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## ORIGINAL ARTICLE

# Relationship between oral health literacy and oral health behaviors and clinical status in Japanese adults

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oral health status

**Abstract** *Background/purpose:* Health literacy is recognized as an important determinant of health as well as a causal factor in health disparities among different population groups. However, the paucity of information on oral health literacy makes urgent the need for more research on this important topic. The objective of this study was to investigate how oral health literacy relates to oral health behaviors, as well as clinical dental and periodontal condition. *Materials and methods:* A self-administered questionnaire and dental examination collected information on demographics of 589 adult residents of Akita prefecture, Japan, including: oral health behaviors; oral hygiene status; oral health literacy; number of natural teeth, decayed teeth, and functional tooth units (FTUs); and community periodontal index. *Results:* Less than half of the participants knew the Japanese words such as “dental plaque,” “scaling,” “gingivitis,” “fluoride mouth rinsing,” “8020 campaign,” “mouthwash,” and “denture plaque,” or answered “true” in response to the statement: “Scaling is related to periodontal disease.” The higher a participant’s oral health literacy, the more often they brushed their teeth or dentures, self-checked oral condition with a mirror, had regular dental checkups, and the better their oral hygiene status. Furthermore, individuals with higher oral health literacy had higher mean numbers of natural teeth, n-FTUs, and nif-FTUs. Participants with higher oral health literacy also had fewer decayed teeth. Participants with low oral health literacy were more likely to fall into a higher category of the community periodontal index code compared to those with high oral health literacy. *Conclusion:* Our findings indicate that oral health literacy is associated with differences in oral health behaviors and clinical oral health status. An understanding of participants’ oral health

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literacy levels is crucial for designing effective health educational materials and creating intervention programs to promote oral health.

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## Introduction

For the past 10 years or so, awareness of the importance of health literacy in dentistry has grown, and efforts have been directed at adapting the concept of health literacy to dental practice and research.<sup>1–5</sup> According to the World Health Organization, health literacy is defined as the “cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health.”<sup>6</sup> In dentistry, *Healthy People 2010* first defined oral health literacy as the “degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions,” a definition consistent with that of general health literacy.<sup>7</sup> Studies have indicated that health literacy is related to various aspects of health, including knowledge, status, outcomes, and the use of services.<sup>8,9</sup> Health literacy is now recognized as an important determinant of health as well as a causal factor in health disparities among different population groups.<sup>1</sup>

People with low health literacy may struggle to comprehend and use information in written materials that contain new ideas or unfamiliar terminology. In contrast, people who exhibit good understanding of the information provided in the health care setting more easily adhere to instructions for self-care, postoperative precautions, medications, and follow-ups. These improved health behaviors, in turn, can promote their health status. Many health instructions and brochures have a level of difficulty beyond the average patient’s reading ability and often contain professional terminology that makes the text difficult to understand,<sup>10</sup> according to studies assessing the reading level of educational materials and postoperative instructions for patients<sup>11,12</sup> and patients’ understanding of verbal informed consent information.<sup>13</sup> However, this situation is commonly encountered in health care settings.

Few studies have been conducted regarding the impact of oral health literacy on oral health behaviors and actual oral health status.<sup>4</sup> One report has indicated that oral health literacy is associated with self-reported oral health.<sup>14</sup> In Japan, no studies have examined the relationship between oral health literacy and clinical oral health. Information on oral health literacy can help dental clinicians and researchers better estimate how well their patients understand the oral health-related information given to them. The paucity of information on oral health literacy makes urgent the need for more research on this important topic.

We hypothesized that oral health literacy may be an important explanatory factor in clinical dental outcome measures—individuals with limited oral health literacy will present with a poorer clinical oral health status. Thus, the objective of this cross-sectional study was to investigate

how oral health literacy relates to oral health behaviors, as well as clinical dental and periodontal conditions in Japan.

## Materials and methods

The participants consisted of 589 adult residents of Akita prefecture, Japan, ages 20 years and older, who were informed about and consented to participate in the “Akita Oral Health Survey.” Akita prefecture is situated in the northwest area of Japan with a population of about 1 million. The participants all underwent a self-administered questionnaire followed by a dental examination between October and December of 2006. After excluding those with incomplete data, the final sample used for the analysis contained 518 participants. Ethical approval for this study was granted by the Tokyo Medical and Dental University Ethical Committee.

