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Knowledge, attitude, and practice of dental patients toward dental defects and dental fillings in Jinan, Shandong Province, China: a mediation analysis

Hongyan Ye^{1†}, Junru Meng^{2†}, Jing Sun³, Ru Li⁴, Wei Wei⁵, Shengnan Zhang¹, Hui Li⁶, Wenyue Zhang^{7*} and Yugang Sun^{7*}

Abstract

Background Dental filling is a prevalent method for treating dental defects. This study aimed to investigate the knowledge, attitude, and practice (KAP) toward dental defects and dental fillings among dental patients in Jinan, Shandong Province, China.

Methods This cross-sectional study was conducted at the main campus and several branch campuses of Jinan Stomatological Hospital, and community locations within Jinan city between October 2023, and January 2024. Spearman correlation analysis and mediation analysis were used to assess the associations and interrelationships between KAP scores.

Results In this study, 2529 dental patients participated, with 69.1% being females. Of these, 1711 had no dental defects, 551 had defects and fillings, and 267 had defects without fillings. Their median knowledge, attitude, and practice (Questions 1–6) scores were 8.00 [5.00, 12.00] (possible range: 0–18), 27.00 [26.00, 29.00] (possible range: 10–50), and 19.00 [15.00, 24.00] (possible range: 9–45), respectively. Mediation analysis revealed that in patients without dental defects, knowledge had a direct effect on attitude ($\beta = -0.983$, 95% CI: -0.999, -0.966, $P < 0.001$). Additionally, attitude had a direct effect on practice ($\beta = -0.797$, 95% CI: -1.490, -0.103, $P = 0.024$), while knowledge had an indirect effect on practice through attitude ($\beta = 0.783$, 95% CI: 0.096, 1.470, $P = 0.026$). In patients with dental defects who had undergone dental fillings, significant direct effects were observed between knowledge and attitude ($\beta = -0.736$, 95% CI: -0.821, -0.650, $P < 0.001$), knowledge and practice ($\beta = 0.396$, 95% CI: 0.214, 0.577, $P < 0.001$), and attitude and practice ($\beta = -0.499$, 95% CI: -0.683, -0.315, $P < 0.001$). Moreover, knowledge had an indirect effect on practice ($\beta = 0.367$, 95% CI: 0.221, 0.513, $P < 0.001$). In patients with dental defects but without any fillings, direct effects were found between knowledge and attitude ($\beta = -0.929$, 95% CI: -1.028, -0.829, $P < 0.001$).

[†]Hongyan Ye and Junru Meng contributed equally to this work.

*Correspondence:
Wenyue Zhang
2009haoxin.qing@163.com
Yugang Sun
yugangsun@163.com

Full list of author information is available at the end of the article



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Conclusions Dental patients had inadequate knowledge, attitude, and practices concerning dental defects and fillings. It is recommended that clinical interventions should focus on enhancing patient education and promoting positive engagement in dental care practices.

Keywords Knowledge, attitude, practice, Dental defects, Dental fillings, Cross-sectional study

Background

Oral health is fundamental to overall well-being and serves as a critical determinant of quality of life [1, 2]. In many developing and underdeveloped countries, dental defects pose a significant challenge to oral health. Dental defects refer to the destruction or loss of dental hard tissues to varying degrees, as well as developmental abnormalities, which result in abnormal tooth shape, occlusion, and contact relationships between adjacent teeth. These conditions can affect the pulp and periodontal tissues, and even overall health, and can also have varying impacts on mastication, development, and aesthetics [3]. Effective prevention and treatment strategies for dental defects are essential for maintaining optimal oral health [4]. In China, dental defects, often associated with dietary habits, ranks among the most prevalent oral diseases, affecting nearly half of all children and a majority of adults [5]. The World Dental Federation (FDI) reports that approximately 3.9 billion subjects worldwide suffer from oral diseases, with school children being disproportionately affected. Untreated dental defects impact a significant portion of the global population, potentially making it the most prevalent disease across all 195 countries [6].

