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# Associations Between Oral Health Literacy and Oral Health Status Among Patients Attending Comprehensive Dental Clinic

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## Abstract

**Objectives:** This study aimed to determine the association between oral health literacy (OHL), oral health status (OHS), and utilization of dental services among maintenance patients.

**Methods:** The study design was a cross-sectional study. Participants were maintenance patients attending the Comprehensive Dental Clinic, Faculty of Dentistry, Chiang Mai University from January to April 2021. Information about the participant's demographic details, including education, and income were collected using a questionnaire. The Decayed-Missing-Filled Teeth index (DMFT), Plaque Index (PI), and utilization of dental service were obtained from the electronic dental record. OHL was assessed using the Thai Version of Rapid Estimate of Adult Literacy in Dentistry (ThREALD-30). Data were analyzed using Spearman correlation and binary logistic regression.

**Results:** A total of 130 participants were recruited for this study. The mean age of participants was 51.1 years. The mean ThREALD-30 score was 26.7±3.76. The OHL scores were significantly negatively correlated with DMFT ( $r=-0.356$ ;  $p=0.002$ ), PI ( $r=-0.398$ ;  $p<0.001$ ), and utilization of dental services ( $r=-0.35$ ,  $p<0.001$ ). After adjusting for age, gender, education and income, OHL was significantly associated with DMFT (OR=1.36;  $p=0.001$ ), and PI (OR=1.26;  $p=0.006$ ).

**Conclusions:** OHL was associated with OHS. Patients with high OHL had good OHS with regular annual dental examinations. An understanding of the OHL of patients is crucial for designing effective oral health education and creating intervention programs to promote oral health.

**Keywords:** comprehensive dental care, maintenance patients, oral health literacy, oral health status

## Introduction

Oral health is a fundamental component of overall health that affects the quality of life. Oral health has been linked to lifestyle, mastication, the digestive system, and socialization regarding communication, personality, and self-confidence. Oral diseases impact health and reduce the quality of life, with higher national public health costs and increased study or work absenteeism.<sup>(1-4)</sup>

Oral diseases are associated with several risk factors including sugar consumption, tobacco use, alcohol use, and improper oral health care.<sup>(5-7)</sup> Therefore, the promotion of oral health not only eliminates the causes of oral diseases at any certain time, but also raises patient awareness about perceiving, understanding, receiving treatment, and maintaining oral health properly in continuous behavior.<sup>(7)</sup> Oral health literacy (OHL) is one of important factors that enables patients to maintain good oral health.<sup>(8,9)</sup>

OHL is 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.<sup>(8)</sup> OHL is one of the essential factors that enables patients to search, understand, analyze, and evaluate the obtained information rationally to make decisions on behaviors that contribute to good oral health. In the previous studies, people with low OHL had a higher risk of developing poor oral health.<sup>(10-12)</sup> Furthermore, OHL was also associated with economic and social factors, education attainment, and the health care system.<sup>(13,14)</sup>

The Comprehensive Dental Clinic, Faculty of Dentistry, Chiang Mai University provides comprehensive dental care that focuses on understanding the whole patients in terms of biological, psychological, and socio-logical aspects. Patients attending the Comprehensive Dental Clinic receive full dental services for prevention, treatment, and oral rehabilitation. Patients who have completed dental treatment are transferred to become maintenance patients. All maintenance patients are recommended to attend dental recall appointments for dental checkups and received continuous care. As a result, OHL is one of the essential keys to keep good oral health during the maintenance phase of care. However, there has been no study to assess OHL and its association with oral health status (OHS) in maintenance patients.

It was hypothesized that patients with high OHL should have good oral health behaviors and be able to maintain optimal oral health. This study aimed to determine associations between OHL and different types of OHS among maintenance patients attending the Comprehensive Dental Clinic.

