Development and Application of a Multidimensional Oral Health Scale

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Abstract

Background: Based on existing measuring tools, we sought to develop a multidimensional oral health scale suitable for domestic use and evaluate its reliability and validity. The scale was applied to conduct an initial investigation of the oral health of college students. It is expected that groups with a high oral health risk can be identified early through large-scale and low-cost questionnaire screening in the future, which can also provide ideas for the development of relevant clinical research.

Methods: The current questionnaire focuses on oral health and health care behaviors. It is multidimensional and incorporates concepts such as oral health literacy. Freshmen from two different university colleges were selected as the research objects, and the questionnaire was distributed electronically. LISREL 8.80 and SPSS 21.0 were used to analyze the validity and reliability of the oral healthy literacy scale, and descriptive analysis was also performed using SPSS 21.0.

Results: The scores of the two scales of oral health literacy were at medium and high levels. The Cronbach's alpha values were 0.96 and 0.95, and both the GFI and AGFI reached 1. The percentages of people who did not brush their teeth or use dental floss were 78.8% and 79.3%, respectively. Only 16.2% knew that the Bass Method was the most important technique to ensure oral health, and only 15.1% knew that regular dental cleaning every six months could also ensure oral health.

Conclusions: At present, college freshmen have not developed correct oral health care behaviors. Dental cleaning should be included in medical insurance reimbursement to encourage people to receive regular oral examinations and dental cleanings.

Background

In 1997, the World Health Organization (WHO) listed dental caries, tumors and cardiovascular disease as the three most common diseases that cause serious harm to human health. The issue of oral health was paid considerable attention in the Seventh Global Health Promotion Conference of the WHO in 2010[1]. Oral health affects the general health status of individuals and their well-being[2]. Dental caries, periodontal disease and other issues cause many adults to lose teeth, making chewing and swallowing difficult. When a person has fewer than 20 teeth, his or her chewing ability and efficiency are greatly affected[3]. Some studies have shown that the bite force and masticatory ability of denture wearers are only 20-25% those of individuals who have real teeth, which indicates that with dentures, chewing efficiency is limited[4].

According to the results of the Fourth National Oral Health Epidemiological Survey reported by the National Health Commission on January 19, 2019, the oral health literacy and health behavior of residents are better than they were ten years ago, but there is still a gap between China and developed countries.

Scholars have been interested in oral health literacy since 2005[5]. Since then, the relationship between oral health literacy and oral health status, behavior and medical treatment has been continuously confirmed[6-13]. Several countries have been at the forefront of the development and application of oral health literacy scales, which can be used to measure subjects' medical knowledge or health literacy as well as their comprehensive oral health knowledge. Available scales include the Test of Functional Health Literacy in Adults (TOFHLA) or the short form Test of Functional Health Literacy in Adults (S-TOFHLA), which are mainly used to measure the patient's ability to read and understand medical knowledge[14]; the Rapid Estimate of Adult Literacy in Medicine (REALM), which is mainly aimed at patients who needs basic care and is used to measure the vocabulary and pronunciation[15]; The European Health Literacy Survey Questionnaire (HLS-EU-Q), which is divided into three dimensions, “health care”, “disease prevention” and “health promotion”, each of which contains four information processing steps (obtaining, understanding, evaluating and applying health information)[16]; the 29-item Health Literacy in Dentistry (HeLD), which was proposed by Australian scholar Jones and includes the seven dimensions of communication, acquisition, acceptance, understanding, utilization, support and economic barriers [17, 18] (in 2015, Kelly revised the HeLD into a simplified oral health literacy scale); and the Comprehensive Measure of Oral Health Knowledge (CMOHK), proposed by Macek in 2010 to test general oral health problems and assess the specific problems related to oral disease knowledge (about dental caries, periodontal disease and oral cancer)[6].

At present, oral health surveys in China rely primarily on the WHO Basic Oral Health Care Adult Questionnaire and The Third National Oral Health Epidemiology Survey Program, but these questionnaires mainly investigate oral health status and behaviors. In this paper, it is suggested that the concept of oral health literacy should be incorporated into an existing questionnaire to develop a multidimensional oral health assessment tool suitable for China. A scale was developed and used to collect data for a pilot investigation and reliability and validity tests, with the aim of implementing large-scale and low-cost oral health literacy screening to identify the groups with a high oral health risk as early as possible, design group or individual intervention programs, and provide ideas for the development of clinical scientific research.

Methods

Developing the first draft of the scale

The Multidimensional Oral Health Scale (MOHS) proposed in this study contains 6 dimensions: (1) Oral Health Literacy (MOHS-L): This subscale uses the items on “disease prevention” and “health promotion” from the Chinese version of the HLS-EU-Q, adapting them to the oral domain. (2) Oral Health Self-evaluation and Status (MOHS-SS) and (3) Oral Health Misunderstandings (MOHS-M): After reading the literature, the members of our team designed each item by referring to the “Guide to Oral Health for Chinese Residents” and the “Guide to Oral Health Behavior for Chinese Residents”. Then, a team of dentists was asked to evaluate the items and determine which should be included in this dimension.

