

PREVALENCE AND ORAL HEALTH-RELATED FACTORS ASSOCIATED WITH MILD
COGNITIVE IMPAIRMENT IN ELDERLY DENTAL PATIENTS AT FACULTY OF DENTISTRY,
CHULALONGKORN UNIVERSITY



A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Geriatric Dentistry and Special Patients Care

Common Course

FACULTY OF DENTISTRY

Chulalongkorn University

Academic Year 2019

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ASSOCIATED WITH MILD COGNITIVE IMPAIRMENT IN
ELDERLY DENTAL PATIENTS AT FACULTY OF DENTISTRY,
CHULALONGKORN UNIVERSITY

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KEYWORD: Prevalence, Mild Cognitive Impairment, Oral health, Elder

Panatcha Weerapol : PREVALENCE AND ORAL HEALTH-RELATED FACTORS ASSOCIATED WITH MILD COGNITIVE IMPAIRMENT IN ELDERLY DENTAL PATIENTS AT FACULTY OF DENTISTRY, CHULALONGKORN UNIVERSITY.
 Advisor: Asst. Prof. ORAPIN KOMIN, D.D.S.. Ph.D. Co-advisor: Assoc. Prof. SOOKJAROEN TANGWONGCHAI, M.D.

-This study aims to assess the prevalence of Mild Cognitive Impairment (MCI) and its oral health-related factors in elderly dental patients at Geriatric dentistry clinic and Prosthodontic clinic of Faculty of Dentistry, Chulalongkorn University. Total 248 dental patients aged 60 years and above were recruit. Average age of participants was 68.68 years with 73.0 % female. Cognitive functions were assessed by Montreal Cognitive Assessment Thai version (MoCA-T). Individual data were obtained by self-reported interview. Oral examinations were evaluated by a dentist. The prevalence of MCI was found 29.4% in elderly dental patients and was higher than among general elders. Oral health-related factors significantly associated with MCI were periodontal disease, number of Natural Teeth (NT), number of Posterior Occluding Pairs (POPs), and complete edentulism.

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Field of Study: Geriatric Dentistry and
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Academic Year: 2019

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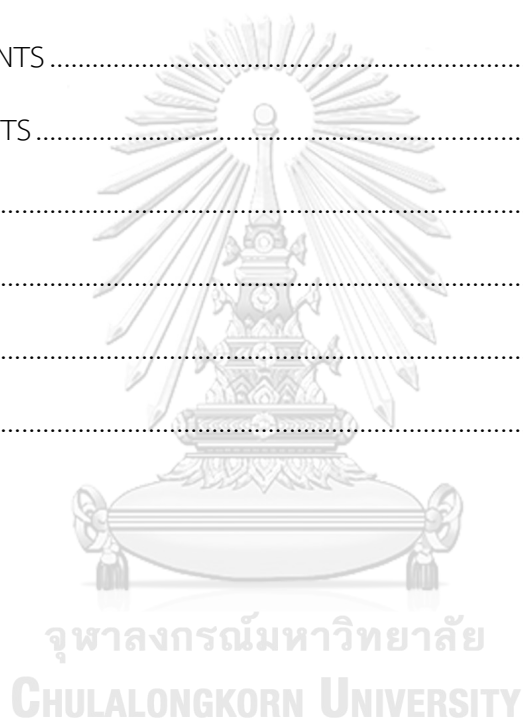
Panatcha Weerapol



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CHAPTER I

INTRODUCTION

Background and Rationale

According to The United Nations, elderly person is defined as those who has chronological age 60 years or over. Globally, approximately 901 million or one-eighth of people was defined as elders in 2015 and it is estimated to be one-sixth of worldwide population by 2030 (1). In Thailand, elderly population has grown substantially by having reached 16% of total population in 2015 and the percentage of elders will project to 37% in 2050 as a super-aged society (2).

Major oral health problems among elderly people can lead to negative impact on their quality of life (3). In geriatric population, oral health problems can be affected by several factors from physical changes such as systemic diseases and medications, sensory and motor deficits, physical and mental impairments, and disability (4). Regarding oral health problems in cognitively impaired elders, they tend to have higher risk of root caries (5), more carious teeth, more often edentulous without using dentures, and have poorer denture hygiene than elders with normal cognition (5, 6).

On the other hands, previous studies showed that having periodontal disease (7), tooth loss and poor mastication (8) were strongly associated with cognitive impairment, especially dementia. Recent studies suggested a causal relationship between masticatory performance and cognition, which has positive effects to cognition (9, 10). Also, periodontal disease was claimed as one of modifiable risk factors for cognitive decline and dementia (7, 11).

Mild Cognitive Impairment (MCI) has known as a transition between normal cognitive decline and untreatable dementia (12). Individuals with MCI have higher risk in progression to dementia as well as dependency status (13) which significantly lead to social and financial burden. As many MCI cases do not progress in cognitive

deficits, moreover some cases can revert to normal cognition (12). Thus, it is beneficial to know better about factors associated with this preventable stage.

There was no study reporting the prevalence of MCI and oral health-related risk factors in dental elderly patients. Therefore, to fill the gap mentioned above, this study aims to assess the prevalence of MCI and oral health-related factors in Thai elderly patients. The data from this study might be useful for clinical applications among modifiable dental factors of MCI patients and any further studies for senior population.

Keywords

Prevalence, Mild Cognitive Impairment (MCI), Oral health, Elders

Objectives

- 1) To assess the prevalence of MCI among Thai elderly dental patients
- 2) To determine oral health-related factors associated with MCI

Expected benefits

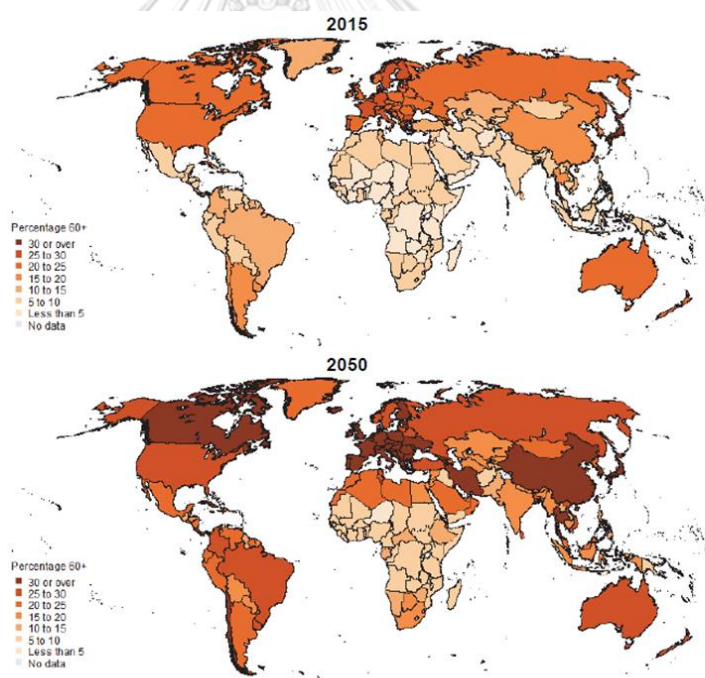
- 1) To know prevalence of MCI among Thai elderly dental patients
- 2) To know oral health-related factors associated with MCI
- 3) To know oral health status and characteristics of MCI patients
- 4) To determine specific key of oral health factors for geriatric oral health promotion and prevention
- 5) To collect descriptive data of general elderly patients of Faculty of Dentistry, Chulalongkorn University

CHAPTER II

LITERATURE REVIEW

1. World aging population and Thailand situation

The United Nations defined elderly persons as those chronological aged 60 years or over. Globally, the aging population phenomenon has substantially experienced in most countries. The number of 901 million people or one in eight people worldwide was elders in 2015. Moreover, the growth of elderly population is virtually increasing in coming decades. By 2050, almost half of population in the world; 44 percent will live in aged-society countries as showed in figure 1 (1).

