Development and use of an oral health literacy tool for older adults

A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy in the Faculty of Biology, Medicine and Health

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Abbreviations

ADA American Dental Association
CAM Complementary and Alternative Medicines
CMU Chiang Mai University
CPITN Community Periodontal Index of Treatment Needs
DMFT Decayed-Missing-Filled Teeth index
ETC Et cetera
GBH Government Health Benefit
HL Health literacy
NCD Non-Communicable Diseases
NIDCR National Institute of Dental Craniofacial Research
NVS Newest Vital Sign
OA-TOFHLiD Test of Functional Health Literacy in Dentistry for Older Adults
OHL Oral health literacy
OHL-AQ Oral Health Literacy Adults Questionnaire
PHC Primary Health Care
REALD Rapid Estimation of Adult Literacy in Dentistry
ROC Receiving Operating Characteristics
S-TOFHLA Short Test of Functional Health Literacy in Adults
SSS Social security scheme
TOFHLA Test of Functional Health Literacy in Adults
TOFHLiD Test of Functional Health Literacy in Dentistry
ToP Toothpick
TV Television
UC Universal Health Coverage
UK United Kingdom
USA United States of America
VHV Village Health volunteer
WHO World Health Organisation
Abstract


Oral health literacy (OHL) is emerging as an important element in the prediction of the oral health status of individuals. The application of health literacy instruments has largely been targeted at younger adults and parents. While lower OHL has been associated with poor oral health, these associations are unproven in older adult populations. Therefore, this work aimed to develop an oral health literacy tool for older adults, and then use it to assess OHL in older adults and explore associations with oral health status and other factors.

A mixed methods approach was utilised including; a literature review, the development of an OHL test, validation studies of the tool, a single cross-sectional study, a qualitative interview, and a protocol for a future study. Each method was used to establish a newly developed tool, explore associated factors, and develop a deeper understanding regarding OHL in older adults.

A Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was developed in two languages (Thai and English) and validated in Thai and American populations. The tool presented good validity and reliability, and the cut-off scores were established in order to classify older adults into Adequate or Inadequate OHL. Further utilisation of the OA-TOFHLiD was explored to assess OHL and identify associations with oral health status. The results indicated that older adults with Adequate OHL had significantly better oral health statuses and less treatment need. In addition, OHL levels classified by OA-TOFHLiD scores presented acceptable sensitivity and specificity to predict oral health status, therefore, the researcher proposed a protocol to use this tool as a screening tool for dental care need in primary care settings with Thai community-living older adults, who were found to have a high prevalence of dental diseases but low dental service utilisation.

These results suggest that the implementation of an OHL test as a screening tool at the community level is needed. Further investigation is also recommended regarding the possibility of using this tool as rapid non-professional screening of older adults for oral health needs.
Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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I also would like to thank Dr Michaela Goodwin, my co-supervisor, for her very hard work, reading my work, giving me great constructive suggestions, and support for improving my work constantly, which were an essential influence for the accomplishment of this PhD study.

Thanks to Chaing Mai University for providing the PhD scholarship for me to pursue my PhD overseas. Thank you to all staff in the division of Community Dentistry at Chaing Mai University, who always gave me all kinds of support. I would like to express my most sincere gratitude to Assoc. Prof Patcharawan Srisilpanan, who recommended me to carry out my PhD with Iain, and has given me support and useful advice for my PhD study. I would like to thank Assist.Prof. Songvuth Tuangratanapahan, Assist.Prof. Piyanart Chatiketu, and Assist.Prof. Areerat Nirunsititrar, for giving me suggestions, caring and supporting. Thank you Ms Rattana Bualoy, Ms Sansanee Ruangson, and Ms Uthsa Oudrang for their support and assistance during the data collection periods in Thailand.

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The author

I studied Dentistry as an undergraduate at Chiang Mai University, Faculty of Dentistry, Thailand during 2004-2010. During my undergraduate years, I was impressed and motivated by community and public health dentistry. The outreach project when I was an undergraduate was to develop a basic health literacy intervention about food and sweets in primary school children. Our group was awarded as ‘The most outstanding project of the year’, and I was awarded ‘Student of the year 2009’, from the Department of Community Dentistry at Chiang Mai University.

After I graduated, I worked as a lecturer in the Department of Community Dentistry at Khon Kean University, Thailand for 2 years. Hence, I gained experience in teaching undergraduate dental students in dental public health subjects. I also had a great opportunity to be involved in many research projects and work with Assoc. Prof. Waranuch Pitiphat the Dean of Faculty of Dentistry, Khon Kean University. She is one of my role models who inspired me to continue working towards research and academic in Dental Public Health.

In 2012, I decided to pursue my Master’s Degree in Primary Health Care Management at the ASEAN Institute for Health Care Development at Mahidol University, Thailand. After I got my Master’s degree in 2013, I started to work as a lecturer in the division of Community Dentistry, Faculty of Dentistry at Chiang Mai University (CMU). Hence, I was inspired by many researchers and pieces of research that I had been involved with. Therefore, I set my goal to pursue a higher degree in research.

In 2015, I received a CMU staff development scholarship to pursue a PhD degree; therefore, I applied to be a PhD student supervised by Iain and Michaela from September 2015.
General introduction

Thesis format declaration

This thesis was written in 'Journal Format' resulting in different sections that would be suitable for publication. Due to the requirement of individual chapters to be discrete, submittable pieces of written work, there is inevitably some repetition, especially in the introduction and methodology sections. This is a recognised limitation of the format but reflects the 'real world' nature of study and manuscript submission.
Study overview

The ultimate goal of the research undertaken in this thesis was to develop and validate an oral health literacy (OHL) tool for older adults, and also to explore its usability in dental public health services. The overview of the study process is illustrated as a flow chart in Figure 0.1

Figure 0.1: Overall working process and chapters in this thesis

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<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
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<td>1</td>
<td><strong>Literature review</strong>&lt;br&gt;Review evidence from previous studies and the potential tools</td>
<td>No tool for older adults</td>
<td>Identify research gaps questions and set the objectives</td>
</tr>
<tr>
<td>2</td>
<td><strong>Identify problems and needs</strong>&lt;br&gt;Retrospective epidemiological study of oral health status and treatment needs in the target population. N = 393</td>
<td>Poor oral health status, low dental service utilisation</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td>3</td>
<td><strong>First pilot of the OA-TOFHLID</strong>&lt;br&gt;The first pilot developed was an OHL test in Thai older adults. N = 105</td>
<td>The pilot OA-TOFHLID total score = 35</td>
<td>Poor predictive validity → test needed to be improved</td>
</tr>
<tr>
<td>4</td>
<td><strong>Optimised OA-TOFHLID</strong>&lt;br&gt;The OA-TOFHLID was further developed by adding 1 reading comprehension section, and tested in Thai older adults. N = 103</td>
<td>The optimised OA-TOFHLID total score = 48</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td>5</td>
<td><strong>Use OA-TOFHLID in clinical setting</strong>&lt;br&gt;The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status. N = 115</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLID was too long for some to complete.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Qualitative study of the OA-TOFHLID</strong>&lt;br&gt;[Subgroup of Chapter 5]&lt;br&gt;Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults. N = 22</td>
<td>Those with adequate OHL presents better oral health status</td>
<td></td>
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<tr>
<td>7</td>
<td><strong>Validation the Short OA-TOFHLID in the US population</strong>&lt;br&gt;The Short OA-TOFHLID was developed by cutting certain prompts, following feedback from participants about the length of the original tool. N = 106</td>
<td>The Short OA-TOFHLID total scores = 39</td>
<td>The test presents acceptable validity → Need to confirm with different population</td>
</tr>
<tr>
<td>8</td>
<td><strong>Re-evaluation the Short OA-TOFHLID in the Thai population [Combined data from Chapter 4 and 5]</strong>&lt;br&gt;The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data. N = 218</td>
<td>The performance of the shortened version was confirm.</td>
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<td>9</td>
<td><strong>A protocol for a pilot study using the Short OA-TOFHLID in community</strong>&lt;br&gt;A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
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1. Chapter 1

Introduction and literature review
Foundation of Chapter 1

This chapter provides an overview of both health literacy and oral health literacy, the definitions and concepts of which have been developed since 1990. The importance of oral health literacy and the associated factors were explored in order to lay the foundations and justify the areas of research within this PhD. The consequences of limited health literacy and oral health literacy were also examined.

The review explored previously established oral health literacy tools and detailed the processes for developing these tools. This information was used as the basis for developing a new oral health literacy tool for different age groups and populations. The review also details the use of health literacy within oral health research. This review provided a summary of the current knowledge regarding health literacy and oral health literacy and identified prevalent gaps, which informed the next chapters of this study.
**Introductions**

Imagine if you were lost in a rural village, where no one speaks English, you are sick and need to go to hospital. You are given a prescription from doctors in a language that you do not understand. You cannot ask for an explanation, as no one understands you. As a result, you would feel completely lost, isolated and desperate. The idea behind this is not just hypothetical, but happens around the world on daily basis. There are large numbers of people who are unable to thoroughly understand health information and struggle with limited health literacy (Paasche-Orlow, Parker, Gazmararian, Nielsen-Bohlman, & Rudd, 2005).

In a study concerning HIV patients in 2000 (Kalichman et al., 2000a), health literacy was associated with health behaviours of HIV patients. Although there were no significantly different health outcomes, for example, numbers of white blood cell counts were the same between a group of patients with low health literacy and those with high health literacy, the poor health behaviours tended to occur among low health literacy group. For example, HIV patients with low health literacy perceived HIV treatment could reduce transmission risks. As a result, they practiced more unsafe sex following new HIV treatments. Another HIV study (Wolf et al., 2007) in 2007 reported that patients with low health literacy were 3.3 times more likely to not adhere to their drug regimen correctly. Health literacy is therefore one of the unexpected determinants of health that may not only affect patients themselves, but could also be hazardous to other people.
1.1 Definitions and concepts of Health Literacy and Oral Health literacy

Definitions and model of health literacy

The definition of literacy has been of academic interest since the mid-twentieth century (Fransman, 2005). The Oxford Advanced Learner’s Dictionary’s definition describes literacy as the ability to read and write (Oxford, 2010). However, concepts and definitions of literacy have been developed and extended into many different dimensions. Literacy can be conceptualised in four different components: 1) Literacy as an autonomous set of skills 2) literacy as applied, practiced and situated, 3) literacy as a learning process and 4) literacy as text (UNESCO, 2005). UNESCO emphasizes that literacy is not only an individual phenomenon, but also a societal phenomenon that is essential in order for people to develop and participate in economic, social and political issues (UNESCO, 2005). The first published test of health literacy was introduced in 1968 by the National Center for Health Statistics of the United States. The assessment, called “the Brief Test of Literacy”, was one part of the Health Examination Survey program used to not only measure literacy data but also explore any relationships between ill health and literacy (Donlon, McPeek, & Chatham, 1968).

In the 1970s, the impact of literacy on health was increasingly described, especially for family planning and health fertility (Karan, Bladen, & Singh, 1978; You Poh Seng Rao & Shantakumar, 1974). As a consequence the concept of health literacy emerged in 1974 (Ratzan, 2001). Health Literacy is one of the factors that many health professionals have been interested in, particularly with regard to impact on health outcomes (Sorensen, Van den Broucke, Fullam, Doyle, Pelikan, Slonska, Brand, & Literacy, 2012). Initially, health literacy was described in relation to health education (Simonds, 1974). However, the meaning of health literacy has been developed over recent time. The most recognised health literacy definition was defined by the Institute of Medicine (IOM), USA, in 2004, as “The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (Institute of Medicine, 2004).
In daily life, health literacy is recognised as the ability of an individual to use health related information in health related activities. This can occur in a variety of situations, for example, adults may encounter new health information presented in pamphlets while visiting their doctors, they may be required to complete a registration form and be asked about their health insurance. Moreover, they may be given a prescription and instructions on their care. All these activities require health literacy in order to read comprehend and use the given information.

From the results of the 2003 National Assessment of Adult Literacy (NAAL), it was found that approximately 14 percent or 41 million U.S adults had below basic health literacy (Kutner, Greenberg, Jin, & Paulsen, 2006). Limited health literacy is higher among older adults, minority groups and people who have never attended or did not complete high school (Easton, Entwistle, & Williams, 2010). In Europe, the results from the European Health Literacy Survey (HLS-EU) conducted in 8 European countries in 2011 found at least 1 in 10 or 12% of the subjects had insufficient health literacy and almost half of respondents showed limited health literacy (Sorensen et al., 2015). From this survey, financial limitation, social status, education, age and gender were the strongest predictors of low health literacy (Sorensen et al., 2015).

Health literacy definitions and models have been developed and explained across various dimensions and purposes, by numerous researchers (Sorensen, Van den Broucke, Fullam, Doyle, Pelikan, Slonska, Brand, & Consortium Health Literacy Project, 2012). However, the most well-known concept was proposed by Nutbeam who classified health literacy (Nutbeam, 2000) into three levels;

1. **Functional Health literacy** = The ability to read and write and to function in health related circumstances successfully.
2. **Interactive Health Literacy** = Having advanced cognitive, literacy and social skills in order to participate in healthcare effectively.
3. **Critical Health Literacy** = The capacity to analyse and use information critically to engage in action to overcome structural barriers to health.

The concept of functional health literacy concerns an individuals’ capacity or skills to manage their health while the interactive and critical health literacy focus beyond the individual competence to critically engage in a wider range of health
activities and greater control over the social determinants of health (Nutbeam, 2008).

Another famous health literacy model was proposed by Paashe-Orlow & Wolf in 2007, which illustrated a pathway of the possible associations between health literacy and health outcomes (Paasche-Orlow & Wolf, 2007). This model suggested health literacy should be considered as both a patient and health system phenomenon. In addition, the model proposed three main health continuums that could be influenced by health literacy which are 1.) Access and utilisation of health care 2.) Patient provider relationship 3.) Self-care (see figure 1.1)

**Figure 1.1: Causal Pathway of Health Literacy and Health Outcome** (Paashe-Orlow & Wolf 2007)
Oral Health Literacy definitions and concepts

Oral Health Literacy is becoming an increasing focus of interest, particularly after it was included in the health promotion and disease prevention agenda, Healthy People 2010 (U.S. Department of Health and Human Services, 2000). Although the field of oral health literacy is increasingly being studied, it is less developed when compared to the field of general health literacy (Isman, 2007).

The term ‘Oral Health Literacy” has been described by the National Institute of Dental Craniofacial Research, (NIDCR) in the U.S. in 2005. Their definition was based on the description of health literacy from the Healthy People 2010 review. In the context of oral health, oral health literacy 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 (Baur et al., 2005). It is believed oral health literacy is one of the most important determinants of oral health. In addition, it is hypothesized that low oral health literacy might be one of barriers to better oral outcomes (Baur et al., 2005).

The American Dental Association (ADA) also provides a definition of oral health literacy, as ‘Oral Health literacy is a shared function of individual patient skills, provider’s ability to communicate effectively and accurately and the information demands placed on patients by healthcare systems’ (American Dental Association, 2010). In 2010, ADA had set the principles, goals and strategies for working on health literacy in Dentistry. Their action plan focuses on 5 areas (American Dental Association, 2010);

1. Training and education - to strengthen the perception in oral health literacy in relation to oral health and quality of life.
2. Advocacy - to eliminate barriers by creating effective programs for people and persuade legislators or policy makers that oral health literacy should be prioritised as a public health concern.
3. Research - to enhance the science-based evidence and increase knowledge transferring from research to practice.
4. Dental practice - to improve communication between workforce and patients and to develop patients’ understanding in dental practice setting.
5. **Build and maintain coalitions** - to set oral health literacy as a priority issue in dentistry and cooperate with related organization.

The oral health literacy concept has been developed according to the knowledge and concepts of general health literacy. Figure 1.2 shows the concept model of oral health literacy is first proposed by The National Institute of Dental and Craniofacial Research workgroup (NIDCR) (National Institute of Dental and Craniofacial Research, 2005). They described oral health literacy as an interaction between the influence of individual factors, cultural and society, healthcare system, and education system. Their combined influence determines cost and oral health outcomes.

**Figure 1.2: The Oral Health Literacy Model (NIDCR)**

Oral health is not only an individual metric, but also relates to family, society and environment as a determinant of health. This model has been developed to display the inter-relationship among macro systems-level factors and individual factors. NIDCR explained that an individual’s oral health literacy could be affected by cultural factors, society, the education system and the healthcare system. Oral health literacy can affect people’s oral health outcomes and costs spent on oral healthcare, as oral health literacy is an important element, which can support people to make health related decisions and interact with health services and health information.
In conclusion, oral health literacy refers to the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health. Oral health literacy also includes the capacity to communicate, assert and enact these decisions.

1.2 Importance of health literacy

Health literacy and its importance to health promotion

From the previous definition, health literacy goes beyond the concept of health education; an approach focusing on individual’s knowledge and behavioural change rather than socioeconomic and environmental determinants of health (Ashton, 2016). It was found health education would be effective only among individuals with higher education levels and those with economical advantage in society (Nutbeam, 2000).

The recent concept of health education has become more comprehensive and aims to impact not only on the individual, but also increase attention to explore and improve various external factors associated with health, for example, social and economic conditions, which are known as the social determinants of health. When health education is successful, people will be able to comprehend health information, interact with health information and health systems and participate in health decisions, and hence effective health education will also lead to an increase in health literacy (Kickbusch, 2001).

Health promotion can also help health professionals recognize that health literacy is not only about knowledge transmission, as it is with conventional health education, but also to consider participatory approaches in order to examine how individuals can develop their knowledge and skills to maintain good health and effective self-care (Nutbeam, 2000).

Health literacy is not just about an individual’s reading and writing abilities. It has been explained as the cognitive skills, which contribute to the motivation of people to increase access to, understand and utilise health information, and
make appropriate decisions in the ways of promoting and maintaining good health. By improving an individual’s access to health information and increasing their capacity to use it effectively, health literacy is crucial in promoting ‘Empowerment’, which is one of important priorities in health promotion in the Jakarta Declaration (WHO, 1998).

**Importance of health literacy**

As described in the previous section, health literacy is an emerging concept in health promotion. By improving people’s health literacy, they will be able to access to more health information and consume it more effectively. Consequently, and importantly improved health literacy leads to empowerment (Nutbeam, 2000).

At an individual level, health literacy can affect a patient’s ability to take medication correctly and also impacts on medication adherence (Davis et al., 2006). In a study of patients with heart failure, it was found that patients with adequate health literacy had more drug adherence than patients with inadequate health literacy (Noureldin et al., 2012). Health literacy is also important for a patient’s ability to take instructions from a health care professional and to learn about prevention and self-care management (Wolf et al., 2009). A patient who has adequate health literacy tends to have the ability to understand disease related information, for example, the cause of disease and how to prevent it. Additionally, they understand instructions, provided by health professionals, in relation to self-care (Wolf et al., 2007)

At population levels, health literacy is associated with many health issues, especially health disparities. Health disparities are inequalities in health, which result from social, economic or environmental prejudice. These inequalities can impact on health outcomes throughout different populations (Creeth, Bosma, & Govier, 2013). Previous research has indicated that health disparities can be decreased by improving health literacy (Zarcadoolas C, Pleasant AF, & Greer DS, 2006). The relationship between health literacy and health disparities has impacts on the following areas: (Mantwill, Monestel-Umana, & Schulz, 2015)
First, health literacy respectively reduces the effect of race or ethnicity on self-reported health status. For example, a study of US older adults aged 65 years and older reported that health literacy significantly reduced the effect of race (black, white, Hispanic) and education-related disparities on self-reported health status (Bennett, Chen, Soroui, & White, 2009). In addition, other studies have investigated the effect of health literacy on decreasing disparities on cancer-related outcomes. One study found that higher prostate-specific antigen (PSA) levels and the more advanced cancer stages were significantly higher in African American than white subjects. However, after adjusting for health literacy levels and age, race was not a significant predictor of higher PSA levels. It was shown that the inclusion of literacy resulted in a reduction of 35% when assessing the association between race and prostate-specific antigen level (Wolf, Knight, et al., 2006).

Health Literacy can also mediate the effects of ethnicity on medication adherence and management. A study by Osborn et al. in 2007 (Osborn, Paasche-Orlow, Davis, & Wolf, 2007) showed African Americans were significantly less likely to adhere to their HIV medication regimen compared to non-African-American participants. However, after including health literacy in the model, there was a 25% reduction in the effect of race resulting in a non-significant effect. The same effect of health literacy on the reduction of race significance were also found in various studies, for example, an asthma quality of life and asthma control study (Curtis, Wolf, Weiss, & Grammer, 2012), a cancer screening behaviour study (Lindau et al., 2002), and an end of life decisions study (Volandes et al., 2008).

Regarding oral health literacy, previous research has also shown that adequate oral health literacy reduces the effect of socioeconomic and environmental factors on oral health status (Guo et al., 2014). In Maryland, USA, Horowitz et al. created a long-term project and proposed a model (see Figure 1.3) to reduce oral health disparities by enhancing oral health literacy at state level. This was based on their search of previously published evidence around improving oral health, which indicated oral health literacy was a key factor across individual, population, and professional levels (Horowitz & Kleinman, 2012).
Figure 1.3: Maryland Oral Health Literacy model: moving science into action (Horowitz & Kleinman, 2012)

Consequence of limited health literacy

There are many studies that demonstrate the relationship between limited health literacy and poorer health outcomes. For example, low health literacy can affect; incorrect use of medication, increase risk in an emergency situation, lack of social empowerment and self-efficacy, increased financial costs associated with a less healthy population, poor self-management of chronic conditions, and improper use of health services (overuse or misuse) which increases costs (Zarcadoolas C et al., 2006).

Previous work has demonstrated the relationship between limited health literacy and utilisation of health services. It was reported that people with limited health literacy were more likely to use emergency care (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). This finding was seen in studies of; older adults (Cho, Lee, Arozullah, & Crittenden, 2008), patients with asthma (DeWalt, Dilling, Rosenthal, & Pignone, 2007) and patients with congestive heart failure (Murray
Furthermore, it was found the emergency room costs for people with inadequate health literacy were significantly higher compared to those with adequate health literacy (Howard, Gazmararian, & Parker, 2005).

Patients with limited health literacy also use fewer preventive services. A study about preventive health behaviour in older adults reported that participants with lower health literacy tended to receive less mammography screening and less influenza immunization (Bennett et al., 2009). In addition, people with lower health literacy were found to have difficulties in health care-related skills. Evidence from previous studies presented that patients with low health literacy tended to have poorer skills on, for example, properly identifying their medication (Kripalani et al., 2006), taking medication appropriately (Raehl, Bond, Woods, Patry, & Sleeper, 2006), and understanding drug labels or health messages correctly (Rothman et al., 2006; Wolf, Davis, Tilson, Bass, & Parker, 2006). Therefore, this consequently increases burden on healthcare providers when they treat people who do not adhere to medical treatment and preventive measures because of their lack of understanding (Health Literacy: A Prescription to End Confusion, 2004).

Poor health outcomes are associated with inadequate, or low health literacy. In studies about mental health, more depressive symptoms were more likely found in participants with low health literacy (Howard et al., 2005; Lincoln et al., 2006). In HIV studies, the association between low health literacy and improper HIV prevention or management were found in many studies (Phillips & Arya, 2016). For example, from the studies of Kalichman et al in 2000, although CD4 levels were not significantly different between patients with low and high health literacy, those with limited health literacy showed inadequate knowledge related to HIV disease (Kalichman et al., 2000b) and tended to have less adherence to antiviral treatments (Kalichman & Rompa, 2000).
Factors contributing to limited health literacy

Patient, family, and caregiver factors

Patient factors contributing to limited health literacy include limited education, difficulty in reading and writing, language barriers, communication skills, and unfamiliarity with medical terms. (Sogie-Thomas, 2006). People with lower education were reported having low health literacy compared to those with higher education (Howard, Sentell, & Gazmararian, 2006; S. Y. Lee, Tsai, Tsai, & Kuo, 2010; Paasche-Orlow et al., 2005; van der Heide et al., 2013). Education directly relates to health literacy because it is associated with the ability to read and write, which is an important pathway to obtain health-related information (van der Heide et al., 2013). Language barriers, for example if information is not in an individual's first language, or difficulties of language, are also one of the main problems affecting health literacy, especially in immigrants (Marks, 2009; Zanchetta & Poureslami, 2006).

These factors affect patients with limited health literacy to interact with both the health care system and providers. Eventually, patients with limited health literacy may lack empowerment, which means that they will accept whatever the system provides without negotiation or power (Institute of Medicine, 2004). In addition, patients with limited health literacy usually feel ashamed or embarrassed of their limitations and do not want to reveal it (Marks, 2009; Sogie-Thomas, 2006). Therefore, they might neither tell the providers when they do not understand nor ask for the clarifications and explanations (Sogie-Thomas, 2006).

Health care provider factors

Health care providers are one the most important factors that contribute to limited health literacy in patients. The most important reason is that clinicians usually do not fully understand what patients know and do not know (Sogie-Thomas, 2006). They commonly assume that all patients are able to understand basic medical words, for example, x-ray, surgical procedure, and infection. However, patient with low health literacy might have difficulties in understanding these words and then cannot follow the doctor's instruction correctly (Berkman et al., 2011).
Furthermore, time limitation is always a problem associated with health care providers. Clinicians are usually rushed and do not have time to communicate and ensure that patients with limited health literacy are able to understand about their disease and instruction (Sogie-Thomas, 2006).

**Healthcare system factors:**

- **Medication →** Instructions may be too complex to understand. For example, the dosing instructions are too long, not stated clearly and comprised of too many steps (Sogie-Thomas, 2006).

- **Time →** According to the individual setting, health providers may have less time to spend with patients (Mann et al., 2001). Therefore, they cannot answer all questions patients may ask (Sogie-Thomas, 2006).

- **Self-care →** Hospital stays have become shorter and more medical treatment is provided outside the hospital (Sogie-Thomas, 2006). As a result, patients usually have to take care of themselves by following written instructions from health services, or searching information from other sources that requires the ability to read and understand it thoroughly. Consequently, patients with low-literacy might have difficulties following such instructions and to perform adequate self-care (Blanchard, 1998).

- **Fragmentation of Care →** Healthcare has been distributed into multi-level services; for example, primary, secondary and tertiary care. A patient may have to see multiple clinicians with different specialties in different settings. As a result, the patient could receive various information which may make them confused (Sogie-Thomas, 2006), i.e. the assimilation of differing pieces and sources of information, possibly in different formats, is complex.

- **Insurance and paperwork →** The information about care eligibility is often complex and difficult for patients to understand. Moreover, it requires a patient to complete different complex forms, for example, registration forms, consent forms, discharge forms that many patients struggle to understand completely (Sogie-Thomas, 2006).
1.3 Developing health literacy and oral health literacy tools

Types of Health literacy assessment

Cognitive abilities, or cognitive intelligence were classified into 2 types: fluid and crystallized. Fluid intelligence is an ability to deal with a new task or use logic to answer a question and solve a problem, whereas crystalized intelligence is an ability to use previous knowledge or background information (such as learning words or vocabularies) (Cattell, 1963).

Functional health literacy skills demonstrate the cognitive abilities used to manipulate individual's health (Wolf et al., 2012). Cognitive abilities are important to access health care, understand reading and numeric health-related information, express individual needs orally, understand instructions given by health professionals, weigh alternatives and decision making (Wolf et al., 2012). It was confirmed the relationship between health literacy measures and both fluid and crystallized cognitive abilities was strongly significant (Wolf et al., 2012).

When considering health literacy, it is not possible to assume a health literacy level simply from a patient's ability to read and write words. Furthermore, it is not easy to measure people’s health literacy directly, as it is for measuring sugar level or cholesterol level in blood. There have been many attempts to develop a test or instrument for assessing health literacy, which can be divided into 2 main traits according to the classification of cognitive intelligence:

**Crystallized trait**

A reading test can represent an individual’s crystallized cognitive abilities. The instruments in this category basically require a patient to read, pronounce and write health-related words correctly. However, each test may have some differences because of its objectives and techniques. The tests that can be classified into this group, are **WRAT-R (Wide Range Achievement Test-Revised)** (Owen & Erchul, 1987), **Rapid Estimate of Adult Literacy in Medicine (REALM)** (Davis et al., 1993), **Literacy Assessment for Diabetes (LAD)** (Nath, Sylvester, Yasek, & Gunel, 2001), and **Medical Terminology Achievement Reading Test**
Rapid Estimate of Adult Literacy in Medicine; REALM

One of the most popular reading tests, commonly used in health care research, is the Rapid Estimate of Adult Literacy in Medicine (REALM) (Altin, Finke, Kautz-Freimuth, & Stock, 2014). This test was developed to measure adult’s literacy in the wider medical area. Word recognition and correct pronunciation skills are assessed by this test, but comprehension is not (Davis et al., 1991). It is composed of a list of 66 medical words, which are arranged by complexity. The complexity of a word is determined by the number of syllables and difficulty in pronunciation (Davis et al., 1993).

In order to take the test, patients are asked to read all words in the list as far as possible. The correct pronunciation is marked, and then a score is accumulated. REALM is easy to use for assessing health literacy with a patient. It takes a few minutes to complete the test. Moreover, the REALM requires little training to implement (Davis et al., 1991; Davis et al., 1993). However, there has been criticism that REALM may not be effective enough to measure an individual’s health literacy given it only tests the ability to read words aloud. It may not acknowledge the ability of an individual to show their understanding and apply these words in health related decisions (Leung, Lou, Cheung, Chan, & Chi, 2013).

Fluid trait

The tests in this group assess more complex skills of patients, for example, numeracy skills, reading comprehension and understanding pictures and labels. The tests, which are classified in this group, include Test of Functional Health literacy in Adults (TOFHLA) (R. M. Parker, Baker, Williams, & Nurss, 1995), Peabody Individual Achievement Test-Revised (PIAT-R) (Luther, 1992), and Newest Vital Sign (NVS) (Weiss et al., 2005).

Test of Functional Health literacy in Adults; TOFHLA
One of the most popular tests is the Test of Functional Health literacy in Adults (TOFHLA). The test focuses on various pieces of information that patients might experience when utilising health care services. There are two sections in this test; the first part is a reading comprehension test and the second part is a numeracy test. The 50 items of reading comprehension and 17 items of numeracy questions in this test are adapted from a hospital form and prescription label, using the Cloze procedure, which is a technique that deletes every 5-7 words in a sentence (R. M. Parker et al., 1995). The TOFHLA and the shortened from (S-TOFHLA) have been used to assess patients’ abilities in understanding medication instructions comprehensively (Marvanova et al., 2011), observing and controlling blood sugar (Schillinger et al., 2002), empowering self-care behaviour (Eyuboglu & Schulz, 2016) and attending an appointment correctly (Griffey, Kennedy, D'Agostino McGowan, Goodman, & Kaphingst, 2014).

**Developing TOFHLA**

The 30 examples of information generally used in hospital texts, for example education materials, patient instructions, prescription on bottle labels and registration form were reviewed by a literacy expert. Three passages were selected, including instructions on preparing a patient for a gastrointestinal x-ray, an insurance application form, and a hospital informed consent form, for the reading comprehension section. In the numeracy section, the aim is to examine patient’s ability to take medicine correctly, understand blood sugar levels and an appointment card (R. M. Parker et al., 1995).

The Gunning Fog index (Gunning, 1968) gives a score based on the readability level of text. This is calculated using a weighted average of the number of words per sentence, and the number of long words per total words. A fog index of 12 would indicate the reader would need a reading level of a high school senior in the United States to fully understand the text. The TOFHLA was reported having Gunning Fox Index of 9.4, which approximately equal to the reading level of high school freshman in the United States education system.

The internal reliability of TOFHLA was tested by Cronbach’s Alpha and the Spearman-Brown equal-length coefficient. REALM and WRAT-R were used to obtain an estimate of concurrent validity of TOFHLA. Furthermore, the
Researchers claimed that content validity was enhanced by using actual hospital texts and terms (R. M. Parker et al., 1995).

**Oral health literacy assessment tools**

Seventeen years after the emergence of health literacy assessment tools in medical and general health, researchers in dentistry attempted to develop tools for oral health literacy assessment. The majority of tools used in dentistry were originally developed from those in the medical field, for example, REALD and TOFHLiD.

*Rapid Estimation of Adult Literacy in Dentistry; REALD*

This reading recognition instrument was developed by Lee et al. (J. Y. Lee, Rozier, Lee, Bender, & Ruiz, 2007), who created an instrument especially designed for oral health literacy. The Rapid Estimation of Adult Literacy in Dentistry or REALD-30 was first published in 2007. Initially adopted from health literacy in medicine, REALM or Rapid Estimation of Adult Literacy in Medicine was developed by Davis in 1991. The REALD-30 test is composed of 30 dental words taken from the American Dental Association’s Glossary of Common Dental Terminology used in word recognition test (J. Y. Lee et al., 2007).

Later, REALD-99 was developed by this group of researchers again because REALD-30 reported unclear predictive validity (Richman et al., 2007) (See in table 1.1) Sixty-nine dental words from the same source were added into the previous categories in order to assess more details in oral health and increase accuracy for an oral health literacy test. There have been many more instruments developed from REALD, across a variety of languages and forms. For example, REALM-D, REALD-TS, HK-REALD, BREALD, OHLA-S, OHLA-E, SOHLS (see details in table 1.2).

It was found that REALD has good convergent validity and internal consistency. The test is quick and easy to administer, especially when used in clinical settings. However, it is limited in the same way as REALM in that it focuses solely on reading and recognition skills and not determining functional literacy in dentistry (Gong et al., 2007).
Table 1.1: Words use in the REALD-99 and REALD-30

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Sugar*</td>
<td>27. Pulp*</td>
<td>52. Panoramic</td>
<td>77. Esthetic</td>
</tr>
<tr>
<td>6. Habits</td>
<td>31. Mouth guard</td>
<td>56. Inflammation</td>
<td>81. Halitosis*</td>
</tr>
<tr>
<td>7. Brush*</td>
<td>32. Denture*</td>
<td>57. Restoration*</td>
<td>82. Calculus</td>
</tr>
<tr>
<td>9. Dentist</td>
<td>34. Enamel*</td>
<td>59. Bacteria</td>
<td>84. Malocclusion*</td>
</tr>
<tr>
<td>15. Bleeding</td>
<td>40. Referral</td>
<td>65. Suture</td>
<td>90. Dentition*</td>
</tr>
<tr>
<td>17. Bridge</td>
<td>42. Coverage</td>
<td>67. Trauma *</td>
<td>92. Hyperemia*</td>
</tr>
<tr>
<td>18. Cavity</td>
<td>43. Surgery</td>
<td>68. Extraction*</td>
<td>93. Analgesia*</td>
</tr>
<tr>
<td>20. Implant</td>
<td>45. Deductible</td>
<td>70. Porcelain</td>
<td>95. Hypoplasia*</td>
</tr>
<tr>
<td>22. Braces*</td>
<td>47. Discolored</td>
<td>72. Periodontal*</td>
<td>97. Temporomandibular*</td>
</tr>
<tr>
<td>25. Bleach</td>
<td>50. Cyst</td>
<td>75. Cellulitis</td>
<td></td>
</tr>
</tbody>
</table>

*Denotes words used in REALD-30

Developing REALD-30

All words from the American Dental Association Glossary of Common Dental Terminology were included in the initial process. In addition, the common words in dentistry found in brochures and printed materials were included. Next, all words were arranged by difficulty, which were judged by length, syllables, sound combination and pre-test interview. Then, the researchers came to an agreement on the final 30 words and how to pronounce each word correctly (J. Y. Lee et al., 2007).

During the test, a patient was asked to read each word aloud. The correct pronunciation was counted as one point and summed to give an overall score by an interviewer. The range of REALD-30 score is from 0 to 30 (J. Y. Lee et al., 2007).
Cronbach’s Alpha was used to test for internal reliability. For convergent validity, REALD-30 scores were examined to find the association with scores of REALM and TOFHLA by using Pearson’s correlation (J. Y. Lee et al., 2007). Regarding predictive validity, REALD-30 scores were analysed against two dental outcomes (1. self reported oral health status and 2. oral health related quality of life). The test of predictive validity was conducted using logistic regression analysis for self-reported oral health status and by linear ordinary least squares regression for oral health related quality of life (J. Y. Lee et al., 2007).

**Test of Functional Health Literacy in Dentistry; TOFHLiD**

The TOFHLiD was developed by using a medical health literacy test, the TOFHLA (Test of Functional Health Literacy in Adults) as a template (see Figure 1.4). The items in this test were developed from knowledge about fluoride application in children’s teeth, readability of a consent form for treatment and understanding the Medicaid Rights. The respondents had to read the passage thoroughly and choose words from similar sounding words to fill in the blanks. There are 12 questions in 4 topics with a total score of 100 for TOFHLiD (Gong et al., 2007).
Developing TOFHLiD

Similar to the development of TOFHLA, the research groups consisted of paediatric and public health dentists who reviewed the existing patient education information and materials for use in TOFHLiD. For the reading comprehension section, the panel selected three passages, which were 1) caregiver instructions about a child’s fluoride vanish, 2) dental informed consent and 3) medical rights and insurance. To create the test in the reading comprehension section, the researchers used a modified Cloze method by converting passages into the test and omitting one word in every 5-7 words in a sentence (Newby, 1998). In the numeracy section, an instruction of fluoride toothpaste and a dental appointment card were used to create prompts. The researchers also created questions for testing the numeracy understanding of patients.

TOFHLiD performance was tested by looking at construct validity, predictive validity, and internal reliability. For assessing construct validity, the participants were tested by 3 additional health literacy tests (TOFHLA, REALM and REALD-99). The convergent and discriminant validity was analysed by multi-trait-multimethod (MTMM). Each participant was administered two oral health literacy tools (TOFHLiD and REALD-99) and two medical health literacy tools (TOFHLA and REALM) in order to be compared using 2×2 matrix. If the TOFHLiD was to
be valid, the correlation of TOFHLiD and REALD-99 should be stronger than correlation of TOFHLiD and TOFHLA, or TOFHLiD and REALM (Gong et al., 2007). For determining predictive validity, three hypotheses were generated based on the beliefs that there is an association between oral health literacy and oral health outcomes, completion of education and service utilization. The TOFHLiD scores were used in a multivariate regression model to test predictive validity with oral health outcomes, completion of education and service utilisation (Gong et al., 2007).

With regard to testing reliability, Cronbach’s alpha was used to determine internal reliability. In addition, construct validity of TOFHLiD was tested by, using the Multitrait-Multimethod (MTMM) matrix. According to MTMM matrix, all possible pairwise correlation of the scores from different tools, for example, TOFHLiD-REALD-99 (dental-dental), or TOFHLiD-TOFHLA (dental-medical), was calculated and measured against each other to establish if dentally related health literacy measures were more highly correlated than non-dental measures. If TOFHLiD is valid, correlation between dental and dental tool should be significantly higher than correlation between dental and medical tool. (Gong et al., 2007).

**Examples of other oral health literacy tools**

A further oral health literacy assessment tool was developed which was also based on TOFHLA. This tool is the Oral Health Literacy Instrument (OHLI), and was developed by Sabbahi et al (Sabbahi, Lawrence, Limeback, & Rootman, 2009). OHLI aims to assess the ability of adults to understand written information and numeracy information, similar to TOFHLiD. It is composed of 38 reading comprehension items and 19 numerical items. Unlike TOFHLiD, the researchers focused on the questions about the patients’ oral health knowledge in taking medicine related to the dental field, following post extraction instructions and understanding a dental appointment.

One of the functional oral health literacy tools for adults, which was first developed in Iran called Oral Health Literacy Adults Questionnaire (OHL-AQ) (Naghibi Sistani, Montazeri, Yazdani, & Murtomaa, 2014), recently became well known and has been translated into several languages (Flynn et al., 2016; Ho,
Liu, & Chang, 2019). This tool is a self-administered questionnaire with a short interview. It is composed of 17 items with 4 parts including reading comprehension, numeracy, listening (communication skills), and decision-making. This tool was primarily tested in adults aged between 18 to 64 years old, and was found to have good validity and reliability.

The Hong Kong Oral Health Literacy Assessment Task-P (HKOLHT-P) (Wong et al., 2013) was developed by integrating the reading test (HKREALD-30) and comprehensive test (TOFHLiD) together. It was developed in Chinese with Chinese-cultural elements as the researchers found previous instruments in English were not able to effectively measure oral health literacy in Chinese-speaking patients who are the largest population in Asia. Therefore, the researchers developed an assessment tool in Chinese, focusing on caregivers’ oral health literacy and child oral health status. It is composed of reading comprehension, fill-in-blanks passages, and rearranging sentences section.

Figure 1.5: Part 1 and 3 excerpted from the HKOLHT-P
In conclusion, oral health literacy assessment instruments can be classified into 3 groups;

1. **Word recognition instruments**
   These focus on respondents’ ability to correctly pronounce oral health related vocabularies, for example, REALD-30, REALD-99, REALM-D, TS-REALD, HKREALD-30, OHLA-S, OHLA-E

2. **Functional health literacy instruments**
   These focus on respondents’ ability to understand and apply written information and numerical data for example date and time on a appointment card or drug prescription. The instruments in this group are, for example, TOFHLiD, OHLI, OHL-AQ, HKOHLAT-P, and HeLD.

3. **Assess the level of oral health literacy through measurement.**
   These assess the level of oral health literacy by measuring conceptual oral health knowledge, for example, BHLOHKP, CMOHK.

In order to understand the timeline of the development and brief characteristics of all oral health literacy tools recently available, see Table 1.2
Table 1.2: Chronological overview of oral health literacy tools (Modified from Dickson-Swift et al. 2014)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Name of tools</th>
<th>Year</th>
<th>Characteristics of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>REALD-99</td>
<td>Rapid Estimate of Adult Literacy in Dentistry</td>
<td>2007</td>
<td>Model originally from Rapid Estimate of Adult Literacy in Medicine (REALM). Words were taken from the American Dental Association Glossary of Common Dental Terminology, which related to etiology, anatomy, prevention and treatment common used in Dentistry. Participants need to read the words aloud and if they pronounce it correctly, they will receive one mark.</td>
</tr>
<tr>
<td>REALD-30</td>
<td>Rapid Estimate of Adult Literacy in Dentistry-30</td>
<td>2007</td>
<td>Word recognition questionnaire was developed and shortened from REALD-99 for convenience in using at clinical and community settings.</td>
</tr>
<tr>
<td>TOFHLiD</td>
<td>Test of Functional Health Literacy in Dentistry</td>
<td>2007</td>
<td>Reading comprehension and numeracy developed from Test of Functional Health Literacy in Adult (TOFHLA).</td>
</tr>
<tr>
<td>OHLI</td>
<td>Oral Health Literacy Instrument</td>
<td>2009</td>
<td>This was also developed from Test of Functional Health Literacy in Adult (TOFHLA). It is composed of 2 sections, reading comprehension and numeracy test.</td>
</tr>
<tr>
<td>REALM-D</td>
<td>Rapid Estimate of Adult Literacy in Medicine and Dentistry</td>
<td>2010</td>
<td>Word recognition test developed from REALM and REALD. It contains 84 items in the test.</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Name of tools</td>
<td>Year</td>
<td>Characteristics of test</td>
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<tr>
<td>CMOHK</td>
<td>Comprehensive Measure of Oral Health Knowledge</td>
<td>2010</td>
<td>44 items, the questions are about conceptual knowledge in 4 domains: 1) basic knowledge of oral health 2) dental caries prevention and management 3) periodontal disease prevention and management 4) oral cancer prevention and management</td>
</tr>
<tr>
<td>BHLOHKP</td>
<td>Baltimore Health Literacy and Oral Health Knowledge Project survey</td>
<td>2011</td>
<td>44 items, the 4 domains in the question are the same as CMOHK, but it was developed in 2 phases. First phase, the open-ended questions were developed by experts. The second phase, participants were asked to develop a multiple-choice version.</td>
</tr>
<tr>
<td>TS-REALD</td>
<td>Two-stage Rapid Estimate of Adult Literacy in Dentistry-30</td>
<td>2011</td>
<td>This test was developed based on the REALD-30 following criticisms the original had not had a described psychometric review. TS-REALD tailors the scale to the respondents’ dental health literacy level by conducting a routine test followed by a second part based on the scores from the routine section. This maintains reliability and reduces test length.</td>
</tr>
<tr>
<td>HKREALD-30</td>
<td>Hong Kong Rapid Estimate of Adult Literacy in Dentistry</td>
<td>2012</td>
<td>Dental terminology from REALD-99 were translated into Chinese and shortened into HKREALD-30.</td>
</tr>
<tr>
<td>OHLA-S</td>
<td>Oral Health Literacy Assessment-Spanish</td>
<td>2012</td>
<td>Word recognition test: adaptation from REALD, with an added dimension of comprehensive test in Spanish</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Name of tools</td>
<td>Year</td>
<td>Characteristics of test</td>
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<tr>
<td><strong>OHLA-E</strong> (J. Lee et al., 2013)</td>
<td>Oral Health Literacy Assessment-English</td>
<td>2012</td>
<td>Word recognition test: adaptation of REALD, with an added dimension of comprehensive test in English.</td>
</tr>
<tr>
<td><strong>REALMD-20</strong> (Gironda, Der-Martirosian, Messadi, Holtzman, &amp; Atchison, 2013)</td>
<td>Rapid Estimate of Adult Literacy in Dentistry-20</td>
<td>2013</td>
<td>REALMS, REALD-30 and REALD-99 were combined to create this test because the researchers believe that the field of dentistry and medicine were related. 84 items of REALM-D were developed and shortened into 20 words for a brief screening for clinical use.</td>
</tr>
<tr>
<td><strong>HKOHLAT-P</strong> (Bridges, Parthasarathy, Au, et al., 2014; Wong et al., 2013)</td>
<td>Hong Kong Oral Health Literacy Assessment Task for Pediatric Dentistry</td>
<td>2013</td>
<td>The test was aimed to evaluate caregiver OHL (Pediatric dentistry). It was modeled from TOFHLiD and OHLI, but obtained dental words from Hong Kong media (videos, brochures advertisement, etc. Therefore, the test was in Chinese (Cantonese) and specific in Chinese context.</td>
</tr>
<tr>
<td><strong>OHL-AQ</strong> (Naghibi Sistani et al., 2014)</td>
<td>Oral Health Literacy Adults Questionnaire</td>
<td>2013</td>
<td>The 17-item self-administered questionnaire with a short interview consisted of four sections including reading comprehension, numeracy, listening and decision-making.</td>
</tr>
<tr>
<td><strong>HeLD</strong> (K. Jones, Parker, Mills, Brennan, &amp; Jamieson, 2014)</td>
<td>Health Literacy in Dentistry</td>
<td>2013</td>
<td>Adapted from Health Literacy Measurement Scale (HeLMS), evaluate conceptual health literacy from the patient perspective. Cultural aspects were added into the questionnaire.</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Name of tools</td>
<td>Year</td>
<td>Characteristics of test</td>
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</tr>
<tr>
<td>AHILD</td>
<td>Adult Health Literacy Instrument for Dentistry</td>
<td>2015</td>
<td>The self-administered questionnaire, which was adapted from OECD (Health Literacy) instrument used in general health literacy assessment in Norwegian language.</td>
</tr>
<tr>
<td>HeLD-14</td>
<td>Health Literacy in Dentistry-14</td>
<td>2015</td>
<td>The questions developed and shortened from HeLD-29 into 14 topics due to the requirement from participants and health service researchers.</td>
</tr>
<tr>
<td>BREALD-30</td>
<td>Brazilian Rapid Estimate of Adult Literacy in Dentistry-30</td>
<td>2015</td>
<td>Developed from REALD-30 and translated into Brazilian-Portuguese language.</td>
</tr>
<tr>
<td>SOHLS</td>
<td>Spanish Oral Health Literacy Scale</td>
<td>2015</td>
<td>Experts selected 20 Spanish texts from the written information provided in dental school according to their perception of importance for patients. Participants were asked to complete the questionnaire on the reading difficulty of each text using a Likert scale, ordering them from the most difficult to the easiest.</td>
</tr>
<tr>
<td>OHL-AQ-H</td>
<td>Hindi version of Oral Health Literacy Adults Questionnaire</td>
<td>2016</td>
<td>The original OHL-AQ in Persian was translated into Hindi version, and tested in Indian population.</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Name of tools</td>
<td>Year</td>
<td>Characteristics of test</td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>OHL-AQ English</strong>&lt;br&gt;(Flynn et al., 2016)</td>
<td>English version of Oral Health Literacy Adults Questionnaire</td>
<td>2016</td>
<td>The original OHL-AQ was translated into English version, and tested in a general English speaking population.</td>
</tr>
<tr>
<td><strong>TREALD-30</strong>&lt;br&gt;(Peker, Kose, Guray, Uysal, &amp; Erdem, 2017)</td>
<td>Turkish version of the rapid Estimate of Adult Literacy in Dentistry</td>
<td>2017</td>
<td>A 30-word recognition test was developed from REALD-30 English version with translation process and cross-cultural adaptation into Turkish version.</td>
</tr>
<tr>
<td><strong>REALMD-20</strong>&lt;br&gt;Brazilian-Portuguese version&lt;br&gt;(Cruvinel et al., 2017)</td>
<td>The 20-item Rapid Estimate Adult Literacy in Medicine and Dentistry</td>
<td>2017</td>
<td>REALMD-20 English version was translated and adapted to the Portuguese Brazilian version and tested in a Brazilian adult population.</td>
</tr>
<tr>
<td><strong>REALD-30 Spanish</strong>&lt;br&gt;(R. Cartes-Velasquez &amp; Luengo-Machuca, 2018)</td>
<td>The 30-item Rapid Estimate Adult Literacy in Dentistry</td>
<td>2018</td>
<td>The REALD-30 word recognition test was translated from English into Spanish version, and tested with a Chilean adult population.</td>
</tr>
</tbody>
</table>
Level of health literacy and oral health literacy

In order to be understandable and comparable, several studies and tools have classified health literacy or oral health literacy into certain groups or levels.

For REALM (Davis et al., 1991), after the test is completed with a patient, a researcher will count the total number of correct pronunciation (0-66) and match the total score with a grade from the table below.

**Table 1.3: Level of Health Literacy classified by the REALM**

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Level</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-18</td>
<td>3rd Grade and Below</td>
<td>Will not able to read most low literacy materials; will need repeated oral instructions, materials composed primarily of illustrations, or audio or videos</td>
</tr>
<tr>
<td>19-44</td>
<td>4th to 6th Grade</td>
<td>Will need low literacy material; may not be able to read prescription labels</td>
</tr>
<tr>
<td>45-60</td>
<td>7th to 8th Grade</td>
<td>Will struggle with most patient education materials</td>
</tr>
<tr>
<td>61-66</td>
<td>High school</td>
<td>Will be able to read most patient education materials</td>
</tr>
</tbody>
</table>

In TOFHLA, the functional health literacy score is divided equally into 2 sections (reading comprehensive (50%) and numeracy (50%)). The raw scores are weighted and then ranged from 0-100. Finally, the total score is divided into 3 categories: (Williams et al., 1995)

- **Inadequate** = score 0-59
- **Marginal** = score 60-74
- **Adequate** = 75-100

S-TOFHLA, which is the shortened version of TOFHLA, consisted of 2 reading comprehensions, the total scores were also categorised into 3 levels of health literacy; (Baker, Williams, Parker, Gazmararian, & Nurss, 1999)

- **Inadequate** = score 0-16
- **Marginal** = score 17-22
- **Adequate** = 22-36
Establishing cut-off scores for oral health literacy tools

Regarding instruments in dentistry, in order to classify the level of oral health literacy in patients, studies typically use the reference from previous studies in Medicine. The classifications of level of oral health literacy were various, some studies calculated and used statistical analysis to set the levels and categorise them into each level, for example, tertiles, percentile, mean, etc.

For example, for the first study regarding oral health literacy of adults who are seeking dental care using REALD-30, each correct pronunciation was collected as 1 point, and then points were summed to get the total oral health literacy score. The range of REALD-30 is from 0 (low oral health literacy level) to 30 (high oral health literacy level). After that, the researchers divided REALD-30 scores into 3 categories, which are High (REALD-30 score > 26), Moderate (REALD-30 score 22-25), and Low (REALD-30 score ≤ 21). These cut-off scores were established based on tertiles (M. Jones, Lee, & Rozier, 2007). Another study of female caregivers and health literacy had the REALD-30 score classified into 2 groups, low oral health literacy and high oral literacy. The range of scores was 0 to 30 and the cut of point was 13 or below. The researcher established cut-off point of low oral health literacy based on the lowest quintile of the total scores (Vann, Lee, Baker, & Divaris, 2010). Overall, these cut-off scores are derived from population performance rather than health outcomes.

The oral health literacy scores from OHL-AQ were categorized into three groups; Inadequate, Marginal, and Adequate, by referring to cut-off scores from S-TOFHLA. The total S-TOFHLA scores were originally 36, and were calculated as a percentage. The previously established cut-off scores of 100-S-TOFHLA were 0-53 (inadequate), 54-66 (marginal) and 67-100 (adequate). The OHL-AQ used this ratio as a reference to set its cut-off scores, therefore, 53% of the complete OHL-AQ was set as the upper boundary of inadequate oral health literacy, and 66% of OHL-AQ scores was set as the lower boundary of adequate oral health literacy (Naghibi Sistani et al., 2014).
1.4 Relevant studies of oral health literacy

Since the start of oral health literacy interest in dental public health in the early 2000s, research related to oral health literacy can be classified into three areas:

- Development and validation of a tool (see details in section above and in table 1.2)
- Using a tool to assess oral health literacy and identify associated factors
- Intervention related to oral health literacy

Using a tool to assess oral health literacy and identify outcomes or associated factors

A. Using an oral health literacy tool to evaluate a target population

Oral health literacy has been measured across various populations and age groups. The most common group that has been studied is a parent or a caregiver who takes care of a child’s oral health. The majority of studies focused on finding a relationship between parent’s oral health literacy and child oral health (Brega et al., 2016; Bridges, Parthasarathy, Wong, et al., 2014; Divaris, Lee, Baker, & Vann, 2012; Garrett, Citi, & Gansky, 2012; Haghdoot, Hessari, Baneshi, Rad, & Shahrvan, 2017; Hiu Fong Lai, Kok Wun Wong, Ming Wong, & Kar Yung Yiu, 2017; Miller, Lee, DeWalt, & Vann, 2010; Mohammadi, Malekmohammadi, Hajizamani, & Mahani, 2018; Shin, Braun, & Inglehart, 2014; Vann et al., 2010). Systematic reviews about parent’s oral health and child health outcomes were conducted by DeWalt et al in 2009 (DeWalt & Hink, 2009), and updated by Fermino et al. in 2018 (Firmino et al., 2018), the results confirmed a link between parental oral health literacy and child’s oral health.

The adult population has also been included within oral health literacy research. The majority of studies have been conducted in a clinical or hospital setting (Atchison et al., 2010; Haridas et al., 2014; Holtzman, Atchison, Gironda, Radbod, & Gornbein, 2014; Ramandeep, Arshdeep, Vinod, & Parampreet, 2014), with one study conducted at a participant’s home (Batista, Lawrence, & Sousa, 2017), and another conducted with school teachers in schools (Jagan, Fareed, Battur, Khanagar, & Bhat, 2018). Some studies have been carried out in the particular populations for example, an indigenous Australian population (Jones, Parker, & Jamieson, 2014; Parker et al., 2012), Native Americans (Jamieson,
Older adults were the group that were found to have high prevalence of limited health literacy, however, research into and promoting oral health literacy in older adults is still scarce (Rudd & Horowitz, 2005). One study related to oral health knowledge in older adults found that even though older adults had basic knowledge about oral health disease and prevention, many older patients still did not understand the concept of periodontal disease and oral cancer appropriately (McQuistan, Qasim, Shao, Straub-Morarend, & Macek, 2015). Older patients’ knowledge needs to be improved about the relationship between aging and risk of developing these diseases (McQuistan et al., 2015). Another study of Chinese older adults found that sociodemographic status and ability to choose proper oral hygiene tools was correlated with oral health literacy (Ho et al., 2019). There is a need to study and promote oral health literacy due to the sharp rise in the older adults’ population.

