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Knowledge, attitudes, and practice related to tooth loss and dentures among patients with dental arch deficiencies

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Abstract

Background Tooth loss is a common problem that affects many people worldwide. Exploring knowledge, attitude, and practice (KAP) among patients can identify barriers and challenges in following recommended practices, providing valuable insights for dental healthcare providers, policymakers, and researchers. This study aimed to explore the KAP of patients with dental arch deficiencies regarding tooth loss and dentures.

Methods This web-based, cross-sectional study was conducted among patients with dental arch deficiencies using a self-designed questionnaire.

Result 3166 valid questionnaires were included. Participants' mean KAP scores were 6.84 ± 2.27 (possible range: 0 ~ 12), 39.4 ± 3.72 (possible range: 9 ~ 45), and 27.7 ± 4.36 (possible range: 8 ~ 40), respectively. Multivariable logistic regression analysis showed that knowledge (OR = 1.383), employed (OR = 1.805), family history (OR = 2.158), and treatment (OR = 1.683) were independently associated with attitude. Moreover, knowledge (OR = 1.239), attitude (OR = 1.250), female (OR = 0.619), age (OR = 0.967), college/bachelor (OR = 0.373), and master and above degree (OR = 0.418), employed (OR = 0.554) or student (OR = 0.434), with 10,001–20,000 Yuan household income per month (OR = 0.492), have been married (OR = 0.609), smoking (OR = 0.595), drinking (OR = 0.397), disease duration (OR = 0.972), with family history (OR = 1.676), and with treatment (OR = 3.492) were independently associated with practice (all $P < 0.05$).

Conclusion Patients with dental arch deficiencies have insufficient knowledge, positive attitudes, and moderate practice toward tooth loss and dentures, which might be affected by multiple demographic factors.

Keywords Tooth loss, Dentures, Knowledge, Attitude, Practice, Dental arch deficiencies

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Background

Tooth loss is a common problem that affects many people worldwide [1], and 2.4% of the population suffers from severe tooth loss [2], while the 2030 predicted prevalence of tooth loss in younger adults and younger seniors would be 50% and 65%, respectively [3]. Tooth loss can be caused by dental decay, gum disease, accidents, congenital conditions, or aging [4]. Tooth loss can cause discomfort, impair oral functions (eating and speaking), and affect oral health (occlusion issues, tooth displacement, and open wounds), self-confidence, and overall well-being [5]. The options available for tooth loss include dentures and dental implants. Dental implants are expensive and involve a highly invasive procedure with complications like jaw fracture, but they are long-lasting and effective [6]. Dentures provide a reliable solution for individuals seeking to replace missing teeth [7]. Dentures, either partial or complete, are custom-made based on an initial assessment of oral health, and these are crafted to fit comfortably and resemble natural teeth [8]. Regular maintenance and follow-up are important for denture longevity and to avoid carries and sensitivity to the adjacent teeth. While dentures are cost-effective, dental implants may be suggested as a more permanent option. Tooth loss and dentures are crucial aspects of dental care. Good knowledge about tooth loss and dentures indicates awareness of causes, consequences, treatment options, and the benefits and limitations of dentures [9].

Knowledge, attitude, and practice (KAP) studies can help identify the gaps, misconceptions, and misunderstandings regarding a particular health issue. This study could help identify areas for further education and information. Indeed, the attitude of patients towards tooth loss and dentures significantly affects their decision-making and well-being [10]. It uncovers the emotional and psychological aspects of their experiences, including self-esteem, body image, and social interactions [11]. A positive attitude promotes the willingness to seek treatment and adhere to oral care routines, potentially improving their quality of life [12]. Understanding the practices and behaviors of patients with dental arch deficiencies is crucial for evaluating the efficacy of dentures [13]. Exploring KAP among patients can identify barriers and challenges in following recommended practices, providing valuable insights for dental healthcare providers, policymakers, and researchers. Older adults know that they can replace lost teeth with dentures, but they are unaware of the importance of oral care [14]. Although dental practitioners have a good knowledge of prosthodontics [15], as could be expected, the patients' KAP regarding tooth loss and dentures is mostly unknown.

This study investigated the KAP of patients regarding tooth loss and dentures in dental arch deficiencies. The hypothesis was that individuals have moderate KAP toward dentures, that specific socioeconomic factors influence the KAP, and that better knowledge translates into more positive attitudes and more proactive practice.