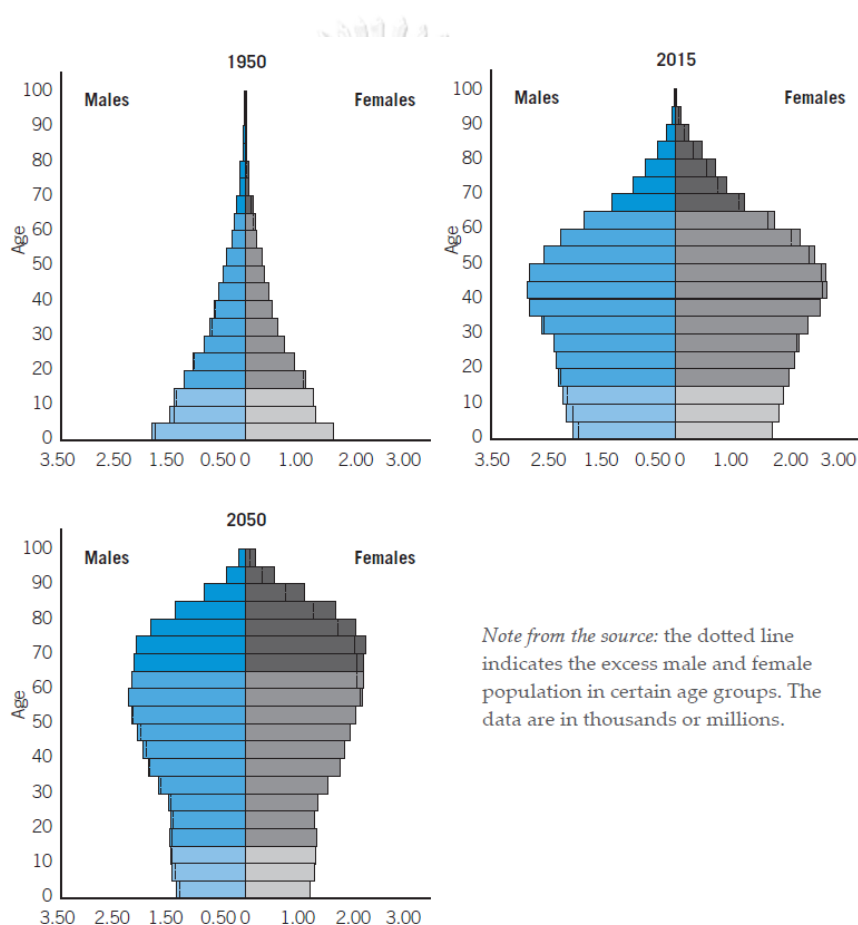


Data source: United Nations (2015). *World Population Prospects: The 2015 Revision*.

Figure 1 Maps of population aged 60 years or over percentage in 2015 and 2050

Data source: United Nations (2015). *World Population Prospects: The 2015 Revision* (1)

Since 2007, Thailand has been an aged society by having proportion of people aged 60 years and over more than 10 percent (14). According to the latest UN population statistics report in 2015, Thailand has 11 million elderly people reached 16% of Thai population and expected to grow to 37% in 2050 (1, 15). As a result of lower birth rate and increasing life expectancy, the proportion of elderly people in Thailand has rapidly projected and changed the population tree structure to be a rectangular appearance showed in figure 2 (15).



Source: UN Department of Economic and Social Affairs. Population Division (2015). World Population Prospects, the 2015 Revision. <http://esa.un.org/unpd/wpp/>

Figure 2 Population trees for Thailand: 1950, 2015 and projections for 2050

Data source: WHO Western Pacific Region (2015). Thai country case study (15)

2. Mild cognitive impairment (MCI)

Mild cognitive impairment (MCI) was first conceptualized in the 1980s. This condition refers to cognitive decline from normal ageing level that's greater than expected normal ageing, but not as severe as dementia which can be noticed by both subjectively and objectively. MCI was known as transitional stage between normal cognitive ageing and dementia that corresponding to stages 2 and 3 of Global Deterioration Scale or the Clinical Dementia Rating (CDR; rating of 0.5). The individual ones with MCI prone to develop AD or other types of dementia. By the way, it is not necessary that MCI is always a pre-dementia syndrome, as many MCI cases do not progress in cognitive deficits, and fortunately some cases can revert to normal cognition (12).

Variations in criteria, population and methodology make a wide range of estimated prevalence of MCI. Anyway, the internationally study shows published range of estimated MCI prevalence was 5.0%–36.7% (12). In Thailand, there are few studies for MCI prevalence among elderly population and certainly no data among dental patients. The most recent study in 2013; The first part of Dementia and Disability Project in Thai Elderly (DDP) shows 425 MCI cases among all 1,998 samples or 21.3% in estimation (16).

3. MoCA-T and MoCA-B for cognitive assessment

Although there are many screening tests for detecting dementia such as the Mini-Mental State Examination (MMSE); the most widely used one, the difficulties in detecting early dementia seems to be trouble when individuals meeting clinical criteria for MCI usually perform in the range of MMSE score for normal individuals.

Since there is no clear accepted and easily screening instrument for MCI screening, the Montreal Cognitive Assessment (MoCA) was developed and designed to solve these problems. MoCA is a high sensitivity and specificity brief cognitive screening tool for MCI detection. Furthermore, it has been proved to be valid and reliable test in various cross-cultural clinical usages presented in multiple languages including Thai language as 'MoCA-T' as shown in figure 3 (17, 18).

