Original Article

Correlates of Oral Health Conditions and Oral Health Literacy Among a Sample of Patients With Cardiovascular Disease: A Cross-sectional Study

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Abstract

Background: Oral health literacy (OHL) and dental health indicators in people with cardiovascular diseases (CVDs) are important health conditions that have been less investigated in this group of patients. The aim of the present study was to evaluate oral health conditions and OHL in adult patients with cardiovascular conditions who referred to dental clinics in southwest, Iran.

Methods: This cross-sectional study was conducted in Ahvaz, Iran in 2021-2022. The oral and dental health status and literacy of 302 people were investigated, and data were collected using a standard questionnaire about OHL (with dimensions of comprehension and calculation ability), as well as demographic and medical information. Then, the patients were clinically examined by a dentist to determine oral health indicators (Decayed, missing, and filled teeth: DMFT) and oral health index (OHI-S). Finally, data were analyzed using SPSS, version 22.

Results: The mean DMFT was 11.06 ± 3.55. According to the OHI-S, 124 (41.1%), 75 (24.8%), and 103 (34.1%) people were categorized in mean, good, and poor oral health levels, respectively. Pearson's correlation coefficient demonstrated a direct, strong, and significant relationship between age and DMFT and OHI ($r=0.702$, $r=0.678$ $P<0.001$). The relationship between understanding ability and DMFT and OHI was inversely correlated ($r=-0.389$, $r=-0.278$, $P<0.001$), and the relationship between calculation ability and OHI, as well as between calculation ability and DMFT was inverse and significant (($r=-0.572$, $P<0.001$) and $r=-0.429$, $P<0.001$, respectively).

Conclusion: The results showed that there is a relationship between OHL and OHI in people with CVD, although it is not in a favorable condition. As a result, the design, implementation, and evaluation of oral health education programs for patients with CVD are highly recommended, and it is imperative that oral and dental health be carefully monitored in these patients.

Keywords: Cardiovascular disease, DMF index, Oral health, Health literacy

Introduction

Cardiovascular disease (CVD) is known as a leading cause of death and disability in most countries around the globe, including Iran. Recent studies have shown the relationship between systemic health and oral health (1,2). It seems that oral and dental health problems are more common among patients with CVD compared with the healthy population. Research indicates that problems such as periodontitis or missing teeth increase put people at greater risk of CVD (3,4). Research has represented that infectious agent related to oral health (e.g., *Streptococcus sanguinis*, *Actinobacillus*, and *Actinomyces* contents) probably have a direct effect on the pathogenesis of atherosclerosis and thrombosis (5). Periodontal condition (periodontitis) is a localized chronic inflammatory condition caused by bacteria and destroys connective tissues and bones supporting the teeth. Males with periodontitis or those who are edentulous are more likely to develop a coronary heart condition in comparison with people without periodontitis (6). Some of the drugs that are used to treat CVD have common side effects such

as decreased saliva flow, dry mouth, and impaired sense of taste, which worsen the health of the oral cavity in these patients (7). Clinical status and oral and dental conditions have been reported to be associated with the quality of life (8). Adult life is often accompanied by oral health problems such as periodontal conditions, tooth loss, and dry mouth, which become worse as the person gets older (9). Research demonstrates that tooth decay and gum conditions are twice as likely in financially vulnerable people, and these people have often unmet oral and dental health needs (10). Based on what was mentioned earlier, it seems that there is a bidirectional relationship between CVD and oral and dental conditions. As such, identifying factors affecting oral and dental health and establishing preventive strategies are necessary (11).

Health literacy has recently been introduced as a key concept linked to people's health (12). It is defined as the extent to which individuals can read, understand, assess, and utilize health-related information and services in order to make well-informed decisions for their health (13). Health literacy is condition specific (14,15). When it comes to oral health, it is known as oral health literacy (OHL), which is a significant component in oral and dental health. OHL is people's ability to obtain, analyze, and use dental information to solve oral and dental problems. This type of health literacy does not involve merely knowledge and awareness, but it is a practical ability that must be acquired by people to improve oral health (3).

Previous studies have documented the relationship between oral health behavior and oral health problems (16). Oral health problems are more prevalent among the population with lower literacy (17). Batista et al reported that OHL is related to oral health, biofilm, and practices and can have recognizable impacts on the quality of life (18). Nonetheless, a growing number of studies attribute low OHL to poor oral health outcomes such as irregular dental attendance, dental neglect, and worse oral health condition (16,19-29). Among different populations, health literacy as one of the main variables among patients with CVD has received little attention in the literature. Therefore, the present study sought to investigate oral health conditions and OHL in adult patients with cardiovascular conditions to fill the gap.