## Materials and Methods

### Study participants and ethical approvals

This research study had been reviewed and approved by the Human Experimentation Committee, Faculty of Dentistry, Chiang Mai University (No.12/2564).

The study population was maintenance patients who attended the comprehensive dental clinic, Faculty of Dentistry, Chiang Mai University, from January to April 2021. The population of maintenance patients who had a dentist appointment was 184. The sample size to estimate a population mean was calculated using the formula of  $n = NZ_{\alpha/2}^2 \sigma^2 / [(N-1) d^2 + Z_{\alpha/2}^2 \sigma^2]$ .<sup>(15)</sup> We adopted the confidence interval of 95%, the standard deviation of 8.71<sup>(16)</sup>, and precision of 0.87 (10% of standard deviation). The result from the sample size calculation was 125 participants.

### Study design and setting

Multistage sampling was used in sequence. For stratified random sampling, the population was divided into small sub-groups corresponding to their age groups e.g., 20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60-69 years. Proportional stratified random sampling was then undertaken then simple random sampling for each division of samples was done by casting lots.

Inclusion criteria were patients aged 20-69 years with an ability to use the Thai language for communication (listening, speaking, reading, and writing). They received the instruction on oral health care, oral disease prevention, treatment, and rehabilitation from the Comprehensive Dental Clinic until they were transferred into the maintenance status. Exclusion criteria were patients with a physical or mental impairment affecting their cognitive function and communication, those unable to perform oral hygiene self-care, and those unwilling to participate in the research.

On the day of the study, informed consent was obtained from the participants. The questionnaire was

administered after participants had given their written consent. The participants needed to complete the background information questionnaire. After completing the questionnaire, the participants underwent an OHL test. This study assessed OHL using the Thai Version of Rapid Estimate of Adult Literacy in Dentistry (ThREALD-30).<sup>(16)</sup> Since the data of this study were collected during the covid-19 pandemic. Data about Decayed, Missing, and Filled Teeth index (DMFT), Plaque Index (PI), and utilization of dental service were collected from the patient's electronic dental record. Data collection from the patient's electronic record reduces contact with the patient and minimizes interference with the dentist's treatment.

### Study variables and statistical analysis

#### *Independent and covariate variables*

OHL was assessed by the ThREALD-30<sup>(16)</sup>, translated from the Rapid Estimate of Adult Literacy in Dentistry (REALD-30) in the English version.<sup>(17)</sup> ThREALD-30 is a validated OHL assessment tool for measuring OHL in the Thai population.<sup>(16)</sup> ThREALD-30 is easy to use and is beneficial for screening the level of OHL. This tool consisted of 30 common dental words with various degrees of difficulty. A participant was requested to read each word aloud to a researcher, and correct pronunciation was scored 1. The total scores ranged from 0-30.

The background section of the questionnaire collected socio-demographic details including gender, age, education attainment (dichotomized into 'high School or lower' and 'college or higher'), and monthly income (dichotomized into 'equal or lower than THB10,000' and 'higher than THB10,000').

#### *Outcome variables*

The outcome variables in this study were OHS and utilization of dental services. OHS was evaluated using DMFT by WHO<sup>(18)</sup> and PI by Ainamo and Bay.<sup>(19)</sup> The dental service utilization collected information on the periods of oral health check-ups after the last dental service. The check-up periods were classified into 'within 12 months' and 'more than 12 months'.

The data were collected from the patients' electronic dental records, which were dental charts examined and recorded by the 6<sup>th</sup>-year dental students, Faculty of Dentistry, Chiang Mai University.

#### *Statistical analysis*

SPSS statistics Macintosh, version 23.0 (IBM Corp, Armonk, NY, USA) was used to analyze the data. Descriptive statistics including mean, standard deviation (S.D.), and percentage, were used to explain the general characteristics of the data. The associations between OHL and OHS and dental service utilization were analyzed using Spearman's rank correlation. To confirm the hypothesis that OHL was associated with OHS and dental service utilization, binary logistic regression was performed. The final model for each outcome was controlled for age, gender, educational level, and income. The statistical significance was set at a *p*-value less than 0.05.