Methods

Study design and participants

This cross-sectional investigation was conducted at Jinan Stomatological Hospital between January and May 2023. The study enrolled patients with dental arch deficiencies, included patients aged 16 to 80 seeking dental care, and excluded infants, toddlers, and pregnant women. This study was approved by the Ethics Committee of Jinan Stomatological Hospital (JNSKQYY-2023-003). Informed consent was obtained from all participants.

Questionnaire

The questionnaire was designed by the investigators and was in Chinese. The initial questionnaire design was reviewed by three experts, and its reliability was evaluated, which showed a Cronbach's α coefficient of 0.861, indicating excellent internal consistency. The final questionnaire was in Chinese and consisted of four dimensions for data collection, totaling 41 items. These dimensions were basic information, knowledge, attitude, and practice, having 15, 12, 10, and 8 items, respectively. Within the knowledge dimension, each item had correct and incorrect answers, receiving 1 point and 0 points, respectively. The cutoff value for the knowledge dimension was set at 70%, with <8 points indicating insufficient knowledge. The attitude and practice dimensions primarily used a five-point Likert scale, ranging from 'very positive' (5 points) to 'very negative' (1 point). For items 1–9 in the attitude dimension, the options 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree' correspond to 5, 4, 3, 2, and 1 points, respectively. However, for items 7 and 10, the scoring was reversed. The cutoff value for the attitude dimension was set at 9–22 for negative attitude, 23–32 for moderate attitude, and 33–45 for positive attitude. In the practice dimension, items 1 to 7 were scored with options 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree' corresponding to 5, 4, 3, 2, and 1 point, respectively. However, for item 8, the scoring was reversed. The cutoff value for practice dimension was set at 8–20 for inactive practice, 21–29 for moderate practice, and 30–40 for proactive practice.

Convenient sampling was used to recruit patients for outpatient care, and the research assistant questioned and assessed whether the patients met the requirements. Six trained research assistants participated in the distribution and collection of questionnaires. Paper questionnaires and online questionnaires (using the Questionnaire Star app) were completed in the outpatient clinic by the study assistant. Before filling in the questionnaire, the respondents were asked about their

wishes, and after the wishes were filled in, they were instructed to fill in the questionnaire requirements. They were required to fill in the questionnaire truthfully. If they did not understand, the research assistant would help them carefully explain. After completing 50 questionnaires, the research assistant checked the completion of the questionnaire and obvious logic problems and sought professional statisticians to conduct questionnaire quality control, including response time, logic, obvious errors, etc. After passing the assessment, large-scale delivery and questionnaire collection began similarly. Incomplete questionnaires, questionnaires with obvious logic errors (e.g., impossible age), or those filled using all the same options (e.g., all first options) were excluded. Only one questionnaire could be submitted using a given IP address for the online questionnaires.

Sample size

The sample size was determined based on the formula for cross-sectional surveys:

$$n = \left(\frac{Z_1 - \alpha/2}{\delta}\right)^2 \times p \times (1-p)$$

In the formula, n represents the sample size for each group, α represents the type I error (which is typically set at 0.05), $Z_{1-\alpha/2}$=1.96, δ represents the allowable error (typically set at 0.05), and p is set at 0.5 (as setting it at 0.5 maximizes the value and ensures a sufficiently large sample size). Hence, the calculated sample size was 384. Considering an estimated questionnaire response rate of 80%, 480 valid questionnaires were needed. In order to improve representativeness and generalizability, we have significantly increased the sample size where we can. Finally, this study enrolled 3166 participants.

Statistical analysis

Stata 17.0 (Stata Corporation, College Station, TX, USA) software was used for statistical analysis. Data for different demographic characteristics and responses to individual questions were counted as n (%). Continuous variables were described using mean ± SD, t-test, or analysis of variance were used to compare different groups. Pearson's correlation analysis was used to examine correlations among the three dimensions. Multivariable logistic regression analysis was conducted to explore the associations between KAP and demographic information. A two-tailed P-value of <0.05 was considered statistically significant.

Results

The questionnaire was distributed among 3166 patients with dental arch deficiencies, and all responded. The mean knowledge, attitude, and practice scores were 6.84 ± 2.27 (possible range: 0 ~ 12), 39.4 ± 3.72 (possible range: 9 ~ 45), and 27.7 ± 4.36 (possible range: 8 ~ 40), respectively. The results showed that males had higher scores than females. Participants from rural areas had the highest scores, followed by those from urban and suburban areas, and highly educated patients had better scores than less educated patients. Similarly, employed individuals had the highest scores, and those with higher household incomes had higher scores. Unmarried, divorced, or widowed participants had higher scores than married individuals. Participants who smoked or drank had higher scores, as did those with social medical insurance and those with a family history of dental arch deficiencies, underlying medical conditions, or who received treatment (all $P<0.05$) (Table 1).