Materials and Methods

The current cross-sectional study was conducted from September 2020 to February 2022, in Ahvaz, Iran. Its statistical population included 302 patients with a history of CVD who were referred to the dental clinics of Khuzestan (Southwest Iran) and were selected using a convenience sampling method. The eligibility criteria were being over 18 years of age and having CVDs such as coronary artery disease, high blood pressure, arrhythmia, congestive heart failure, and valvular problems as diagnosed by a cardiologist. Patients with drug-induced gingival hyperplasia were excluded from the study.

Sample Size

The sample size was calculated based on another study (20) and the following formula:

$$n = (z1 - \alpha2)\ 2 \times p\ (1 - p)\ d2$$

where α, d, and p are 5%, 6%, and 50%, respectively. A total of 294 patients (assuming 10% for the drop sample) were selected finally.

The patients were recruited after obtaining permission from Ahvaz University of Medical Science, visiting the clinics, and making the necessary arrangements with the directors of each clinic. The participants were briefed on the research objectives and how to respond to the questionnaire. The participants were assured of data confidentiality, and they were also reminded of the importance of honest answers. Subsequently, after obtaining informed written consent from the patients with CVD, they were handed the questionnaires. The participants were required to complete the questionnaires by self-report within ten minutes without the presence of a research assistant.

Demographic Information and Medical History Form

This section included information related to age, gender, education level, and income levels [low (failure to meet living expenses), fair (providing living expenses), good (more than providing living expenses), and excellent (much more than necessary to meet expenses) incomes].

In addition, oral and dental health status examinations (the results of the dentist examination) included the DMFT (the number of decayed, missing, and filled teeth) index and oral health index (OHI-S) (OHI-S), and medical history was recorded on the form.

Oral Health Literacy

A two-dimensional health literacy questionnaire evaluated the ability to calculate and comprehend oral and dental health. The health literacy questionnaire was derived form relevant literature (30, 31). Content validity and face validity were evaluated. As far as content validity was concerned, 10 experts were asked to give their opinions about the questionnaire. After considering expert opinions, the content validity ratio (CVR) and content validity index (CVI) were calculated based on scientific recommendations (32) and found to be CVR = 0.99 and CVI = 1, which were both satisfactory (33). As with face validity, 10 participants (excluded from the final study sample) were asked to rate the importance of each item based on a 5-point Likert-type scale (5 = Absolutely important, important, moderately important, slightly important, and 1 = Absolutely not important). The importance rating for the questionnaire was mean (M) = 4.5, which was satisfactory.

Calculation Ability

This parameter was assessed via 14 items with correct answers = 1 and incorrect answers = 0 in the range of 0-14,

with higher scores indicating a better status. The following text evaluates the calculation ability in recognizing the hours of taking medicine. Box 1 presents an example of questions.

Comprehension

It was assessed via 6 items with correct answers = 1 and incorrect answers = 0 ranging from 0 to 6, with higher scores representing a better condition. The following text was prepared and then questions were asked. The text was about post-operative training (Box 2).

Oral Health Examinations

A dentist assessed the conditions of DMFT and OHI-S on ten participants (later excluded from study samples) twice, and the findings were recorded in a checklist. The examinations were separated by 1-day intervals. The Kappa coefficient calculated for measuring intra-examiner reliability was found to be satisfactory (κ = 0.8).

Decayed, Missing, and Filled Teeth

To obtain the DMFT index, the examiner examined favorable lighting conditions using a flat mirror No. 3 and a sharp pigtail probe, and the optical-tactile technique was used to detect caries. The maximum DMFT for a person is 28-32 (if wisdom teeth are present). No tooth was counted more than once (34).

Oral hygiene index was also measured, this index includes debris index (DI) and calculus index (CI) components.

Each of these CI and DI indices was determined based on the code that indicates the amount of debris and mass observed on the tooth surfaces. Six surfaces (four surfaces from the posterior area and two surfaces from the anterior teeth area) were selected for examination.

The buccal surface of the upper first molars (16 and 26), the lingual surface of the upper first molars (36 and 46), the labial surface of the upper right central (11), and the labial surface of the lower left central (31) underwent examination.

