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Original Article

Relationship between oral health literacy and changes in self-assessment of oral health during COVID-19

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KEYWORDS
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Abstract *Background/purpose:* Health literacy is thought to play a major role in implementing health behaviors, such as preventing coronavirus disease 2019 (COVID-19). In this study, we aimed to examine the relationship between oral health literacy (OHL), dietary literacy (DL), and changes in oral health and eating habits during the COVID-19 pandemic.
Materials and methods: The self-assessment questionnaire, including questions on oral and dietary conditions for each period of the COVID-19 pandemic, sources of information, OHL, DL, and frequency of COVID-19 prevention measures, was administered using a web research company. All participants were divided into low- and high-literacy groups based on the median scores: those who scored above the median in the high group and those who scored at or below the median in the low group. Comparisons were conducted between the two groups.
Results: The median OHL and DL scores were 16 and 17 for the 344 participants included in the study (168 males and 176 females); 160 (46.5%) participants had high OHL scores, and 157 (45.6%) had high DL scores. The group with high OHL or DL tended to collect information sent by medical professionals compared to the group with low OHL or DL, had significantly higher scores on self-assessment of oral and dietary conditions, and tended to implement infection control actions more frequently in eating situations.
Conclusion: The high OHL and DL groups gathered information from professionals to have attain oral and dietary conditions regardless of COVID-19 and tended to implement infection prevention measures in oral health and diet.

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Introduction

The coronavirus disease 2019 (COVID-19) turned into a global pandemic. People became aware of the characteristics of COVID-19 and implemented preventive measures against this infection. In response to the infection caused by droplets, such as coughing,[1] physical distance and wearing masks proved useful.[2] The World Health Organization (WHO) also recommended prevention measures, for example, washing hands, sterilizing hands, and wearing a mask.[3] In Japan, a state of emergency was declared in April 2020, and the government requested that people refrain from going out for non-essential work to avoid contact with people.[4] As an infection prevention measure, people were encouraged to manage hand hygiene by washing and disinfecting their hands and wearing masks.[4–6] They were also advised to refrain from eating, drinking, or eating out with others as the risk of infection was particularly high.[4]

Brushing teeth decreases the number of bacteria in the oral cavity, and improving oral hygiene could reduce the risk of respiratory complications.[7] Individuals who have decreased the frequency and duration of tooth brushing since the onset of COVID-19 are more likely to develop the primary symptoms of COVID-19 (fever, cough, and taste and smell disorders);[8] thus, tooth brushing is recommended for its prevention.[9]

Health literacy is important in implementing health actions, such as infection management. Health literacy is defined as "the ability to obtain, understand, evaluate, and utilize health information to maintain and improve quality of life throughout one's life" by WHO and others.[10,11] Many measures of health literacy have been developed, including oral health literacy (OHL)[12,13] and food literacy.[14,15] The OHL has several scales that only measure knowledge,[12,13] while others measure the ability to use the knowledge incorporated. Although some studies using these scales have been published in Japan,[16–18] only few studies have investigated the relationship between OHL and oral health behavior.

A previous study used food literacy scores to examine eating habits before and after COVID-19.[19] It was reported that among people living in 38 countries, including Japan, behaviors such as planning, choice, and preparation of healthy meals increased after the pandemic. However, only a few studies have investigated whether awareness regarding oral health has changed because of COVID-19. Moreover, eating habits vary depending on the condition of oral health, including periodontitis.[20] Thus, it would be meaningful to investigate how OHL and dietary literacy (DL) relate to awareness of oral health and healthy eating.

Therefore, in this study, we aimed to examine the association between differences in OHL or DL, access to information about COVID-19, and self-assessment of oral health and dietary behavior to clarify their ability of individuals with differing literacy levels. Additionally, we explored how people obtained information and acted on their health and oral and nutritional status before and after COVID-19 and examined how their oral and nutritional status changed during COVID-19.

