Utilisation of Oral Health Services and Economic Burden of Oral Diseases in China

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Objective: *To evaluate the use of oral health services, the economic burden of oral diseases and related influential factors in China.*

Method: *Using the multistage, stratified, equal proportion, random sampling method in the 4th National Oral Health Survey of China conducted in 2015 to 2016, residents aged 3 to 5 years, 12 to 15 years, 35 to 44 years, 55 to 64 years, and 65 to 74 years respectively were recruited, clinically examined and answered a questionnaire. Utilisation of oral health services were assessed in all the age groups and the economic burden of oral diseases in the past 12 months were assessed in the 3 to 5 years and 35 to 74 year-old groups. Chi-squared tests, t tests, correlation analysis and a one-way ANOVA were used to determine the relationships of different factors with utilisation of oral health services and the economic burden of oral diseases.*

Results: *In the subject groups – 3 to 5 years, 12 to 15 years and 35 to 74 years – the prevalence of the utilisation of oral health services in the past 12 months was 14.6% (5,876/40,353), 23.6% (27,936/118,592), and 20.1% (2,708/13,461), respectively. In all three groups, receiving dental treatment was the most common reason for subjects' recent dental visit. The average dental cost in the past 12 months was 403.43 CNY (median = 100) for 3 to 5-year-old children and 850.83 CNY (median = 300) for adults aged 35 to 74 years old. Area, education and annual household income per person were the socio-economic influential factors. Oral health status, oral hygiene and attitudes to and knowledge of oral health affected the utilisation of oral health services and the economic burden of oral diseases.*

Conclusion: *The percentage of dental service utilisation was relatively low, and the economic burden was high. The related factors for both utilisation of oral health services and the economic burden of oral diseases included living in area, educational attainment, household income, perceived oral health status, and oral hygiene.*

Key words: *economic burden of oral disease, influence factors, utilisation of oral health services*

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Oral health is an important part of general health, but it is easy to neglect due to the characteristics of chronic progressive development. Research has shown that utilisation of oral health services, in terms of frequency and regularity, was associated with better oral health status[1]. Meanwhile, as the fourth most expensive disease to treat, the economic burden of oral health diseases was heavy in both developed and developing countries[2].

Oral health service use in China remains at a relatively low level compared with developed countries. In Sweden[3], almost 90% of the population claimed to visit a dentist regularly, and 24.1% of men and 34.1% of women had used preventive care in Japan[4]. Based on the 3rd National Oral Health Survey, 68.6% of adults aged 35 to 44 years old and 54.3% of elderly adults aged 65 to 74 years old perceived a need for dental treatment, while less than one-fifth of them (adults: 16.1%, elderly adults: 19.1%) had visited the dentist in the past year[5]. The utilisation of oral health service among 5-year-old children (15%) and 12-year-old adolescents (21%) was also very low.

Currently, huge economic pressure caused by oral diseases has become an increased public health issue across the globe. However, most studies have concentrated on developed countries. Petersen et al suggested that oral disease is the fourth most expensive disease to treat in most industrialised countries[6]. Galloway et al found that the global economic burden of dental diseases amounted to $442B in 2010, of which $298B was attributable to direct treatment costs[7]. According to Righolt et al[8], the estimated direct cost of dental diseases amounted to $356.80B in 2015. The projected spending for treatment of dental disease was $122B in America in 2014.

There is considerable evidence from previous studies that utilisation of oral health services could be affected by educational level, socio-economic status and beliefs about oral health, as well as self-perception of oral health status[9-14]. In addition, lacking the ability to pay out-of-pocket medical expenses can impede an individual's efforts to obtain dental care[15]. In previous studies, the factors affecting the economic burden of oral diseases mainly included socio-economic factors and oral health conditions[16,17].

Overall, studies focussing on oral health service utilisation and the burden of oral diseases in China were rare. The 4th National Oral Health Survey, which provided more comprehensive information on oral health service utilisation and economic burden of oral diseases, was carried out from 2015 to 2016, a decade after the previous national oral health survey. The objective of this study was to investigate the current utilisation of dental care and economic burden of oral diseases and to determine the related factors in China based on the 4th National Oral Health Survey.

Materials and methods

Sampling design

In the 4th National Oral Health Survey of China conducted in 2015 to 2016, a multistage, stratified, equal proportion, random sampling method was used, and participants were selected in three stages using the probability-proportional-to-size (PPS) method with varied population sizes.

