ORIGINAL ARTICLE

Factors associated with oral health service utilization among adults and older adults in China, 2015-2016

Mengru Xu[1] | Menglin Cheng[1] | Xiaoli Gao[1] | Huijing Wu[1] | Min Ding[1] |
Chunzi Zhang[1] | Xing Wang[2] | Xiping Feng[3] | Baojun Tai[4] | Deyu Hu[5] | Huancai Lin[6] |
Bo Wang[2] | Chunxiao Wang[7] | Shuguo Zheng[1] | Xuenan Liu[1] | Wensheng Rong[1] |
Weijian Wang[1] | Tao Xu[1] | Yan Si[1]

[1]Department of Preventive Dentistry, Peking University School and Hospital of Stomatology, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, Beijing, China

[2]Chinese Stomatological Association, Beijing, China

[3]Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

[4]School & Hospital of Stomatology, Wuhan University, Wuhan, China

[5]West China School of Stomatology, Sichuan University, Chengdu, China

[6]Guanghua School of Stomatology, Hospital of Stomatology, Sun Yetsen University, Guangzhou, China

[7]Chinese Center for Disease Control and Prevention, Beijing, China

Correspondence
Tao Xu and Yan Si, Department of Preventive Dentistry, Peking University School and Hospital of Stomatology, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, Beijing, China.
Emails: t-xu@live.com (TX); siyanyy@163.com (YS)

Abstract

Objectives: To explore the factors associated with utilization of oral health services among Chinese adults and older adults according to the Andersen Behavior Model.

Methods: Data from the 4th National Oral Health Survey (2015-2016) in China were used. A total of 7206 people (3669 adults aged 35-44 years and 3537 older adults aged 65-74 years) were included in our analysis. Oral health service utilization in the past 12 months was the outcome variable. Explanatory variables were selected according to the Andersen Behavior Model. Descriptive statistics and bivariate associations (chi-square tests) were analysed, followed by hierarchical Poisson regression models, which were conducted to determine the factors associated with oral health service utilization.

Results: In total, 21.4% (95% CI: 19.4%-23.7%) of adults (35-44 years old) and 20.7% (95% CI: 18.6%-22.9%) of older adults (65-74 years old) utilized oral health services in the past 12 months. Nearly 80% of adults (78.7%, 95% CI: 74.0%-82.7%) and more than 90% of older adults (93.7%, 95% CI: 91.0%-95.6%) visited a dentist for treatment. Adults aged 35-44 years old who were female (IRR: 1.15, 95% CI: 1.00-1.33, P = .047), had good oral health knowledge and attitudes (IRR: 1.30, 95% CI: 1.06-1.59, P = .011), perceived their oral health status as fair (IRR:1.51, 95% CI:1.24-1.85, P < .001) or poor/very poor (IRR:2.52, 95% CI:2.01-3.18, P < .001) and had a decayed, missing and filled teeth (DMFT) index >0 (IRR: 1.52, 95% CI: 1.11-2.09, P = .009) were more likely to report dental visits in the past 12 months. Older adults who utilized oral health services tended to be female (IRR: 1.32, 95% CI: 1.09-1.59, P = .004); to be covered by Urban Resident Basic Medical Insurance (URBMI) (IRR: 1.56, 95% CI: 1.18-2.05, P = .002), Urban Employee Basic Medical Insurance (UEBMI) (IRR: 1.69, 95% CI: 1.32-2.16, P < .001) or government medical insurance (GMI) (IRR: 1.03, 95% CI:1.01-2.16, P = .044); to have a high education level (IRR: 1.37, 95% CI: 1.08-1.74, P = .010); to have an income level in the 2nd tertile (IRR: 1.44, 95% CI: 1.13-1.84, P = .003) or 3rd tertile (IRR:1.52, 95% CI:1.18-1.95, P = .001); and to perceive their oral health status as poor or very poor (IRR: 1.53, 95% CI: 1.21-1.95, P = .001).

Conclusions: Sex and self-perceived oral health status were associated with oral health utilization among Chinese population. Additionally, for older adults, education level, household income and insurance coverage were determinants of dental service use. These findings can aid in creating more targeted policies to increase the use of dental services by Chinese adults.

K E Y W O R D S
adults, China, dental service, older adults

1 | INTRODUCTION

Oral diseases affect 3.9 billion people, causing a great burden worldwide.[1] Regular use of oral health services has been proven to be associated with better oral health status in long-term studies.[2,3] The global mean proportion of individuals utilizing dental services is 54% (95% CI: 50%-59%).[4] However, inequalities in dental service utilization have been found to be globally consistent[5] and considerable in China.[6] The economic burden of oral diseases in China is relatively high,[7] while the use of oral health services among Chinese population is very low compared to that in high-income countries (HICs).[7-11] Thus, recognizing factors associated with the low rate of use of oral health services would not only increase the understanding of oral care use behaviour but also aid in designing a cost-effective oral care system for China in the future.[12]

The Andersen Behavior Model is one of the most well-known models for health care and describes the interrelationships among population characteristics (predisposing factors, enabling resources and need, PEN), health behaviours and health outcomes. This model has also been used to investigate variables that explain the use of services and ways to promote equitable access to health services.[13] Numerous studies have used this model to determine factors related to oral health service utilization through bivariate and multivariable analysis.[11,14-16] The impact of demographic, health-related and social factors on dental service utilization has been assessed in a systematic review building on 103 related studies,[4] among which evidence from China was rare.

