SOCIOECONOMIC INEQUALITY IN RELATION TO ORAL HEALTH AMONG THAI POPULATION: A SECONDARY DATA ANALYSIS

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Public Health in Public Health
Common Course
College of Public Health Sciences
Chulalongkorn University
Academic Year 2018

ความสัมพันธ์ของความไม่เท่าเทียมทางเศรษฐสังคมต่อสุขภาพช่องปากของประชากรไทย: การวิเคราะห์ข้อมูลทุติยภูมิ

น.ส.สิรินทิพย์ อมรสุรเดช

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์ ไม่สังกัดภาควิชา/เทียบเท่า
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2561

Thesis Title	SOCIOECONOMIC INEQUALITY IN RELATION TO ORAL HEALTH AMONG THAI POPULATION: A SECONDARY DATA ANALYSIS
By	Miss Sirinthip Amornsuradech
Field of Study	Public Health
Thesis Advisor	Peter Xenos, Ph.D.

Accepted by the College of Public Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Public Health

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อ.ที่ปรึกษาหลัก : ปีเตอร์ ซีนอส

เนื่องจากสุขภาพช่องปาก มีความสำคัญต่อมนุษย์ทุกคนในชีวิตประจำวันและส่งผลโดยตรงกับสุขภาพร่างกาย ปัญหาสุขภาพช่องปากที่สำคัญในปัจจุบันทั่วโลก ได้แก่ โรคฟันผุ โรคเหงือก และ การสูญเสียฟัน ซึ่งเป็นปัญหาสำคัญของประเทศไทยเช่นกัน ปัจจัยสำคัญปัจจัยหนึ่งที่ส่งผลต่อ สุขภาพช่องปากของประชากร ได้แก่ เศรษฐสังคม ซึ่งประชากรในแต่ละชนชั้นของเศรษฐสังคม มีสุขภาพช่องปากที่ต่างกัน การศึกษาในหลายประเทศพบว่าประชากรที่มีเศรษฐสังคมในระดับสูง มักจะมีสุขภาพโดยรวมและสุขภาพช่องปากดีกว่า ประชากรที่อยู่ในเศรษฐสังคมระดับต่ำว่า ซึ่งปัญหานี้พบได้ในหลายประเทศทั่วโลก อย่างไรก็ตาม การศึกษาปัจจัยด้านเศรษฐสังคมต่อสุขภาพช่องปากในประเทศกำลังพัฒนา รวมทั้งประเทศไทยยังมีน้อย การศึกษานี้จึงมีวัตถุประสงค์เพื่อหาความสัมพันธ์ระหว่าง เศรษฐสังคมที่แตกต่างและสุขภาพช่องปาก รวมทั้งปัจจัยต่างๆที่เกี่ยวข้อง โดยอาศัยข้อมูลจากรายงานการสำรวจสภาวะสุขภาพช่องปากระดับประเทศ ครั้งที่ 7 ในปี พ.ศ. 2555 ในการศึกษานี้ใช้จำนวนฟันผุ สภาวะปริทันต์และการสูญเสียฟัน เป็นตัวชี้วัดสุขภาพช่องปาก และใช้รายได้ ระดับการศึกษาสูงสุด และกลุ่มอาชีพ เป็นตัวชี้วัดด้านเศรษฐสังคม โดยวิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา และ การวิเคราะห์การถดถอยเชิงซ้อน ผลการศึกษาพบว่า เศรษฐสถานะ มีความสัมพันธ์กับสุขภาพช่องปาก ซึ่งสะท้อนให้เห็นถึงความไม่เท่าเทียมของเศรษฐสังคมของสุขภาพช่องปากในประชากรไทย โดย ระดับการศึกษามีผลเห็นได้ชัดมากกว่าตัวชี้วัดอื่น ประชากรที่มีการศึกษาระดับที่สูงกว่ามีสุขภาพช่องปากที่ดีกว่าประชากรที่มีการศึกษาที่ต่ำกว่า นอกจากนี้ พื้นหลังของประชากร พฤติกรรมเกี่ยวกับสุขภาพช่องปากและการเข้าถึงบริการทางสุขภาพช่องปากมีความสัมพันธ์กับสุขภาพช่องปาก

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2561 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

6078835353 : MAJOR PUBLIC HEALTH
KEYWORD: ORAL HEALTH, SOCIOECONOMIC INEQUALITY, THAI POPULATION

Sirinthip Amornsuradech : SOCIOECONOMIC INEQUALITY IN RELATION TO ORAL HEALTH AMONG THAI POPULATION: A SECONDARY DATA ANALYSIS. Advisor: Peter Xenos, Ph.D.

Since major oral health problems include dental caries, periodontal disease and tooth loss. Studies from many countries reports inequality in oral health which has become challenging worldwide. People with lower socioeconomic position prone to have more severe condition in oral health more than those with higher position. However, there are few studies on socioeconomic inequality in oral health in developing countries, including Thailand. This study aimed to determine the relationship of socioeconomic difference in oral health outcome and oral health behavior among Thai adult population. This study is a cross-sectional analytical study using secondary data from the 7th Thailand National Oral Health Survey (2012). Oral health outcomes are indicated by the number of dental caries, tooth loss, and the CPI index. Socioeconomic status(SES) was indicated by income, education and occupational groups. Binary logistic regression analysis was performed to determine relationship between variables and oral health outcomes. Personal background, access to dental service and oral health-related behaviors were adjusted for analysis. Results show that SES relates to oral health which indicates socioeconomic inequality in oral health for Thai population. Education is the most obvious factors that shows significance among socioeconomic variables comparing to income and occupational groups. People with higher education show better oral health status. Personal background, oral health-related behavior and access to dental service also relate to oral health outcomes.

Field of Study:	Public Health	Student's Signature .....
Academic Year:	2018	Advisor's Signature .....

ACKNOWLEDGEMENTS

For my completion of Master Degree thesis, there are many people I would like to thank for.

First, I would like to thank Ajarn Peter Xenos, my thesis advisor for your patient and your kindness in helping and supporting my work on thesis from the beginning to the end. I have learned a lot of useful things from you during the making of Thesis, not only for the work but also for life.

I would also like to thank Asst. Prof. Naowarat Kanchanakhan, my general advisor for being very kind and giving me lots of good advice in my study and in life.

Thanks to my thesis committee for all the useful comments and making this thesis complete in a good way and thanks to all College of Public Health Sciences Ajarns and staffs in every part for being very supportive to students.

I would also like to acknowledge the Bureau of Dental Health, Ministry of Public Health, Thailand for data of the 7th Thailand National Oral Health Survey.

Last, thanks to all of my CPHS friends for cheering and helping each other up in good time and bad time and thank you for my family and all of my friends for being there for me every time I needed you.

Thanks to all the people I mentioned above. Without you all, I could not have finished and survived through my Thesis and my study in Master Degree.

Sirinthip Amornsuradech

TABLE OF CONTENTS

Page

ABSTRACT (THAI) iii
ABSTRACT (ENGLISH) iv
ACKNOWLEDGEMENTS v
TABLE OF CONTENTS vi
List of Figures 11
List of Tables 12
LIST OF ACRONYMS OR ABBREVIATIONS 15
CHAPTER I 16
INTRODUCTION 16
1. Background and Rationale 16
1.1 Research questions 17
1.2 Objectives 17
1.3 Study Hypotheses 18
2. Conceptual framework 19
3. Operational Definitions 20
CHAPTER II 23
LITERATURE REVIEW 23
Global Burden of oral disease 23
Social determinants of oral health 24
Socio-behavioral risk factors in oral health 25
Socioeconomic inequality in access to service 27
Socioeconomic inequality in oral health related behavior 27
Socioeconomic inequality in oral health 28
National Oral Health Survey of Thailand 30
Oral health situation in Thailand 31

CHAPTER III 33
RESEARCH METHODOLOGY 33
1. Study design 33
2. Source of data 33
3. Data preparation 33
4. Study area and population 33
4.1 Study area 33
4.2 Study population 33
5. Sampling design of TNOHS 34
6. Research instruments of TNOHS 35
7. Measurements of study variables 36
7.1 Independent variables 36
7.1.1 Socioeconomic Status 36
7.1.2 Oral health behaviors 38
7.1.3 Access to dental service 38
7.2 Dependent Variables 39
8. Statistical Analysis 41
9. Ethical considerations 42
10. Budget 42
11. Administration and time schedule 43
CHAPTER IV 44
1. Descriptive Analysis 44
2. Binary logistic Regression Analysis 49
2.1 Age group 35-44 years old 49
Dental caries 49
Periodontal status 52
Missing teeth 55
Decayed, Missing and Filled Teeth (DMFT) 58
Posterior occluding pairs (POP) 61