The consequences of dental defects can be significant, leading to irreversible damage to the enamel, dentin, and alveolar bone. This deterioration often results in tooth loss, which can adversely affect speech, chewing function, and aesthetic appearance [7]. Managing dental defects that progress into the dentin and cause cavity formation typically requires dental restorations, commonly known as fillings [8–10]. Fillings, as a common approach in restorative dentistry, are crucial for restoring both dental function and aesthetics. Commonly used dental materials include glass ionomer cements (GICs), resin composites, and stainless steel crowns [11].

The Knowledge, Attitude, and Practice (KAP) survey is a valuable diagnostic tool in research, providing insights into a group's understanding, beliefs, and behaviors related to a specific topic, particularly in the context of health literacy. This survey is based on the premise that knowledge positively influences attitudes, which in turn shape behaviors [12, 13]. Jinan, the capital city of Shandong Province, has a relatively concentrated distribution of oral healthcare resources. However, there may be significant disparities in patients' awareness of oral health and their attitudes towards the treatment of dental defects. Research on this particular group is crucial,

as they are the direct recipients of dental care, and their knowledge, attitudes, and practices play a significant role in the prevention and management of dental issues. Although KAP studies on dental defects exist, most focus primarily on early childhood defects [14], there is a gap in research on dental defects and dental fillings in other populations.

Therefore, this study aimed to explore the KAP toward dental defects and dental fillings among dental patients in Jinan, Shandong Province, China.

Methods

Study design and participants

This cross-sectional study was conducted at the main campus and several branch campuses of Jinan Stomatological Hospital, and community locations within Jinan city between October 2023 and January 2024. The inclusion criteria consisted of participants who demonstrated independent cognitive function, understood the purpose of data collection and analysis, voluntarily agreed to participate and provided informed consent. Conversely, the exclusion criteria included individuals who did not complete the informed consent process, failed to adequately respond to quality control questions, or provided answers that were inconsistent with the questionnaire prompts. Ethical approval for the study was obtained from the Medical Ethics Committee of Jinan Stomatological Hospital (Approval No. JNSKQYY-2023-004), and informed consent was obtained from all participants.

Questionnaire introduction

The questionnaire was refined and enhanced based on feedback from four experts, including three specialists in oral medicine and one in public health. A pilot study involving 55 participants was conducted to assess the questionnaire reliability, yielding a Cronbach's alpha coefficient of 0.939. The final questionnaire, in Chinese, comprised four dimensions: demographic information, knowledge, attitude, and practice dimensions. The knowledge dimension encompassed two aspects with a total of nine questions, graded on a scale where 2 indicated "Very familiar", 1 indicated "Heard of", and 0 indicated "Unclear", with a score range of 0–18 points. The attitude dimension comprised 8 questions, rated on a five-point Likert scale ranging from "Strongly agree" (5 points) to "Strongly disagree" (1 point), with a score range of 8–40 points. The practice dimension included nine questions, similarly employing a five-point Likert scale ranging from

“always” (5 points) to “never” (1 point), with a score range of 9–45 points. Scores exceeding 70% of the maximum in each section denoted adequate knowledge, positive attitude, and adequate practice [15].

Questionnaires were disseminated to study participants using a multifaceted approach, including online surveys facilitated through WeChat and QQ patient groups via the Questionnaire Star platform. Additionally, paper-based questionnaires were administered directly in hospital consultation rooms and community settings. Both paper-based and electronic versions of the questionnaire contained identical questions to maintain consistency across different modes of response. Research assistants responsible for administering paper-based questionnaires and entering data were trained to follow standardized procedures, reducing variability in data collection and entry. All responses, whether collected via paper or electronically, were manually entered into a centralized database and analyzed collectively to ensure data integrity and comparability.