China as a country with a vast territory and large population, nationwide data collection can be relatively difficult; thus, previous research conducted in China mainly focused on the utilization of oral health services among adults in certain provinces and a few large cities.[9-11,17] These regional studies showed that adults were more likely to use dental care if they were wealthier,[9,11,17] were better educated,[9,11,17] were living in urban areas,[9,10] and had worse self-rated oral health status.[11] However, in remote areas such as Tibet, there is little information about oral health service utilization, and such information was not included in the previous National Oral Health Surveys or any other studies. One previous national study (which included only 28 provinces) showed great inequality in oral health service utilization among adults aged 45 and older but did not collect information on self-rated and evaluated oral health status.[18] In an effort to include as much information on oral health as possible, the most recent 4th National Oral Health Survey was conducted during 2015-2016 and included all 31 provinces, municipalities, and autonomous regions in mainland China.[18,19] Thus, it was the first time that comprehensive national data were used to study the determinants of oral health service utilization in mainland China.

According to the 6th National Population Census in 2010,[20] adults aged 60 and older in China accounted for 13.26% of the population. Due to the increasing number of older individuals and the emergence of an ageing society, the oral health diseases and oral health care of older adults require attention.[21] Although age was found to be a factor determining dental care use in China,[6,11] few studies to date have focused on factors associated with oral health service utilization while cross-referencing data for adults and older adults.

Therefore, the objective of this study was to determine the factors associated with utilization of oral health services among adults and older adults in mainland China using the Andersen Behavior Model. This study predicted some similarities and differences in determinants between the adult group and the older adult group that could be used to develop useful policies and interventions aimed at increasing dental service use in the Chinese population.

2 | METHODS

This cross-sectional study used data from the 4th National Oral Health Survey (2015-2016), which covered the four WHO index ages.[22] A multistage, stratified, equal proportion, random sampling method was used, and participants were selected in three stages using probability-proportional-to-size (PPS) sampling with a method of varied population sizes. The details of our sampling method and sample size estimation have been described in previous articles.[7,19] The study protocol was approved by the Stomatological Ethics Committee of the Chinese Stomatological Association, Beijing (No. 2014-003).

A total population of 172 425 (40 360 children aged 3-5 years, 118 601 adolescents aged 12-15 years, 4410 people aged 35-44 years, 4623 people aged 55-64 years and 4431 older adults aged 65-74 years) were enrolled in the survey after signing the informed consent form. The present analysis included 3669 adults (35-44 years old) and 3537 older adults (65-74 years old) who had complete data for all relevant variables (representing 81.5% of the total number of national survey participants; Figure 1).
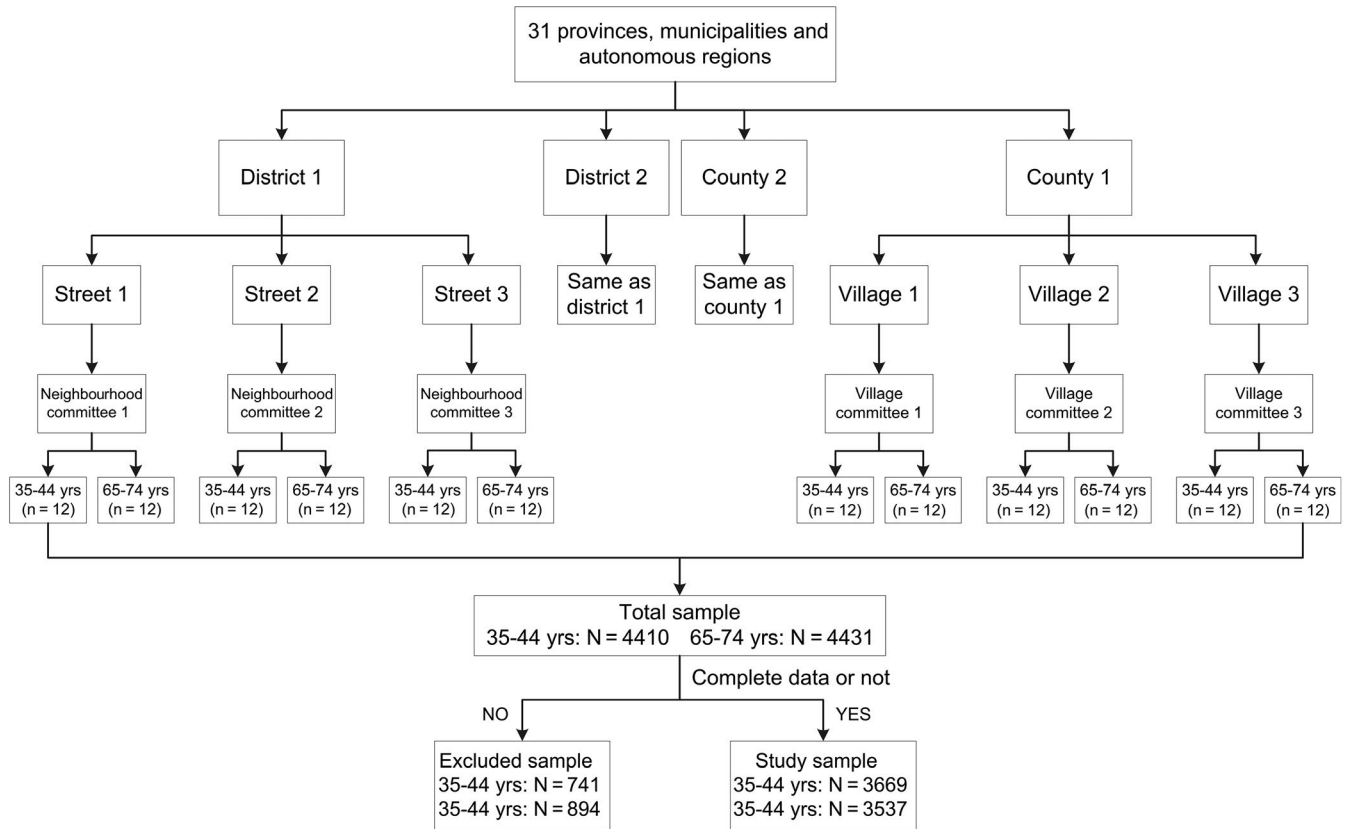
FIGURE 1 Study population flow chart

