Original Article

Development and Validation of Oral Health Literacy Questionnaire for Thai Adults

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ABSTRACT

Aim: The purpose of the study was to develop a valid and reliable oral health literacy questionnaire for the Thai adults. It measures functional, communicative, and critical competency, covering four competencies according to the context of daily living, namely, oral health service, home and community, marketplace, and community public forums. **Materials and Methods:** A cross-sectional study was carried out in 420 Thai adults who were the dental clients of an oral health service system. Subjects were recruited into the study by multistage stratified random sampling. Data were collected by interviewing using the newly developed oral health literacy questionnaire. After checking for the completeness and correctness of the data, the validity and reliability of the questionnaire were analyzed by calculation of the sensitivity, specificity, and positive predictive and negative predictive values. Receiving-operating characteristic (ROC) curve was performed and showed the area under ROC that indicates the diagnostic performance of the questionnaire. **Results:** High reliability was found as Cronbach's alpha = 0.878 and the validity proved by known-group method, presented as ability to classify subjects as having adequate, or inadequate oral health literacy was also high, given the sensitivity = 0.853, the specificity = 0.848, and the area under ROC curve = 0.858. **Conclusion:** The newly developed oral health literacy questionnaire for Thai adults was valid and reliable.

KEYWORDS: Communicative competency, critical competency, functional competency, oral health literacy

INTRODUCTION

Dental caries and periodontal disease are still one of the main health problems among the Thai population, which reflects that promoting oral health through health education and health communication may not be effective.[1,2] Effective oral health self-care is most important to prevent oral disease and promote good oral health.[3,4] Evaluation of health literacy and giving proper health knowledge therefore play an important role in improving population health knowledge and behavior. The key factor of oral health communication is a message on basic oral health knowledge that includes etiology of dental caries and periodontal disease, diet and sugar consumption, tooth brushing, use of fluoride toothpaste, and use of oral health services. Message format has to fit with the level of literacy of the population; messages on pamphlets, posters, or health product labels have to be easily understandable. Information at the front office of the oral health service units should be clear and allow easy access of patients to the proper dental services. The concept of health literacy is to allow the population to access, understand, and be able to apply the health messages.[5-10]

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The health literacy assessment proposed by Nutbeam consists of three competencies: (1) functional health literacy refers to the basic skills in reading and writing that is necessary to function effectively in health situations, (2) interactive health literacy refers to more advanced cognitive and social skills that can be used to communicate in everyday life, distinguish information and understand message forms of communication, and apply the understanding to varying circumstances, and (3) critical health literacy refers to more advanced cognitive and social skills that can be applied to analyze and verify information and can apply the information to make appropriate health decisions and self-management.[11] Beyond competency, Kickbusch and Maag[12] have proposed five different contexts of daily living. The assessment included health literacy at home and in the community, at the workplace, at the healthcare system, at the marketplace, and within the political arena. In a systematic review, Dickson-Swift *et al.* revealed 16 different kinds of oral health literacy instruments; they all mainly assessed the ability to read and word recognition, which is only a functional competency. It may not reflect the actual oral health literacy because it does not include communicative and critical competencies. Rapid Estimate of Adult Literacy in Medicine (REALM) and Test of Functional Health Literacy in Adults (ToFHLA) are the most popular instruments, whereas Rapid Estimate of Adult Literacy in Dentistry (REALD-30) is most frequently used in oral health studies.[13] REALD-30 was translated to a Thai version[14]; however, it has limitations that some words are not familiar to Thais and were less frequently used among the Thai population. Another limitation is that REALD-30 has only assessed word recognition. The Oral Health Literacy-Adult Questionnaire (OHL-AQ) is also favored among oral health studies as it assesses a wider range and competency of health literacy; however, it takes a long time to complete and questions are not quite relevant to the Thai context.[15] There was a Thai version of the oral health literacy questionnaire developed based on the concept of health literacy of Nutbeam, as it is used among children of 2–6 years of age, and which is not appropriate for adults.[16] As mentioned earlier, most of the oral health literacy questionnaires assess mainly word recognition; therefore, the aim of the present study was to develop and test the validity and reliability of a new oral health literacy questionnaire for Thai adults including measurement of functional, interactive, and critical competency in four domains, namely, home and community, marketplace, healthcare system, and political arena. Hopefully, the questionnaire will help oral health personnel to group adults according to

their level of oral health literacy and consequently to facilitate the selection of appropriate interventions to improve oral health behaviors leading to better oral health care among Thai adults.