Statistical analysis

Statistical analysis was conducted using Stata 18.0 (Stata Corporation, College Station, TX, USA). Data were presented as mean \pm standard deviation (SD) for those following a normal distribution, and as medians (interquartile range, IQR) for non-normally distributed data. Categorical responses across demographic characteristics were reported as N (%). For continuous variables, the t-test was used for two-group comparisons when normally distributed, while the Wilcoxon-Mann-Whitney test was applied for non-normally distributed data. For comparisons involving three or more groups, one-way ANOVA was used for normally distributed variables, and the Kruskal-Wallis test was utilized for non-normally distributed variables. Spearman correlation analysis was employed to assess the correlations between knowledge, attitude, and practice scores. Mediation analysis were utilized to explore the relationships between knowledge (K), attitude (A), and practice (P). Two-sided $P < 0.05$ were considered statistically significant in this study.

Results

Demographic characteristics

We collected a total of 652 paper-based questionnaires and 3387 electronic questionnaires, resulting in 4039 responses. During data analysis, we performed a thorough screening process and excluded non-qualifying responses. The criteria for exclusion included: (1) 24 responses lacking informed consent; (2) 177 responses with completion times under 90 s; (3) Missing responses for the first question in the Knowledge (177), Attitude (166), and Practice (118) sections; (4) 68 responses with missing or anomalous age data; (5) 129 responses with

incorrect answers to trap questions; (6) 149 responses with inconsistencies between gender and parental status; (7) 408 responses from participants who had no dental defects but reported dental fillings; (8) 19 responses with missing values across various items. After removing non-qualifying responses, the final sample size was 2529 valid responses. Among the 2529 dental patients who participated in this study, a total of 1711 (67.66%) subjects had no dental defects, 551 (21.79%) subjects had dental defects and had undergone dental fillings, while 267 (10.56%) subjects had dental defects but had not received any fillings. 1748 (69.1%) were females, 1672 (66.1%) lived in urban areas, 1104 (43.7%) had a bachelor's degree, 921 (36.4%) consumed sweets on a regular basis, 1484 (58.7%) engaged in effective tooth brushing, and 1739 (68.8%) brushed their teeth both in the morning and at night every day (Table 1).

Knowledge, attitude and practice dimensions

Their median knowledge, attitude, and practice (Questions 1–6) scores were 8.00 [5.00, 12.00] (possible range: 0–18), 27.00 [26.00, 29.00] (possible range: 10–50), and 19.00 [15.00, 24.00] (possible range: 9–45), respectively (Table 1). The distribution of knowledge dimension revealed that the question with the highest number of participants choosing the “Very familiar” option were “The quality of dental fillings techniques can affect the morphology and occlusal function of teeth after filling” (K9), with 21%. The question with the highest number of participants choosing the “Heard of” option were “Improper oral hygiene habits may lead to dental defects” (K2), with 64.6%. The question with the highest number of participants choosing the “Unclear” option were “Dental defects refer to the varying degrees of external shape and structural damage and abnormalities of dental hard tissues caused by various factors, resulting in the loss of normal physiological and anatomical shapes of teeth and disrupting normal dental morphology, occlusion, and adjacent relationships” (K1), with 34.4% (Supplementary Table 1). When it comes to attitude related to dental defects and fillings, when defects occur, 28.4% strongly agree that dental fillings should be carried out as soon as possible (A5), and 42.4% agree that more attention should be paid to oral health and oral hygiene (A3). When considering dental fillings, 42.3% were not concerned about possible pain or discomfort (A6). Furthermore, 28.5% strongly disagreed that dental defects do not affect eating (A1) (Supplementary Table 1). Participants' responses to the practice items showed that 33.5% paid more attention to the daily protection of their teeth (P4), and 43% sometimes undergo dental check-ups and cleanings (P1). Meanwhile, 39.5% sometimes go to the hospital for examination when feel tooth uncomfortable (P5). In addition, 29.5% reported that they occasionally