Materials and methods

This study was conducted online using the website of a research company (Macromill, Inc., Tokyo, Japan), in October 2021, with participants recruited from survey monitor members. A range of age groups were included: those in their 20s, 30s, 40s, 50s, and 60s and over. In total, 344 participants were selected in equal numbers by sex and age. The recruitment continued until the numbers reached the target sample size required in each group.

Ethical approval was granted by the Ethics Review Committee of Tokyo Medical and Dental University of Dentistry (D2021-051). Before the participants undertook this survey, they were asked to carefully read the research instructions describing the outline and purpose of the research, and informed consent was obtained from all participants via the web before completing the survey. The participants answered the questionnaire anonymously.

Classification of oral health literacy and dietary literacy

To evaluate the ability of individuals to collect information and decide on the required action for healthy eating and oral health habits, this study used the OHL and DL scales developed for Japanese individuals. The DL scale can be used to evaluate participants' dietary habits and ask questions about collecting and applying dietary information. We modified the Healthy Dietary Literacy Scale,[21] which has been tested for reliability and validity for adults in Japan. The OHL scale was used by replacing "diet" with "dental and oral health" in the DL questionnaire.[21]

The participants were asked questions on their sources of information and application of information regarding their oral health or healthy diet: "How are you able to gather and use information?" Each literacy item consisted of five items: correct information is provided for healthy diet/oral health, choosing this information, evaluating whether the information is reliable, understanding the information and disseminating the information to others, and deciding the actions or plans to improve their health based on this information. A score of 1—5 was given per item (from "Not at all": 1 point to "Able enough": 5 points), and the total score of the five items was calculated as the OHL or DL of the participants, ranging from 1 to 25. All participants were divided into low and high-literacy groups based on the median scores.

Questions

The participants answered a questionnaire about socio-demographic characteristics, "Sources of information seen and heard" and "Reliable sources of COVID-19," "State of oral health," "State of dietary habits," and "The frequency of preventive measures for COVID-19." Sociodemographic characteristics included sex, age, marital status, and the presence of children.

The questions on "Sources of information seen and heard" and "The reliable sources of COVID-19" were answered only after the spread of COVID-19, and the items were chosen based on a previous study:[22] "Television," "Radio," "Newspaper publishers, books and magazine publishers," "National, prefectural and municipal governments," "Hospitals, clinics, family doctors and dentists," "Family, friends, and acquaintances," "Corporations and Nonprofit Organizations," "Websites and social networking sites," and "Nothing in particular."

"State of oral health" included self-evaluation of oral health and anxiety for having COVID-19. "State of dietary habits" included questions regarding "Nutritional balance," "Satisfaction with food environment," "The frequency of eating outside," "The frequency of eating food by home delivery," "The amount of eating," "The motivation of eating," and "The anxiety for bacterial and viral infections." These questions were answered on a 10-point scale (from "Very poorly" and "Very anxious": 1 to "Very good" and "No anxiety": 10).

Questions regarding the "State of oral health" and "State of dietary habits" were asked in three periods: before the COVID-19 pandemic (before COVID-19), under declaration, and a state of releasing declaration (releasing declaration). "Before COVID-19" referred to the period before the pandemic began. "Under declaration" referred to the periods during the states of emergency in Japan, from April 7, 2020, to May 25, 2020, January 7, 2021, to March 21, 2021, April 25, 2021, to June 20, 2021, and July 12, 2021, to September 30, 2021. "Releasing declaration" referred to other periods when the declaration was lifted (Fig. 1).

"The frequency of preventive measures for COVID-19" included questions regarding "Wearing a mask while talking with other people," "When dining out, eat in small groups and in short time", "Having a meal with social distancing," "Eating a nutritionally balanced diet," and "Washing your hands and sanitizing them." Each question had 5 options ("Always," "Usually," "Neither," "Very little," and "Nothing").