Missing front teeth.....64

Overall summary of bivariate relationship for age group 35-44 years old.....66

Overall multivariate models of dependent variables for age group 35-44 years old.....68

2.2Age group 60-74 years old.....71

Dental caries.....71

Periodontal status.....74

Missing teeth.....77

Decayed, Missing and Filled Teeth (DMFT).....80

Posterior occluding pairs (POP).....83

Missing front teeth.....85

Overall Bivariate relationship for Age group 60-74 years old.....88

Overall multivariate analysis for independent variables for age group 60-74 years old.....90

2.3 Age group 80 - 89 years old.....92

Dental caries.....93

Periodontal status.....93

Missing teeth.....93

Decayed, Missing and Filled Teeth (DMFT).....95

Posterior occluding pairs (POP).....95

Missing front teeth.....95

Overall Bivariate relationships for Age group 80-89 years old.....97

Overall multivariate analysis for independent variables for age group 80-89 years old.....98

Interactions between income and education.....100

Influence of income, education, behavior and access on oral health outcomes.....101

Age 35-44 years old.....101

Dental caries.....101

Periodontal status.....101

Missing teeth....101
Decayed, Missing and Filled Teeth (DMFT) 102
Posterior occluding pairs (POP) 102
Missing front teeth....102
Age 60-74 years old 102
Dental caries 102
Periodontal status....103
Missing teeth, posterior occluding pairs (POP) and missing front teeth....103
Decayed Missing and Filled Teeth (DMFT) 103
Summary Tables 104
CHAPTER V 107
Discussion....107
SES and oral health outcomes....107
Other related factors 109
Background and oral health outcomes....109
Behavior and oral health outcomes....110
Access and oral health outcomes 111
Recommendation 113
Conclusion 114
REFERENCES 115
Appendix....119
1. Interview form of the 7th National Oral Health Survey, Thailand....119
2. Oral health survey form of the 7th National Oral Health Survey, Thailand....123
3. Tables showing interactions of income and education of oral health outcomes124
4. Tables showing influence of behavior and access in income and education on oral health outcomes for age group 35-44 years old 126
5. Tables showing influence of behavior and access in income and education on oral health outcomes for age group 60-74 years old 132
VITA....138

List of Figures

Page

Figure 1 Conceptual framework.....19

Figure 2 Conceptual framework on social determinants of health from Commission on Social Determinants of Health (CSDH).....24

Figure 3 The risk-factor approach in the promotion of oral health......25

Figure 4 Percentage of population with age of 35-44 and 60-74 years old who have pocket depth ≥ 6 mm, data from the 2nd-7th National Oral Health Survey of Thailand.....32

Figure 5 Sampling Design flow chart of the 7th TNOHS 34

Figure 6 Example of coding according to CPI index according to World Health Organization: Oral health surveys: basic methods. 4th edition. Geneva: WHO; 1997......40

List of Tables

Page

Table 1 Oral health status of Thai population based on Age group, report of the 2nd - 7th Thailand National Oral Health Survey.....32

Table 2 Total number of sample based on age group and region collected in the 7th Thailand National Oral Health Survey.....35

Table 3 Frequency distribution and percentage of variables for all age groups.....46

Table 4 Binary logistic regression models for having 1 or more dental caries in 35-44 years old age group.....50

Table 5 Binary logistic regression models for Community Periodontal Index (CPI) score 3 or more in 35-44 years old age group.....53

Table 6 Binary logistic regression models for missing 5 or more teeth in 35-44 years old age group.....56

Table 7 Binary logistic regression models for DMFT more than 10 in 35-44 years old age group.....59

Table 8 Binary logistic regression models for posterior occluding pairs (POP) less than 4 in 35-44 years old age group.....62

Table 9 Binary logistic regression models for having 1 or more missing front teeth in 35-44 years old age group.....64

Table 10 Overall bivariate analysis for independent variables, age group 35-44.....67

Table 11 Overall Multivariate analysis of all independent variables in one model, age 35-44 years old.....69

Table 12 Binary logistic regression models for having 1 or more dental caries in 60-74 years old age group.....73

Table 13 Binary logistic regression models for Community Periodontal Index (CPI) score 3 or more in 60-74 years old age group.....75

Table 14 Binary logistic regression models for missing 5 or more teeth in 60-74 years old age group.....78

Table 15 Binary logistic regression models for Decayed Missing and Filled Teeth (DMFT) more than 10 in 60-74 years old age group.....81

Table 16 Binary logistic regression models for posterior occluding pairs (POP) less than 4 in 60-74 years old age group.....83

Table 17 Binary logistic regression models for having 1 or more front teeth in 60-74 years old age group 86

Table 18 Overall bivariate relationships for independent variables, age group 60-74 89

Table 19 Overall Multivariate analysis of all independent variables in one model, age 60-74 years old 91

Table 20 Binary logistic regression models for having 1 or more dental caries, Community Periodontal Index (CPI) score of 3 or higher and 5 or more missing teeth in 80-89 years old age group 93

Table 21 Binary logistic regression models for having 10 or more Decayed Missing and Filled Teeth (DMFT), less than 4 posterior occluding pairs (POP) and 5 and 1 or more missing teeth in 80-89 years old age group 96

Table 22 Overall bivariate relationship for independent variables, age group 80-89 years old 97

Table 23 Overall Multivariate analysis of all independent variables in one model, age 80-89 years old 99

Table 24 Summary table showing significance of each oral health outcome for all age groups combined 104

Table 25 Relationship of independent variables and each oral health outcomes 106

Table 26 Effect of interaction between income and education on oral health outcomes, age 35-44 years old 124

Table 27Effect of interaction between income and education on oral health outcomes, age 60-74 years old 125

Table 28 Influence of behavior and access in income and education on dental caries for age group 35-44 years old 126

Table 29 Influence of behavior and access in income and education on periodontal status for age group 35-44 years old 127

Table 30 Influence of behavior and access in income and education on missing teeth for age group 35-44 years old 128

Table 31 Influence of behavior and access in income and education on Decayed Missing and Filled Teeth (DMFT) for age group 35-44 years old 129

Table 32 Influence of behavior and access in income and education on Posterior occluding pairs (POP) for age group 35-44 years old.....130

Table 33 Influence of behavior and access in income and education on missing front teeth for age group 35-44 years old 131

Table 34 Influence of behavior and access in income and education on dental caries for age group 60-74 years old 132

Table 35 Influence of behavior and access in income and education on periodontal status for age group 60-74 years old 133

Table 36 Influence of behavior and access in income and education on missing teeth for age group 60-74 years old 134

Table 37 Influence of behavior and access in income and education on Decayed, Missing and Filled Teeth (DMFT) for age group 60-74 years old 135

Table 38 Influence of behavior and access in income and education on posterior occluding pairs (POP) for age group 60-74 years old.....136

Table 39 Influence of behavior and access in income and education on missing front teeth for age group 60-74 years old 137

LIST OF ACRONYMS OR ABBREVIATIONS

SES	**Socioeconomic status**
TNOHS	**Thailand National Oral Health Survey**
DMFT	**Number of Decayed, Missing and Filled Teeth in the permanent dentition**
CPI	**Community Periodontal Index**
POP	**Posterior occluding pairs**
CSMBS	**Civil Servant Medical Benefit Scheme**
SSS	**Social Security Scheme**
WCF	**Worker Men Compensation Fund**
UC	**Universal Health Coverage**
WHO	**World Health Organization**
GBD	**Global burden of disease**

CHAPTER I
INTRODUCTION

1. Background and Rationale

Oral health is essential for individuals. The functions of the oral cavity directly relate to our daily lives as it plays important roles in eating, speaking and social interaction. Oral health also relates to general health and quality of life (Allen, 2003). Dental caries, periodontal diseases and tooth loss are the most common and main oral health problems throughout the world (Marcenes et al., 2013). The global prevalence of untreated dental caries in the permanent teeth was 35% (Frencken et al., 2017). Severe periodontitis affects 5-20% of most adult populations worldwide, and it is a major cause of tooth loss in both developed and developing countries (Jin et al., 2011; Pihlstrom, Michalowicz, & Johnson, 2005). In many countries, oral health is still an important issue to be focused on, including Thailand. (Bureau of Dental Health, 2013; Marcenes et al., 2013)

One of the basic determinants that effect population oral health is socioeconomic position. Socioeconomic inequalities in oral health is defined as differences in the prevalence or incidence of oral health problems between individual people of higher and lower socioeconomic status (Locker & Ford, 1996). People with lower social position usually have more risk of illness and mortality that those who are in higher position (Wilkinson & Marmot, 2003). Social inequality in oral health considered as one of the principal global challenges for improving oral health among populations. It still persists in many countries in the world, even there are attempts to reduce such gap across the social hierarchy (Poul Erik Petersen, 2003). However, there are few studies of the socioeconomic inequality in oral health status in developing countries which have the different context with such countries, including Thailand (Somkotra, 2011). Moreover, according to World Health Organization(WHO), research on inequities in oral health need to be considered to minimize the gap between the rich and the poor (Poul Erik Petersen & Kwan, 2011).