**B. Oral health literacy and associated outcomes**

Relationships between oral health literacy and oral health outcomes are being increasingly studied. A recent systematic review reported that lower oral health literacy would lead to poorer oral health outcomes, for example, having higher dental caries and lower number of teeth present (J. Y. Lee, 2018). Improving oral health literacy could reduce a patient’s incidence of dental caries, periodontal disease, acute oral infection and result in early detection and treatment of disease like oral cancer (Taylor & Pretty, 2014).

From a study about caregivers and early childhood oral health outcomes, low oral health literacy was associated with a lack of oral health knowledge and lower scores on reported oral health status in young children. In addition, improper practices for example, night-time bottle feeding and absence of daily tooth brushing, were associated with caregivers who had lower oral health literacy (Vann et al., 2010). Fermino et al. conducted a systematic review about the association between parental oral health literacy and oral health outcomes of children in 2018. The review showed some studies reported an association with parents with a lower oral health literacy having children with a higher prevalence.
of caries. However, for dental plaque status, dental service utilisation and other oral health behaviours, the associations with parental oral health literacy were questionable (Firmino et al., 2018).

In adults, Ueno et al. reported that people with higher oral health literacy had higher numbers of remaining teeth and had fewer dental caries. On the other hand, those with low health literacy were found to have a higher score on the community periodontal index (Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013). Wehmeyer et al. studied periodontal status and oral health literacy, and the results demonstrated there was a significant association between health literacy and periodontal status. Patients with higher oral health literacy were less likely to have severe disease, compared to those with lower oral health literacy (Wehmeyer, Corwin, Guthmiller, & Lee, 2014). However, two systematic reviews reported that the results from many studies were controversial. Associations between oral health literacy and oral health status or oral conditions in either primary or permanent teeth were weak with different research methods and statistical analyses (Burns, McGoldrick, & Muir, 2018; Firmino et al., 2017). There is a need for further research with high standard methodology to confirm these associations.

Oral health service utilisation was questionably linked to oral health literacy. Many previous studies found no association between dental utilisation and oral health literacy (Burgette, Lee, Baker, & Vann, 2016; Macek et al., 2010). However, a recent study in Brazilian immigrants living in Canada showed participants with inadequate oral health literacy did not significantly differ in their dental attendance in the previous year compared to the higher oral health literacy participants. It was also reported those with lower oral health literacy used dentists as their primary source of information and did not participate in decision-making about their oral health treatment (Calvasina, Lawrence, Hoffman-Goetz, & Norman, 2016b). Another study found that people who used fewer sources of oral health information, classified as having limited oral health literacy, are more likely to fail to attend a dental appointment (Holtzman et al., 2014).
C. Oral health literacy and associated factors (confounding factors)

Education is one of the strongest factors that is directly associated to oral health literacy. Previous studies have confirmed a higher education level is associated with higher oral health literacy scores (Atchison et al., 2010; M. Jones et al., 2007; Mohammadi et al., 2018; Naghibi Sistani, Yazdani, Virtanen, Pakdaman, & Murtoomaa, 2013; VanWormer, Tambe, & Acharya, 2019). This could be because a person who has attained a formal education (primary school to college or university) would develop basic literacy skills, for example, reading, listening, comprehension of text, and writing. These skills all contribute to oral health literacy, as they gain oral health information, process, and then take actions towards their oral health.

Another associated factor that directly affects health literacy is age, which is related to the cognitive skills of each individual. Cognition is essential for an individual to live independently, manage finances, take medication, follow instructions, or communicate effectively. Older adults are more likely to have declined cognitive abilities due to the effect of aging, or personal medical conditions or chronic diseases (Murman, 2015). In addition, older adults may have physical difficulties, for example poor eyesight, tremor, and movement difficulties that could be essential barriers to achieving good oral health and adequate oral health literacy (Rudd & Horowitz, 2005). A systematic review and meta-analysis about aging and functional health literacy confirmed that older age was strongly associated with limited health literacy, when measuring health literacy by a reading comprehension, numeracy test, or reasoning tool (Kobayashi, Wardle, Wolf, & von Wagner, 2014).

Dental service utilisation could be associated with oral health literacy as a risk factor. Although the results from previous studies were questionable (Burgette et al., 2016; Macek et al., 2017; Naghibi Sistani, Virtanen, Yazdani, & Murtoomaa, 2017; VanWormer et al., 2019), service utilisation could contribute to additional, correct oral health information being given from health personnel directly to an individual. One study of US adults reported that people who did not utilise dental services in the last year significantly predicted having lower oral health literacy in an unadjusted model of logistic regression analysis, however this significance disappeared when controlled for by other confounding variables, such as, age and marital status (M. Jones et al., 2007).
Interventions related to oral health literacy

More recently, certain researchers have developed programs to improve oral health behaviour or promote oral health through oral health literacy related interventions. One study carried out in the UK included a storytelling intervention about sugar snacking and toothbrush routines. This study looked to understand children’s oral health literacy and how they can convert adult health related messages into useful information. The results demonstrated that children’s health and oral health literacy were achieved based on the ability of the adult to provide a health message with a common shared element. The process included taking time to help children to encode the adults’ message and reflect upon it. Children are then able to adapt this message into their practice, which imitated the concept of oral health literacy in adults (Freeman, 2015).

Another study in Norway used a randomised control trial to test the effect of a conceptual model of oral health literacy as a risk factor for clinical dental outcomes. In the intervention group, the researchers conducted an educational communication program tailored to the participants' oral health literacy level whereas the control group was given the general information. At the 6-month post intervention period, the intervention group reported having significantly improved oral hygiene status and gingival status, compared to the control group (Stein, Bergdahl, Pettersen, & Bergdahl, 2018).

Only one intervention related to oral health literacy in older adults has been found. A study in older adults aged 65 or more in the USA provided a community-based program for older adults, which aimed to increase oral health literacy. The program for older adults included educational information and multiple interactions from dental students who attended a community-based geriatric dentistry rotation. The researchers used a word recognition test (REALD-30) to assess older adults' oral health literacy before and after the intervention. The results indicated that after the intervention older adults’ oral health literacy and oral hygiene could be improved by this program (Hjertstedt, Barnes, & Sjostedt, 2014).
1.5 Research questions and objectives of this thesis

Most of the previously established oral health literacy tools were validated in those less than 65 years old. The majority of these tools, assessed for predictive validity, used self-reported oral health status, which had higher information bias, rather than using clinical oral health status. Currently, there is no oral health literacy assessment tool available for older adults. Studies around oral health literacy are mainly in Western or developed countries, which means that certain context, language and cultural differences could impact on the results when used in other settings.

Therefore, a newly developed tool and a study conducted specifically in older adults is needed, particularly given the aging population has been increasing gradually not only in developed countries, but around the world (He, Goodkind, & Kowal, 2016). In addition, working towards adequate oral health literacy would be one of the key successes of oral health promotion and primary prevention in this population.

Objectives of this study

1. To develop an oral health literacy assessment tool for older adults
2. To test the validity and reliability of the tool, and establish cut-off scores for predicting oral health status by oral health literacy scores
3. To assess oral health literacy of older adults using this newly developed tool
4. To identify factors associated with oral health literacy in older adults
5. To propose a protocol to use this tool in a dental public health approach

Research questions

1. Was this oral health literacy tool valid and reliable?
2. What was the level of oral health literacy of Thai older adults?
3. What factors would possibly be associated with oral health literacy of older adults?
4. What is proposed usability of this tool, and how it would be used with the target population in a community?
References


doi:10.17226/10883


2. Chapter 2

Exploration of oral health status of older adults in
Chiang Mai, Thailand
Foundation of Chapter 2

There are currently no baseline data regarding the oral health status of Thai older adults. It is important to be able to identify any oral health problems within this population in order to develop appropriate oral health prevention promotion programs. Therefore, this chapter aims to explore the oral health status of Thai older adults in Chiang Mai, and possible associated factors, before proposing an oral health literacy measurement to be used in community settings.

This chapter will be submitted to the Journal of Public Health and Development.

Authors Contribution
This section was written by PW and was reviewed with contributions by IAP and MG.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review Review evidence from previous studies and the potential tools</td>
<td>No tool for older adults</td>
<td>Identify research gaps and set the objectives</td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs Retrospective epidemiological study of oral health status and treatment needs in the target population. N = 293</td>
<td>Poor oral health statuses, low dental service utilisation</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLD The first pilot developed was an OHL test in Thai older adults. N = 105</td>
<td>The pilot OA-TOFHLD total score = 35</td>
<td>Poor predictive validity ⇒ test needed to be improved</td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLD The OA-TOFHLD was further developed by adding 1 reading comprehension section, and tested in Thai older adults. N = 103</td>
<td>The optimised OA-TOFHLD total score = 48</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLD in clinical setting The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status. N = 115</td>
<td>Those with adequate OHL present better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLD was too long for some to complete</td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLD [Subgroup of Chapter 5] Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults. N = 22</td>
<td>Those with adequate OHL present better oral health status</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLD in the US population The Short OA-TOFHLD was developed by cutting certain prompts, following feedback from participants about the length of the original tool. N = 106</td>
<td>The Short OA-TOFHLD total score = 39</td>
<td>The test presents acceptable validity ⇒ Need to confirm with different population</td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLD in the Thai population [Combined data from Chapter 4 and 5] The performance of the cut-off scores of the Short OA-TOFHLD established in Chapter 7 was tested in this combined data. N = 218</td>
<td>The performance of the shortened version was confirm.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLD in community A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstract

Background: Oral health is an important factor affecting the quality of life of older adults, however, it is complex to measure due to a variety of contributing factors. The severity of oral health disease in this highly heterogeneous population is higher compared to other age groups, and there are combined effects of aging and multiple chronic diseases. Additionally, epidemiological data of this age group are scarce, especially in developing countries.

Objectives: This study aimed to explore oral health status and contributing risk factors of oral health status in Thai older adults who attended Chiang Mai University Dental Hospital.

Methods: A retrospective cross-sectional study was conducted by obtaining existing data from patient charts. All charts of patients aged 60 or above who attended the dental hospital between January 2015 and December 2017 were reviewed for selection. Selected charts had four complete sections; 1.) Demographics, 2.) Oral health behaviour and dental charting, 3.) Chief complaints and oral examination, and 4.) Diagnosis and treatment plans. Descriptive statistics, Chi-square test and binary logistic regression were used to analyse the data.

Results: 393 completed charts were included in the study. Participants were aged between 60-93. The most common reported medical condition was hypertension (49.1%). The older age group (70 years or more) had poorer oral health status and higher treatment needs. Younger age (60-69 years old), or Government Health Benefit (GBH) insurance became significant predictors of having no active decay (p = 0.013 and 0.019 respectively). Males had significantly more periodontal disease compared to females (p = 0.033). From binary logistic regression, GBH was a significant predictor of having no active cavities (p=0.008) and no periodontal condition (p=0.044). A significant predictor of having full edentulous arch was older age (p=0.009), when controlled by the other factors in the model.

Conclusions: Oral health status of older adults was poor, complex, and multifactorial in nature. Older adults are a growing proportion of the population and their increasing treatment needs will challenge the capacity of the dental health workforce and health budget. There is an urgent need to promote oral health with a preventative focus in this cohort of patients.
Introduction

Oral health is an important determinant factor for quality of life (Petersen, 2003). The FDI defined oral health in 2015 as “… multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotionals through facial expressions with confidence and without pain, discomfort, and disease of craniofacial complex” (Glick et al., 2016). Oral health is a fundamental component of physical and mental well-being, which reflects the physiological, social, and psychological attributes that are essential to the quality of life (Hescot, 2017). Therefore, it is important for individuals to maintain good oral health throughout their life.

Aging is a chronologically normal process of life, and has many physiological consequences on health (Tosato, Zamboni, Ferrini, & Cesari, 2007). Regarding oral health, aging has both direct and indirect effects on hard and soft tissues of the mouth (Lamster, Asadourian, Del Carmen, & Friedman, 2016). Aging individuals may have a normal aging mouth or suffer from oral diseases. Figure 2.1, proposed by Lamster et al. in 2016, exemplifies the continuum of normal oral aging and disease, which is useful for health professionals in making decisions regarding treatment or prevention programs in this population (Lamster et al., 2016).

Figure 2.1: The continuation of change in aging mouth and diseases with possible modifiers (Lamster et al. 2016)
Around the world the population has been steadily getting older. This is expected to continue, resulting in the proportion of older adults outnumbering the younger generation by the year 2050 (United Nations. Department of Economic and Social Affairs. Population Division., 2017). This has consequences for society, especially in health care expenditure and workforce (Zweifel, Felder, & Meiers, 1999). Even though life expectancy of older people is longer than in previous decades, this does not guarantee those adults are living with good health (W. He, Goodkind, & Kowal, 2016). A high number of older adults were found to be suffering from noncommunicable diseases (NCDs) and medical conditions (W. He et al., 2016). For example, 65.4% of Chinese older adults were found to have NCDs (Gong, Yu, Yi, Wang, & Tuo, 2018), and at least 25.2%, or approximately 12 million American older adults had diabetes mellitus in 2015 (Centers for Disease Control and Prevention, 2017), which was found to have links with oral health status in previous studies (Critchlow, 2017; Petersen, 2003). Periodontal diseases and tooth loss were found to have links to increased risk of cardiovascular disease (Cheng et al., 2018; Stewart & West, 2016), diabetes mellitus (Preshaw et al., 2012; Taylor, 2001), and other chronic diseases (Holmstrup et al., 2017). Therefore, promotion and prevention in oral health is essential since it can reduce the risk of these systemic conditions in individuals.

Oral diseases, especially dental caries and periodontal disease, are the most common chronic diseases found in humans (Benjamin, 2010; Petersen, Bourgeois, Ogawa, Estupinan-Day, & Ndiaye, 2005), and older adults were found to have poorer oral health than other age groups (Griffin, Jones, Brunson, Griffin, & Bailey, 2012). The main oral health conditions of this population are dental caries, tooth loss, dry mouth, and oral cancer (Thomson, 2014). An oral health survey in England and Wales reported that older adults had a higher number of untreated caries, lower number of sound teeth, and a lower number of restored teeth (Public Health England, 2016). Another study compared the oral health status of two age groups of Chinese and New Zealand adults using national survey data. The older age group (65-74 years old) was found to have a lower mean number of teeth, higher caries experience, and a higher prevalence of periodontal disease with more severe attachment loss, compared to the lower age group (35-44 years old) in both countries (S. He & Thomson, 2017). These results emphasize that oral health in the older population is still an issue in developed and developing countries.
Oral health status has been recorded and studied internationally for many years, however in Thailand, there is no oral health database particularly for the older population. Even though there has been a national oral health survey every 6 years since 1970 (Department of Health, 2018), it presents only general descriptive information regarding oral health, and no further analysis has been conducted to identify risk factors in specific age groups. There is a need to explore the oral health status and risk factors of poor oral health in the Thai older population. The objectives of this study were to determine oral health status and identify factors associated with the oral health status of Thai older adults.

Methods

Study design and setting

This study used a descriptive, retrospective dental chart review design. The data was obtained from patient charts at the dental hospital of the Faculty of Dentistry at Chiang Mai University. This dental hospital is the largest dental care and teaching hospital in the northern region of Thailand, and the third largest dental hospital in the country. The number of patients seen per year is approximately 20,000 (2015-2017). The ethical approvals for this study were obtained from the Faculty of Dentistry at Chiang Mai University (Reference number 44/2017) as the local setting, and the University of Manchester (Reference number 2018-28224728) as the sponsor of the research. All patients were informed their data might be used in research and they consented to having their data used before they received the treatment.

Dental chart

A dental hospital chart is normally hand-written by a dentist or a dental student (under the double checked process and under the license of a dental instructor). The patient chart is composed of five main sections 1.) Demographic data and medical records of the patient, 2.) General oral health assessment and soft tissue basic screening 3.) Chief complaints, signs and symptoms of each problematic tooth obtained from the patients, and the main findings from oral screening together with radiographic or advanced tests (for example, electric pulp vitality
test, hot-cold test, biopsy), 4.) Diagnosis of each problematic tooth and treatment need, 5.) Chronological record of any treatment that a patient had received in this dental hospital. After completing a primary oral screening in the diagnostic clinic during the first visit, all patient charts are scanned and kept as electronic files on the hospital intranet system for baseline data.

**Subject selections, data collection and data analysis**

The aim of this study was to use the data collected across three retrospective years. As little was known about the population, a sample size was calculated with a % frequency of the outcome factor (either based on area lived in, retirement status or health insurance type) at 50% (+/-5%), with a Confidence Interval of 95% requires a minimum sample size of 384 in order to gain a representative sample.

Charts from patients who registered and attended the dental hospital from 1\textsuperscript{st} January 2015 to 31\textsuperscript{st} December 2017 were included. All charts of patients aged 60 or older on 1\textsuperscript{st} January 2015 in this dental hospital were selected from the hospital intranet system. The researcher accessed and scanned every selected patient file provided on the system. The inclusion criteria were to have four completed sections; 1.) Demographic and medical history section, 2.) General oral health assessment and soft tissue screening section, 3.) Chief complaint and detailed oral examination section, and 4.) Diagnosis section. Other charts, which did not meet the above criteria, were excluded.

The data collection process was conducted from 1\textsuperscript{st} January 2018 to 6\textsuperscript{th} February 2018, using the hospital computer at the Oral Health Prevention and Promotion clinic at the Faculty of Dentistry of Chiang Mai University. The data of each participant was recorded and entered into the researcher’s Clinical Record Form (CRF) spreadsheet in Microsoft Excel (version 2011, Microsoft Corp. Redmond, USA). Then SPSS for Mac version 23.0 (IBM Corp., 2015) was used for all data analysis. Descriptive statistics such as mean and standard deviation (SD), percentage, and frequency were calculated. Chi-square tests were used to compare and identify significant differences between groups of variables. Finally, multivariate logistic regression was conducted to explore the associated factors of oral health status.
Data Management

All confidential, patient identifiable data (name, address, national identification number, telephone number) were kept securely on the hospital intranet system, and not recorded on to the CRF. The hospital number (HN) was used to identify each patient before creating an identification number (ID) used only in this study.

Results

There were 2,797 older adult patients age 60 or more attending the hospital from 1st January 2015 to 31st December 2017. In this study, 391 dental charts were selected purposely because they had completed sections 1 to 4. For comparison, the participants were classified into 2 age groups; the young older adults (60-69) and intermediate to old older adults (70 or more).

Table 2.1 presents general characteristics of the participants in this study. Overall, the majority of the participants who utilised this dental hospital were male (55.5%), aged 60-93 years. The overall mean age was 68.2 years (SD 6.4). Almost half of the participants were retired (48.6%). More than half (60.6%) of the participants lived in an urban area, and had universal health coverage (52.9%) as their health insurance.

The number of young older adults was two times higher than the older group (n=278 and 113 respectively). The older group had more female participants than male. However, the proportion of occupations, residential area, and type of insurance are comparatively similar in both groups.
Table 2.1: Characteristics of the participants in this study (n = 391)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>60-69 (n = 278)</th>
<th>70 or more (n = 113)</th>
<th>All (n = 391)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>165</td>
<td>59.4</td>
<td>52</td>
</tr>
<tr>
<td>Female</td>
<td>113</td>
<td>40.6</td>
<td>61</td>
</tr>
<tr>
<td><strong>Occupation (previous and current)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government pensioner</td>
<td>90</td>
<td>32.4</td>
<td>31</td>
</tr>
<tr>
<td>Business or Freelance worker</td>
<td>42</td>
<td>15.1</td>
<td>10</td>
</tr>
<tr>
<td>Farmer, Gardener</td>
<td>24</td>
<td>8.6</td>
<td>4</td>
</tr>
<tr>
<td>Not working or Other</td>
<td>122</td>
<td>43.9</td>
<td>68</td>
</tr>
<tr>
<td><strong>Residential area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>170</td>
<td>61.2</td>
<td>67</td>
</tr>
<tr>
<td>Rural</td>
<td>71</td>
<td>25.5</td>
<td>25</td>
</tr>
<tr>
<td>Not available</td>
<td>37</td>
<td>13.3</td>
<td>21</td>
</tr>
<tr>
<td><strong>Type of Health Insurance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universal coverage</td>
<td>145</td>
<td>52.2</td>
<td>62</td>
</tr>
<tr>
<td>Social security</td>
<td>8</td>
<td>2.9</td>
<td>2</td>
</tr>
<tr>
<td>Government health benefits</td>
<td>78</td>
<td>28.1</td>
<td>31</td>
</tr>
<tr>
<td>Others (self-paid, private insurance)</td>
<td>47</td>
<td>16.9</td>
<td>18</td>
</tr>
</tbody>
</table>

Self-reported general health and perceived oral health status

From Table 2.2, the majority of older adults (79.5%) reported perceived good general health. Only 12.8% reported they had health changes within the last year, however, 24.5% were described as currently under the regular care of physicians. The top-five medical conditions of the participants were hypertension (49.1%), hyperlipidemia (24.0%), diabetes mellitus (15.9%), cardiovascular disease (9.7%), and arthritis or gout (6.1%). The mean number of medications was 1.60 (SD 1.50), and 75% percent of the participants took at least one medication regularly.

'Old' older adults (defined as 70 or older) were found to have a higher proportion of medical conditions (hypertension, hyperlipidemia, and diabetes) than the younger group. The older group also had a higher mean number of medications (1.90 medications per day, SD 1.52) compared to the younger group (1.47 medications per day, SD 1.48).
Table 2.2: Descriptive statistics for self-reported oral health status, medical conditions, and perceived health statuses

<table>
<thead>
<tr>
<th>Items</th>
<th>60-69 (n = 278)</th>
<th>70 or more (n = 113)</th>
<th>All (n = 391)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Self-rated general health (Is your general health good?)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>222</td>
<td>79.9</td>
<td>89</td>
</tr>
<tr>
<td>No</td>
<td>43</td>
<td>15.5</td>
<td>19</td>
</tr>
<tr>
<td>Not available</td>
<td>5</td>
<td>4.4</td>
<td>5</td>
</tr>
<tr>
<td>Currently experiencing a health change (Has there been a change in health within last year?)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37</td>
<td>13.3</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td>228</td>
<td>82.0</td>
<td>94</td>
</tr>
<tr>
<td>Not available</td>
<td>13</td>
<td>4.7</td>
<td>6</td>
</tr>
<tr>
<td>Have been hospitalised before (Have you ever been hospitalised or had surgery?)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90</td>
<td>32.4</td>
<td>31</td>
</tr>
<tr>
<td>No</td>
<td>42</td>
<td>15.1</td>
<td>10</td>
</tr>
<tr>
<td>Not available</td>
<td>24</td>
<td>8.6</td>
<td>4</td>
</tr>
<tr>
<td>Currently under the care of a physician</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>170</td>
<td>61.2</td>
<td>67</td>
</tr>
<tr>
<td>No</td>
<td>71</td>
<td>25.5</td>
<td>25</td>
</tr>
<tr>
<td>Not available</td>
<td>37</td>
<td>13.3</td>
<td>21</td>
</tr>
<tr>
<td>Top 5 medical conditions or diseases;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>121</td>
<td>43.5</td>
<td>71</td>
</tr>
<tr>
<td>No</td>
<td>140</td>
<td>50.4</td>
<td>37</td>
</tr>
<tr>
<td>Not available</td>
<td>17</td>
<td>6.1</td>
<td>5</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64</td>
<td>23.0</td>
<td>30</td>
</tr>
<tr>
<td>No</td>
<td>197</td>
<td>70.9</td>
<td>78</td>
</tr>
<tr>
<td>Not available</td>
<td>17</td>
<td>6.1</td>
<td>5</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>41</td>
<td>14.7</td>
<td>21</td>
</tr>
<tr>
<td>No</td>
<td>220</td>
<td>79.1</td>
<td>87</td>
</tr>
<tr>
<td>Not available</td>
<td>17</td>
<td>6.1</td>
<td>5</td>
</tr>
<tr>
<td>Cardiovascular diseases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>9.0</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td>236</td>
<td>84.9</td>
<td>95</td>
</tr>
<tr>
<td>Not available</td>
<td>17</td>
<td>6.1</td>
<td>5</td>
</tr>
<tr>
<td>Arthritis, gout, rheumatoid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>6.5</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>243</td>
<td>87.4</td>
<td>102</td>
</tr>
<tr>
<td>Not available</td>
<td>17</td>
<td>6.1</td>
<td>5</td>
</tr>
<tr>
<td>Number of regular medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>82</td>
<td>29.5</td>
<td>17</td>
</tr>
<tr>
<td>1-4</td>
<td>173</td>
<td>62.2</td>
<td>87</td>
</tr>
<tr>
<td>5 or more</td>
<td>13</td>
<td>4.7</td>
<td>6</td>
</tr>
<tr>
<td>Not available</td>
<td>10</td>
<td>3.6</td>
<td>3</td>
</tr>
</tbody>
</table>
Chief complaints, utilisation of dental services, and other oral conditions

Table 2.3 demonstrates that the most common chief complaint for visiting a dentist at this hospital were toothache (23.8%), no teeth and needing a replacement (11.8%), tooth mobility (10.2%), ill-fitted prosthesis (7.9%), and decayed tooth (6.4%). The majority of participants (79.5%) reported that they had never utilised dental services. Only a few participants reported that they had past jaw injury or facial trauma (3.1%), xerostomia (2.8%) and joint sound or pain (1.8%). Overall, the majority of the patients had moderate calculus deposits (38.1), and fair oral hygiene status (54.0%), which were assessed by the dentist who performed an oral examination at the first visit. When the two age groups were compared, there were some similarities in the five highest chief complaints in both younger and older groups. However, the older group were more concerned with missing teeth, tooth mobility and ill-fitting protheses, while the younger group were concerned with toothache and tooth decay.
Table 2.3: Descriptive statistics for chief complaints, utilisation, and oral health conditions

<table>
<thead>
<tr>
<th>Items</th>
<th>60-69 (n = 278)</th>
<th>70 or more (n = 113)</th>
<th>All (n = 391)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td><strong>Top 5 Chief complaint of older adults for dental utilisation at this dental hospital</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Toothache</td>
<td>71</td>
<td>25.5</td>
<td>22</td>
</tr>
<tr>
<td>2. No tooth, need to replace missing teeth</td>
<td>28</td>
<td>10.1</td>
<td>18</td>
</tr>
<tr>
<td>3. Tooth mobility</td>
<td>26</td>
<td>9.4</td>
<td>14</td>
</tr>
<tr>
<td>4. Ill-fitted prosthesis</td>
<td>31</td>
<td>7.9</td>
<td>17</td>
</tr>
<tr>
<td>5. Decayed tooth/ teeth</td>
<td>19</td>
<td>6.8</td>
<td>6</td>
</tr>
<tr>
<td>Not available</td>
<td>3</td>
<td>4.0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Have utilised dental services before</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>222</td>
<td>79.9</td>
<td>89</td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>16.2</td>
<td>20</td>
</tr>
<tr>
<td>Not available</td>
<td>11</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Have experienced these oral health conditions:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Ulceration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
<td>4.0</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>256</td>
<td>92.1</td>
<td>107</td>
</tr>
<tr>
<td>Not available</td>
<td>11</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>Xerostomia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>3.6</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>257</td>
<td>92.4</td>
<td>108</td>
</tr>
<tr>
<td>Not available</td>
<td>11</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>Joint sound or pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>260</td>
<td>93.5</td>
<td>109</td>
</tr>
<tr>
<td>Not available</td>
<td>11</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>Past jaw injury or facial trauma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>4.3</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>255</td>
<td>91.7</td>
<td>109</td>
</tr>
<tr>
<td>Not available</td>
<td>11</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Dentist-assessed calculus deposit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None, very little</td>
<td>4</td>
<td>1.4</td>
<td>5</td>
</tr>
<tr>
<td>Mild</td>
<td>62</td>
<td>22.3</td>
<td>27</td>
</tr>
<tr>
<td>Moderate</td>
<td>114</td>
<td>41.0</td>
<td>35</td>
</tr>
<tr>
<td>Heavy</td>
<td>69</td>
<td>24.8</td>
<td>27</td>
</tr>
<tr>
<td>Not available</td>
<td>29</td>
<td>10.4</td>
<td>19</td>
</tr>
<tr>
<td><strong>Dentist-assessed overall oral hygiene</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>11</td>
<td>4.0</td>
<td>6</td>
</tr>
<tr>
<td>Fair</td>
<td>154</td>
<td>55.4</td>
<td>57</td>
</tr>
<tr>
<td>Poor</td>
<td>82</td>
<td>29.5</td>
<td>32</td>
</tr>
<tr>
<td>Not available</td>
<td>31</td>
<td>11.2</td>
<td>18</td>
</tr>
</tbody>
</table>
Oral health status and treatment needs

Oral health status and conditions are reported in Table 2.4. In this study, the mean number of teeth present was 20.14 (SD 8.77) looking at all patients combined. The younger group had higher mean number of teeth (21.01, SD 7.89), compared to the older group (17.97, SD 10.19). The majority of participants in both age groups had at least 20 functional teeth (67.3% and 69.9% respectively). The samples in older group had higher prevalence of full edentulous arches (15.9%), compared to the younger group (3.6%).

With regards to dental caries, the percentages of patients with at least one active or untreated dental caries were high in both age groups (86.7% and 77.0% respectively). The mean numbers of fillings were higher in the lower age group 7.24 (SD 5.62), compared to the older group 6.32 (SD 5.60). However, the mean number of missing teeth of the younger age was lower than the older group (10.99, SD 7.98 and 14.02, SD 10.19 respectively). Overall, the mean Decay-Missing-Filled Teeth Index (DMFT) was 18.50, the older group (17.34, SD 9.29) had higher mean DMFT compared to the younger group (21.31, SD 11.79). The prevalence of participants with tooth wear was high in both age groups (76.3% in the younger group and 70.8% in the older group).

For periodontal status, 76.3% of the young group and 73.5% of the older group were diagnosed as having periodontal disease. Tooth mobility was 46.8% and 49.6% for younger and older groups respectively. Regarding prosthesis status, only 10.4% in the young age group, and 15.0% in the old age groups currently had at least one prosthesis. 17.6% of the younger group and 26.5% of the older group were found to have ill-fitting or broken prosthesis. Additionally, more than one third (41.7%) of the participants in both age groups were found to have soft tissue abnormalities (e.g. red or white lesions, fibrosis, or other soft tissue abnormalities).

Regarding treatment needs, the majority of participants in the younger and older group (83.8% and 67.3%, respectively) had at least one or more filling need, and the mean number of fillings needed were 7.95 (S.D.13.46) and 5.39 (S.D. 10.36), respectively. More than half of the participants in both age groups had at least one tooth that needed to be extracted (59.6%), and needed prosthesis (69.6%). A higher percentage of participants in the older group required tooth extraction.
(64.6%), compared to the younger group (57.6%). In addition, participants in older group required more prosthesis treatment compared to the younger group (79.6% vs. 65.5% respectively). Almost all participants (92.1%) in the younger group required periodontal treatment, compared to 77.9% in the older group.

Table 2.4: Descriptive statistics for oral health statuses and treatment needs of the subjects in this study

<table>
<thead>
<tr>
<th>Oral Health Status</th>
<th>60-69 (n = 278)</th>
<th>70 or more (n = 113)</th>
<th>All (n = 391)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of teeth</td>
<td>21.01 (7.98)</td>
<td>17.97 (10.19)</td>
<td>20.14 (8.77)</td>
</tr>
<tr>
<td>Percent with 20 or more teeth</td>
<td>67.3%</td>
<td>56.6%</td>
<td>63.7%</td>
</tr>
<tr>
<td>Mean number of active caries</td>
<td>4.21 (3.44)</td>
<td>3.65 (3.74)</td>
<td>4.05 (3.53)</td>
</tr>
<tr>
<td>Percent with one or more active decay</td>
<td>86.7%</td>
<td>77.0%</td>
<td>83.9%</td>
</tr>
<tr>
<td>Mean number of fillings</td>
<td>7.24 (5.62)</td>
<td>6.32 (5.60)</td>
<td>6.98 (5.62)</td>
</tr>
<tr>
<td>Percent with one or more filling</td>
<td>83.1%</td>
<td>80.5%</td>
<td>82.4%</td>
</tr>
<tr>
<td>Mean number of missing teeth from all causes</td>
<td>10.99 (7.98)</td>
<td>14.02 (10.19)</td>
<td>11.86 (8.77)</td>
</tr>
<tr>
<td>Percent with at least one missing tooth from all causes</td>
<td>73.0%</td>
<td>85.0%</td>
<td>76.5%</td>
</tr>
<tr>
<td>Percent with full edentulous arches (upper and lower)</td>
<td>3.6%</td>
<td>15.9%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Mean Decay-Missing-Filled Teeth (DMFT)</td>
<td>17.34 (9.29)</td>
<td>21.31 (11.79)</td>
<td>18.50 (10.23)</td>
</tr>
<tr>
<td>Percent with periodontitis</td>
<td>76.3%</td>
<td>73.5%</td>
<td>75.4%</td>
</tr>
<tr>
<td>Percent with mobility</td>
<td>55.8%</td>
<td>60.2%</td>
<td>57.0%</td>
</tr>
<tr>
<td>Percent with one or more prosthesis</td>
<td>10.4%</td>
<td>15.0%</td>
<td>11.8%</td>
</tr>
<tr>
<td>Percent with ill-fitted/ broken prosthesis</td>
<td>17.6%</td>
<td>26.5%</td>
<td>20.2%</td>
</tr>
<tr>
<td>Mean number of teeth with wear (occlusal, incisal and cervical)</td>
<td>5.25 (5.28)</td>
<td>4.98 (5.20)</td>
<td>5.18 (5.26)</td>
</tr>
<tr>
<td>Percent with one or more tooth with wear</td>
<td>76.3%</td>
<td>70.8%</td>
<td>76.4%</td>
</tr>
<tr>
<td>Percent with soft tissue abnormalities</td>
<td>42.8%</td>
<td>38.9%</td>
<td>41.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Needs</th>
<th>60-69 (n = 278)</th>
<th>70 or more (n = 113)</th>
<th>All (n = 391)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of teeth with filling need</td>
<td>7.95 (13.46)</td>
<td>5.39 (10.36)</td>
<td>5.78 (5.44)</td>
</tr>
<tr>
<td>Percent with at least one filling or restoration need</td>
<td>83.8%</td>
<td>67.2%</td>
<td>79.5%</td>
</tr>
<tr>
<td>Mean number of endodontic treatment need</td>
<td>0.33 (0.72)</td>
<td>0.30 (1.01)</td>
<td>0.32 (0.81)</td>
</tr>
<tr>
<td>Percent with at least one endodontic treatment need</td>
<td>23.0%</td>
<td>15.9%</td>
<td>21.0%</td>
</tr>
<tr>
<td>Mean number of teeth with extraction need</td>
<td>2.71 (14.34)</td>
<td>1.52 (9.26)</td>
<td>1.95 (2.58)</td>
</tr>
<tr>
<td>Percent with at least one tooth extraction need</td>
<td>57.6%</td>
<td>64.6%</td>
<td>59.6%</td>
</tr>
<tr>
<td>Percent with at least one unit prosthesis need (upper or/and lower)</td>
<td>65.5%</td>
<td>79.6%</td>
<td>69.6%</td>
</tr>
<tr>
<td>Percent with periodontal treatment need</td>
<td>92.1%</td>
<td>77.9%</td>
<td>88.0%</td>
</tr>
<tr>
<td>Percent with other complex dental treatment need (e.g. oral medicine, occlusion, surgery)</td>
<td>15.5%</td>
<td>16.8%</td>
<td>15.9%</td>
</tr>
</tbody>
</table>

*All mean or percentage excluded missing data.
Oral conditions with associated factors

The results from Table 2.5 show dichotomised characteristics of the participants in order to compare three oral health conditions with different characteristics. Regarding dental caries status, participants were dichotomised into ‘have active/untreated caries’ and ‘no active caries’ groups. The results demonstrated a significant difference between groups of younger older adults and intermediate to old older adults (P = 0.013), in which the younger group presented a higher proportion of having dental caries than the older group. A significant difference was also found between participants with government health benefits (GHB) insurance and the other types of insurance (P = 0.019), in which people with GHB insurance had a lower prevalence of dental caries than participants with other health insurances.

Regarding periodontal disease, participants were categorised into ‘healthy or gingivitis’ and ‘periodontal disease’ groups. It was found that gender presented a significant result. Males and females were significantly different in having periodontal disease (P = 0.033), while the other characteristics (young or old older adults, government insurance or other insurance, living in urban or rural areas, good or not good general health, multimorbidity (a presence of two or more chronic medical conditions in a person) (Wolff, Starfield, & Anderson, 2002), and polypharmacy (a prescribing of multiple items on one individual; counted as five or more medications) (Deurden, Avery, & Payne, 2013), were found to have no significant difference between groups. Number of natural functional teeth was categorised into 2 groups, 0-19 teeth and 20 or more teeth, 20 being the sufficient number of teeth for eating and enjoying meals (Lee & Sabbah, 2018; Yamanaka et al., 2008). This study found an association between age and number of teeth. However, the younger age group (60-69 years old) was presented as having 20 or more natural functional teeth at a higher rate than the older age group (P = 0.067). There was no other association between number of teeth and any other characteristic observed in this study.
Table 2.5: Comparing three essential oral health conditions in the different sub-groups of characteristics and medical conditions

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Carious status</th>
<th>Periodontal status</th>
<th>Number of teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Active caries</td>
<td>Active Caries</td>
<td>Total</td>
</tr>
<tr>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>14.5</td>
<td>180</td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>15.9</td>
<td>148</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young older adults (60-69)</td>
<td>34</td>
<td>12.4</td>
<td>241</td>
</tr>
<tr>
<td>Intermediate to old older adults (70 or more)</td>
<td>25</td>
<td>22.3</td>
<td>87</td>
</tr>
<tr>
<td><strong>Type of health insurance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government health benefits</td>
<td>9</td>
<td>8.3%</td>
<td>99</td>
</tr>
<tr>
<td>Universal coverage or others</td>
<td>50</td>
<td>17.9%</td>
<td>229</td>
</tr>
<tr>
<td><strong>Residential Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>36</td>
<td>15.3</td>
<td>199</td>
</tr>
<tr>
<td>Rural</td>
<td>16</td>
<td>16.7</td>
<td>80</td>
</tr>
<tr>
<td><strong>Medical Conditions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-rated general health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>47</td>
<td>15.2</td>
<td>262</td>
</tr>
<tr>
<td>Not good</td>
<td>11</td>
<td>17.7</td>
<td>51</td>
</tr>
<tr>
<td>Multimorbidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24</td>
<td>16.8</td>
<td>119</td>
</tr>
<tr>
<td>No</td>
<td>32</td>
<td>14.3</td>
<td>192</td>
</tr>
<tr>
<td><strong>Number of medications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>54</td>
<td>15.1</td>
<td>303</td>
</tr>
<tr>
<td>Polypharmacy(≥5)</td>
<td>4</td>
<td>21.1</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 2.6 presents multivariate logistic regression models of oral conditions. Modes I, II, and III were for predicting the prevalence of dental caries, periodontal disease, and full edentulous respectively. Regarding dental caries (Model I) and periodontal disease (Model II), the type of health insurance (government benefit) was the only significant preventive predictor of these two oral conditions (Model I Adjusted OR = 0.355, CI 0.150-0.748, P = 0.008 and Model II Adjusted OR = 0.384, CI 0.151-0.975 P = 0.044), controlled by gender, age, residential area, utilisation of dental services in the previous year, multimorbidity and polypharmacy. However, for predicting edentulousness in older adults, the older (70 years old or more group) became the only significant predictor of being full edentulous. The older age group was three times more likely to have full edentulous (Adjusted OR = 3.280, CI 1.347-7.898, P = 0.009), controlled by gender, type of insurance, residential area, utilisation of dental services in the previous year, multimorbidity and polypharmacy.

Table 2.6: Multivariate logistic regression analyses to explore a risk factor of essential oral health conditions

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Having active caries (Yes/No)</th>
<th>Having Periodontitis (Yes/No)</th>
<th>Full edentulous (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted OR</td>
<td>CI</td>
<td>P value</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td>0.515-</td>
<td>0.928</td>
</tr>
<tr>
<td>Female</td>
<td>0.971</td>
<td>1.832</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>1</td>
<td>0.317-</td>
<td>0.148</td>
</tr>
<tr>
<td>70 or more</td>
<td>0.614</td>
<td>1.189</td>
<td></td>
</tr>
<tr>
<td>Residential area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>1</td>
<td>0.483-</td>
<td>0.894</td>
</tr>
<tr>
<td>Rural</td>
<td>0.955</td>
<td>1.886</td>
<td></td>
</tr>
<tr>
<td>Type of health insurance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>0.150-</td>
<td>0.748</td>
</tr>
<tr>
<td>Government benefit</td>
<td>0.335</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental utilisation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>1</td>
<td>0.446-</td>
<td>0.989</td>
</tr>
<tr>
<td>Never</td>
<td>1.006</td>
<td>2.266</td>
<td></td>
</tr>
<tr>
<td>Multimorbidity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>0.483-</td>
<td>0.855</td>
</tr>
<tr>
<td>Yes</td>
<td>0.940</td>
<td>1.830</td>
<td></td>
</tr>
<tr>
<td>Number of medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>1</td>
<td>0.369-</td>
<td>0.512</td>
</tr>
<tr>
<td>Polypharmacy</td>
<td>1.592</td>
<td>6.396</td>
<td></td>
</tr>
<tr>
<td>Overall %</td>
<td>84.3%</td>
<td>89.2%</td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05
Discussion

There are a number of methodological limitations that should be considered when interpreting these data. The first is the lack of calibration of the examiners. Retrospective data from the patients’ chart (secondary data) were used, for which the examiners were not calibrated before the data was recorded. However, the data from the patient charts were generally standardised and reliable given dental caries, periodontal status, and the treatment needs were assessed comprehensively by using radiographic pictures, clinical findings from oral examination by a dentist, or a double examination if the patient was primarily examined by a dental student.

The second limitation is the bias in subject selection. Chiang Mai University dental hospital is the biggest in the northern region of Thailand and covers approximately 500,000 older adults in the area. It offers three levels of care; primary, (oral health prevention and promotion); secondary (treatment of general oral diseases); and tertiary care (referral from general practices or primary and secondary care hospitals). Therefore, the severity of oral diseases of participants presented in this study could be over exaggerated, compared to the national oral health survey, which included randomized samples (8th Thai National Dental Public Health Survey Report 2017). In addition, the proportion of age groups in this study did not represent the population. The proportion of the younger age group (60-69 years old) in this study was 2.4 times higher than the older age group, in which the general population was reported approximately 1.6 times higher number of younger adults ("Thai population by age 2018," 2018).

When compared to the 8th Thai Oral Health Survey 2017 results (Department of Health, 2018), our samples in both age groups presented higher number of functional teeth, higher number of fillings, and lower number of missing teeth. This could potentially be due to the patients’ health seeking behaviour and oral hygiene care at the health care setting being higher than the general population. In contrast, the mean and prevalence of active or untreated caries and the prevalence of periodontal diseases in this study were higher compared to the survey results. This could have been observed as those who visited the dental hospital usually attend to seek treatment for oral disease. However, the findings in this study were valuable to show the epidemiology of oral disease in attending,
community-dwelling Thai older adults and could be utilised as baseline data for a future work.

The results of this study provide an overview of Thai older adults’ oral health status and treatment needs in a defined population. Previous oral health surveys have not identified any risk factors of oral health for this age group. Therefore, this study aimed to describe an epidemiology profile of oral health diseases of Thai older adults in Chiang Mai and nearby areas. The general characteristics of the participants in this study were persons living in an urban area, with higher education, and higher health utilisation, compared to the general Thai older population (Department of Health, 2018). Thai older adults presented for emergency care (pain, tooth mobility, decayed teeth, or needing prosthesis), and only 5% of dental service utilisation was for prevention or check-up. This finding corresponds with results from a previous study indicating older adults in developing countries utilised dental service for symptomatic care, most frequently dental pain (Kandelman, Arpin, Baez, Baehni, & Petersen, 2012). In contrast, results from studies in developed countries such as in the UK (Public Health England, 2016) and USA (Skaar & Hardie, 2006; Skaar & O’Connor, 2012), found older adults had higher rates of dental services utilisation, and an increasing proportion utilised preventative care over previous decades.

With regards to oral health status, the results in this study show the majority of patients had poor oral health and high treatment needs. They had high prevalence of active or untreated caries, and a high mean number of active caries (DT) in both age groups (young and old older adults). The majority of patients in this study had periodontal disease with half of participants displaying extensive symptoms, such as tooth mobility or heavy calculus deposit, and almost all samples requiring periodontal treatment. This finding confirmed the previous studies from around the world, which found that older adults were generally assessed as having poor oral health status with complex oral treatment needs (Auluck, 2005; Griffin et al., 2012; S. He & Thomson, 2017; Karki, Monaghan, & Morgan, 2015; Petersen & Yamamoto, 2005). When comparing between age group (lower than 70 and 70 or more), it was found the younger group had a higher prevalence of oral diseases (dental caries (DT), and periodontal disease), but the older age group had higher caries experience (DMFT). This could be due to the fact the older age group had a lower number of natural teeth, therefore, the chance of having teeth with disease was decreased. A previous study reported
similar results with the mean number of dental caries (DT) declining as the age of the participants increased (Ahluwalia, Cheng, Josephs, Lalla, & Lamster, 2010). However, a separate cohort study observed the dental caries increment in older adults was approximately one affected surface per year, which suggests older adults are still a caries active population (Thomson, 2004). Therefore, it should be noted that as the findings in this research were from cross-sectional descriptive data, they might not be sufficient to predict the rate of dental caries over time.

When comparing differences in oral health status to different characteristics of the participants, health insurance was shown to be a significant factor in predicting oral health diseases (dental caries and periodontal disease) in this study. People with government health benefits (GHB) had fewer oral diseases compared to the other types of health insurance, which held true when controlled for by other possible associated factors. This could be due to two main reasons. Firstly, people with GHB worked for the government and usually had higher educational attainment, or had a close family member as a government officer. Therefore, this benefit could indicate indirect educational level, which can affect oral health care and in turn affect oral health status of an individual. Secondly, GHB provides better oral health care benefits than the other types of insurances (i.e. the ability to use any public dental hospital without needing registration, endodontic treatment, and fixed prosthesis). This finding was consistent with findings from a previous study that although there is free dental care provided as part of Universal Coverage (UC) for every Thai older adult, oral health inequalities exist between different types of health insurances, and affect the oral health status and oral health utilisation of Thai older adults (Somkotra, 2013).

Conclusion and suggestions for future study

Oral health diseases such as dental caries and periodontal disease are mostly preventable. Although the aging process affects oral diseases, the burden of this process could be modified by several potential factors, for example, general health status, financial resources, and Oral Health Literacy (OHL) (See figure 2.1) (Lamster et al., 2016). However, previous government dental health programs for Thai older people have mainly focused on tooth replacement campaigns (prosthesis program) (Srisilapanan et al., 2016), which only address the
consequence, rather than the cause of an oral health problem. It is vital the principal causes of poor oral health are addressed, particularly as an ageing population is likely to increase demand on oral health care systems. Future research needs to emphasize active oral health prevention and promotion programs, especially in primary care settings, and enhance the ability of oral self-care in older people, rather than setting the oral health system as a passive treatment unit.
References


Thomson, W. M. (2004). Dental caries experience in older people over time: what can the large cohort studies tell us? Br Dent J, 196(2), 89-92; discussion 87. doi:10.1038/sj.bdj.4810900


3. Chapter 3

Development and a Pilot Study of the Test of Functional Health Literacy in Dentistry for Older Adults
Foundation of Chapter 3

Chapter 2 demonstrated the oral health of Thai older adults was poor with a need to shift the focus to prevention in oral health related matters. The literature review in Chapter 1 described the importance of health literacy in oral health but identified no Oral Health Literacy (OHL) tools for older adults, therefore, the researcher primarily aimed to develop a new OHL tool for this target population. This chapter provides an overview of the development process a new OHL tool, which was consisted of two phases; 1.) The background of the template and the development of the tool. 2.) A pilot study of the tool in a target population. The purpose of this study was to develop and validate a pilot version of the OHL tool for older adults. The development of the tool was conducted during December 2015 to April 2016, and the pilot study to validate the tool was conducted during June to July 2016.

This chapter was submitted to the Journal of Investigative and Clinical Dentistry in July 2019 and a decision is pending.

Authors Contribution
This section was written by PW and was reviewed with contributions by IAP and MG.
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review</td>
<td>No tool for older adults</td>
<td>Identify research gaps questions and set the objectives</td>
</tr>
<tr>
<td></td>
<td>Review evidence from previous studies and the potential tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs</td>
<td>Poor oral health statuses, low dental service utilisation</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td></td>
<td>Retrospective epidemiological study of oral health status and treatment needs in the target population. N = 393</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLID</td>
<td>The pilot OA-TOFHLID total score = 35</td>
<td>Poor predictive validity → test needed to be improved</td>
</tr>
<tr>
<td></td>
<td>The first pilot developed was an OHL test in Thai older adults. N = 105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLID</td>
<td>The optimised OA-TOFHLID total score = 48</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td></td>
<td>The OA-TOFHLID was further developed by adding 1 reading comprehension section, and tested in Thai older adults. N = 103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLID in clinical setting</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLID was too long for some to complete.</td>
</tr>
<tr>
<td></td>
<td>The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status. N = 115</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLID [Subgroup of Chapter 5]</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td></td>
<td>Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults. N = 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLID in the US population</td>
<td>The Short OA-TOFHLID total scores = 39</td>
<td>The test presents acceptable validity → Need to confirm with different population</td>
</tr>
<tr>
<td></td>
<td>The Short OA-TOFHLID was developed by cutting certain prompts, following feedback from participants about the length of the original tool. N = 106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLID in the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the shortened version was confirm.</td>
<td>The test presents acceptable validity → Need to confirm with different population</td>
</tr>
<tr>
<td></td>
<td>The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data. N = 218</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLID in community</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
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</tbody>
</table>
Abstract

Background
Oral health literacy is emerging as an important element in oral health promotion, but few studies have been conducted in older adults. This work aimed to develop and validate a Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD). The development process of the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) is described.

Method
A convenience sample of 105 older adults, aged 60+ years were recruited from 3 settings in Chiang Mai, Thailand (one dental hospital and 2 senior citizen clubs). Two existing health literacy tools and the newly developed test were administered to the participants. Dental caries, treatment need, number of teeth and prosthesis status were examined by a dentist. Oral health literacy scores were validated using health literacy scores and oral health status.

Results
It was found that OA-TOFHLiD was positively correlated with education level, income, self-reported general literacy, S-TOFHLA score, and DMFT. However, it was negatively correlated to number of decayed and number of missing teeth \( (p<0.05) \). Cronbach’s alpha was 0.88 and the intra-class correlation coefficient was 0.86.

Conclusion
This study demonstrated that OA-TOFHLiD has acceptable validity and reliability. However, the predictive validity of OA-TOFHLiD was non-significant when controlling for other factors, therefore, an additional topic was added to the reading comprehension section in order to optimise the predictive ability of the tool.
Background

Health literacy (HL) is “The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (Ratzan, 2001). From the results of the 2003 National Assessment of Adult Literacy (NAAL), it was found that approximately 14 percent, or 41 million, U.S. adults health literacy scored below a basic level (Kutner, Greenberg, Jin, & Paulsen, 2006). Limited health literacy is higher among older adults, minority groups and people who have never attended, or did not complete, high school (Easton, Entwistle, & Williams, 2010). In Europe, the results from the European Health Literacy Survey (HLS-EU) conducted in 8 European countries in 2011 found that 12% of those sampled had insufficient health literacy and almost half of respondents showed limited health literacy (Sorensen et al., 2015). From this survey, financial limitation, social status, education, age and gender were strong predictors of low health literacy (Sorensen et al., 2015).

The concept of oral health literacy (OHL) has been developed according to the knowledge and concepts of general health literacy. Figure 3.1 shows The National Institute of Dental and Craniofacial Research framework for oral health literacy (NIDCR) (National Institute of Dental and Craniofacial Research, 2005). They describe OHL as an interaction between individual, cultural and society, healthcare system, and education system factors. Their combined influence determines the outcomes and costs of oral health.

Figure 3.1: The Oral Health Literacy Framework (NIDCR)
In dentistry, the relationship between OHL and oral health outcomes has been studied. It is suggested that improving OHL could reduce the incidence of dental caries, periodontal disease, acute oral infection and result in early detection and treatment of disease such as oral cancer (Taylor & Pretty, 2014). One study found that people with higher OHL had higher numbers of natural teeth and fewer carious lesions than those with lower scores. Subjects with low OHL were found to have poorer community periodontal index (CPI) scores (Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013). Another study found a significant relationship between OHL and periodontal status, patients with higher OHL were less likely to have severe disease, compared to those with lower OHL (Wehmeyer, Corwin, Guthmiller, & Lee, 2014).

While there is a clear link between OHL and health outcomes in children and their parents (Divaris, Lee, Baker, & Vann, 2012; Miller, Lee, DeWalt, & Vann, 2010; Vann, Lee, Baker, & Divaris, 2010), there has been little attention given to OHL in older adults, and yet this group represent a growing and increasingly important population given the well-recognised demographic shift (He, Goodkind, & Kowal, 2016). There is therefore a need to develop and test an OHL tool optimised for older adults.

There have been no published studies related to OHL in Thailand and there is no validated instrument to assess OHL in the Thai language. Studies concerning oral health literacy have been mainly carried out in Western countries, and there is a US centric approach to many where the focus is on navigating the complex US insurance systems – something that is not a barrier to care in many other countries such as Thailand or the UK. Therefore, as health systems, cultural, and age differences might affect the measurement of OHL (as demonstrated by the NIDCR model), these are drivers to create a new, non-US centric oral health literacy tool.

Countries are becoming increasingly diverse and multicultural. In order to address the diversity of the world’s population, it is important that tools and questionnaires are developed and tested in culturally sensitive contexts. Previous OHL studies have developed tests in English, therefore this study aimed to develop both a Thai and English version simultaneously. The assessment was created to test functional oral health literacy, which could be used across various cultures and
healthcare systems. The study consisted of 2 phases; firstly in the development of the tool, and secondly to pilot the tool.

Methods

Phase 1: Development of the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD), pilot version

The Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was developed using the outline approach of the Test of Functional Health Literacy in Dentistry (TOFHLiD) (Gong et al., 2007) which itself was modified from the medical health literacy test called Test of Functional Health Literacy in Adults (TOFHLA) (Parker, Baker, Williams, & Nurss, 1995). The items in TOFHLiD were developed to assess knowledge about fluoride application on children’s teeth, readability of a consent form for treatment and an understanding the Medicaid Rights in the US. The modified cloze procedure (a sequence of deleted words from a full passage) used in TOFHLiD required a respondent to read the passage thoroughly and choose correct alternative words to fill in the blanks. There are 68 reading comprehension and 12 numeracy questions, with the total score equal to 100. TOFHLiD was reported as having good reliability and validity to measure OHL (Gong et al., 2007). However, the contents used in TOFHLiD are specific to children’s oral health and to those individuals living in the USA. Therefore, in developing a new OHL tool, the researchers created new passages in the reading comprehension section. In the prompt section, only the fluoride toothpaste label remained from the original TOFHLiD.