In the absence of the first molar, the second or third molar, and in the absence of two central teeth, the adjacent central teeth (21 and 41, respectively) were examined. All 8 teeth were divided into three gingival, middle, and incisal levels, and by moving a probe from the incisal edge to the gingival edge, the grade of each tooth was determined and the grades were given as follows (34):

DI criteria were divided as follows:
- Absence of debris or stain (color) on dental surfaces = 0
- The presence of soft debris in less than one-third and the absence of stain on the surface of the tooth = 1
- The presence of soft debris in more than one-third and less than two-thirds of the tooth surface = 2
- The presence of soft debris on more than two-thirds of the tooth surface = 3
- The criteria for determining the amount of crime (CI) were classified as follows:
- No mass = 0
- Upper gingival mass less than one-third of tooth surface = 1
- The upper gingival mass covers more than one-third of the tooth surface but does not exceed two-thirds of the discussed surface, or there are individual points of subgingival mass = 2
- Upper gingival mass more than two-thirds of the tooth surface or the presence of a uniform wide band of subgingival mass around the tooth collar = 3

Debris index DI-S and mass CI-S were determined, the sum of which is the OHI-S index. The mean oral health index of all people was determined by calculating the mean of each of these indexes.

OHI-S = CI-S + DI-S

The score of CI-S and DI-S is between zero and three, and the score of OHI-S is between zero and six variables, which are divided as follows:
- Good: 1.2
- Mean: 1.3-3
- Weak: 3.1-6 (19).

Statistical Analysis

Data were analyzed using SPSS, version 22 (Chicago, IL, USA). The variables were described using descriptive

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Box 1. An Example of Oral Health Literacy (Calculation Ability)

Amoxicillin 500 mg
Date of start of use: 1.10.2021
Expiration date: None
Instructions for use: Tablets should be taken 3 times a day for 7 days
If you take the first pill on Friday at 10 AM, at what time should you take the next pill?

Box 2. An Example of Oral Health Literacy (Comprehension Ability)

Having a little discomfort, pain, bleeding, bruising, swelling, stiffness of the jaw joint, and sensitivity around the teeth. Numbness may occur for a few hours after tooth extraction and is quite common if the surgery was difficult, as well as if the gum tissue is retracted due to the tooth extraction. The swelling is at its maximum until the second-third day and then it starts to sleep. If you have access to ice and put an ice pack on your face for 20 minutes, the swelling may decrease. Then, the ice pack should be removed for 20 minutes and then put back in. This should be performed for 6 hours after which it will no longer work. If ice is unavailable, a bag of frozen vegetables can have the same effect.
A sample question: "If your tooth is pulled on Monday, how many days after that is the swelling at its peak?"

statistics, including dispersion indices. To test the research hypotheses, the normal distribution of the quantitative data was assessed using the Shapiro-Wilk test. To compare quantitative indicators between two groups, the Mann-Whitney test was used, and the Kruskal-Wallis test was employed for more than two groups. The relationship between different levels of oral and dental health and oral and dental indicators was analyzed using Pearson's correlation test, and P values less than 0.05 were considered statistically significant. Further, the ability to understand and calculate the questions was investigated using the Mann-Whitney and Kruskal-Wallis tests. The linear correlation between the studied constructs and DMFT and OHI indices was evaluated by Pearson's correlation test.

Results

In this research, 320 people were invited, and finally, 302 cases entered the study. The main reasons for non-participation were lack of enough time to participate in the study and lack of consent for the examination. The oral and dental conditions of 302 people were examined, of whom 129 (42.7%) were males and 173 (57.3%) were females. The participants' mean age was 40.43 with a standard deviation of 12.39. Most of the studied patients had a university education with 43.4%. In addition, 56.53% of the examined patients were employed, while 3.4% of them were unemployed. The mean DMFT in the examined population was 11.06 ± 3.55. The OHI variable was analyzed by classification. Accordingly, 124 (41.1%), 75 (24.8%), and 103 (34.1%) people were classified according to the OHI_S index in the mean, good, and poor levels of oral and dental health, respectively.

Results of Oral and Dental Health Indicators

Table 1 provides the comparison results of DMFT and OHI caries index according to gender, marital status, education, occupation, and income, as well as suffering from diabetes, heart disease, or gastrointestinal disease. The DMFT index was slightly higher among males compared with females, but the difference was not statistically significant ($P > 0.05$). However, the DMFT index showed a statistically significant relationship with the marital status, education, employment status, and income of the participants ($P < 0.05$) so that the mean DMFT in married people was

Table 1. Mean and SD of DMFT and Oral Health Indicators by Demographic and Medical Variables (n = 302)