The analysis of the knowledge dimension showed that the highest percentage of correct answers (85.72%) was recorded for question K1, which asked about understanding dental arch deficiency and its impact on the total number of teeth. On the other hand, question K7, which asked about the suitability of fixed dental prostheses for cases with a higher number of missing teeth and healthy adjacent teeth and periodontal tissues, received the lowest percentage of correct answers (2.97%). The highest rate of incorrect answers (97.03%) was also for question K7, while question K1 had the lowest percentage of wrong answers (14.28%) (Table S1).

The distribution of attitude dimension revealed a wide spectrum of responses to the 'strongly agree' option among participants. Question A3, concerning the effect of missing teeth on teeth alignment and its consequences, received the highest agreement rate at 54.17%. In contrast, question A4, which states that missing teeth can lead to other oral conditions such as periodontal disease and dental caries, had the lowest agreement rate at 22.3% (Table S2).

Regarding practice attitudes, participants responded to the 'always' option in various ways. The highest percentage (27.8%) was recorded for question P7, which indicated a willingness to follow medical advice and cooperate with all pretreatment checks and treatments before dentures. The lowest percentage (6.31%) was for question P8, indicating an unwillingness to use dentures to treat missing teeth (Table S3).

Pearson's correlation analysis showed a positive correlation between knowledge and attitude ($r=0.646$, $P<0.001$), between knowledge and practice ($r=0.661$, $P<0.001$), and between attitude and practice ($r=0.705$, $P<0.001$) (Table 2). Furthermore, multivariable logistic regression analysis showed that female (OR = 0.561, 95% CI: 0.445–0.707, $P<0.001$), age (OR = 0.956, 95% CI: 0.947–0.966, $P<0.001$), college/bachelor (OR = 0.572, 95% CI: 0.354–0.924, $P=0.022$) and master or above degree (OR = 0.378, 95% CI: 0.212–0.674, $P=0.001$), employed

Table 1 Demographic information of patients with dental arch deficiencies

Variables	*N* (%)	Knowledge		Attitude		Practice	
		Mean ± SD	*P*-value	Mean ± SD	*P*-value	Mean ± SD	*P*-value
Total	3166 (100)	6.84±2.27		39.4±3.72		27.7±4.36	
Gender			**<0.001**		**<0.001**		**<0.001**
Male	1129(35.66)	8.21±1.48		41.65±2.73		30.81±3.8	
Female	2037(64.34)	6.08±2.27		38.15±3.61		25.97±3.64	
Age	52.26±14.22						
Residence			**<0.001**		**<0.001**		**<0.001**
Rural	111(3.51)	8.33±1.56		42.02±3.36		31.51±3.7	
Urban	2485(78.49)	7.14±2.18		39.89±3.57		28.25±4.32	
Suburban	570(18)	5.27±2.02		36.73±3.12		24.52±2.74	
Education			**<0.001**		**<0.001**		**<0.001**
≤ Middle School	240(7.58)	8.32±1.29		42.57±1.91		31.89±3.62	
High School	358(11.31)	8.35±1.25		42.31±2.12		31.53±3.5	
Bachelor	2186(69.05)	6.72±2.29		39.01±3.59		27.1±3.99	
Master and above	382(12.07)	5.22±2		36.88±3.64		24.88±3.46	
Occupation			**<0.001**		**<0.001**		**<0.001**
Employed	1734(54.77)	7.81±1.8		40.98±3.1		29.72±4.09	
Unemployed	895(28.27)	5.68±2.22		37.45±3.48		25.29±3.24	
Self-employed	273(8.62)	5.69±2.25		37.46±3.68		25.37±3.57	
Student	264(8.34)	5.6±2.17		37.62±3.46		24.98±3.21	
Household income, Yuan per month			**<0.001**		**<0.001**		**<0.001**
<5,000	236(7.45)	8.32±1.29		42.46±2.22		31.69±3.91	
5,001-10,000	1071(33.83)	8.07±1.61		41.3±2.88		30.19±3.86	
1,0001-20,000	623(19.68)	6.75±2.3		39.17±3.57		27.13±3.92	
>20,000	74(2.34)	6.2±2.24		38.57±3.27		26.51±3.75	
Prefer not to say	1162(36.7)	5.5±2.12		37.2±3.39		24.96±3.04	
Marital status			**<0.001**		**<0.001**		**<0.001**
Unmarried/Divorced/Widowed	616(19.46)	8.15±1.73		41.73±3.06		30.79±4.24	
Married	2256(71.26)	6.73±2.24		39.15±3.62		27.3±4.09	
Prefer not to say	294(9.29)	4.96±1.84		36.4±2.92		24.22±2.42	
Smoking			**<0.001**		**<0.001**		**<0.001**
Yes	465(14.69)	6.57±2.29		38.89±3.65		26.98±4.09	
No	2701(85.31)	8.4±1.34		42.34±2.6		31.85±3.48	
Drinking			**<0.001**		**<0.001**		**<0.001**
Yes	575(18.16)	6.48±2.27		38.75±3.62		26.79±4.02	
No	2591(81.84)	8.48±1.3		42.34±2.61		31.76±3.46	
Medical insurance			**<0.001**		**<0.001**		**<0.001**
Social medical insurance	1841(58.15)	7.79±1.8		40.93±3.13		29.52±4.1	
Commercial medical insurance	235(7.42)	6.07±2.26		37.87±3.42		25.7±3.47	
Both social and commercial medical insurance	919(29.03)	5.51±2.17		37.34±3.44		25.24±3.32	
No medical insurance	171(5.4)	4.87±2.03		36.12±3.13		24±2.97	
Disease duration	19.82±12.42						
Family history			**<0.001**		**<0.001**		**<0.001**
Yes	1616(51.04)	7.93±1.76		41.15±3		29.96±4.02	
No	889(28.08)	6.13±2.27		38.18±3.62		25.99±3.62	
Not sure	661(20.88)	5.15±1.93		36.74±3.19		24.46±2.67	
With treatment			**<0.001**		**<0.001**		**<0.001**
Yes	2661(84.05)	6.94±2.22		39.52±3.6		27.96±4.28	
No	505(15.95)	6.3±2.42		38.76±4.27		26.31±4.55	
Underlying diseases			**<0.001**		**<0.001**		**<0.001**
Yes	2036(64.31)	6.56±2.3		38.95±3.67		27.19±4.16	
No	1130(35.69)	7.36±2.12		40.2±3.69		28.6±4.57	