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLE

The study was a cross-sectional survey in 420 Thai adults, who were the dental clients of an oral health service system. First, the OHL questionnaire in Thai language was developed by modifying the health literacy assessment proposed by Kickbusch and Maag,[12] which assesses health literacy in three competencies, namely, functional, communicative, and critical skills. The context of literacy assessment was reduced to four when compared with the original model which includes five contexts. As the population in Thailand are mostly farmers working in the rural area, the literacy at the workplace was removed because no health-related competency was used in this context. The questionnaire was first assessed by three experts to obtain content validity and then it was pilot tested in 20 adults to test its face validity. Later, the developed questionnaire was then tested for its concurrent validity and internal consistency among 420 Thai adults in the oral health service system. The computed sample size required 389 subjects to achieve 90% sensitivity and 70% specificity precision with a 95% confidence interval. To compensate for sample dropout, the study, therefore, increased the number of samples to 420.[17] To avoid selection bias, samples were recruited with a multistage stratified random sampling method. All subjects were asked to complete the consent form before joining the study. This study was approved by the Ethical Committee Faculty of Dentistry, Prince of Songkla University, code EC6107-27-P-HR.

QUESTIONNAIRE DEVELOPMENT

Common oral health-related words existing in printed media were collected, and words frequently used were selected to form a list of words for reading and writing in functional competency assessment. Drug dosage and administration questions were arranged according to the OHL Adults Questionnaire (OHL-AQ) to test numeracy skills of the functional competency as well.[15] For the communicative and critical competence, eight questions, with a total of 21 items, were set up to cover literacy in four contexts containing questions on use of dental treatment rights information, use of services timetable, knowledge on use of toothpaste and tooth brushing habits, use of information on oral healthcare product labels, and patient rights notices.

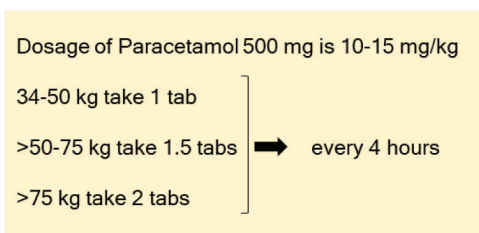## QUESTIONNAIRE: ORAL HEALTH LITERACY-THAI ADULT QUESTIONNAIRE

Part 1: reading, writing, listening, and calculating skills assessment

Q1. Read aloud the following words and phrases to be heard clearly: Enamel, Plaque, Root planing, Periodontal tissue, Exposed pulp, Standard toothbrush, Professor doctor, Temperature 38 degrees Celsius, Specialized dental department.

Q2. Listen to the sound of words from the audio record. And write the vocabulary in space:

……………………(X-ray), ………………… (Milligram), ………………(Antibiotic), ……………(Oral surgery), ………………(Village public health volunteers)

Q3. From the following diagram, answer questions 3.1 and 3.2

> Dosage of Paracetamol 500 mg is 10-15 mg/kg
>
> 34-50 kg take 1 tab
> >50-75 kg take 1.5 tabs ➡ every 4 hours
> >75 kg take 2 tabs

Q3.1 If you weigh 65 kilograms and need paracetamol, how many tablets can you take each time? Answer..