The outcome variable was oral health service utilization in the 12 months prior to data collection. Explanatory variables were derived from the questionnaire and clinical examination and then classified into three aspects (PEN) based on the Andersen Behavior Model as follows.

Predisposing factors consisted of demographic factors (sex and education) and health beliefs. The education level was obtained via the self-reported final education level and then categorized into three groups: low (junior high school or lower), medium (senior high school) and high (college and higher). Four questions related to oral health attitudes and eight questions related to oral health knowledge were asked to evaluate oral health beliefs (see Appendix Tables S1 and S2).

Enabling factors included resources that affect an individual's ability to access the healthcare system. Annual household income per capita was calculated and then categorized into tertiles for each age group as follows: 1st tertile/low, 2nd tertile/medium and 3rd tertile/high. Information on public medical insurance and private medical insurance was obtained via our questionnaire. Public medical insurance types in China consist of the New Cooperative Medical Scheme (NCMS), Urban Resident Basic Medical Insurance (URBMI), Urban Employee Basic Medical Insurance (UEBMI) and government medical insurance (GMI).

Regarding need factors, both perceived and evaluated need were included. Perceived oral health was determined based on the question 'How do you perceive your oral health status?' (very poor/

poor/moderate/good/very good). Evaluated oral health was assessed through a clinical examination performed in a mobile dental chair under artificial light assisted with a flat dental mirror and the Community Periodontal Index (CPI) probe according to the standardized criteria of the WHO.[22] Two or three trained and licensed dentists in every province (the mean Kappa values of inter-examiner reproducibility were higher than 0.60 for the periodontal examinations and higher than 0.80 for the dental caries examinations) conducted the examination, and three other trained individuals acted as recorders. Only the decayed, missing and filled teeth (DMFT) index and the number of teeth were used to indicate the evaluated need because using periodontal-disease-related indices (such as attachment loss and bleeding on probing) would have restricted the analysis to dentate participants.

Post-stratification weights were used to adjust for differences in the age-by-sex-by-location-by-province distribution between the sample and the general population in the 31 provinces involved in the study, consistent with the 6th National Demographic Census in 2010.[23] Comparisons of the characteristics of participants with complete data (study sample) and those excluded due to missing values for relevant variables (excluded sample) were conducted with chi-square tests. No significant difference was observed in the prevalence of dental visits in the past 12 months between the study sample and the excluded sample for 65-74-year-olds ($P = .258$), but the corresponding difference for 35-44-year-olds was significant ($P = .036$). Other demographic characteristics (ie sex, education

and location of residence) were then compared within the group of 35-44-year-olds, and no significant difference was found.

First, descriptive statistics, including proportions and 95% confidence intervals (CIs), were determined considering the complex sampling design and the sample weights.[24,25] Bivariate associations between each variable of interest and the outcome variable were analysed with a chi-square test. Then, variables that presented with $P < .20$ in the bivariate analysis were considered for the multivariable hierarchical analysis according to the predisposing, enabling and need factors. The independent variables with $P > .20$ were removed across the models in the hierarchical analysis. Poisson regression with robust variance estimation was performed when log-binomial regression failed to converge[26] due to the overestimation of relative risk using logistic regression.[27] The incidence rate ratio (IRR) and 95% CI were reported. All statistical analyses were performed using STATA SE 15.0 (Stata Corp). The P values reported are two-tailed, and statistical significance was set at .05.

3 | RESULTS

The characteristics of the sample population by age groups are summarized in Table 1.

In total, 21.4% (95% CI: 19.4%-23.7%) of adults aged 35-44 years old and 20.7% (95% CI: 18.6%-22.9%) of older adults aged 65-74 years old had visited a dentist in the past 12 months.

Table 2 shows the reasons for the most recent dental visit among those who reported dental visits in the past 12 months. Most adults (78.7%, 95% CI: 74.0%-82.7%) and older adults (93.7%, 95% CI: 91.0%-95.6%) had visited a dentist for treatment. However, only few people utilized preventive oral health services.

Table 3 shows the results of the bivariate associations. For 35-44-year-olds, all predisposing, enabling and need factors (except number of teeth) were associated with dental visits in the past 12 months. Additionally, for 65-74-year-olds, private medical insurance (enabling factor) and evaluated need factors were not significantly associated with oral health service utilization.