Table 1 Demographic characteristics

Variables	N = 2529	No dental defects (N = 1711)	Dental defects with fillings (N = 551)	Dental defects without fillings (N = 267)	P
Gender					< 0.001
Male	781(30.9)	245(14.3)	385(69.9)	151(56.6)	
Female	1748(69.1)	1466(85.7)	166(30.1)	116(43.4)	
Age					< 0.001
18 ~ 29	698(27.6)	235(13.7)	339(61.6)	124(46.4)	
30 ~ 39	588(23.3)	352(20.6)	154(28.0)	82(30.7)	
40 ~ 49	807(31.9)	712(41.6)	43(7.8)	52(19.5)	
50 and above	434(17.2)	411(24.0)	14(2.5)	9(3.4)	
Residence					< 0.001
Rural	426(16.8)	107(6.3)	220(39.9)	99(37.1)	
Urban	1672(66.1)	1177(68.8)	328(59.5)	167(62.5)	
Suburban	431(17.0)	427(25.0)	3(0.5)	1(0.4)	
Education					< 0.001
Junior high school and below	216(8.5)	50(2.9)	123(22.3)	43(16.1)	
High school/ technical school	325(12.9)	91(5.3)	171(31.0)	63(23.6)	
College	674(26.7)	394(23.0)	185(33.6)	95(35.6)	
Bachelor's degree	1104(43.7)	981(57.3)	57(10.3)	66(24.7)	
Master's degree and above	210(8.3)	195(11.4)	15(2.7)	0(0.0)	
Employment					< 0.001
Employed	1156(45.7)	454(26.5)	494(89.7)	208(77.9)	
Unemployed	239(9.5)	184(10.8)	26(4.7)	29(10.9)	
Retired	339(13.4)	300(17.5)	18(3.3)	21(7.9)	
Other	795(31.4)	773(45.2)	13(2.4)	9(3.4)	
Average monthly income					< 0.001
< 2000	76(3.0)	11(0.6)	48(8.7)	17(6.4)	
2000–5000	446(17.6)	112(6.5)	248(45.0)	86(32.2)	
5000–10,000	730(28.9)	420(24.5)	204(37.0)	106(39.7)	
10,000–20,000	316(12.5)	248(14.5)	27(4.9)	41(15.4)	
> 20,000	243(9.6)	226(13.2)	10(1.8)	7(2.6)	
Prefer not to disclose	718(28.4)	694(40.6)	14(2.5)	10(3.7)	
Marital status					< 0.001
Unmarried	649(25.7)	188(11.0)	332(60.3)	129(48.3)	
Married	1015(40.1)	683(39.9)	211(38.3)	121(45.3)	
Divorced	260(10.3)	248(14.5)	2(0.4)	10(3.7)	
Widowed	81(3.2)	76(4.4)	1(0.2)	4(1.5)	
Prefer not to disclose	524(20.7)	516(30.2)	5(0.9)	3(1.1)	
Medical insurance type					< 0.001
Only social medical insurance	1030(40.7)	370(21.6)	478(86.8)	182(68.2)	
Only commercial medical insurance	226(8.9)	162(9.5)	33(6.0)	31(11.6)	
Both social and commercial insurance	1105(43.7)	1018(59.5)	36(6.5)	51(19.1)	
No insurance	168(6.6)	161(9.4)	4(0.7)	3(1.1)	
Often consume sweets					< 0.001
Yes	921(36.4)	309(18.1)	452(82.0)	160(59.9)	
Often drink beverages					< 0.001
Yes	733(29.0)	206(12.0)	387(70.2)	140(52.4)	
Effective tooth brushing					< 0.001
Yes	1484(58.7)	748(43.7)	516(93.6)	220(82.4)	
Frequency of tooth brushing					< 0.001
Only in the morning	299(11.8)	67(3.9)	178(32.3)	54(20.2)	
Only at night	320(12.7)	95(5.6)	150(27.2)	75(28.1)	
Both in the morning and at night	1739(68.8)	1382(80.8)	220(39.9)	137(51.3)	
After every meal	145(5.7)	141(8.2)	3(0.5)	1(0.4)	

