in villages (OR=0.75, 95% CI: 0.64–0.88). Detailed information is shown in Figure 3.

Discussion

This study observed a significantly higher of complete tooth loss and dental visits in menopausal women than in non-menopausal women, and therefore we further explored complete tooth loss and dental visits in menopausal women. Notably, by consulting relevant literature, we found that this is the latest study based on the CHARLS database to investigate the prevalence of complete tooth loss and dental visits in menopausal women, as well as related risk factors. Based on multivariate logistic regression, risk factors affecting complete tooth loss in menopausal women included age, place of residence, and smoking. Age and place of residence were also major risk factors for dental visits among menopausal women. The risk factors of complete tooth loss and dental visits interact with each other. The risk factors for complete tooth loss may directly increase the probability of dental visits by inducing tooth loss, and regular and long-term dental check-ups and treatments can reduce the incidence of tooth loss. This is also reflected in this study.

Age is an important factor influencing complete tooth loss and dental visits in menopausal women. As age increases menopausal women are more likely to experience tooth loss and are less likely to visit the dentist. Another study¹⁹ also confirmed that menopausal symptoms worsen as menopause progresses. Consider that as age increases, estrogen levels decline in menopausal women. Imbalances in hormone levels can affect the activation of bone cells and immune cells, causing a decrease in bone density throughout the body and affecting alveolar bone loss leading to tooth loss.²⁰ A cross-sectional study also confirms that clinical oral bone loss is age-related, especially in women over 70 years of age.²¹ It has also been certified that postmenopausal age is a related factor leading to periodontal attachment loss.²² Although age is