Table 4 shows the hierarchical Poisson regression models for 35-44-year-olds. Predisposing factors were associated with oral health service utilization in model 1. Sex, oral knowledge and attitude scores and public medical insurance type were included in model 2. In the final model (model 3), adults aged 35-44 years old who were female (IRR: 1.15, 95% CI: 1.00-1.33, $P = .047$), had good oral health knowledge and attitudes (IRR: 1.30, 95% CI: 1.06-1.59, $P = .011$), perceived their oral health status as fair (IRR:1.51, 95% CI:1.24-1.85, $P < .001$) or poor/very poor (IRR:2.52, 95% CI:2.01-3.18, $P < .001$) and had a DMFT index >0 (IRR: 1.52, 95% CI: 1.11-2.09, $P = .009$) were more likely to report dental visits in the past 12 months.

The hierarchical Poisson regression models for older adults are presented in Table 5. Predisposing variables in model 1 and enabling variables in model 2 were associated with oral health service utilization. In the final model (model 3), 65-74-year-olds who utilized oral health services tended to be female (IRR: 1.32, 95% CI: 1.09-1.59,

$P = .004$); to be covered by URBMI (IRR: 1.56, 95% CI: 1.18-2.05, $P = .002$), UEBMI (IRR: 1.69, 95% CI: 1.32-2.16, $P < .001$) or GMI (IRR: 1.03, 95% CI: 1.01-2.16, $P = .044$); to have a high education level (IRR: 1.37, 95% CI: 1.08-1.74, $P = .010$); to have an income level in the 2nd tertile (IRR: 1.44, 95% CI: 1.13-1.84, $P = .003$) or 3rd tertile (IRR: 1.52, 95% CI: 1.18-1.95, $P = .001$); and to perceive their oral health status as poor or very poor (IRR: 1.53, 95% CI: 1.21-1.95, $P = .001$).

4 | DISCUSSION

Based on Andersen's healthcare utilization model, the present study explored factors associated with oral health service utilization among adults and older adults in mainland China using national data. Sex and self-perceived oral health status were found to be associated with oral health utilization among Chinese population. Additionally, for older adults, education level, household income and insurance coverage were determinants of the use of oral health services.

In a previous study,[7] unweighted analysis from the same data source (all participants) was used to estimate the prevalence of oral health service utilization (19.8% for 35-44-year-olds and 20.5% for 65-74-year-olds). The present study, which included participants who had complete data for all relevant variables after weight estimation, showed low rates of dental visits compared to those in high-income countries[4] and treatment-oriented patterns of oral health service utilization among Chinese adults. A slight increase in dental visits was observed from 2005 to 2015,[28] similar to the trend found in some European countries, indicating that welfare regimens with universal access increased service utilization.[4]

Regarding predisposing factors, the present study found that oral health beliefs could affect oral health service utilization in adults aged 35-44 years old, which was similar to the findings of previous studies.[4,29] This association in older adults was significant only in the bivariate analysis. Those who believed that routine dental visits were necessary tended to utilize oral health services.[29] Meanwhile, good oral care behaviours were considered closely related to oral health beliefs,[30] and such behaviours could also help to identify self-recognized problems and allow individuals to seek early dental treatment. Due to the relative mutability of beliefs,[13] oral health beliefs can be strengthened to increase the use of oral health services. Although the Chinese government has designated every September 20th as 'National Love Teeth Day' to increase public awareness for oral health since 1989, significant efforts to promote oral health should be conducted to enhance public knowledge of disease prevention via routine dental visits.

Enabling resources comprised the main differences in factors associated with oral health service utilization between 35-44-year-olds and 65-74-year-olds. Consistent with a study conducted in 14 European countries among adults aged 50 years and older,[31] this study found that older adults with lower income were less likely to seek dental services. Although some studies also showed the same trend in the younger population,[32] a bivariate association was observed only for 35-44-year-olds. This result could be explained by

TABLE 1 Characteristics of the study population, by age groups (weighted n for 35-44 y old = 3668, weighted n for 65-74 y old = 3553)

	35-44 y old		65-74 y old	
	n	% (95%CI)	n	% (95%CI)
Oral health service utilization in past 12 mo				
Yes	785	21.4 (19.4, 23.7)	735	20.7 (18.6, 22.9)
No	2883	78.6 (76.3, 80.6)	2818	79.3 (77.1, 81.4)
Sex				
Male	1874	51.1 (50.4, 51.7)	1784	50.2 (49.4, 51.1)
Female	1794	48.9 (48.3, 49.6)	1769	49.8 (48.9, 50.6)
Educational attainment level				
Low	1870	51.0 (46.0, 56.0)	3006	84.6 (81.6, 87.2)
Moderate	726	19.8 (17.5, 22.3)	380	10.7 (9.0, 12.6)
High	1072	29.2 (24.9, 33.9)	167	4.7 (3.4, 6.5)
Location				
Rural	1720	46.9 (40.7, 53.2)	1983	55.8 (49.5, 61.9)
Urban	1948	53.1 (46.8, 59.3)	1570	44.2 (38.1, 50.5)
Annual household income per capita				
1st tertile (low)	1295	35.3 (30.6, 40.3)	1478	41.6 (36.1, 47.3)
2nd tertile (medium)	1166	31.8 (29.2, 34.6)	1034	29.1 (26.0, 32.5)
3rd tertile (high)	1207	32.9 (28.5,37.6)	1041	29.3 (24.6, 34.5)
Medical insurance coverage				
NCMS	1786	48.7 (42.4, 55.1)	2032	57.2 (50.8, 63.5)
URBMI	396	10.8 (8.5, 13.5)	416	11.7 (9.2, 14.7)
UEBMI	1339	36.5 (31.2, 42.2)	966	27.2 (22.6, 32.3)
GMI	40	1.1 (0.6, 2.0)	64	1.8 (1.2, 2.7)
No basic medical insurance	107	2.9 (2.2, 3.9)	75	2.1 (1.5, 2.9)
Private medical insurance				
No	3455	94.2 (92.2, 95.7)	3503	98.6 (97.8, 99.0)
Yes	213	5.8 (4.3, 7.8)	50	1.4 (1.0, 2.2)