Table 1 (continued)

Variables	N=2529	No dental defects (N=1711)	Dental defects with fillings (N=551)	Dental defects without fillings (N=267)	P
Not brushing daily	26(1.0)	26(1.5)	0(0.0)	0(0.0)	
Current presence of dental defects					< 0.001
Yes	701(27.7)	186(10.9)	388(70.4)	127(47.6)	
No	1435(56.7)	1138(66.5)	162(29.4)	135(50.6)	
Uncertain or do not remember	393(15.5)	387(22.6)	1(0.2)	5(1.9)	
Dental defects^a					< 0.001
Yes	818(32.3)	0(0.0)	551(100.0)	267(100.0)	
No	1322(52.3)	1322(77.3)	0(0.0)	0(0.0)	
Uncertain or do not remember	389(15.4)	389(22.7)	0(0.0)	0(0.0)	
Dental fillings^b					< 0.001
Yes	551(21.8)	0(0.0)	551(100.0)	0(0.0)	
No	1696(67.1)	1431(83.6)	0(0.0)	265(99.3)	
Uncertain or do not remember	282(11.2)	280(16.4)	0(0.0)	2(0.7)	
Knowledge score^c	8.00 [5.00, 12.00]	5.00 [4.00, 8.00] ^d	13.00 [12.00, 15.00] ^e	12.00 [10.00, 13.00] ^f	< 0.001
Attitude score^c	27.00 [26.00, 29.00]	27.00 [25.00, 28.00] ^d	29.00 [27.00, 30.00] ^e	28.00 [27.00, 29.00] ^f	< 0.001
Practice score (Questions 1–6)^c	19.00 [15.00, 24.00]	16.00 [14.00, 19.00] ^d	25.00 [23.00, 27.00] ^e	23.00 [21.00, 25.00] ^f	< 0.001
Practice score (Questions 1–8)^c	/	NA	33.00 [30.50, 35.00]	31.00 [27.00, 33.00]	< 0.001
Practice score (Questions 1–10)^c	/	NA	37.00 [34.00, 40.00]	NA	NA

^a Such as tooth decay, residual roots, residual crowns, etc. ^b Dental filling, commonly known as tooth restoration, is the process of repairing damaged or decayed teeth to restore them to their normal state. ^c Analyzed using Kruskal-Wallis test. ^d indicates a significant difference in knowledge, attitude, and practice scores between the groups with no dental defects (N=1711) and those with dental defects with fillings (N=551). ^e denotes a significant difference in these scores between the groups with dental defects with fillings (N=551) and those with dental defects without fillings (N=267). ^f signifies a significant difference in knowledge, attitude, and practice scores between the groups with dental defects without fillings (N=267) and those with no dental defects (N=1711)

Table 2 Pearson correlation analysis

	Knowledge	Attitude	Practice
No dental defects (N=1711)			
Knowledge	1.000		
Attitude	0.402 (P<0.001)	1.000	
Practice	0.733 (P<0.001)	0.386 (P<0.001)	1.000
Dental defects with fillings (N=551)			
Knowledge	1.000		
Attitude	0.095 (P=0.025)	1.000	
Practice	0.451 (P<0.001)	0.061 (P=0.155)	1.000
Dental defects without fillings (N=267)			
Knowledge	1.000		
Attitude	0.273 (P<0.001)	1.000	
Practice	0.607 (P<0.001)	0.265 (P<0.001)	1.000

participate in oral health education activities or lectures (P6) (Supplementary Table 1).

Spearman correlation analysis

Spearman correlation analysis showed that in patients without dental defects, there were significant positive correlations between knowledge and attitude (r=0.402, P<0.001) and knowledge and practice (r=0.733, P<0.001). However, the correlation between attitude and practice was weaker (r=0.386, P<0.001). In patients who had dental defects and had undergone dental fillings, knowledge was weakly correlated with attitude (r=0.095,

P=0.025), and practice (r=0.451, P<0.001). In patients who had dental defects but had not received any fillings, there were significant weak positive correlations between knowledge and attitude (r=0.273, P<0.001), attitude and practice (r=0.265, P<0.001), and a stronger relationship between knowledge and practice (r=0.607, P<0.001) (Table 2).