Ethical approval for the study was obtained from the Ethics Committee of Chinese Stomatological Association (Approval no. 2014-003) and informed consent was obtained from each subject or guardian.

Subjects

The target population was residents aged 3 to 5 years, 12 to 15 years, 35 to 44 years, 55 to 64 years, and 65 to 74 years old from all 31 provinces, autonomous regions and municipalities of the mainland of China.

The sample size was $n = deff \dfrac{\mu_\alpha \, p \, (1-p)}{\delta^2}$

deff was the design effect, p was the prevalence of dental diseases in each group in the 4th National Oral Health Survey; μ was the level of confidence, and d was the relative error.

Data collection and measures

Questionnaires
Participants or children's parents (or grandparents) received a questionnaire and a clinical examination according to the basic methods. Among all the participants, subjects in other age groups filled in the questionnaires themselves, except for children aged 3 to 5 years, whose parents (or grandparents) filled out the questionnaires on their behalf.

Several questions were designed to understand the dental service utilisation condition and economic burden. However, adolescents aged 12 to 15 years were not included in the analysis of economic burden.

Clinical examination
WHO standardised criteria were used for clinical registration. The examinations were performed in a mobile

Table 1 The percentage of oral health service utilisation in the past 12 months in different age groups.

Age (years)		N	Percentage (%)	P *	
3 to 5 (N = 40,353)	3	1,285	10.4	< 0.001[a]	< 0.001[b]
	4	1,900	13.6		
	5	2,691	19.2		
	Total	5,876	14.6		
12 to 15 (N = 118,592)	12	7,350	26.4	< 0.001[a]	
	13	7,611	24.6		
	14	6,876	22.4		
	15	6,099	20.9		
	Total	27,936	23.6		
35 to 74 (N = 13,461)	35-44	875	19.8	0.751[a]	
	55-64	926	20.0		
	65-74	907	20.5		
	total	2,708	20.1		

* chi-squared test; [a] P value between sub-groups; [b] P value among the three age groups

Table 2 Reasons for not visiting a dentist in the past 12 months in different age groups.

	3 to 5 years old (N = 34,480)		35 to 74 years old (N = 10,751)	
Reasons	N	Percentage (%)	N	Percentage (%)
No dental diseases	24,772	71.8	5,993	55.7
Dental disease was not severe	4,305	12.5	3,028	28.2
No need to cure primary teeth	3,432	10.0	/	/
Economic issue	373	1.1	930	8.7
Inconvenience	692	1.7	/	/
No time	1,772	4.4	878	8.2
No dentists nearby	589	1.7	347	3.2
No reliable dentists	851	2.5	225	2.1
No reimbursement	/	/	392	3.6
Fear of pain	1,497	4.3	335	3.1
Fear of infectious diseases	446	1.3	61	0.6
Difficulty of registration	233	0.7	82	0.8
Other reasons	2,297	6.7	1,012	9.4
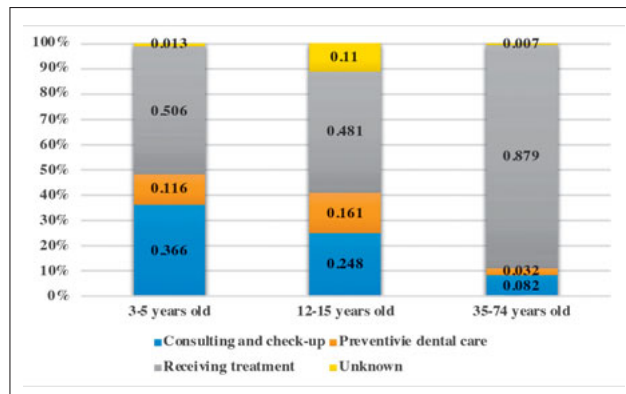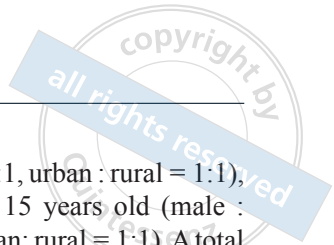
Fig 1 The percentage of the reasons for the last dental visit in the past 12 months.

dental chair under artificial light. Extra equipment included a flat dental mirror and Community Periodontal Index (CPI) probe. Each examination was conducted by three trained and licensed dentists while three other trained individuals acted as recorders.