Existing oral health related literature was reviewed, for example, posters, leaflets, information sheets, labels from oral health products, and various articles in order to develop oral health related information to be used within the reading comprehension section. Three passages regarding 1.) Dental caries, 2.) Periodontal disease, 3.) Prevention of oral health diseases was selected from the reviewed materials. The modified Clozed technique (Porter, 1976) was used to create a test by deleting every 1 to 9 words in passages and giving 4 alternatives in each blank. This technique is widely accepted as a valid test in measuring reading comprehension, language proficiency, and knowledge of vocabulary (Porter, 1976). A respondent who is capable of completing a test needs to have
the ability to predict the missing words from contextual clues. This capability relies on the ability to read fluently, to understand grammar and context and to comprehend meanings of given words. In an oral health literacy comprehension test, a respondent needs to have familiarity with medical or dental contexts in order to understand those passages and select the appropriate answers for the blanks. There are 9 questions in each topic and the total score for this section is 27 (See Figure 2.2).

**Figure 3.2: Example of reading comprehension part of the OA-TOFHLiD in Thai and English version**

The prompt section aimed to measure the ability to understand numeracy and the ability to read dental product labels. A picture of a fluoride toothpaste label and a chlorhexidine mouthwash label (see Figure 2.3) were used as prompts for participants to read and then answer questions. There were 4 questions in each prompt with a total score of 8 for this section. The total score for OA-TOFHLiD ranged from 0 (the lowest OHL) to 35 (the highest OHL). These labels
and questions were selected based on the age profile of the users and to make the questions meaningful.

**Figure 3.3: Example of Prompt 2 in the OA-TOFHLiD**

![Prompt 2 Chlorhexidine Mouthwash](image)

**Prompt 2 Questions (4 points)**

1. How often should you use this mouthwash daily? ______________________________
2. What quantity of mouthwash you should use each time? _____________________
3. If you have gum disease, how long should you use the mouthwash for? ______
4. What might occur to your teeth and tongue when you use this mouthwash? _

**Translation process and pretest**

This process aimed to achieve equivalence tests for two different populations (Thai and English-speaking populations). The instrument was developed in both Thai and English at the same time by a researcher (PW), who is fluent in Thai and English, and who worked closely together with the supervisory team (IAP and MG). The two versions were examined by two experts in dental public health who were also fluent in Thai and English to determine the semantic equivalence. OA-TOFHLiD was pretested in 10 native Thai and 10 native English speakers in order to evaluate if it were understandable and was appropriate in both languages. In
the pilot test, the researcher asked participants to provide comments on the test and explain the reasons for choosing their answers. Minor modifications were made from the feedback before implementing the test in a pilot study.

**Phase 2: Pilot study with Thai older adults**

**Sample recruitment**

Data collection was conducted from May 2016 to June 2016 in Chiang Mai, the second largest province in Thailand. The settings were selected based on the criteria of including both urban and rural areas in order to obtain a variety of participants. This study obtained ethical approval from the Faculty of Dentistry, Chiang Mai University Ethical Committee (Reference number 19/2016), and the University of Manchester Research Ethics Committee (Reference number 2017-0106-2408).

In the urban area, data collection was conducted at the Comprehensive Clinic, Faculty of Dentistry, Chiang Mai University, which is situated in the city center of Chiang Mai. In the rural area, data collection occurred in 2 settings. The first was at Chor-Lae Senior Club in Maetang District, which is 75 kilometres from the city center in the north part of Chiang Mai. The second was at Hod Senior Clubs in Hod district, which is 90 kilometers from the city center in the south part of Chiang Mai.

Older adults aged over 60 years old who attended the settings during data collection were recruited through convenience sampling. A patient information sheet was given to each participant and this information was reiterated by the research assistant. Participants gave written consent if they decided to take part in the study. Exclusion criteria included those who could not read or write in Thai, or had a serious medical condition, which affected their ability to complete the test by themselves (e.g. vision problems or cognitive impairment).
Reference measurements

Previously validated HL tools; Short-Test of Functional Health Literacy in Adults (S-TOFHLA) and The Newest Vital Sign (NVS) were used as reference standard tests in this study. S-TOFHLA (Baker, Williams, Parker, Gazmararian, & Nurss, 1999) is a shortened version of TOFHLA, which measures functional health literacy using the modified cloze procedure. It is composed of 2 reading comprehension passages with 36 items. S-TOFHLA has acceptable properties to test the health literacy of people in various age groups and requires less time to complete compared to the original TOFHLA. NVS (Weiss et al., 2005) is a health literacy test that uses an ice cream nutritional label as a prompt and has 6 questions pertaining to the label. It aims to test numeracy skills (understanding and application of numbers and mathematical concepts) and reading comprehension skills. In a previous study, NVS was found to have greater sensitivity in identifying people with limited health literacy than other tests (Osborn et al., 2007). These two tests were translated into Thai by a researcher (PW), and checked for conceptual and semantic equivalence by 2 bi-literate (Thai-English) professors in dental public health.

Data collection

During data collection, three sets of self-administered questionnaires (OA-TOFHLiD including a demographic questionnaire, S-TOFHLA, and NVS) were provided to participants by the research assistant. After completing the questionnaires, participants were given an oral examination by a dentist. The examination was carried out in a dental unit chair under the unit light at the clinical setting, and in a mobile dental unit with a mobile dental lamp at the community settings. Only mouth mirrors were used in the oral examination. The diagnostic criteria were adapted from the criteria used in the 6th Thai Oral Health Survey. For dental caries detection, the WHO criteria were used (Decayed-Missing-Filled Teeth - DMFT index).
Data analysis for validity and reliability assessment

Data Analysis

SPSS version 23.0 for Mac (IBM Corp., 2015) was used for all statistical analysis in this study. Descriptive statistics (mean, standard deviation and percentage) were utilised to detail the characteristics of data. Normality of the OA-TOFHLiD scores were examined using the Kolmogorov-Smirnov test, and were not normally distributed. Participants were dichotomised into several categories based on age (60-69 / 70 or more), gender (male / female), level of education (high school or lower/ higher than high school), residential area (urban / rural), income (lower than poverty line/ higher than poverty line), use of dental services in the past year (use / not use) for further analyses.

Face Validity

OA-TOFHLiD was given to two experts in the field of dental public health to assess the face validity. This included if the test used appropriate language and layout, was appropriately translated and appeared to measure the construct intended. Following this assessment OA-TOFHLiD was modified based on the experts’ comments.

Concurrent validity

It was hypothesized that people with higher OHL would be more likely to have a higher level education, higher income, have used dental services during the past year, and have a higher self-reported general literacy level. In order to test these hypotheses, and evaluate concurrent validity, Spearman Rank’s correlation coefficient was conducted to explore any potential correlation between OA-TOFHLiD score across these variables.

Convergent validity

To identify if the newly developed test was theoretically associated with the existing reference tests, OA-TOFHLiD score, Short Test of Functional Health Literacy in Adults (S-TOFHLA), and the Newest Vital Sign (NVS) were assessed using Spearman’s Rank correlation coefficient. Multiple linear regression was
used to analyse and control for age, education, residential area, and characteristics of dental services utilisation.

**Discriminant validity**

Mann-Whitney U-Test was used to determine if OA-TOFHLiD could discriminate between different groups in the population. For a number of variables participants were divided into two groups this included, age (60-69 / 70 or higher), income (lower than poverty line / higher than poverty line), occupation (government officers / other occupations), residential area (urban / rural), use of dental service in the past year (use / not use), and DMFT (having DMFT under the mean DMFT / higher than the mean DMFT).

**Predictive validity**

Oral Health status of older adults was used as a proxy measure to analyse predictive validity by examining the correlation between oral health status and OA-TOFHLiD scores. The oral status included caries status and treatment need, plaque index, prostheses status and prosthesis needs, and number of posterior occluding pairs of teeth.

To determine if OHL could predict oral health status, a binary logistic regression was used to determine if there was a relationship between these two variables. In the model, OA-TOFHLiD was set as an independent variable for predicting oral health status, controlled for by age, education level, residential area, and use of dental service. For the dependent variable, participants were categorized into two groups by oral health status as a dependent variable. In the **good oral health group**, the participant must have 1.) No active caries (new cavity or undermined caries), 2.) No teeth with a poor prognosis (caries that cannot be treated or need to be extracted), and 3.) Having no prosthesis treatment need. Participants who did not meet the above criteria were categorized into the **poor oral health group**.

**Reliability**

Ten percent of participants were asked to complete the questionnaire twice. The test-retest reliability of the OA-TOFHLiD was measured using Intraclass correlation coefficient (ICC). The internal consistency of OA-TOFHLiD was
examined using Cronbach’s Alpha. In addition, the examiner repeated oral screening in this group of participants after completing the questionnaire in order to perform intra-rater reliability of an examiner by assessing correlation between the first and the second oral screening results.

Results

Descriptive results

General characteristics of participants present in Table 3.1. A total of 105 participants took part in the study (57% female / 43% male). Participants were aged between 60 to 84 years old with a mean age of 67.44 years (SD 5.86) and the median and modal age of 66 years. A quarter of participants were over 70 years old.

The majority of participants had primary or secondary school education as the highest level of education and lived in an urban area. The majority of the participants were retired civil servants (40%), which is different from retirement form other occupations. Although the civil servants are retired, they receive government pensions (not more than 70% of the mean of the last 60-month salaries) and medical benefits from the government.

For dental service utilisation, only 31.4% of the participants had used the dental service during the previous year, with 6 participants (5.7%) having never utilised dental services before. Tooth extraction was the most commonly reported treatment (20%), followed by cleaning and periodontal treatment (19%) and restorations (18.1%). The majority of participants (50.5%) used dental services only when they had a problem rather than attending for a regular check-up (27.6). Community hospitals (37.1%) and dental schools (26.7%) were the most common settings for dental service utilisation.
Table 3.1: Characteristics of the participants in this study

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number (n = 105)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>45</td>
<td>42.9</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>57.1</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>76</td>
<td>72.4</td>
</tr>
<tr>
<td>70 or Higher</td>
<td>29</td>
<td>27.6</td>
</tr>
<tr>
<td>Educational Level</td>
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<td></td>
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<tr>
<td>Primary School</td>
<td>41</td>
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</tr>
<tr>
<td>Secondary</td>
<td>25</td>
<td>23.8</td>
</tr>
<tr>
<td>College</td>
<td>7</td>
<td>6.7</td>
</tr>
<tr>
<td>University or Higher</td>
<td>32</td>
<td>30.5</td>
</tr>
<tr>
<td>Area</td>
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<td></td>
</tr>
<tr>
<td>Urban</td>
<td>66</td>
<td>62.9</td>
</tr>
<tr>
<td>Rural</td>
<td>39</td>
<td>37.1</td>
</tr>
<tr>
<td>Income</td>
<td>Min = 0 THB, Max = 85000 THB ($2830)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean = 11641.87, SD 14099.36 THB ($470), Median = 6000 THB ($200), Mode = 700 THB ($23.5)</td>
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</tr>
<tr>
<td>Income group</td>
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<tr>
<td>Lower than poverty line</td>
<td>63</td>
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<td>Higher than poverty line</td>
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<tr>
<td>Occupation</td>
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<td>Civil servant (retired)</td>
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<td>Agriculture (farmer, gardener)</td>
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<td>15.2</td>
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<tr>
<td>House worker</td>
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<td>13.3</td>
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<tr>
<td>No job or Other</td>
<td>10</td>
<td>9.5</td>
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<tr>
<td>Use of Dental services in past 1 year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>33</td>
<td>31.4</td>
</tr>
<tr>
<td>Not Use</td>
<td>62</td>
<td>59</td>
</tr>
<tr>
<td>Not sure, cannot remember</td>
<td>10</td>
<td>9.5</td>
</tr>
<tr>
<td>Type of care in previous year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral exam</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Cleaning and periodontal treatment</td>
<td>20</td>
<td>19.0</td>
</tr>
<tr>
<td>Fillings</td>
<td>19</td>
<td>18.1</td>
</tr>
<tr>
<td>Endodontic treatment</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Extraction</td>
<td>21</td>
<td>20.0</td>
</tr>
<tr>
<td>Prostheses</td>
<td>13</td>
<td>12.4</td>
</tr>
<tr>
<td>Self-reported literacy level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>8</td>
<td>7.6</td>
</tr>
<tr>
<td>Very good</td>
<td>25</td>
<td>23.8</td>
</tr>
<tr>
<td>Good</td>
<td>37</td>
<td>35.2</td>
</tr>
<tr>
<td>Average</td>
<td>35</td>
<td>33.3</td>
</tr>
<tr>
<td>Need help when reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No need</td>
<td>84</td>
<td>80.0</td>
</tr>
<tr>
<td>Sometimes</td>
<td>19</td>
<td>18.1</td>
</tr>
<tr>
<td>Perceived Oral health Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent to good</td>
<td>67</td>
<td>63.8</td>
</tr>
<tr>
<td>Fair to poor</td>
<td>38</td>
<td>36.2</td>
</tr>
<tr>
<td>Perceived urgent dental treatment need</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>44</td>
<td>58.1</td>
</tr>
<tr>
<td>No</td>
<td>61</td>
<td>41.9</td>
</tr>
</tbody>
</table>

For the test scores, the mean scores of OA-TOFHLiD, S-TOFHLA and NVS were 30.4, 29.1 and 3.88, respectively (Table 3.2).
Table 3.2: Descriptive statistics for all related measurements

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure (total score)</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental</td>
<td>OA-TOFHLiD n= 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (35)</td>
<td>30.41</td>
<td>12</td>
<td>35</td>
<td>5.16</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension (27)</td>
<td>23.85</td>
<td>10</td>
<td>27</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Understanding numeracy and text (8)</td>
<td>6.56</td>
<td>0</td>
<td>8</td>
<td>1.76</td>
</tr>
<tr>
<td>Medical</td>
<td>S-TOFHLA n= 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (36)</td>
<td>29.08</td>
<td>6</td>
<td>36</td>
<td>7.43</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 1 (20)</td>
<td>16.33</td>
<td>1</td>
<td>20</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 2 (16)</td>
<td>12.74</td>
<td>0</td>
<td>16</td>
<td>4.10</td>
</tr>
<tr>
<td></td>
<td>NVS (6) n= 105</td>
<td>3.88</td>
<td>0</td>
<td>6</td>
<td>1.64</td>
</tr>
</tbody>
</table>

Concurrent validity

Characteristics of scores from 3 tests showed a non-normal distribution. Therefore, Spearman’s rank correlation was used to explore correlations. From the analyses, it was found that there were significant correlations between OA-TOFHLiD and education, income, and self-reported level of general literacy. Education level presented a strong positive correlation with OA-TOFHLiD score and income and self-reported general literacy levels showed moderate positive correlations (Table 3.3).

Table 3.3: Spearman correlation coefficients of OA-TOFHLiD with related measurement (concurrent and convergent validity)

<table>
<thead>
<tr>
<th>Related measurement</th>
<th>r</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education level</td>
<td>0.744</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Monthly income</td>
<td>0.593</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Number of dental service utilisation (in last year)</td>
<td>0.057</td>
<td>0.576</td>
</tr>
<tr>
<td>Self-reported level of general literacy</td>
<td>0.491</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-TOFHLA</td>
<td>0.694</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>NVS</td>
<td>0.047</td>
<td>0.637</td>
</tr>
<tr>
<td>Oral health Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMFT</td>
<td>0.230</td>
<td>0.018*</td>
</tr>
<tr>
<td>- Number of Decay</td>
<td>-0.266</td>
<td>0.006*</td>
</tr>
<tr>
<td>- Number of Missing</td>
<td>-0.437</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>- Number of Filled</td>
<td>0.541</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed).
Convergent validity

The OA-TOFHLiD score was highly correlated with the S-TOFHLA score according to the Spearman’s rank correlation. However, OA-TOFHLiD score was not significantly correlated with NVS (Table 3.3). A Spearman’s rank correlation was also run between NVS and S-TOFHLA and this was also found to have no significant correlation. \((r = 0.119, \ p\text{-value} = 0.637)\)

In Table 3.4, univariate (Model I) and multivariate (Model II) regression analyses were performed to demonstrate the relationship between OA-TOFHLiD and two standard health literacy tests, controlled for by age, education, residential area, and use of dental services in last year. It was found that OA-TOFHLiD was positively associated with S-TOFHLA in both model I and II. However, no significant association was found between OA-TOFHLiD and NVS.

Table 3.4: Multivariate linear regression results for the OA-TOFHLiD with the S-TOFHLA, and the OA-TOFHLiD with the NVS (convergent validity)

<table>
<thead>
<tr>
<th></th>
<th>Outcome Measurement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S-TOFHLA</td>
<td>NVS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
<td>Model I</td>
<td>Model II</td>
</tr>
<tr>
<td></td>
<td>(\beta) (CI)</td>
<td>(\beta) (CI)</td>
<td>(\beta) (CI)</td>
<td>(\beta) (CI)</td>
</tr>
<tr>
<td>OA-TOFHLiD</td>
<td>1.07** (0.88, 1.26)</td>
<td>0.65** (0.40, 0.89)</td>
<td>-0.02 (-0.08, 0.05)</td>
<td>-0.08 (-0.16, 0.02)</td>
</tr>
<tr>
<td>Age (&lt; 70)</td>
<td>-</td>
<td>3.18** (1.13, 5.23)</td>
<td>-</td>
<td>-0.27 (-1.03, 0.48)</td>
</tr>
<tr>
<td>Education (Higher than high school)</td>
<td>-</td>
<td>-0.18 (-2.47, 2.11)</td>
<td>-</td>
<td>-0.15 (-1.00, 0.69)</td>
</tr>
<tr>
<td>Residential area (urban)</td>
<td>-</td>
<td>5.418**(2.58, 8.25)</td>
<td>-</td>
<td>1.09* (0.05, 2.13)</td>
</tr>
<tr>
<td>Utilisation of Dental service in last year (use at least 1 visit)</td>
<td>-</td>
<td>-0.20 (-2.03, 1.62)</td>
<td>-</td>
<td>-0.16 (-0.84, 0.50)</td>
</tr>
<tr>
<td>(R^2)</td>
<td>54.9%</td>
<td>65.6%</td>
<td>0.2%</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

* \(P < 0.05\)
** \(P < 0.01\)
**Discriminant validity**

Table 3.5 shows the discriminant validity assessed by exploring the difference of OA-TOFHLiD scores between dichotomised groups of occupation, income, characteristics of dental service utilisation, DMFT, using a Mann-Whitney test. There were statistically significant differences between different groups when looking at income, occupation, residential area and DMFT. However, no significant differences in the OA-TOFHLiD score were found between different age groups and dental service utilisation.

<table>
<thead>
<tr>
<th>Groups</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (60-69/ 70 or higher)</td>
<td>0.055</td>
</tr>
<tr>
<td>Income (lower than poverty line/ higher)</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Occupation (retired government officer/ other occupation)</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Residential Area (urban/ rural)</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Use dental service in the last year (use/ not use)</td>
<td>0.057</td>
</tr>
<tr>
<td>DMFT (less than mean (5.84 teeth)/ higher than mean)</td>
<td>0.038*</td>
</tr>
</tbody>
</table>

*Mann-Whitney test, the significant value is less than 0.05

**Mann-Whitney test, the significant value is less than 0.001

**Predictive validity**

Any association between OA-TOFHLiD scores and DMFT were explored using Spearman’s Rank correlation to evaluate predictive validity (presented in Table 3). OA-TOFHLiD showed a positive but weak correlation with DMFT ($r = 0.230$, p-value = 0.018). When breaking down DMFT into each sub-category, it was found that the number of decayed teeth (D) and missing teeth (M) were negatively correlated with the oral health literacy score. But number of filled teeth (F) had a stronger positive correlation (Table 3.3).

Table 3.6 displays the results from a binary logistic regression, which was used to determine further predictive validity of OA-TOFHLiD on oral health status. It was found that OA-TOFHLiD was a significant predictor for oral health status in the univariate analysis (p = 0.045). However, when controlling for age, education,
residential area and dental service utilisation, the significant association disappeared.

Table 3.6: Binary logistic regression for OA-TOFHLiD and oral health status (predictive validity)

<table>
<thead>
<tr>
<th></th>
<th>Oral health status (Good)</th>
<th></th>
<th>Model I</th>
<th></th>
<th>Model II</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SE</td>
<td>P-value</td>
<td>OR (CI)</td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>OA-TOFHLiD</td>
<td>1.00</td>
<td>0.05</td>
<td><strong>0.045</strong>*</td>
<td>1.101(1.00-1.21)</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Age (years old)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.17</td>
<td>0.52</td>
</tr>
<tr>
<td>≥ 70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.59</td>
<td>0.54</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.29</td>
<td>0.73</td>
</tr>
<tr>
<td>≤ High school</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.81</td>
<td>0.46</td>
</tr>
<tr>
<td>Residential area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rural</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Use of Dental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>service</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Not Use</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*p < 0.05

Reliability

For the reliability of the test, the intraclass correlation coefficient (ICC) was 0.859, (95% CI 0.515-0.961). This indicates good agreement between the test and retest score amongst the participants. Cronbach’s Alpha was used to determine Internal reliability or internal consistency of OA-TOFHLiD. It was found that Cronbach’s Alpha of OA-TOFHLiD was 0.884. Therefore, it can be interpreted that this tool has good internal consistency or internal reliability. In addition, the examiner was found to have good reproducibility. The inter-rater reliability was 0.997.

Discussion

Health literacy can be classified into different levels which include functional literacy, interactive literacy, and critical literacy (Nutbeam, 2000). In this study, the researchers aimed to develop OA-TOFHLiD as a functional oral health literacy
tool in older adults. Functional health literacy encompasses having sufficient basic skills in reading and writing that means individuals can perform effectively in different health contexts (Nutbeam, 2000). This implies functional health literacy is a basic requirement for improving further health literacy.

In previous OHL studies, several types of functional OHL tools have been developed and validated (Dickson-Swift, Kenny, Farmer, Gussy, & Larkins, 2014). The majority of tools are word recognition or pronunciation tests; these are easier to administer and have a shorter completion time than those of comprehension test (Lee, Rozier, Lee, Bender, & Ruiz, 2007). However, in this study, a reading comprehension tool was selected as an outline for developing an OHL tool for older adults because the original TOFHLiD demonstrated good convergent validity, predictive validity and its ability to discriminate between medical and oral health literacy was acceptable (Gong et al., 2007). This type of test is also more consumable and is more acceptable to both patients and professionals who can understand the link between the questions and health, vs. the somewhat esoteric nature of word pronunciation.

The overall performance of OA-TOFHLiD indicated good validity and good reliability. This test demonstrated good concurrent validity, which was assessed by a significant correlation between OA-TOFHLiD with educational level, income, and self-reported literacy level and confirms our hypotheses that these factors are related to OHL of older adults. Moreover, for discriminant validity, OA-TOFHLiD score demonstrated a significant difference when looking at the characteristics of older adults. Therefore, it could be assumed that OA-TOFHLiD has an acceptable ability to discriminate between groups.

For convergent validity, OA-TOFHLiD displayed high correlation with S-TOFHLA. Even though S-TOFHLA does not measure OHL directly, medical health literacy and oral health literacy are based on a similar theoretical background and concept. Interestingly, OA-TOFHLiD was not correlated with the NVS and the NVS was also not correlated with S-TOFHLA. This could be due to the fact the structure of these two tests are completely different and measure a different spectrum of health literacy. OA-TOFHLiD and S-TOFHLA are reading comprehension tests, but the NVS is based more on numeracy and calculation. As previous research has also reported inconsistencies between S-TOFHLA and NVS in identifying people with limited health literacy in English speakers.
(Ramirez-Zohfeld et al., 2015). In this study with Thai older adults, participants noted difficulties when completing the NVS test, as a nutritional label is not compulsory in Thailand and participants were not used to this type of information. It is therefore suggested that future validation studies of OA-TOFHLiD should not utilise NVS as a reference test.

Predictive validity for OA-TOFHLiD was not fully established in our study. Although it was not expected to see a positive correlation between DMFT and OA-TOFHLiD scores, the correlation coefficient showed a weak positive correlation ($r = 0.230$). When looking at each DMFT component separately; the numbers of Decay (DT) and Missing (MT) teeth were negatively correlated with the OHL scores. These findings confirmed our hypothesis that lower OHL is associated with poorer oral health (higher number of decay and missing teeth). On the other hand, the number of Filled teeth (FT) was positively correlated with OHL scores. This positive correlation could be explained, as participants with higher OHL scores could be more likely to attend and use dental services thus they had a higher number of filled teeth.

Looking at the binary logistic regression, OA-TOFHLiD alone had the ability to predict oral health status of the participant, but when controlling for other variables in the model, the significant association disappeared. This could be as the scores from OA-TOFHLiD are correlated with these other factors and with a small sample there is insufficient power and precision to detect a significant difference.

**Proposed improvement for OA-TOFHLiD**

Following the pilot study, the questionnaire was improved based on the feedback received from the participants; for example, increasing the font size to make it clearer for older participants. In addition, the researcher added one more reading comprehension passage (12 points) based on a consent form for dental treatment, which patients normally encounter when they utilise dental services. This aimed to improve the predictive validity of the test as it was hypothesised that people who utilised the services would have higher OHL scores. The addition of these scores may increase the validity of the OA-TOFHLiD if they further contribute to the distinction between high and low OHL.
Conclusion

This study presents the development of a new oral health literacy instrument. OA-TOFHLiD was found to have acceptable psychometric properties for evaluating OHL in older adults. However, there were some properties that needed to improve and re-evaluated. Further studies need to be carried out to improve the convergent validity and predictive validity of this test. The OA-TOFHLiD has the potential to be used within studies examining interventions or development around oral health literacy in older adults and its impact on improved oral health and quality of life.
Reference


4. Chapter 4

Validation of a Test of Functional Health Literacy in Dentistry for Older Adults in Thailand
Foundation of Chapter 4

The first version of the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) demonstrated good reliability and acceptable validities, however, some properties i.e. predictive validity was found to be insufficient. Therefore, this chapter describes the further development of the tool. The researcher adjusted the format of the pilot version according to the recommendations from the participants in the previous study. In addition, one reading comprehension section was added to increase the total score of the test. After development, the tool was tested again in Thai older adults. The modified OA-TOFHLiD achieved good validities and reliability and the cut-off scores to classify older adults into Adequate and Inadequate oral health literacy were established in this study.

The author plans to submit this Chapter to Journal of Investigative and Clinical Dentistry after Chapter 3 is accepted (to be used as a reference).

Authors Contribution
This section was written by PW and was reviewed with contributions by IAP and MG.
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review</td>
<td>No tool for older adults</td>
<td>Identify research gaps/questions and set the objectives</td>
</tr>
<tr>
<td></td>
<td>Review evidence from previous studies and the potential tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs</td>
<td>Poor oral health statuses, low dental service utilisation</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td></td>
<td>Retrospective epidemiological study of oral health status and treatment needs in the target population. N = 393</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLID</td>
<td>The pilot OA-TOFHLID total score = 35</td>
<td>Poor predictive validity (\Rightarrow) test needed to be improved</td>
</tr>
<tr>
<td></td>
<td>The first pilot developed was an OHL test in Thai older adults. N = 105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLID</td>
<td>The optimised OA-TOFHLID total score = 48</td>
<td>The test presents the ability of OHL to predict oral health status</td>
</tr>
<tr>
<td></td>
<td>The OA-TOFHLID was further developed by adding 1 reading comprehension section and tested in Thai older adults. N = 103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLID in clinical setting</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLID was too long for some to complete.</td>
</tr>
<tr>
<td></td>
<td>The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status. N = 115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLID [Subgroup of Chapter 5]</td>
<td>Those with adequate OHL presents better oral health status</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults. N = 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLID in the US population</td>
<td>The Short OA-TOFHLID total scores (\geq 39)</td>
<td>The test presents acceptable validity (\Rightarrow) Need to confirm with different population</td>
</tr>
<tr>
<td></td>
<td>The Short OA-TOFHLID was developed by cutting certain prompts, following feedback from participants about the length of the original tool. N = 106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLID in the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data. N = 218</td>
<td>The performance of the shortened version was confirm.</td>
</tr>
<tr>
<td></td>
<td>The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data. N = 218</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLID in community</td>
<td>Expected to see the most appropriate route to deliver the test in communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstract

Background
Oral health literacy (OHL) is emerging as an important element in the prediction of the oral health status of individuals. Older adults have not been as extensively studied for oral health literacy. A Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was therefore developed.

Method
A Convenience sample of 103 older adults aged 60 years or above were selected from 2 settings; one dental hospital and one senior citizen club in Chiang Mai, Thailand. An oral health literacy test, a validated health literacy test, and a socio-demographic questionnaire were administered. Dental caries, oral treatment needs, number of teeth and prosthetic status were recorded by a dental examiner. Oral health literacy scores from the new tool were compared to health literacy scores and oral health status.

Results
OA-TOFHLiD was positively correlated with years of education, income, self-reported general literacy, S-TOFHLA score, and number of filled teeth ($p < 0.05$). It was negatively correlated to age, DMFT, number of active decay and number of missing teeth ($p < 0.05$). Cronbach’s alpha was 0.88.

Conclusion
The initial study demonstrated that OA-TOFHLiD has acceptable validity and reliability but that further research is required to understand the relationship between health literacy and oral health outcomes of interest.

Keywords: oral health literacy, instrument development, older adults
Background

There has been increasing interest in the utility and measurement of health literacy, especially as it offers the potential to explain differences in health outcomes among otherwise apparently homogenous populations (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). It has been studied in many areas of health, including oral health (National Institute of Dental and Craniofacial Research, 2005). Initially, health literacy was described as the ability of patients to understand information, follow directions, ask questions, report conditions and solve problems related to their health (Parker, Baker, Williams, & Nurss, 1995). However, the most recognised definition of health literacy was provided by Healthy People 2010 as, “The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (U.S. Department of Health and Human Services, 2000).

The importance of health literacy is related to many situations in daily life. For example, patients with low health literacy may not be able to correctly comply with medications (Kalichman & Rompa, 2000; Kripalani et al., 2006; Nourelidin et al., 2012; Raehl, Bond, Woods, Patry, & Sleeper, 2006). Many studies have shown that people with limited health literacy will present with poorer general health, oral health behaviour and outcomes than those with adequate health literacy (Firmino et al., 2018; Holtzman, Atchison, Gironda, Radbod, & Gornbein, 2014; Howard, Gazmararian, & Parker, 2005; Lincoln et al., 2006; Taylor & Pretty, 2014; Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013; Vann, Lee, Baker, & Divaris, 2010; Wehmeyer, Corwin, Guthmiller, & Lee, 2014; Zarcadoolas, Pleasant, & Greer, 2006). Additionally, when one considers the important role of self-care within oral health, the degree to which an individual patient, or population group, can understand and implement oral health improvement messages, health literacy is crucial in order to deliver the outcomes of such health promotion activities (Nutbeam, 2000).

In order to evaluate the success of an oral health literacy intervention or program, many researchers have developed tools to evaluate OHL in different languages and for various populations. One of the most well-known tools in oral health literacy is the Rapid Estimate of Adult Literacy in Dentistry (REALD-30 and
REALD-99) (Lee, Rozier, Lee, Bender, & Ruiz, 2007; Richman et al., 2007) and the Test of Functional Health Literacy in Dentistry (TOFHLiD) (Gong et al., 2007). REALD has been developed based on Rapid Estimate of Adult Literacy in Medicine (REALM) (Davis et al., 1993), and the REALD test hypothesized that simple word recognition can measure OHL efficiently (Lee et al., 2007; Richman et al., 2007). Subjects are asked to pronounce a range of increasingly complex dental terms correctly, the more correctly pronounced, the higher their OHL score. Such systems are simple, rapid (as their name suggests) and easily administered (Lee et al., 2007). REALD assessments are very popular, and have been used as an OHL assessment tool in several published studies (Geltman et al., 2014; Shin, Braun, & Inglehart, 2014; Vann et al., 2010). However, there has been criticism of OHL being measured using this tool as it is argued there is too much emphasis on pure reading ability rather than innate health seeking behaviours. The link between pure literacy and health literacy may, in many subjects be strong – however in certain groups it may not be indicative (Kobayashi, Wardle, Wolf, & von Wagner, 2014).

The Test of Functional Health Literacy in Dentistry (TOFHLiD) was modified from the Test of Functional Health Literacy in Adults (TOFHLA), which is a general health literacy assessment tool (Gong et al., 2007). This test is composed of a reading comprehension and a numeracy test, which aim to assess OHL of caregivers taking care of children’s oral health. Such tests are more complex, more time consuming to administer but aim to challenge the functional application of knowledge and hence may be more valid and more closely linked to outcomes of interest (Gong et al., 2007). However, TOFHLiD is not often used in dental public health studies. Reasons for this include the US centric nature of the test (relying on a knowledge of the US health insurance system) and that it aims to measure OHL of parents in relation to the oral health care of their children.

It has been reported that inadequate health literacy is most often found in minority groups or those with significant levels of deprivation (Cutilli, 2007; Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Although the age range within these groups included participants of an older age, the older adult population has not been exclusively researched in terms of oral health literacy (Hjertstedt, Barnes, & Sjostedt, 2014; McQuistan, Qasim, Shao, Straub-Morarend, & Macek, 2015). Older adults are an increasing part of most populations and they can present a particular challenge in terms of delivering both professional and self-care (Naik,
Teal, Pavlik, Dyer, & McCullough, 2008; Polly, 1992; Zavertnik, 2014). Older adults have increased risk of root caries, periodontitis, and incremental tooth loss (Ramsay et al., 2015). Older adults caries risk is similar to that of younger children, with roughly one surface increment per year (Thomson, 2004). While the number of edentulous patients has dramatically decreased in recent years, incremental tooth loss continues, and the restorative condition and function of those remaining teeth can be complex to maintain, especially in those patients with cognitive impairment (Chalmers, Carter, & Spencer, 2002).

There is a need to assess and improve oral health literacy for this group. However, there is no specific test of functional oral health literacy that is appropriate for older adults. Therefore, this study aimed to further develop and examine the validity and reliability of a new OHL measurement for older adults, called “Thai Test of Functional Health Literacy in Dentistry for Older Adults (Thai OA-TOFHLiD)”.

Methods

Overview of the study

This study involved 2 stages; the further development of the OA-TOFHLiD and testing with the population.

Instrument development

Since the content of the original TOFHLiD are very specific to children’s oral health and the US health system (Gong et al., 2007), it was decided to change all content, but still use the template to develop the new test. Researchers initially reviewed existing oral health related media, for example, posters, leaflets, information sheets, labels of oral health products, and commonly used text in the dental health services. The OA-TOFHLiD was developed from selected pieces of reviewed information. The new OHL tool consists of 2 parts, the Reading Comprehension and Understanding Directions.

From the pilot study (described in Chapter 3), the reading comprehension section of previous version of OA-TOFHLiD was developed in relation to 3 topics
regarding tooth decay, gum disease and oral health prevention. In this study, the total score was increased by adding one more passage adapted from a consent form for tooth extraction (figure 4.1) to improve the predictive validity of the test. Therefore, the Reading Comprehension section includes 4 subtopics in the final version. In this part, several words in the passages were deleted, every 5-10 words. Respondents who complete the test need to choose a word that would fit into the sentence from 4 alternatives provided, one of which is a correct answer. There are 39 items in this part. The Understanding Directions section is comprised of 2 prompts: A Toothpaste label and Chlorhexidine Mouthwash label. In each prompt, respondents are required to read the label provided, and then answer questions regarding the information on that label. The maximum score for the comprehension section is 39 and for the direction section is 9, which brings a total score 48. Finally, the socio-demographic questionnaire was added into the OA-TOFHLiD in order to use this data for validity analyses.

Figure 4.1: Example of an additional reading comprehension section in the OA-TOFHLiD
Convergent validity of the new OA-TOFHLiD was tested using the ‘Short Test of Functional Health Literacy in Adults’ (S-TOFHLA). S-TOFHLA is a validated health literacy measurement tool, reduced from the Test of Functional Health Literacy in Adults (TOFHLA) (Baker, Williams, Parker, Gazmararian, & Nurss, 1999). It is composed of 2 reading comprehension passages related to health care settings. The total score of S-TOFHLA is 36 and the maximum time for completing it is approximately 12 minutes. S-TOFHLA provides the cut off points of health literacy levels; 0-16 as ‘Inadequate’, 17-22 as ‘Marginal’ and ‘23-36’ as ‘Adequate’ functional health literacy. It has been found that S-TOFHLA has acceptable psychometric properties to test the health literacy of people in various age groups and requires less time to complete the test compared to the original TOFHLA (Parker et al., 1995). This instrument was translated into Thai by the bi-literate (Thai/English) researcher, and double-checked by 2 bi-literate (Thai/English) professors in Dental Public Health before it was used in this study.

**Study design and settings**

This study was a cross-sectional survey conducted in January to February 2017, in Chiang Mai, which is the second largest city in Thailand. We selected 2 settings based on urban and rural area criteria; the rural area was the Chor-Lae sub-district senior club, the urban area was the Comprehensive Clinic, Faculty of Dentistry, Chiang Mai University. There were two ethical approvals obtained, one from a local study setting, the ethical committee of Faculty of Dentistry, Chiang Mai University, Thailand (Reference number 19/2016), and another one from a sponsor, the University of Manchester Research Ethic Committee 1 (Reference number 2017-0106-2408).

**Sample Selection**

The sample size was based on a previous validation study of TOFHLiD (Gong et al., 2007), which was approximately 100 participants. In this study, the total number of participants is 103. Convenience sampling was used to include participants aged over 60 years, who attended the settings on the data collection days. Poster advertisements of the study were posted at the setting one month before the data collection period. A patient information sheet was given to each participant and also explained by the research assistant. If they were able to participate in the study, participants gave written informed consent. The exclusion...
criteria included those who could not read or write in the Thai language, or who had a serious medical condition that affected their ability to complete the test by themselves (e.g. vision problems, or cognitive impairment).

**Questionnaires administration and oral examination**

On the data collection day, two self-administered questionnaires (Thai OA-TOFHLiD with demographic questionnaire, and S-TOFHLA,) were given to the participant. After completing all the questions, the participant was examined by a dental professional. The examination was undertaken in a dental unit in the clinic, and in a mobile dental unit in the community settings. Only a mouth mirror was used in the oral examination. The diagnostic criteria were adapted from those used in the 6th Thai Oral Health Survey (Dental Health Division, 2008). Dental caries was scored using the WHO criteria (World Health Organization, 2013). Therefore, an oral examination of each participant was undertaken to obtain caries status and treatment needs, the DMFT index (the total number of teeth that are Decayed [only carious cavities were considered], Missing [reasons from caries] or Filled [reasons from caries]), prostheses status and prosthesis needs, and number of functional natural teeth.

**Statistical Analysis**

Descriptive statistics were performed to present characteristics of the respondents in this study, oral health status (e.g. number of decayed teeth, missing teeth, filled teeth, number of present teeth), treatment needs and also the test scores obtained from Thai OA-TOFHLiD and S-TOFHLA.

For the concurrent validity, it was hypothesized that oral health literacy is correlated with age, educational level, income, frequency of utilisation of dental services in the past year and self-rated ability to read and write. This was tested using Spearman’s rank correlation. Spearman’s rank correlation and linear regression analysis were used to determine if a correlation existed between the Thai OA-TOFHLiD score and validated S-TOFHLA score (convergent validity). Predictive validity was considered by exploring the ability of Thai OA-TOFHLiD score to predict oral health status, examined by using Spearman’s rank correlation and binary logistic regression. The internal consistency reliability of the questionnaire was assessed by Kuder-Richardson-20 (KR-20). The Receiver
Operating Characteristic (ROC) curve and Area Under the Curve (AUC) were used to determine the cut off score of OA-TOFHLiD.

SPSS software for Mac version 23 (IBM Corp, 2015) was used for data analysis. For multivariate analysis, the participants were divided into several categories based on age, gender, level of education, residential area, income, use of dental services in the past year, number of caries/filling/missing teeth. All statistical analyses were performed two-tailed, and determined at 0.05 alpha level.

Results

Descriptive results

The demographic characteristics of the participants in this study are displayed in Table 4.1. A total of 103 participants took part, 62% were female. The mean age of participants was 67.95 (Standard deviation (SD) 6.52) years. Almost half of the respondents had middle school education or lower and lived in the urban area, and had a monthly income below the Thai poverty line. Regarding dental service utilisation, 54.4% of the participants had used dental services in the previous year (Table 4.1). The majority of participants (50.5%) used dental services on a symptomatic basis rather than regular check-ups (27.6). Community hospitals (37.1%) and dental schools (26.7%) were the two most common settings where participants accessed dental services.

According to self-rated ability to read and write (general literacy), most of the participants rated they had good to excellent level of literacy. Half of the participants perceived that they had fair to poor oral health (Table 3.1). In addition, 71.8% of the respondents perceived that they currently have dental problems, however, only 46.6% thought their dental problems need to be treated urgently.
For the test scores, the mean scores of Thai OA-TOFHLiD and S-TOFHLA are presented in Table 4.2. The mean scores obtained from Thai OA-TOFHLiD and S-TOFHLA were 34.84 (SD 10.50) and 26.50 (SD 8.68) respectively. Psychometric properties of Thai OA-TOFHLiD were assessed based on the test scores (Table 3.2).

![Table 4.1: Demographic characteristics of the participants in the study](image)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>39</td>
<td>37.9</td>
</tr>
<tr>
<td>Female</td>
<td>64</td>
<td>62.1</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>66</td>
<td>64.1</td>
</tr>
<tr>
<td>70-79</td>
<td>31</td>
<td>30.1</td>
</tr>
<tr>
<td>80 or higher</td>
<td>6</td>
<td>5.8</td>
</tr>
<tr>
<td>Educational Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school or Lower</td>
<td>47</td>
<td>45.6</td>
</tr>
<tr>
<td>High school</td>
<td>14</td>
<td>13.6</td>
</tr>
<tr>
<td>College</td>
<td>4</td>
<td>3.9</td>
</tr>
<tr>
<td>University or Higher</td>
<td>34</td>
<td>33.0</td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>54</td>
<td>52.4</td>
</tr>
<tr>
<td>Rural</td>
<td>49</td>
<td>47.6</td>
</tr>
<tr>
<td>Monthly Income (poverty line = 50.82 USD/month)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower than poverty line</td>
<td>54</td>
<td>52.4</td>
</tr>
<tr>
<td>Higher than poverty line</td>
<td>49</td>
<td>47.6</td>
</tr>
<tr>
<td>Use of Dental services in past 1 year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>56</td>
<td>54.4</td>
</tr>
<tr>
<td>Not Use</td>
<td>35</td>
<td>34.0</td>
</tr>
<tr>
<td>Not sure, cannot remember</td>
<td>12</td>
<td>11.7</td>
</tr>
<tr>
<td>Self-rated Literacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent to Good</td>
<td>59</td>
<td>57.3</td>
</tr>
<tr>
<td>Fair to Poor</td>
<td>40</td>
<td>38.8</td>
</tr>
<tr>
<td>Self-rated oral health status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent to good</td>
<td>40</td>
<td>38.9</td>
</tr>
<tr>
<td>Fair to poor</td>
<td>61</td>
<td>59.3</td>
</tr>
<tr>
<td>Perceived urgent dental treatment need</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>48</td>
<td>46.6</td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>48.5</td>
</tr>
</tbody>
</table>
Table 4.2: Descriptive statistics for all measurements

<table>
<thead>
<tr>
<th>Type</th>
<th>Measures</th>
<th>Scores (n= 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Dental</td>
<td>OA-TOFHLiD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (48)</td>
<td>34.84</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension (39)</td>
<td>28.92</td>
</tr>
<tr>
<td></td>
<td>Understanding numeracy and text (9)</td>
<td>5.91</td>
</tr>
<tr>
<td>Medical</td>
<td>S-TOFHLA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (36)</td>
<td>26.50</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 1 (16)</td>
<td>11.71</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 2 (20)</td>
<td>14.78</td>
</tr>
</tbody>
</table>

Validity and Reliability

Face validity

The Thai OA-TOFHLiD had been peer-reviewed twice (trial version and finalised version). Two experts in the field of health communication and dental public health had examined the tool for face validity, which was judged by its satisfactory translation, correct words used and the construct of the texts. The pilot of the instrument was conducted with 105 older adults in the previous study (See Chapter 3). Modifications were made to the test prior to utilisation in the study.

Concurrent validity

There was a significant correlation between Thai OA-TOFHLiD and age, education level, income, frequency of dental service utilisation in the previous year, self-rated ability to read and write. Table 4.3 shows that years of education presented the strongest positive correlation (r= 0.633, p<0.001) with Thai OA-TOFHLiD score, and self-reported general literacy and monthly income both showed moderate positive correlation (r= 0.458 and 0.497, p < 0.001 respectively) (Table 4.3).
Table 4.3: Spearman correlation coefficients of the OA-TOFHLiD, with related measurements (concurrent, convergent, and predictive validity)

<table>
<thead>
<tr>
<th>Related measurement</th>
<th>Correlation with OA-TOFHLiD</th>
<th>r</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>-0.357</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Years of formal education</td>
<td></td>
<td>0.633</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td>0.458</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Frequency of dental service utilisation (last year)</td>
<td></td>
<td>0.266</td>
<td>0.010*</td>
</tr>
<tr>
<td>Self-rated ability to read and write (general literacy)</td>
<td></td>
<td>0.497</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td>0.833</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Oral health Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMFT</td>
<td></td>
<td>-0.198</td>
<td>0.045*</td>
</tr>
<tr>
<td>- Number of Decay</td>
<td></td>
<td>-0.428</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>- Number of Missing</td>
<td></td>
<td>-0.318</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>- Number of Filled</td>
<td></td>
<td>0.554</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Number of present functional teeth</td>
<td></td>
<td>0.466</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

* P < 0.05
**P < 0.001

Convergent validity

To test whether this newly developed tool had convergent validity, it needed to achieve correlation with the standard validated tool, S-TOFHLA. After Spearman Correlation analysis, it was found the Thai OA-TOFHLiD score was highly correlated with S-TOFHLA score (r = 0.833, p < 0.001) (Table 4.3).

Univariate and multivariate regression analysis were also performed to demonstrate the relationship between Thai OA-TOFHLiD and the validated health literacy tests (Table 4.4). In univariate analysis, it was found that Thai OA-TOFHLiD score was positively associated with S-TOFHLA score (B = 0.65, p < 0.001). When controlled for age, education, residential area, and utilisation of dental services in the multivariate analysis, the association was still significant (B = 0.54, p < 0.001).
Table 4.4: Univariate and multivariate linear regression of the OA-TOFHLiD to predict the S-TOFHLA (convergent validity)

<table>
<thead>
<tr>
<th></th>
<th>S-TOFHLA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Univariate</td>
</tr>
<tr>
<td></td>
<td>B (CI)</td>
</tr>
<tr>
<td>OA-TOFHLiD</td>
<td>0.65** (0.55, 0.74)</td>
</tr>
<tr>
<td>Age (&lt;70)</td>
<td>-</td>
</tr>
<tr>
<td>Education (&gt; high school)</td>
<td>-</td>
</tr>
<tr>
<td>Utilisation of Dental services in last year (Use at least once)</td>
<td>-</td>
</tr>
<tr>
<td>Number of Natural Functional teeth (Have teeth higher than mean)</td>
<td>-</td>
</tr>
<tr>
<td>R²</td>
<td>64.9%</td>
</tr>
</tbody>
</table>

* P < 0.05
**P < 0.001

Predictive validity

Predictive validity was based on the ability of oral health literacy scores to predict oral health status. Initially, it was found that DMFT was significantly related with Thai OA-TOFHLiD, but showed a very weak relationship (r = -0.198*, p < 0.05). However, when each component of DMFT was separately analysed, it was found the total number of decayed (D) and missing teeth (M) were negatively correlated with oral health literacy score (r = -0.428 and r = -0.318, p < 0.001 respectively), but the total number of filled teeth (F) was positively correlated (r = 0.554, p < 0.001); see Table 3.3.

For further investigation, binary logistic regression was used to determine the predictive validity of Thai OA-TOFHLiD on oral health status. In order to perform binary logistic regression, the participants were categorised into 2 groups regarding their oral health status obtained from the oral examination as the dependent variable. Three poor oral health conditions were used to consider oral health status 1.) Having active caries (new cavities or untreated caries), 2.) Having total natural functional teeth less than 20, 3.) Having posterior occlusal pairs less than 5 pairs (included pairs from prosthesis teeth, but excluded complete dentures). In the good oral health group, the participant must have
none of these conditions. All other participants who met one or more the above criteria were categorized into the poor oral health group. From the univariate analysis, Thai OA-TOFHLiD score was a significant predictor for oral health status ($p < 0.001$). When controlled for by age, gender, education, and dental service utilisation in model II, Thai OA-TOFHLiD scores demonstrated significant ability to predict oral health status ($p < 0.05$) (Table 4.5).

Table 4.5: Univariate and multivariate logistic regression of the OA-TOFHLiD to predict oral health status

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Good Oral Health Status</th>
<th>Univariate analysis (Model I)</th>
<th>Multivariate analysis (Model II)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>P-value</td>
</tr>
<tr>
<td>OA-TOFHLiD</td>
<td>0.12</td>
<td>0.03</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Controlled variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (&lt; 70 years old)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Education (≤ High school)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Use of Dental service (Use)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% of Model correction</td>
<td>69.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P <0.05, ** P < 0.01

Reliability

It was found that KR-20 of Thai OA-TOFHLiD was 0.884. Therefore, It can be interpreted that this tool has good internal consistency or internal reliability.
Determining cut-off score for OA-TOFHLiD

From Figure 4.2, the Receiving Operating Characteristics curve (ROC) with Area Under the Curve (AUC) was used to categorise participants into different levels of oral health literacy by Thai OA-TOFHLiD scores. The testing variable is the Thai OA-TOFHLiD raw scores (0-48) and the state variable is Negative Oral Health Status. The Negative Oral health Status is an inversely coded ‘Oral Health Status’ (1 equals poor oral health and 0 equals good oral health) as the study aimed to determine the sensitivity of the tool as correctly identifying individuals with poor oral health and the specificity as its ability to identify those with good oral health.

Figure 4.2: ROC Curve of using the OA-TOFHLiD scores to predict Negative Oral Health Status in older adults

After performing the ROC curve, it was found the AUC is 0.753 (P < 0.001, CI 0.654-0.852). This AUC showed the probability of the Thai OA-TOFHLiD to differentiate people between good and poor oral health was fair (range between 0.70-0.80). The ROC curve analysis also provided the sensitivity and specificity at each cut-off score, displayed in Table 4.6. We proposed that 40.5 would be appropriate cut-off scores of Thai OA-TOFHLiD because it provides optimal balance between good sensitivity (73.1%) to detect poor oral health status, and acceptable specificity (61%) to distinguish people without disease. Therefore, the
cut off score of OA-TOFHLiD will be 0-40 *Inadequate OHL*, and 41-48 *Adequate OHL*.

Table 4.6: Performance of the OA-TOFHLiD scores to predict Oral Health Status at various cut-off points of OHL scores (n=103)

<table>
<thead>
<tr>
<th>Cut-off scores</th>
<th>Poor Oral Health Status</th>
<th>Good Oral Health Status</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True Positive (TP)</td>
<td>False Negative (FN)</td>
<td>False Positive (FP)</td>
<td>True Negative (TN)</td>
</tr>
<tr>
<td>≥ 35</td>
<td>38</td>
<td>29</td>
<td>7</td>
<td>29</td>
</tr>
<tr>
<td>≥ 36</td>
<td>43</td>
<td>24</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>≥ 37</td>
<td>43</td>
<td>24</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>≥ 38</td>
<td>45</td>
<td>22</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>≥ 39</td>
<td>46</td>
<td>21</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>≥ 40</td>
<td>46</td>
<td>21</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>≥ 41</td>
<td>49</td>
<td>18</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>≥ 42</td>
<td>50</td>
<td>17</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>≥ 43</td>
<td>51</td>
<td>16</td>
<td>15</td>
<td>21</td>
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<td>≥ 44</td>
<td>56</td>
<td>11</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>≥ 45</td>
<td>61</td>
<td>6</td>
<td>22</td>
<td>14</td>
</tr>
</tbody>
</table>

*The yellow highlight shows proposed cut-off scores*

Discussion

Research activity regarding oral health literacy in older adults is scarce. There is no tool available for assessing the oral health literacy of Thai older adults. The purpose of this study was to develop an older adult oral health literacy assessment and assess its utility in a pilot study.

Thai OA-TOFHLiD was designed to measure comprehensive oral health literacy; the ability of older adults to read passages and choose alternative words (which could have almost similar pronunciation e.g. fluoride and fluorescent) correctly. Furthermore, questions in the reading comprehension passages required basic oral health knowledge, for example, the participant was asked how many times per day they need to brush their teeth. In the prompts, the ability to read the label and understanding numbers were examined.

The overall performance of Thai OA-TOFHLiD suggested good validity and good reliability. For concurrent validity, this test demonstrated the significant correlation between OHL scores and years of education, self-rated literacy level which are validated measures from previous studies (Furuya, Kondo, Yamagata, &
Hashimoto, 2015; van der Heide et al., 2013). Results of convergent validity indicated that Thai OA-TOFHLiD displayed high correlation with S-TOFHLA. Even though S-TOFHLA does not measure OHL directly, medical health literacy and oral health literacy are based on similar theoretical backgrounds and concepts. Therefore, this result suggests that Thai OA-TOFHLiD has the ability to measure OHL.

Predictive validity for Thai OA-TOFHLiD was partially established in our study. DMFT was significantly negatively correlated with Thai OA-TOFHLiD, which could imply the higher oral health literacy score, the lower number of DMFT, however, the correlation coefficient was not high. Interestingly, the number of filled teeth was found to have the strongest correlation with Thai OA-TOFHLiD among the three DMFT measurements. It was inferred that people who had their teeth filled were more likely to know about dental caries and treatment and they might access more oral health information from the dental professionals or services when they received the care. Having more natural functional teeth was also correlated with oral health literacy score assessed by Thai OA-TOFHLiD. This finding was also found in a previous study using a validated oral health literacy tool (Holtzman, Atchison, Macek, & Markovic, 2017). This could be as people with higher oral health literacy have a better understanding of oral health self-care which impacts on maintaining their natural teeth. Previous validation of oral health literacy tools suggested using Poisson regression for predicting DMFT (Junkes et al., 2015), however, the sample size in this study did not give sufficient power to run this type of analysis. Therefore, the binary logistic regression was used to predict the compound variable (oral health status) instead. The results indicated the Thai OA-TOFHLiD has an ability to predict the oral health status in univariate, and also the multivariate analyses controlled by those affected factors.

One of the limitations found in this study is that we could not prove the proposed cut-off scores we obtained from the ROC curve and AUC is accurate in the population. There is a need to confirm the sensitivity and the specificity of Thai OA-TOFHLiD to distinguish good or poor oral health in a future study in order to be able to use it as the pre-screening tool by non-professionals in community settings. Another limitation was the time spent completing the Thai OA-TOFHLiD, participants spent approximately 20 minutes completing the test, moreover, some respondents, especially those from the rural area and with lower education, spent more time to complete the test (up to 1 hour). In comparison, the word recognition
test (REALD) did not take more than 5 minutes which may be more convenient to use in a clinical or hospital setting in this population (Lee et al., 2007). Therefore, there might be a need to revise or shorten the OA-TOFHLiD in future studies.