## Results

### General characteristics

Participant characteristics are presented in Table 1. The number of participants was 130, comprising 69 males (53.1%) and 61 females (46.9%). The mean age was 51.08±13.69 years. Fifty percent of the participants had college or university qualifications. Approximately one-fourth of the participants had monthly incomes lower than THB 10,000. For dental service utilization, the study participants were divided according to the length of time they received dental check-ups after their last dental visit. It was found that most of the participants came for dental check-ups within 12 months of 103 (79.2%).

The mean score of ThREALD-30 in this study was 26.7±3.76. The maximum score among the participants was 30 and the minimum score was 11. There were of 32 participants (24.6%) with a maximum score of 30.

In Table 2, the mean of DMFT was 5.11±3.23 teeth/person. When the individual components of DMFT were analyzed, it was found that the highest proportion of filled teeth (FT) was 3.56±2.43 teeth/person, followed by missing teeth (MT) of 0.99±1.47 tooth/person, and the lowest proportion of decay teeth (DT) was 0.54±0.78 tooth/person. The mean of PI was 1.29±0.50.

### The associations between oral health literacy and oral health statuses

The associations between OHL and OHS in Table 3 presented that OHL significantly showed a negative correlation with DMFT ( $r=-0.356$ ;  $p=0.002$ ), decayed teeth ( $r=-0.283$ ;  $p=0.001$ ), missing teeth ( $r=-0.346$ ;  $p<0.001$ ),

and PI ( $r=-0.398$ ;  $p<0.001$ ).

Binary logistic regression analyses were performed to predict the variables affecting DMFT and PI demonstrated in Table 4. The mean of participants' DMFT was used to dichotomize the variable. Participants who had DMFT higher than the mean of the group ( $DMFT>5.11$ ) were classified into a group "0" and the ones who did not meet this cut-off were categorized into a group "1". Additionally, the mean of participants' PI was used to dichotomize the variable into 2 groups. Participants who had PI higher than the mean of the group ( $PI>1.29$ ) were classified into a group "0" and ones who had PI scores lower than the mean were categorized into a group "1". When adjusted by controlled variables (age, gender, education, and income) in the binary logistic regression models (Model II), the results displayed that OHL could significantly predict DMFT (Adjust OR 1.36,  $p=0.001$ ), and PI (Adjust OR 1.26,  $p=0.006$ ). When the individual components of DMFT were binary logistic regression analyzed, the results displayed that OHL could significantly

predict Missing teeth (MT) (Adjust OR 1.26,  $p=0.003$ ), not significantly predict Decayed teeth (DT) (Adjusted OR=1.14,  $p=0.098$ ) and Filled teeth (FT) (Adjusted OR=1.22,  $p=0.010$ ).

**The association between oral health literacy and dental service utilization**

An analysis of the association between OHL and dental service utilization found that OHL scores were correlated with the periods of an oral health checkup after the last dental service with statistical significance ( $r=-0.35$ ,  $p<0.001$ ).

The binary logistic regression analyses were used to confirm this association presented in Table 5. In the univariate analysis (Model I), OHL was able to predict the use of dental services within 12 months (Crude OR=1.24,  $p<0.001$ ). However, when adjusted by controlled variables (age, gender, education, and income) in Model II, the association between OHL and dental service utilization was not significant (Adjusted OR=1.14,  $p=0.083$ ).