Quality control

Before the survey, all examiners were trained in theoretical and clinical knowledge by a standard examiner. In addition, each of them passed the Kappa consistency check, and the mean Kappa values used to determine inter-examiner reproducibility were > 0.60 for the periodontal exam and > 0.80 for the dental caries exam. Duplicate examinations were randomly conducted in 5% of the participants to compare the findings between the examiners. The mean Kappa values between original and reviewed records were > 0.75 for the periodontal exam and > 0.90 for the dental caries exam.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics v. 20.0 (IBM, Armonk, NY, USA). Chi-squared tests and *t* tests were used to analyse the utilisation of the oral health service and the dependent variable was "whether they visited a dentist in the past 12 months". Correlation analysis, *t* tests and a one-way ANOVA were used to analyse the economic burden of oral diseases and the dependent variable was "dental costs in the last 12 months". All *P* values reported are two-tailed. Statistical significance was set at 0.05.

Results

A total of 172,425 Chinese citizens participated in the present study, among which were 40,360 children aged

3 to 5 years old (male : female = 1:1, urban : rural = 1:1), 118,601 adolescents aged 12 to 15 years old (male : years old (male: female = 1:1, urban: rural = 1:1). A total of 40,353 children aged 3 to 5 years old, 118,59 adolescents aged 12 to 15 years old and 11,461 adults aged 35 to 74 years old answered questions related to dental visiting behaviour. Since no information on economic burden was reported in the 12 to 15 age group, 6,149 samples with economic burden of oral diseases were selected for further analysis, among which 3,719 were aged 3 to 5 years old and 2,430 were from the 35 to 74-year-old age range.

Oral health service utilisation patterns in the past 12 months

In total, 5,876, 27,936 and 2,708 Chinese subjects aged 3 to 5 years (14.6%), 12 to 15 years (23.6%) and 35 to 74 years (20.1%), respectively, used oral health services in the past 12 months (Table 1). There were significant differences between the prevalence of oral health service utilisation among these three age groups.

Figure 1 demonstrates reasons for the most recent dental visit among those who had dental visits in the past 12 months. Receiving dental treatment was the most common reason for the most recent dental visit in all three groups. Most adults aged 35 to 74 years old (87.9%) went to the dentist for dental treatment, while half of all children aged 3 to 5 years (50.6%) and adolescents aged 12 to 15 years (48.1%) reported receiving dental treatment. A total of 11.6% of 3 to 5-year-old children and 16.1% of 12 to 15-year-old adolescents utilised preventive dental care, while only 3.2% adults aged 35 to 74 years old received preventive care.

Reasons for not visiting a dentist in the past 12 months

Table 2 shows the reasons for the absence of dental visits in the past 12 months in children and adults. The most common reason reported was "no dental diseases" in these two groups. In addition, 12.5% of 3 to 5-year-old children and 28.2% of 35 to 74-year-old adults did not consult a dentist, believing that their dental disease was not severe.

Factors related to oral health service utilisation

Table 3 presents several significant factors relating to oral health utilisation in the past 12 months. Subjects of all three age groups living in urban areas, with better daily oral health care habits, poor perceived oral health status and higher levels of DMFT (dmft) were more

Table 3 Factors related to oral health service utilisation among different age groups.

	3 to 5 years old		12 to 15 years old		35 to 74 years old	
	N (%)	P	N (%)	P	N (%)	P
Area		< 0.001[a]		< 0.001[a]		< 0.001[a]
Urban	3,560 (17.4)		15,461 (25.6)		1,632 (23.9)	
Rural	2,316 (11.7)		12,475 (21.4)		1,076 (16.2)	
Education *		< 0.001[a]		< 0.001[a]		< 0.001[a]
Junior high school or lower	1,765 (9.7)		4,924 (19.0)		1,639 (16.3)	
Senior high school	2,507 (16.3)		17,219 (22.5)		854 (25.9)	
Bachelor's degree or higher	1,601 (23.8)		5,793 (36.3)		214 (31.1)	
Perceived oral health status#		< 0.001[a]		< 0.001[a]		< 0.001[a]
Very good/good	1,897 (8.4)		9,694 (24.0)		573 (14.4)	
Fair	2,326 (17.1)		13,464 (21.8)		1,180 (20.3)	
Poor/very poor	1,652 (38.7)		4,773 (29.0)		945 (26.2)	
Perceived general health status#		< 0.001[a]		< 0.001[a]		< 0.001[a]
Very good/good	4,352 (15.1)		17,527 (27.9)		1,271 (16.2)	
Fair	1,393 (13.3)		9,337 (21.1)		1,118 (20.3)	
Poor/very poor	130 (13.1)		1,069 (24.1)		319 (17.7)	
Frequency of teeth brushing		< 0.001[a]				< 0.001[a]
Twice and more than twice per day	2,032 (25.0)		12,869 (33.3)	< 0.001[a]	1,262 (26.0)	
Once a day	2,391 (14.9)		12,580 (19.7)		122 (17.9)	
Less than once a day	1,453 (9.0)		2,481 (15.4)		226 (12.5)	
Use of dental floss		/		< 0.001[a]		< 0.001[a]
Yes	/		23,365 (21.8)		256 (19.6)	
No	/		4,566 (39.7)		147 (36.0)	
Score of oral health knowledge #	/	< 0.001[b]	/	< 0.001[b]	/	< 0.001[b]
Score of oral health attitude#	/	< 0.001[b]	/	< 0.001[b]	/	< 0.001[b]
DMFT (dmft)	/	< 0.001[b]		< 0.001[b]	/	< 0.001[b]
Number of teeth with gingival bleeding	/	/	/	< 0.001[b]	/	< 0.001[b]