## The questionnaire

The self-administered questionnaire written in Japanese included demographics (age and gender); oral health behaviors, such as frequency of tooth or denture brushing (every day, sometimes, or none); frequency of oral health self-check with a mirror (every day, sometimes, or none); regular dental checkup (yes or no); smoking status (nonsmoker, past smoker, or current smoker); and questions related to oral health literacy.

The oral health literacy questions assessed the degree of participants’ dental knowledge. The terms or sentences for measuring oral health literacy were collected from a sample of oral health educational brochures and written materials generally provided to dental patients or from a list of terms commonly encountered in dental settings. They were selected to represent a wide range of dental areas, such as causes or names of dental diseases, preventive dental procedures, dental hygiene devices, and the name of the national dental health campaign.

Oral health literacy questions used in this study consisted of 14 dental terms and two sentences. The 14 dental terms were as follows: dental plaque, interdental brush, dental floss, dental calculus, scaling, gingivitis, periodontal disease, fluoride mouth rinsing, fluoridated toothpaste, 8020 campaign, electric toothbrush, mouthwash, denture plaque, and denture cleanser. Participants were instructed to check the terms they knew. The two sentences were “Smoking is related to periodontal disease,” and “Periodontal disease can be prevented by self-care.” Participants answered “true” or “false” to these sentences.

To calculate the oral health literacy score, each item was scored as 1 if checked or answered “true,” and 0 if not. The total score for the index was a simple sum of responses, ranging from 0 to 16. For statistical analysis, the oral health

literacy scores were categorized into three levels: low (0–5), medium (6–10), and high (11–16).

### Oral examination

We conducted clinical examinations which included the assessment of the number of natural teeth (we excluded third molars from the analysis), number of decayed teeth, prosthetic condition, number of functional tooth units (FTUs), community periodontal index (CPI), and oral hygiene status. Thirty dentists from the local dental association performed all oral examinations using a dental mirror, an explorer, and a CPI probe. A training session was held before the study began, and a handbook describing detailed standardized clinical criteria was distributed to all participating dentists.

The FTU<sup>15</sup> is an index of posterior tooth occlusion defined as pairs of occluding posterior natural teeth (i.e., sound, restored, and carious teeth) and artificial teeth on implant-supported, fixed (bridge pontics), or removable prostheses. We classified carious teeth with extensive coronal destruction and missing teeth as nonfunctional. Two occluding premolars were defined as one FTU, and two occluding molars were defined as two FTUs. Therefore, a person with a complete dentition had 12 total FTUs. FTUs were further divided by tooth composition into n-FTUs (FTUs of natural teeth only) and nif-FTUs (FTUs of both natural teeth and artificial teeth on implant-supported or fixed prostheses).

We used the CPI index for the periodontal assessment, in which the dentition was divided into sextants. The highest CPI code in six segments was recorded as representative for the person (code 0: no signs of periodontal disease, code 1: gingival bleeding after gentle probing, code 2: supragingival or subgingival calculus, code 3: 4–5 mm deep pathologic pockets, and code 4: 6 mm or deeper pathologic pockets).

We evaluated oral hygiene condition visually by examining all teeth and dentures without using a disclosing solution, classifying observations into three categories: (1) good—plaque covering less than one-third of tooth surfaces; (2) fair—plaque covering more than one-third but less than two-thirds of tooth surfaces; and (3) poor—plaque covering more than two-thirds of tooth surfaces. The worst score was recorded as representative for the person.

### Statistical analysis

We computed descriptive statistics reporting percentages or means for participants' demographics, oral health-related indices, and oral health literacy. The association between the three levels of oral health literacy and oral health-related indices was analyzed with Kendall's tau-c test.

Testing with the Shapiro–Wilk W indicated that neither the number of teeth nor the number of FTUs was normally distributed. Therefore, we used a generalized linear model (GLM) of the negative binomial model with a logit built-in link function, which showed a better fit than the Poisson distribution with a log built-in link function.<sup>16,17</sup>

For the GLM, we treated the number of natural teeth, decayed teeth, and FTUs as response variables, and the

three levels of oral health literacy as explanatory variables. To control for potential confounding factors, i.e., demographics (age and gender) and oral health indices (smoking status, tooth or denture brushing, self-check with a mirror, regular dental checkup, and oral hygiene status) were also included as covariates.

For the 453 individuals in whom we performed CPI measurement (excluding those with code X: missing index teeth), we analyzed the influence of the three levels of oral health literacy on the three CPI code categories (0, 1 & 2, and 3 & 4) using an ordinal logistic regression with complementary log–log link function, adjusting for the same covariates used in the GLM. The SPSS statistical package, version 18.0J (SPSS Japan Inc., Tokyo, Japan), was used for all statistical analyses.