Thailand National Oral Health Survey (TNOHS) is one crucial process to obtain oral health status, behavior and risk factors of oral diseases of Thai population. Data from the survey can be used in building oral health policy and programs. The data is not

only for solving oral health problems at national level effectively, but also for comparing oral health condition, behavior and related risk factor with previous surveys in Thailand and international level, which keep on changing overtime. Dental Health Bureau, Ministry of Public Health, Thailand has been conducting National Oral Health Survey every 5 years since 1977. The latest National Oral Health Survey of Thailand that is available at the time of this study is the7th survey conducted in 2012. The report provide descriptive data of oral health status and related factors of all age groups and comparison between regions, which can represent oral health status of Thai population. However, the association between oral health status and related factors were not provided in the report.

This study aims to determine the relationship between different socioeconomic status and oral health outcome of Thai population using data from The 7th National Oral Health Survey of Thailand, 2012. It would provide more understanding about socio-behavioral determinants related to oral health and benefit the policy maker for building public policy or programs that improve oral health of Thai population covering every social class.

1.1 Research questions

a) Is there any relationship between socioeconomic status and oral health among Thai population?

b) Do dental caries, periodontal status and tooth loss differ by socioeconomic groups?

c) Do oral health behavior and access to dental service have any effect on relationship between socioeconomic status and oral health outcomes?

d) Is there any relationship between other related factors and oral health outcomes?

1.2 Objectives

General objectives:

To determine the relationship between socioeconomic status and oral health of Thai population

Specific objectives:

a) To determine dental caries, periodontal status and tooth loss in different socioeconomic groups

b) To determine effect of oral health behavior and access to dental service on relationship between socioeconomic status and oral health outcomes

c) To determine the relationship between other related factors and oral health outcomes

1.3 Study Hypotheses

a) There is a relationship between socioeconomic status and oral health among Thai population.

b) Dental caries, periodontal status and tooth loss differ by socioeconomic groups.

c) Oral health behavior and access to dental service have effect on relationship between socioeconomic status and oral health outcomes.

d) There is relationship between other related factors and oral health outcomes.

2. Conceptual framework

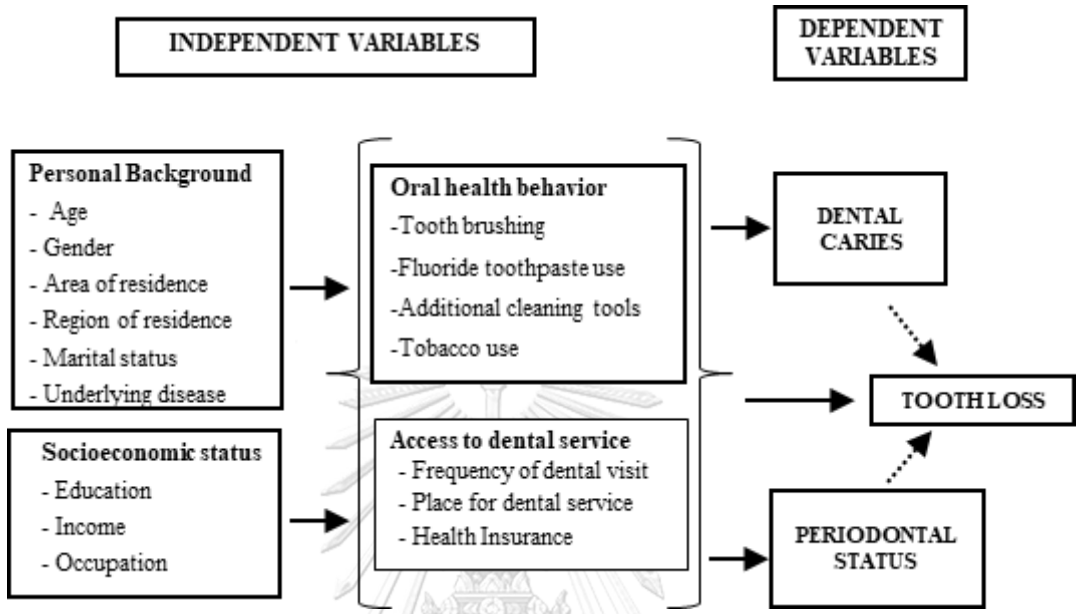


Figure 1 Conceptual framework

3. Operational Definitions

- **Socioeconomic inequality :** Difference in level of socioeconomic position measured by income, occupational grade, or educational attainment (Kawachi, Subramanian, & Almeida-Filho, 2002)

- **Socioeconomics status (SES)**: socioeconomic status of the population indicated by education, income, and occupational group.

- **Income:** defined by range of average income per month in the survey questionnaire, classified into low income group (including "No income", "1-5,000 baht" and "5,001-15,000 baht"), and high income group (including "15,001-30,000 baht", "30,001-50,000 baht" and "50,001 baht or more").

- **Education**: Highest education level attained categorized into 'Primary education or lower complete' (including "Never attend school", "Primary school" ,and "Middle School") and 'At least secondary education complete' (including "High school", "High Vocational Certificate", "Bachelor degree", and "Higher than bachelor degree").

- **Occupation**: work or job of the population at the time of the survey based on category in the survey questionnaire, which were categorized as 'Personal Business' (including "Personal business as employer", "personal business without employee" and "unpaid family business worker"), 'Wage-earner/freelance', 'Agriculture', 'Housekeeper', 'Other' (including "Employee/Government worker", "Associates of network/ clubs", "Elderly with income", "Study" and "Finding a job").

- **Age group**: range of population age divided into 35-44, 60-74, and 80-89 years old following the 7th Thailand National Oral Health Survey

- **Age:** age of population in years counted until the latest birth date at the time of the survey

- **Area of residence:** residential area where population lived at the time of the survey categorized into Bangkok, other urban (urban area outside Bangkok) or inside municipality, and rural or outside municipality.

- **Region of residence**: geographical region of Thailand where the population lived at the time of the survey which are central, northern, northeast, southern region and Bangkok

- **Marital status**: marital status of the population at the time of the survey, defined as Single, Married, Previously married (including “divorced”, “widowed” and “separated”)

- **Underlying disease**: condition which population having diabetes mellitus or not

- **Oral health behavior**: behaviors that have influence on oral health including frequency of tooth-brushing, use of fluoride toothpaste and use of additional cleaning tools and tobacco use

- **Frequency of tooth brush**: categorized in to dichotomous variable which are ‘brushing at least 2 times per day’ and ‘less than 2 times per day’.

- **Use of fluoride toothpaste**: categorized as ‘use of fluoride toothpaste’ and ‘no use of fluoride toothpaste’

- **Additional cleaning tools use** determined by using dental floss or interdental brush used considered as additional cleaning tools use. The categorized are ‘use of additional cleaning tools’ and ‘no use of additional cleaning tools’.

- **Tobacco use:** tobacco smoking status including ‘non-smokers’ and ‘smokers’ (including “former smoker”, and “current smoker”)

- **Access to dental service:** was measured by frequency of dental visit, place of dental service use and health insurance coverage

- **Frequency of dental visit** refers to dental visit in the past year, which categorized into ‘at least once’ and ‘less than once’

- **Place for dental service use** refers to place which the population received dental health service. The categories are ‘Public provider’ (including “Dental mobile unit with dental personnel from government agency”, “PCU/Primary health care”, “Local hospital” and “Provincial hospital”) and ‘Private provider’ (“private clinic/private hospital”).