Abbreviations: GMI, government medical insurance; NCMS, New Cooperative Medical Scheme; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.

TABLE 2 Reasons for the most recent dental visit in the past 12 months by age groups

	35-44 y old (weighted n = 785)		65-74 y old (weighted n = 735)	
Reasons	n	%[a] (95%CI)	n	%[a] (95%CI)
Consultation and check-up	95	12.1 (9.5, 15.5)	39	5.3 (3.7, 7.6)
Prevention	67	8.5 (5.8, 12.2)	5	0.7 (0.2, 2.3)
Treatment	618	78.7 (74.0, 82.7)	689	93.7 (91.0, 95.6)
Unknown	5	0.7 (0.3, 1.7)	2	0.3 (0.1, 1.0)

[a]The rate is calculated among those who had dental visits in the past 12 mo.

the closely association between income and the ability to afford dental treatment costs; moreover, older adults were more prone to have economic barriers to visiting dental clinics than younger adults.

Insurance coverage is another important enabling factor that many studies have shown to be associated with dental visits.[18,33,34] Overall, China has provided universal basic medical coverage since 2009 because of the fourth medical reform.[35,36] Although universal basic medical insurance provides certain benefits, there are still a variety of out-of-pocket costs for dental visits depending on the type of insurance. Health care and drug packages covered by the UEBMI are more generous than those of the NCMS and URBMI.[6,8,36] The present study found that the type of public medical insurance had a

TABLE 3 Bivariate comparisons of oral health service utilization in the past 12 months, by age groups

	35-44 y old		65-74 y old	
	Proportion (95%CI)	P^a	Proportion (95%CI)	P^a
Predisposing factors				
Demographic factors				
Sex				
Male	19.4 (16.8, 22.1)	.005	18.4 (16.0, 21.2)	.016
Female	23.6 (21.1, 26.3)		23.0 (20.1, 26.1)	
Educational attainment				
Low	15.8 (13.7, 18.1)	<.001	18.6 (16.4, 20.1)	<.001
Medium	22.5 (18.3, 27.3)		29.9 (24.7, 35.5)	
High	30.6 (27.6, 33.7)		38.0 (31.6, 44.8)	
Belief				
Knowledge and attitude score				
0-8	15.5 (13.0, 18.3)	<.001	17.2 (14.9, 19.7)	<.001
9-12	25.5 (22.9, 28.3)		27.7 (24.6, 31.0)	
Enabling factors				
Location				
Rural	15.8 (13.7, 18.3)	<.001	14.9 (12.7, 17.4)	<.001
Urban	26.4 (23.5, 29.6)		28.0 (25.2, 31.1)	
Annual household income per capita				
1st tertile (low)	16.0(13.8, 18.6)	<.001	12.7 (10.4, 15.4)	<.001
2nd tertile (medium)	22.0 (18.8, 25.7)		22.2 (19.1, 25.6)	
3rd tertile (high)	26.7 (23.9, 29.7)		30.5 (27.0, 34.3)	
Public medical insurance coverage				
NCMS	15.2 (13.2, 17.5)	<.001	13.8 (11.7, 16.3)	<.001
URBMI	19.7 (14.5, 26.3)		27.4 (22.2, 33.3)	
UEBMI	30.1 (26.9, 33.4)		32.1 (27.9, 36.5)	
GMI	25.9 (9.4, 54.3)		27.5 (18.1, 39.3)	
No medical insurance	22.2 (14.2, 33.0)		16.9 (9.2, 29.0)	
Private medical insurance				
No	20.9 (18.8, 23.2)	.016	20.8 (18.7, 23.0)	.455
Yes	29.8 (22.7, 38.0)		16.1 (7.8, 30.3)	
Need factors				
Perceived need				
Perceived oral health status				
Very good/good	14.0 (11.5, 17.0)	<.001	17.4 (14.1, 21.2)	.023
Moderate	23.3(20.7, 26.1)		19.8 (16.4, 23.7)	
Poor/very poor	36.2 (31.2, 41.5)		24.4 (21.5, 27.5)	
Evaluated need				
Carious status				
DMFT = 0	12.2 (8.8, 16.8)	<.001	11.5 (5.5, 22.7)	.086
DMFT > 0	22.6 (20.5, 24.9)		20.8 (18.8, 23.1)	
Number of teeth				
0-19	25.9 (10.2, 52.1)	.660	21.6 (18.5, 25.0)	.578
20-32	21.4 (19.3, 23.7)		20.4 (17.9, 23.2)	

Abbreviations: DMFT, decayed, missing and filled teeth in permanent dentition; GMI, Government Medical Insurance; NCMS, New Cooperative Medical Scheme; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.
^{a}P values are based on chi-square test.