**Conclusion**

This study describes the further development of an oral health literacy instrument not only for older adults but also in a Thai population. OA-TOFHLiD was found to be an acceptable way of measuring psychometric properties for evaluating OHL in older adults. The test appears to support the further development of OHL tools in older adult populations. However, future studies will need to address the convergent validity and predictive validity of such tools. Moreover, the English version of OA-TOFHLiD requires validation in order to expand the applicability of the work internationally.
References


Thomson, W. M. (2004). Dental caries experience in older people over time: what can the large cohort studies tell us? *Br Dent J, 196*(2), 89-92; discussion 87. doi:10.1038/sj.bdj.4810900


5. Chapter 5

Oral Health Status of Thai Community-living Older Adults With Different Oral Health Literacy Levels
Foundation of Chapter 5

The OA-TOFHLiD had been developed and validated in the previous chapters (Chapter 3 and 4). The tool presented good validities and reliability, and established cut-off scores to identify people with Inadequate and Adequate oral health literacy (OHL), which was ready-to-use as an assessment of OHL in older adults. Therefore, this chapter explains how the OA-TOFHLiD was used in the study to assess OHL in Thai older adults. In addition, the researcher aimed to explore associations between OHL and varying backgrounds and oral health statuses. Finally, this study aimed to confirm the ability of the established cut-off scores of the OA-TOFHLiD presented in Chapter 3 in distinguishing people with good or poor oral health status in an entirely new population.

The author plans to submit this chapter to Journal of Dental Public Health after Chapter 4 is accepted (to be used as a reference).

Authors Contribution
This section was written by PW and was reviewed with contributions by IAP and MG.
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review</td>
<td>No tool for older adults</td>
<td>Identify research gaps questions and set the objectives</td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs</td>
<td>Poor oral health status, low dental service utilisation</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLID</td>
<td>The pilot OA-TOFHLID total score = 35</td>
<td>Poor predictive validity (\Rightarrow) test needed to be improved</td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLID</td>
<td>The optimised OA-TOFHLID total score = 48</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLID in clinical setting</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLID was too long for some to complete.</td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLID [Subgroup of Chapter 5]</td>
<td>Those with adequate OHL presents better oral health status</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLID in the US population</td>
<td>The Short OA-TOFHLID total scores =39</td>
<td>The test presents acceptable validity (\Rightarrow) Need to confirm with different population</td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLID in the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data.</td>
<td>The performance of the shortened version was confirm.</td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLID in community</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstract

**Background:** While oral health literacy (OHL) has been associated with oral health diseases and oral hygiene behaviours, these associations are still unclear in older adult populations. This study assessed oral health status in older adults and its links to their OHL scores. Secondarily, the study aimed to evaluate the accuracy of OHL scores in predicting oral health status in older adults.

**Methods:** A single visit cross-sectional study was conducted in January to February 2018 using 115 Thai older adults aged 60 or more who lived in Chiang Mai. Participants were asked to complete the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) along with demographic details, after which an oral health screening was undertaken.

**Results:** Older adults with no active caries, at least one filled tooth, at least 20 natural functional teeth, and overall good oral health had significantly higher OHL scores (p<0.05), compared to those with poorer oral health status. When participants were dichotomised according to their OHL level (adequate or inadequate OHL) for age, years of education, monthly income, number of decayed teeth, number of filled teeth, number of teeth, and number of posterior occlusal pairs, there was a significant difference between the two groups (p<0.05). Multivariate logistic regression analysis showed that adequate OHL (when controlled by age, gender, level of education, and utilisation of dental services in the last year) was a predictor of having good oral health in older adults (p=0.001). Receiving Operating Characteristic (ROC) curve analysis demonstrated a sensitivity (64.5%) and specificity (77.4%) in detecting oral health status.

**Conclusion:** In community-dwelling older adults, oral health status varied between people with adequate and inadequate oral health literacy; older adults with adequate oral health literacy had less oral disease, less treatment need, and better oral health. Our research also showed acceptable sensitivity and specificity in predicting oral health status of older adults. Future studies are needed to identify causal connections between oral health literacy and these variables. In addition, the possible use of oral health literacy as a screening test at the community level needs further investigation.
Introduction

The population of older adults has increased around the world while the fertility rate has decreased (He, Goodkind, & Kowal, 2016). Many countries are becoming aged societies, with the proportion of older adults (age 65 or more) higher than 20% of the total population (He et al., 2016). In Thailand, the number of adults aged 60 or higher has been increasing rapidly; in 2016 15.07% (9.93 million people) were aged over 65 and by 2020 this will have risen to 19.12% (12.62 million people) (National Statistical Office of Thailand, 2014; United Nations. Department of Economic and Social Affairs. Population Division, 2017). An ageing population presents challenges in providing sufficient health care and supportive health services against reduced taxation income. Older adults have an increased risk of health problems, especially older adults with multimorbidity (an individual who has two or more chronic conditions) (van den Akker, Buntinx, & Knottnerus, 1996). Older adults spend more time than other age-group populations in a health setting, and require a large health workforce, consuming extensive resources (Rowe, Fulmer, & Fried, 2016). It is necessary for immediate public health attention in the forms of disease prevention and enhanced health promotion to be given to this group in order to reduce unnecessary health care utilisation and increase their quality of life (National Academic Press (US), 1988).

Since 2000, health literacy (HL) has attracted increased research attention as services seek to further categorise and stratify patient populations, as well as seeking to understand differing outcomes of therapies in the highly heterogeneous older population (Nutbeam, 2000). The definition of HL is “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (U.S. Department of Health and Human Services, 2000). Patient’s adequate HL are more able to understand preventive messages and enact these compared to those with lower HL (Petersen & Kwan, 2010). However, many older adults were found to have below basic HL in previous international studies (Cutilli & Bennett, 2009; Kutner, Greenberg, Jin, & Paulsen, 2006; Sorensen et al., 2015). In addition, limited HL was related to various health conditions, poor health behaviour, and poor medication adherence (Chesser, Keene Woods, Smothers, & Rogers, 2016). Older adults with marginal or inadequate HL had higher mortality
rates compared to elderly people with adequate HL (Baker, Wolf, Feinglass, & Thompson, 2008).

Oral health literacy (OHL) was first described in 2004, derived from the concept of HL, and has been defined as an ability to obtain, understand, and process oral health information (National Institute of Dental and Craniofacial Research, 2005). Many studies have shown an association between OHL and oral health status and behaviours. A study of Japanese adults found that people with higher OHL had a higher number of remaining teeth, lower scores in the community periodontal index (CPI) and had fewer numbers of decayed teeth (Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013). In Brazilian adults, low OHL was associated with dental caries, and inappropriate oral hygiene behaviours such as irregular tooth brushing and dental flossing (Batista, Lawrence, & Sousa, 2017). Patients with higher OHL were less likely to have severe periodontal disease, compared to those with lower OHL (Wehmeyer, Corwin, Guthmiller, & Lee, 2014). People with lower OHL did not have dentists as their primary source of information and did not participate in decision-making about their oral health treatment (Calvasina, Lawrence, Hoffman-Goetz, & Norman, 2016). Oral health of caregivers has also been shown to have an impact on children’s behaviour and oral health status. In a previous study, caregivers with inadequate oral health literacy were associated with risky oral health behaviours such as night-time bottle feeding and no daily brushing (Vann, Lee, Baker, & Divaris, 2010).

A systematic review has reported associations between low OHL and dental caries, however, those associations were found mostly in primary teeth of children whose parents’ OHL had been screened (Firmino et al., 2017). Another systematic review and meta-analysis suggested there was no confirmed association between OHL and oral health behaviours, perception, knowledge, and treatment outcomes (Firmino, Martins, et al., 2018). However, most of the studies included in these systematic reviews and meta-analyses were conducted in young adults or parents taking care of children. None of the studies observed or assessed the older adult population, which may have a variety of complex factors. Most of the studies utilised word recognition OHL tools, the most frequent being used were Rapid Estimate of Adult Literacy in dentistry (REALD-30 and 99) (Firmino, Ferreira, et al., 2018; Firmino et al., 2017; Firmino, Martins, et al., 2018).
The author’s previous study validated a new OHL tool for older adults, the ‘Test of Functional Health Literacy in Dentistry for Older Adults: OA-TOFHLiD’. It was found the OA-TOFHLiD had good validity and reliability (Chapter 4). This study investigates the ability of the tool to predict essential oral health status by observing sensitivity and specificity. We hypothesised that older adults with higher oral health literacy would have better oral health status. This study, therefore, aimed to 1.) Explore oral health status and assess OHL of older adults living in a community in Chiang Mai, Thailand; 2.) Compare oral health status among older adults with different oral health literacy levels; 3.) Confirm the ability of the Thai OA-TOFHLiD to predict oral health by testing sensitivity and specificity of OA-TOFHLiD scores at the proposed cut-off score.

Methods

Study participants and ethical approvals

This research study had been reviewed and approved by two institutes. The setting approval was obtained from the Human Experimentation Committee, Faculty of Dentistry, Chiang Mai University (NO. 44/2017). The sponsor of the researcher approval was obtained from the University of Manchester Research Ethic Committee 2 (Ref: 2018-2822-4728).

The target population were older adults aged 60 or more, living in Chiang Mai province and the surrounding area. The population in Chiang Mai of adults aged 60 or older in 2018 was approximately 300,000. The sample size calculation was based on the prevalence of dental caries in Thai older adults obtained from the 7th National Oral Health Survey by the Bureau of Dental Health in 2012, which was 96.4%, and assumed the precision to be 5%. The result from the sample size calculation was that 59 participants were needed based on the prevalence of active dental caries in this population. However, double the numbers of participants were added to mitigate any dropout during the questionnaire and oral examination, and to make sure that we would include enough participants with adequate and inadequate OHL given the prevalence of older adults with inadequate OHL was approximately 50% (Chapter 4). Therefore, the total number of participants in the study was 115.
Study design and setting

This cross-sectional study was conducted at a single visit at the Oral Health Prevention and Promotion Clinic in the Faculty of Dentistry at Chiang Mai University. The data collection period was from January to February 2018. Poster advertisements were posted at the site to invite participants one month before the study started. Inclusion criteria were those aged 60 years old or older at the date of attending the study and had to be able to understand, read and write in Thai language without any assistance.

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 who consented needed to complete the questionnaire, which was composed of two parts: background information, and the test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD). After completing the questionnaire and OHL test, the participants underwent an oral examination, which was performed by a qualified Thai dentist. The oral health status metrics were composed of dental caries status by Decay-Missing-Filled Teeth Index (DMFT, WHO), treatment needs, prosthesis status, prosthesis needs, number of natural functional teeth and number of posterior occlusal pairs.

Study variables and statistical analysis

Independent and covariate variables

OHL was assessed by the Thai Test of Functional Health Literacy in Dentistry for Older Adults (Thai OA-TOFHLiD). The Thai OA-TOFHLiD is a validated OHL assessment tool for measuring OHL in Thai older adults. It is comprised of a reading comprehension section and a prompt section. In the reading comprehension section, there are four topics: 1.) Tooth decay 2.) Gum disease 3.) Oral Hygiene Care 4.) Consent form for a tooth extraction. The questions in this section were ‘fill-in-blanks’ with four alternatives, the total score was 39. In the prompt section, one picture of a fluoride toothpaste label and one chlorhexidine mouthwash label were provided. Participants needed to read the labels and answer 9 questions at the end of the section. The total score of the two sections was 48. The cut-off score for the OA-TOFHLiD was 41 determined from a previous validation study (Chapter 4); therefore, participants who scored 0-40
were classified as ‘Inadequate OHL’, and scores 41-48 were classified as ‘Adequate OHL’. The time to administer the questionnaire and undertake the oral health screening was approximately 15-20 minutes.

The background section of the questionnaire collected socio-demographics details including gender, age (dichotomised into ‘young old 60-69’ and 70 years old or more), education attainment (dichotomised into high school or lower and college or higher), and monthly income (dichotomised into equal to or lower than the Thai poverty line ($83.5/month) and higher than poverty line). Moreover, utilisation of dental services in the previous year, type of dental insurance, type of dental services used, the place of health service utilisation, self-rated oral health status (0-poor to 5-excellent), self-reported oral health problems (0-no, 1-yes), and self-perceived treatment needs (0-no, 1-yes), were included in this section.

Outcome variables

In this study, several oral health statuses were observed using the following measurements:

- **Active dental caries (Dt)** - determined according to DMFT index by WHO criteria of dental caries. A tooth was counted as ‘Yes’ if it was an untreated decayed tooth (primary caries), or if it was a filled tooth presenting with recurrent caries (secondary caries).
- **Missing teeth (Mt)** - considered the total number of tooth loss in the mouth due to dental disease (extraction, surgical removal, or loss to periodontal disease).
- **Filled teeth (Ft)** - measured by counting the number of teeth with intra or extra coronal restorations
- **Treatment need for caries** - assessed by caries characteristics and severity. Classification of treatment needs was: none, one surface filling, two or more surface fillings, crown for any reason, endodontic treatment, and tooth extraction.
- **Numbers of natural functional teeth** - considered and counted only natural teeth that could function normally and excluded teeth with severe mobility or retained roots.
- **Numbers of posterior occlusal pairs** - counted by asking a participant to bite in centric occlusion and perform jaw movement to see the
number of functioning occlusal pairs (including pairs from natural teeth, fixed prosthesis, or removable prosthesis, but excluding pairs from complete dentures). The numbers of posterior occlusal pairs were between 0-8 pairs (from premolar to second molar, excluding third molar)

- **Denture status** – lower and upper arch were observed separately and categorised according to the type of prosthesis (bridge(s), partial denture(s), or full removable denture(s)).
- **Prosthetic need** – assessed lower and upper arches separately and classified them into several categories (no need, need one-unit, need multi-unit, need full prosthesis, need to repair old denture).

### Oral health status

In the descriptive analyses, several characteristics, oral health statuses, and treatment need variables were dichotomised in order to perform statistical analysis to gain clear comparisons between different characteristics.

In the multivariate logistic regression prediction model of oral health status by OHL scores, we combined three essential dichotomised outcomes derived from the previous oral health studies in older adults to get more comprehensive variables to determine the oral health status of older adults. The first one was “Having active dental caries (yes / no)”, the second was “Having more than four posterior occlusal pairs (yes / no)”, and the final was “Having 20 or more natural functional teeth (yes / no)”. These three binary variables were combined, then categorised dichotomously into ‘good’ and ‘poor’ oral health status.

*Good oral health status (Code 1)* meant a participant had no active caries, 5-8 posterior occlusal pairs, and had at least 20 natural functional teeth. If one failed to complete all three criteria, they were classified as *Poor oral health status (Code 0)*.
Statistical analysis

SPSS version 23 for Mac (IBM Corp, 2015) was used to analyse the data. Descriptive statistics namely mean and SD, median and IQR, and percentage, were used to explain general characteristics of the data. Since the characteristics of the OHL scores were not normally distributed, non-parametric statistical analyses (Mann-Whitney U test, Kruskal-Wallis K test) were performed to compare 1.) OHL scores between people with different characteristics and oral health statuses; 2.) Oral health status in different OHL levels (e.g. numbers of decayed, filled, missing teeth). Univariate and multivariate logistic regression analyses were used to determine an ability of OA-TOFHLiD scores to predict oral health status. Sensitivity and specificity of OA-TOFHLiD in detecting people with poor oral health were obtained by performing Receiving Operating Characteristic (ROC curve) and Area Under the Curve (AUC) analysis.

Results

General characteristics

Participant characteristics are presented in Table 5.1. The number of participants was 115. Most of the participants were female (89.6%). The participants’ age range was between 60-84. The mean age was 67.02 (S.D. 5.13). 41% of the participants had college or university qualification, however, 30.4% had only primary school qualifications or no formal education. Approximately one third of the participants had monthly incomes lower than the Thai poverty line. For previous or present occupation, one third of participants used to work as government officers, and the remainder were not working in paid employment (i.e. housework, caregiver in the family).

For dental service utilisation, only 28.7% of subjects used dental services in the previous year. The services they accessed were preventive care, emergency care, and curative care (46.4%, 23.2%, and 19.6% respectively). The places for dental service utilisation were mostly in dental schools and public hospitals. With regards to health insurance, the majority of the participants were covered by different health insurances. The largest number of participants (40.9%) was covered by government employee benefits (from having worked for the government, or having spouse or children worked for government), followed by
38.3% covered by universal coverage (basic health insurance for all Thai citizens), and 9.6% covered by social security health insurance (given to people who worked in private sectors).

From Table 5.1, when comparing Thai OA-TOFHLiD scores between the different demographics, there were significant differences in mean OHL scores between participants ages 60-69 and ages 70-82 (p=0.004), between those with ‘high school or lower education’ and ‘college or higher education’ (p<0.001), as well those with ‘monthly income or higher than poverty line (> 83.5 USD)’ and ‘equal to, or lower than poverty line (≤ 83.5 USD)’ (p<0.001). Participants with government employee insurance had the highest mean OHL scores (39.36, S.D. 10.73). In addition, a significant difference (p=0.026) was found between the three different insurance types.

Table 5.1: Descriptive characteristics of the participants, with comparisons of the OA-TOFHLiD scores between sub-groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>Percent</th>
<th>Median OA-TOFHLiD</th>
<th>IQR</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>10.4</td>
<td>42.50</td>
<td>6.75</td>
<td>0.132</td>
</tr>
<tr>
<td>Female</td>
<td>103</td>
<td>89.6</td>
<td>41.00</td>
<td>11.00</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>84</td>
<td>73.0</td>
<td>42.00</td>
<td>8.00</td>
<td>0.004*</td>
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<td>70-82</td>
<td>31</td>
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<tr>
<td>Education</td>
<td></td>
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<td></td>
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<td>High School or lower</td>
<td>61</td>
<td>53.0</td>
<td>37.00</td>
<td>13.00</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>College or higher</td>
<td>54</td>
<td>47.0</td>
<td>43.00</td>
<td>4.25</td>
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<tr>
<td>Monthly income</td>
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<tr>
<td>≤ poverty line ($83.5)</td>
<td>30</td>
<td>26.1</td>
<td>31.00</td>
<td>17.75</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>&gt; Poverty line ($83.5)</td>
<td>69</td>
<td>60.0</td>
<td>41.10</td>
<td>5.50</td>
<td></td>
</tr>
<tr>
<td>Not answer</td>
<td>16</td>
<td>13.9</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Dental service utilisation in last year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>76</td>
<td>66.1</td>
<td>42.00</td>
<td>9.67</td>
<td>0.576</td>
</tr>
<tr>
<td>Not use</td>
<td>33</td>
<td>28.7</td>
<td>40.00</td>
<td>7.54</td>
<td></td>
</tr>
<tr>
<td>Not answer</td>
<td>6</td>
<td>5.2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Type of health insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government health benefits</td>
<td>47</td>
<td>40.9</td>
<td>43.00</td>
<td>5.00</td>
<td>†0.026*</td>
</tr>
<tr>
<td>Social security and others scheme</td>
<td>24</td>
<td>20.8</td>
<td>40.00</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>Universal Coverage scheme</td>
<td>44</td>
<td>38.3</td>
<td>39.50</td>
<td>10.00</td>
<td></td>
</tr>
</tbody>
</table>

P-Value obtained from Mann-Whitney U Test, except † P-Value obtained from Kruskal-Wallis K Test
* Significant level at 0.05
** Significant value at 0.001
As can be seen in Table 5.2, the mean score of Thai OA-TOFHLiD in this study was 38.12 (S.D. 9.02). For the level of OHL, 63 participants (54.8%) got OA-TOFHLiD scores of 41 or more and were classified as “Adequate OHL”. 52 participants (45.2%) got scores of 40 or less and were classified as “Inadequate OHL”. The participants in the higher age group (70 or older) had lower OHL scores in all parts.

Table 5.2: Overall and comparing oral health statuses, determined by age group

<table>
<thead>
<tr>
<th></th>
<th>60-69 (N = 84)</th>
<th>70-82 (N = 31)</th>
<th>Overall (N =115)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Number of natural functional teeth</td>
<td>24.9</td>
<td>5.5</td>
<td>20.7</td>
</tr>
<tr>
<td>Number of posterior occluding pairs</td>
<td>5.7</td>
<td>2.2</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Caries experience</strong></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Active Decay</td>
<td>1.3</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Missing Teeth</td>
<td>6.6</td>
<td>5.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Filled Teeth</td>
<td>4.5</td>
<td>4.8</td>
<td>3.6</td>
</tr>
<tr>
<td>DMFT</td>
<td>12.4</td>
<td>6.4</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Treatment need for caries</strong></td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>Need filling (s)</td>
<td>45.2</td>
<td>32.1</td>
<td>35.7</td>
</tr>
<tr>
<td>Need crown (s)</td>
<td>0</td>
<td>3.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Need endodontic treatment (s)</td>
<td>9.5</td>
<td>6.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Need extraction (s)</td>
<td>20.2</td>
<td>35.4</td>
<td>24.3</td>
</tr>
<tr>
<td>Overall having treatment need for caries</td>
<td>41.7</td>
<td>58.1</td>
<td>46.1</td>
</tr>
<tr>
<td><strong>Prosthesis status</strong></td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>Having bridge (s)</td>
<td>4.8</td>
<td>9.7</td>
<td>6.1</td>
</tr>
<tr>
<td>Having partial denture (s)</td>
<td>19.1</td>
<td>38.8</td>
<td>24.3</td>
</tr>
<tr>
<td>Having both bridge (s) &amp; denture (s)</td>
<td>0</td>
<td>3.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Having full removable dentures</td>
<td>0</td>
<td>6.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Overall having prosthesis</td>
<td>27.4</td>
<td>58.1</td>
<td>35.7</td>
</tr>
<tr>
<td><strong>Prosthesis need</strong></td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>Need 1 unit of prosthesis</td>
<td>16.7</td>
<td>19.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Need 2 or more unit of prostheses</td>
<td>32.1</td>
<td>35.5</td>
<td>33.1</td>
</tr>
<tr>
<td>Need full prosthesis</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Need to repair denture (s)</td>
<td>7.2</td>
<td>12.9</td>
<td>8.7</td>
</tr>
<tr>
<td>Overall having prosthetic treatment need</td>
<td>52.4</td>
<td>61.3</td>
<td>54.8</td>
</tr>
<tr>
<td><strong>OA-TOFHLiD scores</strong></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Reading comprehension (39)</td>
<td>32.8</td>
<td>5.2</td>
<td>27.1</td>
</tr>
<tr>
<td>Understanding numeracy and text part (9)</td>
<td>7.1</td>
<td>1.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Total</td>
<td>40.0</td>
<td>6.6</td>
<td>33.1</td>
</tr>
</tbody>
</table>

Oral health status of Thai older adults

In Table 5.2 the participants are classified into two age groups (60-69 and 70 or older) to compare the difference in oral health between different aged older adults,
and to observe overall results. The overall mean number of natural functional teeth was 23.8 (S.D. 6.5). The mean numbers of posterior occluding pairs were 5.5 (S.D. 2.4). The overall prevalence of active dental caries was 46.1%. The mean numbers of active decayed teeth, missing, and filled teeth were 1.6 (S.D. 2.7), 7.7 (S.D. 6.3), and 4.2 (S.D. 4.7) respectively. The number of people who had at least one bridge in the mouth was 13 (11.30%). The number of people who had a complete denture was two (1.74%). The overall percentage of participants who had treatment needs for dental caries was 46.1%, and 54.8% for prosthetic needs.

Table 5.2 also shows a comparison between two different age groups of older adults. Participants aged 70 or older showed poorer oral health. They had more active decayed teeth, more missing teeth, more DMFT, less filled teeth, fewer natural functional teeth, and fewer posterior occlusal pairs. In addition, when exploring treatment needs between the two age groups, it was found that participants in the older age group were more likely to have higher treatment needs for caries (e.g. fillings, crowns) and higher prosthetic needs compared to the lower age group. Interestingly, with regards to the treatment needs for caries, younger participants had higher proportion of filling needs than the older ones (45.2% vs. 32.1%), but the older group had higher proportion of tooth extraction needs (35.4% vs. 20.2%).

Comparing oral health literacy score to oral health status

In Table 5.3, participants were classified dichotomously according to three main areas 1.) Perceived oral health and treatment needs; 2.) Oral health status obtained from an oral examination; and 3) Treatment needs. The results in this table were compared using median and interquartile rank and significant differences between groups were observed using the Mann-Whitney U test as OHL was not normally distributed. In the subgroups of the first topic, there were no significant differences between OA-TOFHLiD scores and different characteristics (perceived as having good vs. poor oral health, perceived as having oral health problems vs. no problems, and perceived treatment needs vs. no need).
### Table 5.3: Mann-Whitney U Test comparing OA-TOFHLiD scores in participants with different characteristics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Group</th>
<th>N</th>
<th>Median OA-TOFHLiD (0-48)</th>
<th>Interquartile range</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived oral health</strong></td>
<td>Having Good to excellent oral health</td>
<td>37</td>
<td>41.00</td>
<td>6.00</td>
<td>0.616</td>
</tr>
<tr>
<td></td>
<td>Having Intermediate to Poor oral health</td>
<td>78</td>
<td>41.00</td>
<td>11.50</td>
<td></td>
</tr>
<tr>
<td>Perceived Having oral health problem</td>
<td>84</td>
<td>41.50</td>
<td>8.75</td>
<td></td>
<td>0.515</td>
</tr>
<tr>
<td></td>
<td>Perceived No oral health Problem</td>
<td>31</td>
<td>40.00</td>
<td>14.00</td>
<td></td>
</tr>
<tr>
<td>Perceived Treatment needs</td>
<td>64</td>
<td>41.0</td>
<td>11.00</td>
<td>11.00</td>
<td>0.529</td>
</tr>
<tr>
<td></td>
<td>Perceived No treatment need</td>
<td>54</td>
<td>42.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Oral Health Status</strong></td>
<td>Having active tooth decay</td>
<td>53</td>
<td>37.00</td>
<td>15.00</td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>No active tooth decay</td>
<td>62</td>
<td>43.00</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>Having filled teeth</td>
<td>79</td>
<td>42.00</td>
<td>6.00</td>
<td>17.50</td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>No filled teeth</td>
<td>36</td>
<td>36.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having missing teeth (exclude wisdom teeth)</td>
<td>96</td>
<td>41.50</td>
<td>13.00</td>
<td></td>
<td>0.597</td>
</tr>
<tr>
<td></td>
<td>No missing teeth (exclude wisdom teeth)</td>
<td>19</td>
<td>41.00</td>
<td>10.75</td>
<td></td>
</tr>
<tr>
<td>Having teeth More than 20</td>
<td>96</td>
<td>42.00</td>
<td>8.00</td>
<td></td>
<td>0.003*</td>
</tr>
<tr>
<td></td>
<td>Having teeth less than 20</td>
<td>19</td>
<td>33.00</td>
<td>21.00</td>
<td></td>
</tr>
<tr>
<td>Having Prosthesis (es)</td>
<td>41</td>
<td>40.00</td>
<td>7.50</td>
<td>14.00</td>
<td>0.127</td>
</tr>
<tr>
<td></td>
<td>No prosthesis</td>
<td>74</td>
<td>41.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good oral health</td>
<td>53</td>
<td>43.00</td>
<td>5.00</td>
<td>14.25</td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>Poor oral health</td>
<td>62</td>
<td>37.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Treatment needs</strong></td>
<td>Having filling Needs</td>
<td>41</td>
<td>36.00</td>
<td>15.50</td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>No filling Needs</td>
<td>74</td>
<td>43.00</td>
<td>5.25</td>
<td></td>
</tr>
<tr>
<td>Having Severely decayed teeth that need to be extracted</td>
<td>28</td>
<td>34.50</td>
<td>19.75</td>
<td></td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>No severely decayed teeth</td>
<td>87</td>
<td>42.00</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>Having Prosthesis needs</td>
<td>63</td>
<td>39.00</td>
<td>13.00</td>
<td></td>
<td>0.012*</td>
</tr>
<tr>
<td></td>
<td>No prosthesis need</td>
<td>52</td>
<td>43.00</td>
<td>5.75</td>
<td></td>
</tr>
</tbody>
</table>

* P < 0.05, ** P < 0.001

From the oral examination, the median scores of OA-TOFHLiD showed a significant difference between people with active decayed teeth vs. no active decay (median OA-TOFHLiD 37.0 vs. 43.0 respectively, p<0.001), and people with filled teeth vs. no filled teeth (median OA-TOFHLiD 42.0 vs. 36.5 respectively, p<0.001). Participants who had more than 20 natural functional teeth had significantly higher median OA-TOFHLiD scores compared to those who had fewer than 20 natural functioning teeth (median OA-TOFHLiD 42 vs. 33 respectively, p=0.003). Participants classified as having good oral health had significantly higher median OA-TOFHLiD scores, compared to the ones classified as having poor oral health (median OA-TOFHLiD 43 vs. 37.5, p<0.001). There were also significant differences between median scores of participants who had treatment needs. Participants with filling needs, tooth extraction needs, and prosthesis needs had lower OHL scores than those without treatment needs (p < 0.001, <0.001, and 0.012 respectively).
Comparing oral health statuses in people with different oral health literacy

In Table 5.4, participants were categorised as having either ‘Inadequate oral health literacy level’ or ‘Adequate oral health literacy level’ by using the OA-TOFHLiD scores. The cut-off score of OA-TOFHLiD established from the previous validation study was 41, therefore, participants who had an OA-TOFHLiD score of 41 or more were classified into the ‘Adequate OHL’ group and the participants who had a OA-TOFHLiD score of 40 or lower were classified into the ‘Inadequate OHL’ group. The result presents that 45.21% of older adults in this study had inadequate OHL.

Three main metrics of 1.) Demographic variables (age, years of education attendance, and monthly income); 2.) Perceived oral health status; and 3.) Oral health status (number of decayed teeth, filled teeth, missing teeth, DMFT, number of natural functional teeth, and number of posterior occlusal pairs), were assessed between those with adequate and inadequate OHL using the Mann-Whitney U Test.

The results demonstrated that participants with adequate OHL and inadequate OHL were different in demographic characteristics. The median age of participants with adequate OHL was significantly lower than the inadequate OHL group (p=0.014). The adequate OHL group also had significantly higher median years of education and significantly higher median monthly income (p<0.001), compared to the inadequate OHL group.

Participants with adequate OHL had better oral health status than those with inadequate OHL. The median number of decayed teeth in the inadequate OHL group was significantly higher than the adequate OHL group (p<0.001). Additionally, the median number of filled teeth, numbers of natural functional teeth, and numbers of posterior occlusal pairs in the adequate OHL group were significantly higher than the inadequate OHL group (p= 0.001, 0.007, and 0.003 respectively). However, there were no significant differences in perceived oral health status, numbers of missing teeth, and overall DMFT between participants with adequate and inadequate OHL.
### Table 5.4: Spearman correlation coefficient of the OA-TOFHLiD scores with several variables, and comparing variables between adequate and inadequate oral health literacy

<table>
<thead>
<tr>
<th>Variables</th>
<th>Spearman Correlations with OA-TOFHLiD</th>
<th>Mann-Whitney U-test Comparing oral health statuses between different OHL levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P-value</td>
</tr>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.298</td>
<td>0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year of Education</td>
<td>0.552</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Income (USD)</td>
<td>0.553</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Oral health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated oral health status (0- poor to 5- excellent)</td>
<td>0.042</td>
<td>0.656</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Health Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decayed Teeth (DT)</td>
<td>-0.499</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing Teeth (FT)</td>
<td>-0.196</td>
<td>0.035*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filled Teeth (FT)</td>
<td>0.418</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMFT</td>
<td>-0.120</td>
<td>0.202</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Natural Functional teeth</td>
<td>0.272</td>
<td>0.003*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Posterior Occluding Pairs</td>
<td>0.304</td>
<td>0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P < 0.05
** P < 0.001

Predicting oral health statuses by oral health literacy

In Table 5.4, a Spearman correlation was used to describe the correlation between OHL scores and possibly related variables. The results found that years of education and monthly income were significantly correlated with OHL scores ($r=0.55, p< 0.001$). Age was also significantly negatively correlated with OHL scores; however, the correlation was weak ($r= -0.30, p= 0.001$). Oral health status also showed correlation with OHL scores. The number of filled teeth (FT), number of natural functional teeth, and number of posterior occlusal pairs presented positive significant correlation with OHL scores, while the number of decayed
teeth (Dt) and number of missing teeth demonstrated negative correlations with OHL scores (p < 0.05). However, when looking at the combined Decayed-Missing-Filled teeth (DMFT) index this was not significantly correlated with OHL scores.

Adequate OHL was significantly associated with good oral health status in both univariate and multivariate logistic regression analyses, presented in Table 5.5. From the univariate model (Model I), participants with adequate OHL had a higher probability of having good oral health (OR = 6.21, p <0.001). In addition, when adjusted by age, gender, level of education, and dental service utilisation in the last year, the significant association between adequate oral health literacy and good oral health status remained (OR = 4.85, p = 0.001), as presented in Model II (Table 5.5).

Table 5.5: Univariate and multivariate logistic regression analysis to predict oral health status by OA-TOFHLiD level

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Exp (B)</th>
<th>CI</th>
<th>P-Value</th>
<th>Exp (B)</th>
<th>CI</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OA-TOFHLiD (Adequate OHL)</td>
<td>6.21</td>
<td>2.72, 14.20</td>
<td>&lt;0.001**</td>
<td>4.85</td>
<td>1.96, 12.05</td>
<td>0.001*</td>
</tr>
<tr>
<td>Controlled variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (&gt;70 years old)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.51</td>
<td>0.57, 4.03</td>
<td>0.407</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.01</td>
<td>0.27, 3.77</td>
<td>0.991</td>
</tr>
<tr>
<td>Education (College or higher)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.56</td>
<td>0.62, 3.92</td>
<td>0.348</td>
</tr>
<tr>
<td>Utilisation of dental services in last year (Yes)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.98</td>
<td>0.40, 2.39</td>
<td>0.959</td>
</tr>
<tr>
<td>Overall% Model correction</td>
<td>70.4%</td>
<td></td>
<td></td>
<td>67.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P-value < 0.01
** P-value < 0.001

Figure 5.1 shows the Receiving Operating Characteristics (ROC) curve and Area Under the Curve (AUC) used to determine sensitivity and specificity of OA-TOFHLiD scores in classifying subjects with poor oral health status. The dependent outcome was ‘Poor oral health status’, which was a variable that was
inversely coded from ‘Good oral health status’. The results demonstrated an AUC of 0.769, which could be represented as a ‘Fair’ to ‘Good’ discriminating ability of OA-TOFHLiD scores in differentiating participants with good or poor oral health (95% confidence interval: 0.684-0.853, p<0.001).

Figure 5.1: ROC curve of the OA-TOFHLiD scores to detect poor oral health status

Table 5.6 presents the sensitivity and specificity of OA-TOFHLiD to predict oral health at each cut-off score. The cut-off score established from the previous validation study was 41 (Chapter 4). At this cut-off score, the sensitivity was 64.5%, which meant that an OA-TOFHLiD below 41 had a fair ability to identify participants with poor oral health. The specificity was 77.4%, which represents a good ability to distinguish people with good oral health if their OA-TOFHLiD is equal to 41 or above.
Table 5.6: Sensitivity and specificity of the OA-TOFHLiD scores to predict oral health status at various cut-off points

<table>
<thead>
<tr>
<th>Cut-off scores ≥</th>
<th>Poor Oral Health</th>
<th>Good Oral Health</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True Positive (TP)</td>
<td>False Negative (FN)</td>
<td>True Positive (FP)</td>
<td>False Negative (TN)</td>
</tr>
<tr>
<td>35</td>
<td>25</td>
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<td>5</td>
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<tr>
<td>45</td>
<td>54</td>
<td>8</td>
<td>34</td>
<td>19</td>
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</tbody>
</table>

The yellow highlight shows proposed cut-off scores

Discussions

In this study, our primary aim was to assess oral health literacy in older adults and compare it to their oral health status. Our secondary aim was to observe the ability of the instrument to predict oral health status of respondents. Our findings show the percentage of older adults with adequate OHL and inadequate OHL were similar (54.8% and 45.2% respectively). OHL scores were significantly different in people with different background characteristics. Participants in the younger-old age group (60-69 years old), with college or higher education, having monthly income higher than the poverty line, and with government insurance benefits had significantly higher OHL scores. The results from this study corresponded to the previous OHL studies in which people with lower age, higher educational level, and higher incomes had higher oral health literacy (Batista et al., 2017; Guo et al., 2014; Haridas et al., 2014). Participants who have government insurance are likely former government employees (pensioners) or have a government employee as a close family member and have higher educational levels and better health insurance than subjects with other types of insurance.

Dental service utilisation was not found to be a significant predictor of OHL, as with a previous study in American older adults (Burgette, Lee, Baker, & Vann, 2016). This could be due to the fact the Thai health insurance system provides
free dental care to all older adults with no limit of usage. Free dental services are situated in every district hospital in Thailand. In addition, active care (e.g. home visits, a mobile unit in a community center) is also sometimes provided. People with adequate or inadequate OHL can access such services whenever they need, with less impact of OHL on making a decision to use the care. i.e. the need to balance a financial decision against a health decision is not required. In addition, the dental service utilisation rate in this study was high (66.1%) with most participants utilising preventive care. In comparison, only 38.6% of older adults from the 8th Thai National Oral Health Survey had utilised dental services in the previous year with the most frequent reason cited as tooth extraction, which is classified as an emergency service (Department of Health, 2018). Therefore, the subjects in this study may not be representative of the general Thai older adults due to the higher standard of inclusion criteria (older adults who can read and write on their own and have utilised dental services at this setting before), the sample recruitment was therefore prone to participation bias. In addition, the participants who were interested in this study may be more likely to be active in self-care and health prevention, which could be the reason why they volunteered to take part in this study. These participants could also have higher OHL than ones who decided not to join the study if they were conscious of their oral health knowledge and literacy.

When participants were classified by age, the 70 or older group had poorer oral health status, fewer natural functional teeth, higher treatment need (including prosthesis provision). These findings are consistent with those reported in other populations (Hassel et al., 2017; S. He & Thomson, 2017; Ramsay et al., 2015). Participants with poorer oral health status had significantly lower OHL scores, compared to ones with better oral health status. This finding was also observed in the previous study in Indian adults aged 18 to 73, in which OHL obtaining from REALD-30 was correlated with caries index; Number of Decay teeth (DT), Missing teeth (MT), Filled teeth (FT), and DMFT (Haridas et al., 2014). However, in this study, DMFT was not shown to have a significant correlation with OHL scores. This could be due to the directional correlations of DT and Mt being significantly negatively correlated with OHL (those with a higher number of decayed and missing teeth had poorer OHL), while the FT was significantly positively correlated with OHL as seen in previous Chapters. It is postulated this correlation could be due to an association between health-seeking behaviour and teeth, which have been filled, and therefore correspond with a higher OHL. Therefore, in regards to
DMFT (as the combination of Dt, Mt, and Ft), the significance was deducted by the effect of different directions of correlations.

The results also highlight that participants with adequate OHL had significantly better oral health, which was consistent with the previous OHL study in US adults aged 36-70 (Baskaradoss, 2018). This includes having lower active or untreated caries, having a higher number of fillings, having more remaining functional teeth, and having a higher number of posterior occlusal pairs. The reason may be that individuals with adequate health literacy have skills in taking care of their oral health by obtaining oral health information, processing it, and implementing it effectively; as a result, they could achieve better oral health than those with inadequate OHL. These results almost entirely agree with a recent systematic review of OHL and oral health status outcomes (Firmino et al., 2017). In that review, the number of missing teeth, restored teeth, natural functional teeth, and prosthesis need were significantly associated with OHL, while the remainder of oral health outcomes e.g. the number of carious teeth and prosthesis use were not associated with OHL. Nevertheless, one-third of the studies included in the systematic review were related to paediatric and parental oral health literacy, and none of them exclusively studied the older adult population. In addition, the majority of the studies used word-recognition tools, for example, REALD-30 (Lee, Rozier, Lee, Bender, & Ruiz, 2007), which is a different type of OHL tool (a word recognition) from the OA-TOFHLiD used in this study.

The predictive ability of OHL in our study shows acceptable results. From the multivariate analysis, the results show an adequate OHL, as measured by the instrument, can predict having good oral health status in older adults. From the ROC Curve analysis, the sensitivity of OHL scores to detect having poor oral health was not high (64.5%), which means that if this OHL tool was used to screen people with poor oral health in a community, some people with poor oral health would be missed. Nonetheless, we propose this is acceptable as if this tool was used in a community screening, individuals with a positive score (higher than 41) could be suggested to visit the dentist for further oral screening. There will be little consequence for false positive results other than the risk of wasting resource on examining healthy individuals.
One limitation in our study is that we could not explain the directional effect and causal relationships of OHL and other background variables on oral health status due to the limitation of the sample size, which was not large enough to perform analyses such as a Path analysis (Mellard, Fall, & Woods, 2010; 2010). Therefore, future studies are recommended to utilize this OHL test in a larger number of participants, across various settings including rural and urban communities in order to obtain participants with diverse demographic backgrounds. In addition, we did not collect oral hygiene behaviours, for example, frequency of brushing and flossing, nor did we measure plaque or periodontal status, variables that could be affected by OHL as found in earlier studies (Baskaradoss, 2018; Holtzman, Atchison, Macek, & Markovic, 2017). Therefore, there is a need to study the association between OHL, periodontal status and oral hygiene behaviour of older adults in the future.

**Conclusion**

This study was the first study to assess oral health literacy in older adults and examine its associations to oral health status. The results found that people with different background characteristics and oral health outcomes had significantly different OHL scores. Older adults with adequate OHL had better oral health status. In conclusion, OHL can predict oral health status in older people. OHL can be administered quickly and by non-health personnel. As such, it may be a suitable screening approach for assessing the oral health needs of older adults.
References


doi:10.4135/9781412961288


Ueno, M., Takeuchi, S., Oshiro, A., & Kawaguchi, Y. (2013). Relationship between oral health literacy and oral health behaviors and clinical status in


6. Chapter 6

Perceived oral health and oral health behaviours of older adults with different oral health literacy levels
Foundation of Chapter 6

The Oral Health Literacy tool for older adults established in the previous chapters (the Test of Functional Health Literacy in Dentistry for Older Adults or OA-TOFHLiD) was found to have good psychometric properties in measuring Oral Health Literacy (OHL). The OHL scores obtained from the OA-TOFHLiD also had predictive validity in relation to several other oral health statuses (active caries status, having more than 20 natural functional teeth, and having more than four posterior occlusal pairs), which are outcomes of health behaviour. However, the quantitative studies in the previous chapters only identified measurable factors; they did not probe into reasons or thoughts behind health decisions. Therefore, this study aims to explore oral health and self-care behaviours, oral health coping and seeking behaviours, and health prioritization of older adults with different OHL levels, in order to gain a wider insight into the effect of OHL in older adults.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review</td>
<td>Review evidence from previous studies and the potential tools</td>
<td>No tool for older adults</td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs</td>
<td>Retrospective epidemiological study of oral health status and treatment needs in the target population, N = 393</td>
<td>Poor oral health statuses, low dental service utilization</td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLiD</td>
<td>The pilot OA-TOFHLiD total score = 35</td>
<td>Poor predictive validity for test needed to be improved</td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLiD</td>
<td>The optimised OA-TOFHLiD total score = 48</td>
<td>The test presents the ability of OHL to predict oral health status</td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLiD in clinical setting</td>
<td>The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status, N = 115</td>
<td>Those with adequate OHL presents better oral health status</td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLiD (Subgroup of Chapter 5)</td>
<td>Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults, N = 22</td>
<td>Those with adequate OHL presents better oral health status</td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLiD in the US population</td>
<td>The Short OA-TOFHLiD was developed by cutting certain prompts, following feedback from participants about the length of the original tool, N = 106</td>
<td>The Short OA-TOFHLiD total scores ≥39</td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLiD in the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the cut-off scores of the Short OA-TOFHLiD established in Chapter 7 was tested in this combined data, N = 218</td>
<td>The performance of the shortened version was confirm.</td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLiD in community</td>
<td>A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
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</tbody>
</table>
Abstract

Background: Oral Health Literacy (OHL) is the ability of an individual to obtain and understand oral health information, then process the information to use in self-care, or to properly make decisions related to oral health. The previous studies in this thesis had measured the associated factors of OHL in older adults quantitatively and found that OHL was related to many oral health conditions. This study aimed to explore perception of oral health status, oral hygiene behaviour, and self-care behaviours in people with adequate and inadequate OHL.

Methods: 22 older adults aged 60 to 73 who attended the Chiang Mai University Dental Hospital from January to February 2018 were purposively selected by asking their permission and availability. Participants were asked to fill out the Test of Functional Oral Health Literacy in Older Adults (OA-TOFHLiD), and then undergo an interview using a structured questionnaire. Responses were written down by the researcher during the interview. Data were analysed using content analysis. The topics for analysis were perception on general health, perception on oral health and oral self-care and health-seeking behaviour, and perception on health information.

Results: There were 8 participants who had OA-TOFHLiD scores of 40 or lower, and were classified as having ‘Inadequate OHL’, and 14 participants who scored over 40 and were classified as having ‘Adequate OHL’. Older adults with Adequate OHL perceived their oral health accurately and matched their oral health status obtained from clinical examination. Those classified with Inadequate OHL had a perception of their own oral health, which did not match their clinical examination. However, oral hygiene care and dental care-seeking behaviour were fairly similar among those with Adequate and Inadequate OHL.

Conclusion: Oral health literacy could potentially close the gap between the individual view and professional view on oral health, which could lead to successful health prevention and promotion programs in older adults.
Introduction

The global burden of oral diseases and conditions is high and oral health inequalities and disparities have been uncovered in populations in both developed countries and developing countries (Farmer, Phillips, Singhal, & Quinonez, 2017; Fischer, O'Hayre, Kusiak, Somerman, & Hill, 2017; Ogunbodede et al., 2015). This is the result of a wide range of factors, including individual oral ecosystem (Zaura & ten Cate, 2015), socioeconomic status (Steele et al., 2015), education (Farmer et al., 2017), residential area and environmental factors (Coles, Kruger, Anjrini, & Tennant, 2017; Gupta, Robinson, Marya, & Baker, 2015), access to health care systems and health insurance (Somkotra, 2013), and oral health literacy (Horowitz & Kleinman, 2012). These disparities and inequalities were found especially in older adult populations (Huang & Park, 2015; Lee, Kim, Hur, & Yang, 2016).

Oral Health Literacy (OHL) has been defined as an ability of an individual to obtain and understand oral health information, then process the information to use in self-care or perform appropriate oral health-seeking behaviours, or make a decision related to oral health properly (National Institute of Dental and Craniofacial Research, 2005). OHL becomes one of the essential approaches in health promotion that can potentially reduce oral health inequalities or disparities (Horowitz & Kleinman, 2012). It is believed that increasing health literacy will empower individuals to have agency and control over their health, rather than ignore it (Rudd & Horowitz, 2005). In developing countries, health education remains a fundamental tool in health promotion and disease prevention. By integrating the concept of oral health literacy, the main aim of health promotion is not just to increase knowledge through simple educational approaches but to increase oral health literacy in order to enable individuals to increase their control over, interact with health personnel and health system effectively, and eventually improve their health (Nutbeam, 2000).

Oral health literacy has been studied and assessed multiculturally and internationally (Dickson-Swift, Kenny, Farmer, Gussy, & Larkins, 2014). Findings from previous studies have shown high oral health literacy is associated with better oral health conditions and less oral disease (Firmino et al., 2017), better oral health behaviours and better oral knowledge (Parker & Jamieson, 2010). The results from the previous chapter (Chapter 5), which measured OHL in Thai older adults also showed similar findings. Adequate OHL was associated with better oral health outcomes, such as
having a lower number of active decayed teeth and a higher number of natural functional teeth. Interestingly, self-rated oral health status of older adults was found not to be associated with OHL scores (Chapter 5), which did not agree with other studies. In younger age groups, it has been reported that people with higher OHL was associated with better perceived oral health status and higher self-rated oral health status (Naghibi Sistani, Yazdani, Virtanen, Pakdaman, & Murtomaa, 2013; Shin, Braun, & Inglehart, 2014). Another study proposed that oral health perceptions of older adults were different to younger groups as their previous experiences could impact on their present health perception (MacEntee, Hole, & Stolar, 1997).

The hypothesis from the quantitative element of this study (Chapter 5) proposed that older adults with adequate oral health literacy would have better oral health, and this association was statistically confirmed. However, this association was not seen for all individuals. Some older adults with adequate OHL were found to have poor oral health, while others with inadequate OHL had good oral health. Therefore, to be able to understand the association between oral health and oral health literacy in older adults thoroughly, perceived oral health, hygiene care, and dental-care seeking behaviour need to be explored between individuals with different OHL levels. The objective of this chapter was to explore oral health perceptions, oral health behaviour and health-seeking behaviour of older adults with Adequate and Inadequate Oral Health Literacy.

**Material and methods**

**Health insurance background**

There are three main health insurance schemes in Thailand; Universal Health Coverage (UC), Social Security Scheme (SSS), and Government Officer Health Benefits (GBH). 80% of Thai older adults are covered by UC, a basic health coverage for all Thai people that is provided by the government. For older adults, UC dental health coverage covers check-ups, x-rays, fillings, cleanings and periodontal treatments (root planing or periodontal surgery), acrylic full dentures (one pair every 5 years), and a health promotion and prevention program. In order to receive treatment, individuals with UC coverage need to register at a hospital within the coverage area where they live and officially have a permanent address.
The GBH scheme is health insurance for government officers and their close family (spouse, parents, and children under 18 years old). The government office pensioners still receive GBH when they retire (60 years old). The dental health benefits are almost the same as UC, but they also cover a metal removable partial denture, a fixed prosthesis (a crown and a bridge), and endodontic treatment. Furthermore, participants with GBH can utilise dental services at any public hospital or clinic without registration.

The SSS is health insurance for people who work in the private sector, which is comparatively the worst dental health insurance among the three main schemes. It only provides coverage for dental treatment of up to 900 Thai Baht (25 USD) annually for any dental treatment (cleaning, filling, tooth extraction, and surgical tooth removal). For denture treatment, partial acrylic dentures are subsidized through insurance, up to 1,500 Thai Baht (43 USD), and the full acrylic dentures are subsidized up to a maximum of 4,400 Thai Baht (125 USD). However, one advantage of this scheme is that people with SSS insurance can utilise dental services at any public or private hospital or clinic.

It is not compulsory to use any dental health insurance when utilising dental services in Thailand. People can choose to go to any private dental practice or public dental hospital, and pay for a dental treatment themselves.

**Oral health status**

“Oral health status” is a composite variable, which combines three essential dichotomised outcomes obtained from oral examinations (as described and used in Chapter 3 and 5). This provides a comprehensive variable, which can be used to determine the overall oral health status of older adults. The first dichotomised outcome was “Having active dental caries (yes / no)”, the second was “Having more than four posterior occlusal pairs (yes / no)”, and the final was “Having 20 or more natural functional teeth (yes / no)”. These three binary variables were combined, then categorised dichotomously into ‘good’ and ‘poor’ oral health status. “Good oral health” status meant a participant currently had no active caries, had at least five posterior occlusal pairs of teeth, and had at least 20 natural functional teeth. Patients with outcomes other than these were categorized as having “Poor oral health”.

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Oral health Literacy

Oral Health Literacy (OHL) was measured by using the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD), which was validated in previous studies (Chapter 2 and 3). It is composed of a 39-score reading comprehension test and a 9-score prompt, with a total score of 48. The cut off scores of the OA-TOFHLiD were 0-40 inadequate OHL, and 41-48 adequate OHL. The test was found to have good validity and reliability to measure oral health literacy in Thai older adults. In Chapter 5, scores on the OA-TOFHLiD were found to have significant associations between several oral health statuses and oral health behaviours (number of teeth, number of active caries, and utilisation of dental services).

Ethical approval

This project obtained ethical approval from two institutes 1.) The University of Manchester Research Ethics Committee (Reference number 2018-288-4728) 2.) Faculty of Dentistry, Chiang Mai University Ethical Committee (Reference Number 44/2017)

Setting and participant recruitment

The study was conducted at the oral health prevention and promotion clinic at the dental hospital of the Faculty of Dentistry at Chiang Mai University in Thailand from January 5th to February 6th, 2018. Study leaflets were posted at the setting three weeks before the start of the study.

The first part of this research involved a quantitative cross-sectional study. Participants in the study completed a demographic questionnaire and an oral health literacy test, then underwent an oral examination by a dentist (see Chapter 5 for more detail). After this was completed, purposive sampling was used to select participants for the second part of this study.

In this qualitative study, participants were invited to attend a one-to-one interview. The researcher informed the selected participants about the objectives and asked for their permission to join in an interview. There were 115 participants who attended the quantitative part of the study, 25 participants were asked to participate the interview, and 22 participants accepted to take part of the qualitative study.
Data collection and analysis

A structured interview was conducted using a prepared interview guideline (see Table 6.2). There were five main topics regarding general health, perception on oral health, oral hygiene care, dental health seeking behaviour and service utilisation, and oral health information. One additional open-ended question was added to obtain the participants’ point of view about their oral health. Interview sessions were carried out by the researcher (PW) in a separated private room within the clinic. Identifying data such as name, address and telephone number were collected in a different spreadsheet. The answers were recorded using field notes. A unique identification number was created for each participant and used on questionnaires and field notes.

For data analysis, field notes of all participants were assessed together with their demographic background and oral health literacy level. An outline of the basic characteristics of people with different OHL level was produced in a summary table (see table 6.3). Content analysis was used to analyse texts through an inductive reasoning approach (Elo & Kyngas, 2008).