- **Health insurance coverage** refers to any health insurance or coverage that people have including ‘Civil Servant Medical Benefit Scheme (CSMBS)’, ‘Social Security Scheme (SSS)’ and ‘Universal Health Coverage (UC)’

- **Other related factors:** refers to personal background of the population including age, gender, marital status, area of residence, region of residence and diabetes mellitus condition

- **Oral health outcomes:** consists of 6 oral health status including dental caries, periodontal status, tooth loss, posterior occluding pairs, missing front teeth and DMFT

- **Dental caries:** indicated by number of untreated caries in the mouth divided into ‘0 dental caries’ and ‘1 or more dental caries’

- **Periodontal Status:** measured by Community Periodontal Index (CPI), categorized into ‘CPI score more or equal to 3’ and ‘CPI score less than 3’

- **Tooth loss:** tooth that was removed due to any reasons. It was measured in the form of number of missing teeth which was categorized in to ‘missing less than 5 teeth’ and ‘missing 5 teeth or more’

- **Posterior Occluding Pairs (POP)**: number of pairs of posterior teeth that is in function to help with the chewing. This study divided into ‘At least 4 pairs and less than 4 pairs’.

- **Missing front teeth**: refers to total number of upper and lower front teeth that has been removed. The analysis divided number of missing front teeth into ‘No missing front teeth’ and ‘1 or more missing front teeth’

- **DMFT:** number of Decayed, Missing and Filled permanent teeth. This study presented as ‘DMFT less than 10’ or ‘DMFT 10 or more’

CHAPTER II
LITERATURE REVIEW

Global Burden of oral disease

From the Global Burden of Disease (GBD) 2010 study, untreated caries, severe periodontitis and severe tooth loss has been the most prevalent conditions in most of the countries across the world. The study revealed that Disability Adjusted Life-Years (DALYs) due to severe periodontitis and untreated caries increased since 1990, while those due to severe tooth loss decreased. (Marcenes et al., 2013).

The greatest burden of oral diseases is on the disadvantaged and low socioeconomic position groups of population. The pattern of oral disease diverse across countries in relation to living conditions, lifestyles and environmental factors, and the implementation of preventive oral health schemes. (Poul Erik Petersen, 2003)

Dental caries defined as “localized, post eruptive, pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity”. (World Health Organization. Oral Health survey basic methods. 4th ed. Geneva; 1997.) Untreated caries was defined as “teeth with unmistakable coronal cavity at dentin level, root cavity in cementum that feels soft or leathery to probing, temporary or permanent restorations with a caries lesion”. Untreated caries could cause disability as “a toothache, which causes difficulty eating”. Severe periodontitis means “a Community Periodontal Index score of 4, a clinical attachment loss more than 6 mm or a gingival pocket depth more than 5 mm”. Disability from severe periodontitis was defined as “bad breath, a bad taste in the mouth, and gums that bleed a little from time to time, but this does not interfere with daily activities.” Severe tooth loss was defined as “having fewer than 9 remaining permanent teeth”, while the definition of disability from tooth loss was “great difficulty in eating meat, fruits, and vegetables”.

Severe dental caries and periodontal disease are major causes of tooth loss. Tooth loss could results in lower quality of life of by decreasing functional capacity and self-esteem which also affect social relationships. (Poul E. Petersen & Ogawa, 2012)

Social determinants of oral health

Commission on Social Determinants of Health (CSDH) was set up by the World Health Organization (WHO) and were tasked to review the evidence on how social structure affect population health, and what governments and public health can do to improve. According to CSDH, a social determinants of health conceptual framework was suggested as Figure 2. Social, economic and political mechanisms create a set of socioeconomic positions, which populations are stratified based on their income, education, occupation, gender, ethnicity and other factors. These socioeconomic positions affect some determinants of health status as intermediary determinants. It reflect people position within social ladders based on their social class, differences in exposure and vulnerability to health-compromising conditions. Illness can also "feedback" on a given individual's social position. For example, by losing job opportunities and reducing income; certain epidemic diseases can similarly "feedback" to affect the functioning of social, economic and political institutions(Solar O & Irwin A, 2010).

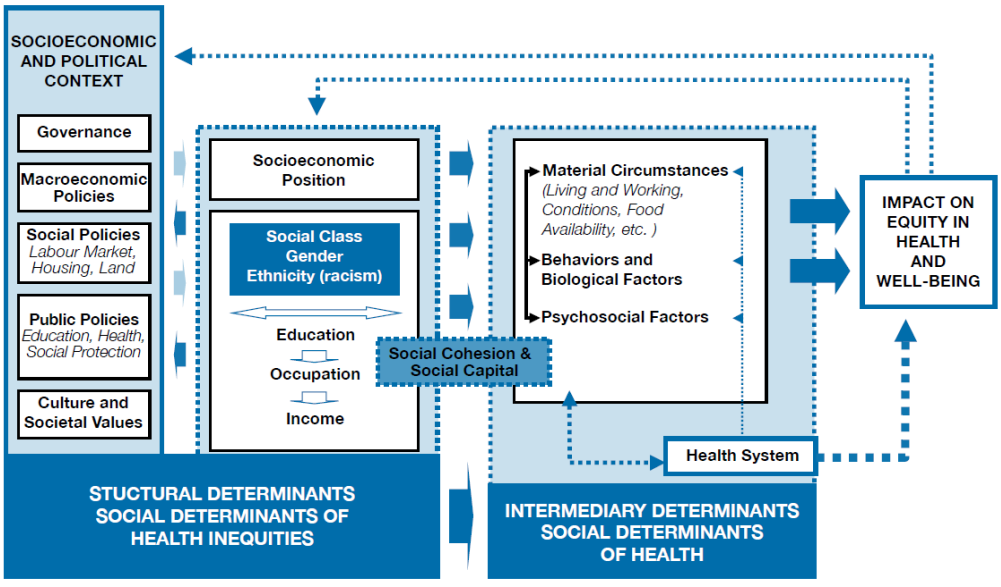


Figure 2 Conceptual framework on social determinants of health from Commission on Social Determinants of Health (CSDH)

A theory explain the interplay between economic, social and cultural resources are related to each other. For example, higher personal income could get more

advanced education. Parents could also invest their financial resources in their children's higher education which can lead them to better paid jobs and increasing their chances for membership in powerful networks. (Abel, 2008)

A systematic review about social determinants and oral health reveals that behaviors accounts for non-communicable diseases and also oral diseases. Oral disease relates to structural determinants, living conditions. Social gradient exists in dental caries, periodontal disease, oral cancer and tooth loss(Tellez, Zini, & Estupiñan-Day, 2014). However, a model by Chandola et al. suggested that social determinants of oral health including social class, environmental factors, psychosocial stress and oral health behaviors interacts in complex casual pathways (Newton & Bower, 2005).

Socio-behavioral risk factors in oral health

Risk factors of oral disease relates to sociocultural determinants including living conditions, education and traditions, beliefs and culture in support of oral health. Communities and countries with under exposure to fluorides prone to have higher risk of dental caries. Environmental risk factors such as poor access to safe water or sanitary facilities effect both oral health and general health. (Figure 3)

However, proper treatment of disease is based on availability and accessibility of the service. Intermediate risk behaviors such as oral hygiene practices, sugars consumption accompanied by tobacco use and excessive alcohol consumption have effects on oral health and also quality of life. (Poul Erik Petersen, 2003)

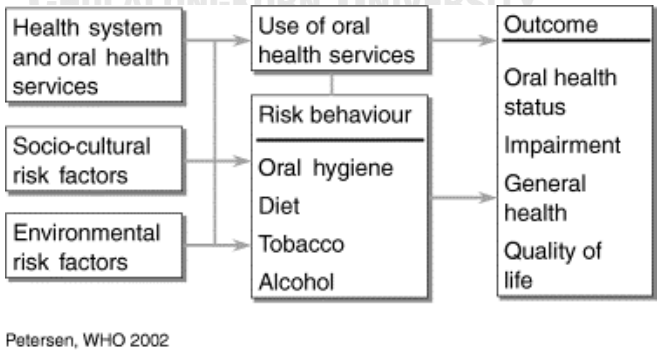


Figure 3 The risk-factor approach in the promotion of oral health.
Source: The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme (Poul Erik Petersen, 2003)

A study of oral health-related behaviors and outcomes through life course explain the onset and progression oral health outcomes through structural and behavioral factors. Structural factors include socioeconomic position, social capital and social and economic policies. Behavioral factors include diet, self-care, and the use of dental care(Broadbent et al., 2016).

Positive dental beliefs at early adulthood results in better dental self-care behaviors in later period of adult age, including attending for routine dental checkups and brushing the teeth frequently. Adult SES is also a strong predictor of the dental self-care behaviors.

Routine dental attendance is associated with better oral health outcomes. People who attend dental service routinely report their oral health better than those who are non-routine attender. They also show a lower caries-associated tooth loss, fewer untreated dental caries and lower Decayed, Missing and Filled teeth (DMFT) (W. M. Thomson, Williams, Broadbent, Poulton, & Locker, 2010).