	Model 1	Model 2	Model 3
	IRR (95%CI)	IRR (95%CI)	IRR (95%CI)
Predisposing factors			
Demographic factors			
Sex			
Male	1.00 (reference)	1.00 (reference)	1.00 (reference)
Female	1.24 (1.08, 1.43)**	1.24 (1.07, 1.42)**	1.15 (1.00, 1.33)*
Educational attainment level			
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)
Moderate	1.33 (1.06, 1.66)*	1.10 (0.87, 1.38)	1.09 (0.86, 1.39)
High	1.73 (1.44, 2.09)***	1.22 (0.96, 1.55)	1.29 (1.00, 1.67)
Belief			
Knowledge and attitude score			
0-8	1.00 (reference)	1.00 (reference)	1.00 (reference)
9-12	1.35 (1.10, 1.66)**	1.31 (1.07, 1.61)*	1.30 (1.06, 1.59)*
Enabling factors			
Location			
Rural		1.00 (reference)	1.00 (reference)
Urban		1.23 (0.96, 1.57)	1.28 (1.00, 1.64)
Annual household income per capita			
1st tertile (low)		1.00 (reference)	/
2nd tertile (medium)		1.09 (0.90, 1.31)	/
3rd tertile (high)		1.09 (0.90, 1.33)	/
Public medical insurance coverage			
NCMS		1.00 (reference)	1.00 (reference)
URBMI		0.97 (0.68, 1.39)	0.95 (0.67, 1.35)
UEBMI		1.33 (1.02, 1.75)*	1.32 (0.99, 1.74)
GMI		1.18 (0.51, 2.73)	1.13 (0.57, 2.27)
No medical insurance		1.22 (0.75, 1.98)	1.16 (0.73, 1.85)
Private medical insurance			
No		1.00 (reference)	1.00 (reference)
Yes		1.22 (0.96, 1.58)	1.25 (0.99, 1.58)
Need factors			
Perceived need			
Perceived oral health status			
Very good/good			1.00 (reference)
Fair			1.51 (1.24, 1.85)***
Poor/very poor			2.52 (2.01, 3.18)***
Evaluated need			
Carious status			
DMFT = 0			1.00 (reference)
DMFT > 0			1.52 (1.11, 2.09)**

TABLE 4 Hierarchical Poisson regression models of oral health service utilization in the past 12 months for 35-44 years old

Abbreviations: CI, confidence interval; DMFT, decayed, missing and filled teeth in permanent dentition; GMI, government medical insurance; IRR, incidence rate ratio; NCMS, New Cooperative Medical Scheme; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.

*P < .05.
**P < .01.
***P < .001.

TABLE 5 Hierarchical Poisson regression models of oral health service utilization in the past 12 months for 65-74 years old

	Model 1 IRR (95%CI)	Model 2 IRR (95%CI)	Model 3 IRR (95%CI)
Predisposing factors			
Demographic factors			
Sex			
Male	1.00 (reference)	1.00 (reference)	1.00 (reference)
Female	1.34 (1.11, 1.61)**	1.32 (1.09, 1.58)**	1.32 (1.09, 1.59)**
Educational attainment level			
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)
Moderate	1.52 (1.18, 1.96)**	1.14 (0.90, 1.45)	1.16 (0.92, 1.48)
High	1.85 (1.48, 2.32)***	1.29 (1.03, 1.63)*	1.37 (1.08, 1.74)*
Belief			
Knowledge and attitude score			
0-8	1.00 (reference)	1.00 (reference)	1.00 (reference)
9-12	1.44 (1.19, 1.75)***	1.21 (1.00, 1.48)	1.20 (0.98, 1.47)
Enabling factors			
Location			
Rural		1.00 (reference)	/
Urban		1.08 (0.88, 1.30)	/
Annual household income per capita			
1st tertile (low)		1.00 (reference)	1.00 (reference)
2nd tertile (medium)		1.43 (1.13, 1.81)**	1.44 (1.13, 1.84)**
3rd tertile (high)		1.48 (1.17, 1.89)**	1.52 (1.18, 1.95)**
Public medical insurance coverage			
NCMS		1.00 (reference)	1.00 (reference)
URBMI		1.47 (1.12, 1.94)**	1.56 (1.18, 2.05)**
UEBMI		1.58 (1.20, 2.07)**	1.69 (1.32, 2.16)***
GMI		1.37 (0.94, 2.01)	1.48 (1.01, 2.16)*
No medical insurance		1.06 (0.60, 1.90)	1.03 (0.57, 1.86)
Need factors			
Perceived need			
Perceived oral health status			
Very good/good			1.00 (reference)
Fair			1.12 (0.86, 1.45)
Poor/very poor			1.53 (1.21, 1.95)**
Evaluated need			
Carious status			
DMFT = 0			1.00 (reference)
DMFT > 0			1.58 (0.77, 3.23)

Abbreviations: CI, confidence interval; DMFT, decayed, missing and filled teeth in permanent dentition; GMI, government medical insurance; IRR, incidence rate ratio; NCMS, New Cooperative Medical Scheme; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.
*P < .05.
**P < .01.
***P < .001.