Mediation analysis

Mediation analysis revealed that in patients without dental defects, knowledge had a direct effect on attitude (β = -0.983, 95% CI: -0.999, -0.966, P<0.001). Additionally, attitude had a direct effect on practice (β = -0.797, 95% CI: -1.490, -0.103, P=0.024), while knowledge had an indirect effect on practice through attitude (β=0.783, 95% CI: 0.096, 1.470, P=0.026). In patients with dental defects who had undergone dental fillings, significant direct effects were observed between knowledge and attitude (β = -0.736, 95% CI: -0.821, -0.650, P<0.001), knowledge and practice (β=0.396, 95% CI: 0.214, 0.577, P<0.001), and attitude and practice (β = -0.499, 95% CI: -0.683, -0.315, P<0.001). Moreover, knowledge had an indirect effect on practice (β=0.367, 95% CI: 0.221, 0.513, P<0.001). In patients with dental defects but without any fillings, direct effects were found between knowledge and attitude (β = -0.929, 95% CI: -1.028, -0.829, P<0.001) (Table 3), and models fit well (Supplementary Table 2).

Table 3 Mediation analysis

Model paths	Total effects		Direct Effect		Indirect effect	
	β (95% CI)	P	β (95% CI)	P	β (95% CI)	P
No dental defects (N= 1711)						
A sum						
K sum	-0.983 (-0.999, -0.966)	< 0.001	-0.983 (-0.999, -0.966)	< 0.001		
P sum						
A sum	-0.797 (-1.490, -0.103)	0.024	-0.797 (-1.490, -0.103)	0.024		
K sum	0.981 (0.962, 0.999)	< 0.001	0.198 (-0.038, 0.425)	0.577	0.783 (0.096, 1.470)	0.026
Had dental defects and experience of dental fillings (N= 551)						
A sum						
K sum	-0.736 (-0.821, -0.650)	< 0.001	-0.736 (-0.821, -0.650)	< 0.001		
P sum						
A sum	-0.499 (-0.683, -0.315)	< 0.001	-0.499 (-0.683, -0.315)	< 0.001		
K sum	0.762 (0.692, 0.833)	< 0.001	0.396 (0.214, 0.577)	< 0.001	0.367 (0.221, 0.513)	< 0.001
Had dental defects, but no experience of dental fillings (N= 267)						
A sum						
K sum	-0.929 (-1.028, -0.829)	< 0.001	-0.929 (-1.028, -0.829)	< 0.001		
P sum						
A sum	0.038 (-0.533, 0.61)	0.946	0.038 (-0.533, 0.61)	0.946		
K sum	0.966 (0.872, 1.061)	< 0.001	0.995 (-0.082, 2.072)	0.076	-0.028 (-1.044, 0.988)	0.956

Discussion

Dental patients showed inadequate knowledge, negative attitudes, and poor practices regarding dental defects and fillings. Knowledge significantly affected both attitudes and practices. Attitudes served as a moderator between knowledge and practices.

The oral health situation in China is concerning, with a high prevalence of periodontitis among adults in mainland China, exceeding 50% across various age groups [16]. Furthermore, another study highlighted that despite the high incidence of dental caries and periodontal disease, the number of people seeking dental care remains low, making oral diseases a significant issue [17]. Extraction of a first or second molar due to dental caries or periodontitis is a common cause of clinical dentition defects [18]. Additionally, there is a low level of knowledge among Chinese residents regarding the causes and prevention of dental diseases, coupled with a somewhat negative attitude towards prevention [19]. A recent study revealed that elderly individuals in the Shanghai region possess limited knowledge, beliefs, and practices related to oral health [20]. These findings echo the patterns observed in our study, where similar gaps in knowledge, attitudes, and practices were identified among the population.