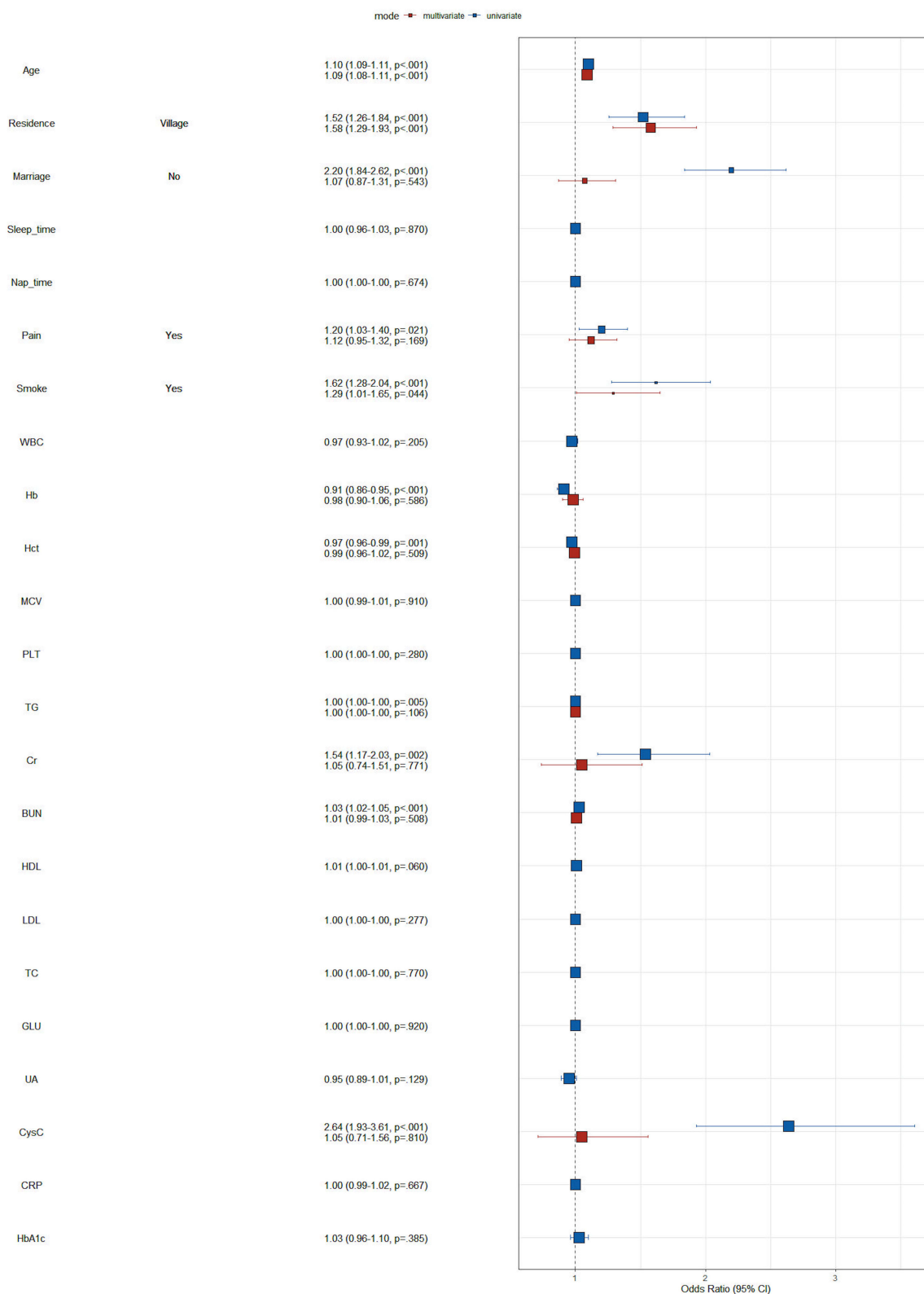


Figure 2 The univariate and multivariate logistic regression analysis of risk factors for complete tooth loss in menopausal women.

Abbreviations: WBC, white blood cell; Hb, haemoglobin; Hct, haematocrit; MCV, mean corpuscular volume; PLT, platelets; TG, triglycerides; Cr, creatinine; BUN, blood urea nitrogen; HDL, high density lipoprotein cholesterol; LDL, low density lipoprotein cholesterol; TC, total cholesterol; GLU, glucose; UA, uric acid; CysC, cystatin C; CRP, C-reactive protein; HbA1c, glycated hemoglobin.

Table 3 Univariate and Multivariate Logistic Regression Analysis of Risk Factors for Dental Visits in Menopausal Women

Variables	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Age (years)	0.99 (0.98–0.99)	<0.001	0.99 (0.98–1.00)	0.006
Residence (%)				
City or Town				
Village	0.75 (0.64–0.88)	<0.001	0.75 (0.64–0.88)	<0.001
Marriage (%)				
Yes				
No	0.86 (0.71–1.04)	0.118		
Sleep_time	1.00 (0.96–1.03)	0.888		
Nap_time	1.00 (1.00–1.00)	0.104		
Pain (%)				
No				
Yes	1.14 (0.99–1.33)	0.070		
Smoke (%)				
No				
Yes	0.98 (0.77–1.25)	0.856		
WBC (1000)	0.98 (0.94–1.02)	0.392		
Hb (g/dl)	1.02 (0.97–1.06)	0.425		
Hct (%)	1.01 (0.99–1.02)	0.319		
MCV (fl)	1.01 (1.00–1.02)	0.107		
PLT (10 ⁹ /L)	1.00 (1.00–1.00)	0.987		
TG (mg/dl)	1.00 (1.00–1.00)	0.225		
Cr (mg/dl)	1.20 (0.94–1.54)	0.150		
BUN (mg/dl)	0.99 (0.97–1.00)	0.135		
HDL (mg/dl)	1.00 (0.99–1.00)	0.169		
LDL (mg/dl)	1.00 (1.00–1.00)	0.339		
TC (mg/dl)	1.00 (1.00–1.00)	0.696		
GLU (mg/dl)	1.00 (1.00–1.00)	0.275		
UA (mg/dl)	1.01 (0.95–1.07)	0.689		
CysC (mg/l)	0.65 (0.46–0.93)	0.019	0.79 (0.55–1.12)	0.179
CRP (mg/l)	1.00 (0.99–1.02)	0.552		
HbA1c (%)	0.98 (0.92–1.05)	0.629		

Abbreviations: WBC white blood cell, Hb hemoglobin, Hct hematocrit, MCV mean corpuscular volume, PLT platelets, TG triglycerides, Cr creatinine, BUN blood urea nitrogen, HDL high density lipoprotein cholesterol, LDL low density lipoprotein cholesterol, TC total cholesterol, GLU glucose, UA uric acid, CysC cystatin C, CRP C-reactive protein, HbA1c glycated hemoglobin.

an unmodifiable factor, the findings highlight that older menopausal women should receive greater attention for oral health management and preventive interventions. Furthermore, our research has found that menopausal women living in rural areas have a higher risk of complete tooth loss and visit the doctor less frequently. The utilization of dental services in urban and rural areas is unfair. The number of health care units in rural areas is small and the distance to access health care services is long, making dental visits difficult in rural areas and resulting in a higher rate of tooth loss than in urban areas.^{23–25} The quality of life in rural areas is lower than that in urban areas. National and international studies have confirmed that a lower quality of life is associated with more severe menopausal symptoms.^{26–28} Menopausal women with a better socioeconomic background have the least number of missing teeth.²⁹ Being unmarried is a risk factor for complete tooth loss in menopausal women. A series of studies^{30–32} have found that married women have a more positive attitude towards menopause and a better quality of life. And a 25-year follow-up on oral health in Sweden also proved that unmarried women were more prone to tooth loss than married women.³³