Q3.2 From the previous item. You weigh 65 kilograms and take the first dose at 9:00 am. When will you be able to take the next dose?
  a. At 9:30 am b. At 10:00 am
  c. At 11:30 am d. At 1:00 pm

Part 2: oral health services system competency assessment

Dental service schedule of a government hospital

Days	Type of services in the working hours*			Services outside the working hours 17:00–20:00 h
	9:00–12:00 h	12:00–13:00 h	13:00–16:30 h	
Monday	Dental check-up/ general dental treatment	Lunch break	Dental check-up/ specialized treatment	No services
Tuesday	Dental check-up/ general dental treatment		Dental check-up/ specialized treatment	Dental check-up/ general dental treatment

*General dental treatment: scaling, filling, tooth extraction; *specialized treatment*: root canal treatment, root planing, wisdom tooth removal. The universal health insurance card holders can use the services during the working hours only. *To postpone an appointment, please call 073-291023 ext. 106, during working hours.*

Q4. From the data in the table, answer questions Q4.1–Q4.4

Q4.1 Are there services outside hours on both Monday and Tuesday?

Q4.2 Can universal health insurance holders get treatments in both working and outside hours?

Q4.3 Can you come to remove wisdom teeth on Monday or Tuesday between 13:00–16:30 h?

Q4.4 Can you call to postpone the dental appointment on Tuesday at 17:30?

Part 3: oral healthcare competency assessment

> **Brushing 2-2-2 for Better Oral Health**
> ✓ Brush teeth 2 minutes
> ✓ Brush teeth 2 times a day
> ✓ Avoid eating and drinking for 2 hours after brushing

Q5. From the given information, which is the correct 2-2-2 brushing method?
  a. Two sets of brushing are upper and lower teeth.
  b. Brush twice a day, morning and day.
  c. Rinsing more water after brushing to keep the mouth clean.
  d. Brushing for at least 2 minutes.

Part 4: consuming oral healthcare products competency assessment

> **Toothpaste A**
> Anticavity toothpaste   NET WT 10g
> Drug facts see information sheet before using
> **Active ingredient and purpose**
> Sodium monofluorophosphate 0.76% (0.15% w/v fluoride ion) help protect against cavities.
> **Toothpaste B**
> **Active ingredient and purpose**
> ✓ Sodium bicarbonate salt whitens teeth and produces fresh breath.
> ✓ Authentic herbal toothpaste leads to healthy gum and strong teeth, reduces tobacco stain, dental stone, sensitive teeth and bad breath.
> ✓ Contains natural herbal extracts, no preservatives.

Q6. From the toothpaste labels, which of the following is most correct?
  a. Both toothpastes contain fluoride.
  b. Both toothpastes contain no fluoride.
  c. Toothpaste A contains fluoride.
  d. Toothpaste B contains fluoride.

Part 5: knowledge and application of health rights assessment

> **The Patient Rights Declaration:** Patients who seek medical services have the rights to receive their complete current information in order to thoroughly understand about their illness from their medical practitioner. Furthermore, the patient can either voluntarily consent or refuse treatment from the medical practitioner treating him/her except in case of emergency or life threatening situation.
>
> **The patient's practice guideline:** Patient must provide accurate personal and medical information for health care professional in treatment procedures.

Q7. From the Patient Rights Declaration, which of the following is most correct?
  a. If the dentist detected additional cavities while undergoing filling another tooth, the dentist does not need to inform the patient.
  b. Patients have the right to see his/her own dental radiographs.
  c. Dentists should inform the patient of complications that may arise during wisdom teeth removal.
  d. Both items b and c are correct.

Q8. From the patient's practice guideline, which of the following is most correct?
  a. It is not necessary for the pregnant patient to notify the dentists prior to dental treatment.
  b. Always notify your dentists about your personal illness and medicine taken.
  c. Patients can see the dentists without any appointment.
  d. Both items a and b are correct.