Our study highlights notable gaps in KAP regarding dental defects and fillings among the surveyed population. Significant associations were found between various demographic and behavioral factors-such as gender, age, residence, education level, employment status, marital status, medical insurance type, and oral health behaviors-and the presence or absence of dental defects and fillings.

These findings align with previous research that emphasizes the role of socio-demographic factors and oral health behaviors in the prevalence of dental defects and the use of dental services. For example, our observation that males have a higher prevalence of dental defects and fillings supports existing literature on gender disparities in oral health outcomes [21]. Additionally, the relationship between younger age groups and higher prevalence of dental defects and fillings contrasts with previous studies [22]. Our results also underscore the need to consider socio-economic factors-such as education, employment, and medical insurance-in oral health interventions, as these factors significantly affect access to dental care [23].

Spearman correlation analysis revealed significant positive correlations between knowledge, attitude, and practice across different subgroups based on dental experience. Notably, individuals without a history of dental defects and those with defects but no fillings demonstrated positive correlations between knowledge, attitude, and practice. This indicates that better knowledge is linked to more positive attitudes and improved oral health practices, consistent with previous research [24]. However, among individuals with dental defects but no fillings, although knowledge was positively correlated with both attitude and practice, the correlation between attitude and practice was not significant. This suggests a potential gap between attitudes and behaviors in this subgroup.

The mediation analysis provided further insights into the relationships among knowledge, attitudes, and practices across all subgroups. It revealed both direct and indirect effects of knowledge on attitudes and practices.

However, in the subgroup of individuals with dental defects but no experience with fillings, there was a notable lack of a direct effect between attitudes and practices. This highlights the need for more investigation into the factors driving behavior change within this group. Potential explanations for these discrepancies may include psychological factors such as perceived barriers to dental care, fear of dental procedures, or varying perceptions of the importance of dental fillings. Dental procedures like deep fillings, root canal therapy, tooth extraction, and tooth preparation are known to cause discomfort [25]. Future research should explore these psychosocial factors to better understand how they influence oral health behaviors in different patient subgroups.

Given the observed differences in correlation and mediation analysis, it is essential to implement targeted interventions tailored to the specific needs of different patient subgroups. For example, improving oral health knowledge should be complemented with strategies to address perceived barriers to dental care and enhance dental health literacy, especially for individuals with dental defects but no experience with fillings. Additionally, promoting positive attitudes toward dental fillings and raising awareness about their role in preventing further dental issues are crucial, particularly for this subgroup. Integrating behavioral change techniques, such as motivational interviewing and cognitive-behavioral therapy, into dental health education programs may help convert positive attitudes into actual behaviors, thereby improving oral health outcomes across diverse populations [26]. By addressing these nuanced differences in knowledge, attitudes, and practices and tailoring interventions accordingly, oral health professionals can more effectively promote preventive behaviors and reduce the prevalence of dental defects and fillings within communities.

The findings reveal that participants have a strong understanding of how improper oral hygiene contributes to dental defects. However, there is a significant knowledge gap regarding technical aspects, such as radiographic examination methods. This gap highlights the need for targeted educational interventions. While there is a reasonable awareness of the importance of oral hygiene in preventing dental defects, efforts should focus on improving understanding of technical aspects, including radiographic techniques [27, 28]. Dental health education programs should incorporate practical demonstrations and simplified explanations of these methods to enhance patient comprehension. Additionally, developing interactive workshops and online resources could provide accessible learning opportunities, helping individuals deepen their understanding of dental health concepts [29, 30].

Although participants generally recognize the importance of oral health in preventing dental defects, many

still hold neutral or negative attitudes toward promptly addressing these issues. This contrast underscores the need to correct misconceptions and promote a positive attitude toward oral health. Educational initiatives should highlight the serious impact of untreated dental defects on overall health and well-being to counter any trivialization of these issues [31, 32]. Additionally, targeted campaigns that emphasize the benefits of preventive measures, such as regular dental check-ups and early intervention, can help shift attitudes toward a more positive approach to oral health care. Including patient testimonials and success stories in educational materials can also improve the effectiveness of these interventions by offering relatable examples of the value of preventive practices [33, 34].