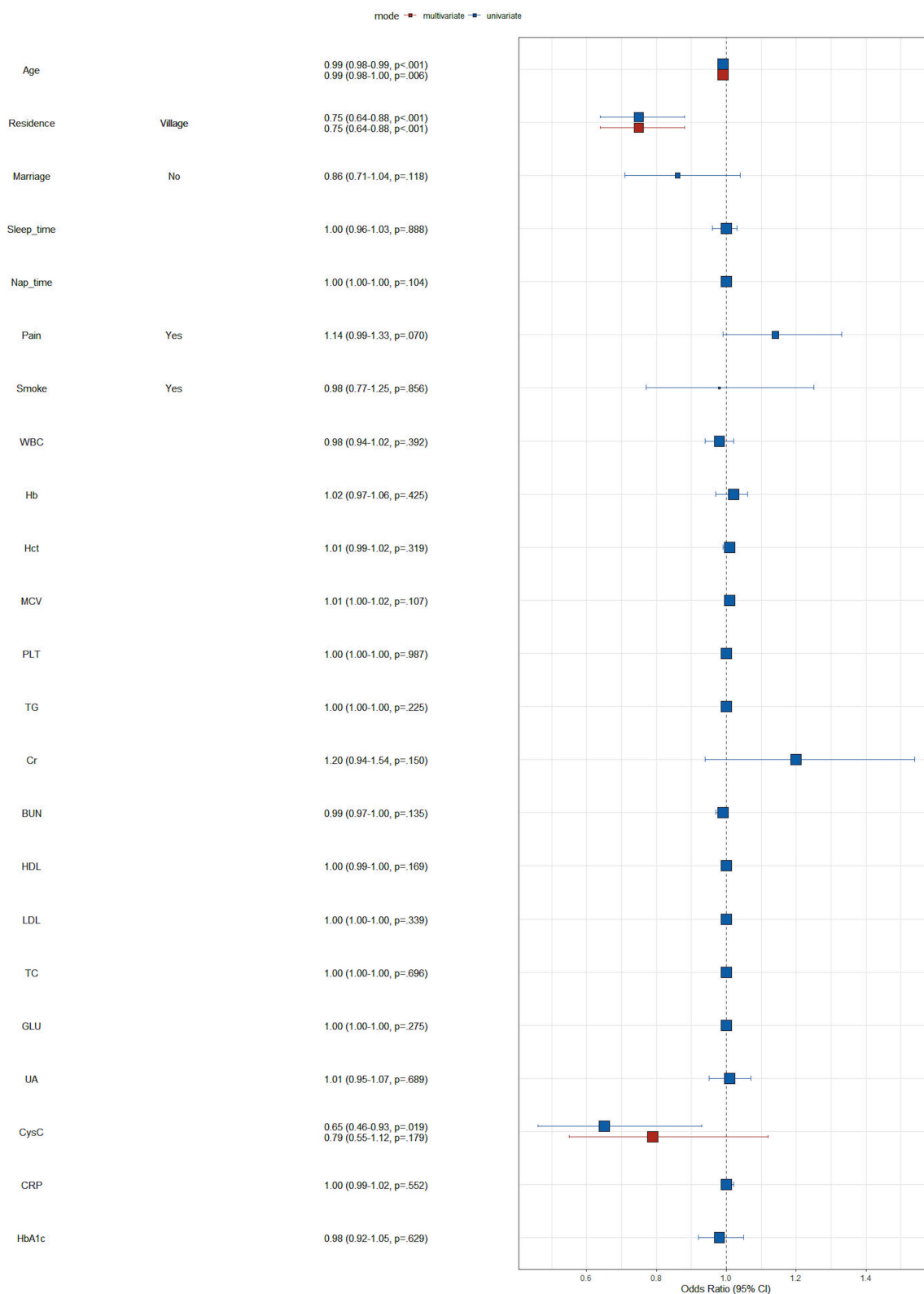


Figure 3 The univariate and multivariate logistic regression analysis of risk factors for dental visits in menopausal women.