		DMFT	P Value	OHI	P Value	CI	P Value	DI	P Value
		Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD	
Gender*	Female	10.72 ± 3.55	0.051	2.17 ± 1.11	0.014	1.01 ± 0.78	0.011	1.16 ± 0.47	0.086
	Male	11.50 ± 3.53		2.50 ± 1.11		1.24 ± 0.79		1.26 ± 0.50	
Marital status*	Single	7.88 ± 2.72	0.001	1.26 ± 0.74	0.001	0.38 ± 0.53	0.001	0.88 ± 0.34	0.001
	Married	11.96 ± 3.23		2.61 ± 1.04		1.31 ± 0.72		1.29 ± 0.49	
Education**	Illiterate	14.9 ± 1.58	0.001	3.43 ± 0.45	0.001	1.91 ± 0.32	0.001	1.52 ± 0.33	0.001
	High school	13.89 ± 2.68		3.27 ± 0.73		1.75 ± 0.45		1.52 ± 0.47	
	Diploma	11.05 ± 3.65		2.41 ± 1.05		1.21 ± 0.74		1.20 ± 0.50	
	University	9.19 ± 2.63		1.62 ± 0.89		0.61 ± 0.64		1.01 ± 0.39	
Employment status**	Unemployed	13.92 ± 2.98	0.001	3.21 ± 1.05	0.001	1.73 ± 0.75	0.001	1.48 ± 0.52	0.001
	Employed	11.03 ± 3.22		2.28 ± 1.05		1.09 ± 0.77		1.19 ± 0.45	
	University student	7.70 ± 3.09		1.22 ± 0.77		0.36 ± 0.49		0.87 ± 0.39	
	Housewife	3.34 ± 12.39		2.78 ± 1.04		1.42 ± 0.68		1.36 ± 0.50	
Income**	Poor	11 ± 4.36	0.001	2.79 ± 0.86	0.001	1.46 ± 0.59	0.001	1.32 ± 0.72	0.023
	Fair	12.88 ± 3.72		2.87 ± 1.13		1.49 ± 0.74		1.38 ± 0.53	
	Good	10.77 ± 3.36		2.23 ± 1.10		1.06 ± 0.78		1.17 ± 0.47	
	Excellent	9.65 ± 3.67		1.63 ± 0.83		0.57 ± 0.56		1.05 ± 0.36	
Heart complication*	Yes	12.89 ± 3.45	0.003	2.79 ± 1.02	0.016	1.47 ± 0.71	0.009	1.32 ± 0.52	0.18
	No	10.86 ± 3.52		2.26 ± 1.12		1.07 ± 0.79		1.91 ± 0.48	
Diabetes*	Yes	13.67 ± 2.66	0.001	3.19 ± 0.78	0.001	1.66 ± 0.52	0.001	1.52 ± 0.45	0.001
	No	46.3 ± 45.10		2.10 ± 1.09		0.97 ± 0.78		1.13 ± 0.46	
Digestive Condition*	Yes	12.48 ± 2.83	0.014	2.68 ± 0.94	0.022	1.44 ± 0.72	0.008	1.24 ± 0.40	0.66
	No	10.88 ± 3.60		2.26 ± 1.14		1.06 ± 0.79		1.20 ± 0.49	
Thyroid*	Yes	12.67 ± 2.91	0.001	3.18 ± 0.94	0.001	1.70 ± 0.62	0.001	1.49 ± 0.49	0.001
	No	10.83 ± 3.58		2.18 ± 1.09		1.02 ± 0.77		1.16 ± 0.47	
Smoking*	Yes	12.95 ± 2.89	0.001	2.95 ± 0.87	0.001	1.60 ± 0.71	0.017	1.35 ± 0.38	0.001
	No	10.76 ± 3.6		2.21 ± 1.13		1.03 ± 0.77		1.18 ± 0.50	

Note. SD: Standard deviation; DMFT: Decayed, missing, and filled teeth; OHI: Oral health index; CI: Calculus index; DI: Debris Index; * Man-Whitney test; ** Kruskal-Wallis test.

more than in single people. Moreover, it was observed that in illiterate people, it was more than in educated people, and in unemployed people, it was more than in employed and students and housewives, while in people with high incomes, it was less than in people with low and medium incomes. It was also found to be more in people who had a history of heart conditions, diabetes, and gastrointestinal disease ($P>0.05$) than in those who did not report these conditions.