strong influence on oral health service utilization among older adults. However, a bivariate association was observed only for 35-44-year-olds. Older adults who were unable to afford the cost of dental visits tended to include those with higher out-of-pocket payments.[6] Thus, expanding dental services with a lower private cost for older adults could be a strategy to increase utilization.[4,6] Unlike some studies

indicating the role of private dental insurance,[34] this study found a significant bivariate association with oral health service utilization only among 35-44-year-olds, a finding that might be due to the limited types of private medical insurance available in China.[8]

With respect to the evaluated need for dental care, adults aged 35-44 years whose DMFT index >0 were more likely to visit the dentist. However, this trend was not observed in older adults, probably because dental caries and tooth loss are common among adults aged 65-74 years in China.[18,37,39] In contrast to the latest systematic review,[4] the present study found that Chinese adults and older adults with worse self-perceived oral health conditions were more likely to utilize dental services as the result of a symptom-driven or treatment-oriented pattern. This pattern was quite different from that the trend in high-income countries for regular dental visits, which help prevent disease development and promote oral health education.

Some limitations of this study should be noted when extrapolating the results to actual application. First, the findings were based on cross-sectional data, which increases the difficulty of establishing a causal relationship between oral health service utilization and the explanatory variables. Thus, the findings should be interpreted cautiously. Second, some data (clinical examinations excluded) were derived from self-reports by adults and older adults, which could cause some recall bias. Because we analysed only the complete data, there was also a possibility of selection bias. Third, the study utilized Andersen's model for examining individual components (PEN) and their relationships with oral health service utilization, but other social and economic factors not included in the final fitted models also influence dental visits, such as geo-locality, number of facilities and dentists, and social capital. However, most known determinants were included, and the model may still have explanatory power. The mechanism by which these factors interact with each other to influence the use of dental services needs to be further assessed in future studies.

To achieve the goal of 'Healthy China 2030',[40] Chinese policy-makers have addressed the importance of oral health,[21] which is also one of the basic themes of the National Nutrition Program (2017-2030).[41] Moreover, with the rapid growth of the ageing population in China, improving oral health conditions and oral health care for older adults has become a major challenge.[21] Thus, the study findings have some implications for policy adjustment to increase the utilization of oral health services. First, to improve oral health awareness, emphasizing the importance of regular check-ups through different methods of oral health education would be helpful to create prevention-oriented patterns. Second, expansion of insurance coverage for dental treatments would be beneficial for older adults who are less able to afford oral health services. Such efforts may help increase the utilization of oral health services and improve the overall oral health condition in Chinese population.

5 | CONCLUSION

This study showed that Chinese adults and older adults had low rates of dental visits and that such visits were mainly treatment oriented.

Use of oral health services depended on sex and self-perceived oral health conditions. In addition, household income and insurance coverage were determinants of dental visits among older adults. This study suggests that it is imperative to actively promote the importance of oral health and expand insurance coverage for oral health services.

AUTHORS' CONTRIBUTIONS

Tao Xu and Yan Si conceived the program of research and are the corresponding authors. Mengru Xu, Menglin Cheng, Xiaoli Gao, Huijing Wu, Min Ding and Chunzi Zhang analysed the data. Mengru Xu drafted the paper. Xing Wang, Xiping Feng, Baojun Tai, Deyu Hu, Huancai Lin, Bo Wang, Chunxiao Wang, Shuguo Zheng, Xuenan Liu, Wensheng Rong, Weijian Wang and Yan Si provided important instructions on the protocol of the Chinese National Oral Health Survey. Tao Xu and Yan Si critically revised the draft. All authors have read and approved the final manuscript for submission.

ORCID

Mengru Xu 🆔 https://orcid.org/0000-0002-4308-7113

Shuguo Zheng 🆔 https://orcid.org/0000-0001-6717-5196

Yan Si 🆔 https://orcid.org/0000-0002-6657-6550

REFERENCES

1. Marcenes W, Kassebaum NJ, Bernabé E, et al. Global burden of oral conditions in 1990–2010: A systematic analysis. *J Dent Res.* 2013;92:592-597.
2. Thomson WM, Williams SM, Broadbent JM, Poulton R, Locker D. Long-term dental visiting patterns and adult oral health. *J Dent Res.* 2010;89:307-311.
3. Crocombe LA, Brennan DS, Slade GD. The influence of dental attendance on change in oral health-related quality of life. *Community Dent Oral Epidemiol.* 2012;40:53-61.
4. Reda SM, Krois J, Reda SF, Thomson WM, Schwendicke F. The impact of demographic, health-related and social factors on dental services utilization: Systematic review and meta-analysis. *J Dent.* 2018;75:1-6.
5. Reda SF, Reda SM, Thomson WM, Schwendicke F. Inequality in utilization of dental services: a systematic review and meta-analysis. *Am J Public Health.* 2018;108:e1-e7.
6. Li C, Yao NA, Yin A. Disparities in dental healthcare utilization in China. *Community Dent Oral Epidemiol.* 2018;46(6):576-585.
7. Cheng ML, Xu MR, Xie YY, et al. Utilisation of oral health services and economic burden of oral diseases in China. *Chin J Dent Res.* 2018;21:275-284.
8. Liu J, Zhang SS, Zheng SG, Xu T, Si Y. Oral health status and oral health care model in China. *Chin J Dent Res.* 2016;19:207-215.