ชื่อ _____
เพศ _____ อายุ _____
ระดับการศึกษา _____ ระดับคะแนน _____
ผู้ทำทดสอบ _____

MONTREAL COGNITIVE ASSESSMENT BASIC (MOCA-B) ฉบับภาษาไทย

EXECUTIVE FUNCTION คะแนน

เวลาเริ่ม _____

(/1)

IMMEDIATE RECALL ไม่มีคะแนน

จากชุดตัวเลขต่อไปนี้ให้จำตัวเลขของวงกลม
ในรอบ 2 นาที แล้วจำตัวเลขต่อไปนี้ 5 นาที

วงกลม	ห้าเหลี่ยม	สี่เหลี่ยม	วงรี	สี่เหลี่ยม
วงกลมที่ 1				
วงกลมที่ 2				

FLUENCY ให้เขียน "ปลา" 30 ตัวภายในเวลา 1 นาที จำนวน _____ ข้อ

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 2 ข้อตอบ: 10-13 ข้อ

7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12 _____ 1 ข้อตอบ: 9-12 ข้อ

13 _____ 14 _____ 15 _____ 16 _____ 17 _____ 18 _____ 0 ข้อตอบ: 5-7 ข้อ

ORIENTATION [] เวลา (2 ข้อ) [] วัน [] เดือน [] ปี [] สถานที่ [] จังหวัด (/6)

CALCULATION เลข 3 คูณเลขจากในสี่เหลี่ยมมุมฉาก 13 เท่า คูณด้วย 3 และ 10 บวก 10 แล้วลบด้วย 10
(1 ข้อตอบ: 18 ข้อตอบถูกต้อง 3 ข้อ)

[] 1 _____ [] 2 _____ [] 3 _____

ABSTRACTION บอกความแตกต่างของรูปต่อไปนี้ให้ตอบวง 2 ที่ตรงกันและวง 1 ที่ตรงกัน
[] วงกลม - สี่เหลี่ยม [] วงกลม - สามเหลี่ยม [] วงกลม - สี่เหลี่ยม [] วงกลม - สี่เหลี่ยม (/3)

DELAYED RECALL (/5)

วงกลม	ห้าเหลี่ยม	สี่เหลี่ยม	วงรี	สี่เหลี่ยม
วงกลมที่ 1				
วงกลมที่ 2				

VISUOPERCEPTION (/3)

วงกลมที่มีเส้นในภาพต่อไปนี้ถูก ยกเว้นวง 1 ข้าง
(จากชุดตัวเลขในภาพ)

วงกลม	วงรี	วงกลม	วงรี	วงกลม
วงกลมที่ 1				
วงกลมที่ 2				

NAMING บอกชื่อวงกลม (จากชุดตัวเลขในภาพ) [] วงกลม [] วงรี [] สี่เหลี่ยม [] สามเหลี่ยม (/4)

ATTENTION จากชุดตัวเลขต่อไปนี้ให้จำเลขของวงกลม
(จากชุดตัวเลขในภาพ)

1 5 8 9 2 0 3 9 4 0 2 6 8 7 4 6 7 5 มีวงกลม _____ วง

จากชุดตัวเลขต่อไปนี้ให้จำเลขของวงกลมและสี่เหลี่ยม
(จากชุดตัวเลขในภาพ)

3 8 5 1 3 0 2 9 2 0 4 9 7 8 6 1 5 7 6 4 มีวงกลม 6-8 และ 9

1 5 8 9 2 0 3 9 4 0 2 1 6 8 7 4 6 7 5 มีวงกลม 6-8 และ 9

Adapted by: Paranyas Inthasart MD
Copyright © 2014, Neurocognitive MD
Final Version June 04, 2014 คะแนนรวม (/30)

Figure 4 Montreal Cognitive Assessment – Basic (MoCA-B)

Data source: The Montreal Cognitive Assessment-Basic: A Screening Tool for Mild Cognitive Impairment in Illiterate and Low-Educated Elderly Adults (20)

4. Factors associated with cognitive decline and dementia

Several factors contribute to onset and progression of MCI, late-onset Alzheimer's disease and other dementias including age, genetics, medical problems especially cardiovascular diseases, diabetes mellitus, mid-life obesity, mid-life hypertension, hyperlipidemia, traumatic brain injury, depression, sleep disturbance, periodontal disease, smoking, alcohol, drug abuse, physical activities, diet, lifelong learning or cognitive training, social engagement, education level, and socio-economic status. Among these factors, the greatest risk factors are age, family history, and genetics; the Apolipoprotein E $\epsilon 4$ allele (21).

However, there are evidences from population-based studies reveal that some risk factors can be modified by individual behaviors and health interventions. The summary of this perspective study concludes that regular physical activity,

management of cardiovascular risk factors; diabetes, obesity, smoking, and hypertension, healthy diet and lifelong learning/cognitive training can reduce the risk of cognitive decline and may reduce the risk of dementia (21).

In oral health aspect, recent studies show the association between oral health problems and cognitive impairment especially periodontal disease, tooth loss and poor mastication (7, 21)

5. Burdens of oral health in elderly people and its relation to cognition

According to the 8th National dental survey in 2017, the major dental problem among Thai elders is 'Tooth loss'. Only 56.1% of elderly population has at least 20 natural teeth and less than half; 40.2% has at least 4 posterior occluding pairs. The main reasons of tooth loss are periodontal disease and dental caries (22). Multiple factors in general aging process of elders relate to oral health problems such as systemic diseases and medications, sensory and motor deficits, physical and mental impairments, and physical disability. The more aging, the more factors lead to poorer oral health. Especially in cognitively impaired elders, they tend to have higher risk of root caries (5). The more carious teeth, the more often edentulous without using dentures, or have poorer denture hygiene than cognitively healthy persons (6).

In the other hands, many studies show that oral health problems; periodontal disease, tooth loss and poor mastication have a strong evidence-based association and correlations with cognitive impairment and Alzheimer's disease. Moreover, recent studies suggest a causal relationship between mastication and cognition, and claim as a modifiable risk factor for cognitively impaired prevention in the study of 'Mastication for the mind--the relationship between mastication and cognition in ageing and dementia' (9) as shown in figure 5.

The relationship between periodontal disease and Alzheimer's disease was first proposed in 2008 by Kamber's hypothesis. The significant bacterial and the inflammatory burden of periodontal disease may enhance the inflammation in the brain, then contribute to the initiation or the progression of Alzheimer's disease. Studies' findings suggest its possibility in 2 ways; Directly (Bacterial invasion) and

Indirectly (Increased brain inflammation via neuronal or systemic pathways by LPS, cytokines, CRP; These molecules would further amplify the inflammatory signal by activating the already primed glial cells and increase production of molecules such as A β peptide, hyperphosphorylated tau proteins. This ultimately activate pathways leading to brain degeneration (23).

There are many epidemiological and biological evidences to support this hypothesis; for example, the longitudinal Nun study in 2007 showed that few number of remaining teeth increased higher risk in prevalence and incidence of dementia (24). For the biological evidences, there are findings about association between periodontal disease and higher human brain amyloid load which is consistent with the previous animal studies. This result implies that peripheral inflammation/infections of periodontal disease are sufficient to produce brain amyloid accumulations (11). Another study in 2013 confirms that lipopolysaccharide (LPS) from periodontal bacteria can access the brain (25). Moreover, study in 2012 reveals that antibody levels to F nucleatum and P intermedia (antibodies to periodontal disease bacteria) were significantly increased in the Alzheimer's patients' serum compared with normal group in years before cognitive impairment (26). Lastly, the study of cognitive decline in Alzheimer's patients showed that periodontitis is associated with an increase in cognitive decline of Alzheimer's disease, independent to baseline cognitive state (27).