Statistical analysis

The chi-square and Wilcoxon rank-sum tests were used to compare the two groups for OHL and DL. The Wilcoxon rank-sum test was used to compare groups at each literacy level. Pearson correlation coefficient was used to identify the correlation between OHL and DL. Furthermore, the 10-point self-rating items were subjected to Friedman's test to compare a total of three periods: "Before COVID-19" to "Under declaration," "Under declaration" to "Releasing declaration," and "Releasing declaration" to "Before COVID-19." When the items were significantly associated, the Bonferroni correction was used. For Bonferroni correction, statistical significance was set at $P < 0.017$, and the others were set at $P < 0.050$. Statistical analyses were performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA).

Results

The total number of participants included in this study was 344 (168 males and 176 females), excluding one whose responses were incomplete. The mean age of the participants was 45.1 (standard deviation: 15.0) years. The median OHL

Please self-evaluate your oral health, general condition, living conditions, financial condition, coronary infections, and vaccinations at each time period with a score.

1: very poorly / very anxious ～ 10：very good / no anxiety)

		1	2	3	4	5	6	7	8	9	10
Before COVID-19	Oral health condition										
	Anxiety for having COVID-19										
Under declaration	Oral health condition										
	Anxiety for having COVID-19										
Releasing declaration	Oral health condition										
	Anxiety for having COVID-19										

How many points would you give to the following items regarding your eating habits during each time period,on a scale of 1 to 10,?

1: very bad / very much - 10: very good / very little

		1	2	3	4	5	6	7	8	9	10
Before COVID-19	Nutritional balance										
	Satisfaction with food environment										
Under declaration	Nutritional balance										
	Satisfaction with food environment										
Releasing declaration	Nutritional balance										
	Satisfaction with food environment										

Figure 1 Example of a self-assessment questionnaire. Abbreviations: COVID-19, coronavirus disease 2019.

and DL scores were 16 and 17. The median score was used to divide the patients into two groups: those who scored above the median in the high group and those who scored at or below the median in the low group. The high OHL group comprised 160 participants (46.5%), and the high DL group comprised 157 people (45.6%) (Table 1). A significant correlation was found between OHL and DL ($r = 0.781$; $P < 0.001$). Regarding information sources, the high OHL and DL groups saw and heard more from the mass media, public institutions, and healthcare providers than the low OHL and DL groups (Figs. 2 and 3). Moreover, they responded significantly more reliably to public institutions and healthcare providers (Figs. 4 and 5).

Comparing self-evaluation items over the three periods, the "Oral health condition" score tended to be lower under declaration than before COVID-19 but higher at the release of declaration than under it (Table 2). The scores of "The anxiety for having COVID-19" ($P < 0.001$) and "Satisfaction with food environment" ($P < 0.001$) under the declaration were significantly lower than that before COVID-19, but

Table 1 Basic literacy attributes among the participants.

		Oral health literacy					Dietary literacy				
		Low		High		*P*	Low		High		*P*
		N	%	N	%		N	%	N	%	
Age	20–29 years old	44	23.9	25	15.6	0.666	45	24.1	24	15.3	0.060
	30–39 years old	46	25.0	24	15.0		42	22.5	28	17.8	
	40–49 years old	34	18.5	32	20.0		36	19.3	30	19.1	
	50–59 years old	37	20.1	35	21.9		34	18.2	38	24.2	
	60 years old and over	23	12.5	44	27.5		30	16.0	37	23.6	
Sex	Male	92	50.0	76	47.5	0.001	99	52.9	69	43.9	0.005
	Female	92	50.0	84	52.5		88	47.1	88	56.1	
Marital status	Unmarried	79	42.9	54	33.8	0.096	74	39.6	59	37.6	0.395
	Married	105	57.1	106	66.3		113	60.4	98	62.4	
Presence or absence of children	Presence	92	50.0	65	40.6	0.084	94	50.3	93	59.2	0.060
	Absence	92	50.0	95	59.4		93	49.7	64	40.8	
COVID-19 vaccination status	2 times	121	65.8	132	82.5	<0.001	125	66.8	128	81.5	0.003
	1 time	24	13.0	9	5.6		24	12.8	9	5.7	
	Planned to be vaccinated	9	4.9	6	3.8		11	5.9	4	2.5	
	Do not inoculate	12	6.5	10	6.3		11	5.9	11	7.0	
	Undecided/hesitant	18	9.8	3	1.9		16	8.6	5	3.2	

Abbreviations: COVID-19, coronavirus disease 2019.