9. Liu L, Zhang Y, Wu W, Cheng R. Characteristics of dental care-seeking behavior and related sociodemographic factors in a middle-aged and elderly population in northeast China. *BMC Oral Health*. 2015;15:66.

10. Wu B. Dental service utilization among urban and rural older adults in China –A brief communication. *J Public Health Dent*. 2007;67:185-188.

11. Yuan C, Zhu L, Li Y, Liu M, Si Y, Zhang F. Oral health services utilization and influencing factors in downtown community residents older than 15 years in Beijing. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2011;46:182-185.

12. Herkrath FJ, Vettore MV, Werneck GL. Contextual and individual factors associated with dental services utilisation by Brazilian adults: a multilevel analysis. *PLoS ONE*. 2018;13:e0192771.

13. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav*. 1995;36:1-10.

14. Xu MR, Yuan C, Sun XY, Cheng ML, Xie YY, Si Y. Oral health service utilization patterns among preschool children in Beijing, China. *BMC Oral Health*. 2018;18:31.

15. Suominen AL, Helminen S, Lahti S, et al. Use of oral health care services in Finnish adults - results from the cross-sectional health 2000 and 2011 surveys. *BMC Oral Health*. 2017;17:78.

16. Marshman Z, Porritt J, Dyer T, Wyborn C, Godson J, Baker S. What influences the use of dental services by adults in the UK? *Community Dent Oral Epidemiol*. 2012;40:306-314.

17. Lo E, Lin HC, Wang ZJ, Wong M, Schawrz E. Utilization of dental services in southern China. *J Dent Res*. 2001;80:1471-1474.

18. Wang X. *Report of the Fourth National Oral Health Survey*. Beijing: People's Medical Publishing House; 2018.

19. Lu HX, Tao DY, Lo E, et al. The 4th National Oral Health Survey in the mainland of China: background and methodology. *Chin J Dent Res*. 2018;21:161-165.

20. National Bureau of Statistics of the People's Republic of China. Bulletin of main data of the sixth national population census in 2010 (No.1). http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/html/fu03.htm. Accessed January 18, 2019.

21. Zhou XD, Xu X, Li JY, et al. Oral health in China: from vision to action. *Int J Oral Sci*. 2018;10:1.

22. WHO. *Oral Health Surveys Basic Methods* (5th ed.). Geneva: World Health Organization; 2013.

23. Tabulation of the 2010 Population Census of the People's Republic of China. http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm. Accessed January 20, 2019.

24. Caplan DJ, Slade GD, Gansky SA. Complex sampling: implications for data analysis. *J Public Health Dent*. 2010;59(1):52-59.

25. He S, Thomson WM. An oral epidemiological comparison of Chinese and New Zealand adults in 2 key age groups. *Community Dent Oral Epidemiol*. 2018;46:154-160.

26. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J of Epidemiol*. 2004;159(7):702-706.

27. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA*. 1998;280:1690-1691.

28. Qi XQ. *Report of the third national oral health survey*. Beijing: People's Medical Publishing House; 2008.

29. Listl S, Moeller J, Manski R. A multi-country comparison of reasons for dental non-attendance. *Eur J Oral Sci*. 2014;122:62-69.

30. Macek MD, Atchison KA, Chen H, et al. Oral health conceptual knowledge and its relationships with oral health outcomes: findings from a Multi-site Health Literacy Study. *Community Dent Oral Epidemiol*. 2017;45:323-329.

31. Listl S. Income-related inequalities in dental service utilization by Europeans aged 50+. *J Dent Res*. 2011;90:717-723.

32. Murakami K, Aida J, Ohkubo T, Hashimoto H. Income-related inequalities in preventive and curative dental care use among working-age Japanese adults in urban areas: a cross-sectional study. *BMC Oral Health*. 2014;14:117.

33. Locker D, Maggirias J, Quinonez C. Income, dental insurance coverage, and financial barriers to dental care among Canadian adults. *J Public Health Dent*. 2011;71:327-334.

34. Srivastava P, Chen G, Harris A. Oral health, dental insurance and dental service use in Australia. *Health Econ*. 2017;26:35-53.

35. Meng Q, Fang H, Liu X, Yuan B, Xu J. Consolidating the social health insurance schemes in China: towards an equitable and efficient health system. *Lancet*. 2015;386(10002):1484-1492.

36. Yu H. Universal health insurance coverage for 1.3 billion people: what accounts for China's success? *Health Policy*. 2015;119(9):1145-1152.

37. Gao YB, Hu T, Zhou XD, et al. Dental caries in Chinese elderly people: findings from the 4th National Oral Health Survey. *Chin J Dent Res*. 2018;21:213-220.

38. Guo J, Ban JH, Li G, et al. Status of tooth loss and denture restoration in Chinese adult population: findings from the 4th National Oral Health Survey. *Chin J Dent Res*. 2018;21:249-257.

39. Wang CX, Ma LL, Yang Y, et al. Oral health knowledge, attitudes, behaviour and oral health status of Chinese diabetic patients aged 55 to 74 years. *Chin J Dent Res*. 2018;21:267-273.

40. The State Council of China. Outline of the Healthy China 2030 Plan (2016). http://www.gov.cn/zhengce/2016-10/25/content_5124174.htm. Accessed October 20, 2018.

41. The State Council of China. National nutrition program (2017-2030). http://www.gov.cn/zhengce/content/2017-07/13/content_5210134.htm. Accessed October 20, 2018.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.