[a] P values calculated by chi-square test;

[b] P values calculated by t test;

* education for the 3 to 5-year-old group was defined by the education level of their parents or caregivers, education for 12 to 15-year-old group is defined by the highest education level of their parents;

perceived oral/general health and score of oral health knowledge and attitude for 3 to 5-year-old group was collected from their parents or caregivers

Table 4 The social-demography and socioeconomic status of children and adult groups.

	Number (%)	Dental cost in the past 12 months (CNY)		Statistics	P	Number (%)	Dental cost in the past 12 months (CNY)		Statistics	P
		Mean	Median				Mean	Median		
Gender				T = -0.35	0.729				T = -0.20	0.844
Male	1,871 (50.3)	397.87	100.00			1,123 (46.2)	843.92	300.00		
Female	1,848 (49.7)	409.06	100.00			1,307 (53.8)	856.77	300.00		
Area				T = 4.64	< 0.001				T = 4.57	< 0.001
Urban	2,219 (59.7)	465.86	150.00			1,454 (59.8)	965.04	400.00		
Rural	1,500 (40.3)	311.08	100.00			976 (40.2)	680.69	200.00		
Education				F = 26.95	< 0.001				F = 3.27	0.038
Junior high school or lower	1,113 (30.0)	249.18	100.00			1,508 (62.1)	807.70	300.00		
Senior high school	1,582 (42.6)	411.27	100.00			749 (30.8)	868.73	300.00		
Bachelor's degree or higher	1,021 (27.5)	560.18	200.00			172 (7.1)	1132.76	300.00		
Annual household income per person				F = 30.87	< 0.001				F = 9.43	< 0.001
Low	875 (32.6)	199.84	70.00			704 (33.5)	632.95	300.00		
Middle	868 (32.3)	284.14	100.00			602 (28.6)	902.28	300.00		
High	941 (35.1)	549.52	185.00			798 (37.9)	982.52	400.00		

likely to use oral health services. Females in the 12 to 15-year-old group and 35 to 74-year-old group were more likely to use oral health services than males, while there was no significant difference between the sexes in the 3 to 5-year-old group ($P = 0.359$). There was a significant association between dental pain experiences and oral health service utilisation in the 3 to 5-year-old and 12 to 15-year-old groups. The annual household income per person was significantly associated with oral health service utilisation.

The economic burden of oral diseases

All economic burdens evaluated in this study were the direct economic burdens of oral diseases. The average dental cost in the past 12 months was 403.43 CNY (median = 100) for 3 to 5-year-old children, and 850.83 CNY (median = 300) for adults aged 35 to 74 years old. The average age was 4.82 (SD = 0.83) for the 3,719 3 to 5-year-old children included in the survey and 56.84

(SD = 12.28) years old for the included 2,430 adults aged 35 to 74.

Influence factors of economic burden for children and adults

Both groups had consistent socio-economic influential factors that included area, education and annual household income per person that were statistically significant (Table 4). The economic burden rose according to levels of education or parents' highest education and household income. People living in urban areas spent more on dental services than those from rural areas.

Tables 5 and 6 show the relationship between different factors and economic burden in the two age groups, respectively. Dental expenses rose with DMFT (dmft) in both groups of children and adults, while it declined with the number of teeth with gingival bleeding and periodontal pockets and the number of remaining teeth in adults. Adults with un-restorative missing teeth paid

Table 5 Influential factors of the economic burden for 3 to 5-year-old children.