Smoking not only affect general health. It also has negative effect to oral heath by affecting both teeth and oral tissue as oral cavity is the first part of the human body to be exposed to smoke (Eman Allam, Weiping Zhang, Cunge Zheng, Richard L. Gregory, & L. Jack Windsor, 2011). Smoking is also associated with tooth loss. Current smokers show more prevalence of tooth loss than former and non-smokers. They also show association with more prevalence of dental caries. (Ojima, Hanioka, Tanaka, & Aoyama, 2007)

Some systemic diseases influence oral health outcomes. People with diabetes mellitus prone to have more severe periodontitis and dental caries than those without such condition (Tavares, Lindefjeld Calabi, & San Martin, 2014). Some drug used in treatment of hypertension can affect dental caries from lower salivary flow and can have side effect in gingival hyperplasia. For cardiovascular disease, medication's side effects could associated with dry mouth which leads to dental caries. Periodontitis was found to be associated to cardiovascular disease. (Bahekar, Singh, Saha, Molnar, & Arora, 2007).

Socioeconomic inequality in access to service

A systematic review and meta-analysis proves that oral health service utilization differs widely between and within countries across the globe. Countries with higher developmental status shows greater regular and preventive utilization of dental services. None or irregular dental service utilization commonly relates to poor oral health. Individuals with less supportive family structures or poor health literacy, poor general and oral health or those with severe tooth loss show lower utilization of dental service. (Reda, Krois, Reda, Thomson, & Schwendicke, 2018).

A study of relationships between income and income inequality with caries experience and dental care levels in adults among rich countries shows that there is significantly related to the number of filled teeth, DMFT score and provision of restorative treatment, but not to the number of decayed or missing teeth (Bernabé, Sheiham, & Sabbah, 2009).

Income Inequality and Use of Dental Services in 66 Countries study shows that there is a greater use of dental services in more equal countries measuring by the Gini coefficient. The association can be explained by investment in health care, but not by a number of confounders at the individual level including demographic and socioeconomic factors and national income (B. Bhandari, J.T. Newton, & E. Bernabé, 2015). Another similar study explains that dentist-to-population ratio is significantly associated with income inequality and use of dental services, but total health expenditure is not (Bishal Bhandari, Jonathan T. Newton, & Eduardo Bernabé, 2015).

In addition, income-related inequality in dental service utilization by several elderly populations in Europe. (Listl, 2011). The unequally utilizing in dental care among Thai children also persists. Socioeconomic-related inequality in dental care utilization is more concentrated among the higher social class. Children with low SES are more likely to utilize dental care at public facilities, particularly primary care facilities (Somkotra & Vachirarojpisan, 2009).

Socioeconomic inequality in oral health related behavior

Recently, a study in US adults found that there are socioeconomic disparities in all behaviors. The less educated and low incomes seem to have worse health-related

behaviors, even after adjusting for covariates. Income and education disparities in all indicator of oral health were reduced after adjusting for health-related behaviors, but did not disappear. Also those who reported having poorer perceived oral health, had higher levels of gingival bleeding, loss of attachment and tooth surface loss compared to the group reporting good perceived oral health (Sabbah, Tsakos, Sheiham, & Watt, 2009).

Another study in Thailand also conclude that there is an association of socioeconomic inequality in oral health-related behaviors among Thai adult population in the period of health system transition. Lower SES groups tends to have more tobacco smoking, and alcohol consumption, while higher SES groups consume more sweetened beverage and snacks/confectionary (Pongsupathananon, 2015).These related to oral health status.

One study of Australian population found out that dental visiting and dental self-care are associated with missing teeth and oral health-related quality of life. Dental self-care alone do not significantly diminish the socioeconomic gradient in either outcome. Dental visiting significantly decrease the socioeconomic gradient in oral health-related quality of life but not the gradient in missing teeth (Sanders, Spencer, & Slade, 2006).

Socioeconomic inequality in oral health

Dental health shares the same situation with Social gradient in life expectancy and general health(Marmot & Bell, 2011). Even prevalence of dental caries in children and tooth loss in adult are lower, the social gradient still persists.

Oral health inequalities can be explained through the relationship between environmental and individual factors. Socioeconomic status difference has influence social support and sense of coherence which mediate stress and results in subjective oral health outcomes, oral health related quality of life (Gupta, Robinson, Marya, & Baker, 2015).

One study in German adult population from National Study shows that education and income affects social inequalities in oral health. Moreover, the combination of low education and low incomes may leads to higher risks of oral disease than one disadvantaged position alone. (Geyer, Schneller, & Micheelis, 2010)

From a systematic review and meta-analysis of socioeconomic position (SEP) and dental caries. Numbers of studies found that dental caries is significantly higher in low-SEP compared with high-SEP individuals. Accordingly, the risk of having caries lesions or caries experience greater in people with personally low or parental educational or occupational background or income. However, the association between low educational background and dental caries was increased in highly developed countries (Schwendicke et al., 2014).There was also an association between social class and decay together with number of DMF permanent teeth in 12 and 15 years old children. In 12 year olds there was a strong association with dental attendance and decay. (O'Brien, 1994)

A systematic review in periodontal health and inequality in social, racial and gender in Brazil conclude that there are more prevalence on periodontal outcomes among social groups placed at the bottom of the social ladder, which may imply as social inequalities in periodontal health. (Bastos, Boing, Peres, Antunes, & Peres, 2011) Many cultural and socio-economic barriers to professional care obstacles the public from reaching proper preventive approaches, receiving early diagnosis and treatment, resulting in limited progress in improving periodontal health (Jin et al., 2011).

Tooth loss in adult is also associated with social gradient. There was evidence that indicates wealth-related inequalities in self-reported total tooth loss and perceived dental- treatment needs in 11 out of 40 low and middle-income countries. Significant gradients were found with evidence of both pro-rich and pro-poor wealth inequalities in oral health.(Bhandari, Newton, & Bernabé, 2016). There is also relationship between state income inequality and self-reported individual tooth loss in the United States (Bernabé & Marcenes, 2011). Moreover, one study in Thai elderly revealed relationship between social inequality and remaining teeth. Elderly people who have low levels of education, low income or owned less durable goods were likely to have less number of naturally functioning teeth. (Srisilapanan, Korwanich, & Lalloo, 2016)

An evidence from a study about socioeconomic inequality in self-reported oral health status in Thailand revealed that population with lower socioeconomic status were more likely to report their oral health status worse than those with higher socioeconomic status. The study demonstrates socioeconomic inequality in oral health is obviously

observed along the spectrum of socioeconomic strata. (Somkotra, 2011)

National Oral Health Survey of Thailand

National Oral Health Survey in Thailand started in since 1977 as the first survey by the Ministry of Public Health under the responsibility of the Dental Health Bureau. Then, the following national oral health surveys were conducted approximately every 5 years in 1984, 1989, 1994, 1999, 2006 and 2012. The latest report available to public is the 7th National Oral Health Survey in 2012 (Bureau of Dental Health, 2013). The objectives of the survey are for oral health condition, oral disease condition and significant factors related to oral health of target population. The survey could also use to evaluate oral health situation, trends of oral health condition and related factors after implementation of policy or programs. The data is also used to compare oral health status of Thai population and other countries (Dental Health Division, 1991, 1995, 2002, 2008).

According to WHO Oral Health Survey Basic Method, oral diseases has special characteristics. The specific epidemiology of oral diseases has allowed development of an approach to sample design and survey planning for the most common oral diseases. The oral health survey, the special considerations concerning the two major oral diseases, dental caries and periodontal disease for they are strongly age-related, exist in all populations of all ages, and differ in only prevalence and severity. However, dental caries is irreversible, and thus information on current status provides data not only on the amount of disease present but also on previous disease experience.

In the survey, index age groups was categorized base on different dentition and oral condition, risk factors and behavior which vary in different age groups. WHO recommend the following age groups:

- *5 years old* group: represent children who started school. It is the best age to use data relates to level of caries in primary dentition.

- *12 years old* : children at this age has been chosen as the global monitoring age for caries for international comparison and monitoring of disease trends.is the age at children have all permanent teeth erupted. It is generally the age that children leave primary school.

- *15 years old*: this group represent adolescents and use for assessing caries prevalence and periodontal disease in adolescents because the permanent teeth have been exposed to oral environment for 3-9 years.

- *35-44 years old*: the standard group for surveillance of oral health in adults. The data from this age group imply effect of dental caries, level of severe periodontal involvement and general effects of care provided.

- *60-69 and 80-*89 *years old*: this group represent the elderly. The data for this group is necessary for planning appropriate care for elderly and monitoring overall effect of oral care service in a population.