**Table 1:** Socio-demographic characteristics and dental service utilization of the participants.

| Characteristics                        | N   | Percentage |
|--|-----|------------|
| <b>Gender</b>                          |     |            |
| Male                                   | 69  | 53.1       |
| Female                                 | 61  | 46.9       |
| <b>Age (mean= 51.08, S.D. = 13.69)</b> |     |            |
| 20-29                                  | 15  | 11.5       |
| 30-39                                  | 12  | 9.2        |
| 40-49                                  | 20  | 15.4       |
| 50-59                                  | 38  | 29.2       |
| 60-69                                  | 45  | 34.6       |
| <b>Education</b>                       |     |            |
| High School or lower                   | 65  | 50.0       |
| College or higher                      | 65  | 50.0       |
| <b>Monthly income</b>                  |     |            |
| ≤ THB 10,000                           | 32  | 24.6       |
| > THB 10,000                           | 98  | 75.4       |
| <b>Last dental visit</b>               |     |            |
| ≤ 12 months                            | 103 | 79.2       |
| > 12 months                            | 27  | 20.8       |

**Table 2:** Mean and standard deviation of oral health indices.

| Oral health status                | Mean ± S.D. |
|-----------------------------------|-------------|
| Decay-Missing-Filled Teeth (DMFT) | 5.11 ± 3.23 |
| Decay Teeth (DT)                  | 0.54 ± 0.78 |
| Missing Teeth (MT)                | 0.99 ± 1.47 |
| Filled Teeth (FT)                 | 3.56 ± 2.43 |
| Plaque index (PI)                 | 1.29 ± 0.50 |

**Table 3:** The correlation coefficient between oral health literacy and oral health status.

| Oral health status | <i>r</i> | <i>p</i> -value |
|--------------------|----------|-----------------|
| Overall DMFT       | -0.356   | 0.002*          |
| Decayed Teeth (DT) | -0.283   | 0.001*          |
| Missing Teeth (MT) | -0.346   | <0.001**        |
| Filled Teeth (FT)  | -0.148   | 0.093           |
| Plaque index (PI)  | -0.398   | <0.001**        |

\**p*<0.01\*\**p*<0.001**Table 4:** Binary logistic regression analyses to confirm the associations between oral health literacy and oral health status.

|                                 | DMFT ≤ 5.11                   |            |                 |                                  |            |                 | PI ≤ 1.29                     |            |                 |                                  |            |                 |
|---------------------------------|-------------------------------|------------|-----------------|----------------------------------|------------|-----------------|-------------------------------|------------|-----------------|----------------------------------|------------|-----------------|
|                                 | Univariate Analysis (Model I) |            |                 | Multivariate Analysis (Model II) |            |                 | Univariate Analysis (Model I) |            |                 | Multivariate Analysis (Model II) |            |                 |
|                                 | Crude OR                      | CI         | <i>p</i> -value | Adjust OR                        | CI         | <i>p</i> -value | Crude OR                      | CI         | <i>p</i> -value | Adjust OR                        | CI         | <i>p</i> -value |
| <b>Independent variable</b>     |                               |            |                 |                                  |            |                 |                               |            |                 |                                  |            |                 |
| ThREALD-30                      | 1.21                          | 1.08, 1.36 | 0.001*          | 1.36                             | 1.14, 1.61 | 0.001*          | 1.30                          | 1.14, 1.48 | <0.001**        | 1.26                             | 1.07, 1.48 | 0.006*          |
| <b>Confounding variable</b>     |                               |            |                 |                                  |            |                 |                               |            |                 |                                  |            |                 |
| - Age                           |                               |            |                 | 1.03                             | 1.00, 1.06 | 0.034           |                               |            |                 | 1.01                             | 0.99, 1.04 | 0.430           |
| - Gender (female)               |                               |            |                 | 1.39                             | 0.65, 2.99 | 0.395           |                               |            |                 | 0.87                             | 0.41, 1.86 | 0.714           |
| - Education (Collage or higher) |                               |            |                 | 2.34                             | 0.85, 6.42 | 0.099           |                               |            |                 | 0.95                             | 0.37, 2.41 | 0.911           |
| - Monthly income (>THB 10,000)  |                               |            |                 | 1.27                             | 0.42, 3.86 | 0.672           |                               |            |                 | 0.60                             | 0.20, 1.78 | 0.356           |