Table 2 Pearson's correlation analysis

	Knowledge	Attitude	Practice
Knowledge	-		
Attitude	0.646 (P<0.001)	-	
Practice	0.661 (P<0.001)	0.705 (P<0.001)	-

(OR=1.655, 95% CI: 1.287–2.127, $P<0.001$), have been married (OR=0.618, 95% CI: 0.455–0.84, $P=0.002$), drinking (OR=0.65, 95% CI: 0.478–0.811, $P=0.004$), with social medical insurance (OR=2.821, 95% CI: 1.59–5.005, $P<0.001$), disease duration (OR=0.989, 95% CI: 0.98–0.999, $P=0.035$), with family history (OR=1.821, 95% CI: 1.443–2.298, $P<0.001$), with treatment (OR=2.332, 95% CI: 1.68–3.237, $P<0.001$), with underlying diseases (OR=0.745, 95% CI: 0.597–0.929, $P=0.009$) were independently associated with knowledge (Table 3). Knowledge (OR=1.383, 95% CI: 1.235–1.55, $P<0.001$), employed (OR=1.805, 95% CI: 1.026–3.176, $P=0.040$), family history (OR=2.158, 95% CI: 1.121–4.152, 95% CI: 0.021), and with treatment (OR=1.683, 95% CI: 1.088–2.603, $P=0.019$) were independently associated with attitude (Table 4). Moreover, knowledge (OR=1.239, 95% CI: 1.141–1.345, $P<0.001$), attitude (OR=1.25, 95% CI: 1.187–1.318, $P<0.001$), female (OR=0.619, 95% CI: 0.484–0.792, $P<0.001$), age (OR=0.967, 95% CI: 0.956–0.978, $P<0.001$), college/bachelor (OR=0.373, 95% CI: 0.237–0.587, $P<0.001$) and master and above degree (OR=0.418, 95% CI: 0.211–0.828, $P=0.012$), employed (OR=0.554, 95% CI: 0.401–0.766, $P<0.001$) or student (OR=0.434, 95% CI: 0.211–0.828, $P=0.033$), with 10,001–20,000 Yuan household income per month (OR=0.492, 95% CI: 0.307–0.79, $P=0.003$), have been married (OR=0.609, 95% CI: 0.45–0.824, $P<0.001$), smoking (OR=0.595, 95% CI: 0.471–0.812, $P=0.006$), drinking (OR=0.397, 95% CI: 0.251–0.585, $P=0.029$), disease duration (OR=0.972, 95% CI: 0.96–0.984, $P<0.001$), with family history (OR=1.676, 95% CI: 1.257–2.234, $P<0.001$), and with treatment (OR=3.492, 95% CI: 2.307–5.285, $P<0.001$) were independently associated with practice (Table 5).