Items were selected for inclusion based on a discussion with ten college students and the dentists' evaluation. (4) Oral Health Care Behavior and Cognition (MOHS-BC) and (5) Oral Health Transmission Channels (MOHS-TC): First, the team interviewed 27 parents and 15 college students individually using a semi-structured outline and developed items based on the interview information. Then, three focus groups were invited to discuss the items, and some of the items were modified. The items selected for inclusion in this dimension were confirmed after the content of each item was reviewed by a dentist. (6) Policy Expectations (MOHS-PE): Based on the policies or public strategies related to dentistry that have been implemented in many other countries but not in China, this study designed each item to assess respondents' expectations regarding the implementation of these strategies and then determined which items to include after evaluation by the expert team.

The steps and process of modifying and finalizing the scale

To ensure the face validity of the multidimensional scale, after the first draft was developed, 18 undergraduate and graduate students were invited to discuss the content of each item and to read the questions to ensure that all the questions could be understood. Expert validity was assessed by the research team, which includes researchers (specialists in health promotion and health education, public health and preventive medicine, child and youth social work, pediatric behavioral psychology and nursing), a professional dentist (a certified dentist for the International Team For Implantology in Switzerland and Bicon in the USA with a master's degree from Loma Linda University in the USA and 15 years of dental working experience), and a management expert (with a master's degree in biomedical materials from South China University of Technology). The final version of this multidimensional scale was confirmed after repeated revision through centralized discussion by the research team.

Scale items and their measurement

MOHS-L

The MOHS-L contains two parts: 15 questions on oral disease prevention and 16 questions on oral health promotion, each including the four information processing steps of obtaining, understanding, evaluating and applying health information. A response scale of 0-3 (from “very difficult” to “very easy”) is used.

MOHS-SS

The MOHS-SS includes 8 items. The first question assesses respondents' self-rated oral health status. Questions 2 to 7 assess the frequency of toothbrush replacement, oral diseases, tooth decay, teeth cleaning, flossing, brushing time and posture.

MOHS-M

The MOHS-M assesses gum bleeding, tooth extraction, wisdom teeth and common oral health myths. An example item is “Suppose that your gums are bleeding. What's your reaction?”. There are a total of 13 questions. Six items cover gingival bleeding, and the item options range from 0 to 3 (“never think that way” to “always think that way”). Five items cover tooth extraction, with response options from 0 to 3 (“very incorrect” to “very correct”). Items related to wisdom teeth include “Do you know what wisdom teeth are?” and “Do you think wisdom teeth need to be removed?”

MOHS-BC

The MOHS-BC includes two parts. One assesses current brushing behavior, floss use and medical treatment behavior, such as “left and right lateral brushing” and “brushing the biting surface of the teeth”. There are 12 questions. The answers are given on a scale from 0 to 3 (“never do this” to “always do this”). The other part mainly assesses cognition on the need for medical treatment, cognition on the behavior of brushing, cognition on floss use and cognition on the behavior of dental cleaning. There are 22 questions in total, with response options from 0 to 3 (“very incorrect” to “very correct”).

MOHS-TC

This section contains six items that primarily assess respondents' oral health knowledge, including “Self-taught” or “Taught by parents or family members”. Responses are given on a scale from 0 to 3 (“never (0%)” to “almost always (71-100%)”.

MOHS-PE

In this section, there are six items evaluating respondents' expectations regarding policy, such as “How many times a year would you like to have free dental cleanings if health insurance were available?” and “Would you go to the dentist's office regularly if health insurance provided a “free” dental cleaning every year?”.

Formal pilot of the scales in a sample population

Research sample

Considering compliance as a factor, this study chose freshmen as the research sample. This population has just entered the college stage after finishing the stressful senior high school stage. They are more likely to ignore their own health care and represent future parents. If the oral health status of college students can be improved, it will have a positive spillover effect on the next generation. In summary, the

team selected freshmen from the class of 2018 from two colleges on different campuses of a university in southern China as research objects.

The data collection process

The research process conformed to the Declaration of Helsinki. After students had had one month to adapt to university life, we contacted the counselors and monitors to invite the whole class selected for this study to participate in a presentation meeting, and the members of the research team explained the research plan and purpose. The questionnaire was distributed electronically. After reading the informed consent form and signing it electronically, the whole class completed the online self-report questionnaire at the same time. The entire process lasted 20-30 minutes.

As the subjects completed the scale, the investigator explained questions that could not be understood, which ensured that the data collection followed a unified procedure and that the data collected were of high quality. Ultimately, 179 people participated in the questionnaire survey.

Data analysis methods

After the data were exported to a cloud system, Excel 2016 was used to collate and check the data, SPSS 21.0 was used for reliability analysis and descriptive analysis (the quantitative data were expressed as the mean ± standard deviation, and the qualitative data were expressed as numbers and percentages), and LISREL 8.80 was used to analyze the validity of the scale.

Because the MOHS-L is a psychological scale for multitopic measurement of the same concept, it is necessary to test its reliability and validity to ensure its applicability. First, the construct validity was verified. For this purpose, confirmatory factor analysis was used, and the following four fitness indicators were used to judge the suitability of the model: (1) c^2/df£5 indicates good fit; (2) GFI>0.90 indicates good fit; (3) AGFI>0.90 represents good fit; and (4) RMSEA£0.05 indicates good fit, a value between 0.05 and 0.08 is considered to indicate better fit, and a value between 0.08 and 0.1 indicates adequate fit. After the validity of the scale was confirmed, the internal consistency reliability was measured (Cronbach's α).