Results

Table 6.1 presents the demographic characteristics of the 22 participants in this study. The age of older adults was from 61 to 73, with the mean age at 64.9. The majority of participants were female (19 of 21). Two-thirds of the participants (68.2%) had at least a high school or higher education background. According to dental health insurance, 31.8% of participants had Government Health Benefits (GBH), 36.36% of participants had Universal Coverage (UC), and the rest (31.83%) had Social Security Scheme (SSS) or others. More than half of participants (59.1%) had not utilised dental services in the previous year, and more than half (54.4%) of participants were found to have a Poor Oral Health Status. Oral Health Literacy (OHL) was assessed using OA-TOFHLiD.
Table 6.1: Demographic characteristics of older adults in this study (n = 22)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range 61-73 years old, Mean 64.86, SD 3.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>19</td>
<td>86.4</td>
</tr>
<tr>
<td>70 or more</td>
<td>3</td>
<td>13.6</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3</td>
<td>13.6</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>86.4</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ Primary school</td>
<td>7</td>
<td>31.8</td>
</tr>
<tr>
<td>High school or more</td>
<td>15</td>
<td>68.2</td>
</tr>
<tr>
<td>Type of dental health insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Health Benefit</td>
<td>7</td>
<td>31.8</td>
</tr>
<tr>
<td>Universal Coverage</td>
<td>8</td>
<td>36.36</td>
</tr>
<tr>
<td>Social Security Scheme, or others</td>
<td>7</td>
<td>31.83</td>
</tr>
<tr>
<td>Utilisation of dental services in the previous year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9</td>
<td>40.9</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>59.1</td>
</tr>
<tr>
<td>Oral health status**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>12</td>
<td>54.4</td>
</tr>
<tr>
<td>Good</td>
<td>10</td>
<td>45.5</td>
</tr>
<tr>
<td>OA-TOFHLiD scores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate (0-40)</td>
<td>8</td>
<td>36.4</td>
</tr>
<tr>
<td>Adequate (41-48)</td>
<td>14</td>
<td>63.6</td>
</tr>
</tbody>
</table>

Table 6.2 presents the interview questions used in this study. There were five main topics. The first topic was about general health, medical conditions, and medication; the second topic was about perceived oral health; the third topic was about oral hygiene behaviour; the forth topic asked about participants’ health seeking behaviour and oral health service utilisation; the last one was about oral health information. All participants answered these five topics. The researcher added one open-ended question at the end of the interview to give participants the option to add comments or suggestions related to their oral health. Results are described under the five topics below:
Table 6.2: Semi-structured interview questions used in this study

<table>
<thead>
<tr>
<th>Topic</th>
<th>Questions</th>
</tr>
</thead>
</table>
| 1. General health | 1.1 Do you currently have any medical conditions? When did it start, and what was a symptom or sign of the disease?  
1.2 How often do you meet your doctor?  
1.3 Do you currently take any medications? How many medications do you have now? Do you currently take any supplements?  
1.4 How do you take care of yourself? What activity do you carry out which you consider to be a self-care? |
| 2. Perception of oral health | 2.1 In general, how is your oral health right now?  
2.2 If it is good, why do you think it is good? Or, if it is bad, why do you think it is bad? Could you please explain and give a reason to support?  
2.3 If you can rate your oral health right now, what score would you give from very bad (0) to very good (10)? |
| 3. Oral hygiene behaviour | 3.1 How do you take care of your oral health?  
3.2 What type of toothbrush that you normally use? Does it have hard, soft, or medium bristles?  
3.3 What about toothpaste? What type of toothpaste do you use and why do you choose this type or brand?  
3.4 Do you use anything else to take care of your oral hygiene? |
| 4. Oral health seeking behaviour and oral health service utilisation | 4.1 When was the last time that you visited a dentist? What did you do and why did you choose to go to this practice/hospital?  
4.2 How often do you go to see the dentist?  
4.3 If you had tooth problems, for example, pain or sensitivity, what would you do? How do you normally encounter this problem? |
| 5. Oral health information | 5.1 How have you gained knowledge around oral care? What is the source of the information you have obtained? Do you think the information that you received is useful, easy to understand or not?  
5.2 Do you think information about oral hygiene care is useful and easy to access or not?  
5.3 What type of media (and information) do you think is appropriate for you? |
| 6. Additional | Do you have any comments or suggestions about oral health care for older adults? |

1. General health and medical condition

- Medical conditions

When describing their medical conditions, it was observed participants fell into one of two groups, the first group (containing 7 participants) described no issues with medical conditions:

“Everything is fine. I don't have any medical conditions” (ID.01 -Adequate OHL)
“I don't have any medical conditions.” (ID.67 - Inadequate OHL)

However, the second group, containing the majority of participants (15), described having at least one medical condition, the most common being Non-Communicable Diseases (NCDs), such as hypertension, diabetes mellitus, or hyperlipidemia. Participants also described the on-going impact of and their concern around these conditions:

“I have hypertension, found out about it in January 2017. I think it's from not getting enough rest. I have headaches and muscular pain” (ID.15 - Inadequate OHL)

“I have an allergy to dust, a neurological disorder (herniated disc), a gastric ulcer, risk of hypertension, stress, and neck pain. The neck pain came from an accident three years ago, and I still feel pain every day.” (ID.35 - Adequate OHL)

- Medical care and medications

Participants, who had medical conditions or chronic diseases, commonly visited a doctor to get treatment for a medical condition, and took medication regularly:

“I visit a doctor every three months at the CMU hospital because I have my health insurance (SSS) registered here. They normally do a blood check-up once a year, and lipid check twice a year. I usually take one tablet of hypertension medication and one multivitamin tablet daily.” (ID.41 - Adequate OHL)

Participants with no medical condition explained that self-care is still important. Some took supplements or alternative herbal medicines:

“I went to the CMU hospital last year for a health check-up. I normally visit a doctor at the hospital once a year for a check-up because I used to work there. I take 1-2 capsules a day of a black sesame oil supplement.” (ID.60 - Inadequate OHL)
Participants who had no medical condition mentioned that if they feel sick, or have something wrong, they treat themselves first rather than seeing a doctor.

“I rarely go to see a doctor. If I feel ill, I normally go to consult the pharmacist and buy medicine from them first because I don’t want to wait for a long time at the hospital.” (ID.01 - Adequate OHL)

“Since I don’t have any medical conditions, I don’t see any doctor regularly. But if I have something wrong, I usually treat myself first.” (ID.03 - Adequate OHL)

- Health care behaviour

A number of participants described two main behaviours in relation to taking care of their health. The first health behaviour was to exercise regularly. The second was associated with maintaining a healthy diet such as eating fresh fruit and vegetables, avoiding eating red meat, and avoiding greasy and sugary food.

“I control my diet by eating more vegetables and fish, and avoiding eating fat and sugar. I exercise by riding my bicycle 3-5 times a week.” (ID.75 - Adequate OHL)

“I usually eat healthy food because I eat a banana for my breakfast every day. I sometimes exercise by climbing a coconut tree.” (ID.54 - Inadequate OHL)

2. Perceived oral health

Self-perceived health and self-rated oral health status were asked twice in order to confirm participants’ perception towards their oral health. The first two questions were “In general, how is your oral health right now?” and “Why do you feel that?” which aimed to let the participant describe their perception about their health. The second question was set as a Likert scale (from 0 to 10) and the participants were asked “If you can rate your oral health right now, what score would you give from 0 poor to 10 excellent?” This question aimed to see how participants quantify their oral health status.
The results interestingly demonstrated that oral health perceptions described by the participants and self-rated oral health scores were not found to be in the same direction, or were inconsistent, especially in participants with inadequate oral health literacy. For example, when they were asked to describe their oral health status, some participants mentioned they had ‘Not good’ or ‘Fair’ oral health statuses. However, when they were asked to rate their oral health status, they gave the score quite high (scores 7 or more), which was unexpected from the researcher as we expected to see scores of less than 5.

Perceived oral health status is arranged into three groups; good, fair or normal, and poor perceived oral health. Within the good group, participants gave various reasons, which could be linked to their perceived ‘good’ oral health. For example, participants described having good oral health because they regularly visit the dentist:

“I think my oral health is good. It is good because I visit a dentist for a check-up once a year. I can chew and my mouth functions normally- and there is nothing wrong. I would give an 8 out of 10. (ID.40 -Adequate OHL)"

“My oral health is very good. I visit a dentist very often because I have an appointment with a dentist for making a denture every month. I'd give an 8 out of 10 for my oral health.” (ID.42 -Inadequate OHL)

With regard to the group of participants that described themselves having ‘fair’ or ‘normal’ oral health status, participants explained they rated themselves fair because they perceived certain oral health problems, but they did not think those problems were severe.

“I think I have fair oral health status because I've had one bridge in my mouth for 5-6 years that sometimes annoys me and gives me pain. But when the dentist checked them with an x-ray, they were normal- no tooth decay. For the score of my oral health, I would give a 6.” (ID. 31 -Adequate OHL)

“I think my oral health is normal, or intermediate since I have some holes in my teeth and I had a crown done a month ago. I would rate myself 8." (ID. 70 -Inadequate OHL)
For the participants who perceived they had poor oral health, all avoided using the word ‘poor’ and instead used the word ‘not good’. Some had significant signs of oral health disease such as toothache, tooth mobility, or bleeding gums. A number of participants noted difficulties, especially in relation to chewing food.

“My oral health is not good. I have tooth decay so I cannot eat or chew food properly and I’ve had a root canal treatment done. Nowadays, I receive symptomatic treatment only. I would give myself only 4 or 5 out of 10.” (ID.62 - Adequate OHL)

“I think it is not good. I have tooth decay, tooth mobility, tooth fracture, but still can chew normally. My gums sometimes bleed while I’m brushing my teeth. I’d give a score of 8 for my oral health status.” (ID.67 - Inadequate OHL)

3. Oral health care behaviour

All participants stated they brush their teeth as part of their daily routine in maintaining their oral health. Participants used either fluoride toothpaste, desensitized toothpaste or herbal toothpaste. Some participants mixed different types of toothpaste when brushing, and some of them switched between different types of toothpaste at different times (See table 6.3). Some participants mentioned ‘salt’ as an active ingredient in their toothpaste because they believe it could help ‘tighten teeth’ (to help loose teeth stick to the gum and bone). However, for the majority of participants, the purpose of using toothpaste was to decrease tooth sensitivity or reduce gum disease. Some participants mentioned the potential whitening effect of toothpaste. Only a few participants described the preventative aspect of toothpaste and no one mentioned the effectiveness of fluoride for preventing dental caries directly.

“I switched between Dok-Bua-Koo (herbal toothpaste with no fluoride), Sensodyne, and Aroon-Roong (herbal toothpaste with no fluoride). I think that herbal toothpaste can reduce tooth sensitivity; especially because Aroon-Roong has salt in it.” (ID.05 - Adequate OHL)
“I use Fluocaril toothpaste because a dentist gave it to me when I visited him last time. I also mix Aroon-Roong (herbal toothpaste with no fluoride) with water and hold it in my mouth for a while before gargling it out, because it tightens my gums.” (ID.64 - Adequate OHL)

“I use Sensodyne because it has good quality and can clean surfaces in-between teeth.” (ID.54 - Inadequate OHL)

All participants brushed their teeth at least twice a day. The majority of participants selected a soft toothbrush from a brand they were familiar with. Some participants used additional cleaning instruments, such as a small proximal toothbrush, toothpick, or dental floss. However, participants used the additional instruments only occasionally.

“I use floss and an interproximal brush because it is easy to use, and good to clean in-between teeth. I don’t like to use toothpicks. They’re not good.” (ID.27 Adequate OHL)

“I sometimes use a toothpick to clean food impaction, but I plan to use dental floss starting tomorrow.” (ID.60 - Inadequate OHL)

4. Oral health utilisation

Half of the participants had utilised dental services in the previous year. The reasons for visiting the dentist were mostly due to pain or abnormality in their oral cavity. However, some participants visited the dentist for a regular check-up and cleaning. Participants primarily received dental services at the public hospital where their health insurance was registered. Some participants visited a doctor at a private practice they felt familiar and comfortable with.

“I visited Dr. Siri’s practice last year for a check-up. I usually go there because it is near my house. I’ve been going there for a long time.” (ID.40 - Adequate OHL)

“I visit a dentist once in a while. I don’t think that I need to see a dentist. I know I have tooth decay but I can take care of it myself and manage it by rinsing my mouth frequently. I don’t have severe pain or mobility that needs
to be treated by a dentist. The last time I visited a dentist was 10 years ago for a tooth extraction.” (ID.67 -Inadequate OHL)

Participants were asked about their pain management and oral health-seeking behaviour if they had a toothache. More than half of the participants stated they used over the counter painkillers if they suffered from dental pain. Several participants stated they would observe their pain at first, and if the pain worsened, they would see a dentist. A few participants would go to see a dentist immediately.

“I would take a painkiller tablet because I don’t want to go to see a dentist. I’m afraid of needles.” (ID.05 Adequate OHL)

“I would go to see a dentist immediately because I think that oral health is important.” (ID.27 -Adequate OHL)

“I would clean and rinse my mouth first, then take a painkiller. If it got worse, or if I couldn’t tolerate it, I would see a dentist.” (ID.82 -Inadequate OHL)

5. Oral health information

Participants indicated they obtained oral health care information from various types of media. Most of the respondents mentioned they received oral health information from television, especially from advertisements for toothpaste. Several participants stated they obtained oral health care knowledge from dentists or health personnel and a leaflet or information board when they utilised dental services. Sometimes health personnel went to their senior clubs to provide information about oral care. Some older adults explained they used the Internet to search for oral health care or knowledge about oral health diseases they had signs or symptoms of. One participant stated she was too busy to learn about oral health care.

“I got information from the Internet, leaflets, and TV advertisements. I applied what I learned to myself.” (ID.31 -Adequate OHL)

“I got information from a dentist and since I’ve been following their directions every day my symptoms have gotten better. For example, I use
desensitized toothpaste and my teeth are less sensitive.” (ID.75 - Adequate OHL)

“I don’t have time to get any oral health information because I work and I am too busy. I am hardly interested in this kind of stuff (information)” (ID.67 - Inadequate OHL)

When asked about how sufficient the information provided for older adults was, half of the participants stated there is enough information regarding oral health care for older adults. However, one stated the information is provided too late. Several participants indicated there is not enough information, or that some older adults could not access information, especially older adults in rural areas. Participants preferred to get information from either the television or the dentist.

“I think it’s enough. I once got information from a workshop that I attended at the hospital, and since then I’ve used it in my self-care. A lot of media like advertisements on TV gave me additional information. But I think it would be better if a dentist could give me oral health instruction one on one.” (ID.07 - Adequate OHL)

“I think it’s not enough. I want to get more information about oral health care in older adults. I would prefer getting knowledge from a ‘Line’ (a mobile chat application) group message.” (ID.42 - Inadequate OHL)
Relationship of oral health literacy level, self-perceived oral health, and clinical oral health status

Table 6.3 presents an overview of background characteristics obtained from the previous quantitative study (Chapter 5), and summarised interview data obtained from this study.

Older adults with adequate OHL and having good oral health status were more likely to perceive themselves to have good oral health. On the other hand, adequate OHL participants with poor oral health status indicated correctly they had some problems in their mouth. However, one participant with good oral health status and adequate OHL also indicated they had poor oral health and rated themselves only 5 out of 10.

“I think my oral health is not good. I usually have gum swelling, but there is no pain, no tooth mobility, and the gum swelling comes only in daytime.” (ID. 52 - Adequate OHL)

With regard to older adults with inadequate OHL participants, they were more likely to show disagreement between their self-perceived oral health status and their oral health status according to clinical examination. Two participants with inadequate OHL stated their perceived oral health status was ‘very good’ or ‘normal’ even though their examined oral health was poor. Only a few participants with inadequate OHL had good oral health status and perceived that it was good or normal.

“My oral health is normal. I don’t have any pain, sensitivity, mobility, or tooth decay. I can chew and function normally.” (ID. 82 - Inadequate OHL with poor oral health status)

Oral health status obtained from the clinical examination was paired with participants’ perceived oral health status, then ‘matched’ or ‘mismatched’ categories were created. ‘Matched’ perceived oral health status and clinical oral health means their perceived oral health matched their clinically observed oral health (i.e. good to good, or poor to poor). In contrast, the ‘Unmatched’ category meant that participants’ perceived oral health status did not match their clinical
oral health status (i.e. good to poor, or poor to good). The results present in a bar chart (Figure 6.1) below.

**Figure 6.1: Percentage of participants with matched and mismatched oral health status in adequate and inadequate OHL groups**

The proportion of participants whose ‘perceived oral health status’ matched with their ‘clinical oral health status’ was higher in older adults with adequate OHL compared to those with inadequate OHL. It could be interpreted the majority of participants with adequate OHL could perceive their oral health status precisely. Whereas 50% of participants with inadequate OHL did not perceive their oral health correctly.
Interrelationship of oral health literacy level and oral health behaviour

From Table 6.3, it can be seen that the frequency of daily brushing did not differ between older adults with adequate and inadequate OHL. The participants in both groups brushed their teeth at least twice a day. Most of the participants selected soft-bristled toothbrushes, however, a few participants with inadequate OHL used both hard and soft toothbrushes. For toothpaste and additional cleaning tools, participants with adequate and inadequate OHL were similar. Both groups selected toothpaste according to their needs of oral health, mostly for relief of tooth sensitivity. The Proxabrush and toothpicks were popular additional cleaning tools for older adults with adequate and inadequate OHL.

Regarding oral health utilisation, the majority of participants did not visit a dentist regularly. Several participants with adequate OHL visited a dentist once or twice a year. Only a few participants with inadequate OHL visited a dentist regularly and mostly for follow-ups of their previous treatment. For dental pain management, painkillers were utilised among people with adequate and inadequate OHL:

“I hardly go to see a dentist because I don't want to wait in a long queue. There are a lot of patients and I think it would be better to take care of myself. Some dentists have been rude to me, so I don't want to see them again.” (ID.35 Adequate OHL)

“I visit a dentist every month to recheck my dentures.” (ID.42 - Inadequate OHL)

“I visit a dentist once in a while. I don't have any abnormality, so I don't need to see a dentist”. (ID.82 - Inadequate OHL)
Table 6.3: Matching perceived oral health and oral health behaviours with OHL levels and clinical oral health status (OHS)

| ID | Gender | Age | Type of health insurance | OHL score | OHL level | Clinical OHS | Utilisation in 1 year | Perceived general health | Perceived oral health | Rated OHS (0-10) | Daily brush times | Toothbrush type | Using F. Toothpaste | Using floss or other cleaning | First gate of managing Toothache | Provided oral health information |
|----|--------|-----|---------------------------|-----------|-----------|--------------|------------------------|-------------------------|------------------------|-----------------|----------------|---------------|----------------|-----------------|-----------------------------|-------------------------------|-----------------------------|
| 01 | Female | 63  | UC                        | 45        | Adequate  | Poor         | Yes                    | Fine                    | Not good              | 7               | 3              | Soft          | Yes D*         | Herbal          | None                        | Painkiller                     | Enough                      |
| 02 | Female | 64  | UC                        | 41        | Adequate  | Good         | Yes                    | Fine                    | Not good              | 8               | 2              | Soft/Hard     | Yes D*         | Herbal          | Proxabrush                   | Painkiller                     | Not enough                 |
| 03 | Female | 64  | UC                        | 42        | Adequate  | Poor         | No                     | Fine                    | Not good              | 5               | 2              | AM            | Soft          | Yes D*         | Herbal          | Floss                        | Painkiller                     | Enough                      |
| 04 | Female | 61  | GBH                       | 44        | Adequate  | Good         | No                     | NCDs                   | Not good              | 7               | 2              | Soft          | Herbal        | None           | None                        | Dentist                       | Enough                      |
| 05 | Female | 61  | GBH                       | 46        | Adequate  | Good         | Yes                    | NCDs                   | Fair                  | 6               | 2              | AM            | Soft          | Yes D*         | Herbal          | Floss/Proxa                   | Painkiller                     | Enough                      |
| 06 | Female | 64  | UC                        | 44        | Adequate  | Good         | No                     | Nuero                  | Not good              | 8               | 2              | AM            | Soft          | Yes D*         | Herbal          | Floss/Proxa                   | Painkiller                     | Not enough                 |
| 07 | Female | 73  | ETC                       | 45        | Adequate  | Good         | Yes                    | Stroke                  | Good                  | 8               | 3              | Soft          | Yes D*        | Herbal          | Toothpick                    | Pharmacist                     | Enough                      |
| 08 | Male   | 68  | SSS                       | 43        | Adequate  | Good         | Yes                    | NCDs                   | Not good              | 8               | 2              | Soft          | Yes           | Floss/Proxa     | Dental          | No                           | Painkiller                     | Enough                      |
| 09 | Female | 61  | GBH                       | 48        | Adequate  | Good         | No                     | NCDs                   | Not good              | 5               | 2              | Soft          | Yes           | Proxa/ToP      | Toothpick                    | Painkiller                     | Not enough                 |
| 10 | Female | 68  | GBH                       | 41        | Adequate  | Poor         | No                     | NCDs                   | Not good              | 4-5             | 2              | Soft          | Herbal        | Floss          | Painkiller                     | Enough                      |
| 11 | Male   | 66  | GBH                       | 47        | Adequate  | Good         | No                     | NCDs                   | Fair                  | 8               | 2              | Soft          | Yes D*        | Toothpick       | Dental          | No                           | Not enough                    |
| 12 | Female | 63  | ETC                       | 45        | Adequate  | Poor         | Yes                    | Cataracts              | Not good              | 4               | 2              | Soft          | Yes           | Proxa/ToP      | Toothpick                    | Painkiller                     | Enough                      |
| 13 | Female | 61  | UC                        | 38        | Inadequate | Poor         | Yes                    | NCDs                   | Not good              | 7               | 2              | Soft          | Yes / Herbal  | None          | None                        | Painkiller                     | Enough                      |
| 14 | Female | 62  | ETC                       | 31        | Inadequate | Poor         | Yes                    | NCDs                   | Very good             | 8               | 3              | Soft          | Yes           | Proxabrush     | Dentist                     | Not enough                    |                             |
| 15 | Male   | 68  | UC                        | 30        | Inadequate | Poor         | No                     | NCDs                   | Not good              | 8               | 2              | Soft          | Yes D*        | Toothpick      | Dental          | Not enough                    |                             |
| 16 | Female | 69  | GBH                       | 38        | Inadequate | Good         | Yes                    | Fine                   | Not good              | 7               | 3              | Soft          | Yes D*        | Toothpick      | Painkiller                    | Not enough                    |                             |
| 17 | Female | 62  | SSS                       | 37        | Inadequate | Poor         | No                     | NCDs                   | Not good              | 8               | 2              | Soft          | Yes           | None          | Painkiller                    | Not enough                    |                             |
| 18 | Female | 62  | GBH                       | 39        | Inadequate | Poor         | Yes                    | Fine                   | Fair                  | 8               | 2              | Soft/Hard     | Yes D*        | None          | None                        | Dentist                      | I don’t know                |
| 19 | Female | 70  | ETC                       | 40        | Inadequate | Good         | Yes                    | Bone                   | Normal                | 10              | 2-3            | Soft/Hard     | WTN           | Proxa/ToP     | Toothpick                    | Painkiller                     | Enough                      |
| 20 | Female | 72  | ETC                       | 38        | Inadequate | Poor         | No                     | NCDs                   | Normal                | 7-8             | 2-3            | Soft/Hard     | Herbal        | Toothpick     | Painkiller                    | Enough                      |                             |
Discussion

The purpose of this study was to explore oral health perception, oral self-care and health-seeking behaviour of Thai older adults with different oral health literacy (OHL) levels. Since the previous chapter showed that older adults with adequate OHL had better oral health outcomes, we anticipated to see better oral health perception, better oral hygiene care, and appropriate routine dental check-up in the Adequate OHL group compared to those with inadequate OHL.

One finding from this study, which supports our hypothesis, was that older adults with Adequate OHL had better perceived oral health status than the inadequate group. Those with adequate OHL were more likely to have a ‘precise’ perception, for example, if their clinical oral health status was good, they could indicate it was good, but if they had an oral health problem, they perceived the problem and elaborated signs or symptoms of the condition accurately, and matched with the oral status obtained from clinical examination. This could be due to the level of oral health knowledge and ability to obtain oral health information in individuals with adequate oral health literacy might be better than ones with inadequate oral health literacy. Therefore, they transformed the information to assess their oral health status more accurately.

However, of the seven participants who had both good clinical oral health status and adequate OHL, more than half of them perceived their status as ‘not good’. This could be explained by participants feeling uncomfortable with their mouth or being concerned it was not up to a professional standard. This is supported by the previous research that proposed a framework for oral health perception in older adults. This demonstrated significant relationships between three major themes: It was proposed that perceived oral health in older adults revolved around three significant components 1.) Comfort, 2.) Hygiene, 3.) Health (MacEntee et al., 1997). This could be the reason why the oral status obtained from clinical examination and the professional perspective (a health or disease detecting approach) did not match the perceived oral health of older adults (a comfort and hygiene approach).

Regarding the previously mentioned hypothesis, we expected to see poorer self-perceived oral health status in older adults with inadequate oral health literacy.
However, the findings were questionable in this group. Although inadequate OHL participants with poor clinical oral health status reported their oral health “Not good” in general as we expected, they rated their oral health status scores by Likert scale higher than seven, which was considered as “Fair or good”. In addition, some inadequate OHL participants even perceived they had ‘excellent’ or ‘normal’ oral health when in fact they had poor clinical oral health status, which needed to be treated. This inconsistency in participants with inadequate OHL could be explained by a previous study reporting that those with limited health literacy skills were more likely to feel shame or unconfident in relation to their health, and therefore were reluctant to admit they had poor health (Parikh, Parker, Nurss, Baker, & Williams, 1996). The inconsistency between OHL scores and perceived oral health status were also found in previous studies (Jones, Parker, & Jamieson, 2014; Parker & Jamieson, 2010). The phenomenon could also be supported by the framework proposed by MacEntee et al. (MacEntee et al., 1997) that perceived oral health status did not purely rely on a disease observed by professionals, but instead found that as long as individuals perceived no pain, or had relative cleanliness, or normal function, they would perceive their oral health status positively.

In addition, the phenomenon in this study could be explained that Thai older adults’ health beliefs were related to the culture of a strong Buddhist society (National Statistical Office of Thailand, 2014). Thais accept oral health problems as part of ageing. They believe in transiency and perceive health problems as a normal stage of life. This finding corresponds to a previous study, which reported that Thai older adults had lower expression of oral health related outcomes, although the oral problems severely impacted their daily life (Srisilapanan et al., 2016). Another study in a developing country using Global Self-Rating of Oral Health (5-item Likert scale from very good to very poor) to evaluate oral health in the low-resource settings found that self-rated oral health status as poor probably linked to a perceived treatment need (Lawal, 2015). Therefore, it could be referred to in this study that the majority of participants, with both adequate and inadequate OHL, perceived ‘Not good’ oral health, but rated their oral health ‘Not bad’ (scores 7 or more) because they might not perceive dental treatment needs as they thought dental problems were a normal process of life.

A previous study in Japanese older adults indicated that higher oral health literacy was associated with better oral health behaviour, such as daily tooth brushing
and regular dental check-ups (Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013). In this study, there were no apparent differences between participants with Adequate and Inadequate OHL and oral hygiene behaviours. It was found the participants with Adequate or Inadequate OHL both routinely cleaned their teeth twice a day. The majority of participants knew about fluoride toothpaste, but didn’t truly comprehend the mechanism or importance of fluoride in tooth care. Therefore, they were more likely to select toothpaste according to their needs, such as decreasing tooth sensitivity or helping gum diseases. Herbal toothpaste was popular among older adult participants with both Adequate and Inadequate OHL. Interestingly, a number of participants mentioned being recommended herbal toothpaste by a friend or family member. Being recommended herbal medicines by family or friends was a pattern also found among Thai older adults with type-2 diabetes mellitus (Putthapiban, Sukhumthammart, & Sripraphradang, 2017). This could be due the fact complementary and alternative medicines (CAM) are strongly believed in and common in Asian cultures, especially among older age groups (Feng, Chiam, Kua, & Ng, 2010; Ng, Tan, & Kua, 2004).

With regards to oral care patterns and dental service utilisation, there was no distinctive pattern between people with different oral health literacy, which corresponded to a finding of a previous study in a different population (Burgette, Lee, Baker, & Vann, 2016). The majority of participants in both the Adequate and Inadequate OHL groups usually sought dental care when they had a problem, especially unmanageable dental pain. However, only a few participants sought dental care for routine check-up. This could be explained by research carried out in Canadian older adults, which described that seeking routine dental care was a habit created during childhood or as a young adult (Khabra, Compton, & Keenan, 2017). In addition, Universal Coverage (UC) has only been implemented in Thailand for 20 years (Somkotra & Lagrada, 2008). Therefore, routine dental utilisation is quite a new habit to Thai culture, especially in the older population who were born long before the emergence of UC. For this group, dental utilisation was mostly for symptomatic care due to its unaffordability for people in a low to middle-income country (Somkotra & Detsomboonrat, 2009).

According to the overall findings of this study, although the oral hygiene behaviours and dental care-seeking behaviour of older adults with different OHL levels were relatively similar, the links between perceived oral health statuses of
the individuals with Adequate and Inadequate OHL were unique and somewhat unclear. However, it could be presumed that individuals with Adequate OHL had an ability to obtain oral health information from various types of media, combine information with their prior experience, and adjust their perceptions on oral health precisely. Consequently, older adults with Adequate OHL had a perception of their oral health, which more closely matched professional views. Eventually, OHL could connect the gap between a professional view and an individual view and lead to better oral health outcomes in older adults.

**Study limitations**

Due to the type of data collection, which is a structured interview and with a time limitation, some questions on the subjects were too broad to examine deeply and fully explore participants’ thoughts. In addition, the majority of the participants of this study were female, and therefore selection bias could be an issue. Therefore, the explanation of links between these oral health perceptions and oral health literacy might not be fully established in this study.

**Conclusions**

The finding from this study confirmed the quantitative part of this study (Chapter 5) that OHL was not associated with self-rated oral health status in older adults, and explained the possible reasons behind the inconsistency between perceived oral health and self-rated oral health scores. However, the pattern of oral hygiene care and dental care seeking behaviour of Thai older adults was explained and it will be useful to develop oral health prevention and promotion for Thai older adults in future studies.
References


7. Chapter 7

Further Validation of a Dental Functional Health Literacy for Older Adults (Short OA-TOFHLiD)
Foundation of Chapter 7

From Chapter 4, the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was shown to have good validity and reliability in the Thai population. In addition, the full version of OA-TOFHLiD was used to explore association between oral health literacy and oral health status in Chapter 5. However, further development of the tool was needed based on the feedback from participants about its length and time spent to complete the original test. The purpose of this study was to develop a shortened version of OA-TOFHLiD and validate the English version with native English-speaking older adults. In this chapter, the researcher explains the development of the short OA-TOFHLiD, and validation process with American older adults.

The author is going to submit this chapter to Gerodontology after Chapter 4 is accepted (to be used as a reference).

Authors Contribution
This section was written by PW and was reviewed with contributions by IAP and MG.
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<td>Review evidence from previous studies and the potential tools</td>
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<td>Identify problems and needs</td>
<td>Poor oral health statuses, low dental service utilisation</td>
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<td>Retrospective epidemiological study of oral health status and treatment needs in the target population. N = 393</td>
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<td>First pilot of the OA-TOFHLID</td>
<td>The pilot OA-TOFHLID total score = 35</td>
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<td>Optimised OA-TOFHLID</td>
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<td>The OA-TOFHLID was further developed by adding 1 reading comprehension section, and tested in Thai older adults. N = 103</td>
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<td>Use OA-TOFHLID in clinical setting</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLID was too long for some to complete</td>
</tr>
<tr>
<td></td>
<td>The tool was used to explore associations between OHL and oral health status, and evaluate the accuracy of the test in predicting oral health status. N = 115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLID [Subgroup of Chapter 5]</td>
<td>Those with adequate OHL presents better oral health status</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oral health perception and oral health behaviour of participants with different OHL levels was explored in Thai older adults. N = 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLID in the US population</td>
<td>The Short OA-TOFHLID total scores = 39</td>
<td>The test presents acceptable validity Need to confirm with different population</td>
</tr>
<tr>
<td></td>
<td>The Short OA-TOFHLID was developed by cutting certain prompts, following feedback from participants about the length of the original tool. N = 106</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLID in the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the cut-off scores of the Short OA-TOFHLID established in Chapter 7 was tested in this combined data. N = 218</td>
<td>The test performance of the shortened version was confirm.</td>
</tr>
<tr>
<td></td>
<td>The performance of the shortened version was confirm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLID in community</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A protocol was developed to use this OHL tool as a basic screening tool for identifying patients with treatment needs by non-professionals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstract

The Test of Functional Health Literacy in Dentistry for Older adults (OA-TOFHLiD) was developed in both Thai and English. In Chapter 4, the Thai version was found to be valid (it measured what it claimed to measure), however, participants in the study reported it was too time-consuming to complete (30 minutes to 1 hour). Therefore, an abbreviated version of the Test of Functional Health Literacy in Dentistry for Older Adults (Short OA-TOFHLiD) was designed to keep 39 reading comprehension items, and delete the two prompts (9 points) from the original version.

106 participants age 60 or more, at 5 congregate-meal sites in Chicago, Illinois, USA completed 2 questionnaires (Short OA-TOFHLiD and Short-Test of Functional of Health Literacy; S-TOFHLA) and 1 oral health literacy pronunciation test (Rapid Estimate of Adult Literacy in Dentistry, REALD-30). Each participant also received an oral health examination. Demographic data, oral health status, and utilisation of services were used to explore any association of the oral health literacy scores with these variables. A Receiver Operating Characteristics curve identified appropriate test score thresholds.

For concurrent validity, Short OA-TOFHLiD was correlated with age (P = 0.026), years of education attendance (P = 0.003), and frequency of dental service utilisation (P = 0.002). For convergent validity, Short OA-TOFHLiD was highly correlated with S-TOFHLA (P < 0.001) and REALD-30 (P < 0.001). The multivariate linear regression found a significant association between Short OA-TOFHLiD and S-TOFHLA and REALD-30 (P < 0.001). For predictive validity, Short OA-TOFHLA was correlated with a number of decayed teeth (P = 0.013) and a number of filled teeth (P = 0.010). In addition, OA-TOFHLiD was predictive of active caries (P = 0.042) in the multivariate logistic regression analysis.

In conclusion, Short OA-TOFHLiD showed acceptable concurrent, convergent and predictive validity.
Introduction

The trend of population ageing is seen all over the world (United Nations. Department of Economic and Social Affairs. Population Division. 2002). An ageing population introduces challenges to health care systems; both from a simple resource perspective but also in terms of an appropriately skilled clinical workforce and policy changes (Kalache & Gatti, 2003). While health technology has been developed to prolong life, it does not necessitate that longer life will be of high quality (Pijnenburg & Leget, 2007). People who live longer may suffer from many diseases, especially chronic non-communicable diseases and their consequences (Pijnenburg & Leget, 2007). Health prevention and health promotion is one approach to reduce the impact of an ageing population on the healthcare system (National Academic Press (US), 1988). The promotion of health literacy within the older adult population may be one way in which health-seeking behaviours, self-care and prevention can be encouraged in older adults (Nutbeam, 2000).

Health Literacy (HL) is the ability of an individual to obtain health information, understand health messages, and then process these into practical behaviours, self-care, or healthy decision-making (Institute of Medicine, 2004). From a systematic review and meta-analysis, it was found that older age was associated with limited health literacy (Kobayashi, Wardle, Wolf, & von Wagner, 2014). The National Assessment of Adult Literacy (NAAL) survey in 2003 indicated US older adults aged more than 65 have the smallest proportion of people with proficient HL skills (Kutner, Greenberg, Jin, & Paulsen, 2006). The majority of US older adults have “below basic” health literacy skills (Cutilli & Bennett, 2009). In contrast, US elders with higher health literacy tend to have better health status, utilise more health prevention programs, and fewer emergency services (Cho, Lee, Arozullah, & Crittenden, 2008). However, one of the key findings of the review was that the health literacy of older people decreased as age increased (Kobayashi, Wardle, Wolf, & von Wagner, 2015). Additionally, HL was significantly lower in older age groups after it was adjusted for cognitive function ability (Baker, Gazmararian, Sudano, & Patterson, 2000). It is a challenge for health personnel to provide health education or interventions to promote the health in this population when put against a backdrop of declining cognitive ability (Richard et al., 2005).
Oral Health Literacy (OHL) was first described in 2005 when it was hypothesised that limited OHL could be a barrier to individuals achieving optimal or improved oral health (National Institute of Dental and Craniofacial Research, 2005). OHL was presented as one of the determinants of oral health status and oral self-care behaviours (Naghibi Sistani, Yazdani, Virtanen, Pakdaman, & Murtomaa, 2013; Ueno, Takeuchi, Oshiro, & Kawaguchi, 2013). Several tools for assessing oral health literacy have been developed from medical health literacy tools, and have mainly focussed on children and their parents’ oral health literacy (Dickson-Swift, Kenny, Farmer, Gussy, & Larkins, 2014). The common form of OHL measurement is a word recognition test, which assesses the ability to correctly pronounce health-related words correctly (Dickson-Swift et al., 2014). The most frequently used OHL tool in research is the Rapid Estimate of Adult Literacy in Dentistry (REALD30; English language) (Dickson-Swift et al., 2014; Firmino et al., 2017). It has also been adapted for use in various different cultural populations, for example, Hong Kong Rapid Estimate of Adult Literacy in Dentistry (HKREALD-30; Cantonese language) (Wong et al., 2012), Brazilian Rapid Estimate of Adult Literacy in Dentistry (BREALD-30; Brazilian-Portuguese language) (Junkes et al., 2015), and Turkish Rapid Estimate of Adult Literacy in Dentistry (TREALD-30; Turkish language) (Peker, Kose, Guray, Uysal, & Erdem, 2017).

As an alternative to word list tools such as REALD, a popular test is the functional oral health literacy tool, however, most of these target parent’s and children’s OHL (Dickson-Swift et al., 2014). Such tools capture the interplay between parents and children’s health behaviours and their common risk factors in what is a largely homogenous population. Older adults represent a highly heterogeneous group both with respect to their risk factors and oral presentation. In many health services such groups are poorly served and hence the need for prevention is greater. The possibility of an association between literacy and oral health in older adults was described in 2005 when the authors proposed that research in this area needed to be conducted (Rudd & Horowitz, 2005). However, there have been only a few studies focusing on OHL in older adults’ population (Khan, Ruby, Goldblatt, Schensul, & Reisine, 2014; Ueno et al., 2013). There is no specific tool to assess functional OHL in older adults, therefore, this study focuses on testing a shortened version of a functional oral health literacy assessment tool specifically for older adults previously described in Chapter 4.
A previously developed Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was tested using both Thai and English versions. The Thai OA-TOFHLiD was shown to be valid (Chapter 4), but some of the older participants struggled to complete the entire test. Therefore, this study aimed to develop and validate an abbreviation version of Test of Functional Health Literacy in Dentistry for Older Adults (Short OA-TOFHLiD).

Instrument development

The OA-TOFHLiD was based on the structure of the Test of Functional Health Literacy in Dentistry (TOFHLiD), established by Gong et al. in 2007 (Gong et al., 2007). The original TOFHLiD aimed to measure OHL of parents in relation to their children’s oral health. As such, TOFHLiD is specific to oral health care in children and also those utilising Medicaid in the United States. Therefore, in developing OA-TOFHLiD, a more general approach was taken to ensure that the test materials were not related to specific health care systems, cultures or policies.

The three most common pieces of information that were usually provided to patients (by the general media, health care providers, websites etc.) were used in the test. These were dental caries, gum disease, and oral hygiene. Additionally, a consent form commonly used in dental practice was included in the test.

One of the research team (PW) developed the OA-TOFHLiD in both Thai and English at the same time. The English version was primarily reviewed by two supervisors (IAP and MG), and both versions were reviewed again by 2 bilingual experts in dental public health and health communication for face validity, and to compare the similarity of the content in the Thai and English tests. The original OA-TOFHLiD has 2 sections, Reading Comprehension and Understanding Numeracy and Text. In the Reading Comprehension section, the selected materials were used to create 4 passages related to 4 topics of basic oral health knowledge: 1. Dental caries, 2. Periodontal disease, 3. Oral hygiene care, 4. Consent form. Passages with missing words were created by deleting words after every 5-10 words. The 4 alternatives were provided below each blank by including one correct answer and similar sounding words or words that seemed to fit the sentence. The total scores for the reading comprehension section are 39. In the Understanding Numeracy and Text part, the aim was to assess the ability of respondents to understand the numbers on the label and product directions, on
large printed pictures of labels of toothpaste and mouthwash. In each label, participants were required to read and use the information given on the directions to answer 4 questions in each prompt giving 9 points in total. The total score of OA-TOFHLiD is 48. A previous validation study of Thai OA-TOFHLiD (described in Chapter 3) found acceptable reliability and validity.

In the Short OA-TOFHLiD, the Understanding Numeracy and Text was removed for two reasons. Firstly, the previous validation study of the Thai OA-TOFHLiD and in the pilot study of OA-TOFHLiD (English version) in 10 older adults found that some of the older participants could not understand the task. They did not read the labels provided in the test, but answered the questions based on their own knowledge. Secondly, some of the participants could not tolerate the length of the original test. Consequently, in the short OA-TOFHLiD version four Reading Comprehension passages remain, resulting in 39 fill-in-blanks with 4 alternatives each, giving 39 points in total.

In order to assess the validity of the newly developed tool, OA-TOFHLiD was tested and compared with two validated tests commonly used in HL and OHL studies. These included; The Rapid Estimate of Adult Literacy in Dentistry (REALD-30) (J. Y. Lee, Rozier, Lee, Bender, & Ruiz, 2007) test which is a word recognition test for assessing oral health literacy. A respondent is required to pronounce 30 dental related words out loud. The correct pronunciations of these words are counted as OHL scores with a possible total score of 30. The other test was The Short test of functional health literacy in Adults (S-TOFHLA) (Baker, Williams, Parker, Gazmararian, & Nurss, 1999), which is a widely used test to assess functional health literacy. It is composed of 2 passages containing a number of deleted words, with four alternatives given that could fill in each blank. The total score for S-TOFHLA is 36.

Methodology

Overview
A cross-sectional cohort design was employed. There was no sample size calculation, but we considered a sample size based on a previous OHL validation study in a U.S. population, in which a hundred participants were adequate for assessing the validity of the tool (Gong et al., 2007). 106 Older adults (≥60 years)
who attended one of 5 congregate-meal sites for older adults in Chicago, Illinois were included in the study. The study was conducted from June to July 2017. The research was reviewed and approved by the University of Manchester Research Ethic Committee 1, reference number 2017-0106-2884.

At each setting, a poster advertisement was displayed one month prior to data collection. Participants who were interested in taking part were required to read a participant information sheet and give written informed consent, this acted as a screening method for eligibility (ability to read, write and understand English). Participants who could not read or write English, or had conditions or diseases that affected cognitive functions were excluded.

In order to validate the new abbreviated OHL tool, consented participants completed two written questionnaires; Short OA-TOFHLiD with demographic questions and Short Test of Functional Health Literacy in Adults (S-TOFHLA), and then performed a word recognition dental health literacy test (Rapid Estimate of Adult Literacy in Dentistry, REALD-30). Following an oral screening was performed by a US-licensed dental hygienist that recorded DMFT index, based on the diagnostic criteria by the World Health Organisation (Ishii & Yoshida, 1978). The number of remaining natural functional teeth, prosthetic status, and prosthetic needs of each participant were also recorded.

Data Analysis

SPSS software for Mac version 23.0 (IBM Corp, 2015) was used to analyse the data. For the overview of characteristics of participants and the scores of 3 tests, descriptive statistics, such as percentage, mean, median, were used. The internal reliability was tested by conducting a Kuder-Richardson 20 (KR-20) test.

Spearman's Rank correlation coefficient was utilised to: 1) Observe concurrent validity: the association between related characteristics such as age, number of dental visits, years of education and Short OA-TOFHLiD Scores 2) Observe convergent validity: identifying the positive correlation between the scores obtained from new the OHL tool with the scores from validated tools (S-TOFHLA and REALD-30) and 3) Observe predictive validity: presented by an ability of the OHL scores obtained from the new tool to correlate with oral health status obtained from the oral screening.
Multivariate linear regression analyses were conducted to confirm the convergent validity, which is an association between the scores of Short OA-TOFHLiD and the validated tools (STOFHLA and REALD-30), controlled by the related variables obtained from the demographic questionnaire, and to confirm an ability of OA-TOFHLiD to predict oral health status (predictive validity). Three oral indexes obtained from the oral screening were used to indicate good or bad oral health. Participants were categorised dichotomously according to 1) having active decayed tooth (or teeth) or not, indicating poor oral health status 2) Having 20 remaining functional natural teeth (FNT), which is an indicator of good oral health status in older adults (Yamanaka et al., 2008) and 3) Utilisation of dental services of any kind in the previous year (Yes/No). The final models of binary logistic regression analysis were performed and controlled for by age, gender, education level and ethnicity, (obtained from the demographic section of the questionnaire).

For determining the cut-off point (threshold) of Short OA-TOFHLiD, the Receiver Operating Characteristic (ROC) curve was undertaken by using the OHL scores to predict active dental caries status (Yes/No). The ROC demonstrated sensitivity and specificity of the OHL scores to predict dental caries at each cut-off score. Finally, an optimum cut off score was selected based on a balance between sensitivity and specificity.

**Results**

**Demographic results of the participants**

The demographic characteristics are presented in Table 7.1. The total number of participants in this study was 106; the majority were female (75.5%), white (88.7%), and aged between 57-90 years old (mean = 67.95, SD 6.52). Most of the participants had at least a high school level of education; only 8.4% of the participants had middle school or lower. For dental service utilisation, more than half (63.2%) of the participants had utilised dental services at least once last year, but only 26.4% had dental health insurance. The three most common services that participants accessed were check-up (57.5%), fillings (18.9%), and new dentures (16.0%). Almost half of the participants rated they had an excellent
ability to read (47%) and write (49%), and 68.8% perceived they had good and very good oral health.

Table 7.1: Demographic characteristics of the participants in this study (n=106)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>26</td>
<td>24.5</td>
</tr>
<tr>
<td>Female</td>
<td>80</td>
<td>75.5</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>23</td>
<td>21.7</td>
</tr>
<tr>
<td>70-79</td>
<td>43</td>
<td>40.6</td>
</tr>
<tr>
<td>80 or higher</td>
<td>40</td>
<td>37.7</td>
</tr>
<tr>
<td><strong>Educational Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school or Lower</td>
<td>9</td>
<td>8.4</td>
</tr>
<tr>
<td>High school</td>
<td>25</td>
<td>59.4</td>
</tr>
<tr>
<td>College</td>
<td>15</td>
<td>14.2</td>
</tr>
<tr>
<td>University or Higher</td>
<td>16</td>
<td>15.1</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>94</td>
<td>88.7</td>
</tr>
<tr>
<td>Black</td>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>5.7</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Having Dental Insurance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28</td>
<td>26.4</td>
</tr>
<tr>
<td>No</td>
<td>70</td>
<td>66.0</td>
</tr>
<tr>
<td>Not sure, cannot remember</td>
<td>8</td>
<td>7.6</td>
</tr>
<tr>
<td><strong>Use of Dental services in past 1 year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>67</td>
<td>63.2</td>
</tr>
<tr>
<td>Not Use</td>
<td>35</td>
<td>33.0</td>
</tr>
<tr>
<td>Not sure, cannot remember</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Type of care in previous year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check up</td>
<td>61</td>
<td>57.5</td>
</tr>
<tr>
<td>Fillings</td>
<td>20</td>
<td>18.9</td>
</tr>
<tr>
<td>Getting a new denture</td>
<td>17</td>
<td>16.0</td>
</tr>
<tr>
<td>Emergency</td>
<td>13</td>
<td>12.3</td>
</tr>
<tr>
<td>Fix a denture</td>
<td>11</td>
<td>10.4</td>
</tr>
<tr>
<td>Cannot remember</td>
<td>4</td>
<td>12.4</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Self-rated ability to read</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>47</td>
<td>44.3</td>
</tr>
<tr>
<td>Very good</td>
<td>28</td>
<td>26.4</td>
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<td>Good</td>
<td>23</td>
<td>21.7</td>
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<tr>
<td>Fair</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Poor</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Self-rated ability to write</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>49</td>
<td>46.2</td>
</tr>
<tr>
<td>Very good</td>
<td>20</td>
<td>18.9</td>
</tr>
<tr>
<td>Good</td>
<td>26</td>
<td>24.5</td>
</tr>
<tr>
<td>Fair</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Poor</td>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Self-rated oral health status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>19</td>
<td>17.9</td>
</tr>
<tr>
<td>Good</td>
<td>54</td>
<td>50.9</td>
</tr>
<tr>
<td>Fair</td>
<td>20</td>
<td>18.9</td>
</tr>
<tr>
<td>Poor</td>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td>Very Poor</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Perceived urgent dental treatment need</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24</td>
<td>22.6</td>
</tr>
<tr>
<td>No</td>
<td>76</td>
<td>94.3</td>
</tr>
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</table>
All scores of the instruments are presented in Table 7.2. The mean scores of Short OA-TOFHLiD, S-TOFHLA, and REALD were 30.41, 26.17, and 21.89 respectively. For the health literacy level classified by S-TOFHLA scores, 79% of participant had ‘Adequate HL’ (scores 23-36), 5.7% had ‘Marginal HL’ (scores 17-22) and, 19.8% had ‘Inadequate HL’ (score 0-16).

The oral health status is also shown in Table 7.2. The mean decayed, missing and filled teeth were 1.11, 14.78, and 7.58 respectively. The mean DMFT was 23.48. The mean number of remaining natural functional teeth is 16.87. The prevalence of active dental caries was 42.5%.

**Table 7.2: Descriptive statistics for all measurements**

<table>
<thead>
<tr>
<th>Type</th>
<th>Measure</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dental Literacy</strong></td>
<td><strong>Short OA-TOFHLiD (n= 106)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension (39)</td>
<td>31.30</td>
<td>9.11</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td><strong>REALD 30 (n= 104)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (30)</td>
<td>21.89</td>
<td>0.47</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td><strong>Medical Literacy</strong></td>
<td><strong>S-TOFHLA (n= 103)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total (36)</td>
<td>26.14</td>
<td>10.84</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 1 (16)</td>
<td>12.58</td>
<td>4.81</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Reading Comprehension 2 (20)</td>
<td>13.57</td>
<td>6.67</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td><strong>Oral Health Index</strong></td>
<td><strong>DMFT (n=106)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decayed teeth</td>
<td>23.48</td>
<td>6.69</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Missing teeth</td>
<td>1.11</td>
<td>2.17</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Filled teeth</td>
<td>14.78</td>
<td>10.44</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.58</td>
<td>6.95</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td><strong>Number of Natural Functional teeth (n=106)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.87</td>
<td>10.46</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td><strong>Number of severe decayed teeth that need to be extracted(n=106)</strong></td>
<td>0.27</td>
<td>1.32</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

The internal reliability was tested by conducting a Kuder-Richardson 20 (KR-20) test. It was found that Short OA-TOFHLiD had very high internal reliability (0.952).
Concurrent Validity

Table 7.3 demonstrates the results of concurrent validity obtained from the Spearman Rank correlation analysis. It was found there was a significant negative correlation between Short OA-TOFHLiD scores and age (P = 0.026), however, this was not found in the other validated tests (S-TOFHLA, REALD-30). Short OA-TOFHLiD, S-TOFHLA and REALD-30 scores were positively correlated with years of education (P = 0.003, 0.003, < 0.001, respectively). The frequency of the dental services utilisation in the previous year was significantly correlated with scores of Short OA-TOFHLiD (P = 0.002) and S-TOFHLA (P = 0.024). All HL and OHL scores were positively correlated with the self-rated ability to read and write (P < 0.001).

Table 7.3: Spearman correlation coefficients of the Short OA-TOFHLiD, the S-TOFHLA, and the REALD-30 with related measurements (concurrent, convergent, and predictive validity)

<table>
<thead>
<tr>
<th>Related measurement</th>
<th>Short OA-TOFHLiD</th>
<th>S-TOFHLA</th>
<th>REALD-30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ρ</td>
<td>P-value</td>
<td>ρ</td>
</tr>
<tr>
<td>Age</td>
<td>-0.217</td>
<td>0.026*</td>
<td>-0.167</td>
</tr>
<tr>
<td>Years of Education</td>
<td>0.290</td>
<td>0.003**</td>
<td>0.288</td>
</tr>
<tr>
<td>Frequency of dental service utilisation (last year)</td>
<td>0.310</td>
<td>0.002**</td>
<td>0.224</td>
</tr>
<tr>
<td>Self-rated ability to read</td>
<td>0.333</td>
<td>&lt;0.001**</td>
<td>0.349</td>
</tr>
<tr>
<td>Self-rated ability to write</td>
<td>0.403</td>
<td>&lt;0.001**</td>
<td>0.371</td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-TOFHLA</td>
<td>0.634</td>
<td>&lt;0.001**</td>
<td>1.00</td>
</tr>
<tr>
<td>REALD-30</td>
<td>0.525</td>
<td>&lt;0.001**</td>
<td>0.458</td>
</tr>
<tr>
<td>Oral health Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMFT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Decay</td>
<td>-0.098</td>
<td>0.315</td>
<td>-0.168</td>
</tr>
<tr>
<td></td>
<td>- Number of Missing</td>
<td>-0.239</td>
<td>0.013*</td>
</tr>
<tr>
<td></td>
<td>- Number of Filled</td>
<td>-0.162</td>
<td>0.096</td>
</tr>
<tr>
<td></td>
<td>Number of present functional teeth</td>
<td>0.251</td>
<td>0.010**</td>
</tr>
<tr>
<td>Number of severe decayed teeth that need to be extracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.268</td>
<td>0.005**</td>
<td>-0.264</td>
</tr>
</tbody>
</table>

* P < 0.05, ** P < 0.01
Convergent Validity

The convergent validity, which was established by testing Spearman’s Rank correlation coefficient between 2 tests that have similar constructs, are shown in Table 7.3. Short OA-TOFHLiD was highly correlated with both the validated HL tool (S-TOFHLA, Spearman’s r = 0.634, P < 0.001), and the validated OHL tool (REALD-30, Spearman’s r = 0.525, P < 0.001). Further investigation by multivariate linear regression is seen in Table 7.4. Associations between Short OA-TOFHLiD and the validated tools remained (P < 0.001), after controlling for age, gender, education, and ethnicity.

Table 7.4: Univariate and multivariate linear regression of the OA-TOFHLiD to predict the reference measurements (convergent validity)

<table>
<thead>
<tr>
<th>Control Variable</th>
<th>S-TOFHLA</th>
<th>REALD-30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P-Value</td>
<td>B (CI)</td>
</tr>
<tr>
<td>OA-TOFHLiD score</td>
<td>&lt;0.001**</td>
<td>0.77 (0.59, 0.96)</td>
</tr>
<tr>
<td>Age (&lt;75)</td>
<td>0.535</td>
<td>1.08 (-2.37, 4.54)</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>0.245</td>
<td>2.31 (-1.61, 6.23)</td>
</tr>
<tr>
<td>Education (≥high school)</td>
<td>0.786</td>
<td>0.84 (-5.27, 6.95)</td>
</tr>
<tr>
<td>Ethnicity (White)</td>
<td>0.617</td>
<td>-1.36 (-6.72, 4.01)</td>
</tr>
<tr>
<td>R²</td>
<td>45.4%</td>
<td></td>
</tr>
</tbody>
</table>

*P <0.05, **P < 0.001

Predictive Validity

The predictive validity of the Short OA-TOFHLiD scores was based on the hypothesis that OHL scores were associated with oral health status, or could predict oral health status. The results of predictive validity from Spearman’s rank correlation analysis are presented in Table 7.3. None of the HL/OHL instruments was correlated to Decay-Missing-Filled Teeth Index (DMFT). However, when DMFT were classified into each sub-category and reanalysed, it was found that only Short OA-TOFHLiD scores correlated with number of decayed teeth (Dt) (Spearman’s r = -0.239, P = 0.013) and number of filled teeth (Ft) (Spearman’s r = 0.251, P = 0.010). Furthermore, the scores of Short OA-TOFHLiD, S-TOFHLA
and REALD-30 were correlated with the number of severely decayed teeth that needed to be extracted (Spearman’s r = -0.302, -0.391, and -0.253 respectively, P < 0.01).

Table 7.5 shows the results of binary logistic regression analyses used to confirm the validity of Short OA-TOFHLiD scores to predict good or bad oral health indicators. When controlling for age, gender, education and ethnicity, it was found that Short OA-TOFHLiD scores were significantly associated with having dental caries (P = 0.042), and utilisation of dental services in the previous year (P = 0.022). However, it was not shown to have a strong association with having natural functional teeth more than 20 (P = 0.062). Age less than 75 became a significant factor (P = 0.026) in predicting having more than 20 functional natural teeth.