Discussion

This study found that patients with dental arch deficiencies have insufficient knowledge, positive attitude, and moderate practice toward tooth loss and dentures, which might be affected by demographic factors, including gender, age, education, employment, household income, marital status, smoking, drinking, disease duration, medical insurance, family history, treatment, and underlying diseases. These findings have implications for tailoring patient education and interventions, improving access to dental care, and addressing the specific needs of individuals with dental arch deficiencies.

The analysis of demographic characteristics of patients with dental arch deficiencies revealed several important insights. Males had higher KAP scores than females, supported by previous studies that reported differences in healthcare-seeking behavior and oral health knowledge between males and females [16, 17]. Participants from rural areas had higher KAP scores than those from urban and suburban areas, which might be because people in rural areas have limited access to dental care facilities and are more cautious about oral health [18]. Highly educated and employed individuals showed better KAP scores, as supported by previous studies that reported a positive correlation between education, stable jobs, and oral health awareness and practices [19, 20]. Self-employed individuals often have higher KAP due to greater financial resources for dental care [21]. Participants with higher household incomes had higher KAP scores. In contrast, those who did not disclose their income scored lower, showing the influence of economic status on oral health, as previously reported [22]. Unmarried, divorced, or widowed participants had higher KAP scores. The literature suggests that marital status can influence healthcare behaviors [23]. Previous studies suggested that participants who smoked and drank had higher KAP scores, possibly indicating their awareness of the negative effects of these habits on oral health [24, 25]. Participants with social medical insurance had higher KAP scores than those with commercial or no insurance, emphasizing the impact of healthcare access through insurance on oral health outcomes [26]. Participants with a family history of dental arch deficiencies and those who had received treatment had higher KAP scores; those factors are known to increase the perceived importance of proactive dental care practices [27, 28]. These findings emphasize the need to tailor oral health education and interventions to specific demographic groups for better oral health outcomes. Taken together, these results suggest that the socioeconomic status appears to be a major contributor to the KAP toward missing teeth and dentures. Indeed, the socioeconomic status is associated with health literacy in general [29].

The results of the KAP dimensions showed that most patients understood their dental condition well, aligning with previous literature that suggests individuals often have a basic understanding of their dental health [30]. Still, the study identified a knowledge gap regarding the suitability of fixed dental prostheses, indicating a need for improved patient education on treatment options for missing teeth [31]. The study also revealed that patients may have misconceptions about treatment choices for dental arch deficiency, highlighting a critical area for intervention and education [32]. While most patients were aware of tooth loss's aesthetic and functional concerns [33], some underestimated the broader oral health

Table 3 Multivariable logistic regression analysis for knowledge dimension about tooth loss and dentures

Knowledge	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Gender				
Male	REF		REF	
Female	0.112(0.094-0.133)	<0.001	0.561(0.445-0.707)	<0.001
Age	0.904(0.897-0.911)	<0.001	0.956(0.947-0.966)	<0.001
Residence				
Rural	REF		REF	
Urban	0.124(0.066-0.233)	<0.001	0.793(0.374-1.679)	0.544
Suburban	0.019(0.01-0.037)	<0.001	0.453(0.204-1.006)	0.052
Education				
≤ Middle School	REF		REF	
High School	0.95(0.596-1.513)	0.828	1.009(0.58-1.754)	0.975
College/Bachelor	0.123(0.085-0.179)	<0.001	0.572(0.354-0.924)	0.022
Master and above	0.029(0.018-0.046)	<0.001	0.378(0.212-0.674)	0.001
Occupation				
Unemployed	REF		REF	
Employed	7.143(5.933-8.599)	<0.001	1.655(1.287-2.127)	<0.001
Self-employed	1.066(0.776-1.465)	0.692	1.143(0.763-1.713)	0.516
Student	0.781(0.553-1.103)	0.161	0.861(0.561-1.322)	0.495
Household income, Yuan per month				
<5,000	REF		REF	
5,001-10,000	0.478(0.324-0.704)	<0.001	1.203(0.757-1.913)	0.434
10,001-20,000	0.13(0.087-0.193)	<0.001	0.882(0.542-1.437)	0.615
>20,000	0.067(0.036-0.124)	<0.001	0.671(0.313-1.437)	0.304
Prefer not to say	0.039(0.026-0.057)	<0.001	0.58(0.357-0.945)	0.029
Marital Status				
Unmarried/Divorced/Widowed	REF		REF	
Married	0.193(0.156-0.24)	<0.001	0.618(0.455-0.84)	0.002
Prefer not to say	0.023(0.015-0.037)	<0.001	0.283(0.165-0.484)	<0.001
Smoking				
No	REF		REF	
Yes	0.215(0.159-0.460)	<0.001	0.25(0.868-1.8)	0.230
Drinking				
No	REF		REF	
Yes	0.381(0.162-0.519)	<0.001	0.65(0.478-0.811)	0.004
Medical insurance				
No medical insurance	REF		REF	
Social medical insurance	14.958(9.377-23.861)	<0.001	2.821(1.59-5.005)	<0.001
Commercial medical insurance	2.849(1.664-4.875)	<0.001	1.613(0.835-3.117)	0.155
Both social and commercial medical insurance	1.610(0.990-2.617)	0.055	1.238(0.686-2.233)	0.479
Disease duration	0.946(0.94-0.952)	<0.001	0.989(0.98-0.999)	0.035
Family history				
No	REF		REF	
Yes	5.722(4.784-6.845)	<0.001	1.821(1.443-2.298)	<0.001
Not sure	0.326(0.249-0.428)	<0.001	0.523(0.378-0.722)	<0.001
With treatment				
No	REF		REF	
Yes	1.732(1.423-2.109)	<0.001	2.332(1.68-3.237)	<0.001
Underlying diseases				
No	REF		REF	
Yes	0.506(0.437-0.586)	<0.001	0.745(0.597-0.929)	0.009