Validity and reliability

The questions were assessed to achieve content validity by three experts in health literacy, the item objective congruence (IOC) values were determined, and the items scored less than 0.5 were altered or replaced. After the revision, all questions have an IOC value of 1 [Table 1].[18,19] As the questionnaire was developed using the domains suggested in the Kickbusch Health Literacy Model, it already had construct validity. Face validity was acquired in a pilot survey at a community memorial hospital of Yaha; 20 adults with various socioeconomic status attending dental clinic were asked to complete the questionnaire. The respondents' readability and perception of each item in the questionnaire were reflected by the respondents. Afterward, the authors discussed and adjusted the questions to ensure that respondents truly understood the questions. All opinions of the respondents were used that lead to achieve the face validity of the questionnaire.[20] Concurrent validity was established to verify the ability of the questionnaire to classify respondents as having adequate or inadequate health literacy, using the known-group method. Twenty percent of the subjects who had previously completed a questionnaire were randomly selected to repeat interviews and were classified as either adequate or inadequate health literacy groups. The interviews used open-ended questions that related to oral health literacy in four contexts as in the newly developed questionnaire. The audio of interviews was recorded for a re-evaluation with expert opinions if in doubt.[21] The criteria for defining subjects as a known group for adequate oral health literacy were as follows: (1) good Thai language skills, ability to read, communicate, and understand oral health content easily and rapidly, (2) can understand the questions and answer correctly, (3) can explain how to brush the teeth properly, and (4) can explain the reason and choose fluoridated toothpaste for caries prevention. After the questionnaire was completely tested and revised, the administration of the questionnaire for overall data collection was standardized to ensure that every query is consistent. The scoring method for reading was divided into three levels: 2= able to read correctly, 1= able to read partially, and 0= not able to read. In the writing section, the scoring was divided into four levels: 3= written correctly, 2= written partially

Item	Expert 1			Expert 2			Expert 3			Total score	Mean IOC score
	1	0	−1	1	0	−1	1	0	−1		
1	/			/			/			3	1
2	/			/			/			3	1
3.1	/				/		/			2	0.67
3.2		/			/				/	−2	−0.67
4.1	/				/		/			2	0.67
4.2	/			/			/			3	1
4.3	/					/	/			1	0.33
4.4	/			/			/			3	1
5	/					/	/			1	0.33
6	/			/			/			3	1
7	/				/				/	0	0
8	/			/			/			3	1
	0.83			0.33			0.67			Overall mean IOC = 0.61	

Table 1: Content validity of oral health literacy questionnaire for Thai adults

IOC (item objective congruence) exhibits level of item related to the aim of measurement, content validity score, 1= agree, 0= neutral, −1= disagree

correct with one place error, 1= written partially correct with two or more places errors, and 0= not written. Calculation and understanding of numbers and communicative and critical skill responses were allocated 1 point when answered correctly and 0 when wrong. The total score of the questionnaire was 50. The data collection among all subjects was carried out by the principal investigator.

STATISTICAL ANALYSIS

The data were first checked for the completeness, and all missing data were checked immediately after finishing each subject's data collection. Later, the data were entered into the computer with Epidata and analyzed with SPSS. The subjects' characteristics were presented as frequency and percentage. The distribution of oral health literacy was investigated using mean and standard deviation, separately by oral health literacy domains. Receiving-operating characteristic (ROC) curve was performed from optimal cut-off points and showed the area under ROC that indicates the diagnostic performance of the questionnaire.[22-24] The validity and reliability of the questionnaire were demonstrated by calculation of the sensitivity, specificity, and positive predictive value (PPV) and negative predictive value (NPV) to diagnose subjects to be inadequate and adequate oral health literacy. The relationship between the levels of oral health literacy and subjects' sociodemographic status was examined by the χ^2 test. Whereas the relationship between the level of oral health literacy and its competency and context and the relationship between level of oral health literacy and oral health behaviors were examined by the independent *t*-test. Statistical significance was set at $\alpha < 0.05$.

RESULTS

There were 14 dropouts in the study as a result of incomplete questionnaires. A total of 406 subjects were included in the study: 68 males (9.3%) and 338 females (92.7%), the average age was 36 years, ranging from 20 to 59 years. Most subjects had a senior high education or higher (80%), with monthly income below 15,000 THB (76.1%), and live in the countryside (66.5%). Almost all subjects brushed their teeth twice a day (97.8%). More than half of the subjects used floss or mouthwash daily (59.1%). Half of the subjects had not visited dentist in the previous 6 months (52.7%). Almost half of the subjects had received oral health information via internet (44.1%).