## Results

### Demographics and oral health behaviors

Among the 518 individuals included for the analysis, the mean age was  $58.4 \pm 15.4$  (SD), and more than 60% (61.2%) were female. More than 90% of participants brushed their teeth or dentures every day (Table 1). About 10% of participants self-checked their oral condition with a mirror every day. The majority of the participants did not have a regular dental checkup. About three-fourths were nonsmokers.

### Oral health literacy

Of the 518 participants, 164 had a low score for oral health literacy, 207 had a medium score, and 147 had a high score. More than 70% of participants were knowledgeable about terms such as “electric toothbrush,” “dental calculus,” and “periodontal disease” (Fig. 1). They demonstrated a relatively high knowledge of the fact that “periodontal disease can be prevented by self-care.” On the other hand, very few participants knew the term “denture plaque,” and only about 15% of participants knew the term “scaling.” Less

**Table 1** Frequency of oral health behaviors of participants.

Variable		N	%
Tooth or denture brushing	Every day	482	93.1
	Sometimes	27	5.2
	None	9	1.7
Self-check with a mirror	Every day	58	11.2
	Sometimes	235	45.4
	None	225	43.4
Regular dental checkup	Yes	99	19.1
	No	419	80.9
Smoking status	Current smoker	85	16.4
	Past smoker	54	10.4
	Nonsmoker	379	73.2

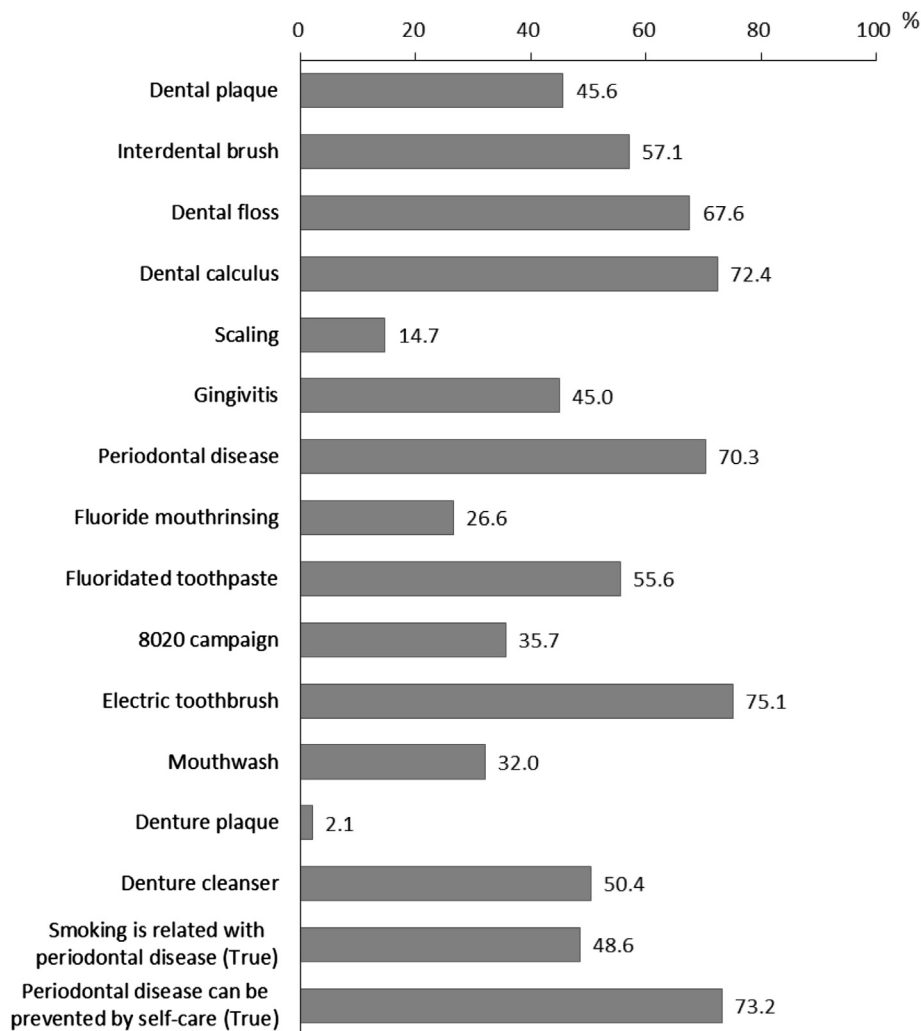


Figure 1 Proportion of participants who reported they knew the words or responded "true."

than half of the participants believed "smoking is related to periodontal disease."