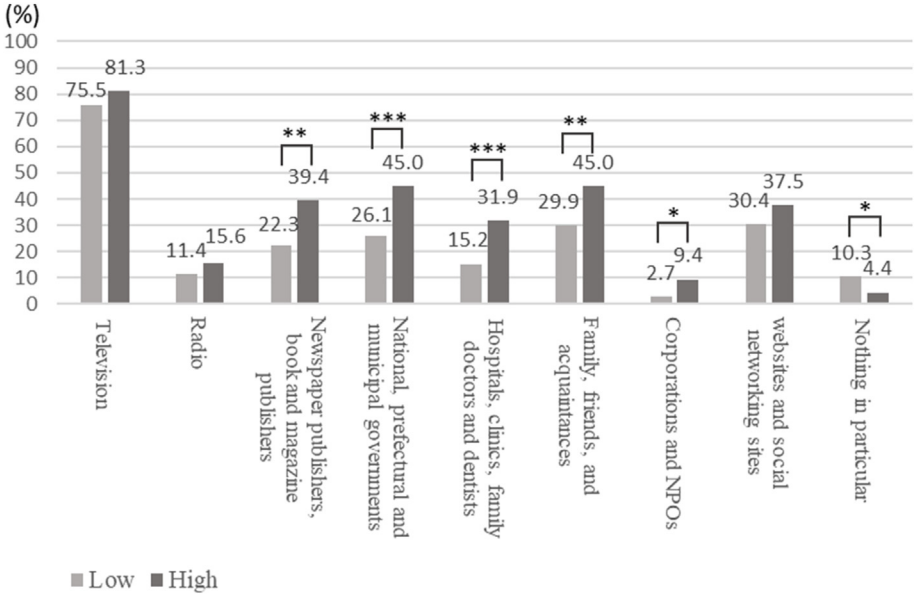

Figure 2 Comparison between two groups on the oral health literacy sources of information seen and heard. *: $P < 0.050$, **: $P < 0.01$ ***: $P < 0.001$. Abbreviations: NPO, Nonprofit Organization.