VALIDITY AND RELIABILITY

The study determined the level of validity of the oral health literacy questionnaire by selecting the suitable cutting point for the score in the range of 28–40. It was found that the cut-off score ≥ 36 is appropriate, because the sum of sensitivity and specificity was maximum at 1.701 [Table 2]. The sensitivity is 0.853, which means that the test can accurately identify 85% of the subjects with inadequate oral health literacy, whereas the specificity is 0.848, which means the test can correctly indicate that 85% of people have adequate oral health literacy [Table 3]. The ROC curve gives an area under curve of 0.858, indicating that the questionnaire has a good diagnostic performance [Figure 1].

ORAL HEALTH LITERACY SCORE

The mean overall OHL score was 39.32 ranging from 10 to 50. Almost three quarters (73.5%) of the subjects were categorized as adequate oral health literacy. Table 4 shows that the three competency skills, namely, functional, communicative, and critical competency scores, were

Table 2: Sensitivity, specificity, PPV, and NPV by cut-off scores of oral health literacy questionnaire

Cut-off	Sensitivity (Se)	Specificity (Sp)	Sum of Se and Sp	PPV	NPV
≥ 28	0.471	0.935	1.406	0.842	0.705
≥ 29	0.471	0.935	1.406	0.842	0.705
≥ 30	0.529	0.935	1.464	0.857	0.729
≥ 31	0.588	0.913	1.501	0.833	0.750
≥ 32	0.647	0.870	1.517	0.786	0.769
≥ 33	0.676	0.870	1.546	0.793	0.784
≥ 34	0.706	0.870	1.576	0.800	0.800
≥ 35	0.765	0.870	1.635	0.813	0.833
≥ 36	0.853	0.848	1.701	0.806	0.886
≥ 37	0.853	0.783	1.636	0.744	0.878
≥ 38	0.853	0.761	1.614	0.725	0.875
≥ 39	0.853	0.696	1.549	0.674	0.865
≥ 40	0.882	0.565	1.447	0.600	0.867

PPV = positive predictive value, NPV = negative predictive value

Level of oral health literacy	Gold standard		Total	
	Inadequate OHL	Adequate OHL		
Inadequate	29	7	36	PPV 0.806
Adequate	5	39	44	NPV 0.886
Total	34	46	80	—
	Se 0.853	Sp 0.848	1.701	—

Table 3: Validity of the oral health literacy questionnaire at cut-off score ≥36
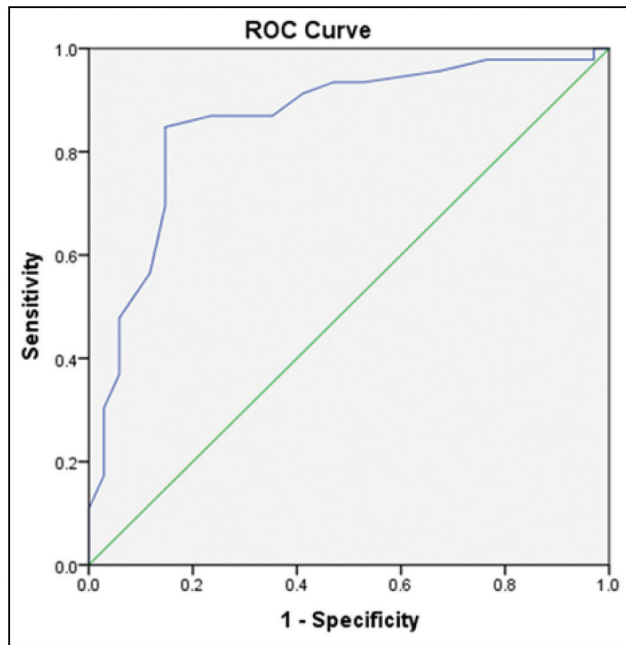
Figure 1: Diagnostic performance (ROC curve) classifying adequate and inadequate oral health literacy with area under curve of 0.858

significantly lower among those who were categorized as inadequate oral health literacy ($P < 0.001$). Additionally, the oral health literacy score by location and context also exhibits similar to competencies; those who have lower score in health literacy in every context were categorized as inadequate oral health literacy. The oral health literacy was found highest in the oral health care system context, whereas in the political arenas context, it was found to have lowest score [Table 4].