The validity results for “oral disease prevention” showed that the coefficient between each item and its scale exceeded 0.95, the *t* values were all greater than 1.96, and the values of GFI, AGFI, RMSEA and c^2/df£5 were 1.00, 1.00, 0.01 and 1.03, respectively. Regarding reliability, the Cronbach's α value of the total scale was 0.96, and the Cronbach’s α values of the four subscales were between 0.85 and 0.93, which indicates that the reliability and validity of the scale are good (see Table 1). The validity results for “oral Health promotion “ showed that the coefficient between each item and its scale exceeded 0.96, the *t* values were all greater than 1.96, and the values of GFI, AGFI, RMSEA and c^2/df£5 were 1.00, 1.00, 0.04 and 1.31, respectively. Regarding reliability, the Cronbach's α value of the total scale was 0.95, and the

Cronbach's α values of the four subscales were between 0.84 and 0.94, which indicates that the reliability and validity of the scale are good (see Table 2).

Table 1
The validity and reliability analysis results for oral disease prevention scale

Factors	Items	Validity analysis		Reliability analysis	
		Confirmatory factor analysis		Internal consistency reliability	
		λ values	t values	λ values with the total score of this factor	Standard Cronbach's α
On a scale from very easy to very difficult, how easy would you say it is to:					
Obtaining health information	1. …find information on treatments of oral disease (such as dental caries, gingivitis, periodontal disease, etc.) that concern you?	0.96	62.16	0.72	0.93
	2. …find information helpful to your oral health that concern you?	1.00	178.70	0.78	
	3. …find information on how to prevent oral disease that concern you?	1.00	–	0.79	
	4. …find information on how to prevent or manage oral health problems like certain pathogens or calculus that concern you?	0.98	123.56	0.78	
Understanding health information	5. …understand health warnings about oral disease such as dental caries, gingivitis, periodontal disease?	0.98	94.80	0.75	0.88
	6. …understand why you need teeth cleaning (such as dental stones unable to be cleaned up via brushing teeth)?	1.00	–	0.72	
	7. …understand why you need regular oral examination (such as dental caries, gingivitis)?	0.99	128.96	0.80	
Evaluating health information	8. …judge how reliable health warnings are, such as dental caries, gingivitis, periodontal disease and other oral diseases?	0.96	60.22	0.75	0.92
	9. …judge when you need to go to a doctor for a check-up?	0.97	990.44	0.75	
	10. …judge when you need teeth cleaning	0.95	53.44	0.74	

	11. …judge which oral health screenings you should have?	1.00	–	0.77	
	12. …judge if the information on oral health risks in the media is reliable?	1.00	113.01	0.75	
Applying health information	13. …decide if you should go to the clinic or hospital for oral health examination?	1.00	–	0.78	0.85
	14. …decide how you can protect yourself from oral diseases based on advice from family and friends?	1.00	115.01	0.73	
	15. …decide how you can protect yourself from oral diseases based on information in the media?	1.00	85.58	0.67	

Note: 1. Response categories range from 0 to 3 [0=Very difficult; 1=Fairly Difficult; 2=Fairly Easy; 3=Very Easy]

2. –: This item is the reference index of the relevant factor in the confirmatory factor analysis model. We preset the coefficient value of this item to 1.00, thereby the t value is not estimated.

Table 2
The validity and reliability analysis results for oral health promotion scale

Factors	Items	Validity analysis		Reliability analysis	
		Confirmatory factor analysis		Internal consistency reliability	
		λ values	t values	λ values with the total score of this factor	Standard Cronbach's α
On a scale from very easy to very difficult, how easy would you say it is to:					
Obtaining health information	1. …find information on oral health promotion activities such as correct tooth brushing behavior, teeth cleaning?	0.99	96.59	0.72	0.94
	2. …find out about activities that are good for your oral health?	0.90	121.16	0.77	
	3. …find information on how your neighborhood and friends could be more oral health-friendly?	0.99	168.45	0.82	
	4. …find out about political changes that may affect oral health?	0.99	191.24	0.77	
	5. …find out about efforts to promote your oral health at work?	1.00	–	0.79	
Understanding health information	6. …understand advice on oral health from family members or friends?	0.97	83.35	0.70	0.88
	7. …understand information on how to choose toothbrush or toothpaste suitable for you?	0.96	120.12	0.76	
	8. …understand information in the media on how to make your oral healthier?	0.98	106.81	0.78	
	9. …understand information on how to keep your oral healthy like correct brushing and cleaning behavior?	1.00	–	0.79	
Evaluating health information	10. …judge where your life affects your oral health and well-being?	0.96	162.99	0.77	0.93

	(Instructions: Behavior, food)				
	11. …judge which habits and customs help you to stay oral healthy?	0.97	188.80	0.77	
	12. …judge which everyday behavior is related to your oral health?	1.00	–	0.75	
Applying health information	13. …make decisions to improve your oral health?	0.95	68.22	0.65	0.84
	14. …join a sports club or exercise class on oral health care if you want to?	0.96	62.06	0.49	
	15. …influence your living conditions that affect your oral health and wellbeing?	1.00	–	0.64	
	16. …take part in activities that improve oral health and well-being in your community or school?	0.96	66.46	0.49	

Note: 1. The item options range from 0 to 3 [0=Very difficult; 1=Fairly Difficult; 2=Fairly Easy; 3=Very Easy]
2. –: This item is the reference index of the relevant factor in the confirmatory factor analysis model. We preset the coefficient value of this item to 1.00, thereby the t value is not estimated.