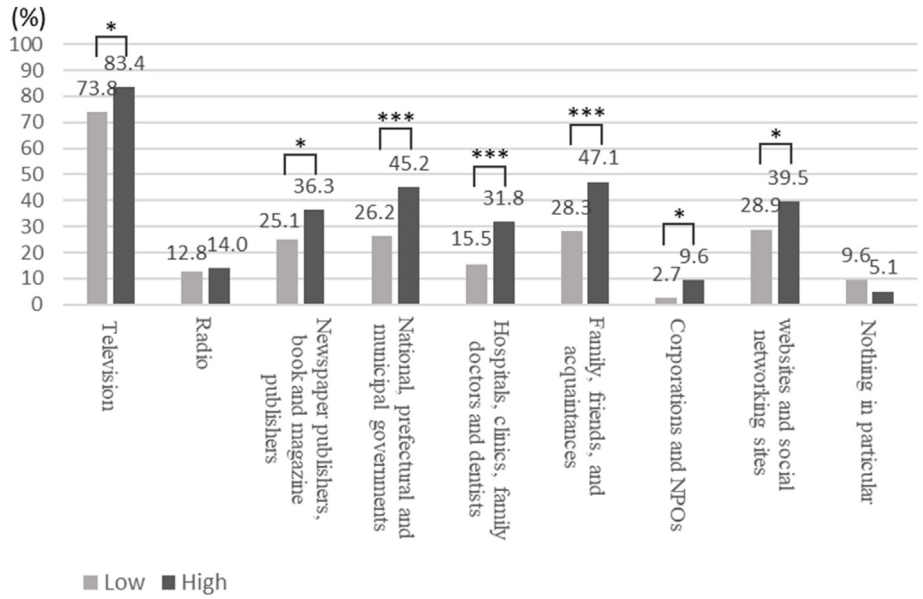

Figure 3 Comparison between two groups on the dietary literacy sources of information seen and heard. *: $P < 0.050$, **: $P < 0.01$ ***: $P < 0.001$. Abbreviations: NPO, Nonprofit Organization.

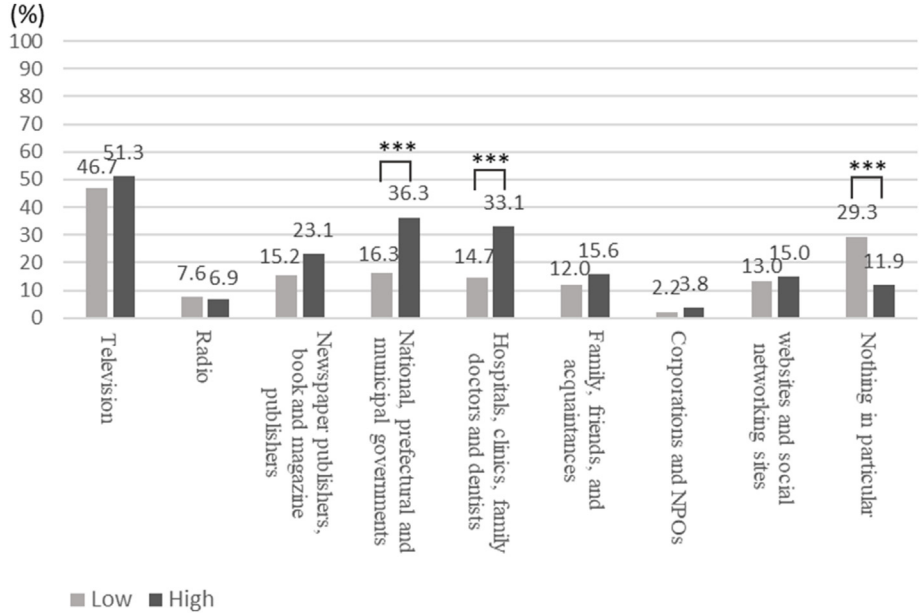

Figure 4 Comparison between two groups based on reliable oral health literacy sources. *: $P < 0.050$, **: $P < 0.01$ ***: $P < 0.001$.

these scores at releasing declaration were not recovered (Table 2).

The results of the comparison of self-evaluation items by each literacy level for each period are shown in Table 3. In the self-assessment of "Oral health condition," the high OHL group had significantly higher scores than the low OHL group in all items, indicating that their oral health condition was good. Regarding the "State of dietary habits," the score of the high OHL group was higher than the low OHL group with respect to the question on "Satisfaction with food environment" ($P < 0.001$). In contrast, the score for the question "The anxiety for bacterial and viral infections" did not show a significant difference under declaration ($P = 0.193$). This showed that, regardless of the OHL level, participants were strongly anxious about bacterial and viral infections. The results of the DL scale showed a similar tendency ($P = 0.123$). In terms of the frequency of prevention measures for COVID-19, the high OHL groups acted more significantly than the low OHL group in almost all aspects (Table 4).