Table 4 Multivariable logistic regression analysis for attitude dimension about tooth loss and dentures

Attitude	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Knowledge	1.664(1.522-1.819)	<0.001	1.383(1.234-1.549)	<0.001
Gender				
Male	REF		REF	
Female	0.208(0.116-0.372)	<0.001	0.866(0.389-1.928)	0.725
Age	0.948(0.933-0.964)	<0.001	0.999(0.977-1.021)	0.921
Residence				
Rural	REF		REF	
Urban	0.958(0.297-3.093)	0.943	3.707(0.912-15.063)	0.067
Suburban	0.302(0.092-0.988)	0.048	2.624(0.621-11.087)	0.190
Occupation				
Unemployed	REF		REF	
Employed	5.729(3.532-9.293)	<0.001	1.805(1.026-3.176)	0.040
Self-employed	0.974(0.578-1.641)	0.922	1.041(0.602-1.801)	0.886
Student	1.375(0.758-2.494)	0.294	1.451(0.783-2.686)	0.237
Household income, Yuan per month				
<5,000	REF		REF	
5,001-10,000	0.824(0.181-3.741)	0.802	0.825(0.163-4.161)	0.815
10,001-20,000	0.245(0.057-1.053)	0.059	0.613(0.119-3.173)	0.560
>20,000	0.202(0.033-1.235)	0.083	0.703(0.096-5.134)	0.728
Prefer not to say	0.11(0.027-0.449)	0.002	0.492(0.098-2.478)	0.390
Marital Status				
Unmarried/Divorced/Widowed	REF		REF	
Married	0.28(0.129-0.607)	0.001	0.626(0.271-1.443)	0.271
Prefer not to say	0.124(0.053-0.289)	<0.001	0.602(0.239-1.522)	0.284
Smoking				
Yes	2.883(1.335-6.225)	0.007	0.638(0.199-2.049)	0.450
No	REF		REF	
Drinking				
Yes	3.232(1.569-6.659)	0.001	0.485(0.159-1.477)	0.203
No	REF		REF	
Medical insurance				
Social medical insurance	6.985(3.608-13.523)	<0.001	1.554(0.743-3.249)	0.241
Commercial medical insurance	1.316(0.632-2.741)	0.463	0.761(0.351-1.648)	0.488
Both social and commercial medical insurance	1.263(0.703-2.272)	0.463	0.909(0.491-1.682)	0.762
No medical insurance	REF		REF	
Disease duration	0.98(0.965-0.995)	0.009	1.008(0.991-1.024)	0.360
Family history				
No	REF		REF	
Yes	5.207(2.921-9.284)	<0.001	2.158(1.121-4.152)	0.021
Not sure	0.512(0.343-0.765)	0.001	0.729(0.478-1.111)	0.141
With treatment				
Yes	2.326(1.556-3.477)	<0.001	1.683(1.088-2.603)	0.019
No	REF		REF	
Underlying medical conditions				
Yes	0.666(0.443-1.000)	0.050		
No	REF			

implications of tooth loss, emphasizing the importance of educating patients about the potential consequences [34]. Patients placed importance on suitability and comfort when making decisions about dentures, aligning with previous research that emphasizes the role of patient satisfaction in treatment success [35, 36]. Most patients were willing to follow medical advice and cooperate with pre-treatment checks and treatments, highlighting the importance of patient compliance and cooperation in achieving successful outcomes [37]. However, some