Results

In terms of oral health literacy, because the number of items on each subscale differs, the mean score of a single question is used for comparison, and the score range is 0–3 points. The results showed that the score of the college students on the oral disease prevention scale (2.58) was slightly lower than that on the oral health promotion scale (2.69). The score for obtaining information on oral disease prevention (2.84) was the highest, and that for evaluating oral disease prevention (2.33) was the lowest, as detailed in Fig. 1.

The self-evaluation of oral health status is reported on a scale from 0 to 10. The average value was 6.31, and the average percentage of students who replaced their toothbrush every three months was 58.7%. The percentage of people without tooth decay was 43.6%; 56.4% of the respondents said they had never calculated the time they spent brushing, and 21.2% of the interviewees said they had never paid attention to their brushing posture. Those who said they brushed their teeth and used floss accounted for 21.1% and 20.7%, respectively. Regarding the response to gingival bleeding evaluated by the MOHS-M, most respondents thought it “might be lit” (87.7%), followed by those who thought they should “eat more fruit” (82.7%), and those who never considered the need for medical treatment (87.7%) (see Fig. 2). Only 27.9% of the respondents knew what a wisdom tooth was, and 52.5% knew that “wisdom teeth should be photographed and pulled out if their position is irregular”. As Fig. 3 shows regarding the understanding of tooth extraction, only 30.1% knew that there should be “no mouthwash or brushing within 24 hours after tooth extraction”.

The correct oral health care behavior is listed in Table 3 and includes tooth brushing behavior (posture, frequency, time; 9 items), medical treatment behavior (1 item) and flossing behavior (1 item). It is worth noting that 55.9% of the respondents still use the incorrect left and right lateral brushing method, while only 6.2% use the Bass Method every time they brush. Cognition on oral health behavior includes four aspects: the need to see a doctor (3 items), tooth brushing behavior (7 items), the use of dental floss (6 items) and dental cleaning behavior (6 items), as shown in Table 4. The results show that more than 40.0% of the respondents have misunderstandings regarding the use of fluorinated toothpastes. A similar percentage believed that flossing makes the gap between your teeth larger. Only 15.1% knew that regular dental cleaning every six months can ensure oral health.

Table 3
Descriptive statistics for the Correct oral health care behavior [n(%)]

The following description, please choose the option that best suits you	**never do this**	**sometimes do this**	**usually do this**	**always do this**
Tooth brushing behavior				
Brush the occlusal surface of the teeth	10 (5.6)	24 (13.4)	44 (24.6)	101 (56.4)
Brush the tooth surface near the outside of the cheek	2 (1.1)	13 (7.3)	43 (24.0)	121 (67.6)
Brush the tooth surface near the inside of the tongue	8 (4.5)	42 (23.5)	41 (22.9)	88 (49.2)
Rinse your mouth after eating	22 (12.3)	107 (59.8)	30 (16.8)	20 (11.2)
Brush your teeth after each meal	75 (41.9)	84 (46.9)	10 (5.6)	10 (5.6)
Brush your teeth for at least 2 minutes	10 (5.6)	56 (31.3)	61 (34.1)	52 (29.1)
Brush your teeth at least twice a day	7 (3.9)	37 (20.7)	42 (23.5)	93 (52.0)
Brush your teeth before going to bed at night	4 (2.2)	35 (19.6)	32 (17.9)	108 (60.3)
Use Bass Method	134 (74.9)	25 (14.0)	9 (5.0)	11 (6.1)
Flossing behavior				
Use dental floss or interstitial brush before going to bed at night	151 (84.4)	18 (10.1)	3 (1.7)	7 (3.9)
Medical treatment behavior				
Visit your dentist every six months to check your oral health	133 (74.3)	32 (17.9)	5 (2.8)	9 (5.0)

Table 4
Descriptive statistics for the Cognition on oral health behavior [n(%)]

For the following description, please select “the option that best matches your point of view”	very incorrect	a little incorrect	a little correct	very correct
Cognition on the need to see a doctor				
If your teeth are in normal condition, you do not need to see a dentist *	24 (13.4)	46 (25.7)	73 (40.8)	36 (20.1)
Don't go to the dentist as long as your teeth don't hurt *	50 (27.9)	69 (38.5)	42 (23.5)	18 (10.1)
Need to see a dentist every six months to check your oral health	12 (6.7)	25 (14.0)	85 (47.5)	57 (31.8)
Cognition on the tooth brushing behavior				
Brushing with fluoride toothpaste can strengthen teeth	19 (10.6)	54 (30.2)	72 (40.2)	34 (19.0)
Try to avoid using fluoride toothpaste to prevent fluorosis *	52 (29.1)	80 (44.7)	38 (21.2)	9 (5.0)
Toothbrush needs to be replaced every three months	4 (2.2)	14 (7.8)	51 (28.5)	110 (61.5)
The toothbrush needs to be replaced after is broken *	126 (70.4)	34 (19.0)	13 (7.3)	6 (3.4)
The most important factor to ensure oral health is “toothbrush” *	45 (25.1)	87 (48.6	39 (21.8)	8 (4.5)
The most important factor to ensure oral health is “toothpaste” *	41 (22.9)	77 (43.0)	50 (27.9)	11 (6.1)
The most important factor to ensure oral health is “brushing posture”	21 (11.7)	52 (29.1)	77 (43.0)	29 (16.2)
Cognition on the use of dental floss				
Using “dental floss” will make the gap between the teeth larger *	47 (26.3)	64 (35.8)	54 (30.2)	14 (7.8)
Dental floss is better than toothpicks and does not damage the gums easily	13 (7.3)	38 (21.2)	85 (47.5)	43 (24.0)
Use dental floss to clean the teeth better	10 (5.6)	40 (22.3)	93 (52.0)	36 (20.1)
Floss between teeth at least once a day	27 (15.1)	58 (32.4)	72 (40.2)	22 (12.3)
Dental floss is only needed when food is stuffed between teeth *	42 (23.5)	85 (47.5)	38 (21.2)	14 (7.8)