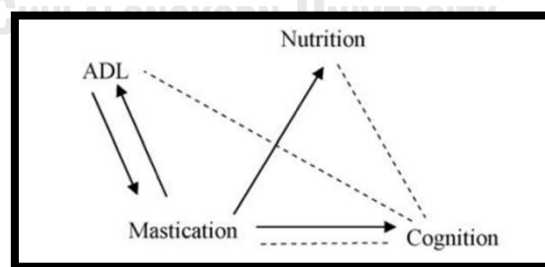


Figure 5 Interplay of factors associated with mastication and cognition

Arrows indicate causal/longitudinally observed relationships

Dotted lines indicate correlations

ADL = Activities of Daily Living

Dara source: Mastication for the mind--the relationship between mastication and cognition in ageing and dementia (9)

CHAPTER III

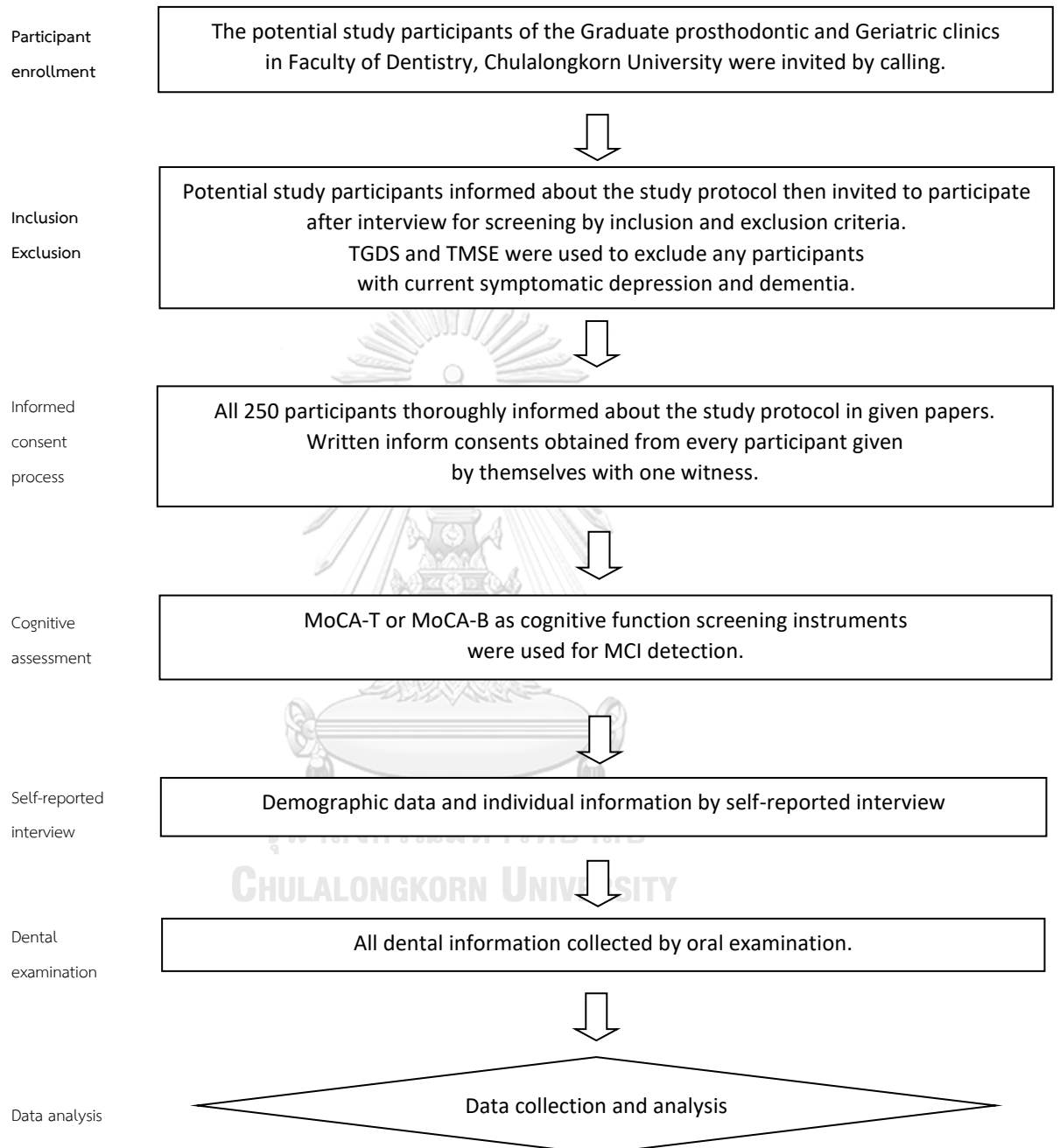
RESEARCH METHODOLOGY

This cross-sectional descriptive study enrolled 250 elderly patients who are current patients at the Graduate prosthodontic clinic and the Geriatric clinic in Faculty of Dentistry Chulalongkorn University during June 2018 to June 2019. Potential study participants were invited after screening by specific inclusion and exclusion criteria. All 250 participants must have potential to give their written consents form for study participation after being thoroughly informed about the study protocol. Participation always be voluntary. The study protocol was under the approval of Ethical committee of Chulalongkorn University (HREC-DCU 2017-088) and Institutional Review Board of Faculty of Medicine, Chulalongkorn University (IRB no. 612/62).

This study data collection had 3 parts including 1) Montreal Cognitive Assessment Thai version (MoCA-T) or Montreal Cognitive Assessment-Basic (MoCA-B) as a cognitive function screening instrument, 2) Demographic data and individual information by self-reported interview and 3) Dental information by oral examination. Two participants were excluded after self-reported interview. All of data collection procedures will be completed and all blinded to only one investigator.

Statistical analysis will be performed using SPSS version 22.0 with two-tailed p-values in all analyses by setting the alpha level of significance at 0.05. Descriptive statistics showed in mean with standard deviations (SD) or frequency and percentage. Student t-test and Chi-square compared between MCI and normal groups.