### Clinical oral health status

The mean numbers of natural teeth and decayed teeth were 18.7 (9.5 SD) and 1.1 (2.2 SD), respectively. The mean numbers of n-FTUs, nif-FTUs, and total FTUs were 5.4 (4.6 SD), 6.2 (4.8 SD), and 9.9 (3.1 SD), respectively. Degrees of oral hygiene status of the participants were 13.9% good, 58.3% fair, and 27.8% poor. The proportions of participants within each CPI code category were 12.4% (code 0), 6.8% (code 1), 28.9% (code 2), 33.6% (code 3), and 18.3% (code 4), respectively.

### Oral health behaviors and oral hygiene status by oral health literacy

There were significant relationships between the level of oral health literacy and oral health behaviors and oral hygiene status, but not with smoking status ( $P = 0.876$ ) (Table 2). The higher the oral health literacy of

participants, the more often they brushed their teeth or dentures, self-checked their oral condition with a mirror, had a regular dental checkup, and the better their oral hygiene status.

### Clinical teeth conditions by oral health literacy

There were significant associations between the level of oral health literacy and clinical dental conditions, except with total FTUs ( $P = 0.088$ ), after adjusting for possible confounding variables (Table 3). The individuals with higher oral health literacy showed higher mean numbers of teeth present, n-FTUs, and nif-FTUs. Participants with higher oral health literacy also had fewer decayed teeth.

### CPI by oral health literacy

Low oral health literacy was significantly correlated with CPI index (Table 4). A positive coefficient indicated that individuals with low oral health literacy were more likely to fall into a higher CPI code category compared to those with high oral health literacy.

**Table 2** Frequency of oral health behaviors and oral hygiene status by three levels of oral health literacy.

Variable		Oral health literacy, N (%)			P
		Low	Medium	High	
Tooth or denture brushing	Every day	136 (82.9)	201 (97.1)	145 (98.6)	<0.001
	Sometimes	20 (12.2)	5 (2.4)	2 (1.4)	
	None	8 (4.9)	1 (0.5)	0 (0.0)	
Self-check with a mirror	Every day	9 (5.5)	22 (10.6)	27 (18.4)	<0.001
	Sometimes	64 (39.0)	91 (44.0)	80 (54.4)	
	None	91 (55.5)	94 (45.4)	40 (27.2)	
Regular dental checkup	Yes	25 (15.2)	33 (15.9)	41 (27.9)	<0.01
	No	139 (84.8)	174 (84.1)	106 (72.1)	
Smoking status	Current smoker	26 (15.8)	36 (17.4)	23 (15.7)	0.876
	Past smoker	18 (11.0)	18 (8.7)	18 (12.2)	
	Nonsmoker	120 (73.2)	153 (73.9)	106 (72.1)	
Oral hygiene status	Good	9 (5.5)	27 (13.0)	36 (24.5)	<0.001
	Fair	93 (56.7)	125 (60.4)	84 (57.1)	
	Poor	62 (37.8)	55 (26.6)	27 (18.4)	

## Discussion

Our results indicate that low oral health literacy is associated with poor oral health behaviors and clinical status, defined as the numbers of natural teeth, decayed teeth, n-FTUs, nif-FTUs, and the CPI. This relationship was sustained even after adjusting for potentially confounding variables.

These findings are consistent with former reports that found a close association between health literacy and general health status in the clinical literature.<sup>18–21</sup>

However, the process by which low oral health literacy leads to poor clinical oral health outcomes is uncertain. This is partly because the assumption of causality between poor oral health literacy and poor oral health status cannot be tested with the cross-sectional design of the current study. Because dental caries and periodontal diseases progress gradually over time, participants with low oral health literacy might have practiced unfavorable oral health behavior for a long time. Only total FTUs did not show a significant association with oral health literacy. The probable explanation of this result is that participants who had few natural teeth recovered their FTUs with dentures, as demonstrated in previous studies.<sup>15,22</sup>

Until now, oral health literacy has received little attention in the dental literature, especially in Japan. This is partly because the general literacy rate in Japan is very high (about 99%, according to the Central Intelligence Agency, *The World Factbook*).<sup>23</sup> However, findings from this study revealed that less than half of the participants knew

**Table 3** Adjusted means of clinical dental conditions by three levels of oral health literacy.

Indices	Oral health literacy	Mean	SD	P for trend
Natural teeth	Low	15.02	4.24	<0.001
	Medium	18.71	4.33	
	High	18.82	4.45	
Decayed teeth	Low	1.08	1.09	<0.05
	Medium	0.94	0.96	
	High	0.80	0.91	
n-FTUs	Low	3.95	2.18	<0.001
	Medium	4.84	2.17	
	High	5.15	2.26	
nif-FTUs	Low	4.42	2.31	<0.001
	Medium	5.78	2.39	
	High	6.08	2.47	
total-FTUs	Low	10.35	3.52	0.088
	Medium	9.53	3.11	
	High	9.77	3.32	

Adjusted for age, gender, smoking status, tooth or denture brushing, self-check with a mirror, regular dental checkup, and oral hygiene status.