For the following description, please select “the option that best matches your point of view”	very incorrect	a little incorrect	a little correct	very correct
People with large gaps do not need to use dental floss *	58 (32.4)	95 (53.1)	20 (11.2)	6 (3.4)
Cognition on the dental cleanings behavior				
“Dental cleanings” will enlarge the gap between the teeth *	66 (36.9)	81 (45.3)	26 (14.5)	6 (3.4)
Dental cleanings will make teeth soft *	57 (31.8)	77 (43.0)	36 (20.1)	9 (5.0)
Dental cleanings can cause bleeding gums *	55 (30.7)	75 (41.9)	37 (20.7)	12 (6.7)
The teeth may still be yellow after dental cleanings	14 (7.8)	38 (21.2)	92 (51.4)	35 (19.6)
The doctor made a mistake in dental cleanings and stuck the tip into the gums, causing bleeding of the gums	39 (21.8)	53 (29.6)	73 (40.8)	14 (7.8)
Clean teeth every six months to ensure oral health	24 (13.4)	68 (38.0)	60 (33.5)	27 (15.1)
Note: * Wrong statement				

The results of the MOHS-TC showed that 64.8%, 60.3% and 60.3% of respondents were self-taught, taught by parents or family members or taught at school or via the TV or Internet, respectively. Of the respondents, 69.3% said they would be very willing to go to the dental clinic to have their teeth cleaned regularly if health insurance provided “free” dental cleaning once a year. Regarding the frequency, 66.9% of respondents said twice a year is enough.

Discussion

The reliability and validity of the scale

Oral health has been listed as the third major threat to human health and causes serious harm. If early intervention can be carried out to rectify misunderstandings and change behavior by improving literacy, the cost of later treatment will be greatly reduced. The MOHS proposed in this study includes 6 dimensions, the reliability and validity of the scale are good, and the subscales can be used independently. Thus, the future application value is high.

Referencing the HLS-EU-Q, our team combined existing scales to compile an oral health literacy scale with local characteristics. In terms of reliability and validity, the Cronbach's alpha of the MOHS-L was higher than that of the HeLD[17] (0.91) and that of the CMOHK [6] (0.74), reaching 0.95, indicating better

reliability and validity. In terms of content, most of the existing tools that measure oral health literacy focus on word recognition, numeracy and reading skills[19, 20]. The MOHS-L is divided into two parts: oral disease prevention and oral health promotion. The subscale covers four information processing steps, namely, acquisition, understanding, evaluation and application, and comprehensively evaluates the level of oral health literacy.

The oral health of college students needs to be improved

Studies have shown that self-assessment of oral health status can represent the actual oral health level to some extent[2]. Although the self-rated oral health literacy of college students was at medium and high levels, most of the respondents did not brush their teeth correctly. The percentage who had never used the Bass Method exceeded 70%. The reason may be that the respondents are college students, and their responses may have been influenced by social expectations or may reflect the phenomenon of “different knowledge and practice”, which is worthy of further discussion. In addition, the results show that nearly half of the respondents have misunderstandings regarding the use of fluorinated toothpaste, though their knowledge level is better than the average knowledge level of adults on the fourth National Oral Health Epidemiological Survey, which may be due to the different age composition of the surveyed population. In a cross-sectional study of adults in 10 provinces, autonomous regions and municipalities in China, 2.6% used dental floss more than once a day[21]. That rate of dental floss use was slightly higher than the rate reported in this study, possibly because the participants in this study were college students, and other age groups were not included. Previous studies have shown a correlation between low levels of oral health literacy and brushing frequency and floss use[9]. The lower the level of oral health literacy is, the lower the frequency of brushing[22] and the worse the periodontal health[23], indicating directions for future research.

In addition, the cognition of the interviewed college students regarding gingival bleeding was incorrect: 80% of the respondents did not realize that it might be caused by the presence of dental stones, Only 30% of respondents exhibited a correct understanding of oral care after tooth extraction. The results of the MOHS-TC may partly explain these findings. Studies have shown that children of parents with lower levels of health literacy exhibit fewer healthy behaviors[24]; thus, parents' oral health literacy level influences their children's oral health[25]. The older generation has been influenced by traditional concepts, and their cognition on brushing, flossing, teeth cleaning and tooth extraction is not comprehensive enough[26].