\**p*<0.01\*\**p*<0.001**Table 5:** Binary logistic regression analysis to confirm the association between oral health literacy and dental service utilization.

|                                 | Visited the dentist in last 12 months (yes/no) |            |                 |           |            |                 |
|---------------------------------|--|------------|-----------------|-----------|------------|-----------------|
|                                 | Model I  |            |                 | Model II  |            |                 |
|                                 | Crude OR                                       | CI         | <i>p</i> -value | Adjust OR | CI         | <i>p</i> -value |
| <b>Independent variable</b>     |  |            |                 |           |            |                 |
| ThREALD-30                      | 1.24   | 1.11, 1.39 | <0.001*         | 1.14      | 0.98, 1.32 | 0.083           |
| <b>Confounding variable</b>     |  |            |                 |           |            |                 |
| - Age                           |  |            |                 | 1.01      | 0.97, 1.05 | 0.624           |
| - Gender (female)               |  |            |                 | 1.14      | 0.45, 2.88 | 0.781           |
| - Education (collage or higher) |  |            |                 | 0.62      | 0.18, 2.13 | 0.449           |
| - Monthly income (>THB 10,000)  |  |            |                 | 0.38      | 0.13, 1.16 | 0.089           |

\**p*<0.001

## Discussions

In this study, our primary objective was to determine the association between OHL, OHS and utilization of dental services among maintenance patients. Our finding shows that OHL was significantly associated with OHS and dental service utilization. Those with higher OHL had a lower number of DMFT, lower PI, and received dental service for oral health checkups within 12 months after their last dental visit.

The ThREALD-30 scores of the participants in this study were relatively high with a mean score of  $26.7 \pm 3.76$ , compared to the mean OHL scores in the validation study with a mean ThREALD-30 score of  $20.12 \pm 8.71$ .<sup>(16)</sup> The reason could be because this study was purposively conducted in the Comprehensive Dental Clinic at the Faculty of Dentistry, Chiang Mai University. The participants included in this study were maintenance patients. These patients had been accessing healthcare services for treatment, rehabilitation, and the prevention of oral diseases along with full dental health education. Hence, they were more likely to have better OHL scores compared to the general Thai population. In this study, most of the participants are elderly. Therefore, the relationship between age and OHL/OHS are not analyzed.

This study found significant associations between OHL and OHS based on DMFT and PI. The result found that the participants had a mean DMFT of 5.11 teeth/person and found 39 participants with new tooth decay. Although the patient was in the maintenance phase, poor oral health behavior can lead to new tooth decay. A Previous study found low oral health literacy is associated with poor oral health behavior.<sup>(10)</sup> Statistical analysis in this study demonstrated a significant association between OHL and DMFT. This finding corresponded to the previous studies of Deerkasa *et al.*<sup>(16)</sup>, Wanichsaithong *et al.*<sup>(20)</sup>, and Haridas R *et al.*<sup>(21)</sup> When the individual components of DMFT were analyzed, OHL presented negative associations with the missing teeth (MT) and the decayed teeth (DT) which could be implied that a person with higher OHL was more likely to have fewer decayed and missing teeth. It was also congruent with the study conducted by Blizniuk *et al.*, indicating that patients with adequate OHL would lose fewer teeth than those with inadequate OHL.<sup>(22)</sup> In this study, OHL was not associated with the filled teeth (FT). This may be attributed to utilizing oral health services. OHL and OHS can change over time. Patients who

have a higher number of fillings may be individuals with high OHL. Patients with high OHL have skills in taking care of oral health, recognizing the presence of the disease, and receiving appropriate dental care before disease progression.<sup>(23)</sup>

In addition, there was a negative association between OHL and PI. People with high OHL would have lower plaque on the teeth. This finding correlated with the previous study in the Brazilian adult population, which found that patients with low OHL had more plaques on the teeth<sup>(24)</sup>, which reflected oral hygiene caused by oral self-care behaviors of each patient. Patients with low OHL were likely to have poor oral health behaviors, delayed diagnoses of medical conditions, no understanding of medical instructions, and poor adherence to medical instructions.<sup>(9,11,12,23,25-27)</sup> These consequently had resulted in poorer oral health status in patients with inadequate OHL.