Abbreviations: WBC, white blood cell; Hb, haemoglobin; Hct, haematocrit; MCV, mean corpuscular volume; PLT, platelets; TG, triglycerides; Cr, creatinine; BUN, blood urea nitrogen; HDL, high density lipoprotein cholesterol; LDL, low density lipoprotein cholesterol; TC, total cholesterol; GLU, glucose; UA, uric acid; CysC, cystatin C; CRP, C-reactive protein; HbA1c, glycated hemoglobin.

This study confirmed that pain is a risk factor for tooth loss in menopausal women. Pain during menopause may include musculoskeletal discomfort, headaches or migraines, vulvar and vaginal pain, as well as mouth pain.^{34,35} There is a bidirectional relationship between chronic pain and tooth loss. A study³⁶ has shown that pain is a risk factor for tooth loss, and severe tooth loss has a higher rate of chronic pain. Periodontal disease can activate the systemic host immune response and chronic low-grade inflammation, generating neuropeptides, which further leads to chronic pain throughout the body.³⁷ Furthermore, our research also found that smoking is a serious risk factor for tooth loss in menopausal women. The view that smoking affects overall health has become a consensus. The related diseases include lung diseases, cardiovascular diseases, endocrine diseases, oral diseases, etc. A study has shown that smoking in postmenopausal women is associated with tooth loss, and those who do not smoke are more likely to retain their teeth.³⁸

Hemoglobin, hematocrit, creatinine and blood urea nitrogen can affect tooth loss in menopausal women. Low levels of hemoglobin and hematocrit may indicate anemia. Anemia is a global health issue that affects a large number of women of all ages.³⁹ The number of natural teeth is negatively correlated with anemia and can be regarded as an independent risk indicator of anemia.⁴⁰ Serum creatinine and blood urea nitrogen levels are important indicators for determining clinical renal function.⁴¹ Studies^{9,42} show that chronic kidney disease and tooth loss may be related, and this association is particularly significant among postmenopausal women. Furthermore, in this study, cystatin C was found to be associated with total tooth loss and dental visits in menopausal women, who have relatively high levels, tend to have a higher probability of tooth loss, and are reluctant to make dental visits. Related studies^{43,44} have investigated that serum cystatin C may be a realistic surrogate for osteoporosis in postmenopausal women, and serum cystatin C is significantly elevated in osteoporosis. Another study⁴² also confirmed that serum cystatin C levels were associated with the number of remaining teeth in postmenopausal women. This is consistent with the results of the present study. This study has significant strengths. First, this work utilized data from CHARLS with a large sample size. Secondly, the objective of this study was to assess the prevalence and risk factors of complete tooth loss and dental visits in menopausal women. Relevant research is scarce. This study also had limitations. The study did not delve into the specifics of complete tooth loss and dental visits, such as whether dental implants were present and the reasons for the visits. Considering these limitations, future studies should include more comprehensive variables to improve the generalizability and accuracy of the study.

Conclusion

This study systematically analyzed the prevalence of complete tooth loss and dental visits among menopausal women and their associated risk factors. Menopausal women had a higher prevalence of complete tooth loss and dental visits compared to non-menopausal women. Age, place of residence, and smoking significantly increase the risk of complete tooth loss, while age and place of residence are important predictors of dental visits. Menopause is positively correlated with the risk of complete tooth loss, indicating that menopausal women should pay more attention to their dental health, improve compliance with dental visits, and actively intervene to prevent tooth loss. The results of this study provide a theoretical basis for menopausal women to intervene in complete tooth loss and dental visits. In addition, Future studies will focus on assessing the prevalence and risk factors for complete tooth loss and dental visits in different populations.

Data Sharing Statement

The data that support the findings of this study are available from the China Health and Retirement Longitudinal Study (CHARLS) website, subject to the registration and application process. Further details can be found at <http://charls.pku.edu.cn/>.

Ethics

Ethics approval and consent to participate All CHARLS surveys received ethical authorization from the Institutional Review Board (IRB) at Peking University (IRB00001052-11015). Furthermore, the protocol of the blood-based biomarker sample collection study was approved by the ethical review committee of Peking University (IRB00001052-11014). All participants completed the informed consent forms. This study has been determined to meet the criteria outlined in item 1 and 2 of Article 32 of the Measures for Ethical Review of Life Science and Medical Research Involving Human Subjects dated February 18, 2023, China, obtained exemption from ethics review (Approval No.: 2025015).

Consent for Publication

All authors agree to publish.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no relevant financial or non-financial interests to disclose.

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