Most previous studies on oral health are cross-sectional studies [27]. Oral health education in colleges and universities generally consists of single lectures, which do not fully meet the unique health needs of the population and are not sufficiently attractive to students [28]. Moreover, there is no follow-up intervention, so the expected effect cannot be achieved. Evidence suggests that school education is closely related to the health literacy level[29]; therefore, we should enrich school-based education methods, develop effective

systematic interventions, and take the concept of health literacy into account when planning interventions[30].

Oral health policies may improve oral health

The international community is paying increasing attention to oral health and has introduced policies to improve it. For example, Maryland's Medicaid Program covers prenatal dental care[31]. South Korea carried out the 'Family-Love Dental Program' from 2010 to 2016 to increase oral health services for MIW (marriage-immigrant women)[32]. Studies have shown that health promotion strategies can alter oral health literacy and have a positive impact on oral health outcomes [9]; people without insurance are less likely to visit the dentist[28].

The results of this survey also showed that respondents would be willing to go to the dental clinic if medical insurance provided “free” dental cleanings, which indicates that the implementation of dental cleanings policy may promote oral health care behaviors in the public to some extent. Considering the seriousness of Chinese oral health problems, the state has formulated and issued a number of policies. In the “Three Minus Three Health” campaign jointly proposed by the National Health Commission and four other departments, the first area of focus is a healthy oral cavity, which fully demonstrates the seriousness of oral health problems and the importance of national policy with respect to oral cavity problems. The “Healthy Oral Cavity Action Plan (2019-2025)” clearly proposes that a social environment supporting oral cavity health should be basically in place by 2025 and that the oral health literacy level and the formation rate of healthy behavior should be significantly improved. In addition, the “Outline of the 2030 Plan For a Healthy China”, “The 13th Five-year Health Plan” and the “Long-term Plan For the Prevention and Treatment of Chronic Diseases” also set clear requirements and specific indicators for the improvement of Chinese oral health. It is suggested that dental cleaning be included in the scope of medical insurance reimbursement to promote regular oral examination and the habit of dental cleaning so that the concept of prevention is deeply rooted in citizens’ minds. This step would improve awareness of oral protection, promote good habits, and ensure regular oral examination and timely tooth cleaning. In other words, for oral health, the concept of prevention should be emphasized, starting at the source.

Limitations

There are also limitations in this study. First, because the questionnaire was self-designed and the HLS-EU-Q was used as a reference, several problems need to be further addressed in the process of data analysis. In addition, as the data are the results of a one-time survey, the test-retest reliability of the scale needs to be further investigated. Second, the sample size and representativeness of this scale are limited because the selected population used to pilot the questionnaire included only college freshmen, and the population applicability of the scale can be further discussed in future studies. Finally, the bias caused by medical and health resources, socioeconomic status and other factors was not taken into account in the scale development. In future studies, the scale should be calibrated to produce a comprehensive

measurement tool integrating effective assessments of function, attitude, knowledge level and language communication to enable the clinical and preventive detection of oral health status and literacy level[33], identify the factors influencing oral health and oral health literacy, provide a theoretical basis for effective interventions, and improve the national oral health status.

Conclusions

At present, college freshmen have not developed correct oral health care behaviors. Dental cleaning should be included in medical insurance reimbursement to encourage people to receive regular oral examinations and dental cleanings.

List Of Abbreviations

WHO: World Health Organization

TOFHLA: Test of Functional Health Literacy in Adults

S-TOFHLA: short form Test of Functional Health Literacy in Adults

REALM: Rapid Estimate of Adult Literacy in Medicine

HLS-EU-Q: European Health Literacy Survey Questionnaire

HeLD: Health Literacy in Dentistry

CMOHK: Comprehensive Measure of Oral Health Knowledge

MOHS: Multidimensional Oral Health Scale

MOHS-L: Oral Health Literacy

MOHS-SS: Oral Health Self-evaluation and Status

MOHS-M: Oral Health Misunderstandings

MOHS-BC: Oral Health Care Behavior and Cognition

MOHS-TC: Oral Health Transmission Channels

MOHS-PE: Policy Expectations

MIW: Marriage-immigrant women

Declarations

Ethics approval and consent to participate

The protocol for this study was approved by the Research Ethics Committee of the Medical School, Xiamen University, China (XDYX2020004). All adults who participated in the study signed a consent form.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Yi-Chen Chiang, Yanhua Su, Lingyan Yang , Benhua Zhao and Shengnan Lin made substantial contributions to conception and design, Shengnan Lin, Meijie Chu, An Li, Xinlan Cai, Jin Xiao , Ruixin Wang and Fangcong Luo collected the data; Shengnan Lin, Meijie Chu, An Li, Xinlan Cai, Jin Xiao and Ruixin Wang analysed and interpreted the data; Shengnan Lin drafted the article; Yi-Chen Chiang, Yanhua Su, Lingyan Yang and Benhua Zhao revised it critically for important intellectual content. All authors approved the final manuscript and agreed to be accountable for all aspects of the work.