Group	Number (%)	Dental cost in the last 12 months (CNY)		Statistics	P
		Mean	**Median**		
dmft	3,719 (100.0)	/	/	r = 0.08	< 0.001
Have had toothache or discomfort in the past 12 months				F = 4.64	0.003
Never	1,327 (35.7)	323.46	70.00		
Sometimes	1,973 (53.1)	444.49	200.00		
Usually	362 (9.7)	455.77	200.00		
Unclear	57 (1.5)	511.51	100.00		
Perceived child's oral condition				F = 15.72	< 0.001
Very good/good	1,129(30.4)	293.10	100.00		
Fair	1,491 (40.1)	396.83	130.00		
Poor/very poor	1,098 29.5)	526.02	200.00		
Tooth brushing habit				T = -6.47	< 0.001
Good	1,247 (33.5)	312.19	100.00		
Not good	2,472(66.5)	584.31	200.00		
Score of oral health knowledge	3,719 (100.0)	/	/	r = 0.09	< 0.001
Score of oral health attitude	3,719 (100.0)	/	/	r = 0.06	< 0.001
Out-of-pocket payment (%)		/		T = -5.016	< 0.001
100	2,640 (77.4)	447.05	200.00		
< 100	773 (22.6)	260.15	0.00		
The reason for the last visit to a dentist				F = 69.47	< 0.001
Examination	1,159 (31.2)	104.02	10.00		
Prevention	391 (10.5)	241.50	100.00		
Treatment	2,145 (57.7)	593.11	300.00		
Unclear	24 (0.6)	547.58	45.00		

[a] Pearson's correlation analysis was used for these factors;

[b] One-way ANOVA was used for these factors;

[c] Independent sample t test was used for these factors.

[#] Eight questions were designed for the knowledge of children's parents and six questions were designed for the attitude.

less for dental services. Children whose perceived oral health by their parents was general or bad, spent more on dental services. By contrast, the perceived oral health of adults did not affect dental costs. Adults who brushed their teeth more than twice a day were likely to pay more for a dental service, while children who had good toothbrushing habits spent less on dental services. Scores for oral health knowledge and oral health attitudes were positively related to the economic burden of oral diseases for children. While for adults, only scores of oral health knowledge were positively associated with dental expenses. Statistically, children who paid for dental expenses 100% out-of-pocket cost more than those who had insurance. The dental costs were significantly more when the major reason for the last dental visit was therapy rather than prevention or examination.

Discussion

The rates of oral health service utilisation among 5-year-old children (19.2%), 12-year-old adolescents (26.4%), 35 to 44-year-old adults (19.8%) and 65 to 74-year-old adults (20.1%) in our study were higher than those in the 3rd National Oral Health Survey, respectively (5-year-olds group: 15.0%, 12-year-olds group: 21.0%, 35 to 44-year-olds group: 16.1% and 65 to 74-year-old group:19.1%)[5]. However, the prevalence of oral health service utilisation remained at a relatively low level compared with some developed countries (37% to 90%)[3,4,12]. The group of 12 to 15-year-old adolescents had the highest prevalence of oral health service utilisation in the current study.

The main reason for the three age groups to make their last visit to a dentist was for treatment, while the main reason for not visiting a dentist was "no dental diseases". The results showed a primary treatment-oriented pattern of utilisation of dental services, which was directly reflected in the economic burden of oral diseases.

The economic burden was pretty high all around the world, especially in middle- to low-income countries. Compared with high-income countries, the economic burden of oral diseases in China was still heavy. In 2015, Righolt et al[8] used a systematic method to evaluate the global economic burden of oral disease. The highest expenditures were found for the United States ($119.07B), followed by China ($60.11B). Listl et al[7] reported that direct treatment costs due to dental diseases worldwide were estimated at US$298 billion annually, corresponding to an average of 4.6% of global health expenditure.

In line with previous studies, factors that both affected the utilisation of oral health services and the economic burden of oral diseases mainly included socio-economic factors[5,18], social-demographic factors[11,19] and oral health status[9,20]. The direct economic burden of oral diseases came from the utilisation of oral health services, while different purposes for utilisation of oral health services produced huge differences in economic burden. Therefore, it was unsurprising that the household income and out-of-pocket payment for oral diseases were significant[12]. Moreover, residence location was a significant factor in line with Liu[12], since there is more access to oral health in urban areas. Educational attainment was also found to be related to oral health service utilisation and economic burden, maybe because a highly educated population tends to have a better financial level and oral health KAP (knowledge, attitude and practice)[11].