SCHEMATIC OF STUDY DESIGN



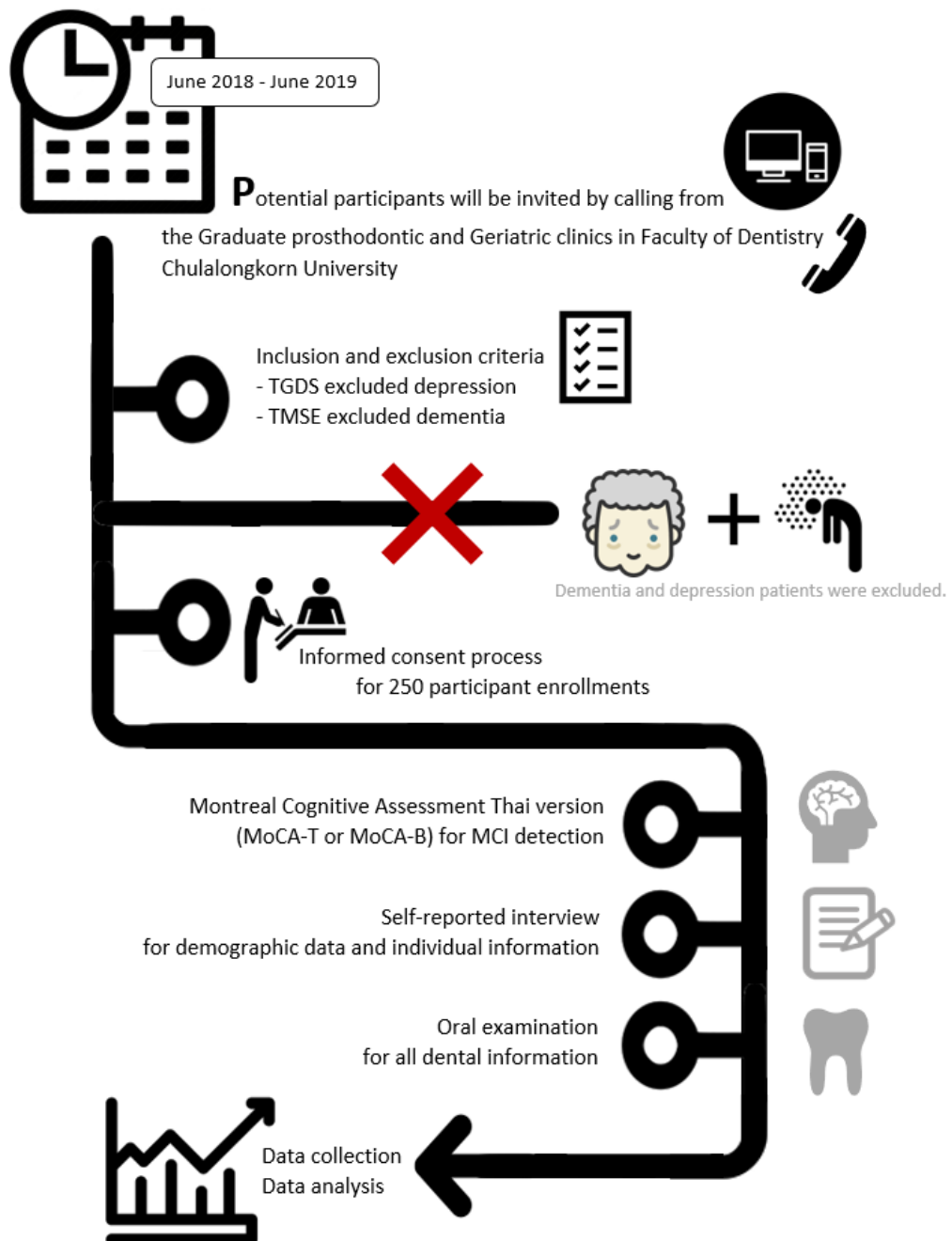


Figure 6 Schematic design of study protocol

Research design

A Cross-sectional descriptive study

Sample population

The sample population in this study is Thai elderly dental patients at the Graduate prosthodontic clinic and the Geriatric clinics in Faculty of Dentistry, Chulalongkorn University

Sample size

The sample size is calculated based on 95% level of confidence and 5% acceptable error of estimation in the following formula for adequate sample size in the prevalence study (28).

$$N = \frac{Z^2 P(1-P)}{d^2}$$

N is the sample size

Z is the statistic corresponding to 95% level of confidence; Z = 1.96

P is expected prevalence that will be obtained from previous study (16); P = 0.2

d is precision corresponding to effect size; d = 0.05

The number of 246 participants were obtained for this study. The sampling of this study based on participant's convenience and volunteerism according to the period study time during June 2018 to June 2019.

Approach to participants

The potential study participants who were active current patients at the Graduate prosthodontic and Geriatric clinics in Faculty of Dentistry, Chulalongkorn University during June 2018 to June 2019 were invited by calling. They were briefly

informed about the study protocol then were invited to participate after small interview for screening by inclusion and exclusion criteria in the first call for invitation. The second call was done for participation approval.

Inclusion Criteria

In order to participate in this study, an individual must meet all following criteria:

1. Be current patients of the Graduate prosthodontic and Geriatric clinics Faculty of Dentistry, Chulalongkorn University
2. Male or female aged 60 years or over at the day of participation
3. Have capacity to give consent by themselves
4. Have ability to communicate in Thai
5. Be in well-controlled systemic diseases
6. Be voluntary to participate the study

Exclusion Criteria

Any individuals who met any of the following criteria were excluded from participation in this study by self-reported interview, TGDS test for current depression and TMSE 2002 test for dementia screening:

1. TMSE score lower than 24
2. TGDS score higher than 6
3. History of psychiatric illness
4. History of cerebrovascular accident
5. History of major head trauma or any brain disease (e.g. seizure, tumor, abscess)

Informed consent processes

All participants were thoroughly informed about the study protocol in given papers. A written informed consent was obtained from every participant given by themselves with one witness.

Data collection

This study data collection had 3 parts including MoCA-T or MoCA-B, Individual data, and dental information. All of data collection procedures were completed and all blinded to only one investigator.

- I. Montreal Cognitive Assessment-Thai version (MoCA-T) or Montreal Cognitive Assessment-Basic (MoCA-B) as a cognitive function screening instrument were used for MCI detection. In this study, any participants with score below 25 were defined as MCI and referred to specialist for further clinical consideration and diagnosis and proper treatment
- II. The individual information including 23 topics were recorded by self-reported interview in Thai language.
 1. Age
 2. Sex
 3. Marital status
 4. Living condition
 5. Educational level
 6. Occupation defined as the longest job in life
 7. Current income per month (Thai Baht)
 8. Weight in kilogram
 9. Height in centimeter
 10. Body Mass Index (BMI)
 11. Lawton Instrumental Activities in Daily Living as functional status
 12. Mini Nutritional Assessment (MNA) as a nutritional status

13. Current medical problems

- Hypertension
- Dyslipidemia
- Diabetes Mellitus
- Chronic kidney disease

14. Past medical history

- History of obesity defined as history of BMI over 30 kg/m² in lifetime except pregnancy period by asking for lifetime maximum weight
- History of hypertension \geq 10 years defined as history of hypertension treatment over 10 years

15. Family history of dementia

16. Continuous sleeping hours

17. Smoking status

18. Alcohol status

19. Drug abuse status

20. Regular exercise

21. Lifelong learning or cognitive training

22. Social engagement

23. Social media using

III. Dental information in 7 topics were collected by oral examination under dental unit's light.

1. Current dentition status

Main investigator examined participant's oral cavity then classified the dentition status into one of five types including Natural teeth (Having \geq 4 POPs), Partial edentulous with denture (Having \geq 4 POPs; including denture's occluding pairs), Partial edentulous without denture (Having $<$ 4 POPs), Complete edentulous with denture, and Complete edentulous without denture.

2. Denture history

The investigator asked participants for the number of current denture and reason for new denture classified into 6 choices; lost without knowing where to find, lost but knowing where to find, broken, esthetic concern, problem with function or pain in function, and other reasons.

3. Current denture type and quality with patient's satisfaction

The investigator asked participants for the time since current denture has been used and participant's satisfaction (including acceptable and unacceptable). After that, the investigator evaluated the dentures in support, stability, retention, and occlusion in centric then classified into acceptable or unacceptable for quality of denture in professional opinion.

4. Number of natural teeth

Main investigator examined participant's oral cavity and counted the number of functional NT in total NT and then classified in 2 groups; having less than 20 NTs or having at least 20 NT. By the way, the counted teeth must not be unrestorable pathologic teeth, retained root, too loose that need to be extracted, implant teeth, or pontic of any dental prostheses.