Oral health situation in Thailand

From the report of the 7th National Oral Health Survey in 2012, accumulation of dental caries and periodontal disease for 35-44 years old group was report. There was 39.3% of population with inflammation of the gum and easy bleeding, 15.6% with periodontitis involving attachment loss and 35.2% with untreated dental caries. The problem causes severe pain that leads to tooth loss in the next period of age if they are not treated properly in time. Some risk behavior of this age group include tobacco use which involve in 19.6 % of the population. The average smoking is 11.7 cigarettes per day. Utilization of oral health service in the past year was 37.9%, and 39.0% of those use oral health service when they have toothache or tooth sensitivity. Only 10% go to dentist for routine checkup.

Trend of population with age 35-44 years old who have periodontitis with attachment loss seems to decline overtime. However, majority of prevalence is gum inflammation of gingivitis with bleeding and calculus. If the condition do not have proper treatment, it will accumulate and the disease become more severe in later period of life. That results in the presence in more severity of periodontal disease in elderly about 11.4% in 2012, which is twice as that in adult population in the same year of survey.

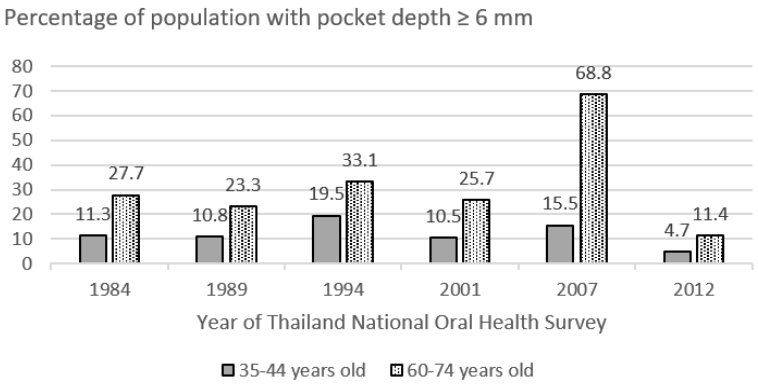


Figure 4 Percentage of population with age of 35-44 and 60-74 years old who have pocket depth ≥ 6 mm, data from the 2nd-7th National Oral Health Survey of Thailand

For elderly age groups, tooth loss remains as major problem. Approximately 88.3% of elderly have partial tooth loss, while 7.2% have total tooth loss. Surprisingly, tooth loss increases by age. Age group 80-89 who totally loss their teeth were 32.2%. Elderly with age 60-74 years old who have at least 20 functional teeth are 57.8. But, only 23.5% of those with age 80 and above have such amount of functional teeth.

Trend of having at least 20 functional teeth in adult and elderly groups has increased over time when comparing the latest survey in 2012 to previous surveys. Even the oral health situation in Thailand of every age groups gets better, the number of problems in oral health status still exist in every age groups. (Table 1)

Table 1 Oral health status of Thai population based on Age group, report of the 2nd - 7th Thailand National Oral Health Survey

Age Group	Criteria	Year of Survey					
		1984	1989	1994	2001	2007	2012
34-44	% of person with at least 20 functional teeth	92.7	91.7	91.9	92.3	96.2	97.8
60-74	% of person with at least 20 functional teeth	47.2	40.8	47.7	49.0	54.8	57.8
	% of person with total tooth loss (edentulism)	16.2	20.6	16.3	8.2	10.5	7.2

CHAPTER III
RESEARCH METHODOLOGY

1. Study design

A descriptive study using secondary data from a cross-sectional study of the 7th National Oral Health Survey of Thailand 2012

2. Source of data

Data from the 7th Thailand National Oral Health Survey which is a cross-sectional study conducted from January until September of 2012 was used in this study. The survey use methodology as suggested in Oral Health Surveys Basic Methods 4th edition (World Health Organization, 1997). The permission to access and use data of the survey was approved by Dental Health Bureau, Ministry of Public Health, Thailand.

Data of socioeconomic status including education, income, occupation, oral health behavior, access to dental service and tobacco use were extracted from the interview. Oral health status and index based on each age groups were from oral examination results.

3. Data preparation

Independent and dependent variables were recoded and grouped according to measurement and plan for analysis. Missing data was coded to exclude them from analysis.

4. Study area and population

4.1 Study area

The survey conducted in five regions of Thailand: Central, northern, northeast, southern region and Bangkok .The sample was drawn from each region including urban area and rural areas.

4.2 Study population

The population in the study include all sample from age 35-44, 60-74 and 80-89 years old age group from the National Oral Health Survey. The sample from each region and area of the country represents Thai adults and elderly population. In the survey, index age groups was categorized base on different dentition and oral condition,

risk factors and behavior which vary in different age groups. The total number of sample and population in the survey are shown in Table 2

5. Sampling design of TNOHS

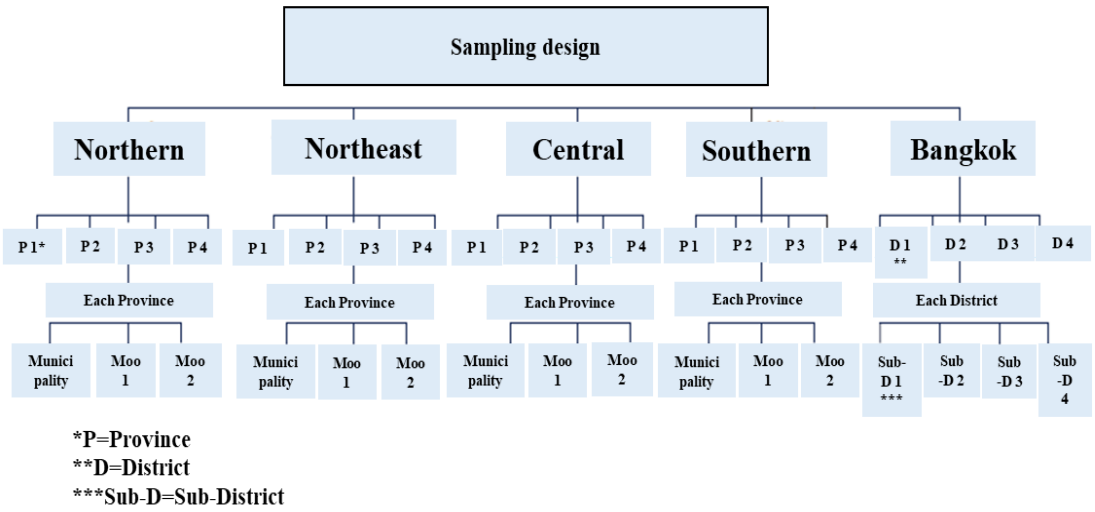
The 7th National Oral Health Survey used stratified multi-stage sampling as sampling method (Bureau of Dental Health, 2013)

1st stratified:- Four provinces from 4 regions of Thailand (Northern, Northeast, Central and Southern) including 4 areas from Bangkok were selected using systematic random sampling technique. The total areas were 17 provinces including Bangkok.

2nd stratified:- Each Province divide to urban and rural area based on definition of Ministry of the Interior. Proportion of population in urban: rural was 1:2 based on proportion of population of register, Department of the Interior, Ministry of the Interior, 1982.

- Set the number of survey sites, number of sample in each site was more than 20 sample (with equal number of male and female)
- Each province in the region conducted the sampling method for equal number of sample

Figure 5 Sampling Design flow chart of the 7th TNOHS



The total number of sample for all age groups that was surveyed were 12,752. Population that included in this study were only age group 35-44 and 60-74 and 80-89 years old with total number of 3,186. Sample in each region for age group 80-89 in

table 2 were calculated from the analysis, since the number was not presented in the survey report because this age group was used to represent at national level only, according to Dental Health Bureau, Ministry of Public Health. This study include all sample from the survey.

Table 2 Total number of sample based on age group and region collected in the 7th Thailand National Oral Health Survey

Age Group (Years old)	Region					Total
	Bangkok	Central	Northern	Northeast	South	
35-44	134	317	257	554	256	1,518
60-74	120	302	253	295	294	1,264
80-89	89*	98*	93*	94*	30*	404
Total	708	608	942	644	284	3,186

*Sample for age group 80-89 were calculated from the data analysis, since the numbers were not presented in the survey.