The relationship between sociodemographic status and the level of oral health literacy shows that the majority of the subjects were female with age below 40, whereas it was not associated with the level of oral health literacy. Only 39.5% of the subjects have university degree, but 93.7% of them were categorized as adequate oral health literacy. Regarding income, among a quarter (23.9%) of the subjects had income higher than 15,000 THB, and 92.8% had adequate oral health literacy, which is consistent with residential area where most (86.8%) of the city dwellers had adequate oral health literacy ($P < 0.05$) [Table 5]. Table 6 shows that majority of the subjects brush teeth twice a day

(97.7%) and use dental floss and/or mouthwash daily. Among those who had adequate oral health literacy, it was found that 64.4% use floss and/or mouthwash ($P < 0.01$). Visiting dentist in the last 6 months and receiving oral health information from the internet were found to be associated with adequate oral health literacy ($P < 0.01$) [Table 6].

DISCUSSION

The newly developed oral health literacy questionnaire for Thai adults achieved satisfying validity and reliability test results. It fulfills the purpose to acquire new tool to classify subjects to be either inadequate or adequate oral health literacy. The questionnaire consisted of basic functional literacy assessing reading, writing and numeracy computation, and communicative and critical competency. The questionnaire covers four contexts, namely, oral healthcare system, home and community, marketplace, rights and regulation about oral health. In the development process of the oral health literacy questionnaire, the authors performed several steps to create questionnaires, starting by defining the competencies and key performance indicators to be measured. Questions were set up according to those competencies, and the questionnaire pilot tested and improved before bringing it to three qualified persons in health literacy to examine it for validity, after which all comments were taken into consideration and the questionnaire revised as necessary. The trial questionnaire was found to be reliable and able to measure what was intended to be measured. The selection of vocabulary or phrases used for reading and writing tests ranged from easy to difficulty Thai words related to daily dental practice. However, some words or phrases when translated to English may appear to be either easier or more difficult than the Thai words. To reduce bias when testing, the reading scoring was clearly defined to be three levels, scored from 0 to 2 points. In the writing section, the scoring was divided into four levels. Calculation and understanding of numbers and communicative and critical skills were given 1 point when answered correctly and 0 when answered incorrectly. A grading score has advantages that the interviewer did not have to decide which score corresponded to the answer of the subjects. This resulted in reducing the

information bias that may arise from data collection. The calculation related to paracetamol was used to test subjects' computation competency as it is a medicine that is often used in dentistry. If volunteers could answer this question, it was expected that they could apply it to medicine use in their daily life. In the other parts of the questionnaire, the questions were all related to oral health issues in different contexts. The structure of the questionnaire consisted of two main parts: the question-stem gave oral-health-related information and the questions that the subjects must complete. The structure of the questionnaire was consistent with that of Naghibi Sistani *et al.*,[15] which is appropriate for testing in an oral health service context. Those who come for health services should have accurate and enough information that can assure the dental services fulfilled their needs. Thus, they can also communicate the information

accurately. All questions posed were consistent across the questionnaire and indicate high internal consistency. Hence, the questionnaire could be shortened and the level of internal consistency is still high. The results were consistent with previous studies on determination of functional literacy in dentistry by Kapoor *et al.*,[25] who showed a Cronbach's alpha (α) of 0.84, OHL-AQ by Naghibi Sistani *et al.*[15] who obtained a Cronbach's alpha (α) of 0.72, and by Vichayanrat *et al.*[16] who obtained a Cronbach's alpha (α) of 0.76.