5. Number of POPs

Main investigator counted the number of POPs in total and then classified in 2 groups; having less than 4 POPs or at least 4 POPs.

An occluding pair was defined as a pair of occluding teeth which functionally met in centric occlusion of the subjects. The occluding pairs counted on the premolars, first molars, second molars. This study considered either occluding premolars or molars as one occluding pair.

6. Periodontal disease

The assessment for periodontal disease conducted as follows: Clinical Attachment Loss recorded in millimetres at six sites per tooth. CAL defined the long-term periodontal inflammatory/infectious condition. CAL

was obtained by adding the probing depth to the distance from the free gingival margin to the cemento-enamel junction (positive if the gingival margin is apical to the cement-enamel junction and negative if it is coronal. The probing depth (PD) was measured as the linear distance in millimetres from the gingival margin to the base of the periodontal pocket.

The presence of at least 2 proximal sites of non-adjacent teeth having clinical attachment loss ≥ 3 mm. was defined as present periodontal disease (11).

7. Present of active tooth decay

Main investigator examined for any active dental caries and any signs of pulp exposure then counted and recorded in number of present active carious teeth and number of pulp-exposed teeth according to clinical signs.

Data analysis and statistics

Statistical analysis was performed using the IBM Statistics Package for the Social Sciences (SPSS) version 22.0 and two-tailed p-values calculated in all analyses. The alpha level of significance was set at 0.05.

Descriptive statistics were used to describe the characteristics of the all collected data. For continuous data, means and standard deviations (SD) were presented. Categorical data was described in frequency and percentage.

Independent student t-test and Chi-square were performed to compare correlation between MCI and normal groups in univariate analysis when data was continuously and normally distributed.

Ethical consideration

The study protocol was under the approval by Ethical Committee of Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2017-088) and Institutional Review Board of Faculty of Medicine, Chulalongkorn University (IRB no. 612/62). This study was under the Belmont Report (1974); three basic ethical principles relevant to research involving human subjects.

1. Respect for person

All participants and their relatives were thoroughly informed about the study protocol before giving their consents in written consent forms with one witness. Participation always be voluntary.

2. Beneficence

All participants got free dental check-up, cognitive screening test and referral to appropriate specialists in case of depression, dementia, or MCI after screened by the tests. After participation, everyone received the oral care product gifts.

3. Justice

Equitable selection of participants was done by convenience and volunteerism.

CHAPTER IV

RESULTS

Total 73 of 248 (29.4%) participants had MCI. After 25 (10.1%) participants from Geriatric clinic all recruited, 223 (89.9%) participants from Graduate prosthodontic clinic joined the study invitation after inter-department permission approved. Average age of participants was 68.68 ± 6.01 years with female 73.0 %. Around half, 140 (56.5%) participants was still married. Majority of participants was living with spouse or family (86.3%). The illiterates accounted for 35 (15.7%) participants which MoCA-B was performed. There were 149 (60.1%) had stable occupational group; civil servant and private employee, and 149 (60.1%) had monthly income more than 10,000 THB. The mean IADL and BMI was 7.94 ± 0.40 and 23.63 ± 3.97 kg/m², respectively. Of the 248 participants, 217 (87.5%) were in normal BMI range; 18.5-29.99 kg/m², 205 (82.7%) had normal nutritional status, and 44 (17.7%) had family history of dementia.

Table 1 showed demographic and nutritional characteristics of MCI and normal group. After comparing MCI group with normal cognition group, participants with MCI had higher percentage of having age > 70 years old (58.9% vs 29.7%, $p < 0.001$), lower percentage of being married (46.6% vs 60.6%, $p = 0.043$), lower percentage of having education of bachelor degree and over (28.8% vs 53.7%, $p < 0.001$), higher percentage of unstable occupation, being self-employed or unemployed (56.2% vs 33.1%, $p = 0.001$) and lower percentage of having monthly income from 10,000 Baht and above (49.3% vs 64.6%, $p = 0.025$). On average, MCI group did not differ from normal cognition group in terms of functional assessment defined by Lawton IADL score. Nevertheless, MCI had significantly higher percentage of having underweight or obesity (19.2% vs 9.7%, $p = 0.040$) and having risk of malnutrition (26.0% vs 13.7%, $p = 0.020$) compared with normal cognition group.

Table 1 Demographic and nutritional characteristics of MCI and normal group

Characteristics	All (n=248)	MCI (n=73)	Normal (n=175)	P-value
Age (years)				<0.001*
60-70	161 (64.9)	30 (41.1)	123 (70.3)	
>70	87 (35.1)	43 (58.9)	52 (29.7)	
Mean age (mean \pm SD)	68.68 \pm 6.01	72.12 \pm 7.14	67.25 \pm 4.94	<0.001* T
Gender				0.589
Male	66 (27.0)	18 (24.7)	49 (28.0)	
Female	181 (73.0)	55 (75.3)	126 (72.0)	
Marital status				0.043*
Married	140 (56.5)	34 (46.6)	106 (60.6)	
Others	108 (43.5)	39 (53.4)	69 (39.4)	
Current living condition				0.683
Alone	34 (13.7)	9 (12.3)	25 (14.3)	
With spouse/family	214 (86.3)	64 (87.7)	150 (85.7)	
Education				<0.001*
Less than Bachelor's degree	133 (53.6)	52 (71.2)	81 (46.3)	
Bachelor's degree and over	115 (46.4)	21 (28.8)	94 (53.7)	
Occupation				0.001*
Employee	149 (60.1)	32 (43.8)	117 (66.9)	
Self-employed/Unemployed	99 (39.9)	41 (56.2)	58 (33.1)	
Monthly income (THB)				0.025*
<10,000	99 (39.9)	37 (50.7)	62 (35.4)	
\geq 10,000	149 (60.1)	36 (49.3)	113 (64.6)	
Lawton IADL score (mean \pm SD)	7.94 \pm 0.40	7.84 \pm 0.71	7.99 \pm 0.11	0.070 T
BMI (kg/m²)				0.040*
Normal (18.5-29.99 kg/m ²)	217 (87.5)	59 (80.8)	158 (90.3)	
Underweight / Obesity	31 (12.5)	14 (19.2)	17 (9.7)	
Mean BMI (mean \pm SD)	23.63 \pm 3.97	23.93 \pm 4.89	23.50 \pm 3.53	0.499 T
Nutritional status (MNA)				0.020*
Normal	205 (82.7)	54 (74.0)	151 (86.3)	
At risk to Malnutrition	43 (17.3)	19 (26.0)	24 (13.7)	

Chi-square and Independent t-test (T) were performed.

* (star) stands for statistical significance P-value <0.05

Table 2 showed medical and behavioral characteristics of participants. For the current medical problems, 109 (44.0%) had hypertension which 71 (28.6%) had it at least 10 years and over, 130 (52.4%) had dyslipidemia, 41 (16.5%) had diabetes mellitus, and 6 (2.4%) had kidney disease. There were 45 (18.1%) participants who used to have BMI \geq 30 kg/m² in their lifetime. For behavioral characteristics, there were 146 (58.9%) had at least 5 hours of continuous sleeping, 198 (79.8%) had never smoked, 218 (87.9%) had no alcohol consumption, and 241 (97.2%) had never used drugs, 159 (64.1%) had physical exercise at least once a week, 240 (96.8%) still had social engagement by going out at least once a week, and 202 (81.4%) had ability to use social media.