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Figures

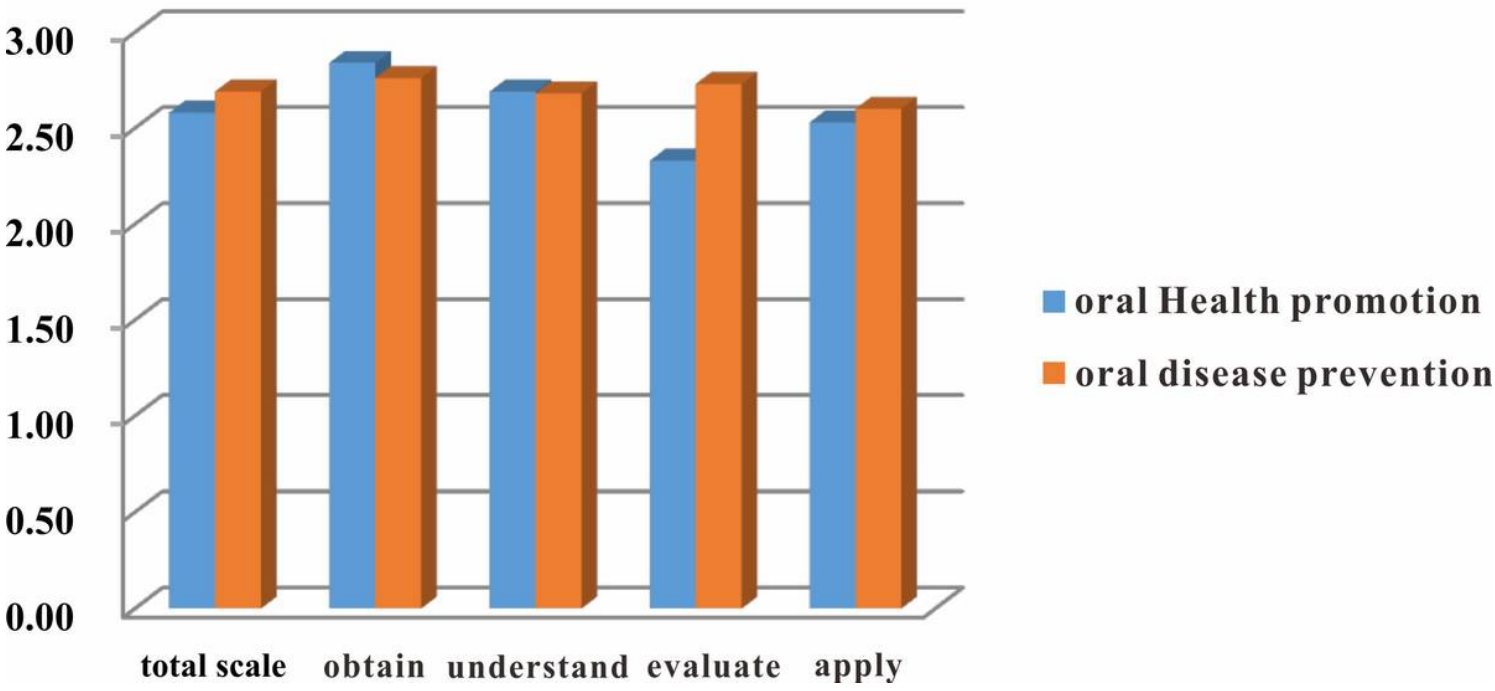

Figure 1

The total score of the Oral Health Literacy Scale (Disease Prevention and Health Promotion) and average score of each questionnaire