This questionnaire takes 20–30 min to complete, so it may not be possible to screen oral health literacy in a large population. The questionnaire should be shortened while being able to distinguish adequate and inadequate oral health literacy. However, it is suitable for evaluating the effectiveness of the oral health

Table 4: Level of oral health literacy by competency and context ($n = 406$)					
Competency and context	**Overall score**	**Mean ± SD**	**Oral health literacy**		**P-value**
			Inadequate, $n = 108$	**Adequate, $n = 298$**	
Competencies					
Reading, writing, and numeracy skills (functional)	35	29.16 ± 4.93	23.19 ± 3.82	30.79 ± 2.43	< 0.001
Communicative skill	8	6.06 ± 1.70	4.25 ± 1.67	6.71 ± 1.15	< 0.001
Critical skill	7	4.10 ± 1.70	2.42 ± 1.22	4.71 ± 1.41	< 0.001
Contexts					
Oral healthcare system	4	3.06 ± 1.06	2.08 ± 0.98	3.41 ± 0.84	< 0.001
Home and community	4	2.64 ± 1.05	1.70 ± 0.94	2.98 ± 0.86	< 0.001
Marketplaces	4	2.45 ± 1.16	1.46 ± 1.06	2.81 ± 0.97	< 0.001
Political arenas	3	2.01 ± 0.83	1.42 ± 0.80	2.22 ± 0.74	< 0.001
Mean overall score	50	39.32 ± 7.16	29.60 ± 5.33	42.84 ± 3.59	< 0.001

Table 5: Relationship between sociodemographic status and level of oral health literacy ($n = 406$)				
SES and demographics	**n (%)**	**Oral health literacy**		**P-value**
		Inadequate (%)	**Adequate (%)**	
Gender				
Male	68 (16.7)	19 (27.9)	49 (72.1)	0.784
Female	338 (83.3)	89 (26.3)	249 (73.7)	
Age (years)				
20–29	146 (36.0)	36 (24.7)	110 (75.3)	0.366
30–39	109 (26.9)	27 (24.8)	82 (75.2)	
40–49	96 (23.6)	25 (26.0)	71 (74.0)	
50–59	55 (13.5)	20 (36.4)	35 (63.6)	
Education				
Primary and junior high school	80 (19.6)	51 (63.7)	29 (36.3)	< 0.001
Senior high school and vocational school	166 (40.9)	47 (28.3)	119 (71.7)	
Bachelor degree or higher	160 (39.5)	10 (6.3)	150 (93.7)	
Monthly income in THB (USD)*				
≤ 15,000 (480)	309 (76.10)	101 (32.7)	208 (67.3)	< 0.001
> 15,000 (480)	97 (23.90)	7 (7.2)	90 (92.8)	
Areas				
City dwellers	136 (33.50)	18 (13.2)	118 (86.8)	< 0.001
Rural dwellers	270 (66.50)	90 (33.3)	180 (66.7)	

*The exchange rate of US dollar to Thai Baht: 1 USD to 31.25 THB

Table 6: Relationship between level of oral health literacy and oral health behaviors (*n* = 406)

Oral health behaviors	*n* (%)	Oral health literacy		*P*-value
		Inadequate (%)	Adequate (%)	
Tooth brushing				
≤Once a day	9 (2.2)	2 (1.9)	7 (2.3)	0.764
≥Twice a day	397 (97.8)	106 (98.1)	291 (97.7)	
Daily used floss and/or mouthwash				
Yes	240 (59.1)	48 (44.4)	192 (64.4)	< 0.001
No	166 (40.9)	60 (55.6)	106 (35.6)	
Visit dentist in the last 6 months				
Never	214 (52.7)	69 (63.9)	145 (48.7)	0.007
Ever	192 (47.3)	39 (36.1)	153 (51.3)	
Source of oral health information received				
Internet	179 (44.1)	17 (15.7)	162 (54.4)	
TV, caregivers, and magazines	159 (39.2)	54 (50.0)	105 (35.2)	
No access to any information	68 (16.7)	37 (34.3)	31 (10.4)	< 0.001