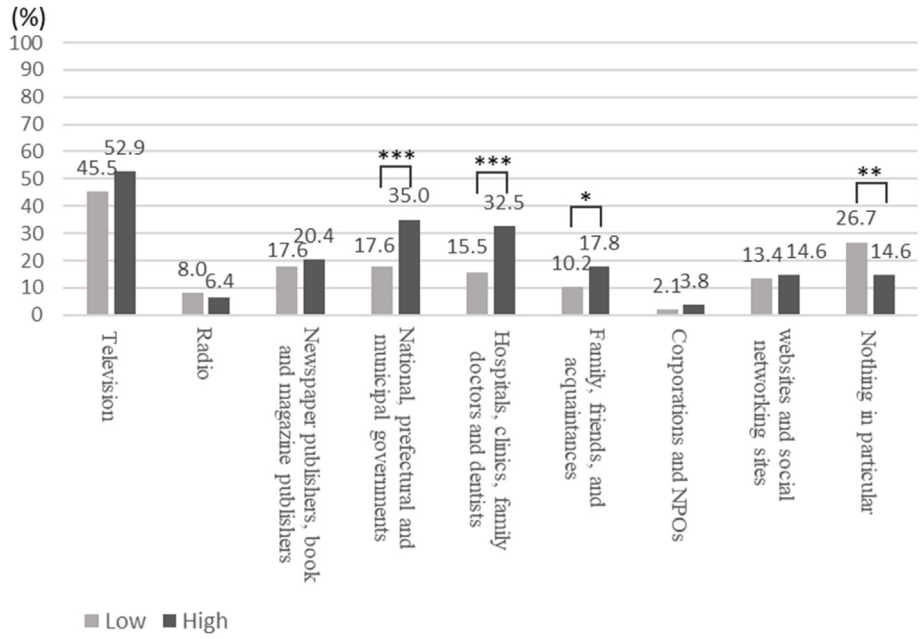

Figure 5 Comparison between two groups based on reliable oral dietary literacy sources. *: $P < 0.050$, **: $P < 0.01$ ***: $P < 0.001$.

Table 2 Comparison of coronavirus disease 2019 (COVID-19) and 3 periods in self-assessment items.

		Mean			Friedman's test	Bonferroni correction
		Before COVID-19	Under declaration	Releasing declaration		
State of oral health	Oral health condition	6.01	5.88	5.90	0.014	
	Anxiety about having COVID-19	6.64	5.38	5.59	<0.001	Under declaration < before COVID-19, Releasing declaration < before COVID-19
State of dietary habits	Nutritional balance	6.17	6.10	6.17	0.210	
	Satisfaction with the food environment	6.37	6.01	6.19	<0.001	Under declaration < before COVID-19, Under declaration < releasing declaration
	The frequency of eating outside	6.15	5.77	5.99	0.018	
	The frequency of eating delivery	6.38	6.15	6.28	0.053	
	The amount of eating	5.96	5.81	6.00	0.075	
	The motivation of eating	6.11	5.93	6.02	0.038	
	The anxiety about bacterial and viral infections	6.15	4.73	5.23	<0.001	Under declaration < releasing declaration < before COVID-19

Abbreviations: COVID-19, coronavirus disease 2019;.Before COVID-19, before the COVID-19 pandemic; Releasing declaration, a state of releasing declaration.

Table 3 Comparison between two literacy groups in the self-assessment items.