6. Research instruments of TNOHS

The 7th Thailand National Oral Health Survey tools and method was conducted based on WHO document of Oral Health Surveys Basic Methods 4th edition (World Health Oraganization, 1997) There were 2 parts of the survey:

1. Oral Examination by dentist with Oral examination set according to WHO recommendation

2. Interview based on important factors for each age group were used to interview the sample. Data collected from the interview through face-to-face interview for each age groups. General data was recorded including age, gender, religion, income, occupation and education. The interview included data about systemic disease related to oral health, oral care behavior, smoking and betel nut chewing behavior, utilization of service, perception of knowledge and self-evaluation of oral health. However, age group 80-89 years old do not have interview part.

Standardization of examiners and interviewers was calibrated to test reliability of the data collection.

The survey team included

- Dentist from Provincial Health offices, hospitals, health centers of department of health, or from universities that register for survey program and pass the selection from bureau of dental health. Oral examination was performed by dentists who passed the standardization process and standard kappa value.
- Note taker: are academician from dental health bureau or trained personals who experience in national oral health survey
- Interviewers: are academician or person in selected province who passed standardization and trained for interview from survey team of dental health bureau
- Consultants : Dentists of dental health bureau who used to be examiners in national oral health survey

7. Measurements of study variables

7.1 Independent variables

7.1.1 Socioeconomic Status

Socioeconomic status was determined based on available data in the survey as education level, average income per month and occupational groups as mentioned in operational definition.

Education

Education in the survey is available in the form of highest education level or the level that was currently attended at the time of survey: “Never attend school”, “Primary school” , “Middle School”, “High school”, “High Vocational Certificate”, “Bachelor degree”, and “Higher than bachelor degree”

In finding models using logistic regression analysis, education was categorized into 2 categories which are Primary or lower education complete (includes : “Never attend school”, “Primary school” ,and “Middle School”) and At least secondary education complete (includes “High school”, “High Vocational Certificate”, “Bachelor degree”, and “Higher than bachelor degree”)

The education levels were transfer in to average years of schooling using Thailand household data in 2000 from conducted by Thailand National Statistical Office (NSO) as a reference. The data was extracted from IPUMS international

(Minnesota Population Center). The average years was calculated by using cross tabulations between highest education attainment and years of schooling based on gender and age. However, there were some inconsistence in the distribution of the data on age group 35-39 years old and 80 years old and above. The average years of schooling for the group turned out to be the same number in every educational level. So, years of schooling used in 80 and above age group was assumed to be the same as 60-74 age group. For age group 35-44, average years of schooling from age 35-39 was used.

Income

Income in the TNOHS defined by average income per month which classified in range as "No income", "1-5,000 baht","5,001-15,000 baht", "15,001-30,000 baht", "30,001-50,000 baht", "50,001 baht or more" in the survey. The average value of each groups was calculated to use in the study to make income as continuous variable.

Income was also classified into low income group ("No income", "1-5,000 baht","5,001-15,000 baht"), and high income group ("15,001-30,000 baht", "30,001-50,000 baht", "50,001 baht or more").

Occupation

In the survey, occupation was categorized in the survey as "Personal business as employer", "Personal business without employee", "Unpaid family worker", "Employee/Government worker", "Wage-earner", "Agriculture", "Housekeeper without income", "Associates of network/ clubs", "Study", "Elderly with income", "Finding a job", and "other". Even there is International Standard Classification of Occupations (ISCO-08) by International Labour Organization to classify occupation. Interviewing form for occupation is not specific in detail of type of work or what position in the work that person was in. So, this study tried to categorize some similar groups of occupation according to the availability of the survey and number of cases suitable for analysis in to 5 categories:

1 "Personal Business" (include "Personal business as employer", "personal business without employee" and "unpaid family business worker")

2 "Wage-earner/freelance"

3 "Agriculture"

4 “Housekeeper”

5 “Other” (including “Employee/Government worker”, “Associates of network/ clubs”, “Elderly with income”, “Study” and “Finding a job”

7.1.2 Oral health behaviors

Frequency of tooth brushing

From the question “How do you clean your oral cavity regularly? (Choose only 1 choice) And what time of the day? (Can choose more than 1 choice)”. Frequency of tooth brushing is for answering “Use tooth brush” and times of brushing per day is counted from choice “After wake up”, “After breakfast”, “After Lunch”, “After dinner” and “Before bed”.

Frequency of tooth brush was categorized in to dichotomous variable which are brushing 2 times per day (answering 2 or more times of brushing per day) and less than 2 times per day (answering once per day or do not use tooth brush).

Additional cleaning tools use determined by the question “In case of ‘Natural teeth’ and ‘using tooth brush’, do you use any kind of additional cleaning tools other than toothbrush?” Answering dental floss or interdental brush used considered as additional cleaning tools use. Answering no or other tools was grouped as no use of additional cleaning tools.

Use of fluoride toothpaste: categorized from “In case of ‘Natural teeth’, what brand of toothpaste do you use (1 brand that using most often)”. Then brand with fluoride and non-fluoride was categorized from information from Dental Health Bureau, Ministry of Public Health of Thailand.

Tobacco use is determine by smoking status. “From question Do you smoke?”, answering “No” was considered as non-smoker, “Use to” and “Yes” as smoker.

7.1.3 Access to dental service

Frequency of dental visit

From question “In the past year, did you go to see dentist or oral health professional?” Answering “Yes” was categorized into dental visit once a year or more. While answering “No” was categorized as dental visit less than once a year.

Place for dental service use categorized into public provider, private provider. From question “In case of “Went to see dentist in the past year”, Where did you go to see dentist?”, Public provider include “Dental mobile unit with dental personnel from government agency”, “PCU/Primary health care”, “Local hospital” and “Provincial hospital”. Private provider is “private clinic/private hospital”. People who answering both public and private provider is categorized into private provider

Health Insurance coverage refers to any health insurance or coverage that people have. From question “In present, do you have any kind of insurance in health care?”, types of coverage are categorized into Civil Servant Medical Benefits Scheme (CSMBS), Social Security Scheme (SSS) /Worker men Compensation Fund (WCF) and Universal Coverage(UC). People who answer private health insurance and Company welfare are excluded from the analysis since there are few number of cases.

7.2 Dependent Variables

Dental caries

Usually, dental caries status was determined by DMFT index for every age group. DMFT is a standard index to evaluate permanent teeth status that is decayed (D), missing due to caries (M) and filled (F). However, when looking at data and distribution the number of missing teeth due to caries turn to be 0 in almost every age group. The report of the survey uses missing due to caries and due to other reason to calculate “M”. It could be preventing from recall bias since people who loss many teeth could not remember reason of removing their every teeth. So, the outcome of dental caries in this study use number of teeth with active and untreated caries (DT). It is able to indicate only prevalence of dental caries, but not caries experience. According to distribution, the number of dental caries was categorized into ‘no dental caries’ and ‘1 or more dental caries’

Periodontal status

According to WHO method, periodontal status for age group 35-44 years and

60-74 and 80 years old above should be measured using Community Periodontal Index (CPI). Each scores represent different periodontal status:

Score 0: health periodontal conditions

Score 1: gingival bleedings

Score 2: calculus

Score 3: shallow periodontal pockets (4 to 5 millimeters)

Score 4: deep periodontal pockets (6 millimeters or more)

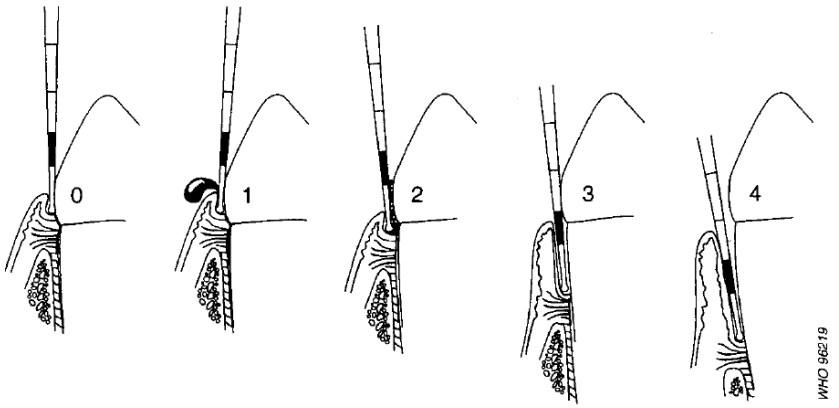


Figure 6 Example of coding according to CPI index according to World Health Organization: Oral health surveys: basic methods. 4th edition. Geneva: WHO; 1997.

The TNOHS had additional score 5 for the presence of calculus with bleeding. This study combined the CPI score 5 into score 2 as they are calculus present following WHO guideline.