**Table 4** Ordinal logistic regression on three categories of CPI code (0, 1 & 2, and 3 & 4) with three levels of oral health literacy.

Oral health literacy	N	Coefficient	SE	P
Low	118	0.557	0.221	<0.001
Medium	191	0.061	0.161	0.376
High	144	Reference		

Adjusted for age, gender, smoking status, tooth or denture brushing, self-check with a mirror, regular dental checkup, and oral hygiene status. CPI = community periodontal index; SE = standard error.



terms such as dental plaque, scaling, gingivitis, fluoride mouth rinsing, 8020 campaign, mouthwash, and denture plaque. Furthermore, the proportion of individuals who thought smoking is related with periodontal disease was also less than half. This implies that lay people have difficulty reading commonly used educational materials and cannot fully understand written health information, or that they are not attracted to these brochures and never try to read them. Health professionals routinely assume that patients possess adequate health literacy skills, although they may not. Therefore, dental professionals should determine the oral health literacy level of both their target audience and the written materials before disseminating them to patients.

Several instruments have been developed to measure a person's health literacy level.<sup>24,25</sup> Assessment of health literacy skills has generally been divided into two types: word recognition tests and comprehension tests. Word recognition tests, in which participants read aloud a list of common medical words, test the ability to recognize, or read and pronounce individual words. Word recognition tests are simple, quick, and easy to administer, but do not measure reading comprehension or interpretation.<sup>11</sup> Comprehension tests, on the other hand, assess a person's ability to understand written texts. Compared with word recognition tests, comprehension tests require more time and skill to administer.

In the dental field, five kinds of oral health literacy instruments have been developed: the Rapid Estimate of Adult Literacy in Dentistry (REALD-30),<sup>26</sup> REALD-99,<sup>27</sup> the Test of Functional Health Literacy in Dentistry,<sup>28</sup> Oral Health Literacy Instrument,<sup>29</sup> and Comprehensive Measure of Oral Health Knowledge.<sup>30</sup>

However, these instruments are all intended for English-speaking participants, and may not be directly applicable to Japanese-speaking participants. Different linguistic modalities (i.e., Japanese: ideograms, English: phonograms) complicate the adaptation of an existing English measure into a version suitable for Japanese. For this reason, we developed a new oral health literacy test to measure Japanese individuals' ability to recognize basic terms and knowledge specifically related to dentistry. The instrument provides estimates of oral health literacy but does not measure all proposed domains of a health literacy construct. In addition, we used a simple sum of 16 responses given as a total score, but further examination of the score is required if the weighting sum is used. Another shortcoming of the instrument is its inability to determine if participants correctly understand the meaning of a term; they were only asked if they knew the words.

Furthermore, the current study used a convenience sample of adults taking part in the community oral health survey, and our results may not be representative of all Japanese adults. Intra- or inter-examiner variability in assessments, such as kappa values, were also not evaluated. Therefore, our conclusions should be considered in light of the study's limitations.

Despite these limitations, this study has several strengths. This is the first report to use a clinical examination as an outcome measure to assess the association of oral health literacy with oral health behaviors and oral health status in Japan.

Our finding that oral health literacy relates to differences in clinical oral health outcomes adds important evidence to the growing knowledge of the role of oral health literacy in dentistry. The results suggest that improved oral health literacy may be linked with improved oral health. Because knowledge acquired by education since childhood is thought to affect oral health behaviors and oral health status in adults, health education is a key component of oral health programs. Therefore, an understanding of participants' oral health literacy levels is crucial in designing effective health educational materials for individuals, as well as designing intervention programs to successfully achieve oral health promotion at a community level.

This is an important first step in the development of more sophisticated oral health literacy research for the Japanese population. Further research is needed to construct an index with a full array of oral health literacy domains, including reading, writing, speaking, listening, and basic numeration, as well as to investigate its relationship with clinical oral health status using a representative sample.

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