After comparing MCI group with normal cognition group, participants with MCI had higher percentage of having hypertension (54.8% vs 39.4%, $p=0.026$), higher percentage of having history of obesity (11.0% vs 4.0%, $p=0.040$), higher percentage of having history of hypertension over 10 years (42.5% vs 22.9%, $p=0.002$), and lower percentage of social media using (65.8% vs 88.0%, $p<0.001$).

Table 2 Medical and behavioral characteristics of MCI and normal group

Characteristics	All (n=248)	MCI (n=73)	Normal (n=175)	P-value
Medical problems (Present, %)				
- Hypertension	109 (44.0)	40 (54.8)	69 (39.4)	0.026*
- Dyslipidemia	130 (52.4)	43 (58.9)	87 (49.7)	0.187
- Diabetes Mellitus	41 (16.5)	15 (20.5)	26 (14.9)	0.272
- Kidney disease	6 (2.4)	0 (0.0)	6 (3.4)	0.120 F
- History of Obesity (BMI \geq 30)	15 (6.0)	8 (11.0)	7 (4.0)	0.040*
- History of Hypertension (\geq 10 years)	71 (28.6)	31 (42.5)	40 (22.9)	0.002*
Family history of Dementia				0.986
Yes	44 (17.7)	13 (17.8)	31 (17.7)	
No	204 (82.3)	60 (82.2)	144 (82.3)	
Continuous sleeping hours				0.782
<5 hours	102 (41.1)	31 (42.5)	71 (40.6)	
\geq 5 hours	146 (58.9)	42 (57.5)	104 (59.4)	
Smoking status				0.349
Current smoker	3 (1.2)	0 (0.0)	3 (1.7)	
Ex-smoker	47 (19.0)	14 (19.2)	33 (18.9)	
Never	198 (79.8)	59 (80.8)	139 (89.4)	
Alcohol consumption status				0.365
Almost daily	1 (0.4)	0 (0.0)	1 (0.6)	
Social drinker	29 (11.7)	6 (8.2)	23 (13.1)	
Never	218 (87.9)	67 (91.8)	151 (86.3)	
Drug abuse				0.084
Current user	2 (0.8)	0 (0.0)	2 (0.8)	
Ex-user	5 (2.0)	0 (0.0)	5 (2.0)	
Never	241 (97.2)	73 (100.0)	168 (97.2)	
Physical exercise				0.536
More than once a week	147 (59.3)	40 (54.8)	107 (61.1)	
Once a week	12 (4.8)	3 (4.1)	9 (5.1)	
Never	89 (35.9)	30 (41.1)	59 (33.7)	
Social engagement				0.099
More than once a week	214 (86.3)	67 (91.8)	147 (84.0)	
Once a week	26 (10.5)	3 (4.1)	23 (13.1)	
Never	8 (3.2)	3 (4.1)	5 (2.9)	
Social media using				<0.001*
Yes	202 (81.5)	48 (65.8)	154 (88.0)	
No	46 (18.5)	25 (34.2)	21 (12.0)	

Chi-square and Fisher's exact test (F) were performed.

* (star) stands for statistical significance P-value <0.05

All oral health characteristics were reported as shown in Table 3. The current dentition of participants mostly had at least one fixed or removable prostheses, 179 (72.2%) cases. There were 106 (42.7%) had periodontal disease and 80 (32.3%) had active caries. The average number of active carious teeth and pulp-exposed teeth was 0.81 ± 1.65 and 0.25 ± 1.07 , respectively. The mean number of natural functional teeth was 20.54 ± 7.78 , while 159 (64.1%) participants had at least 20 NT. The mean number of posterior occluding pairs was 4.06 ± 2.92 , while 142 (57.3%) had at least 4 POPs. For the masticatory performance visual score from 0-9, the average score was 4.92 ± 2.23 . When it came into low and high masticatory performance level, 131 (52.8%) was in high level.

After comparing MCI group with normal cognition group, participants with MCI had higher percentage of having edentulous dentition (8.2% vs 1.7%, $p=0.021$), higher percentage of having periodontal disease (56.2% vs 37.1%, $p=0.006$), lower percentage of having at least 20 NT (50.7% vs 69.7%, $p=0.004$), and lower percentage of having at least 4 POPs (39.7% vs 64.6%, $p<0.001$). On average, MCI group had lower number of NT ($p=0.003$) and POPs ($p=0.002$) than normal cognition group.

Table 3 Oral health related factors associated with MCI

Characteristics	All (n=248)	MCI (n=73)	Normal (n=175)	P-value
Dentition				0.022*
Natural teeth (28NT)	20 (8.1)	6 (8.2)	14 (8.0)	
Fixed prostheses	39 (15.7)	6 (8.2)	33 (18.9)	
Fixed and removable prostheses	27 (10.9)	9 (12.3)	18 (10.3)	
Removable prostheses	104 (41.9)	36 (49.3)	68 (38.9)	
Complete denture	9 (3.6)	6 (8.2)	3 (1.7)	
Partial edentulism	49 (19.8)	10 (13.7)	39 (22.3)	
Complete edentulism	0 (0.0)	0 (0.0)	0 (0.0)	
Dentition grouping by NT				0.021* F
Prostheses with NT	239 (96.4)	67 (91.8)	172 (98.3)	
Complete denture	9 (3.6)	6 (8.2)	3 (1.7)	
Periodontal disease				0.006*
Present	106 (42.7)	41 (56.2)	65 (37.1)	
Absent	142 (57.3)	32 (43.8)	110 (62.9)	
Active dental caries				0.054
Present	80 (32.3)	30 (41.1)	50 (28.6)	
Absent	168 (67.7)	43 (58.9)	125 (71.4)	
Natural teeth (NT)				0.004*
<20 NT	89 (35.9)	36 (49.3)	53 (30.3)	
≥20 NT	159 (64.1)	37 (50.7)	122 (69.7)	
Mean NT ± SD	20.54 ± 7.78	18.00 ± 9.05	21.61 ± 6.93	0.003* T
Posterior Occluding Pairs (POPs)				<0.001*
<4POPs	106 (42.7)	44 (60.3)	62 (35.4)	
≥4POPs	142 (57.3)	29 (39.7)	113 (64.6)	
Mean POPs ± SD	4.06 ± 2.92	3.18 ± 3.03	4.42 ± 2.81	0.002* T

Chi-square, Independent t-test (T), and Fisher's exact test (F) were performed.