Table 5 Multivariable logistic regression analysis for practice dimension about tooth loss and dentures

Practice Dimension	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Knowledge	2.259(2.122-2.406)	<0.001	1.239(1.141-1.345)	<0.001
Attitude	1.788(1.714-1.865)	<0.001	1.25(1.187-1.318)	<0.001
Gender				
Male	REF		REF	
Female	0.106(0.089-0.125)	<0.001	0.619(0.484-0.792)	<0.001
Age	0.906(0.899-0.913)	<0.001	0.967(0.956-0.978)	<0.001
Residence				
Rural	REF		REF	
Urban	0.158(0.098-0.254)	<0.001	0.891(0.477-1.663)	0.716
Suburban	0.01(0.006-0.019)	<0.001	0.463(0.21-1.02)	0.056
Education				
≤ Middle School	REF		REF	
High School	0.725(0.487-1.08)	0.114	0.746(0.447-1.245)	0.262
College/Bachelor	0.091(0.065-0.126)	<0.001	0.373(0.237-0.587)	<0.001
Master and above	0.019(0.011-0.031)	<0.001	0.418(0.211-0.828)	0.012
Occupation				
Unemployed	REF		REF	
Employed	9.541(7.586-11.999)	<0.001	1.805(1.305-2.496)	<0.001
Self-employed	0.846(0.537-1.334)	0.472	0.759(0.415-1.389)	0.371
Student	0.484(0.276-0.849)	0.011	0.434(0.211-0.828)	0.033
Household income, Yuan per month				
<5,000	REF		REF	
5,001-10,000	0.43(0.309-0.598)	<0.001	0.928(0.604-1.428)	0.735
10,001-20,000	0.098(0.069-0.14)	<0.001	0.492(0.307-0.79)	0.003
>20,000	0.068(0.035-0.13)	<0.001	0.818(0.345-1.94)	0.648
Prefer not to say	0.023(0.016-0.034)	<0.001	0.426(0.259-0.701)	0.001
Marital Status				
Unmarried/Divorced/Widowed	REF		REF	
Married	0.175(0.144-0.212)	<0.001	0.609(0.45-0.824)	0.001
Prefer not to say	0.011(0.005-0.023)	<0.001	0.404(0.166-0.982)	0.046
Smoking				
Yes	11.413(8.944-14.563)	<0.001	1.595(1.147-2.218)	0.006
No	REF		REF	
Drinking				
Yes	11.606(9.322-14.451)	<0.001	1.397(1.035-1.885)	0.029
No	REF		REF	
Medical insurance				
Social medical insurance	24.872(11.609-53.286)	<0.001	1.503(0.574-3.941)	0.407
Commercial medical insurance	3.429(1.468-8.005)	0.004	0.904(0.306-2.667)	0.854
Both social and commercial medical insurance	2.733(1.246-5.994)	0.012	1.578(0.585-4.252)	0.367
No medical insurance	REF		REF	
Disease duration	0.938(0.932-0.944)	<0.001	0.972(0.96-0.984)	<0.001
Family history				
No	REF		REF	
Yes	7.139(5.807-8.777)	<0.001	1.676(1.257-2.234)	<0.001
Not sure	0.223(0.145-0.343)	<0.001	0.610(0.358-1.038)	0.068
With treatment				
Yes	2.207(1.755-2.774)	<0.001	3.492(2.307-5.285)	<0.001
No	REF		REF	
Underlying diseases				
Yes	0.567(0.487-0.660)	<0.001	0.850(0.655-1.102)	0.220
No	REF		REF	

patients were reluctant to choose dentures to treat missing teeth, indicating that patient preferences for treatment options vary [38]. In addition, some patients were inconsistent in oral health and denture practices, emphasizing the need for continuous patient education and support to improve oral health behaviors [39]. Hence, these findings underscore the importance of tailored patient education and interventions to bridge knowledge gaps, improve attitudes toward tooth loss consequences, and encourage consistent oral health practices among patients with dental arch deficiencies.