	Period		Oral health literacy			Dietary literacy		
			Low	High	*P*	Low	High	*P*
			Mean	Mean		Mean	Mean	
Self-evaluation of oral health	Before COVID-19	Oral health condition	5.50	6.61	<0.001	5.48	6.66	<0.001
		Anxiety about having COVID-19	6.11	7.24	<0.001	6.16	7.21	0.001
	Under declaration	Oral health condition	5.41	6.43	<0.001	5.46	6.38	<0.001
		Anxiety about having COVID-19	4.87	5.98	<0.001	4.98	5.86	0.006
	At the release declaration	Oral health condition	5.41	6.46	<0.001	5.43	6.45	<0.001
		Anxiety about having COVID-19	4.92	6.36	<0.001	5.11	6.16	0.001
Self-evaluation of dietary habits	Before COVID-19	Nutritional balance	5.52	6.91	<0.001	5.57	6.87	<0.001
		Satisfaction with the food environment	5.71	7.12	<0.001	5.70	7.17	<0.001
		The frequency of eating outside	5.81	6.54	0.001	5.66	6.73	<0.001
		The frequency of eating delivery	5.87	6.98	<0.001	5.87	6.99	<0.001
		The amount of eating	5.61	6.36	<0.001	5.52	6.48	<0.001
		The motivation for eating	5.65	6.64	<0.001	5.63	6.69	<0.001
		The anxiety about bacterial and viral infections	5.54	6.84	<0.001	5.61	6.79	<0.001
	Under declaration	Nutritional balance	5.52	6.76	<0.001	5.45	6.87	<0.001
		Satisfaction with the food environment	5.48	6.61	<0.001	5.40	6.73	<0.001
		The frequency of eating outside	5.53	6.05	0.049	5.48	6.12	0.026
		The frequency of eating delivery	5.65	6.73	<0.001	5.77	6.61	0.001
		The amount of eating	5.46	6.21	<0.001	5.39	6.31	<0.001
		The motivation for eating	5.56	6.36	<0.001	5.45	6.51	<0.001
		The anxiety about bacterial and viral infections	4.57	4.91	0.193	4.53	4.96	0.123
	At the release declaration	Nutritional balance	5.60	6.83	<0.001	5.54	6.92	<0.001
		Satisfaction with the food environment	5.60	6.87	<0.001	5.55	6.96	<0.001
		The frequency of eating outside	5.62	6.41	0.001	5.46	6.62	<0.001
		The frequency of eating delivery	5.72	6.93	<0.001	5.76	6.90	<0.001
		The amount of eating	5.58	6.48	<0.001	5.56	6.52	<0.001
		The motivation of eating	5.61	6.49	<0.001	5.53	6.60	<0.001
		The anxiety about bacterial and viral infections	4.77	5.76	<0.001	4.84	5.68	0.001

Abbreviations: COVID-19, coronavirus disease 2019; Before COVID-19, before the COVID-19 pandemic; Releasing declaration, a state of releasing declaration.

Table 4 Comparison between two literacy groups in the self-assessment items.

Prevention measures for COVID-19	Frequency	Oral health literacy					Dietary literacy				
		Low		High		*P*	Low		High		*P*
		N	%	N	%		N	%	N	%	
Wearing a mask when you have a conversation with someone	Always	95	51.6	94	58.8	0.361	91	48.7	98	62.4	0.013
	Usually	44	23.9	30	18.8		43	23.0	31	19.7	
	Sometimes	26	14.1	14	8.8		30	16.0	10	6.4	
	Very little	11	6.0	11	6.9		13	7.0	9	5.7	
	Nothing	8	4.3	11	6.9		10	5.3	9	5.7	
Having a meal with social distancing	Always	78	42.4	86	53.8	0.001	74	39.6	90	57.3	<0.001
	Usually	52	28.3	56	35.0		58	31.0	50	31.8	
	Sometimes	33	17.9	11	6.9		33	17.6	11	7.0	
	Very little	13	7.1	4	2.5		13	7.0	4	2.5	
	Nothing	8	4.3	3	1.9		9	4.8	2	1.3	
When dining out, eat in small groups and in short time	Always	79	42.9	88	55.0	0.006	76	40.6	91	58.0	<0.001
	Usually	56	30.4	49	30.6		59	31.6	46	29.3	
	Sometimes	26	14.1	12	7.5		29	15.5	9	5.7	
	Very little	12	6.5	6	3.8		12	6.4	6	3.8	
	Nothing	11	6.0	5	3.1		11	5.9	5	3.2	
Eating a nutritionally balanced diet	Always	44	23.9	57	35.6	<0.001	38	20.3	63	40.1	<0.001
	Usually	55	29.9	57	35.6		56	29.9	56	35.7	
	Sometimes	62	33.7	38	23.8		69	36.9	31	19.7	
	Very little	14	7.6	6	3.8		14	7.5	6	3.8	
	Nothing	9	4.9	2	1.3		10	5.3	1	0.6	
Washing your hands and sanitizing them	Always	101	54.9	117	73.1	<0.001	100	53.5	118	75.2	<0.001
	Usually	44	23.9	34	21.3		46	24.6	32	20.4	
	Sometimes	26	14.1	4	2.5		26	13.9	4	2.5	
	Very little	8	4.3	4	2.5		10	5.3	2	1.3	
	Nothing	5	2.7	1	0.6		5	2.7	1	0.6	

Abbreviations: COVID-19, coronavirus disease 2019.