Oral health status included the perceived and evaluated oral health. The dmfta had a different effect on economic burden with the number of teeth with gingival bleeding and teeth with periodontal pockets and remaining teeth. It may reflect that the oral disease economic burden and the need to search for medical help was given priority to caries[16]. However, in adults perceived oral health did not affect dental costs, while it did so in children. One of the reasons was the medical behaviour of children mostly relied on their parents[21]. The other reason was that people's recognition of oral health was usually inconsistent with the actual situation[10]. People with poor perceived oral health had less demand to search for dental services. And the demand to search for dental services may not produce expenditure because the dental costs directly depend on the treatment.

Adults who had better oral hygiene and more positive attitudes and more knowledge could find oral health problems in time and see a dentist and utilise more preventive oral health services. Good oral health hygiene helped to reduce economic burden of oral disease in children. The probable explanation was that good hygiene habits reduced the risk of caries[22]. By contrast, adults' common oral diseases were more complicated than children's, and adults with good toothbrushing habits were likely to spend more on oral health services, which may be due to their more positive attitude to visiting a dentist. It also explains the self-paying ratio had significant impact on children's dental expenses but not on that of adults.

This study helps to describe the current status of oral health service utilisation and dental economic burden in China and furthermore provides evidence for decision-makers to make related policies to improve the utilisa-

Table 6 Influential factors for the economic burden of oral disease in 35- to 74-year-old adults.

Group	Number (%)	Dental cost in the last 12 months/CNY		Statistics	P
		Mean	Median		
DMFT	2,430(100.0)	/	/	r = 0.12	< 0.001
Number of teeth with gingival bleeding	2,430(100.0)	/	/	r = -0.85	< 0.001
Number of teeth with periodontal pocket	2,430(100.0)	/	/	r = -0.57	0.005
Number of retained teeth	2,430(100.0)	/	/	r = -0.14	< 0.001
Unrepaired missing teeth				T = 2.86	0.004
Yes	887(36.5)	738.67	300.00		
No	1,542(63.5)	915.74	335.00		
Frequency of tooth brushing				F = 6.40	0.002
< 1/day	211(8.7)	646.14	300.00		
1/day	1,115(45.9)	769.01	300.00		
≥ 2/day	1,104(45.4)	972.59	400.00		
Score of oral health knowledge	2,430(100.0)	/	/	r = 0.04	0.035
Score of oral health attitude	2,430(100.0)	/	/	r = 0.04	0.075
Out-of-pocket payment (%)				T = -1.434	0.153
< 100	437(18.6)	745.71	200.00		
100	1,915(81.4)	867.67	300.00		
Reason for the last visit of dentist				F = 22.23	< 0.001
Examination/prevention	239(9.9)	216.66	80.00		
Treatment	2,175(89.5)	924.51	400.00		
Unclear	15(0.6)	326.67	200.00		

[a] Pearson's correlation analysis was used for these factors;

[b] One-way ANOVA was used for these factors;

[c] Independent sample t test was used for these factors.

[#] Eight questions were designed to test the knowledge of children's parents and six questions were designed to evaluate their attitude

tion of oral health services and reduce the economic burden of oral diseases. As the planned next stage of our study, multi-factor analysis and regression model establishment will be used to further explore the related factors of the utilisation of oral health services and the burden of oral diseases.

Conclusion

In general, the rate of dental service utilisation was still relatively low, and the economic burden was pretty high. For both utilisation of oral health services and the economic burden of oral disease, affecting factors include area of residence, educational attainment, household income, oral health status and oral health KAP.

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Conflicts of interest

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

Author contribution

Drs Meng Lin CHENG and Meng Ru XU, analysed the data; Drs Meng Lin CHENG, Meng Ru XU, Yan Yi XIE, Xiao Li GAO, and Hui Jing WU drafted the manuscript; Drs Xing WANG, Xi Ping FENG, Bao Jun TAI, De Yu HU, Huan Cai LIN, Bo WANG, Yan SI, Chun Xiao WANG, Shu Guo ZHENG, Xue Nan LIU, Wen Sheng RONG, and Wei Jian WANG trained the investigators, designed and supervised the survey; Drs Yan SI and Chun Xiao WANG designed and directed the study. All authors have read and approved the final manuscript for submission.

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