Results of Oral Health Literacy

No statistically significant difference between these variables was observed based on gender ($P>0.05$). Single people had a higher mean score in terms of the ability to understand and calculate, and the mean of these two dimensions demonstrated a statistically significant difference among these groups. Further, with the increase in education, there was an increase in the studied indicators ($P<0.05$), and working people and students had more understanding and calculation abilities. People who did not have a history of diabetes and thyroid disease had better understanding and calculation abilities ($P<0.05$). However, as far as other diseases were concerned, no statistically significant difference was found in the level of understanding and calculation ability ($P>0.05$, Table 2).

The linear correlation between the studied constructs and DMFT and OHI indices was investigated by the Pearson correlation test. According to the results of this test, there was a direct, strong, and significant relationship between age and DMFT and OHI ($r=0.702$, $r=0.678$, $P<0.001$). The relationship between understanding ability and DMFT and OHI was weak and inverse ($r=-0.389$, $r=-0.278$, $P<0.001$), while the relationship between calculation ability and OHI was good, inverse, and significant ($r=-0.572$, $P<0.001$). Furthermore, the relationship between calculation ability and DMFT was moderate, inverse, and significant ($r=-0.429$, $P<0.001$).

Discussion

The current study aimed to evaluate the oral and dental conditions of CVD patients referring to dental clinics in southeast Iran. According to our results, 41.1% of the participants were classified according to the OHI_S index in the mean oral health level, and 24.8% and 34.1% were in the good and poor health levels, respectively. The mean index of OHI_S classified in our study was generally low among the participants, which is comparable with the results of other studies in different countries (35-37).

Table 2. Scores of Oral Health Literacy Dimensions by Demographic and Medical Variables

		Comprehension (Mean±SD)	P Value	Calculation (Mean±SD)	P Value
Gender*	Female	4.24±0.54	0.540	10.53±4.24	0.386
	Male	4.21±0.61		10.45±4.21	
Marital status*	Single	4.43±0.70	0.001	11.94±1.96	0.001
	Married	4.17±0.53		10.08±2.29	
Education**	Illiterate	3.80±0.41	0.001	7.55±1.70	0.001
	High school	3.97±0.26		8.32±1.59	
	Diploma	4.05±0.56		10.23±1.98	
	University	4.53±0.57		12.11±1.55	
Employment status**	Unemployed	4.08±0.28	0.001	9.38±2.14	0.001
	Employed	4.29±0.57		10.74±2.27	
	University student	4.56±0.55		12.56±1.07	
	Housewife	3.95±0.53		2.08±9.05	
Income**	Poor	3.80±0.44	0.001	3.70±9.20	0.001
	Fair	3.94±0.46		8.55±2.34	
	Good	4.27±0.58		10.82±2.10	
	Excellent	4.56±0.59		12±1.88	
Heart complication*	Yes	4.24±0.51	0.99	2.11±10.17	0.278
	No	4.23±0.59		10.53±2.38	
Diabetes*	Yes	4.04±0.38	0.001	9.49±2.14	0.002
	No	4.27±0.61		10.73±2.35	
Digestive Condition*	Yes	4.09±0.52	0.120	10.06±1.83	0.126
	No	4.25±0.59		10.55±2.41	
Thyroid condition*	Yes	3.92±0.43	0.001	9.08±1.77	0.001
	No	4.27±0.58		10.69±2.36	
Smoking*	Yes	4.23±0.60	0.566	9.97±1.79	0.058
	No	4.20±0.41		10.57±2.42	

Note. SD: Standard deviation; *Man-Whitney test; ** Kruskal-Wallis test.

Therefore, education in the field of oral and dental health is more necessary for people who have a lower level of education. We found a statistically significant relationship between the DMFT caries index and the marital status, education, employment status, and income of the participants. Hong et al analyzed the oral health status of CVD patients through oral examination (DMFT index, periodontal index, and oral health status) and examined oral health behavior using a questionnaire. Compared with the control group, the mean index of missing teeth in CVD patients was significantly higher. The M component of the DMFT index among CVD patients was higher in comparison with a control group (38), which is in line with the results of our study.

Previous studies from different countries investigating OHL in terms of gender reported no significant differences (35,36,39), which conforms to the findings of the present study. However, in the study conducted by Naghibi Sistani et al in Tehran, a higher level of OHL was found among female participants (37). This can be due to the greater desire of females to observe oral and dental hygiene and to be more aware of the information provided about oral and dental hygiene through the media. Research shows that people with limited OHL are at greater risk for oral conditions and problems associated with these conditions (18).