Table 7.5: Multivariate logistic regression of the Short OA-TOFHLiD to predict oral health statuses

<table>
<thead>
<tr>
<th>Predicting variables</th>
<th>Having active caries (Yes/No)</th>
<th>Having natural teeth more than 20 (Yes/No)</th>
<th>Utilisation in last year (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B SE P-value Exp (B) (95% CI)</td>
<td>B SE P-value Exp (B) (95% CI)</td>
<td>B SE P-value Exp (B) (95% CI)</td>
</tr>
<tr>
<td>Short OA-TOFHLiD Scores</td>
<td>-0.05 0.03 0.042* 0.95 (0.90-0.99)</td>
<td>0.05 0.02 0.062 0.95 (0.91-1.00)</td>
<td>0.06 0.03 0.022* 1.06 (1.01-1.12)</td>
</tr>
<tr>
<td>Control Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (&lt;75)</td>
<td>-0.88 0.45 0.052 0.42 (0.17-1.01)</td>
<td>-1.09 0.49 0.026* 0.34 (0.13-0.88)</td>
<td>0.85 0.47 0.073 2.33 (0.92-5.88)</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>0.72 0.50 0.151 2.04 (0.77-5.43)</td>
<td>-0.96 0.61 0.114 0.38 (0.12-1.26)</td>
<td>0.29 0.53 0.581 1.34 (0.47-3.79)</td>
</tr>
<tr>
<td>Education (high school)</td>
<td>-0.41 0.79 0.607 0.67 (0.14-3.14)</td>
<td>0.59 0.79 0.455 1.80 (0.38-8.46)</td>
<td>-0.71 0.84 0.398 0.49 (0.10-2.54)</td>
</tr>
<tr>
<td>Ethnicity (White)</td>
<td>-0.40 0.67 0.549 0.67 (0.18-2.50)</td>
<td>0.88 0.77 0.254 0.41 (0.09-7.88)</td>
<td>0.37 0.71 0.597 1.45 (0.36-5.80)</td>
</tr>
<tr>
<td>% of Model correction</td>
<td>64.1%</td>
<td>72.8%</td>
<td>65.3%</td>
</tr>
</tbody>
</table>

*P < 0.05

Thresholding of Short OA-TOFHLiD

Figure 7.1 displays the Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC) curve using Short OA-TOFHLiD scores to determine if dental caries are present. The AUC is 0.617 (P = 0.039, CI 0.509-0.726), which
could be interpreted that the probability of OHL scores to identify people with current active dental caries is poor to fair.

**Figure 7.1:** ROC curve of the Short OA-TOFHLiD scores predicting presence of active caries in older adults

Table 7.6 presents numbers of true positive, false positive, true negative, false negative, sensitivity and specificity of Short OA-TOFHLiD in detecting having active caries status. We considered the appropriate cut-off point of Short OA-TOFHLiD would be at 35 because it demonstrated the balanced sensitivity and the specificity (60.0% and 60.7% respectively). Therefore, the OA-TOFHLiD scores between 0-34 represents are classified as potentially ‘Inadequate OHL’, and 35-39 represents ‘Adequate OHL’.
Table 7.6: Performance of the Short TOFHLiD scores to predict active caries status at various cut-off points of OHL scores (n=106)

<table>
<thead>
<tr>
<th>Cut-off scores</th>
<th>Having Active Caries</th>
<th>No Active Caries</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True Positive (TP)</td>
<td>False Negative (FN)</td>
<td>False Positive (FP)</td>
<td>True Negative (TN)</td>
</tr>
<tr>
<td>≥ 30</td>
<td>14</td>
<td>31</td>
<td>13</td>
<td>48</td>
</tr>
<tr>
<td>≥ 31</td>
<td>15</td>
<td>30</td>
<td>13</td>
<td>48</td>
</tr>
<tr>
<td>≥ 32</td>
<td>17</td>
<td>28</td>
<td>16</td>
<td>45</td>
</tr>
<tr>
<td>≥ 33</td>
<td>18</td>
<td>27</td>
<td>16</td>
<td>45</td>
</tr>
<tr>
<td>≥ 34</td>
<td>22</td>
<td>23</td>
<td>19</td>
<td>42</td>
</tr>
<tr>
<td>≥ 35</td>
<td>27</td>
<td>18</td>
<td>24</td>
<td>37</td>
</tr>
<tr>
<td>≥ 36</td>
<td>30</td>
<td>15</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>≥ 37</td>
<td>35</td>
<td>10</td>
<td>38</td>
<td>23</td>
</tr>
<tr>
<td>≥ 38</td>
<td>39</td>
<td>6</td>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>39</td>
<td>45</td>
<td>0</td>
<td>57</td>
<td>4</td>
</tr>
</tbody>
</table>

*The yellow highlight shows proposed cut-off scores*

Comparing performances of the OA-TOFHLiD and the Short OA-TOFHLiD

The performances of the original version previously presented in Chapter 4, compared to the performances of the shortened version of the OA-TOFHLiD is demonstrated in Table 7.7.

Overall, participants spent less time completing the shortened version compared to the original. For the assessment of validity, the concurrent validity and the convergent validity of both versions were equal. However, for predictive validity, the scores from the original version were shown to have significant correlations with all subcategories of oral health status, while the abbreviated version presented only some significant correlations. In addition, in multivariate logistic regression, the OHL scores from the original version were able to predict the gold standard oral health status while the short version could predict only one of three subcategories of the gold standard (dichotomous active caries status).

Considering the accuracy of the test, the OA-TOFHLiD has higher sensitivity and specificity in identifying participants with poor oral health status, compared to the Short OA-TOFHLiD.
Table 7.7: Performances and validity of the original version (Chapter 4) and the shortened version of the OA-TOFHLiD

<table>
<thead>
<tr>
<th>Performances</th>
<th>OA-TOFHLiD</th>
<th>Short OA-TOFHLiD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion time</td>
<td>15-30 minutes</td>
<td>8-20 minutes</td>
</tr>
<tr>
<td>Content</td>
<td>4 reading comprehension tests, 2 prompts (total scores = 48)</td>
<td>4 reading comprehension tests (total scores = 39)</td>
</tr>
</tbody>
</table>

Validity

<table>
<thead>
<tr>
<th>Concurrent validity</th>
<th>Significant correlation</th>
<th>Significant correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Years of Education</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Frequency of dental services</td>
<td>-</td>
</tr>
</tbody>
</table>

Convergent validity

- S-TOFHLA
- REALD-30

Predictive validity

- Number of teeth
- Decay Teeth (DT)
- Missing Teeth (MT)
- Filled Teeth (FT)
- DMFT
- Additional
  - Significant ability to predict ‘Gold Standard’ Good oral health in multivariate logistic regression
  - Significant ability to predict only dichotomous dental caries status in multivariate logistic regression

Accuracy to detect poor oral health by OHL at the proposed cut-off score

- Sensitivity
- Specificity

*Gold standard Good oral health status meant a participant had no active caries, 5-8 posterior occlusal pairs, and had at least 20 natural functional teeth. If one failed to complete all three criteria, they were classified as Poor oral health status.

Discussion

The aim of this study was to validate an abbreviated version of the OA-TOFHLiD (Short OA-TOFHLiD). Despite attempts to measure OHL in a general population (Jones, Parker, Mills, Brennan, & Jamieson, 2014; J. Lee, Stucky, Rozier, Lee, & Zeldin, 2013; J. Y. Lee et al., 2007; Macek et al., 2010; Naghibi Sistani, Montazeri, Yazdani, & Murtomaa, 2014), no previous works have been undertaken in an older adult population. The increasing importance of this group combined with their high degree of heterogeneity and poorly understood risk factors means such work is needed. This tool focused on evaluating the OHL of community-dwelling
independent older adults because this group usually make decisions regarding their health on their own, which require HL and OHL skills to act efficiently.

From the data collection process, participants usually spent between 5-20 minutes completing the short OA-TOFHLiD. This was longer than the other validated OHL tests. However, they spent a shorter amount of time on the test compared to the previous study of the full version of OA-TOFHLiD (maximum 45 minutes) and there were no complaints about the length of the test. The majority of participants completed the test without any help from the researcher i.e. by reading the directions on the first page of the test. However, a few participants could not understand the directions, resulting in further explanation and examples from the researcher.

For concurrent validity, the result from this study found that Short OA-TOFHLiD scores negatively correlated with the age of the participants, which means the older the participants are, the lower the OHL scores recorded. This finding confirmed our hypothesis with respect to possible cognitive decline, and also confirmed previous study findings (Baker et al., 2000; Kobayashi et al., 2014). Educational level was correlated with OHL scores obtained from Short OA-TOFHLiD, which is comparable with previous findings from HL research (van der Heide et al., 2013).

The Short OA-TOFHLiD found appropriate convergent validity compared to the previous validated HL tool - S-TOFHLA, which shares the same construct of health literacy assessment. The result showed that OHL scores correlated with the medical HL scores from S-TOFHLA, which were consistent with a previous validation study (Gong et al., 2007). However, the validated dental health literacy tools (REALD-30) and the short OA-TOFHLiD presented a lower correlation. Although OA-TOFHLiD and REALD were classified as tools to assess functional or basic OHL regarding the Nutbeam classification (Nutbeam, 2000), they have a different approach in measuring oral health literacy. OA-TOFHLiD is a reading comprehension test, which required reading comprehension skills for understanding texts and choosing appropriate words to fit in those contexts. In contrast, REALD-30 is a word recognition test, which required only correct pronunciations of words to obtain an OHL score. Some people may not truly understand the meaning of the words in the test, but they still could pronounce them correctly (Khan et al., 2014).
The association between OHL and self-rated oral health status was still unclear. In a previous study of a U.S. adult population aged between 17-65 years old, it was found that with higher OHL scores, there was an increased prevalence of self-rated oral health status deemed as ‘excellent’ or ‘very good’ (J. Y. Lee, Divaris, Baker, Rozier, & Vann, 2012). However, this study did not find any correlation between self-rated oral health status and OHL scores. One explanation for this has been explored in a previous study, that indicated older adults who rated themselves as having good oral health status may be less aware of health problems compared to other age groups (Locker & Slade, 1994). Additionally, perceived oral health status might not be a reliable measurement in this age group because the association between clinical and perceived oral health status in older adults was found to be weak and inconsistent (Locker & Slade, 1994). Therefore, this study did not use perceived oral health status as the major outcome for predictive validity in this study.

Regarding predictive validity, Short OA-TOFHLiD was found to perform well at predicting oral health among the three tools used in the validation study (Table 7.3). It is the only one out of three tests that presented a significant correlation with the number of active caries recorded. This also showed that although medical literacy and dental literacy were highly correlated, the use of a medical tool alone is insufficient to capture important details regarding oral health. When controlling for the effects of age, gender, education level and race on OHL, the significant association between OHL scores obtained from shortened OA-TOFHLiD and dental caries status still remained. Dental services utilisation in the previous year was determined as an outcome of good oral health behaviour because the majority of the participants in this study utilised it for examinations (check-ups) where prevention therapies and advice should be provided. Interestingly, Short OA-TOFHLiD also predicted this oral care behaviour of older adults, which has not been found in previous OHL studies (Burgette, Lee, Baker, & Vann, 2016). However, links between low HL and medical health service utilisation have been observed in previous research. People with low HL utilised more unnecessary health services and had more expenditures, which is an undesirable situation for a general health system (Rasu, Bawa, Suminski, Snella, & Warady, 2015).

In order to dichotomise Short OA-TOFHLiD into two groups, we proposed that scores 35 through 39 were categorised as Adequate OHL and the scores lower than these are classified as Inadequate OHL. These cut-off scores were quite
high in order to achieve increased sensitivity to detect active caries status in this study. The results from the ROC curve showed that 60% of people with OHL lower than 35 have at least one active dental caries in the mouth, indicating only an acceptable level of sensitivity. There is a need to improve the sensitivity and specificity of this cut-off score of the tool in future studies in real community settings and various populations.

This study had several limitations. Firstly, we could not perform test-retest reliability as the process, including the 2 questionnaires, one pronunciation task and oral screening, took 1.5-2 hours to complete. In addition, data sharing protocols prevented us from accessing participants by post or other means. A second limitation is the study was conducted in congregate-meal sites situated in communities, where ethnicity was homogeneous, with most of the participants being female and white. Therefore, caution is warranted when interpreting the final model of multivariate analysis, where gender and ethnicity were entered as control factors when looking at Short OA-TOFHLiD scores ability to predict oral health status. In addition, as this study was a cross-sectional study causal links cannot be made. The final limitation is the Short OA-TOFHLiD can only evaluate OHL in older participants who have an ability to read and write, thus older adults with declining physical skills may not be able to participate.

**Conclusion**

There is a real need for a simple oral health-screening device for older adults in communities and residential settings. For example, the Short OA-TOFHLiD could be administered to new residents in care facilities to determine their oral health or used as a screening tool in communities for epidemiological or care prioritisation purposes.

The Short OA-TOFHLiD was found to have good concurrent, convergent and predictive validity to assess functional oral health literacy in older adults. Although it has lost some performances comparing to the original version, the tool itself is comprehensive, easy to understand, and easy to administer, it can be administered by non-dental professionals. Further work is needed to optimise the cut off points, either as a single score, or by looking at individual components within the tool, to tailor the outcomes for any given application. For example, one
may wish to optimise specificity for a community-screening programme, while balance sensitivity and specificity for an epidemiological approach.
References


8. Chapter 8

Evaluation of the Short Test of Functional Health Literacy in Dentistry in Older Adults (Short OA-TOFHLiD) in Thai older adults
Foundation of Chapter 8

The English short version of the Test of Functional Health Literacy in Dentistry in Older Adults (Short OA-TOFHLiD) was validated in American older adults as presented in Chapter 7. It was found to have acceptable concurrent, convergent and predictive validities. Additionally, the cut-off score to distinguish between ‘Adequate’ and ‘Inadequate’ oral health literacy was established in the English version. Therefore, this chapter aimed to use this cut-off point to confirm its performance in the Thai population by using secondary data obtained from two previous studies (Chapter 4 and 5).

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Results</th>
<th>What was learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Literature review</td>
<td>No tool for older adults</td>
<td>Identify research gaps questions and set the objectives</td>
</tr>
<tr>
<td>2</td>
<td>Identify problems and needs</td>
<td>Poor oral health status and treatment needs in the target population. N = 393</td>
<td>Need a preventive care focus on oral health promotion</td>
</tr>
<tr>
<td>3</td>
<td>First pilot of the OA-TOFHLiD</td>
<td>The pilot OA-TOFHLiD total score = 35</td>
<td>Poor predictive validity (\rightarrow) test needed to be improved</td>
</tr>
<tr>
<td>4</td>
<td>Optimised OA-TOFHLiD</td>
<td>The optimised OA-TOFHLiD total score = 48</td>
<td>The test presents the ability of OHL predict oral health status</td>
</tr>
<tr>
<td>5</td>
<td>Use OA-TOFHLiD in clinical setting</td>
<td>Those with adequate OHL presents better oral health status</td>
<td>Feedback: there were complaints indicated that OA-TOFHLiD was too long for some to complete.</td>
</tr>
<tr>
<td>6</td>
<td>Qualitative study of the OA-TOFHLiD [Subgroup of Chapter 5]</td>
<td>Those with adequate OHL presents better oral health status</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Validation the Short OA-TOFHLiD In the US population</td>
<td>The Short OA-TOFHLiD total scores = 39</td>
<td>The test presents acceptable validity (\rightarrow) Need to confirm with different population</td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluation the Short OA-TOFHLiD In the Thai population [Combined data from Chapter 4 and 5]</td>
<td>The performance of the shortened version was confirm.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A protocol for a pilot study using the Short OA-TOFHLiD in community</td>
<td>Expected to see the most appropriate route to delivery the test in communities</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>General discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstract

**Background:** A new oral health literacy (OHL) tool has been validated and assessed in the previous chapters, called the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD). The short version of the OA-TOFHLiD was validated in a US population, and cut off score between adequate and inadequate OHL was established. The objective of this study was to use the established cut-off scores from the US subjects within a different population.

**Methods:** Two sets of data from the previous studies using Thai subjects were combined, the first one being a validation study from January 2017 (Chapter 4) and the second one a validated tool to assess oral health literacy from January 2018 (Chapter 5). Descriptive statistics were used to explain variables. Sensitivity and specificity at each cut off point was tested by conducting the Receiver Operating Characteristics (ROC) Curve, and Area Under the Curve (AUC). Spearman’s correlation and a Mann-Whitney U test were used to find correlation and compare different characteristics between Adequate and Inadequate OHL. The ability of the Short OA-TOFHLiD scores to predict oral health status was tested by univariate and multivariate logistic regression analysis.

**Results:** The combined data consisted of 218 Thai older adults between 60-88 years old. The mean score of the Short OA-TOFHLiD was 30.17 (SD 7.79) with a range from 1 to 39. When using the previously established threshold (≥35) to distinguish between Adequate and Inadequate OHL, the significant differences between characteristics and oral health conditions were presented. The sensitivity and specificity of OHL scores in predicting oral health status at the proposed cut off point were 68% and 55.9%, respectively.

**Conclusion:** The Short OA-TOFHLiD with the proposed cut-off scores was found to have good performance in differentiating people with different characteristics in Thai and US subjects. Although the sensitivity in detecting older adults with poor oral health was not high, it will be beneficial to use it as a primary screening tool for communities where there is a scarcity of health professionals.
Introduction

It has been more than 40 years since the term ‘health literacy’ was initially used in 1974 (Simonds, 1974). Since then health literacy has gained a lot of attention with the creation of definitions, assessment tools, and interventions related to health literacy from many researchers around the world (World Health Organization Regional Office for Europe, 2013). Oral health literacy (OHL), which was developed from health literacy, was first described in 2005 (Baur et al., 2005; Rudd & Horowitz, 2005). Oral health literacy was defined as “The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate oral health decisions” (U.S. Department of Health and Human Services, 2000). In dentistry, studies have reported that people with adequate oral health literacy have better oral health knowledge and oral health behaviour (Firmino et al., 2018), which are associated with better oral health outcomes (Firmino et al., 2017). Therefore, oral health literacy is believed to be one of the key elements to reduce oral health disparities or inequalities, and has become one of the goals of many oral health promotion and prevention interventions (Nutbeam, 2000).

Previous studies related to the development of oral health literacy tools mostly focused on measuring functional oral health literacy (Dickson-Swift, Kenny, Farmer, Gussy, & Larkins, 2014). One of the most recognized oral health literacy tools was developed from a medical health literacy tool, called The Rapid Estimate of Adult Literacy in Dentistry (REALD), the design of which originated from the Rapid Estimate of Adult Literacy in Medicine (REALM) (Lee, Rozier, Lee, Bender, & Ruiz, 2007; Richman et al., 2007). This test was a word recognition OHL tool, and assessed the ability of a patient to pronounce words correctly (Davis et al., 1993). The REALD-99 test was made from 99 dental related words (Richman et al., 2007). A short version called the REALD-30 was also validated which reduced the number of words from 99 to 30 (Lee et al., 2007). It was found the validation and reliability of the REALD-99 and REALD-30 were fairly similar, except there was a higher predictive validity in the REALD-99 (Richman et al., 2007). However, the REALD-30 became more popular because it is faster to administer in a clinical setting and has satisfactory performance (Dickson-Swift et al., 2014).
Another well-known functional OHL tool is the Test of Functional Health Literacy in Dentistry (TOFHLiD), which was developed and validated in 2007 (Gong et al., 2007). This test was created based on the platform of the Test of Functional Health Literacy (TOFHLA) (Parker, Baker, Williams, & Nurss, 1995), which is composed of a reading comprehension test and a prompt. This type of OHL tool aims to assess functional health literacy by evaluating reading, writing, and numeracy skills of participants. The TOFHLiD was originally developed to measure OHL of parents who were taking care of their children’s oral health. It consisted of three reading comprehension parts (1. Instruction following vanish application, 2. Consent form for dental treatment, 3. Medicaid rights and responsibility) and four prompts (1. Toothpaste tube, 2. Clinical appointment card, 3. Fluoride tablet prescription label, 4. Fluoride drop prescription label) (Gong et al., 2007). Although the TOFHLiD seems to be a very comprehensive OHL test, it was not as popular as the REALD tests because the content was specific to children’s oral health and related to the US health system, and therefore not as appropriate for older age groups or different populations. In addition, the participants generally needed to spend at least 20 minutes to complete the full test, which is inconvenient in a fast-paced clinical setting (Dickson-Swift et al., 2014; Jordan, Osborne, & Buchbinder, 2011).

There has been no specific tool which comprehensively evaluates oral health knowledge, practice, and conditions to measure OHL in older adults, even though the older population was the first group to be described in relation to oral health literacy over three decades ago (Rudd & Horowitz, 2005). Therefore, an OHL test aiming to measure functional oral health literacy in the general older adult population, called the Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was developed. It was found the OA-TOFHLiD had good validity and reliability (Chapter 4). In addition, OA-TOFHLiD cut-off points were established in order to distinguish people with ‘Adequate’ or ‘Inadequate’ OHL. The cut-off scores were re-tested in a separate population (Chapter 5) and it was reported that people with Adequate OHL had better oral health outcomes, such as a lower mean number of active caries, higher number of natural functional teeth, and less treatment needs.

The Short OA-TOFHLiD was developed further due to feedback from older participants about the length of the original version. In addition, the prompts in the original version, which were the labels of fluoride toothpaste and
chlorhexidine mouthwash, were too complex for some older adults. Therefore, a short version of OA-TOFHLiD was developed by deleting the prompts from the original version, and tested with US older adults (Chapter 7). In the validation study of the Short OA-TOFHLiD (Chapter 7), it was found the predictive validity was not fully established. In addition, the Thai Short OA-TOFHLiD has not been evaluated. Therefore, the primary objective of this study was to evaluate the previously established cut-off score of the Short OA-TOFHLiD in Thai subjects. The secondary objective was to assess the other performances of the Short OA-TOFHLiD, such as predictive ability, sensitivity and specificity of the tool to detect people with poor oral health status.

Methodology

Study design and subjects

This study had a cross-sectional design, which utilised secondary data included from two previous studies (Chapter 4 and 5). The first study (Chapter 4) was conducted in June 2016 with 103 Thai older adults to validate the OA-TOFHLiD, and the second study (Chapter 5) was conducted with 115 Thai older adults in June 2017 to measure oral health literacy and associated factors in Thai older adults using the OA-TOFHLiD. The inclusion criteria of the participants in both studies were the same: 1.) Age 60 years or more 2.) Can read and write Thai language without any assistance 3.) Do not have any serious medical conditions or disabilities that would affect the ability to complete an OHL test by themselves (e.g. vision problems, cognitive impairment). Both studies had been reviewed and approved by the University of Manchester Research Ethic Committee (Reference number 2017-0106-2408 and 2018-2822-4728), and the Human Experimentation Committee of the Faculty of Dentistry at Chiang Mai University (Number 19/2016 and 44/2017).

Oral Health Literacy Measurement (Independent Variable)

In Chapter 7, a short version of the OA-TOFHLiD was developed by cutting two prompts from the original version. In the ‘Understanding Numeracy and Texts’ section, a fluoride toothpaste label and a chlorhexidine mouthwash label reading were cut. The remaining part was a reading comprehension test, which was
comprised of four topics related to dental caries, gum disease, oral hygiene care, and an example of a dental treatment consent form. The total possible score of the original OA-TOFHLiD was 48, but the total score on the short version was reduced to 39. The short version of the OA-TOFHLiD was previously validated with American older adults at five congregate meal sites and community centers in Chicago, Illinois in June 2017. The time of administration the test was approximately 10-15 minutes. The results from the US population indicated that the Short OA-TOFHLiD had acceptable concurrent validity, convergent validity, and predictive validity. In addition, cut-off scores were established in the validation study, with scores between 0 and 34 considered ‘Inadequate OHL’, and scores between 35 and 39 ‘Adequate OHL’.

**Dependent variables**

Demographic data were obtained using the same questionnaire as the two previous studies described in Chapter 4 and 5. Age, gender, educational attainment, monthly income, utilisation of dental service, health insurance, and self-rated oral health status (0 poor to 5 excellent) were obtained. The demographic data were dichotomised into two groups for further analysis.

Oral health status metrics from the two previous studies were gained through clinical examination by the same dentist and determined by the same indices. A Decay-Missing-Filled Teeth (DMFT) index with the WHO criteria (Ishii & Yoshida, 1978) was used to measure dental caries status. Furthermore, treatment needs, number of natural functional teeth, number of posterior occlusal pairs, prosthesis status, and prosthesis needs were examined and collected.

An overall oral health status variable was created in Chapter 4 and 5 in order to carry out comparisons between those deemed as having good or poor oral health. Oral health status was determined using a composite score of three essential oral health variables: 1.) Having no active caries; 2.) Having natural functional teeth equal to, or more than 20; 3.) Having posterior occlusal pairs (including pairs from natural teeth, implants, pontics or removable prostheses, but excluding full dentures) equal to, or more than five. Participants who were classified as having ‘Good oral health status’ had to meet all three above-mentioned criteria. Ones who could not meet at least one criterion were classified as having ‘Poor oral health status’.
Statistical analysis

The two data sets were combined and cleaned in SPSS version 23.0 for Mac (IBM Corps, 2015). A new file was created to analyse all the data. The characteristics of the participants and background data were summarised using descriptive statistics, such as percentage, mean and standard deviation (SD), median, and interquartile range (IQR). The Receiving-Operating Characteristics (ROC) curve with Area Under the Curve (AUC) was run, and sensitivity and specificity were calculated for each cut off point for this Thai older adults population. These cut off points then can be compared to the optimal cut off point determined from the USA data to determine if the optimal cut off remains the same across different populations. As the data was not normally distributed, non-parametric tests were used for analysis. Spearman’s correlation analysis was used to determine the correlation between OHL scores and possible related factors found in the previous studies. For further tests, this previous established cut off score of Short OA-TOFHLiD (≥35) was used to dichotomise subjects in this study into 2 groups (Adequate and Inadequate OHL). The dichotomised data was used as independent variables in several tests. Mann-Whitney U tests were employed to compare different outcomes between participants with adequate and inadequate OHL. In addition, univariate and multivariate logistic regression analyses were used to test the ability of OHL level (Adequate OHL) to predict oral health status.

Results

Background characteristics are presented in Table 8.1. The total number of older adults in this study was 218, and the majority of participants were female (65.1%). The age range was 60 to 88 and the mean age was 67.46 (SD 5.83). More than half of the participants had high school or lower education and had a monthly income lower than the Thai poverty line, which was less than 2,644 Thai Baht (75.5 USD) per month. For health insurance, the percentage of people with Government Health Benefits (GBH) was slightly higher than the percentage of people with Universal Coverage (UC) (39.9. % and 36.7% respectively). For dental service utilisation, 60.6% of the participants had used dental services in the previous year.
Table 8.1: Characteristics of the subjects (n=218)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>76</td>
<td>34.9</td>
</tr>
<tr>
<td>Female</td>
<td>142</td>
<td>65.1</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>150</td>
<td>68.8</td>
</tr>
<tr>
<td>70 or higher</td>
<td>68</td>
<td>31.2</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or lower</td>
<td>122</td>
<td>56.0</td>
</tr>
<tr>
<td>College or higher</td>
<td>91</td>
<td>41.7</td>
</tr>
<tr>
<td>No answer</td>
<td>5</td>
<td>2.3</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;Poverty line (2644 THB)</td>
<td>118</td>
<td>54.2</td>
</tr>
<tr>
<td>≤Poverty line</td>
<td>84</td>
<td>38.5</td>
</tr>
<tr>
<td>No answer</td>
<td>16</td>
<td>7.3</td>
</tr>
<tr>
<td>Insurance Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC</td>
<td>80</td>
<td>36.7</td>
</tr>
<tr>
<td>GHB</td>
<td>87</td>
<td>39.9</td>
</tr>
<tr>
<td>SSS</td>
<td>17</td>
<td>7.8</td>
</tr>
<tr>
<td>Other</td>
<td>24</td>
<td>11.0</td>
</tr>
<tr>
<td>No answer</td>
<td>10</td>
<td>4.6</td>
</tr>
<tr>
<td>Dental service utilisation in the past year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>132</td>
<td>60.6</td>
</tr>
<tr>
<td>No</td>
<td>79</td>
<td>36.2</td>
</tr>
<tr>
<td>No answer</td>
<td>7</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table 8.2 presents an overview of indexes that were used in this study. Regarding OHL measurement, the range of Short OA-TOFHLiD scores was from 1 to 39 and the mean score was 30.17 (SD 7.79). For dental caries status, the mean number of decayed teeth (D) was 1.59 (SD 2.70), the mean number of missing teeth (M) was 6.91 (SD 6.89), the mean number of filled teeth (F) was 3.35 (SD 4.29), and the mean Decay-Missing-Filled Teeth (DMFT) was 13.41 (SD 7.32). The mean number of natural functional teeth, excluding implants, bridge pontics, or poor prognosis teeth that could not function properly, was 23.11 (SD 7.09) and the mean posterior occlusal pairs was 5.47 (SD 2.52).
### Table 8.2: Descriptive statistics for all related measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Part</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short OA-TOFHLiD</td>
<td>Total (39)</td>
<td>30.17</td>
<td>7.79</td>
<td>1</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Number of Decayed teeth (DT)</td>
<td>1.59</td>
<td>2.70</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Number of Missing teeth (MT)</td>
<td>6.91</td>
<td>6.89</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Number of Filled teeth (FT)</td>
<td>3.35</td>
<td>4.29</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Decay-Missing-Filled Teeth Index (DMFT)</td>
<td>13.41</td>
<td>7.32</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Number of Natural Functional teeth</td>
<td>23.11</td>
<td>7.09</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Number of posterior occlusal pairs</td>
<td>5.47</td>
<td>2.52</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Sensitivity and specificity were calculated for each cut off point for this population and Receiving Operating Characteristics (ROC) was calculated. The USA data suggested a score of equal or greater than 35 would be the optimal cut off point to determine adequate or inadequate OHL based on oral health status. The previous established cut-off scores (from chapter 4) of the Short OA-TOFHLiD were applied to this data and classified subjects into two groups. The people who got Short OA-TOFHLiD scores from 0 to 34 were classified as ‘Inadequate OHL’, and scores from 35 to 39 were classified as ‘Adequate OHL’. There were 86 older adults who were classified as having Adequate OHL, while 132 older adults were classified as having Inadequate OHL.

The sensitivity and specificity of the Short OA-TOFHLiD to detect ‘Poor oral health’ at each cut-off score is demonstrated, and the established cut off point was highlighted in Table 8.3. Participants who fell into different criteria were put into different columns. True Positive (TP) determines that a participant who was classified into Inadequate OHL (with the cut-off score in each row on the table) had Poor oral health status. False Negative (FN) presents ones with Adequate OHL but had Poor oral health status. False Positive (FP) shows participants who had Inadequate OHL but had Good oral health status. True Negative (TN) represents ones who had Adequate OHL and Good Oral Health status.

Table 8.3 presents that the previous established cut off score of 35 on the Short OA-TOFHLiD was the most optimal in distinguishing between those with poor and good oral health status within an acceptable sensitivity and specificity. At this cut-off score, the best balance between sensitivity and specificity was found to be...
68.0% and 55.9%, respectively, which confirmed that 35 seems to be the most appropriate across two different groups (USA and Thai).

Table 8.3: Sensitivity and specificity of each cut-off point of the Short OA-TOFHLiD

<table>
<thead>
<tr>
<th>Cut-off scores of Inadequate OHL</th>
<th>Poor Oral Health (n=150)</th>
<th>Good Oral Health (n=68)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True Positive (TP)</td>
<td>False Negative (FN)</td>
<td>False Positive (FP)</td>
<td>True Negative (TN)</td>
</tr>
<tr>
<td>30</td>
<td>62</td>
<td>88</td>
<td>16</td>
<td>52</td>
</tr>
<tr>
<td>31</td>
<td>64</td>
<td>86</td>
<td>19</td>
<td>49</td>
</tr>
<tr>
<td>32</td>
<td>71</td>
<td>79</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>33</td>
<td>76</td>
<td>74</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>34</td>
<td>88</td>
<td>62</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td>35*</td>
<td>102</td>
<td>48</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>36</td>
<td>112</td>
<td>38</td>
<td>41</td>
<td>27</td>
</tr>
<tr>
<td>37</td>
<td>125</td>
<td>25</td>
<td>51</td>
<td>17</td>
</tr>
<tr>
<td>38</td>
<td>137</td>
<td>13</td>
<td>62</td>
<td>6</td>
</tr>
<tr>
<td>39</td>
<td>146</td>
<td>4</td>
<td>67</td>
<td>1</td>
</tr>
</tbody>
</table>

The yellow highlight shows proposed cut-off scores

The ability of the Short OA-TOFHLiD scores in differentiating people with good or poor oral health was additionally assessed by ROC curve and Area Under the Curve (AUC) of ROC curve. The AUC was 0.616 (p = 0.006, 95% CI 0.538-0.694), which could be interpreted to mean the Short OA-TOFHLiD scores had a ‘fair’ ability (AUC between 0.6-0.7) to differentiate people with Poor or Good oral health in Thai population.

Table 8.4 presents correlation between correlation between short OA-TOFHLiD scores and possible related factors. In this study, the Short OA-TOFHLiD scores were found to be significantly negatively correlated with age (r = -0.346, p <0.001), positively correlated with years of education (r = 0.618, p < 0.001) and positively correlated with monthly income (r = 0.535, p<0.001). Regarding oral health status, the Short OA-TOFHLiD was significantly negatively correlated with number of decayed teeth (r = -0.471, p < 0.001) and number of missing teeth (r = -0.214, p = 0.002). However, the OHL scores were significantly positively correlated with number of filled teeth (r = 0.489, p < 0.001), natural functional teeth (r = 0.371, p < 0.001), and posterior occlusal pairs (r = 0.334, p < 0.001). However, DMFT and self-rated oral health status were not significantly correlated with the Short OA-TOFHLiD.
Table 8.4: Spearman correlation coefficients between Short OA-TOFHLiD and related measurements

<table>
<thead>
<tr>
<th>Variables</th>
<th>Spearman Correlations with Short OA-TOFHLiD</th>
<th>Mann-Whitney U-test Comparing oral health statuses between different OHL levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P-value</td>
</tr>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.346</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Education</td>
<td>0.618</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Income (USD)</td>
<td>0.535</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perceived Oral health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated oral health (0-poor to 5-excellent)</td>
<td>-0.019</td>
<td>0.778</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Oral Health Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decayed Teeth (DT)</td>
<td>-0.471</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing Teeth (FT)</td>
<td>-0.214</td>
<td>0.002*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filled Teeth (FT)</td>
<td>0.489</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMFT</td>
<td>-0.131</td>
<td>0.053</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Natural Functional teeth</td>
<td>0.371</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Posterior Occluding Pairs</td>
<td>0.334</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P < 0.05, ** P < 0.001

Table 8.4 also displays the comparison of demographic variables and oral health variables between people with inadequate and adequate OHL classified by the previous established cut off score from Chapter 7. Comparisons of several variables between these two groups of different OHL levels were presented using the medians of each variable, and were also assessed by a Mann-Whitney U test to see a significant difference. The results were that participants with adequate OHL had significantly lower age (p = 0.002), higher years of education (p < 0.001), and higher monthly income (p < 0.001). Considering oral health status, older adults with adequate OHL had better oral health outcomes, specifically significantly lower number of dental caries (p < 0.001), lower number of missing teeth (p = 0.021), higher number of filled teeth (p< 0.001), higher number of
natural functional teeth, and higher number of posterior occlusal pairs (p< 0.001),
compared to those with inadequate OHL.

The results of logistic regression analysis are demonstrated in Table 8.5. This
analysis aimed to assess the ability of the Short OA-TOFHLiD cut-off scores to
predict a composite variable of oral health statuses. Subjects were classified into
adequate and inadequate OHL by the previously mentioned criteria, and became
an independent variable in univariate and multivariate logistic regression. The
result from the univariate analysis was that participants with Adequate OHL were
2.71 times more likely to have Good oral health status (p < 0.001). When
controlling variables were added (age, gender, education, and dental service
utilisation) into the multivariate logistic regression model, the overall model
correction was improved and there was an association between Adequate OHL
and Good oral health (Exp (B) = 2.13, p = 0.026).

Table 8.5: Univariate and multivariate logistic regression analysis to
predict oral health status by Short OA-TOFHLiD

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Oral health status (Good)</th>
<th>Univariate Analysis (Model I)</th>
<th>Multivariate Analysis (Model II)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Exp (B)</td>
<td>CI</td>
</tr>
<tr>
<td>Adequate OHL (Short OA-TOFHLiD ≥ 35)</td>
<td>2.71</td>
<td>1.49, 4.95</td>
<td>0.001*</td>
</tr>
<tr>
<td>Controlled variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (&gt;70 years old)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Education (College or higher)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Utilisation of dental services in last year (Yes)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overall% model correction</td>
<td></td>
<td>68.1%</td>
<td></td>
</tr>
</tbody>
</table>

*P-value < 0.05
Discussion

This study primarily aimed to assess the previously established cut-off scores of the Short OA-TOFHLiD on a Thai population. We were looking at the ability of this cut-off score to distinguish different health status outcomes, and to confirm the predictive ability of Short OA-TOFHLiD scores to predict oral health conditions.

Methodology discussion

With regard to the research methodology, two sets of data from the previous studies were combined due to the time limitations of this PhD study, and to maximize the use of previously collected data. This set of data was used to determine if the threshold of the Short OA-TOFHLiD obtained from a USA population could be used in an entirely different population (Thai population). Although some researchers have stated the use of secondary data is less reliable and should be used cautiously (Kimberlin & Winterstein, 2008), in this study, the use of secondary data was appropriate due to several reasons. Firstly, the data collection method of the two studies had the same protocols even though the objectives of the studies were different. The demographic questionnaire, the OHL tool, and the oral examination indices were the same. Therefore, the primary data of the two studies could be combined easily.

In addition, the examiner of the two previous studies (Chapter 4 and 5) was the same person, for which the intra-rater reliability (or stability) was tested and found to have high reliability (see Chapter 3). Therefore, the oral health statuses, which were dependent variables in this study, were supposed to have high reliability.

The last reason was that the development process of the Short OA-TOFHLiD was not too complex. The short version was created by eliminating the second part (the prompts of fluoride toothpaste and mouth rinse labels), which was independent from the first part of the test. The Short OA-TOFHLiD scores used in the data analysis were the scores calculated from the remaining part of the tool. Therefore, using the secondary data in this study was deemed appropriate.

Chapter Discussion
Assessment of the sensitivity and the specificity of each cut-off score of the Short OA-TOFHLiD in predicting ‘Oral health status’ were performed. The purpose behind this process was to confirm a cut-off score of an OHL tool that could be used as an indicator, or provide a basic screening test to identify an older adult with inadequate OHL and Poor oral health status in a community. The Short OA-TOFHLiD score at the proposed cut-off score (≥ 35) tested with the Thai population had fairly similar sensitivity and specificity as found in the US population (Chapter 7). However, when comparing between the original OA-TOFHLiD and the Short OA-TOFHLiD, the sensitivity and the specificity of the original version (Chapter 4 and 5) were better than the short version, the slightly decreased performances of a shortened version were also found in studies of both medical (Baker, Williams, Parker, Gazmararian, & Nurss, 1999) and dental literacy tool assessment (Lee et al., 2007).

The results of the Spearman correlation analyses showed significant correlations between the Short OA-TOFHLiD scores and age, years of education, and income in the Thai older population, which corresponded with the results from the previous validation study in US older adults (Chapter 7). In addition, the Short OA-TOFHLiD tested in the Thai population was found to have a better correlation to oral health statuses than the American population. The previous study in US older adults found that there was no significant correlation between the Short OA-TOFHLiD and number of missing teeth (MT) or number of present natural functional teeth; however, this study found significance in those correlations. The reason could be due to combining two sets of data, which increased the total sample size, and affected the chance of presenting significant correlation in the diseases or conditions which did not have a high prevalence in the population (Bonett & Wright, 2000).

In the previous study (Chapter 5), the original version of OA-TOFHLiD showed (based on the specific cut off points) that adequate or inadequate OHL could discriminate between people with different conditions using the Mann Whitney U test. This study aimed to use the same methods seen in the previous chapter to evaluate oral health literacy levels obtained from the Short OA-TOFHLiD, in which the proposed cut-off scores of 35 or more were defined as adequate OHL, and 34 or lower defined as inadequate OHL. The results showed that OHL from the Short OA-TOFHLiD had an ability to distinguish people in relation to oral health and related factors similar to the original OA-TOFHLiD in the previous
study (see Chapter 5). General characteristics, such as, age, years of education, and income were significantly different between ones with adequate and inadequate OHL, which matched findings from the previous study (Chapter 5). The oral status in this study, such as the mean number of decayed teeth, missing teeth, fillings, functional teeth, and posterior occlusal pairs were also significantly different between people with different OHL levels. This finding of the short version corresponded with the results of the full version of OA-TOFHLiD in Chapter 5, and was also consistent with the findings from another OHL study in US adults aged 36 to 70; that people with adequate OHL had significantly better oral health status (Baskaradoss, 2018).

The univariate and multivariate logistic regression analysis aimed to evaluate the ability of the Short OA-TOFHLiD to predict the composite ‘Oral Health Status’, which the researcher created from three variables based on an individual’s oral health. This was used as the ‘gold standard’ for oral health status of older adults in previous chapters. In the original version of OA-TOFHLiD tested in Thai subjects in the previous studies (Chapter 4 and 5), it was shown that an adequate OHL from an OA-TOFHLiD could predict ‘Good oral health status’, however, in the validation study of the Short OA-TOFHLiD in US older adults (Chapter 7), this ability had disappeared. In the validation study the Short OA-TOFHLiD scores could only predict the dichotomous variable of active dental caries (Yes / No having active caries). Interestingly, the results in this study provided evidence the Short OA-TOFHLiD scores, tested in Thai older adults, could predict the ‘gold standard’ of oral health status, and this ability existed when controlled for by related variables in multivariate analysis.

**Conclusion**

The Short OA-TOFHLiD and the proposed cut-off score from the previous study were found to have good performance in differentiating people with different characteristics and oral statuses in Thai subjects. In addition, the sensitivity of OHL scores in detecting older adults with poor oral health was acceptable. It will be beneficial for use as a primary screening tool for a community, where there is a scarcity of health professionals. Although the complexity was reduced from the original test, the performance of the Short OA-TOFHLiD was satisfactory. The advantages of this short version are that the Short OA-TOFHLiD is more suitable
to use in a clinical setting because it is easy to understand and this version reduces the time of administration, compared to the full version of the OA-TOFHLiD. Additionally, a training session for using this tool is not needed and a person who provides this test does not need to be health professional. The suggestion for future study is to assess this OHL tool in a real community setting, as a screening tool for older adults who are at risk of having dental health problems.
References


9. Chapter 9

A proposed protocol for a pilot study using Oral Health Literacy as a screening tool in community settings
Foundation of Chapter 9

The new oral health literacy assessment tool, developed in the previous chapters, presented good reliability and acceptable predictive validity in relation to oral health in an older adult population. Chapter 6 demonstrated oral health literacy level could be used as a predictor for several oral health statuses, including, active dental caries, number of natural functional teeth, and number of posterior occlusal pairs, tested in the older adults at a hospital setting. This chapter outlines a protocol for a future study in order to test the use of this instrument as a screening tool for older adults at risk of poor oral health conditions in the community.

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Abstract

Background
A policy for dental health in Thai adults was proposed by the Ministry of Public Health in 2015. Since then dental programs in communities have been driven by non-dental-professionals. These seek to assess older adults at risk and refer them into primary care. Therefore, there is a need for a simple screening tool for non-professional use.

Objective
This study aims to explore the use of the Short version of the Test of Functional Health Literacy for Older Adults (Short OA-TOFHLiD) to identify older adults with dental needs in communities, using inadequate oral health literacy (OHL) as an indicator. In addition, appropriate routes for delivery will be comprehensively evaluated for urban and rural areas.

Methods
The proposed study will incorporate mixed-methods research. Urban and rural sub-districts in Chiang Mai will be purposively selected. Two different routes for using Short OA-TOFHLiD in the community will be explored. The first route will utilise Village Health Volunteers (VHV) who will assess OHL of older adults at home. In the second route, the Short OA-TOFHLiD will be conducted by staff from a community senior club who will approach attending older adults. Following recruitment and completion of the OHL test, all participants will be referred to a primary care setting to undergo a clinical oral examination by dental personnel. Some of these participants will also be interviewed by a researcher to gain their opinion about the overall process. Further evaluation will involve focus group interviews with those who could deliver the OHL tests in their community and those working at primary care facilities. This quantitative and qualitative data will be pooled and evaluated together to assess the accuracy of the OHL tool in screening older adults with a risk of dental diseases or conditions, and to determine the most effective methods for delivering OHL tests in the community.

Expected outcomes
The sensitivity and specificity of the Short OA-TOFHLiD to detect older adults with poor oral health will be observed by calculating the number of True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN). In addition, the results from the qualitative outcome will be used to determine the appropriateness of the route of delivery in the community. This evaluation will indicate the best route for using this OHL test in communities in future.
Introduction

Thailand established a successful Primary Health Care (PHC) system offering universal healthcare in 1980 (Kauffman & Myers, 1997). The Thai oral health care system has been developed and reformed over the last 20 years since the introduction of PHC and the emergence of Universal Coverage (UC). UC offers basic health insurance for all Thai people, which includes dental insurance. This insurance aims to reduce inequity in oral health between people with different socioeconomic status. A previous study in 2009 demonstrated the overall oral health of the Thai population has improved following UC given the improved access to care and equity to health care (Somkotra & Detsomboonrat, 2009).

Within Thai primary care, the concept of the ‘District health care system’ implemented on a national level by the Ministry of Public Health since the 1970s has seen public district hospitals established in almost every district in Thailand. Thai people’s health improved gradually (Vachrotai, 1979), and health service utilisation, health equity, and overall health outcomes sharply and significantly improved after UC development (Suraratdecha, Saithanu, & Tangcharoensathien, 2005). Alongside the district health care system, the dental health system has improved by increasing the number of dental personnel in every district hospital and focusing on providing adequate dental treatment (Lexomboon, 2000). Previous limitations of dental health insurance and lack of dental health care promotion and prevention in primary care were addressed following health care reform and UC in 2000. Currently, every district hospital has at least one dentist and can provide various types of dental care, equitably without financial limitation (Somkotra & Detsomboonrat, 2009).

Thai oral health services have been classified into 3 categories; primary, secondary, and tertiary, as well as medical primary care (see Figure 9.1). Generally, Thai people are registered with the district hospital where they reside, as their primary care provider and are able to receive dental treatment via walk-in services. If required treatment is too difficult or complex, a dentist in primary care usually refers a patient into secondary care (or directly into tertiary care), in order to consult and receive advanced treatment from a specialist. Secondary and tertiary care services, which were established before the emergence of primary care facilities, are more passive and treatment based. Secondary and
tertiary care services are mostly based in city centers or urban areas. This was a significant barrier in relation to access for people in the community, especially for those who lived in rural areas, before the development of primary care facilities (Tangcharoensathien, Witthayapipopsakul, Panichkriangkrai, Patcharanarumol, & Mills, 2018).

Figure 9.1: Overall levels of oral health services in Thailand

Older adults in developing countries do not utilise dental services as regularly as older adults in developed countries. This is particularly observed in Thai older adults who are Buddhist and believe in the concept of Transiency of Life (the philosophy of letting things go) (Sasat & Bowers, 2013). Although the UC scheme provides extensive dental care for older adults, for example, check-ups and cleaning, fillings, extraction, and dentures, the inequity in oral health care utilization of Thai older adults still exists, especially in those who are poor and living in a rural area (Somkotra, 2013). In addition, limited finance, transportation, and increased assistance required to navigate the service were considered barriers to dental care of older adults (Montini, Tseng, Patel, & Shelley, 2014). With the development of an ageing society (He, Goodkind, & Kowal, 2016), combined with a passive, symptomatic dental care system, current services may be unable to cope with future dental health care demand in this changing population.
From the 8th national oral health survey in 2017, Thai older adults were found to have a high prevalence of dental caries, high percentage of severe periodontitis, and issues with tooth loss and subsequent need for tooth replacement (Department of Health, 2018). A recent epidemiological study of oral health disease and treatment need of Thai older adults (Chapter 2) found the oral health status of Thai older adults who visited a tertiary hospital was generally poor. The majority of older adults (83.9 percent) in the study were found to have at least one tooth with decay. One-third of participants (36.3%) had less than 20 teeth and almost all participants needed periodontal treatment (Chapter 2). The level of poor oral health in older adults is of concern and suggests recent dental programs implemented in primary care may be inadequate to address oral health needs in older adults. Given the difference observed between rural and urban areas, this issue may be even more pronounced in rural regions. Therefore, there is a significant need for those people at risk of oral disease to be incorporated into the oral health system as early as possible, before oral diseases become more severe, and puts additional pressure on the dental health system.

The Thai government has been attempting to improve the oral health of older adults. During the first decade of UC (2002-2011), oral health services for older adults tended to be more passive than active. Dental policies and programs for older adults were more likely to focus on providing treatment and prostheses (Srisilapanan et al., 2016). More recently, the Bureau of Dental Health, Ministry of Public Health (MoPH) proposed a dental health program for Thai older adults from 2015 to 2022. This aims to increase access to services, promotion and prevention programs, treatment and oral rehabilitation (Bureau of Dental Public Health, 2015). In addition, the government plans to develop health personnel, technology and innovation related to dental health needs for seniors, including systems support, monitoring, managing budgets and systematic assessment (Bureau of Dental Public Health, 2019).

Prayoonwong et al. in 2015 proposed a model for community-based oral health services for Thai dependent older adults at a primary care level. They suggested that improving oral health within a community would require several keys aspects in order to be successful. One of the most important aspects was to have a primary care system with strong collaborative links between home (older adults), community, and health care services (Prayoonwong, Wiwatkhunupakap, Lasuka, & Srisilapanan, 2015). One way to incorporate this is by utilising Village Health
Volunteers (VHV). VHVs are key people within the Thai primary care system. They are a non-professional community health worker who resides in that community. This volunteer program was established in 1978, and the program has followed public health policy and changing health needs since this time (Kauffman & Myers, 1997). A VHV is usually responsible for approximately 20 households in his or her village, they provide peer support within their community, and become the connector between community-living people and health personnel at a primary care level. A previous study utilised VHVs to promote knowledge regarding HIV prevention, during an outbreak in communities, and to report health issue occurring in the community to health personnel at a sub-district health promoting hospital (Mashimo et al., 2001).

The recent national dental program for older adults (Bureau of Dental Public Health, 2015) have attempted to promote oral health in primary care via the VHV program and at a community senior clubs. VHVs have been trained to perform simple oral health screening in some pilot communities and senior clubs. However, a recent report found several obstacles to perform oral health screening by non-professional. Therefore, this study proposes the use of a newly developed oral health literacy tool for older adults as a screening tool in a community by non-professionals.

The Test of Functional Health Literacy in Dentistry for Older Adults (OA-TOFHLiD) was developed and validated, and cut-off scores of Adequate and Inadequate oral health literacy were established (Chapter 3). The tool was found to have good concurrent and convergent validities in measuring Oral Health Literacy (OHL) of older adults. In addition, this tool presents acceptable predictive validity of OHL scores to predict essential oral health status. OA-TOFHLiD was further tested in Chapter 5 and found that OA-TOFHLiD scores were predictive of oral health status when they were dichotomised to adequate or inadequate OHL. An adequate OHL was a significant predictor of having good oral health in an older adult (No active decay, having 20 or more natural functional teeth, and having 5 posterior occlusal pairs or more). Within the conclusion of the previous chapters, it was suggested this OHL tool could be used in a real community setting since it was easy and convenient to administer by both professional and non-professional with little or no training required. Therefore, this study aims to explore different routes to use this OHL tool for independent older adults in community settings.
Aims

Primary objectives
• To compare and explore the appropriate routes for delivering an OHL tool for urban and rural areas.

Secondary objectives
• To identify barriers and explore potential support engagement from people who could be involved with the OHL delivery process.
• To develop active integrated oral health care access within primary care by using OA-TOFHLiD as a medium

Methodology

Ethical approval
This study protocol will be submitted to the Faculty of Dentistry at Chiang Mai University Ethical Committee for the review and ethical approval for the study.

Type of the study
A mixed-methods study – combining quantitative data collection on OHL from the OA-TOFHLiD tool and oral health status from clinical examinations and qualitative data from individual interviews and focus groups with patients and health care professionals involved in the process.

The duration of the data collection
Approximately 1 year
• Month 1-3: setting selection and seeking collaboration from sub-district health promoting hospitals in the urban and rural area.
• Month 4: ethic application and getting ethical approval
• Month 5: training VHV's and senior club staffs for the research process and use of OA-TOFH LiD, training dental personnel and oral screening calibration
• Month 6-7: data collection process with older adults including subject recruitment, OHL test and evaluation in communities, and oral examination at primary care settings
• Month 8: staff evaluation by focus groups
• Month 9-10: data analysis
• Month 11-12: writing up

Settings

The study will be conducted in Chiang Mai province, Thailand. Two districts will be purposively selected based on the criteria of urban and rural district of the Ministry of Public Health, Thailand. In addition, these districts must have a health promoting hospital with at least one dental hygienist in the hospital, and at least one senior club in the area.

Subjects and sample sizes

Convenient sampling will be used to recruit potential participants into this study.

The sample size calculation was based on the prevalence of untreated dental caries in Thai older adults obtained from the 8th National Oral Health Survey by the Bureau of Dental Health in 2017, which was 52.6% (Department of Health, 2018), and assumed the precision to be 5%. The population in Chiang Mai of adults aged 60 or older in 2018 was approximately 300,000.

The result from the sample size calculation was that 383 participants were needed, however, twenty percent of participants were added to mitigate any dropout during the questionnaire and oral examination. The total number of participants in each area and was 460. These older adults will be included from across 4 settings for primary assessment;

1. Urban district
   - 115 older adults at home (from 3-5 villages in one sub-district)
   - 115 older adults at seniors clubs (from 3-5 seniors clubs)
2. Rural district
   - 115 older adults at home (from 3-5 villages in one sub-district)
   - 115 older adults at seniors clubs (from 3-5 seniors clubs)

After completing the OA-TOFHLiD and obtaining OHL scores, all participants will be referred to obtain clinical assessment by a dental hygienist-therapist. We expect to see 80% of total participants from primary assessment to attend the secondary assessment, which will be approximately 383 older adults.

**Inclusion characteristics**
Participants must:
1. Be 60 years old or older on the day they attend the study, and have lived in the assigned district for at least 3 months (to be fully registered as an official resident in the area and being registered for public health insurance at the sub-district health promoting hospital)
2. Be able to read and write in Thai without additional assistance
3. Have no severe medical condition that would affect cognitive functions
4. Be of Thai nationality with public health insurance (Government Health Benefit (GBH), or Universal Coverage (UC). UC must be registered at the district where the study will be conducted)

**Exclusion characteristics**
Participants will be excluded from participation if:
1. Participants are unable to read and understand the patient information sheet and informed consent procedure.
2. They currently have a serious medical condition.
3. They are not willing to be assessed for their oral health literacy, or not willing to have an oral examination by dental personnel.
4. Participants are aware they will be moving out from the current district that they currently live.

**Study procedure**

**A. Setting selection**
In Thailand, the country is divided into 77 provinces; a province is divided into several districts. Chiang Mai, the 2nd largest city and hub of the Northern region of Thailand, has 25 districts. The city center of Chiang Mai is called the ‘Muang’ district and the parameter districts of Muang are called suburban areas (5 districts), the other districts are considered as rural areas. Every district contains several sub-districts, for example, Muang District (city center) has 16 sub-districts in total, and every sub-district in Thailand has a sub-district health promoting hospital (HPH). However, only some HPHs have dental personnel posted at the hospital, others have a dentist or a dental hygienist-therapist regularly rotated from a district hospital to work in HPH once or twice a week.

This study aims to compare the delivery process of an oral health literacy tool at primary care level between urban-suburban and rural area, therefore, we expect to include 2 sub-districts; 1 urban/ suburban and 1 rural sub-district. These 2 sub-districts must have a dental hygienist therapist working at their health-promoting hospital. In addition, there must be at least one senior club with regular staff in the potential sub-district. Finally, we aim to identify sub-districts where the Village Health Volunteer (VHV) program is active and cooperative.

**B. Training Staff and calibration**

Once the settings are selected, a researcher will contact the director of a sub-district health promoting hospital to seek collaboration and gain permission to work with their dental staff in their primary care service, including dental hygiene therapists and village health volunteers (VHVs) who work in the area. A separate training and calibration exercise will be conducted prior to data collection.
1. Training of the Short OA-TOFHLiD and user guideline

Village Health Volunteers and senior club staff who work in the selected areas or settings will be invited to attend the training session about the Short OA-TOFHLiD. The researcher (PW) will explain how to use this OHL to measure OHL in older adults, how to explain to a participant, and how to assess scores. The practice of OHL use, assessment, and a referral will be simulated between staff and VHVs before going to the real community setting.