In this study, dental service utilization for checkups was found significantly correlated with OHL scores. In the Comprehensive Clinic, the recommended duration for dental check-up depends on the risk of oral disease of each person. The period may be varied from every 3 months, 6 months or 12 months. However, within 12 months, everyone receives an appointment for a dental check-up at least 1 time. A group with higher OHL tended to utilize the dental service within 12 months after their last dental service. People with adequate OHL seem to understand the benefits of seeking timely dental care. The results were consistent with the finding of Jamieson LM *et al.*, which highlighted that people visiting a dentist for a period exceeding one year were likely to have low OHL when compared with people who visited dentists annually.<sup>(28)</sup> On the other hand, some studies found no significant association between dental utilization and OHL.<sup>(9,29)</sup> That could be because those studies did not classify the reasons for dental service utilization, such as routine care, prevention, or emergency dental care. The reasons for dental service utilization appear to affect the data analysis because people with low OHL would often visit the dentists for emergency care, but hardly for preventive dental services. In addition, this study found that 79.2% of the participants had visited and received a dental service for oral health checkups within 12 months after their last dental service, which was a relatively high percentage compared to the general Thai population.<sup>(30)</sup> It could be due to the

dental service at Comprehensive Dental Clinic aims to enable patients to optimize their oral health and develop self-care behaviors. Proper instruction for dental service is therefore emphasized by the dentists to all patients. They are annually recalled for a check-up visit, even in the absence of any symptoms. The recommended recall interval is specifically determined for each patient based on an assessment of previous disease severity and risk of occurrence of new dental disease. Consequently, most of the maintenance patients attending Comprehensive Dental Clinic are expected to have awareness regarding oral disease prevention and utilize dental services for oral health checkups regularly.

In the Comprehensive Clinic, the maintenance patients refer to those who have already received several dental services for prevention, treatment, and rehabilitation. Therefore, maintenance patients were expected to have optimal oral health status and can perform self-care behaviors in the long term. Self-care management includes good oral health behaviors, perception of oral health diseases and treatment needs, and regular oral health checkups. The results of this study prove our hypotheses and highlight the importance of the association between OHL and OHS and dental service utilization. Therefore, it is suggested that improving the OHL should be emphasized in the curriculum for prevention regimen in every patient because it presents to contribute sustainable oral health in each individual.

A limitation of the present study was its cross-sectional design which did not enable establishing cause and effect relationships. The tool used to assess OHL was based on the ThREALD-30 used for assessment of the functional OHL only. However, previous studies demonstrated word recognition test correlate well with comprehension and functional health literacy.<sup>(31)</sup> The DMFT and PI data representing OHS in this study were obtained from secondary data (medical records stored on an electronic database), and the examiners were not previously calibrated. However, this may not have much impact on the validity and reliability of the data since the measurements are routinely checked by dental specialists (faculty staff) before being entered into the electronic database.

## Conclusions

OHL is associated with OHS. People with higher OHL are likely to have a lower number of DMFT and PI,

which reflects better OHS compared to those with lower OHL. In terms of behaviors for dental service utilization, an association is found between OHL and behaviors for dental service utilization. People with higher OHL would visit and receive dental services for oral health checkups within 12 months after their last dental service. When adjusted by controlled variables (age, gender, education, and income), the present study shows that OHL can predict DMFT and PI with statistical significance.

## Conflicts of Interest

The authors declare no conflicts of interest.

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