* (star) stands for statistical significance P-value <0.05

CHAPTER V

DISCUSSION

We investigated the prevalence of MCI in a group of Thai dental elderly patients and analyzed all current evidence-based potential risk factors of MCI from three complements: bio-socio-economic, medical, and behavioral, and notably oral health factors. From our study, the prevalence of MCI was found approximately 29.4% which is higher than the study in 2013 that showed 21.3% of MCI among Thai general elders in community setting (16). The discrepancy of prevalence might be a result of different tools, measurement of cognitive function, and study setting. As to the internationally published range of estimated MCI prevalence, it was reported 5.0%–36.7% by variations in criteria, population and methodology (12). Alternatively, all participants recruited from Geriatric and Prosthodontic clinic might be more at risk to malnutrition, lack of oral sensory and motor stimulation, changed food preferences and behaviors from social impacts due to oral health and mastication problems than general elders. This implied a point of view in the differences between general population and dental patients who suffered or subjectively needed treatments from oral health problems, particularly in elders.

We found 15 factors significantly related to MCI in univariate analysis as shown in three perspectives. However, there were factors that not significantly related to MCI which was inconsistent with the previous review. No differences in living conditions and functional status (IADL) among MCI and normal elders were accordant to some evidences. Elders who living alone were not at greater risk of poor cognition, but social isolation were (29, 30). MCI individuals demonstrated normal IADL comparable with cognitively normal individuals but took longer time to complete (13). Alternatively, our study might have inadequate population to see the relevance of factors mentioned above.

After multivariate adjusted, we found that the risk factors associated with MCI were age over 70 years, unstable occupational group, non-social media user, edentulism, periodontal disease, fewer number of POPs, having less than 4 POPs, and low masticatory performance. Age is the greatest risk factor of cognitive decline as earlier evidences reported (21, 31, 32). Being self-employed, unemployed, or being housewife defined as unstable occupational group in this study regarded to inconsistent income and lack of welfare. This might be the influences of lower formal education, less cognitively required work and poorer health welfare compared to civil servant and private employee, the stable occupational group. Earlier study reported that elders with cognitively required or higher complexity occupations advantage for maintaining better cognition with slower rate of cognitive decline (33, 34). The novel factor found in this study was 'not using social media'. Social media is another social connection device maintaining social relations nowadays, especially in connecting with different generations and receiving new information for elders. It can enhance physical and cognitive challenges for elders in self-adaptation to technology as one of lifelong learning behavior (35). Moreover, using social media for reading and chatting is a part of cognitive training. According to the study in 1984, increasing social interactions as well as dealing with a complex physical environment can improve cognition (36). The social media use among older ages were reported beneficial beyond social engagement to the function of inhibitory control, and also suggested its impact in information processing and cognitive function (37).

For oral health related factors, our study found that periodontal disease was associated with MCI and was accordant to earlier evidences which indicated chronic periodontal disease as the first established oral health modifiable risk factors for Alzheimer's disease (7) and vascular dementia (38). By 3 mm clinical attachment loss representing for history of periodontal burden, systemic inflammation/infection was the explained mechanism of amyloid accumulation in vulnerable brain regions (11, 39). Serological marker of periodontitis was found associated with impaired delayed

memory and calculation (40). Further, active chronic periodontitis was claimed as important factor in driving cognitive decline once Alzheimer's disease was established (41, 42). On the other hand, elders with cognitive impairment have worse oral health, more retained roots, more coronal and root caries, more often edentulous without using a denture, and poorer denture hygiene than cognitively healthy elders due to impaired motor skills for oral hygiene care, self-neglect, and dependency (6, 43). While this study did not detect any differences in dental caries among MCI and normal participants, the expected reasons were different criteria for only visible cavitated active dental caries without further investigations. Periodontal disease as well as infection from carious lesion resulted in tooth loss and finally led to changes in dentition which had an influence on decreased masticatory efficiency and function (44). Edentulism and complete denture wearers was not only significantly associated with cognitive impairment in this study, but also in previous study (45) which presented in significant oral disability, led to deterioration of their dietary habits (46), and recognized at risk for malnutrition (47). Previous study suggested that tooth loss was also a possible indicator of past periodontitis (42). The changes of food preference due to masticatory difficulties might also result in poorer nutrition. Especially, the loss of Posterior Occluding Pairs (POPs); the strategic parts of the dental arch and critical for adequate oral function, closely related to chewing ability (48) and lower oral health related quality of life (3). These might be reasons for our findings agreeing with earlier study that loss of posterior teeth occlusion independently associated with cognitive decline (49). Moreover, some evidence claimed that lower number of teeth led to higher risk dementia incidence(24). After tooth loss and dentitional change, the last but significant factor found related to MCI is masticatory performance, consequentially. Along with previous study, our findings showed that masticatory performance was stronger associated with cognitive impairment than the number of remaining teeth (50). Several evidences claimed mastication was beneficial to brain function (10) and some suggested a causal relationship (9, 51). The probable mechanisms of this relation explained that

mastication enhances cerebral cortex activity (52) and blood flow (53-55), notably in the hippocampus (8) by the hypothalamic-pituitary-adrenal (HPA) axis and the neuronal mechanisms (10, 51). Therefore, it is plausible that mastication as one of basic human instincts be responsible for mastication-induced amelioration of cognitive function deficits.

Our knowledge is the first to specifically assess the prevalence of MCI and oral health-related risk factors in dental elderly patients after adjusted by all risk factors currently discovered and provides primary data for the further studies in this area, especially for lifelong prevention. Longitudinal study with appropriate designed was suggested to investigate through this transitional stage for the key oral modifiable factors or any causal effects.

However, our study was cross-sectional design which limited to only association of potential risk factors. Sampling depended on voluntariness and presence of potential participants at study site. Our participants limited to urban population due to the location of study site which located in center of Bangkok and was mostly in young-old to middle-old population by average age 68.68 years. All the data drawn from this population might be affected by independent lifestyle regards to IADL mean score 7.94 from 8.

The clinical implications of this study were mindful attention and awareness for elderly patients who had those potential risk factors of cognitive impairment, especially active periodontal disease. Regular periodontal follow-up, cognitive screening, and holistic prevention were recommended. Any patients with suspected cognitively impaired symptoms should be referred to specialist without any delay.

The cause of cognitive impairment appears to be multifactorial, likewise the prevention. There is no absolute one main factor that can make the cognition better or worse. Our effort is to find the most practical evidence-based knowledge and make multidisciplinary approach as health care profession team. The integrative

collaboration may be the leverage for cognitively impaired prevention and the brace for the global aged society. Therefore, not only dental geriatricians but also general dental practitioners should consider periodontal disease prevention and natural teeth preservation especially posterior teeth and/or dental substitution as needed to maintain masticatory function in treatment planning for long term benefit through patients' lifetime. **The value and attention of each natural teeth and each posterior occluding pair demonstrated in this study should be given to prevent of the loss oral function.** As one of multidisciplinary approaches, these modifiable oral health factors might be beneficial to the prevention of cognitive impairment and dependency in late life.



CHAPTER IV

CONCLUSION

The prevalence of MCI was approximately 29.4% in elderly dental patients which higher than among Thai general elders. Oral health-related factors significantly associated with MCI after adjusted by all risk factors currently discovered were periodontal disease, number of natural teeth, number of posterior occluding pairs, and complete edentulism. Mindful attention and awareness for elderly patients having those potential risk factors of cognitive impairment were necessary. Periodontal disease prevention and natural teeth preservation was suggested to maintain mastication as oral function in treatment planning for long term benefit through patients' lifetime.

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