2. Examiner calibration of oral examination

Prior to the start of the study, a separate calibration exercise will be performed on at least 20 older adults who will be examined on two separate days by the examining dental hygienist-therapists and a ‘gold standard’ examiner. Intra and inter-examiner agreements for recording caries index (DMFT) and periodontal index (CPITN) must exceed a weighted kappa score of 0.80 or further training will be provided and the calibration exercise repeated until acceptable levels of agreement are achieved. This exercise will occur after the feasibility exercise, closer to the intended study start date.

Reproducibility

During the clinical assessments, a random sample of approximately 5% of subjects will be asked to return for repeat assessments to determine intra-assessor reproducibility. This will be based upon logistical considerations and the willingness of the subject.

C. Participants inclusion

Participants will be recruited according to the inclusion criteria listed above. Details about how to recruit participants in each setting are described in section D below.
D. Process of the study

The studies in two different areas will be take place at the same time. In both the urban and rural areas, two routes for OHL delivery will be conducted, and compared (see Figure 9.2). The primary OHL assessment will be conducted in all participants (n=400) to identify participants with Inadequate OHL for further investigation.

Two routes for OHL test delivery will be conducted by different key persons and different settings;

1. Village Health Volunteers (VHVs) as key people to visit participants home

1.1. VHVs, who are trained by a researcher to distribute the Short OA-TOFHLiD, will go to a participant’s house in their area of responsibility. They will explain the study to potential subjects and obtain consent to participate of those who meet the recruitment criteria and agree to take part in this study. (Each VHV expected to reach approximately 10 older adults in their area)

1.2. A participant who consents and agrees to participate in this study will be asked to complete the Short OA-TOFHLiD (primary assessment).

1.3. Following competition of the Short OA-TOFHLiD, a VHV will calculate the OHL scores of a participant. Then a VHV will give an appointment card with OHL scores on the card, and invite that person to visit dental personnel at a health-promoting hospital.

1.4. An older adult who attends the primary care setting will be examined orally and evaluate treatment needs by a dental hygienist-therapist (secondary assessment).

1.5. Purposively selected participants will be asked to evaluate this process during a face-to-face interview. Opinion, barriers, and additional comments will also be gained through this interview with a researcher (PW)

1.6. Further evaluation will include focus group discussion with VHVs who deliver OHL tool in their communities. This aims to obtain an opinion about the process, pros and cons, and obstacles during a process.
2. Senior club’s officers as key people to delivery OHL assessment at the club

2.1. Staff at senior clubs, will be trained by a researcher to use the Short OA-TOFHLiD, and will recruit individuals who attend activities at the club. They will explain the study to potential participants and obtain consent to participate in this study from those eligible and willing to participate,

2.2. A participant will be asked to complete the Short OA-TOFHLiD, once this is complete, staff will calculate the participants’ scores.

2.3. Staff will give an appointment card with each individual’s OHL scores to the participant, and invite that person to visit dental personnel at a health-promoting hospital.

2.4. An older adult will be referred to a dental hygienist-therapist who will carry out an oral examination and evaluate treatment needs (secondary assessment).

2.5. A referred participant will be asked to evaluate this process during a face-to-face interview. Further opinions, barriers, and additional comments will be gained through this interview carried out by a researcher (PW)

2.6. Further evaluation will include focus group discussion with the staffs who would deliver the OHL tool in their communities. In order to gain their opinion regarding the process, pros and cons and obstacles during the process.
E. Evaluation process

The evaluation will concentrate on three distinct groups in this study to comprehensively assess the potential delivery process in both urban and rural areas.

**Older adults evaluation**

1. Oral health literacy will be assessed by the Short OA-TOFHLiD in all participants.
2. Oral health will be examined through an oral examination in all participants.
3. Participant opinion on the process, pros and cons, additional comments and suggestions will be obtained via semi-structured interview in some selected participants.

**VHVs and senior club staff evaluation**

1. VHVs and senior club staff will collect data on
   1.1 The number of participants they approached and recruited.
1.2 The numbers of participants who successfully participated in the OHL test, the number referred to into primary care and the number who subsequently attended a primary care clinic.

2. VHV and senior club staff opinion regarding the delivery process, encountered obstacles will be obtained via focus group interviews

3. Pros and cons, additional comments and suggestions will be obtained through these focus groups

_Dental Personnel (at primary care settings) evaluation_

1. Personnel will conduct oral screening, completing an Oral health assessment form (to determine if the referred participants have oral diseases, or conditions that need to be treated or not)

2. Dental Personnel’s opinion regarding the referral process and encountered obstacles will be obtained via focus group interviews.

3. Pros and cons, additional comments and suggestions will be obtained through these focus groups.

**Questionnaire used**

Oral health literacy of older adults will be assessed by the Short version of the Test of Functional Health Literacy in Dentistry for Older Adults (Short OA-TOFHLiD) with a short demographic questionnaire. The full version of this instrument was validated and used with Thai older adults in Chapter 4 and 5. In this study, the Short OA-TOFHLiD, which was further validated in Chapter 7 and retested in the Thai samples in the previous study (Chapter 8), will be used to assess OHL because it is more convenient for non-professionals to use in real community settings. This self-administered OHL test is composed of four topics of reading comprehension (39 points). The time of completion is approximately 8-20 minutes, and the previous established cut-off scores are 0-34 Inadequate OHL, and 35-39 Adequate OHL.

Oral health assessment form to be completed by a dental hygienist-therapist contains 2 parts; 1.) _Oral screening section_, this includes is a full dental chart for evaluating dental caries using Decay-Missing-Filled Teeth (DMFT index), treatment needs for each tooth, prosthesis status and prosthesis needs, community periodontal index of treatment needs (CPITN) and oral hygiene status, and number of natural functional teeth and posterior occlusal pairs. 2.)
Subjective evaluation from a dental professional would be assessed using Likert-scale questions, for example, “From 1 (strongly agree) to 5 (strongly disagree), do you think this patient has dental conditions or diseases that need to be treated?”

**Interviews**

Older adults who attend oral screening at the primary care setting will be purposively selected to take part in a further interview. The semi-structure interview will be conducted by a researcher (PW) to gain their opinion regarding the OHL tool, process of delivery, referral process, barriers or obstacles to dental care at the primary care setting, and additional comments or suggestions about overall study process, in order to gain useful information to develop the most appropriate process to use OHL as a screening tool in community-living older adults.

Focus groups and in-depth semi-structure interview will be conducted across in 3 groups of people who could be part of this screening and referral system (VHVs, seniors club’s officer, and dental hygienist-therapists) in order to gain comments and additional suggestions for improving the OHL delivery process.

**F. Data management and analysis**

Management of primary data, questionnaires and data collection sheets from the primary source data will be verified by the investigator or examiner’s signature when complete. Paper records will be kept securely in a locked room at the sponsor’s office. Electronic data and voice recordings obtained from interviews/focus groups will be uploaded and stored in the secure, password protected the university-shared drive.

For data analysis, descriptive statistics for example, mean and standard deviation, percentage will be calculated using SPSS version 23 for Mac (IBM Corp., 2015) to describe general characteristics of participants. The short OA-TOFHLiD will be primarily assessed by a VHV or a senior club staff, and reassessed by the researcher. Descriptive statistics such as mean, standard deviation, and range will be calculated for oral health literacy scores. The previous established cut-off scores will be used to classify participants into 2
groups (Adequate and Inadequate OHL). Sensitivity and specificity will be evaluated by Receiving Operating Characteristic (ROC curve) and Area Under the Curve (AUC) to see the ability of the OA-TOFHLiD level (inadequate) to identify participants with inadequate OHL, with possibility of having poor oral health. The percentage of participants who have been referred correctly (True Positive; TP), percentages of participants who may have been missed (False Negative; FN), percentage of participant who truly has no dental treatment need (True Negative; TN), and percentage of participants who may have been unnecessary referred (False Positive; FP) will be calculated. In addition, percentages will be used to explain, for example, the correctness of VHVs or senior club staffs in calculating OHL scores, the proportion of successful referral (participant attending the secondary assessment at the primary care), and participants and staffs’ satisfaction of the process.

For qualitative data analysis, all interviews will be voice-recorded, and transcribed verbatim. Framework analysis, which has been used in many dental health service studies (Borreani, Jones, Scambler, & Gallagher, 2010), will be used to analyse data gained from interviews and focus groups. Firstly, raw transcribed data will be processed by identifying recurring themes and arranging these into a structured framework. Explanations, examples, or quotes will be developed along the themes to give clearer points of views and understanding of all dimensions of the participants.

According to the mixed methods research, the stage of comprehensive evaluation would be triangulation between qualitative and quantitative approaches (Johnson, Onwuegbuzie, & Turner, 2007). This process aims to capture different dimensions and gain a better understanding of the same phenomenon, therefore, all dimension of data for example, sensitivity and specificity of the OHL test (quantitative), percentage of successful referral (quantitative), satisfaction scores (quantitative), and opinions or perspective towards using the OHL tool in communities (qualitative) will be compared and evaluated to understand the use of OA-TOFHLiD via two different delivery methods (VHVs, or senior club’s staff). The conclusions of this pilot study will be made based on the quantitative findings, which focus on ability of the tool to identify older adults with inadequate OHL, satisfaction scores of participants, and proportion of successful referral. In addition, qualitative findings, such as staff comments and cooperation, will be considered together to find the most
appropriate delivery process of the OA-TOFHLiD in the urban and rural area. The results will be useful as a model for creating longitudinal OHL assessment and process of monitoring older adults with inadequate OHL in more communities in a future study.
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10. Chapter 10

General discussion
Summary of the main finding and discussion

Based on the literature review in Chapter 1, Oral Health Literacy (OHL) is defined as a comprehensive ability of individuals to obtain information related to oral health, process health information, and take appropriate actions towards their oral health (Baur et al., 2005). It has been hypothesized that those who have adequate oral health literacy can achieve better oral health (Horowitz & Kleinman, 2008; Lee, 2018). Therefore, there has been ample research conducted in this area, especially in developing an oral health literacy tool to measure oral health literacy in different populations or target groups (Dickson-Swift, Kenny, Farmer, Gussy, & Larkins, 2014). The assessment of health literacy in Dentistry is increasingly seen as an important patient and population-based measure, however, there is no oral health literacy assessment tool exclusively for older adults (Dickson-Swift et al., 2014). Indeed, previous research in this area has focussed on parents of young children, thus making these tools inappropriate for older adults. Children’s oral health needs and risk factors are largely homogenous and well described (Firmino et al., 2018), however, older adults represent a more diverse, heterogeneous population with less well-characterised risk factors (Rudd & Horowitz, 2005).

This thesis primarily aimed to develop a new oral health literacy tool for older adults. From the literature review process, all available OHL tools were reviewed and a potential tool was selected that could be a template for further development. The researcher decided to use the Test of Functional Health Literacy in Dentistry (TOFHLiD) by Gong et al., (Gong et al., 2007) as a template for this study. Although this OHL tool is less popular in clinical use due to its length and complexity, this OHL test has appropriate validity and reliability. In addition, the characteristics of this OHL test are more likely to measure appropriate functional OHL, i.e. basic skills in reading or writing necessary to be able to effectively function in everyday situations (Nutbeam, 2000). However, the TOFHLiD was developed to measure OHL of parents who take care of children’s oral health, and based on the American health insurance and health system. Therefore, the researcher decided to create new reading comprehension tests and prompts which were more relevant to older adults and neutral to any culture and health system in order to be used in general older populations.

Chapter 2 was conducted to identify oral health problems and treatment needs in the older population in this specific area, by using the secondary data from the biggest
dental hospital in the northern region of Thailand. The results found that although public dental care is inclusive and free for Thai older adults, the utilisation rate was low and mostly used for dental treatment, rather than prevention services (Somkotra, 2013; Srisilapanan et al., 2016). The majority of older adults were found to have active dental caries, periodontal diseases, and inadequate functional teeth, which could affect their quality of life. These results emphasized the urgent need to have active dental care and an early detection system at the community level for older adults at risk for dental diseases.

In Chapter 3, the Test of Functional Health Literacy in Dentistry for Older Adults was developed as a pilot version in both Thai and English at the same time (three reading comprehensions and two prompts), and tested in Thai older adults. The pilot version was found to have acceptable psychometric properties, however, some properties, especially the convergent validity and predictive validity, needed to be improved in order to better evaluate OHL in older adults. Further research was conducted to improve this test and presented in Chapter 4, where the final version of OA-TOFHLiD was achieved and the cut-off scores of adequate and inadequate OHL were established. The optimised OHL tool was found to have good concurrent and convergent validity, as well as predictive validity, which is the ability of OHL scores to predict clinical oral health status.

After the development of the OHL tool in Chapters 3 to 4, we aimed to use it to assess oral health literacy in the target population, and also identify associations with oral health status and other factors in Chapter 5. The results found that almost half of the participants had Inadequate OHL. The background characteristics (i.e. age, years of education, monthly income), and essential oral health outcomes (number of decayed teeth, filled teeth, natural functional teeth) were significantly different in people with different OHL levels. Older adults with adequate OHL had less oral disease, less treatment need, and better oral health. In addition, the OA-TOFHLiD scores presented acceptable sensitivity and specificity in predicting oral health status by the proposed cut-off scores (adequate OHL predicted good oral health status while inadequate OHL predicted poor oral health status).

In order to understand the perceptions and health behaviour of older adults with adequate and inadequate OHL thoroughly, a qualitative study was further conducted and presented in Chapter 6. This chapter explained the interesting characteristics of older adults with different OHL levels. Participants with adequate OHL were more likely
to have accurate perceived oral health status compared to the clinical oral health status assessed by a dental professional. However, the pattern of oral hygiene care and dental care seeking behaviour of older adults with adequate or inadequate OHL did not differ greatly, which could be because of the strong effects of culture and health beliefs in the Asian older generation.

Chapter 7 explains the validation study of the Short OA-TOFHLiD English version in American older adults who lived in communities (congregate meal sites and senior clubs). The reasons behind choosing a validation among older American adults were 1.) Good collaboration: The researcher tried to contact senior clubs or churches in the UK but most of them were not easy to contact, or declined to participate in this type of study that involved complex questionnaires and oral examination. Therefore, the supervisor (IAP), who had previous collaboration with a non-profit organization in the USA called Oral Health America (OHA), suggested conducting the validation study through this group 2.) Feasibility: OHA is an organization, which works with several oral health issues targeting children and older populations, and they have a close connection with local organisations that work with older adults. Therefore, they were able to find the required number of participants in the fixed and limited time of the study. The results from the validation of the short OA-TOFHLiD are presented in Chapter 7. Although the short OA-TOFHLiD was found to have inferior predictive validity compared to the original version (lower OHL scores could predict having active caries status only), the overall performances were good, and participants spent shorter time and had less stress completing the OA-TOFHLiD compared to the original version. The tool itself is comprehensive, easy to understand, and easy enough to administer it could be administered by non-dental professionals.

Chapter 8 looked to maximize the utilisation of the previous collected data from the studies in Chapter 4 and 5 by combining them, and then reanalysing it to evaluate the established cut-off scores of the short OA-TOFHLiD from Chapter 7 on the Thai population. The Short OA-TOFHLiD scores from the previous data sources were created by deleting the scores of the prompts from the original OA-TOFHLiD scores in each data set, then combining and reanalysing them. The results showed the proposed cut-off score from the previous US study were found to have good performance in differentiating people with different characteristics and oral statuses in Thai subjects. In addition, the sensitivity of OHL scores in detecting older adults with poor oral health by Inadequate OHL was acceptable.
After the OHL tool developing process (Chapter 2, 3, 4, 7, and 8) and the use of the original version in the clinical setting (Chapter 5 and 6), the researcher proposed to use the Short OA-TOFHLiD in a community as a simple screening tool. Chapter 9 presents the protocol for a future study to use the OHL tool at the community level. The Thai primary care system has been established for more than 30 years and is well-known for management of public health issues such as HIV and dengue fever prevention (Mashimo et al., 2001), however, dental health in primary care is quite new and uncertain due to the shortage of dental personnel and a dental health budget. This chapter proposes the use of OHL in primary care levels via two routes 1.) Screening older adults by a Village Health Volunteer at home 2.) Screening older adults by staff at a community senior club, in order to compare and explore appropriate approaches for urban and rural areas. The results will be explored comprehensively by mixed methods. In the quantitative part, we will explore the sensitivity and specificity of the OHL tool in detecting persons at risk in communities, and also satisfaction scores and percent correction of the scores screened by non-professional staff. In addition, the qualitative study will include all groups of people involved in the process, in order to gain opinions about its strengths and weaknesses. In consequence, the overall quantitative and qualitative results will be determined to identify a proper route in each area, then a longitudinal framework of using OHL tools in broader communities will be proposed.

**Strengths and weaknesses**

The strength of this study is the newly developed tool itself. The OA-TOFHLiD was developed to be neutral to any culture or health system; therefore, it will be useful for any future research related to older adults in any population. The tool was developed and validated in English and Thai at the same time by the bilingual researcher and rechecked by two native English academic dental public health professionals, and the semantic equivalence between Thai and English versions was verified by two bilingual dental professors of dental public health and health communication. Therefore, this tool will be useful not only in Thailand but also in any English-speaking populations.

Furthermore, the items in the OA-TOFHLiD were truly created based on the concept of *functional oral health literacy*, which is in an ability in reading or writing to be able to effectively function in everyday situations. To complete this test, an individual is required to read and comprehend the oral health passages in the test, then select the
correct word from choices to complete the sentences. Although functional oral health literacy is the undermost health literacy among three levels of health literacy categorised by Nutbeam (Nutbeam, 2000), which are functional, interactive, and critical health literacy, the functional OHL is important as a fundamental requirement for all people to fully function within oral health and self-care, such as understanding a toothpaste label, or understanding a consent form when they go to see a dentist for dental treatment.

Another strength of this PhD study is the process of validation. We not only created a new tool, but also developed and validated it until the standard validities and reliability were achieved. In addition, the predictive validity of this tool, which was based on the assumption that OHL is associated with oral health status, was validated, and cut-off scores were established directly with oral health status obtained from clinical examination by one dentist. This is the gold standard method to obtain oral health status, compared to the previous validation of TOFHLiD, which used the perceived oral health status assessed by measurements, for example, the oral health related quality of life (OHRQoL) and the short form Oral Health Impact Profile (OHIP-14) (Gong et al., 2007). Therefore, because of the outstanding predictive validity, together with high concurrent and convergent validity of the OA-TOFHLiD, this tool is appropriate and ready to use as a basic screening tool in a real community setting with no or minimal training needed because it is self-administered and easy to understand.

The shortcomings were mostly addressed at the end of every chapter. However, one of the weaknesses found during the development process was that currently there is no gold standard measurement of health literacy or oral health literacy. The validation studies in chapter 2, 3 and 4 selected previously established tools to correlate with our newly developed tool based on a previous study (Gong et al., 2007; Naghibi Sistani, Montazeri, Yazdani, & Murtomaa, 2014), that used S-TOFHLA and REALD as reference measurements for assessment of convergent validity. In addition, the REALD (dental word pronunciation test) was unable to translate directly into Thai, therefore, in the Thai validation studies, only a medical reference tool (S-TOFHLA) was used to establish convergent validity. In addition to the validation chapters (Chapter 2,3,4), there was no sample size calculation besides referencing the number of participants from the previous study (Gong et al., 2007). This was because at that time we did not know the prevalence of participants with adequate and inadequate oral health literacy in the target population. Therefore, the sample size calculation could not be performed.
The other weakness of this study is the probability of having a participant selection bias. The tool, as used, would explicitly exclude anyone who is illiterate. The importance of this should be recognized, in that those without literacy may be more likely to have greater oral health needs. Additionally, the majority of participants in the studies, especially in Chapter 5, 6, and 7, were female, which could be biased against the outcome variables such as oral health status and oral hygiene behaviours of a general population. The studies were mostly limited at the clinical setting due to the feasibility of this PhD study. The participants of the studies in Chapter 3 and 5 were included by convenient sampling from anyone who saw a poster invitation at the Chiang Mai University dental hospital during the study period, which might have been individuals who were more likely to have interest in their oral health, or were familiar with the dental context. This could cause the overall oral health literacy scores in this study to be higher than the population. However, in the multivariate logistic regression analyses to test the prediction of oral health status by OHL scores, the models were controlled by age, education, and dental service utilisation, in order to reduce the effect of above-mentioned characteristics of participants.

The last weakness of this study relates to oral health status. The gold standard oral health status used in all chapters was based on active dental caries, number of functional teeth, and number of posterior occlusal pairs. However, periodontal status was not included in the validation studies or the usage study. This was because the periodontal status measurement was limited to clinical settings and required a specific instrument (a WHO periodontal probe). In addition, probing in gingival sulcus might cause discomfort for general older adults, and complications for older adults with medical conditions or taking medication.

Implications for policy and recommendations for future research

- **Implications for policy**

As previously mentioned in Chapter 9, the Thai dental service system for older adults focuses on providing treatment for older adults at care settings, which is a response to a problem instead of treating the root of the cause. Therefore, early health prevention and promotion is required to close this gap. Integration of oral health into primary care with an evidence-based approach is proposed in Chapter 9, where a protocol for future study to use the OA-TOFHLiD as a
screening tool in communities by a non-professional is recommended. The outcome from the future study in Chapter 9 will be high-quality evidence that can be a reference for a proposal to a health agency for broader use in national, and hopefully international level.

- **Future research** - other than the protocol in Chapter 9, recommended future studies are:
  - Creation of an intervention to improve oral health literacy (as an output), which will indirectly improve oral health status, quality of life, and overall health of older adults
  - Extension to pre-ageing population (40 to 59 years old): validation of a tool across age groups, used for screening people who have inadequate oral health literacy who might be at risk of dental diseases or poor oral health in their older age
  - Using this OHL tool as an evaluation for intervention in other studies, particularly behavioural studies or health education programs

**Conclusion**

The new oral health literacy (OHL) tool for older adults called the Test of Functional Oral Health Literacy for Older Adults (OA-TOFHLiD) was developed and validated in the Thai population, and found to have appropriate validities and reliability. The short version in English was also created and validated with native English speakers (U.S. older adults). The cut-off scores of the original and shortened version of OA-TOFHLiD were established and used to classify people into two levels: Adequate and Inadequate OHL. The tool was further used to find associations between OHL and oral health status. The results showed that older adults with Adequate OHL had significantly better oral health statuses and fewer treatment needs. In addition, OHL levels classified by OA-TOFHLiD scores presented acceptable sensitivity and specificity to predict oral health status, which is one of the strengths of this tool. From all findings in this thesis, the researcher proposed a protocol to use this tool as a screening tool for active dental care in primary care settings with Thai community-living older adults, who were found to have a high prevalence of dental diseases but low dental service utilisation. Eventually, this OHL tool was proposed for use in broader contexts by creating early dental disease prevention programs and promoting oral health in older people.
References


11. Chapter 11

Appendices
Appendix 11.1: Thai patient information sheet study (Chapter 3 and 4)

เอกสารชี้แจงผู้เข้าร่วมการวิจัย

(Permission Information Sheet)

ในเอกสารนี้มีข้อความที่ท่านต้องรับข้อความทั้งหมดไม่มีข้อใจ โปรดสอบถามปรึกษากับท่านภักดี หากท่านมีเรื่องที่ต้องการสอบถาม โปรดโทรมาที่ ทุนแพทย์ ประจำชั่วโมงท่าน หรือทุนแพทย์ที่ท่านได้ ชื่อในข้อความต่อไปนี้จะเป็นการที่มีข้อความดังข้างต้น

ชื่อโครงการ (ภาษาไทย): การพัฒนาและทดสอบเครื่องมือวัดความมั่นคงทางทันตศุลภาพในผู้สูงอายุ

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วัตถุประสงค์ของการวิจัย

โครงการวิจัยในที่นี้เพื่อทดสอบแบบสอบถามเพื่อวัดความมั่นคงทางทันตศุลภาพ ซึ่งจะมีประโยชน์ที่คาดว่าจะได้รับผล สามารถใช้เป็นเครื่องมือเพื่อประเมินความมั่นคงของผู้สูงอายุของชาติ เกี่ยวกับสุขภาพของปากของผู้สูงอายุได้ ซึ่งจะทำให้ทันตแพทย์สามารถตัดสินได้ว่าเป็นการรักษา งานชีวิตนั้น และส่งเสริมสุขภาพโดยเฉพาะสำหรับผู้สูงอายุ

ท่านได้รับข้อมูลให้เข้าร่วมการวิจัยนี้ทั้งหมดเป็นผู้ที่มีอายุมากกว่า 60 ปีบริบูรณ์ ในวันที่ท่านเข้าร่วมและท่านเป็นผู้ที่เข้าใจภาษาไทยเป็นอย่างดี สามารถอ่านและทำแบบสอบถามได้ด้วยตนเองโดยไม่ต้องมีผู้ช่วยอย่างใดในงานวิจัยนี้จะมีผู้ช่วยท่านเข้าร่วมการวิจัยนี้ทั้งหมด 100 คน ใช้ระยะเวลาที่จะทำ การวิจัยชั่วโมง 1 ปี

ขั้นตอนการปฏิบัติตามการเข้าร่วมโครงการวิจัย

ถ้าท่านสมัครใจเข้าร่วมโครงการและลงนามในเอกสารชี้แจงเรียนได้รับการชดเชยอย่างไร ผู้เข้าร่วมจะขอให้ท่านกรอกต่อไปนี้

1. ท่านสะดวกไหมเลยแบบสอบถามจะมีกี่ห้อง 13 ห้อง ได้โดยเริ่มไม่ต่ำ 15 นาทีในการทำให้ครบถ้วน ชุดที่สิ้นสุดที่ห้อง 9 ห้อง โดยใช้เวลาไม่ต่ำ 7 นาที

2. ท่านอาจจะต้องเปลี่ยน ซึ่งให้ท่านช่วยเปลี่ยนให้ดีและชัดเจนตามคำที่ท่านเห็น คำเพื่อประโยชน์ในแบบสอบถามโดยเป็นเครื่องมือการแพทย์และทันตแพทย์ โดยศูนย์ทางการแพทย์จะมี 66 ท่าน และศูนย์ทันตแพทย์จะมีท่านละ 30 ท่าน

3. ที่ความช่วยเหลือ ทันตแพทย์ที่เข้าร่วมของการพัฒนาท่าน โดยไม่ได้พิจารณาและผลกระทบ (ค่าใช้ มากกว่าสิ่งที่ท่านได้) ในการดูแลสุขภาพของปากท่าน ได้แก่ ข้าวเครื่องจักร การมีพิษภัยสุขภาพเชื้อฟัน และสภาพสุขภาพปื้นหลัง โดยไม่ได้มีการเรียนรู้ใดๆเกี่ยวกับการเข้าร่วมการทำ ท่าน
ภาวะเสี่ยงและ/หรือความไม่สบายที่อาจเกิดขึ้น งานบริษัทที่ไม่มีความเสี่ยงที่จะเกิดขึ้นเกี่ยวกับการวิจัยใดๆ ท่านยังคงเสี่ยงเสี่ยงและอาจมีผลต่อสุขภาพและชีวิตได้ ทั้งนี้ท่านต้องรู้ไว้และมีความรับผิดชอบ ที่จะทำการวิจัยต่อไปท่านสามารถดูคู่มือต่างๆ หรือการตรวจทำปากได้ตลอดเวลา

การเข้าร่วมโครงการวิจัยของท่านจะเป็นไปด้วยความสมัครใจ

หากท่านไม่เข้าร่วมในโครงการวิจัยนี้จะไม่มีผลกระทบใดๆ ทั้งในปัจจุบันและอนาคตต่อการรักษา

แพทย์ของท่าน โดยท่านจะได้รับการตรวจสอบการวิจัยและรักษาโรคตามวิธีการที่เป็นมาตรฐาน

ท่านจะได้รับ

ทางที่ดีที่สุดในการรักษา ท่านจะได้รับคำตอบแทนจำนวน 250 บาท

ท่านจะได้รับการตรวจหัวใจ คำแนะนำในการรักษา รวมถึงได้รับคำตอบแทนจำนวน 250 บาท

การรักษาตามลับ

ข้อมูลส่วนตัวของท่านจะถูกเก็บรักษาไว้โดยไม่ได้รับผลกระทบต่อการรักษา บริษัทจะรักษาข้อมูลนี้เป็นข้อมูลส่วนบุคคล สำหรับการวิจัยในอนาคต ท่านมีสิทธิ์ที่จะได้รับการแนะนำการรักษาอย่างเป็นทางการ เลิกการวิจัยได้ เลิกการรักษาได้ ได้รับคำแนะนำการรักษาได้ ได้รับคำแนะนำการรักษาได้ เลิกการวิจัยได้ เลิกการรักษาได้ ได้รับคำแนะนำการรักษาได้ เลิกการวิจัยได้ เลิกการรักษาได้ ได้รับคำแนะนำการรักษาได้ เลิกการวิจัยได้ เลิกการรักษาได้

หากท่านมีข้อสงสัยเกี่ยวกับการวิจัยนี้ ท่านสามารถแจ้งให้ทราบโดยเร็ว ไม่

ให้สูญ

ขอขอบคุณที่สามารถติดต่อได้

หากท่านมีข้อขัดข้องที่จะสอบถามเกี่ยวกับการวิจัย ท่านสามารถติดต่อได้ที่:

อ.ทพ. บุญบุตร วินิจฉัยทาง ภาควิชานิติเวชกรรมรูมาตวะและระบบการรักษา คณะแพทยศาสตร์ มหาวิทยาลัยมหิดล ถนนสุทธวงศ์ ถ.ธนบุรี อ.เมือง จ.เจお客様 50200 โทรศัพท์ 053-944468
Appendix 11.2: Thai patient information sheet study Chapter 2 and 3

4. ความเสถุนเรื่องความไม่สบายต่างๆ ที่อาจเกิดขึ้น

งานวิจัยนี้ไม่มีความเสี่ยงที่จะจะเกิดขึ้นเมื่อบรรจุรู้รายวิจัยอื่นๆ ท่านอาจต้องเผชิญบางมูลและ
อาจรู้สึกถึงความไม่สบายบางมูลก็ได้ ทั้งนี้ทางท่านจะไม่สบาย
ใจ ที่จะทำการวิจัยต่อไป ท่านสามารถเปลี่ยนแปลงได้ตามใจ หรือการตรวจของปากได้ตลอดเวลา

5. ประโยชน์ที่คาดว่าจะได้รับ

ท่านจะได้รับการตรวจสุขภาพได้รับค่าค่าและทำการรักษา รวมถึงให้คำแนะนำเรื่องวิธีการรักษา

6. ค่าใช้จ่าย

ท่านไม่ต้องเสียค่าใช้จ่ายใดๆในการเข้าโครงการ แต่หากท่านมีการพบโรคในช่องปาก ที่
จำเป็นต้องได้รับการรักษา ท่านจะได้รับเงินส่งเสริมและแนะนำให้ไปพบทันตแพทย์ เพื่อทำการตรวจ
ซ่อมแซมและรักษาในสถานพยาบาลที่ท่านมีสิทธิ์ ซึ่งท่านจะได้รับค่าตอบแทนค่าใช้จ่ายในการรักษาระบบคลุมสิทธิ์ที่ท่านมีสิทธิ์

7. การยุติเรื่องที่เกี่ยวข้องกับงานวิจัย

งานวิจัยนี้ไม่มีความเสี่ยงเรื่องการบาดเจ็บใดๆที่เกิดขึ้นได้

8. บุคคลที่ทำการบันทึกผลด้วยมีมีกฎหมายหรือข้อตกลงที่เกี่ยวกับการวิจัย

หากท่านมีปัญหาข้อดีก็สามารถแจ้งกับโครงการวิจัยนี้ ท่านสามารถติดต่อ
สำนักงานพยาบาลที่อยู่ บ้านปัตตานิยม สถาบันสุขภาพ สถาบันทันตกรรมควบคุมและชุมชน
คลินิกศึกษาศาสตร์ มหาวิทยาลัยชุมชนใหม่ โทร. 0539444468 หรือ โทร. 081-798516

เมื่อท่านได้รับใบอนุญาตซื้อหรือมีใบอนุญาตขายได้ท่านพึงท่านจะแจ้งแก่ และ
เอกสารการ ที่จะแจ้งร่วมโครงการวิจัยนี้ ที่จะแจ้งข้อมูลของท่านข้างล่างนี้

ลงชื่อ................................................................. ลงชื่อ.................................................................
ชื่ออาสาสมัคร............................................. ชื่อผู้รับ......................................................
วันที่................................................... วันที่...................................................

ลงชื่อ................................................................. ลงชื่อ.................................................................
พบ................................................................. พยาบาล......................................................
วันที่................................................... วันที่.......................................................
Appendix 11.3: The Thai version of the Test of Functional Health Literacy in Older Adults (OA-TOFHLiD) with demographic section

Test of Functional Health Literacy in Dentistry in Older Adults (OA-TOFHLiD)

แบบทดสอบความรู้ด้านทันตกรรมสุขภาพสำหรับผู้สูงอายุ

แบบทดสอบมีหัวข้อ 6 ส่วนคันนี้

แบบทดสอบส่วนที่ 1
จะสอบถามถึงวัยคนเก่าที่รู้จักท่านผู้ที่ไม่ได้แก่ เท่า อายุ การศึกษา สภาพทางสมอง ทราบ และการใช้บริการทางสุขภาพในระบบที่สัมผัส

แบบทดสอบส่วนที่ 2-5
เป็นข้อมูลที่ท่านอาจจะให้สัมพันธ์กับนักทันตกรรม ทันตแพทย์ หรือผู้มีประสบการณ์ทางด้านสุขภาพอื่น ๆ ซึ่งค่าคะแนนในแบบทดสอบนี้จะมีการประเมินโดยให้ข้อมูลที่สัมพันธ์ไปในแบบที่มี 4 ระดับ ขอให้ท่านช่วยยืนยันความหมายที่สูงสุดให้ได้สูงสุดเท่าที่จะเป็นไปได้ รวมทั้งหมดมี 38 ข้อ

แบบทดสอบส่วนที่ 6
จะสอบถามให้ท่าน 2 รูปค่าสุขภาพสุขภาพอื่น ๆ จากนั้นให้ท่านตอบถูกต้องได้ถึง 8 ข้อ

Version 3
ส่วนที่ 1: ข้อมูลต่างๆ

1. เพศ [ ]ชาย [ ]หญิง [ ]ไม่ระบุ

2. อายุ [ ]ปี เกิดวันที่ [ ]เดือน [ ]ปีพ.ศ.

3. เข้าชาติ [ ] ผู้ถือหนังสือเดินทาง [ ] ผ่านวิเคราะห์

4. ระดับการศึกษาสูงสุด [ ] ไม่ได้เข้ารับการศึกษา [ ] ประกาศนียบัตรวิชาชีพชั้นต้น (ปรก.)

[ ] ประกาศนียบัตรวิชาชีพชั้นต้นสูง (ปรก.)

[ ] ประกาศนียบัตรวิชาชีพระดับสูง (ปรก.)

[ ] ประกาศนียบัตรวิชาชีพระดับสูงสุด (ปรก.)

[ ] อนุปริญญา

[ ] ปริญญาตรี

[ ] ปริญญาโท

[ ] ปริญญาเอก

5. รายได้เฉลี่ยต่อเดือน [ ] บาท อาชีพ [ ]

6. ทำนองเสรีระดับการงานของเด็กเนื่องได้รับของอยู่ในระดับใด

[ ] ดีเยี่ยม [ ]ดีมาก [ ]ดี [ ]ปานกลาง [ ]ดีมากกว่า [ ]ดี

[ ] ผ่านการบังคับไม่ได้

7. ทำนองจำเป็นต้องมีคุณสมบัติของเด็กเนื่องของอยู่ในระดับใด

[ ] ไม่จำเป็นต้องมีคุณสมบัติ [ ] ต้องมีคุณสมบัติอยู่ในระดับต่ำ [ ] ต้องมีคุณสมบัติอยู่ในระดับต่ำกว่า [ ] ต้องมีคุณสมบัติอยู่ในระดับต่ำกว่าทุกครั้ง
การใช้บริการทางทันตกรรม

1. ใน 1 ปีที่ผ่านมา ท่านไม่ใช้บริการทางทันตกรรม หรือได้รับบริการทางทันตกรรมบ้างหรือไม่
   ☐ ใช้ครั้งเดียว ☐ ไม่ใช้ ☐ ไม่ได้ให้แน่ใจ
   ถ้าใช้บริการครั้งใดได้รับบริการทางทันตกรรมท่านได้รับบริการทางทันตกรรมประเภทใด (โปรดระบุ)________________________________________

2. โดยทั่วไปแล้ว ท่านไม่ใช้บริการทางทันตกรรมเมื่อใด
   ☐ ไม่ใช้บริการเป็นประจำ (ตรวจสอบสุขภาพตนเองปกติเป็นประจำทุกปี) ☐ นานๆครั้ง ☐ เมื่อมีปัญหาการฟันผุหรือมีปัญหาเกี่ยวกับสุขภาพ

3. ท่านใช้สิทธิประกันสุขภาพประเภทใด
   ☐ หลักประกันสุขภาพหลักหน้า (30บาท) ☐ ประกันสังคม ☐ สิทธิการชราภัยการเรียนรู้งาน ☐ สิทธิ์ส่วน (ระบุ)________________________

4. ปัจจุบันไม่ใช้บริการทางทันตกรรมที่ไหน
   ☐ โรงพยาบาลประจำอำเภอ/โรงพยาบาลส่งเสริมสุขภาพประจำตัวบุคคล ☐ โรงพยาบาลประจำจังหวัด
   ☐ คลินิกเฉพาะทางศาสตร์ ☐ คลินิกเอกชน ☐ อื่นๆ โปรดระบุ________________________

5. เหตุผลใดทำให้ท่านเลือกไม่ใช้บริการทางทันตกรรมที่สถานที่เหล่านี้

6. โดยปกติแล้ว ท่านดินที่ไม่ใช้บริการทางทันตกรรมโดยทั่วไป (โปรดระบุ)________________________________________

7. ท่านมีข้อเสียในการใช้บริการทางทันตกรรมหรือไม่
   ☐ ไม่มี ☐ มี โปรดระบุ________________________________________
การรับผู้ช่วยพื้นบ้าน

1. ท่านติดตั้งสู่ข่ายพื้นบ้านท่านโดยรวมกันในขณะนี้เป็นอย่างไร

☐ ตื่นเต้น  ☐ นิ่งมาก  ☐ ตี ☐ ป่ากลาง ☐ ไม่ติด

2. เคยมีเหตุบุคคลจากบ้านหรือไม่ท่านมีเหตุ

☐ มี ☐ ไม่มี ☐ จ้างไม่ได้/ไม่แน่ใจ

3. เคยมีเหตุบุคคลจากบ้านหรือไม่ ท่านเป็นโรคเหลือก

☐ มี ☐ ไม่มี ☐ จ้างไม่ได้/ไม่แน่ใจ

4. ครั้นเมื่อท่านติดต่ำ ท่านมีปัญหา หรือ มีความคิดคัดให้ขอยืมท่านหรือไม่

☐ ไม่มี ☐ มี โปรดระบุ

5. ท่านติดต่ำ ปัญหาหนึ่งในข้อท่านท่านมีปัญหา จำนวนใดท่านต้องการรักษาอย่างน้อยค่านั้นหรือไม่

☐ จำนวนเฉพาะ

☐ ไม่จำเป็น เพราะ

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ส่วนที่ 2 ความสูญเสียด้านกิจการสุขภาพของปาก (โรคพิษภูมิ)

1A. กระดาษ
2. ช่องปาก
3. สาเหตุ
4. ระดับ

1B. อาการ
2. ไข้
3. มี
4. อาการ

1C. 1. ท้องไม้
2. ชู
3. เป็นรุ้
4. เจ็บปวด

วิธีการด้านนี้วิวิธีตามระดับ

1D. 1. ปัสสาวะ
2. เลือด
3. ซอง
4. เลือดออก

1E. 1. เหมือน
2. เกิด
3. ยาม
4. เต็ม
คำถาม การรับประทานอาหารที่มีความเสี่ยงดังต่อไปนี้ให้เกิดพิษมณีขึ้น

1F
1. บนหัวผักผลไม้
2. ให้ทอด ลับสาหร่าย
3. เหล้า เปียร์รัต
4. ข้าว ลูกข้าว

นอกจากนี้ ผู้ดูแลรับประทานอาหาร โดยเฉพาะ การไม่

1G
1. กินยาตามมูลสัตว์
2. ออกกำลังกายด้วยแม่แหม่
3. ฆ่าพัน
4. กัดพัน

ยินดีกว่านี้ เป็นจุดที่จะสมการ ที่ให้เกิดพิษมณี ได้แก่ กรณี

1H
1. สังพล
2. น้ำหนัก
3. กลูบภัต
4. ผักเรือ

1I
1. สาค่ายไม้
2. ปากเหงา น้ำลายบั้นธง
3. ประโยค
4. อาการกลืนสิ่งไข้
ส่วนที่ 3 ความรู้สึกที่เกี่ยวข้องกับสุขภาพของปาก (โรคเหงือกอักเสบและโรคบริเวณ)

โรคเหงือก เป็นโรคที่ __________ ในผู้สูงอายุ โรคเหงือกในขณะที่เกิดแล้ว จะเรียกว่า โรคเหงือกอักเสบ โดยมีอาการเหงือก __________ หรือมีเลือดออก

2A
1. ปวดได้บ่อย
2. ไม่มีทางพบ
3. หาย
4. ปวดได้ยุ่งครั้ง

2B
1. ลำบากซน
2. ไม่
3. ใส่ไฟ
4. บาง

ถ้าเป็นโรคเหงือกอักเสบไม่ได้รับการ __________ ก็จะก่อให้สุขภาพ __________ มาขึ้น ถ้าเรียกว่า โรคบริเวณอักเสบ หรือจำานวนมาก

2C
1. ให้กินจิ้มไจ
2. หลอด
3. เครื่องพิษ
4. รักษา

2D
1. ใกล้
2. รุนแรง
3. ติด
4. ข้างๆ
ชื่อผักตักผักย่อยส่วนหนึ่ง เช่น ผักย่อยส่วนหนึ่งแย่งช่างแย่งช่าง ทำให้เกิดอาการปวดพันได้ดังนี้

**2E**
1. ที่เริ่มต้น
2. ไปว่างใส่
3. ลอย
4. ตกลง

โดยสามารถกล่าวถึงการบีบรับโรคดังกล่าว

**2F**
1. กระตุก
2. ใช้
3. เชิดพัน
4. หมอง

โดยสามารถกล่าวถึงการบีบรับโรคดังกล่าว

**2G**
1. ดำเนินที่สูง
2. ลงมาตัว
3. เปียกชู
4. ลอย

โดยสามารถกล่าวถึงการบีบรับโรคดังกล่าว

**2H**
1. ควบคุม
2. ควบคุมเริ่ม
3. เฝ้า
4. ดื่มน้ำกลิ่น

โดยสามารถกล่าวถึงการบีบรับโรคดังกล่าว

**2I**
1. ลูกสูบ
2. รู้จะ
3. เข้าใจ
4. เข้าใจ

โดยสามารถกล่าวถึงการบีบรับโรคดังกล่าว
ส่วนที่ 4 ความรู้เบื้องต้นเกี่ยวกับสุขภาพของปาก (การป้องกันโรค)

สำหรับการป้องกันโรคฟันผุนั้น ทำดังนี้: 

3A
1. น้ำ
2. กดแปรง
3. แปรงฟัน
4. ใช้ไม้จิ้มฟัน

3B
1. สีปากเด็กและเด็กโต
2. รักษาครั้งต่ำนละหน่อย
3. ใบวันอีสต์ภูริ
4. รับและส่งฟันล่างจากที่

3C
1. ชูไม้สิ่ง
2. น้ำที่
3. รินน้ำที่
4. ริน

3D
1. ควร
2. จำก
3. โดย
4. ไม่

3E
1. พลูออยาล์เด็ก
2. พลูออยาล์
3. คาเฟอีน
4. ไม่นก
การเลือกแกรมพิมพ์ก่อนดูอย่างไร เพราะแกรมพิมพ์ที่เหมาะสมนั้นสามารถ สะดวกพิมพ์ออกทั้งหมดได้อย่างมีประสิทธิภาพ

3F
1. สอดรู
2. ประมาณ
3. ฉาหาร
4. ติด

โดยทั่วไป แกรมพิมพ์ที่มีลักษณะและเป็นสีเล็กที่สะดวกและปลอดภัยที่สุด

3G
1. เบียบ
2. ไหม
3. แก้ว
4. ผูก

นอกเหนือจากนี้ เพื่อที่จะทำให้สถิตของข้อมูลและอัตรา ทำงควรใช้ใหม่ชัดเจนที่ความสวยงามบริเวณและยากที่สุด

3H
1. มาหนึ่งชั่ว
2. บอดกลาง
3. ป่วยๆ
4. ถนนครั้ง

3I
1. ทุจริบ
2. พอควร
3. ทุจริต
4. ทุ่ม لبن

ID__________
ส่วนที่ 5 ไบโอติกสำหรับการนอนพื้น

ทางเดินกิ่งสูงฉาบเนื้อจาก

<table>
<thead>
<tr>
<th>4A</th>
<th>4B</th>
</tr>
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<tbody>
<tr>
<td>1. เต็ม</td>
<td>1. ไข่หัวด้าน</td>
</tr>
<tr>
<td>2. การติดอาวุธ</td>
<td>2. เล่นประสาท</td>
</tr>
<tr>
<td>3. การอับถุร</td>
<td>3. การติดเชื้อ</td>
</tr>
<tr>
<td>4. การตัด</td>
<td>4. การตัดสินใจ</td>
</tr>
</tbody>
</table>

ผู้ถือและการติดเชื้อที่ซ้ำ ข้าพเจ้าอาจจำเป็นต้องได้รับการรักษา

<table>
<thead>
<tr>
<th>4C</th>
<th>4D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. เต็มเติม</td>
<td>1. ระดับ</td>
</tr>
<tr>
<td>2. เที่ยวพ่อ</td>
<td>2. ความเสี่ยง</td>
</tr>
</tbody>
</table>
| 3. ขนก | 3. เลี้ยงกีก | 3. สารกล
| 4. กลบ | 4. สารกล

ข้าพเจ้าเข้าใจ

ที่อาจเกิดขึ้นจากการถูกนอนพื้น

Version 3
Page 11
เช่น บางครั้งอาจมีความเจ็บป่วย การแพร่กระจายของการเรื้อน, การสูญเสียความรู้สึกของพื้น, ริมฝีปาก และเนื้อเยื่อบริเวณช่องเดี๊ยงได้

<table>
<thead>
<tr>
<th>4E</th>
<th>1. ตะไกร</th>
<th>2. ปลัด</th>
<th>3. นก</th>
<th>4. น้ำเสียง</th>
</tr>
</thead>
</table>

หรือเกิดจากขางทางใกล้ ๆ ได้ ทำให้เจ็บเจ็บใจว่าเจ็บเจ็บหลายจุด เช่นได้รับการรักษาเพิ่มเติมโดยกันหนาที่เฉพาะทางที่มี

4F

| 1. เต้น | 2. ถูกกิน | 3. ติด | 4. หัก |

4G

| 1. การแพทย์เขียน | 2. ความน้อย | 3. การประยุกต์ | 4. สุขภาพถาวร |

ระหว่าง หรือ หลังจากการรักษา สภาพที่เกิดขึ้นนั้นต้องเป็นความรับมือของเจ้าพ่อเจ้าแม่
ข้าพเจ้าได้รับข้อมูลเกี่ยวกับการรักษาที่ได้ถูกสอบถามแล้ว ข้าพเจ้าจะทำการรักษารายงานผลแพทย์ดังนี้

4H
1. ตะแกรง
2. ปีกษา
3. หัวขาด
4. นำร่อง

ข้าพเจ้ามีการรับประทานยาดังกล่าวดูแลรักษาอย่างครบถ้วน ข้าพเจ้ายินดีที่จะทำการรักษาทั้งหมดแบบนี้

4I
1. ยาบูรษา
2. เต้าหัว
3. ยา
4. เปิดแผล

การรักษาต่อไปนี้เป็น รวมถึงความเสี่ยงของการรักษา ข้าพเจ้ายินดีที่จะทำการรักษาตามที่ได้รับคำแนะนำ

4J
1. กำลัง
2. เป็นกล้า
3. ธรรมชาติ
4. ไม่ใช้

ID__________
ส่วนที่ 1 ให้หัวฉีดพื้นหลังของสูตร จากนั้นให้สอบคำถามที่ตรีวิมณ์ใช้บริษัทหลังสุด (สามารถบริการเก็บมูลบุญได้ระหว่าต่อคำถาม)

Prompt 1: ยาสีฟัน

วิธีใช้ แบ่งพื้นอย่างน้อยวันละ 2 ครั้ง หลังอาหารทุกมื้อและก่อนนอน เชื่อให้เกิดประสิทธิภาพสูงสุด

- คั้นเดือน • มีสารวิเคราะห์พื้นขาว 1,000 ล้านในส่วนต่ำ • ห้ามกิน • แลกเท้าค้าน
- ทาอี ควรใช้ยาสีฟันปริมาณเท่ากับเปลือกถังเทียมและมีจุดใหญ่ลูกลมบนยาสีฟัน

ในกรณีที่เด็กได้รับสารพื้นผิวที่ต้องทำแห้งเจริญ ควรบริษัททันตแพทย์หรือแพทย์
Prompt 2 น้ำยาบ้วนปาก คลอรีเซทิด

Chlorhexidine Mouthwash 600 ml

น้ำยาบ้วนปาก คลอรีเซทิด กลูโคแนล 0.12 %

วิธีใช้ ซอมบ้นปากครั้งละ 1 ช้าคิด (10 ชื่ื)
วันละ 1 ครั้ง แล้วแต่ผลลัพธ์ และสั่นไปโบกเป็นกลางที่
กีบบลังก์

- สำหรับผู้เรียกเพื่อสีมีให้ใช้ต้องกัน 1 เติม
(หรือ 1 ช้าคิด)

- สำหรับผู้ป่วยในใดๆ ใช้ผลิตภัณฑ์กีบบลังก์และหลัก
และใช้ต้องเป็นเรื่องดังกล่าวหากเป็นไปได้

- สำหรับผู้ป่วยในใครซึ่งจะขอให้ใช้ทันที

คำเตือน

- จำเป็นใจในการติดตามผู้ป่วยที่น้ำยาบ้วนปาก

- หลังจากน้ำยาบ้วนปากเหล่านี้ ดังนี้ควรใช้สารพันธุ์ในเวลา
ที่ดีที่สุดกับน้ำยาบ้วนปากนี้

- เมื่อนั้นให้น้ำยาบ้วนปากนี้อาจทำให้เกิดการสีมี
ของผิวและหลักได้ ซึ่งเป็นอาการที่เกิดขึ้นเพียง
ชั่วคราว ควรที่จะดื่มต่อๆไปMinMax 5 หรือ
หมู่ใจ ล้างระดับที่สูงตามคำแนะนำที่ได้ดังการแก้
ไข

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Prompt 1 ข้าพเจ้า

- ตั้งค่าลำดับข้าพเจ้าระดับให้ท่านควรวางแผนอย่างหน่อยที่สุด ที่ครั้งต่อไป
- ท่านควรวางแผนหลังจากข้าพเจ้าหรือไม่
- ท่านติดตามการวางแผนเพิ่มเติมกับข้าพเจ้าหรือไม่
- ฉันต้องส่งผลกระทบที่ถูกหรือในการวางแผนเพิ่มเติมข้าพเจ้าหรือไม่ หรือเรียกว่าความเริ่มต้น

Prompt 2 นำความน่าบ่นปกครอง

- ตั้งค่าลำดับข้าพเจ้าปัจจุบันให้ท่านควรใช้นำความน่าบ่นปกครองอย่างหน่อยที่สุด ครั้งต่อไป
- ท่านควรใช้นำความน่าบ่นปกครองเป็นมาตรการในการควบคุมเพื่อให้ถูกต้อง
- ถ้าท่านเป็นผู้เลือกท่านควรใช้นำความน่าบ่นปกครองเพื่อตัดสินเป็นมาตรการตามท่าน
- ถ้าท่านใช้นำความน่าบ่นปกครองผ่านขั้นตอนนี้ จะมีผลต่อการขับเคลื่อนในบ้างอย่างที่เพียงพอหรือไม่
Appendix 11.4: The key answers of the Thai OA-TOFHLiD

Thai OA-TOFHLiD: Key Answers

<table>
<thead>
<tr>
<th>ส่วนที่</th>
<th>ส่วนที่2</th>
<th>ส่วนที่3</th>
<th>ส่วนที่4</th>
<th>คำสำคัญ Prompt A (คะแนนเต็ม 5 คะแนน)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A 2</td>
<td>2A 1</td>
<td>3A 3</td>
<td>4A 4</td>
<td>1) 2 (ครั้งวัน)</td>
</tr>
<tr>
<td>1B 4</td>
<td>2B 4</td>
<td>3B 4</td>
<td>4B 3</td>
<td>2) ไม่ทาร</td>
</tr>
<tr>
<td>1C 3</td>
<td>2C 4</td>
<td>3C 2</td>
<td>4C 1</td>
<td>3) ไม่ปลอดภัย</td>
</tr>
<tr>
<td>1D 1</td>
<td>2D 2</td>
<td>3D 1</td>
<td>4D 2</td>
<td>4) (โลหิตยนต์) พลังใจโรค</td>
</tr>
<tr>
<td>1E 2</td>
<td>2E 3</td>
<td>3E 2</td>
<td>4E 3</td>
<td>และ 1450 (ppm)</td>
</tr>
<tr>
<td>1F 4</td>
<td>2F 4</td>
<td>3F 3</td>
<td>4F 4</td>
<td>คำสำคัญ Prompt B (คะแนนเต็ม 4 คะแนน)</td>
</tr>
<tr>
<td>1G 3</td>
<td>2G 1</td>
<td>3G 4</td>
<td>4G 1</td>
<td>1) 2 (ครั้งวัน)</td>
</tr>
<tr>
<td>1H 1</td>
<td>2H 2</td>
<td>3H 1</td>
<td>4H 2</td>
<td>2) 10 (จิต), หรือ 1 (ทารครอง)</td>
</tr>
<tr>
<td>1I 2</td>
<td>2I 4</td>
<td>3I 1</td>
<td>4I 3</td>
<td>3) 1 (เดือน), หรือ 1 (ข้ามจานหนัก)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4) เปลี่ยนศีรษะ (ของเล่นเพื่อ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>หงาย)</td>
</tr>
<tr>
<td>คะแนนเต็ม 9</td>
<td>คะแนนเต็ม 9</td>
<td>คะแนนเต็ม 9</td>
<td>คะแนนเต็ม 12</td>
<td>คะแนนเต็มทั้งหมด 48</td>
</tr>
</tbody>
</table>

*ขอความในวงเล็บ จะมีหรือไม่มีก็ได้ ให้ถือว่าได้คะแนน
Appendix 11.5: Thai translated version of The Short Test Of Functional Health Literacy in Adults (S-TOFHLA)

แบบทดสอบความสามารถทางสุขภาพที่กำหนดความเข้าใจข้อมูลข่าวสารและความเข้าใจเกี่ยวกับสิทธิและหน้าที่ในฐานะผู้ใช้สุขมีลักษณะดังนี้

(Shortened Version of the Test of Functional Health Literacy in Adults; STOFHLA)

โปรดให้ทำแบบทดสอบดังนี้และตรวจดูผลลัพธ์ที่ได้รับในการประเมินความสามารถในการเข้าใจข้อมูลสุขภาพที่กำหนด จำนวน 4 คำถาม