promotion program. In addition, oral health literacy of oral health risk factors cannot be measured because there are no questions about risk factors. The highlight of this questionnaire is that it covers the three core competencies of health literacy based on the Nutbeam concept, a cornerstone of health literacy, that is, to access and understand oral health information and be actionable, such as brushing teeth properly, choosing the right toothpaste, and the ability to access oral health services. Because there are no studies in Thailand that can be used as the gold standard for the concurrent validity assessment, known-group validation methods were found to be useful in such conditions. This study found sensitivity = 0.853, specificity = 0.848, PPV = 0.806, and NPV = 0.886, which were considered very high, indicating that the questionnaire was appropriate to discriminate between inadequate and adequate oral health knowledge and better than that of Haun *et al.*,[26] who reported a sensitivity of 0.74 and specificity of 0.67.

The present study found relatively high oral health literacy score, 39.32 out of 50, with 73.4% having adequate oral health literacy, higher than that of Schaeffer *et al.*[27] A study in Germany revealed that only 45.7% had adequate oral health literacy. The present study collected data in the oral health care unit, and most of the people who use the service already have some level of knowledge as only 10% of Thai population have access to dental health services.[28] Furthermore, many of the subjects in the present study were civil servants and more than a third were students who had a relatively good level of education. The values obtained from this study may be exaggerated and cannot be used as an indication of the overall health literacy of the general population. Analyzing after the establishment of cut-off scores, it was found

that overall the majority of subjects had adequate oral health literacy.

Unsurprisingly, this study found that those with a higher education degree and higher incomes and living in urban areas had adequate levels of literacy. People living in urban areas have more access to the internet and information; it was consistent with the study by Hongal *et al.*[29] and elsewhere in the world. As a result of having a better level of oral health literacy, it is not surprising that this group behaves better, uses oral cleaning accessories such as floss and mouthwash, and had more visits to the dentist in the last 6 months than people with inadequate oral health literacy. Jones *et al.*[30] found that those who have inadequate oral health literacy visit dentists less often and have poor oral health status. Baskaradoss *et al.*[19] revealed that children's DMFT/dmft is associated with poor oral health literacy of the caregivers. This reflects that people with a sufficient level of literacy have reading skills and critical thinking skills and are able to use that information to improve their oral health. Those who were categorized in an adequate oral health literacy group have higher intelligence in all social contexts. These individuals are able to apply their knowledge efficiently whether at home and community, in the marketplace for shopping, including the use of the oral health services and acknowledgment of the rights of their own access to various services. The results conform to the health promotion model proposed by Nutbeam[11] and the health literacy model of Sørensen *et al.*[31]

The results of the study showed that this questionnaire was designed to comprise all dimensions of health literacy measurements: from basic reading and writing skills to critical thinking. Thus it takes time to complete the questionnaire. The authors, therefore, suggest that the

questionnaire may be adjusted to have a smaller number of questions, as the relatively high item Cronbach's alpha values indicate a high degree of internal consistency among questions. The elimination of some of the questions still yields the desired measurement objectives. An additional study including the population who did not come to dental services should, therefore, be undertaken, which will provide an overview of the level of oral health literacy in the general adult population.

CONCLUSION

The newly developed oral health literacy questionnaire for Thai adults achieved a satisfying validity and reliability level. It can be used to categorize individuals to be either inadequate or adequate oral health literacy. Three quarters of the subjects had adequate oral health literacy, which is associated with education and income and has residential area in the city. Adequate oral health literacy leads to better oral health behaviors and often visit dentist. Oral health promotion programs should provide information at a level that inadequate literacy people can understand, which should lead to behavioral changes and better oral health outcomes.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

AUTHORS CONTRIBUTIONS

All authors contributed to the conception and design of the work, data collection, data analysis and interpretation, drafting the article, critical revision, and approval of the article's final version to be published.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP); and approved by the Research Ethics Committee, Faculty of Dentistry, Prince of Songkla University, protocol code EC6107-27-P-HR on 13 November 2018.

PATIENT DECLARATION OF CONSENT

Informed consent (written and oral) was obtained from all the participants.

DATA AVAILABILITY STATEMENT

Not applicable.

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