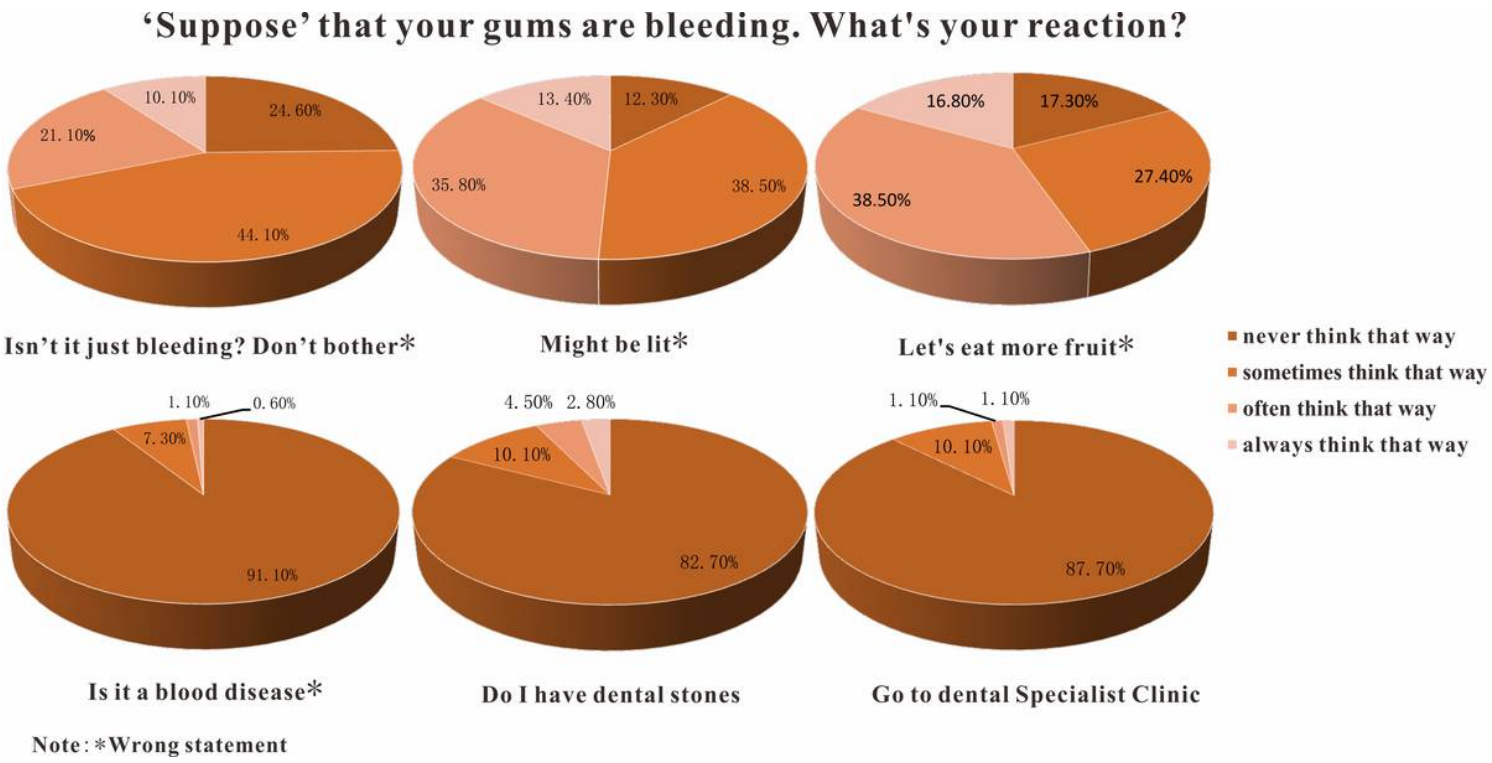

Figure 2

The misunderstanding of "Gum Bleeding" knowledge

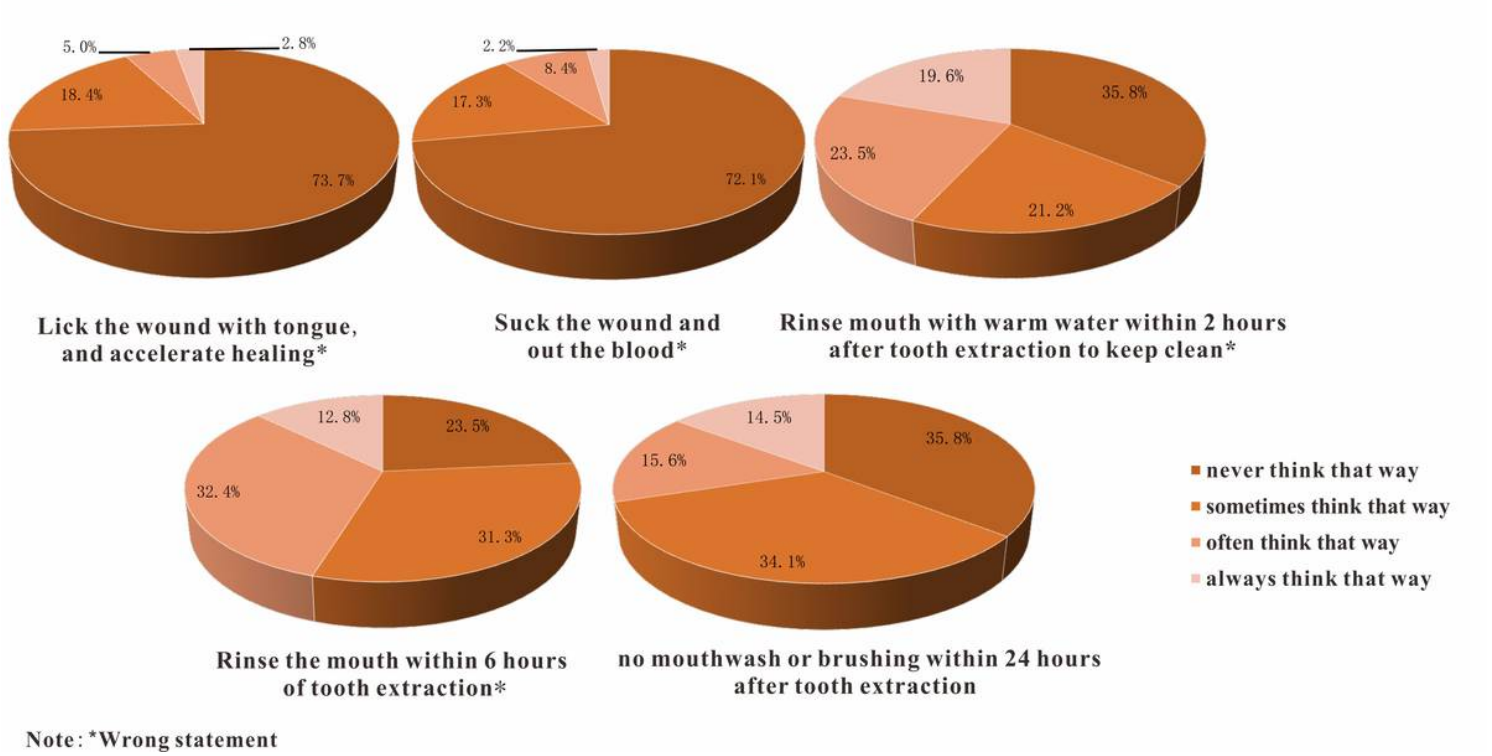

Figure 3

The misunderstanding of "Tooth Extraction" knowledge