กรุณาทำให้เสร็จภายใน 7 นาที

ข้อความที่ 1 เรื่องการเตรียมตัวเข้าทำข้อสอบ

ข้อความที่ 2 สิทธิในการรักษาพยาบาลและความรับผิดชอบของผู้ป่วย
ไปให้ค้นแนวโน้มปัจจัยก่อนรับการฝึกหัด

เมื่อแพทย์แจ้งทำไปถึง операционный  เพื่อใช้ประโยชน์ในการพัฒนาโรคเพิ่มเติม

1. ช่องท้อง
2. เบญจาน
3. ใบหยดหย่อม
4. เรือไข่

ท่านจะต้องทำให้ท้อง ในรันที่จะมารับการฝึกหัด

1.B  1. หมอพิษ
   2. ร่าง
   3. มีพิษพิษพิษ
   4. เลือด

1.C  1. ยู่
   2. เป็น
   3. ที่
   4. นี้

การฝึกเชิงขั้นตอนนั้นจะ  ประดำเนิน 1 ถึง 3  ในกรณีทำตามหมวด

1.D  1. ใช้เวลา
   2. อยู่
   3. ตีพุ่ง
   4. อยู่

1.E  1. ดีใจ
   2. สมอง
   3. ข้ามใจ
   4. อาหาร
วัสดุบนพื้นหลังเชิง

ในกรณีนี้ให้ท่านเขียนตามที่จะต้องการ เช่น ผลไม้, ผลไม้หรือ ฤดูกาลเจ้า

ข้อ 1
1. ใคร
2. ชื่อ
3. สาขา
4. ชื่อ

ข้อ 2
1. ชื่อ
2. ชื่อ
3. ชื่อ
4. ชื่อ

และหลัง

ไปแล้วท่านส่งเงินไม่ได้
หรือติดเครื่องเสีย

ข้อ 1
1. หนัง
2. เติมเงิน
3. ประจำ
4. ก่อน

ข้อ 2
1. ล่าย
2. ถ่าย
3. ถ่าย
4. รับประทาน

ข้อ 1
1. ทุกชนิด
2. บางชนิด
3. ยอด
4. หลักหลา

และ

ลงว่าท่านจะส่งอีกครั้ง

ข้อ 1
1. เป็น
2. มี
3. พร้อม
4. ขุด
วันที่สิ้นสุดการดูแลเด็กไข้

ท่านจะต้องไม่รับประทาน

- น้ำมัน
- เคิร์ซ์มา
- ยาฟอร์มา
- คลินิค

และท่านจะต้องไม่

- 1M
  1. ซิมป์
  2. ฝีม
  3. แผลผัก
  4. ใส้

- 1N
  1. หัวใจ
  2. หายใจ
  3. น้ำป่า
  4. มะเร็ง

ถ้ามีปัญหาใด ๆ กรุณาติดต่อ
เบื้องหน้า โทร 053-616-450

- 10
  1. กำเริบ
  2. กลิ่น
  3. ช่วงระยะเวลา
  4. ข้อสงสัย

- 1P
  1. เป็น
  2. ผลิต
  3. ปริมาณ
  4. ปัจจัยพัน
ข้อความที่ 2

ในกรณีประสบการณ์พยาบาล

ข้อเท็จจริงแสดงความ  โดยให้ความ  ให้ถึงแพทย์

2A
1. อินธนูเมีย
2. พร้อมใจ
3. ส่งออกสาร
4. ได้รับ

2B
1. รับรู้
2. สนับสนุน
3. เห็น
4. เข้าใจ

และระบุสาเหตุในที่มุมภาพของ

2C
1. ท่าน
2. ที่
3. โรงพยาบาล
4. หน่วย

ที่ได้รับ  ให้มีความร่วมในการดูแล ตรวจ วินิจฉัย และให้การรักษาพยาบาล

2D
1. สง
2. มอบหมาย
3. คู่
4. ประกัน
ได้ดำเนินการตรวจสอบ และรักษาจัดเก็บ โดยที่จัดพิมพ์ไว้ได้รับทราบ

<table>
<thead>
<tr>
<th>2E</th>
<th>2F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. แผน</td>
<td>1. หมาย</td>
</tr>
<tr>
<td>2. วิจัย</td>
<td>2. ไป</td>
</tr>
<tr>
<td>3. วิจัยขั้น</td>
<td>3. เสนทาง</td>
</tr>
<tr>
<td>4. งาน</td>
<td>4. รายละเอียด</td>
</tr>
</tbody>
</table>

เกี่ยวกับแผนการตรวจวินิจฉัยและการรักษา ข้างต้น

<table>
<thead>
<tr>
<th>2G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. พอร่า</td>
</tr>
<tr>
<td>2. พอร่าม</td>
</tr>
<tr>
<td>3. ลม</td>
</tr>
<tr>
<td>4. มา</td>
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รวมถึงความ ผลข้างเคียง และข้อร้อง ผลที่อาจเกิดขึ้นภายนอก

<table>
<thead>
<tr>
<th>2H</th>
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<tbody>
<tr>
<td>1. ภูมิ</td>
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<tr>
<td>2. ปรับที่</td>
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<td>3. ส่วนชู</td>
</tr>
<tr>
<td>4. เผื่อน</td>
</tr>
</tbody>
</table>

ยิ่งที่มีผลลักษณะๆที่อาจเป็นไปได้อย่าง อนาคตเป็นที่จะค้นหาข้อตกลงที่แล้ว

<table>
<thead>
<tr>
<th>2I</th>
</tr>
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<tbody>
<tr>
<td>1. ขั้นตอน</td>
</tr>
<tr>
<td>2. กลุ่มเครือ</td>
</tr>
<tr>
<td>3. ต่อ</td>
</tr>
<tr>
<td>4. เซ็นส์</td>
</tr>
</tbody>
</table>
และข้าพเจ้าจะรวมนักดิว่า คณะแพทย์และบุคคลากรที่มีความ不能为空ไม่สามารถ__________ถึง

2) 1. ช่วง
2. ร่างเรือน
3. รับประทาน
4. ลูกส่ง

ความสำเร็จของการกิจยาบาลดังกล่าวได้

ข้าพเจ้าขอแสดงความยินยอมโดยความสมัครใจให้คณะแพทย์และบุคคลากรที่มีอย่างเดียวดังกล่าว

ชื่อผู้มอบหมาย
อื่นๆอีกหลายครูแสดงชื่อ

2K
1. คลินิก
2. กระทำ
3. รับประทาน
4. ยืน

2L
1. ข้ามน้ำ
2. รู
3. ช้ำแย่
4. ลูกส่ง

ของการกระทั่งดังกล่าว อาทิเช่น การควบคุม การใช้กระษัตร์ความรู้สึก การให้เลือด

การตรวจวินิจฉัยทางวิทยา การคัดเลือกเนื้อหรือส่วนของหัวใจ

และการตรวจวัคซีนาหรือคำแนะนำเพื่อมิให้เกิดการทับหนักใด
ข้อผิดพลาดที่เกิดจากการทำตามที่กล่าวมาได้ทำเป็น

2M
1. งาน
2. คิด
3. ตัดมิตรภาพ
4. รับรู้

การย้ายฝั่งข้าวซึ่งจะถูกนำเข้าเป็นสิ่งที่

2N
1. ที่
2. เท่าน
3. ประโยค
4. ประโยคมน์

ข้อผิดพลาดที่เกิดจากการทำตามที่กล่าวมาได้ทำเป็น

2O
1. ศัพท์
2. เทีห์
3. พา
4. บ็อบ

ถ้ามีบุคคลที่มีสุขภาพ ประกอบด้วย แพทย์ประจำบ้าน แพทย์ประจำบ้านค้นโรค นักสุขภาพและ

นักศึกษาแพทย์ และบุคคลอื่นๆ ซึ่งอาจจะช่วยนักวิจัยของกลุ่ม

2P
1. กับ
2. สำนวน
3. เกม
4. สำนวน

8
ตั้งใจทำแผนที่หรือบุคคลานที่มีอุบัติเหตุได้เช่นกัน โดยประมาณแล้ว

| 2Q | 1. ตั้งใจ  
2. ทำให้เข้าใจ  
3. ช่วย  
4. ร่วม |

| 2R | 1. ตั้งใจ  
2. จับตัวเอง  
3. แทรกซ้อน  
4. ทาย |

| 2S | 1. บทบาท  
2. สนับสนุน  
3. ทำตาม  
4. จุดประสงค์ |

 güçlü จะต้อง้ ข้าพเจ้าเพิ่มเติมที่จะให้ข้อมูล ณ ที่นี้

| 2T | 1. ตั้งใจ  
2. ทำให้เข้าใจ  
3. ทาย  
4. ร่วม |

ข้าพเจ้าขอแสดงความยินดี เพื่อรับการรับบมาโดยความมีหน้าให้ ณ ที่นี้

ลงชื่อ: (ผู้ประสาน)
ลงชื่อ: (แพทย์ผู้รับผิดชอบ)
Appendix 11.6: The key answers of the Thai S-TOFHLA

Thai S-TOFHLA Key Answers

<table>
<thead>
<tr>
<th>ส่วนที่1</th>
<th>ส่วนที่2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>2A</td>
</tr>
<tr>
<td>1B</td>
<td>2B</td>
</tr>
<tr>
<td>1C</td>
<td>2C</td>
</tr>
<tr>
<td>1D</td>
<td>2D</td>
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<td>1E</td>
<td>2E</td>
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<td>2G</td>
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<tr>
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<td>2I</td>
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<tr>
<td></td>
<td>2T</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
Appendix 11.7: Thai translated version of The Newest Vital Sign with English original version

### The Newest Vital Sign, Thai version

แบบทดสอบ นิวเวิร์ส ไวทอล ไซน์

ขอความร่วมมือให้ทานอย่างละเอียดเคร่งขรึม แล้วตอบคำถามในแบบทดสอบไป

-----------------------------------

| ชื่อสารอาหาร | หน่วย (กรัม) | ร้อยละของปริมาณที่แนะนำต่ำร้าน *
<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>ไข่มันหั่นmetros</td>
<td>13</td>
<td>20%</td>
</tr>
<tr>
<td>ไข่มันอิ่มเต็ม</td>
<td>9</td>
<td>40%</td>
</tr>
<tr>
<td>โคเutils</td>
<td>28</td>
<td>12%</td>
</tr>
<tr>
<td>ไอดีเมี่ยม</td>
<td>55</td>
<td>2%</td>
</tr>
<tr>
<td>คาร์บอนะเutils</td>
<td>30</td>
<td>12%</td>
</tr>
<tr>
<td>ไวยาหาร</td>
<td>2</td>
<td>น้ำตาล 23 กรัม</td>
</tr>
<tr>
<td>โฟลีกซ์</td>
<td>4</td>
<td>8%</td>
</tr>
</tbody>
</table>

* ร้อยละของปริมาณที่แนะนำต่ำร้าน โดยคิดจากความต้องการร้านละ 2000 ไพล่เครื่องร้านละความต้องการร้านละ 12 ไพล่เครื่องร้านละความต้องการร้านละ 8 ไพล่เครื่องร้านละความต้องการร้านละ 4 ไพล่เครื่องร้านละความต้องการร้านละ 2 ไพล่เครื่องร้านละความต้องการร้านละ 1 ไพล่เครื่องร้านละความต้องการร้านละ 1 ไพล่เครื่องร้านละความต้องการร้านละ 0.5 ไพล่เครื่องร้านละความต้องการร้านละ 0.5 ไ plagelionlasanid
<table>
<thead>
<tr>
<th>คำคม</th>
<th>ค่าตอบที่ถูกต้อง</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ถ้าทำรับปริญญาโดยศิลปศาสตร์บัณฑิตจะต้องมี 1,000 หน่วยกิตซึ่งต้องมีภาคที่มีหลักการทั้งหมด</td>
<td>ไม่</td>
</tr>
<tr>
<td>2. ถ้าในหนังสือกำลังได้รับปริญญาบัณฑิต จะต้องมีภาคที่มีสิ่งเท่ากับ 60 หน่วยกิต ทั้งหมดจะต้องมีภาคที่มีสิ่งเท่ากับ</td>
<td>ไม่</td>
</tr>
<tr>
<td>คำตอบ: คำตอบข้างต้นนี้ ซึ่งได้ข้อตกลง</td>
<td>ไม่</td>
</tr>
<tr>
<td>□ 1 ล้าน (หรือเท่ากันมากกว่า)</td>
<td>ไม่</td>
</tr>
<tr>
<td>□ ครึ่งล้าน</td>
<td>ไม่</td>
</tr>
<tr>
<td>**หมาย: ถ้าหากผู้ประกอบจะกำหนด 2 หน่วยบิลกึ่ง ให้ความต้องการ “การเปลี่ยนหุ้นไทยเกี่ยวกับ”</td>
<td>ไม่</td>
</tr>
<tr>
<td>3. สมมุติว่า ทำรับปริญญาทางศิลปศาสตร์บัณฑิต 1 หน่วยบิลกึ่ง หน่วยกิตต้องมี</td>
<td>ไม่</td>
</tr>
<tr>
<td>□ 33 หน่วยกิต คือคำตอบที่ถูกต้อง</td>
<td>ไม่</td>
</tr>
<tr>
<td>4. รับประโยชน์จากปริญญาต่อไป 2,500 หน่วยกิตต่อวัน ทำรับปริญญาทางศิลปศาสตร์บัณฑิต 1 หน่วยบิลกึ่ง</td>
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</tr>
<tr>
<td>□ 10 ประเทศปัจจุบัน คือคำตอบที่ถูกต้อง</td>
<td>ไม่</td>
</tr>
<tr>
<td>5. สมมุติว่า ทำรับปริญญาทางศิลปศาสตร์บัณฑิต 1 หน่วยบิลกึ่ง ทำรับปริญญาทางศิลปศาสตร์บัณฑิต 1 หน่วยบิลกึ่ง</td>
<td>ไม่</td>
</tr>
<tr>
<td>□ ไม่เปิดเลย</td>
<td>ไม่</td>
</tr>
<tr>
<td>6. (ตามผู้ตอบแบบสอบถาม ที่ตอบ “ไม่เปิดเลย” ในข้อ5) เพราะเหตุใดไม่เปิดเลยกัน</td>
<td>ไม่</td>
</tr>
<tr>
<td>□ เพราะไม่ได้มีบัณฑิตปัจจุบันของนักเรียนหลักสูตร</td>
<td>ไม่</td>
</tr>
</tbody>
</table>

คะแนนรวมที่ได้รับถูกต้อง
Implementation Guide for the Newest Vital Sign

Health literacy — the ability to read, understand and act upon health information — is now known to be vital to good patient care and positive health outcomes. According to the Institute of Medicine’s groundbreaking report on health literacy, nearly half of all American adults — 90 million people — have difficulty understanding and using health information. When patients lack the ability to understand and act upon medical information, it can put their health at risk.

The Newest Vital Sign is a new tool designed to quickly and simply assess a patient’s health literacy skills. It can be administered in only 3 minutes and is available in English and Spanish. The patient is given a specially designed ice cream nutrition label to review and is asked a series of questions about it. Based on the number of correct answers, health care providers can assess the patient’s health literacy level and adjust the way they communicate to ensure patient understanding.

There are many ways to integrate the Newest Vital Sign (NVS) into a private practice or clinic setting to improve communication with patients. Improved communication can help increase your patients’ ability to understand and act upon the information you provide; ultimately improving patient satisfaction and health outcomes.

How To Use the Newest Vital Sign

1. Who and when to administer the Newest Vital Sign.
   - A nurse (or other trained clinic staff) is the preferred administrator of the Newest Vital Sign.
   - Administer at the same time that other vital signs are being taken.

2. Ask the patient to participate.
   A useful way to ask the patient is an explanation similar to this:
   “We are asking our patients to help us learn how well patients can understand the medical information that doctors give them. Would you be willing to help us by looking at some health information and then answering a few questions about that information? Your answers will help our doctors learn how to provide medical information in ways that patients will understand. It will only take about 3 minutes.”

3. Hand the nutrition label to the patient.
   The patient can and should retain the nutrition label throughout administration of the Newest Vital Sign. The patient can refer to the label as often as desired.

More...
4. **Start Asking the 6 questions, one by one, giving the patient as much time as needed to refer to the nutrition label to answer the questions.**
   - There is no maximum time allowed to answer the questions. The average time needed to complete all 6 questions is about 3 minutes. However, if a patient is still struggling with the first or second question after 2 or 3 minutes, the likelihood is that the patient has limited literacy and you can stop the assessment.
   - **Ask the questions in sequence.** Continue even if the patient gets the first few questions wrong. However, if question 5 is answered incorrectly, **do not ask question 6.**
   - **You can stop asking questions if a patient gets the first four correct.** With four correct responses, the patient almost certainly has adequate literacy.
   - **Do not prompt patients who are unable to answer a question.** Prompting may jeopardize the accuracy of the test. Just say, “Well, then let’s go on to the next question.”
   - **Do not show the score sheet to patients.** If they ask to see it, tell them that “I can’t show it to you because it contains the answers, and showing you the answers spoils the whole point of asking you the questions.”
   - **Do not tell patients if they have answered correctly or incorrectly.** If patients ask, say something like: “I can’t show you the answers till you are finished, but for now you are doing fine. Now let’s go on to the next question.”

5. **Score by giving 1 point for each correct answer (maximum 6 points).**
   - **Score of 0-1** suggests high likelihood (50% or more) of limited literacy.
   - **Score of 2-3** indicates the possibility of limited literacy.
   - **Score of 4-6** almost always indicates adequate literacy.

**Record the NVS score** in the patient’s medical record, preferably near other vital sign measures.

---

**Best Practices for Implementation: Summary**

- A nurse (or other trained clinic staff) is the preferred administrator of the Newest Vital Sign.
- Administer the NVS at the same time that the patient’s other vital signs are being taken.
- Record the NVS score in the patient’s chart, preferably near other vital sign measures.
- Tailor communication to ensure patient understanding.
<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size</td>
</tr>
<tr>
<td>Servings per container</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount per serving</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>250</td>
</tr>
<tr>
<td>Fat Cal</td>
<td>120</td>
</tr>
<tr>
<td>%DV</td>
<td></td>
</tr>
<tr>
<td>Total Fat</td>
<td>13g</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>28mg</td>
</tr>
<tr>
<td>Sodium</td>
<td>55mg</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>30g</td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>2g</td>
</tr>
<tr>
<td>Sugars</td>
<td>23g</td>
</tr>
<tr>
<td>Protein</td>
<td>4g</td>
</tr>
</tbody>
</table>

*Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Ingredients:** Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.
**Score Sheet for the Newest Vital Sign Questions and Answers**

**READ TO SUBJECT:**
This information is on the back of a container of a pint of ice cream.

1. If you eat the entire container, how many calories will you eat?
   **Answer:** 1,000 is the only correct answer

2. If you are allowed to eat 60 grams of carbohydrates as a snack, how much ice cream could you have?
   **Answer:** Any of the following is correct: 1 cup (or any amount up to 1 cup), half the container. Note: If patient answers “two servings,” ask “How much ice cream would that be if you were to measure it into a bowl?”

3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?
   **Answer:** 33 is the only correct answer

4. If you usually eat 2,300 calories a day, what percentage of your daily value of calories will you be eating if you eat one serving?
   **Answer:** 10% is the only correct answer

**READ TO SUBJECT:**
Pretend that you are allergic to the following substances: penicillin, peanuts, latex gloves, and bee stings.

5. Is it safe for you to eat this ice cream?
   **Answer:** No

6. (Ask only if the patient responds “no” to question 5): Why not?
   **Answer:** Because it has peanut oil.

Number of correct answers:

**Interpretation**
Score of 0-1 suggests high likelihood (50% or more) of limited literacy.
Score of 2-3 indicates the possibility of limited literacy.
Score of 4-6 almost always indicates adequate literacy.

February 2011
Appendix 11.8: English participant information sheet (Chapter 7 study)

Oral Health Literacy in Older Adults

Participant Information Sheet

You are being invited to take part in a research study as part of a student project. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for taking the time to read this.

Who will conduct the research?

Dr. Pimpinut Wanichsaihong, PhD Student at Dental Health Unit, The University of Manchester, UK

What is the purpose of the research?

Oral health literacy is emerging as an important element in the prediction of the oral health status of individuals. Older adults have not been studied for either general or oral health literacy.

This research is for testing the new tool (questionnaire) to measure oral health literacy in older adults by comparing it to available related instruments and your oral health status.

Why have I been chosen?

You have been chosen because you are a part of the local community. You have not been individually selected; all older adults aged of 60 or more have been asked if they are happy to participate. Whether or not you are included in the study will be based on the requirements detailed below.

In order to take part in this study, you must:

- Be aged at least 60
- Be in good general health
- Be able to read, understand and agree to the informed consent procedure
- Be examined by a dental professional for obtaining your current oral health status

You will not be eligible to take part in the study if:

- You are unable to read and understand the patient information sheet and informed consent procedure.
- You are having cognitive impairment that prevents participation in the informed consent procedure.
- You cannot tolerate a simple dental examination
- You do not want to take part

What would I be asked to do if I took part?

If you decide that you want to take part and have completed the appropriate consent form, you will be asked to do the following steps:
1. **Oral Examination**

We endeavour to minimise any disruption to your time and you will only be examined by a qualified examiner for *approximately 5-10 minutes*. Only a mouth mirror will be used in the examination, which is quick and painless. The examinations and equipment used have a safe history of use around the world and no risks are associated with the procedures involved. We will also collect some demographic data.

2. **Completing 2 Questionnaires by yourself**

The first questionnaire is OA-TOFHLiD which is a new instrument aiming to test your oral health literacy. The second questionnaire is S-TOFHLA, which is an available general health literacy assessment tool. To complete these 2 questionnaires, it will take *approximately 30 minutes*.

3. **Completing pronunciation task**

You will be asked to complete REALD, which is one of available oral health literacy tools. In this task, there are 30 words relating to dentistry and you need to read it out loud one by one to the researcher. In this task, it will take *around 1-5 minutes*.

**What happens to the data collected?**

After the data collected, the analysis will be taken place to see the association between oral health literacy scores obtained by the available tools and our new tool. Moreover, the analysis aims to find the association between your oral health literacy score and your oral health status (for example number of active tooth decay, number of missing teeth, and etc.)

**How is confidentiality maintained?**

We will store all of the collected information in either secure physical or digital locations. You will be assigned a unique ID number if you participate in the study, this means that the collected information does not contain your name, i.e. the results are anonymous. The only people who have access to the information are the scientists involved in the study. For the interview data, there is no audio or video recorded. Electronic and paper data will be stored and kept secure for 5 years, then they will be destroyed.

**What happens if I do not want to take part or if I change my mind?**

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw up to the time of data analysis without giving a reason and without detriment to yourself.

**Will I be paid for participating in the research?**

If you meet the inclusion criteria and complete participation in this study, you will receive 25 dollars store card.

**What is the duration of the research?**

Total time to participate in this study is *approximately 45 minutes*.

**Where will the research be conducted?**

Participating sites in Chicago.
Will the outcomes of the research be published?

The results of this study may be published in a scientific journal. Published information may include any of the information collected from the questionnaires and the examinations but will not include any details that could link the information back to you, i.e. name or initials. We will provide a copy of the results to you if you would like to see them. The study may be monitored by external bodies such as the ethics committee or regulatory authorities. Once again, you will not be identified during this process.

Who has reviewed the research project?

This study has been reviewed by the University of Manchester Research Ethics Committee 1 and internally reviewed by the supervisory team.

What if something goes wrong?

Please be reassured that the examiners are fully qualified dental practitioners with years of experience. If they notice anything in your mouth that they feel needs treatment, they will write to you to let you know and advise you of whether you could benefit from a routine or urgent appointment with your dentist. This will be based on the nature of any problems that the examiner sees in your mouth. You should then make an appointment to see your dentist. If your are not registered with a dentist, the letter will include details of how to find a dentist in your area.

What if I want to make a complaint?

Minor complaints

If you have a minor complaint then you need to contact the supervisor.

Professor Iain Pretty

Dental Health Unit, The University of Manchester, Williams House, Manchester Science Park, Lloyd Street North, Manchester M15 6SE. Tel: +44 0161 226 1211

Email: Iain.A.Pretty@manchester.ac.uk

Formal Complaints

If you wish to make a formal complaint or if you are not satisfied with the response you have gained from the researchers in the first instance then please contact the Research Governance and Integrity Manager, Research Office, Christie Building, University of Manchester, Oxford Road, Manchester, M13 9PL, by emailing: research.complaints@manchester.ac.uk or by telephoning +44 0161 275 2674 or 275 2046.

What Do I Do Now?

If you are happy to take part in the study, please fill out the consent form and questionnaires in the envelope. After you have completed these, place them in the sealed box in the waiting area.

You will then have completing the pronunciation task and when this is finished, you will have the oral examination taken if you are still happy to participate. The examiner will confirm again that you are happy to participate before oral examination and interview.
I would like to thank you for reading this information sheet and for considering the participation of your child in this study. Please do not hesitate to ask for more information, should you require it.

Yours sincerely,

[Signature]

Professor Iain A. Pretty  
Professor in Dental Public Health

This Project Has Been Approved by the University of Manchester’s Research Ethics Committee [UREC 2017-0106-2408].

| Address Details |
|-----------------|-----------------|-----------------|
| Professor Iain A Pretty  
Professor of Dental Public Health  
(Supervisor) | Ms. Pimput Wenchsalihong  
Doctoral Student | Dr. Michaelia Goodwin  
Project Manager  
(Co-supervisor) |
| Dental Health Unit  
The University of Manchester  
Williams House  
Manchester Science Park  
Lloyd Street North  
Manchester  
M15 9SE | Dental Health Unit  
The University of Manchester  
Williams House  
Manchester Science Park  
Lloyd Street North  
Manchester  
M15 9SE | Dental Health Unit  
The University of Manchester  
Williams House  
Manchester Science Park  
Lloyd Street North  
Manchester  
M15 9SE |
Appendix 11.9: English participant consent form (Chapter 7 study)

PARTICIPANT CONSENT FORM

Please read the information sheet enclosed and if you agree to consent please sign the form.

Your contact details (optional)

Address:

Postcode:

Contact number:

Email Address:

By signing this consent form you are agreeing to the following things (please initial):

☐ I confirm that I have read the information sheet for this study and have had the opportunity to consider the information.

☐ I understand I am free to withdraw at any time without giving any reason and without detriment to myself.

☐ I understand that relevant sections of my data collected during the study may be looked at by individuals from the University of Manchester from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to these records.

I agree to take part in the above study

☐ Yes ☐ No

Name of the participant_________________________ Surname_________________________

Signature of the participant_________________________

Todays Date_______/_______/_______

Please return this page to the researcher

Chief Investigator: Ian Pretty
Dental Health Unit - Williams House, Lloyd Street North, Manchester Science Park, Manchester, M15 6SE
0161 228 1211

Principal Investigator: Pinpin Wanchaitong
Dental Health Unit - Williams House, Lloyd Street North, Manchester Science Park, Manchester, M15 6SE
0161 228 1211

ID______________

Version 2/ 21 March 2017
Appendix 11.10: The English version of the Test of Functional Health Literacy in Older Adults (OA-TOFHLiD) with demographic section

(*The study in Chapter 4 used the short OA-TOFHLiD, which the section 5 (prompt part) was deleted from the OA-TOFHLiD original version)

Oral Health Literacy Questionnaire

There are 5 topics:

Topic 1-4 This is information that you might receive when you go to the dentist. In each passage, there are some missing words or phrases. Please read thoroughly and circle the most appropriate choice.

Topic 5 Two pictures will be given for you to look at the product label. After that, you need to answers the questions regarding their use.
Basic knowledge in Oral Disease: Please circle the most appropriate choice among four alternatives

PART 1: Tooth decay

Decay is __________disease which is common in the population. The initial __________ of tooth decay is __________ in your tooth. When it

1A 1B 1C
1. an affected 1. tax 1. general
2. an oral 2. inner 2. roughness
3. a popular 3. system 3. a cavity
4. a bone 4. sign 4. pain

gets worse, you often have ______ Tooth decay is a multifactorial disease. Factors affecting tooth decay are usually ______ lifestyle and habits.

1D 1E
1. pain 1. like
2. bleeding 2. from
3. numbness 3. medication
4. sweating 4. walk
The most frequent factor is consuming high-risk foods for tooth decay e.g. 

1. sleeping, relaxing
2. steak, bacon
3. beer, wine
4. sweets, candles

In addition, some risk habits, especially not 

1. taking the medicine according to doctor's prescription
2. exercising regularly
3. brushing your teeth
4. flossing

Moreover, other factors can affect the development of decay such as having

1. bad eyesight
2. dry mouth or less saliva flow
3. joint pain
4. dizziness

26 May 2017 (version 2)
PART 2: Gum disease

Gum disease is also ______ found in older adults. The initial gum disease is called gingivitis and the symptoms can include______ or bleeding gums.

1. frequently
2. never
3. not
4. always

If gingivitis is not __________, it can develop to become more _________, called periodontitis. The symptoms of periodontitis can

1. encouraged
2. clever
3. ready
4. treated

include receding gums and _______ teeth. When it gets worse, sometimes __________ can develop under your gum leading to toothache.

1. additional
2. transparent
3. loose
4. black

1. bone
2. fever
3. tingling
4. pus
The main cause of gum disease is ______ from not cleaning your teeth effectively, then_______ accumulates around your teeth and gums.

2G
1. mostly
2. modestly
3. moisturising
4. risky

ZH
1. stain
2. plaque
3. mould
4. sign

Other factors, for example, having________ disease such as diabetes or smoking can also raise the severity of gum disease.

2I
1. communicating
2. unruly
3. empathy
4. chronic
PART 3: Prevention

To prevent tooth decay, you should ___________ at least ___________ for two ___________ each time.

3A: 1. sit  
     2. rinse  
     3. brush your teeth  
     4. use toothpick

3B: 1. once a week  
     2. once a day, before bed  
     3. on Tuesday  
     4. twice a day, after meal

3C: 1. hours  
     2. minutes  
     3. seconds  
     4. days

Moreover, you _______ select a toothpaste that contains _________ to enhance the preventive effect. Furthermore, for decay and gum disease prevention, toothbrush selection is also important because a proper toothbrush can ___________ plaque from teeth effectively.

3D: 1. should  
     2. from  
     3. by  
     4. do not

3E: 1. fluorescent  
     2. fluoride  
     3. caffeine  
     4. bromine

3F: 1. enemy  
     2. average  
     3. remove  
     4. enhance

26 May 2017 (version2)
In general, a __________-bristled toothbrush will be the most comfortable and safest choice.

1. smooth
2. silky
3. soft
4. soft

Additionally, in order to make your teeth __________ clean, you should use dental floss to clean the area in between your teeth __________.

1. more
2. less
3. often
4. rarely

1. daily
2. fairly
3. weekly
4. monthly
PART 4: Pretend you are attending your dentist for a tooth extraction and you have read the consent form for the procedure

The alternatives to ________ of teeth have been explained to me. I understand removing teeth does not always remove the________.

4A
1. add
2. renewal
3. amput
4. removal

4B
1. flu
2. nerve
3. infection
4. decision

however, it may be necessary to have_________ treatment. I understand the__________ that may be involved in having teeth removed,

4C
1. further
2. enough
3. testern
4. foul

4D
1. ticks
2. risks
3. tricks
4. sound

some of which are pain, swelling, spread of infection, loss of feeling in my teeth, lips,_________ and surrounding tissue, or____________ jaw.

4E
1. hip
2. lung
3. tongue
4. tone

4F
1. featured
2. obstructed
3. fastened
4. fractured
I understand I may need further treatment by a specialist if__________ arise during or following treatment, the cost of which is my responsibility.

1. complications
2. implications
3. applications
4. sanitation

I have received information about the proposed treatment and I have__________ the treatment with my dentist.

1. abandoned
2. discussed
3. frightened
4. disgusted

I have been given an opportunity to__________ questions and have them fully answered. I understand the__________ of the recommended treatment.

1. let
2. buy
3. ask
4. ignore

1. force
2. neutral
3. nature
4. unclear

26 May 2017 (version2)
alternate treatment, and the risks of the treatment. I consent to with the recommend treatment.

1. options
2. obesity
3. captions
4. ethics

1. differentiate
2. prepare
3. prolong
4. proceed
PART 5: Please read the labels for the toothpaste and mouth rinse. Then read each question and write down your answers.

Prompt 1. Toothpaste label questions

1. How often should you use it?
2. Can you brush your teeth after a meal?
3. Do you think that the toothpaste is safe for older adults?
4. What active ingredient does this toothpaste contain?, and at what concentration?

Prompt 2. Mouth rinse label questions

1. How often should you use this mouthwash daily?
2. What quantity of mouthwash you should use each time?
3. If you have gum disease, how long should you use the mouthwash for?
4. What might occur to your teeth and tongue when you use this mouthwash?
Usage Direction • Brush at least twice a day • For the most effectiveness, brush after meals and before bed

Warning ♦ Contains Sodium Fluoride 1450 ppm F ♦ Do not swallow ♦ Children of 6 years and under. Use pea size amount for supervised brushing to minimize swallowing. In case of intake of fluoride from other sources, consult a dentist or doctor.
Chlorhexidine Mouthwash 600 ml

Chlorhexidine Gluconate 0.12 %, Oral Rinse

**Direction**  Fill measuring cup to the fill line (10 ml)
Use twice daily. Rinse mouth thoroughly for 1 minute then spit out.

- Gum disease: One-month course (or 1 bottle) is recommended.
- Mouth Ulcer: use regularly until it heals, and continue to use for 2 days after healing.
- Denture sore mouth: Denture should be cleaned and then soaked in the mouthwash for 15 minutes twice daily.

**Warning**
- Do not use if you are sensitive to chlorhexidine or any of the other listed ingredients.
- Toothpaste may stop the mouthwash working properly if used immediately afterwards. To prevent this, use toothpaste at a different time of day.
- Discolouration of the tongue and teeth may occur when using the mouthwash. This is temporary. Tongue staining disappears after treatment stops and tooth discoloration is normally removed by brushing.
Demographic information (Please complete or ask for help if necessary)

1. Gender □ Male □ Female □ Prefer not to say

2. Age _______ years

3. Ethnicity □ White/Caucasian □ Black or African American □ Hispanic or Latino □ Asian
   □ Native American or American Indian □ Pacific Islander □ Other

4. What is your highest degree or level of school you have completed?
   □ No schooling completed
   □ Middle/ Junior High school level
   □ High/ Senior High school qualification (e.g. Diploma)
   □ University or College qualification below a Bachelor’s Degree
   □ University of College Degree (Bachelor’s Degree or higher)

5. a. Are you retired? □ Yes □ No
   b. Previous / Current Occupation: ____________________________

6. Do you smoke? □ Yes □ No, past smoker □ No, never smoked

7. a. Please assess your ability to read
   □ Excellent □ Very good □ Good □ Fair □ Poor □ Not able to read
b. Please assess your ability to write

☐ Excellent   ☐ Very good   ☐ Good      ☐ Fair    ☐ Poor    ☐ Not able to read

8. How often do you need help reading instructions?

☐ Never   ☐ Rarely    ☐ Sometimes   ☐ Often    ☐ Always

Dental service utilization

1. a. When was your last dental visit?

☐ 6 months ago or less   ☐ 1 year ago   ☐ 2 years ago   ☐ More than 2 years ago

2. Why did you make your last dental visit?

☐ Regular checkup   ☐ To fix a cavity   ☐ To get a new denture   ☐ To fix a denture

☐ For emergency (pain, infections)  ☐ I do not remember   ☐ Other, please specify:__________________

3. How often do you visit the dentist?

☐ Regular care (every 12 months)   ☐ Not regularly   ☐ Emergency treatment only

4. Do you have dental insurance?

☐ Yes, please specify:__________________   ☐ No    ☐ Not sure, cannot remember

5. Type of dental service provider that you regularly use

☐ Private dental clinic / Private hospital   ☐ Public dental clinic / Public hospital

☐ University dental clinic   ☐ Other, please specify:__________________
Perceived oral health

1. How is your oral health in general?
   - [ ] Very good
   - [ ] Good
   - [ ] Fair
   - [ ] Poor
   - [ ] Very poor

2. Have you ever been told you have tooth decay?
   - [ ] Yes
   - [ ] No
   - [ ] Cannot remember/unsure

3. Have you ever been told you have gum disease?
   - [ ] Yes
   - [ ] No
   - [ ] Cannot remember/unsure

4. Do you think that you have a dental problem currently?
   - [ ] No
   - [ ] Yes, please explain: __________________________________________

5. Do you think that your current dental problem needs to be treated?
   - [ ] Need, please explain: __________________________________________
   - [ ] Do not need, please explain: _____________________________________

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★
Appendix 11.11: The key answers of the English OA-TOFHLiD

**OA-TOFHLiD: Key answers**

<table>
<thead>
<tr>
<th>Topic A</th>
<th>Topic B</th>
<th>Topic C</th>
<th>Topic D</th>
<th>Answer for Prompt 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>2A</td>
<td>3A</td>
<td>4A</td>
<td>1) Twice/ 2 times a day</td>
</tr>
<tr>
<td>1B</td>
<td>2B</td>
<td>3B</td>
<td>4B</td>
<td>2) Yes</td>
</tr>
<tr>
<td>1C</td>
<td>2C</td>
<td>3C</td>
<td>4C</td>
<td>3) Yes</td>
</tr>
<tr>
<td>1D</td>
<td>2D</td>
<td>3D</td>
<td>4D</td>
<td>4) (Sodium) Fluoride and 1450 (ppm)</td>
</tr>
<tr>
<td>1E</td>
<td>2E</td>
<td>3E</td>
<td>4E</td>
<td>3</td>
</tr>
<tr>
<td>1F</td>
<td>2F</td>
<td>3F</td>
<td>4F</td>
<td>4</td>
</tr>
<tr>
<td>1G</td>
<td>2G</td>
<td>3G</td>
<td>4G</td>
<td>1) 2 times a day</td>
</tr>
<tr>
<td>1H</td>
<td>2H</td>
<td>3H</td>
<td>4H</td>
<td>2) 10 ml or 1 measuring cup</td>
</tr>
<tr>
<td>1I</td>
<td>2I</td>
<td>3I</td>
<td>4I</td>
<td>3) 1 month or 1 bottle</td>
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<td></td>
<td></td>
<td></td>
<td>4J</td>
<td>4) Staining or discoloration</td>
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<td></td>
<td></td>
<td>4K</td>
<td>1</td>
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<td>4L</td>
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</table>
Appendix 11.12: The Short Test Of Functional Health Literacy in Adults (S-TOFHLA)

Short Test of Functional Literacy in Adults
STOPHLA
READING COMPREHENSION

HAND PATIENT THE READING COMPREHENSION PASSAGES TO BE COMPLETED. FOLD BACK THE PAGE OPPOSITE THE TEXT SO THAT THE PATIENT SEES ONLY THE TEXT.

PREFACE THE READING COMPREHENSION EXERCISE WITH:

"Here are some other medical instructions that you or anybody might see around the hospital. These instructions are in sentences that have some of the words missing. Where a word is missing, a blank line is drawn, and 4 possible words that could go in the blank appear just below it. I want you to figure out which of those 4 words should go in the blank, which word makes the sentence make sense. When you think you know which one it is, circle the letter in front of that word, and go on to the next one. When you finish the page, turn the page and keep going until you finish all the pages."

STOP AT THE END OF 7 MINUTES

PASSAGE A: X-RAY PREPARATION
PASSAGE B: MEDICAID RIGHTS AND RESPONSIBILITIES
PASSAGE A

Your doctor has sent you to have a _______ X-ray.
   a. stomach
   b. diabetes
   c. stitches
   d. germs

You must have an _______ stomach when you come for ______.
   a. asthma
   b. empty
   c. incest
   d. anemia
   a. is.
   b. am.
   c. if.
   d. it.

The X-ray will _______ from 1 to 3 _______ to do.
   a. take
   b. view
   c. talk
   d. look
   a. beds
   b. brains
   c. hours
   d. diets
THE DAY BEFORE THE X-RAY.

For supper have only a __________ snack of fruit, __________ and jelly,
   a. little    a. toes
   b. broth    b. throat
   c. attack   c. toast
   d. nausea   d. thigh

with coffee or tea.

After __________, you must not __________ or drink
   a. minute,    a. easy
   b. midnight,  b. are
   c. during,    c. drank
   d. before,    d. eat

anything at __________ until after you have __________ the X-ray.
   a. ill        a. are
   b. all        b. has
   c. each       c. had
   d. any        d. was
THE DAY OF THE X-RAY.

Do not eat ____________.
   a. appointment.
   b. walk-in.
   c. breakfast.
   d. clinic.

Do not ____________, even ____________.
   a. drive,   a. heart.
   b. drink,   b. breath.
   c. dress,   c. water.
   d. dose,   d. cancer.

If you have any ____________, call the X-ray ____________ at 616-4500.
   a. answers,   a. Department
   b. exercises,   b. Sprain
   c. tracts,   c. Pharmacy
   d. questions,   d. Toothache
PASSAGE B

I agree to give correct information to _________ if I can receive Medicaid.

a. hair  
b. salt  
c. see  
d. ache

I _______ to provide the county information to _________ any

a. agree  
b. probe  
c. send  
d. gain

a. hide  
b. risk  
c. discharge  
d. prove

I ________ statements given in this _________ and hereby give permission to

a. emphysema  
b. application  
c. gallbladder  
d. relationship

the _________ to get such proof. I _________ that for

a. inflammation  
b. religion  
c. iron  
d. county

a. investigate  
b. entertain  
c. understand  
d. establish

Medicaid I must report any _________ in my circumstances

a. changes  
b. hormones  
c. antacids  
d. charges
within ______ (10) days of becoming __________ of the change.
   a. three   b. one   c. five   d. ten
   a. award   b. aware   c. away   d. await

I understand ______ if I DO NOT like the __________ made on my
   a. thus   b. this   c. that   d. than
   a. marital   b. occupation   c. adult   d. decision

case, I have the __________ to a fair hearing. I can __________ a
   a. bright   b. left   c. wrong   d. right
   a. request   b. refuse   c. fail   d. mend

hearing by writing or __________ the county where I applied.
   a. counting   b. reading   c. calling   d. smelling

If you __________ TANF for any family __________, you will have to
   a. wash   b. want   c. cover   d. tape
   a. member   b. history   c. weight   d. seatbelt
a different application form. we will use
a. relax
b. break
c. inhale
d. sign

Since,
Whether,
However,
Because,

the on this form to determine your
a. lung
b. date
c. meal
d. pelvic

hypoglycemia.
eligibility.
osteoporosis.
schizophrenia.
Short Test of Functional Health Literacy in Adults (STOFHLA)

Joanne R. Nuss, Ph.D., Ruth M. Parker, M.D., Mark V. Williams, M.D., & David W. Baker, M.D., M.P.H.

TOFHLA is a measure of the patient's ability to read and understand health care information, their functional health literacy. TOFHLA Numeracy assesses their understanding of prescription labels, appointment slips, and glucose monitoring. TOFHLA Reading Comprehension assesses their understanding of health care texts such as preparation for a diagnostic procedure and Medicare Rights & Responsibilities.

Date ______/_____/_____

Name ___________________________  ______ M _____ F

Birthday ______/_____/______  Age ______  SSN or ID# ______________________

Hospital or Health-care Setting __________________

City, State _______________________

Short Form Administered:  _____ English  _____ Spanish

STOFHLA - Score

TOFHLA Total Score:
Reading Comprehension Raw Score (0-36)  

Functional Health Literacy Level:

0 - 16 -- Inadequate Functional Health Literacy

17 - 22 -- Marginal Functional Health Literacy

23 - 36 -- Adequate Functional Health Literacy
Appendix 11.13: The key answers of the English S-TOFHLA

<table>
<thead>
<tr>
<th>Passage A</th>
<th>Passage A</th>
<th>Passage A</th>
<th>Passage B</th>
<th>Passage B</th>
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<td>A1 a</td>
<td>A6 a</td>
<td>A12 c</td>
<td>B17 c</td>
<td>B24 d</td>
<td>B33 d</td>
</tr>
<tr>
<td>A2 b</td>
<td>A7 c</td>
<td>A13 b</td>
<td>B18 a</td>
<td>B25 b</td>
<td>B34 c</td>
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<td>A3 d</td>
<td>A8 b</td>
<td>A14 c</td>
<td>B19 d</td>
<td>B26 c</td>
<td>B35 b</td>
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<td>A4 a</td>
<td>A9 d</td>
<td>A15 d</td>
<td>B20 b</td>
<td>B27 d</td>
<td>B36 b</td>
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<tr>
<td>A5 c</td>
<td>A10 b</td>
<td>A16 a</td>
<td>B21 d</td>
<td>B28 d</td>
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<td>B22 c</td>
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Appendix 11.14: Clinical record form

**CLINICAL RECORD FORM**

**General Information**
Date of examination
Do you have any medical condition? Yes (please specify)

**DENTITION STATUS AND TREATMENT NEED**

<table>
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</table>

**STATUS**

Crown: 0 = Sound, P = Decayed, 1 = Decayed, 2 = Filled, with decay, 3 = Filled no decay, 5 = Missing, any other reason, 6 = Fissure, 7 = Bridge abutment, special crown or veneer, 8 = Unrestored tooth, 9 = Not recorded

Root: 0 = Sound, 1 = Decayed, 2 = Filled, with decay, 3 = Filled no decay, 4 = Unrestored root, 9 = Not recorded

**TREATMENT**

0 = None, P = Preventive, caries arresting care, F = Fissure sealant, R = Restorative restoration, 1 = One surface filings, 2 = Two or more surface fillings, 3 = Crown for any reason, 4 = Pulp care and restoration, 5 = Extraction, 6 = Need for other care (Specify), 9 = Not recorded

**PROSTHETIC NEED**

<table>
<thead>
<tr>
<th></th>
<th>Upper</th>
<th>PROSTHETIC NEED</th>
<th>Upper</th>
<th>Lower</th>
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<tbody>
<tr>
<td>0 = No prosthesis</td>
<td>0 = No prosthesis needed</td>
<td>1 = Need for one-unit prosthesis</td>
<td></td>
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</tr>
<tr>
<td>1 = Bridge</td>
<td>2 = Need for multi-unit prosthesis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 = More than one bridge</td>
<td>3 = Need for full prosthesis (replacement of all teeth)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = Partial denture</td>
<td>4 = Need to repair denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 = Both bridge(s) &amp; denture(s)</td>
<td>5 = Not to repair denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 = Full removable denture</td>
<td></td>
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</tr>
<tr>
<td>9 = Not recorded</td>
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</table>

**Number of Posterior Occlusal Pair**
Appendix 11.15: Thai participant information sheet (Chapter 5 and 6 study)

(Version 1, 191017)

In accordance with ethical standards, all participants who have agreed to participate in the study have been provided with a copy of the study information sheet. This includes information on the study, its purpose, procedures, and any potential risks involved. Participants have been informed that they are free to withdraw at any time without any consequences.

Chaiwut Phukha, The University of Manchester

Thai participant information sheet (Participant Information Sheet)

In accordance with ethical standards, all participants who have agreed to participate in the study have been provided with a copy of the study information sheet. This includes information on the study, its purpose, procedures, and any potential risks involved. Participants have been informed that they are free to withdraw at any time without any consequences.

The study was conducted in Thailand, with the participation of 80 participants from various backgrounds. The study was approved by the ethical review board of the University of Manchester. Participants were informed of the study's purpose, procedures, and any potential risks involved.

Participants were informed that they were free to withdraw at any time without any consequences. The study was approved by the ethical review board of the University of Manchester. Participants were informed of the study's purpose, procedures, and any potential risks involved.

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3. การข้อมูลเพิ่มเติม

คำแนะนำในการเข้าร่วมโครงการวิจัยจะต้องเป็นไปด้วยความสมัครใจ

หากต้องการเข้าร่วมโครงการวิจัยจะต้องสมัครใจอย่างสม่ำเสมอ ทั้งในปัจจุบันและอนาคตที่ท่านประสงค์

ค่าตอบแทนที่จะได้รับ

- ตามมติผู้ที่เข้าร่วมโครงการจะได้รับค่าตอบแทนจำนวน 300 บาท

ค่าใช้จ่ายที่ผู้เข้าร่วมโครงการจะต้องมีค่าตอบแทน

อีกที่ตามมติผู้เข้าร่วมโครงการจะต้องมีค่าตอบแทนจำนวน 300 บาท

ประโยชน์ที่จะได้รับ

- ตามมติผู้เข้าร่วมโครงการจะได้รับค่าตอบแทนจำนวน 300 บาท

การรักษาความลับ

ข้อมูลส่วนตัวของท่านจะถูกเก็บรักษาไว้เป็นความลับ และจะไม่เปิดเผยให้กับผู้ที่ไม่ได้เข้าร่วมโครงการนี้

ชื่อผู้วิจัยที่สามารถติดต่อได้

อ. ทุ่ง ภิบูรณ์ นิยม สำนักงานบริการ ภาควิชาการพยาบาลและครอบครัว คณะแพทยศาสตร์
มหาวิทยาลัยบูรพา ค. ดุสิต ต. ดุสิต อ. เมือง จ. ชัยภูมิ 50200 โทรศัพท์ 053-944468
ในส่วนนี้เรียนหัวข้อเรื่องความสัมพันธ์ระหว่างสภาวะทัศนคติสุขภาพ พฤติกรรมการดูแลและผลงานบริการสุขภาพ กับความพร้อมรู้ด้านทัศนคติสุขภาพ

ท่านกำหนดกรอบที่จะเข้าร่วมในโครงการวิจัยเรื่องต้องการสำนึกในความต้องการให้ท่านทราบถึงผลพวงของการที่จะมี

เมื่อท่านกรอบที่จะเข้าร่วมโครงการ เราจะขอท่านแจ้งเป็นไปตามที่ขอในโปรแกรมสุขภาพที่จะทำให้ตัดสินใจ

ในการรับผิดชอบที่จะมีการควบคุมที่จะทำไม่มีการระดม ท่านอาจ

ตัดสินใจไม่เข้าร่วมโครงการหรือขอถอนตัวออกจากการสมัครได้ โดยท่านจะไม่ต้องมีประโยชน์

ของท่านเกี่ยวกับการสูญเสียประโยชน์ของท่านเกี่ยวกับการสูญเสียตามกฎหมาย

2. วัตถุประสงค์ของการวิจัย

โครงการวิจัยนี้ที่จะเข้าร่วมความรู้ด้านทัศนคติสุขภาพ และค้นหาความสัมพันธ์ระหว่าง

ความรู้ด้านทัศนคติสุขภาพกับพฤติกรรมดูแลสุขภาพ รวมถึงสุขภาพของปาก รวมถึงพฤติกรรม

การรับผิดชอบในการสุขภาพ จะมีประโยชน์ในการอย่างไร จะมีผลต่อ สามารถแสดงผลและเป็นการค้นหาของ

นักการแพทย์ที่มีความรู้ด้านเรื่องสุขภาพของปาก และปลอดภัยที่จะทำให้ท่านเข้าใจปัญหาที่เกิดขึ้นกับสุขภาพของปากของทุกๆ ร่างกาย

และ

3. วิธีการ

ณ คลินิกสุขภาพที่มีสุขภาพและทันตกรรมป้องกัน คลินิกเฉพาะทางครั้งนี้ ถ้าท่านสมัครเข้าร่วม

โครงการและลงนามในเอกสารยินยอมได้รับทราบกล่าวในคุณ ผู้วิจัยจะต้องให้ท่านทำความลงต่อไปนี้

1. ทัศนคติสุขภาพ มี 1 ขั้น มีท่าทีที่จะให้ผลกระทบถึงสุขภาพของปากและสุขภาพที่สมบูรณ์ของที่ให้ ตามที่สมัครได้

2. ขั้นตอนที่จะเข้าร่วมที่มีสุขภาพที่ดีของสุขภาพผู้ที่มีสุขภาพดีของปากที่ได้ จำนวนที่ขอที่มีสุขภาพ

มากกว่าค่าที่ต้องการ และมีการป้องกันโรค (ที่มี) รวมถึงการตรวจคัดกรองร่างกายของปาก โดยไม่มี

มีทักษะความสามารถที่จะสื่อสารกับผู้ที่มีสุขภาพดีของปาก ของท่าน ใช้เวลาประมาณ 5 นาที
3. หลักสูตรพยาบาล ท่านอาจจำเป็นต้องใช้หลักสูตรพยาบาลให้กับการดูแลสุขภาพของท่านและ
เมื่อพบการป่วยหรือการบาดเจ็บ รวมถึงความคิดเห็นของท่านต่อการดูแลสุขภาพ
สุขภาพ โดยคำแนะนำของท่านจะมีการปรับเปลี่ยนด้วยข้อดีข้อเสียของ ใช้เวลาไม่เกิน 25 นาที

4. ความเสี่ยงหรือความไม่สบายต่าง ๆ ที่อาจเกิดขึ้น

งานพยาบาลมีความเสี่ยงที่อาจจะเกิดขึ้นเมื่อเข้าสู่การรักษาต่าง ๆ ท่านอาจต้องเปลี่ยน
และ อาจรู้สึกไม่สบายที่สินะ รวมไปถึงอาจจะเกิดความไม่พอใจในบางครั้งที่ผ่านมา หากท่านรู้สึกละ
สบายใจ ที่จะทำงานที่รักษาต่อไป ท่านสามารถมีการควบคุมด้านที่ หรือการดูแลต่าง ๆ ได้ตลอดเวลา

5. ประโยชน์ที่คาดว่าจะได้รับ

ท่านจะได้รับการตรวจสอบฟันธงที่ได้รับคำแนะนำจากการรักษา รวมถึงได้รับแบบสอบถามจำนวน 300 แบบ

6. คำให้แจ้ง

ท่านไม่ต้องแจ้งคำว่าไม่รักษาหรือจ้างค่าบริการ แต่หากท่านมีข้อสงสัยหรือต้องการให้ข้อมูลเพิ่มเติม ที่
จะเป็นข้อมูลที่มีความสำคัญ ท่านจะได้รับคำแนะนำในการตัดสินใจและมีการให้โทษที่เหมาะสม
เพื่อการทำงานอย่างปลอดภัยและรักษาในสถานที่ที่ทำเนียบมีการรักษา ซึ่งท่านจะต้องมีข้อมูลเป็นไปตาม
การ รักษาเฉพาะตามสิทธิ์ที่ทำเนียบมีอยู่ในแบบที่

7. การบันทึกข้อมูลการจ้างงานปรึกษา

งานพยาบาลมีความเสี่ยงที่ในการจ้างงานปรึกษาใด ๆ ที่เกิดขึ้นให้

8. บุคคลที่ทำนายการผลิตต่อเนื่องในปัญญาหรือคำแนะนำเกี่ยวกับโครงการวิจัย

หากท่านมีปัญหาหรือคำแนะนำเกี่ยวกับโครงการวิจัย การ ช่วยเหลือ
ปัญหา
ปัญหา ที่เกี่ยวกับสถานะ ภาควิชาการและสถานะของท่านและช่วยให้ผลทางวิชาการ
สามารถติดต่อที่ (053) 944468 หรือ โทรศัพท์มือถือ (084-7380864)

เมื่อท่านได้รับคำแนะนำ หรือมีผู้รับคำแนะนำอยู่ท่านจะต้องทราบและ
สถานะที่จะเข้าร่วมโครงการวิจัยนี้ ข้อมูลขั้นตอนของท่านอาจดังนี้

ชื่อ…………………………………………………………… ชื่อ…………………………………………………………
ชื่ออาสาสมัคร……………………………………………… ชื่อผู้วิจัย………………………………………………
วันที่…………/…………/…… วันที่…………/…………/……
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