A study from India also showed their participants had a moderate KAP toward the replacement of missing teeth; although 83% felt the need to replace missing teeth, 57% highlighted financial limitations, and most preferred fixed partial prostheses [40]. Another study from India reported that 45% of the participants were willing to replace missing teeth, and most (72%) had a fixed partial denture [41]. Akeel [42] also reported that 82% of their participants were willing to replace missing teeth. In developing countries, the socioeconomic status and the lack of government support for dental care are major impediments to getting dentures for missing teeth [43]. In the present study, most participants indicated an unwillingness to use dentures to treat missing teeth, but the exact reasons were not explored.

Pearson's correlation analysis revealed significant associations between KAP scores and dental arch deficiencies. Individuals with a better understanding of dental arch deficiency tended to have more positive attitudes and engaged in appropriate oral healthcare practices. It suggests that knowledge shapes attitude and drives positive oral health behaviors [44]. Similarly, the moderate positive correlation between knowledge and practice indicates that individuals with higher knowledge scores are more likely to translate their awareness into action through appropriate oral healthcare practices [45]. Moreover, individuals with positive attitudes were more inclined to adopt recommended oral healthcare practices, suggesting that a favorable attitude can be a key driver for adopting beneficial dental practices [46]. These findings highlight the importance of considering the various dimensions of KAP in the context of dental arch deficiencies.

The multivariable regression analysis provided valuable insights into the factors associated with KAP related to dental arch deficiency. The study found that various demographic and lifestyle factors were significantly associated with KAP scores. Gender was found to have a significant association with knowledge, with previous studies indicating that gender can impact oral health knowledge [47, 48]. Older individuals were found to have lower knowledge about dental arch deficiencies, which may be due to generational differences in access to oral health information [49]. Suburban residents and self-employed individuals were found to have slightly lower odds of knowledge, possibly due to differences in healthcare access and information availability [50–52]. The study also found a significant positive association between knowledge and attitude, highlighting the importance of knowledge in shaping the attitude of individuals toward dental arch deficiency [53]. Unemployed individuals were found to have lower odds of a positive attitude, reflecting the psychological and financial stress associated with unemployment [54]. Marital status was found to influence attitude, with being married associated with lower odds of a positive attitude. It may be related to differences in social support and responsibilities [55, 56]. Non-smokers and non-drinkers were found to have lower odds of a positive attitude, indicating that these behaviors influence individuals' perspectives on oral health [57, 58]. The study highlighted the association of knowledge and attitude with oral healthcare practices [59]. Females and older individuals were found to have lower odds of positive practices, suggesting the need for targeted interventions to address gender and age-related disparities [60]. Education was found to be positively associated with practice, emphasizing the role of education in promoting healthier dental practices [24, 61–64]. Hence, this study highlights various factors influencing the KAP of individuals related to dental arch deficiency. Targeted interventions should consider these factors to enhance oral health promotion and education efforts. Targeted educational programs should address specific knowledge gaps, attitudes, or practices related to dental arch deficiencies, and collaborations between dental healthcare providers and policymakers are recommended to improve patient care and access to dental services.

This study has several limitations. First, it was conducted at a single center, and data was collected at a single point in time, limiting the applicability of the findings to other settings or populations. Establishing causality or determining the temporal relationships between variables is also impossible. Second, the study used convenient sampling and relied on self-reported responses, which may introduce selection and recall bias. The survey was designed by the investigators and can be influenced by local practices and policies, limiting the possible comparisons among studies. Third, data were only collected for a short period, preventing the tracking of changes over time. Fourth, potential confounding factors that may influence the results were not considered. Finally, all KAP studies are at risk of the social desirability bias, which entails that some participants can be tempted to answer what they know they should think or do instead of what they are really thinking or doing [65, 66].

Conclusion

In conclusion, patients with dental arch deficiencies have limited knowledge, positive attitudes, and moderate practice toward tooth loss and dentures. These factors may be influenced by various demographic factors such as gender, age, education, employment, household income, marital status, smoking, drinking, disease duration, medical insurance, family history, treatment, and underlying diseases.

Abbreviations

KAP knowledge, attitude, and practice

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Not applicable.

Author contributions

Jing Sun, Junru Meng, and Jianliang Shan carried out the studies, participated in collecting data, and drafted the manuscript. Huijun Lu and Wei Wei performed the statistical analysis and participated in its design. Shengnan Zhang and Li Zhang participated in the acquisition, analysis, or interpretation of data and drafted the manuscript. All authors read and approved the final manuscript.

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Data availability

All data generated or analyzed during this study are included in this article and supplementary information files.

Declarations

Ethics approval and consent to participate

This work has been carried out in accordance with the Declaration of Helsinki (2000) of the World Medical Association. This study was approved by the Ethics Committee of Jinan Stomatological Hospital (JNSKQYY-2023-003). Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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