Discussion

This study evaluated the changes in oral health and eating habits during the COVID-19 pandemic and the relationship between OHL and DL. Our results showed that individuals with high OHL and DL scores reported that their oral health was healthy and that their dietary status was good, regardless of the spread of COVID-19.

Regarding the source of information about COVID-19, the group with high OHL and DL scores gathered this information from medical and dental professionals ("Hospitals, clinics, and family doctors and dentists" who were the "Reliable sources") compared to the low OHL and DL score groups. It is possible that the respondents trusted the company to be professional in infectious disease control and could provide information by presenting scientific evidence.

The comparison of the three time periods for the self-assessment of "Oral health condition" showed no significant differences; when compared at the OHL level and DL level, the high OHL and DL groups were significantly better in maintaining their "Oral health condition." This showed that regardless of the spread of COVID-19, the high OHL group was aware of the daily maintenance of good oral health. Dietary habits like masticatory function may closely relate to oral status. A study using OHL to evaluate dental knowledge showed that the higher the OHL, the better the subjective oral health condition.[17] The high DL group is willing to improve and maintain their dietary habits even when infectious diseases are prevalent, which may have led to their good oral status. In contrast, there was no significant difference in "The anxiety for bacterial and viral infections" between the OHL and DL groups under declaration. It is suggested that COVID-19 was an unknown virus under the declaration and that anxiety about it was strong regardless of literacy. In a previous study on DL, psychological stress during the spread of COVID-19 was associated with a decrease in planning, choosing, and preparing healthy meals.[19]

Although participants showed increased satisfaction levels with the food environment at the time of the declaration compared with that during the declaration, it was seen that the dietary environment had not recovered to pre-COVID-19 levels. At that time, the peak of the fifth wave had passed in Japan, just after the declaration was lifted on October 1, 2021.[23] Lifting the restriction on the operating hours of restaurants may have contributed to an increase in satisfaction with the dining environment.

The present study has a few limitations. First, the study was conducted online; therefore, answers from people who cannot use the Internet might not be reflected in this study. As the target audience was limited to surveying members of a certain marketing research company, it may not represent each age group set at the time of sample extraction. Second, the answers to the self-evaluation items asked before and after COVID-19 relied on the participants'

memories. It is difficult to compare their condition at the same time during the three periods of COVID-19 because the content and degree of restrictions were different even when the same state of emergency was declared, which may have resulted in different conditions at the time of the state of emergency declaration among participants. Third, the state of the oral health and eating habits used in this study were subjectively self-evaluated retrospectively, therefore there are possibility of bias such as memory bias and subjective biases. A previous study has shown a relationship with periodontal disease in the group with low OHL scores.[17] However, most studies on the association between OHL and periodontal disease lack unified criteria;[24] therefore, it is necessary to verify this using objective data on periodontal disease and oral hygiene.

This study was the first to examine oral and dietary status using multiple health literacy measures during the COVID-19 pandemic. Increasing the levels of health literacy will help people become aware of their health status and acquire the correct methods of disease prevention. Our study highlights the fact that it is important for dentists and other health professionals to provide correct knowledge about oral diseases and a healthy diet to prevent infections. On the other hand, our findings indicated that information needs to be tailored to reach those with low OHL and DL values. It is also necessary to verify information and effectively disseminate preventive measures for COVID-19 or other new infectious diseases.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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