Haridas et al found a significant relationship between OHL, oral and dental health status, and the number of DMFT index (40). Furthermore, in another study, participants with OHL had more OHL and fewer missing teeth compared to participants with insufficient OHL. There was also a significant relationship between behavioral characteristics and oral health status with the level of OHL (41). According to the results of our study, OHL and DMFT scores had a strong negative correlation, which is consistent with the results of two studies conducted in India (40) and the United States (42). This could be because people with low OHL levels are more likely to delay the diagnosis of any dental condition, and their condition worsens accordingly. The results of our study suggest that single people had better oral health conditions compared to married people. This might be due to the important priority of oral and dental hygiene and the importance of beauty in the lives of single people compared to married people.

Through a conceptual relationship model, de Buhr et al proposed that individuals' health results from their health-related decisions, which are influenced by health literacy and moderated by various social and demographic factors (43). The highest risk of developing oral and dental conditions was related to people with low OHL (44). Health literacy is a known mediator between socioeconomic factors, health behavior, and oral health outcomes in different populations, explaining the gradient of oral health status and outcomes (45). An individual's health literacy capacity is affected by education, culture, language, and characteristics of health-related environments. Our results in the confirmation of other studies show that health literacy is a highly important predictor of health, health behavior, and health outcomes of people in society (45,46). To plan and design oral health programs, it is important to know and consider the current state of OHL, behaviors, and personal habits related to oral health in society. Research assessing OHL is currently in its infancy. In particular, little is known about OHL in developing countries, including Iran (47). Therefore, there is still a need for more research to obtain comprehensive information in this field.

Limitations of the Study
Since the present study was cross-sectional research, it is impossible to infer any cause-and-effect relationship between the variables. This study examined patients referring to clinics, thus the generalization of the results to the entire population of patients with CVD would be problematic.

Conclusion
DMFT had a significant relationship with the participant's marital status, education, employment status, and income. The level of education, employment, and age had a direct relationship with increasing OHL. Therefore, in general, the results of this study revealed that the increase in OHL and education has a direct relationship with the increase in oral and dental hygiene. It is recommended that oral health education programs should be designed, implemented, and evaluated for patients with CVD, as well as monitoring the oral and dental health of patients with cardiovascular conditions.

Authors' Contribution
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Competing Interests
None.

Ethical Approval

All participants in this study were briefed on the study objectives and ensured that their information would remain confidential. This study was extracted from an earlier research project (U-99134). The present study was reviewed and approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1399.356).

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References

1. Hujoel PP, Drangsholt M, Spiekerman C, DeRouen TA. Periodontal disease and coronary heart disease risk. JAMA. 2000;284(11):1406-10. doi: 10.1001/jama.284.11.1406.
2. Duangthip D, Crystal YO, Chu CH. Oral health and policy for patients with special health care needs. Front Oral Health. 2021;2:802255. doi: 10.3389/froh.2021.802255.
3. Ikeda A, Iso H, Toyoshima H, Fujino Y, Mizoue T, Yoshimura T, et al. Marital status and mortality among Japanese men and women: the Japan Collaborative Cohort Study. BMC Public Health. 2007;7:73. doi: 10.1186/1471-2458-7-73.
4. Loscalzo J. Approach to the patient with possible cardiovascular disease. In: Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J, eds. Harrison's Principles of Internal Medicine. 20th ed. New York, NY: McGraw-Hill Education; 2018.
5. Tuominen R, Reunanen A, Paunio M, Paunio I, Aromaa A. Oral health indicators poorly predict coronary heart disease deaths. J Dent Res. 2003;82(9):713-8. doi: 10.1177/154405910308200911.
6. DeStefano F, Anda RF, Kahn HS, Williamson DF, Russell CM. Dental disease and risk of coronary heart disease and mortality. BMJ. 1993;306(6879):688-91. doi: 10.1136/bmj.306.6879.688.
7. Sanchez P, Everett B, Salamonson Y, Redfern J, Ajwani S, Bhole S, et al. The oral health status, behaviours and knowledge of patients with cardiovascular disease in Sydney Australia: a cross-sectional survey. BMC Oral Health. 2019;19(1):12. doi: 10.1186/s12903-018-0697-x.
8. Sheiham A. Oral health, general health and quality of life. Bull World Health Organ. 2005;83(9):644.
9. Scannapieco FA, Cantos A. Oral inflammation and infection, and chronic medical diseases: implications for the elderly. Periodontol 2000. 2016;72(1):153-75. doi: 10.1111/prd.12129.
10. Lima RB, Buarque A. Oral health in the context of prevention of absenteeism and presenteeism in the workplace. Rev Bras Med Trab. 2019;17(4):594-604. doi: 10.5327/z1679443520190397.
11. Hosseinpour F, Panahi R, Ranjbar Omidi B, Khorasani E, Dehghankar L. The relationship between tooth decay with stress and BMI among elementary students in Iran. Front Public Health. 2022;10:920004. doi: 10.3389/fpubh.2022.920004.
12. Dadaczynski K, Okan O, Messer M, Leung AYM, Rosário R, Darlington E, et al. Digital health literacy and web-based information-seeking behaviors of university students in Germany during the COVID-19 pandemic: cross-sectional survey study. J Med Internet Res. 2021;23(1):e24097. doi: 10.2196/24097.
13. Liu C, Wang D, Liu C, Jiang J, Wang X, Chen H, et al. What is the meaning of health literacy? A systematic review and qualitative synthesis. Fam Med Community Health. 2020;8(2):e000351. doi: 10.1136/fmch-2020-000351.
14. Tavousi M, Haeri-Mehrizi A, Rakhshani F, Rafiefar S, Soleymanian A, Sarbandi F, et al. Development and validation of a short and easy-to-use instrument for measuring health literacy: the Health Literacy Instrument for Adults (HELIA).