Despite participants' strong commitment to limiting sugary beverages and sweets, they reported lower engagement with essential dental health services like regular check-ups and cleanings. This gap highlights the need to address barriers to accessing dental care. To improve awareness of the importance of regular check-ups and cleanings as part of preventive care, targeted efforts are required [35, 36]. Community-based outreach programs and mobile dental clinics in underserved areas could enhance access to essential services for those facing transportation or financial challenges. Additionally, offering incentives such as discounted or subsidized dental care for individuals with low socioeconomic status could promote higher uptake of preventive services and ultimately lead to better oral health outcomes [37, 38].

Despite its contributions, this study has several limitations. Firstly, the cross-sectional design limits the establishment of causal relationships between variables. Secondly, the study was conducted in a specific geographic area, limiting the generalizability of findings to broader populations. Lastly, the reliance on self-reported data may introduce response bias and inaccuracies. However, despite these limitations, this study offers valuable insights into the knowledge, attitude, and practice regarding dental defects and fillings among dental patients. The large sample size, rigorous statistical analysis using structural equation modeling, and the focus on an underexplored region contribute to the strength of this paper.

Conclusions

In conclusion, the findings reveal insufficient knowledge, negative attitudes, and inadequate practices among dental patients regarding dental defects and fillings. There is a pressing need for targeted educational interventions to improve patient awareness and foster a more positive attitude toward dental care. Such efforts should focus on encouraging preventive practices and timely treatment-seeking behaviors.

Abbreviations

KAP Knowledge, attitude, and practice
FDI World Dental Federation
SD Standard deviation

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-20503-y>.

Supplementary Material 1

Acknowledgements

None.

Author contributions

Hongyan Ye, Junru Meng, Jun Sun, and Ru Li carried out the studies, participated in collecting data, and drafted the manuscript. Shengnan Zhang, Hui Li and Wei Wei performed the statistical analysis and participated in its design. Wenyue Zhang and Yugang Sun participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

Funding

The study was supported by grants from the Science and Technology Development Program of Jinan Municipal Health Commission (2020-3-49,2023-2-161), the Dean' Research Fund of Jinan Stomatological Hospital (2021-01) and Clinical medicine science and technology innovation plan of Jinan (202328023) to Jing Sun. The Big Data Technology Plan Project of Jinan Municipal Health Commission 2023 (2023-YBD-2-23) to Shengnan Zhang, and Young Scientist Program of Beijing Stomatological Hospital, Capital Medical University (YSP202314) to Wei Wei.

Data availability

All data generated or analysed during this study are included in this published article and its 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. Ethical approval for the study was obtained from the Medical Ethics Committee of Jinan Stomatological Hospital (Approval No. JNSKQYY-2023-004), and informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Jinan Stomatological Hospital East Branch, Jinan Stomatological Hospital, Jinan 250014, China

²Hospital Infection Management Office, Jinan Stomatological Hospital, Jinan 250000, China

³Department of Periodontology, Central laboratory, Jinan Key Laboratory of Oral Tissue Regeneration, Jinan Stomatological Hospital, Jinan 250000, China

⁴Department of Prosthodontics, Jinan Stomatologic Hospital Shungeng Branch, Jinan 250001, Shandong, China

⁵Department of Prosthodontics, Beijing Stomatological Hospital, School of Stomatology, Capital Medical University, Beijing, China

⁶Department of Neurology, The People's Hospital of Gaoqing District, Zibo 255100, Shandong, China

⁷Department of Oral Surgery, Jinan Stomatologic Hospital Shungeng Branch, Jinan 250001, Shandong, China

Published online: 29 October 2024

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