15. Mirsalimi F, Ghofranipour F, Noroozi A, Montazeri A. The postpartum depression literacy scale (PoDLiS): development and psychometric properties. BMC Pregnancy Childbirth. 2020;20(1):13. doi: 10.1186/s12884-019-2705-9.
16. Cho HA, Im AJ, Sim YR, Jang HB, Lim HJ. The association between oral health literacy and oral health behaviors in North Korean defectors: a cross-sectional study. BMC Public Health. 2020;20(1):1074. doi: 10.1186/s12889-020-08550-7.
17. Silva-Junior MF, da Luz Rosário de Sousa M, Batista MJ. Health literacy on oral health practice and condition in an adult and elderly population. Health Promot Int. 2021;36(4):933-42. doi: 10.1093/heapro/daaa135.
18. Batista MJ, Lawrence HP, da Luz Rosário de Sousa M. Oral health literacy and oral health outcomes in an adult population in Brazil. BMC Public Health. 2017;18(1):60. doi: 10.1186/s12889-017-4443-0.
19. Barasuol JC, Daros BCI, Fraiz FC, Menezes J. Caregiver oral health literacy: relationship with socioeconomic factors, oral health behaviors and perceived child dental status. Community Dent Health. 2020;37(2):110-4. doi: 10.1922/CDH_4550Barasuol05.
20. Adil AH, Eusufzai SZ, Kamruddin A, Wan Ahmad WMA, Jamayet NB, Karobari MI, et al. Assessment of parents' oral health literacy and its association with caries experience of their preschool children. Children (Basel). 2020;7(8):101. doi: 10.3390/children7080101.
21. Dieng S, Cisse D, Lombrail P, Azogui-Lévy S. Mothers' oral health literacy and children's oral health status in Pikine, Senegal: a pilot study. PLoS One. 2020;15(1):e0226876. doi: 10.1371/journal.pone.0226876.
22. Lopes RT, Neves É TB, da Costa Dutra L, Gomes MC, Paiva SM, de Abreu M, et al. Socioeconomic status and family functioning influence oral health literacy among adolescents. Rev Saude Publica. 2020;54:30. doi: 10.11606/s1518-8787.2020054001842.
23. Neves ÉTB, da Costa Dutra L, Gomes MC, Paiva SM, de Abreu M, Ferreira FM, et al. The impact of oral health literacy and family cohesion on dental caries in early adolescence. Community Dent Oral Epidemiol. 2020;48(3):232-9. doi: 10.1111/cdoe.12520.
24. Neves ÉTB, de Lima LC, da Costa Dutra L, Gomes MC, Siqueira M, Paiva SM, et al. Oral health literacy, sociodemographic, family, and clinical predictors of dental visits among Brazilian early adolescents. Int J Paediatr Dent. 2021;31(2):204-11. doi: 10.1111/ipd.12660.
25. Singh P, Singh R, Kumari S, Kumari S, Singh S, Singh JP. Impact of oral health literacy on periodontal health among low-income-group workers of dental institutes in Patna, Bihar, India. J Contemp Dent Pract. 2020;21(7):787-91.
26. Mialhe FL, Santos BL, Bado FMR, de Oliveira Júnior AJ, Soares GH. Association between oral health literacy and dental outcomes among users of primary healthcare services. Braz Oral Res. 2022;36:e004. doi: 10.1590/1807-3107bor-2022.vol36.0004.
27. Niazi S, Eusufzai SZ, Saddki N. Predictors of oral health literacy in pregnant women. Health Care Women Int. 2022:1-15. doi: 10.1080/07399332.2022.2046751.
28. Valdez R, Spinler K, Kofahl C, Seedorf U, Heydecke G, Reissmann DR, et al. Oral health literacy in migrant and ethnic minority populations: a systematic review. J Immigr Minor Health. 2022;24(4):1061-80. doi: 10.1007/s10903-021-01266-9.
29. Wang Y, Inglehart MR, Yuan C. Impact of parents' oral health literacy on their own and their children's oral health in Chinese population. Front Public Health. 2022;10:809568. doi: 10.3389/fpubh.2022.809568.

30. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. J Gen Intern Med. 1995;10(10):537-41. doi: 10.1007/bf02640361.

31. Haerian Ardakani A, Morowati Sharifabad MA, Rezapour Y, Pourghayumi Ardakani A. Investigation of the relationship of oral health literacy and oral hygiene self-efficacy with DMFT and Gingival index in students of Ardakan University. Payesh. 2015;14(3):351-62. [Persian].

32. Karimy M, Fakhri A, Vali E, Vali F, Veiga FH, Stein LAR, et al. Disruptive behavior scale for adolescents (DISBA): development and psychometric properties. Child Adolesc Psychiatry Ment Health. 2018;12:17. doi: 10.1186/s13034-018-0221-8.

33. Waltz CF, Bausell RB. Nursing Research: Design, Statistics, and Computer Analysis. FA Davis Company; 1981.

34. Mehrdad K. International Epidemiologic Index in Dentistery Researches in Order to World Health Organization. Jahad Daneshgahi of Shahid Beheshti University Publishing; 2021.

35. Atchison KA, Gironda MW, Messadi D, Der-Martirosian C. Screening for oral health literacy in an urban dental clinic. J Public Health Dent. 2010;70(4):269-75. doi: 10.1111/j.1752-7325.2010.00181.x.

36. Jones M, Lee JY, Rozier RG. Oral health literacy among adult patients seeking dental care. J Am Dent Assoc. 2007;138(9):1199-208. doi: 10.14219/jada.archive.2007.0344.

37. Naghibi Sistani MM, Yazdani R, Virtanen J, Pakdaman A, Murtomaa H. Oral health literacy and information sources among adults in Tehran, Iran. Community Dent Health. 2013;30(3):178-82.

38. Lee HJ, Choi EK, Park JB, Han KD, Oh S. Tooth loss predicts myocardial infarction, heart failure, stroke, and death. J Dent Res. 2019;98(2):164-70. doi: 10.1177/0022034518814829.

39. Sabbahi DA, Lawrence HP, Limeback H, Rootman I. Development and evaluation of an oral health literacy instrument for adults. Community Dent Oral Epidemiol. 2009;37(5):451-62. doi: 10.1111/j.1600-0528.2009.00490.x.

40. Haridas R, Supreetha S, Ajagannanavar SL, Tikare S, Maliyil MJ, Kalappa AA. Oral health literacy and oral health status among adults attending dental college hospital in India. J Int Oral Health. 2014;6(6):61-6.

41. Blizniuk A, Ueno M, Zaitsu T, Kawaguchi Y. Association of oral health literacy with oral health behaviour and oral health status in Belarus. Community Dent Health. 2015;32(3):148-52.

42. Baskaradoss JK. Relationship between oral health literacy and oral health status. BMC Oral Health. 2018;18(1):172. doi: 10.1186/s12903-018-0640-1.

43. de Buhr E, Tannen A. Parental health literacy and health knowledge, behaviours and outcomes in children: a cross-sectional survey. BMC Public Health. 2020;20(1):1096. doi:10.1186/s12889-020-08881-5.

44. Basir L, Karimy M, Khoshroo S, Behbudi A, Azizi Malmiri R, Araban M. Association between Oral Health Literacy of Mothers with Child who has Epilepsy and the Children's Oral Health. Health Educ Health Promot 2020; 8 (4) :217-222

45. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. Ann Intern Med. 2011;155(2):97-107. doi: 10.7326/0003-4819-155-2-201107190-00005.

46. Berkman ND, Davis TC, McCormack L. Health literacy: what is it? J Health Commun. 2010;15 Suppl 2:9-19. doi: 10.1080/10810730.2010.499985.

47. Hongal S, Torwane NA, Goel P, Chandrashekar BR, Jain M, Saxena E. Assessing the oral health literacy: a review. Int J Med Public Health. 2013;3(4):219-24. doi: 10.4103/2230-8598.123406.