The outcome for periodontal status is divided in to dichotomous variable as CPI score equal or more than 3 (score 3, 4) or less than 3 (score 2, 1, 0). Person with CPI score 3 which represent periodontal pocket 4-5 millimeter indicating progress of periodontal disease (severe inflammation of the gum and supporting structure of the tooth) and score 4 represent severe periodontitis which prone to have poor prognosis and result in tooth loss.

Tooth loss

In this study tooth loss was presenting in number of missing teeth which includes missing teeth due to any reason. From frequency distribution of all age for

missing teeth, the cut point was set at 5 missing teeth. So, in the analysis, number of missing teeth was categorized into ‘less than 5’ and ‘5 or more’

There are some other dependent variable that could indicate tooth loss, so some additional dependent variables were also analyzed in this study.

Posterior occluding pairs (POP)

Posterior occluding pairs is related to quality of life and chewing ability. Posterior occluding pairs refers to number of pairs of upper and lower back teeth that touch or bite. This study use cut point at 4 and divided into ‘At least 4 pairs and less than 4 pairs’.

Missing front teeth

Missing front teeth relates to personalities and esthetics. It refers to number of upper and lower front teeth that has been removed. The analysis divided number of missing front teeth into ‘No missing front teeth’ and ‘1 or more’.

DMFT

DMFT is used to determine the overall oral health of the population. This index had been recommended by the WHO to facilitate comparability over different studies. DMFT composed of ‘D’ for decayed tooth, ‘M’ for missing tooth and ‘F’ for number of filled teeth. Total number of D, M and F add up to be DMFT score. This study presented as ‘DMFT less than 10’ or ‘DMFT 10 or more’

8. Statistical Analysis

Data was analyzed using SPSS Software version 22. Descriptive analysis was presented in frequency, percentage, for categorical variables and presented in mean and standard deviation for continuous variable.

Bivariate analysis was perform using binary logistic regression to determine relationship of independent variables and dependent variables without controlling for other variables. Next, multivariate regression analysis was performed. Each group of independent variables were put together in their own models to see the change of the effect if controlled for the same variables in those groups. Then, all independent variables were put together in one models to see changes in significance and the coefficient.

Then further analysis was performed to find association between SES variables and oral health outcomes with and without controlling for groups of behavior and access variables. The interaction effect of some SES were combined and tested for the effect.

Since the data from TNOHS was divided into 3 age groups. The analysis was performed separately for each age group. For age group 80-89 years old, the survey only have data for oral health outcome and some independent variable, but no interview information. The analysis for some model was missing in this age group.

Multicollinearity was tested and found that education and income show some correlation with insurance and gender show correlation with smoking.

9. Ethical considerations

The research proposal was reviewed and approved by Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (COA No.095/2018). All data collected from each individual will be kept private and confidential.

10. Budget

List	**Budget (Baht)**
Transportation	5,000
Photocopies and binding	1000
Office equipment	1,000
Publication	3,000
Total	10,000

11. Administration and time schedule

Schedule	Time															
	2017				2018											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Literature Review																
Proposal Development																
Thesis Proposal Exam																
Ethical Approval																
Data Collection																
Data Analysis																
Report Writing																
Thesis Exam																
Publication																

CHAPTER IV

1. Descriptive Analysis

Distributions of independent and dependent variables included in the study is shown in table 3. Independent variables included Socioeconomic Status (SES), personal background, behavioral and access variables. There were 3,186 Thai population included in the study consisting of 1,518 Thai adult population of age 35-44 years old, 1,264 of elderly age 60-74 years old and 404 of 80-89 years old. The 3 age groups were presented separately. Some variables for the oldest group were not available from the 7th Thailand National Oral Health Survey (TNOHS), which presented as N/A in the table.

SES variables shows different distributions among 3 age groups. Most population in age group 35-44 and 60-74 years old were in low income categories. There were more percentage of the younger age group in high income category (18.1%), but it dropped to 8.1% for the older age group. The percentage with secondary school complete drops from 38.9% among 35-44 years old to 4.0% among 80-89 years old group. This could be because younger generation people access to education more than previous generation. Occupational group show some difference between the 3 age groups. There are about the same percentage of the population in the first two age groups who work in agriculture, which is the highest percentage among all population. The 'others' occupational group seems to rise from 23.6% to 26.6% to 89.9%. This is due to the 'others' occupational group included being elderly and retired, so most of 80 years old are just being elderly and no not work.

For background variables, the proportion of female is higher than male in all age groups. However, the proportion of female do not rise from youngest to the oldest age group as expected. This is because of the methodology in the national survey purposively selected number of sample from both genders equally. So, the distribution is not like in normal population that female would occupied more proportion in the population than male in old age groups due to longer life expectancy.

For marital status, age group 60-74 years old show higher percentage of being previously married than the younger group as people might became widowed from divorce and from death of their partners when they got older. On the other hand, being

single appears more in the youngest age group due to the changing of social value. People tend to get married at older age than previous generation and some people even prefer to be single. However, percentage of married population are similar in both age groups.

The distributions of area and region of residence are presented according to methodology of the 7th TNOHS. The samples were drawn with ratio of urban (other than Bangkok) and rural as 1:2 from distribution of the population to represent the population in those provinces and regions. Therefore, percentage of sample in rural and other urban area are quite similar in all age groups. The highest percentage are from rural area, follow by other urban area. Bangkok show lowest percentage of sample of less than 10% in all ages. Distribution for regions in the 2 elderly groups are quite similar in all regions other than Bangkok. For diabetes status, about 17.5% of older population present diabetes, which is much higher than the youngest group that shows only 3.5%. Normally, diabetes are more prevalent in older age.

For behavior variables, age group 35-44 years old show more percentage of brushing more than 2 times a day than the older group, which present only 72.5%. This might be because of younger people are more educated and to better routine oral health care. Fluoride toothpaste use do not show big difference between the two groups. Since toothpaste are mostly based on preference of individuals and also the availability of the products. Only about 10.7% of 35-44 population use additional cleaning tools in addition to tooth brush, and the percentage drops to 3.1% in older age group. It implies that normal population do not use additional cleaning tools, which might due to no promoting of using them, unlike tooth brushing.

About 27.8% of younger population are smokers which involved currently smokers or former smokers. It shows close percentage with the older age group. More than 70% of both age groups are non-smokers, but there are slightly less percent in younger generation.

People at age 35-44 years old go to dental visits at least once a year with 37.7% of all population. The older age group show less percent but not much different. This is

surprised that more than half of population do not go to dental visit in the past year in adult and elderly.

For place of dental service, more than ¾ of population in both age groups goes to public provider. May be because of the lower price and more coverage for health coverage in public providers. It is related to health insurance coverage that Universal Health Coverage (UC) show more proportion of population than other health insurance coverage. Since UC is the main social health insurance program in Thailand covering approximately 75% of the population.

Among all oral health outcomes, trends of having oral disease or more severe disease are increasing through age groups. The oldest age group seems to show more tooth loss than the younger age groups from distribution of missing teeth, posterior occluding pairs, missing front teeth. About 92.6% of oldest population show more than 5 missing teeth, 84.4% have less than 4 posterior occluding pairs and 89.4% have more than 1 missing front teeth. However, for dental caries and periodontal status, the middle age group seems to show highest percentage, not the oldest group. This is because of the oldest group seems to lose a lot of teeth that it could not count as having dental caries or measuring the CPI score to show periodontal status. Nevertheless, the Decayed, Missing and Filled Teeth (DMFT) index could show us the overall oral disease experience, which show that the older we get the more we experience oral diseases including tooth decay, fillings and tooth loss.

Table 3 Frequency distribution and percentage of variables for all age groups

Age groups (years old)	**35-44**		**60-74**		**80-89**	
	n=1518	**%**	**n=1264**	**%**	**n=404**	**%**
SES Variables						
Income						
Low income [a]	1242	81.9	1161	91.9	N/A	N/A
High income [a]	275	18.1	103	8.1	N/A	N/A
Education						
Primary complete or less	928	61.1	1150	91.0	388	96.0
At least secondary complete	590	38.9	114	9.0	16	4.0
Occupation						
Business	191	12.6	119	9.4	4	1.0
Wage-earner/freelance	310	20.4	130	10.3	3	0.7
Agriculture	568	37.4	468	37.0	15	3.7
Housekeeper	90	5.9	211	16.7	19	4.7
Others [b]	359	23.6	336	26.6	363	89.9

Age groups (years old)	35-44		60-74		80-89	
	n=1518	%	n=1264	%	n=404	%
Background Variable						
Age [c] (Mean ± SD)	39.58 ± 2.78		66.01 ± 4.13		83.03 ± 2.49	
Gender						
Male	726	47.8	619	49.0	179	44.3
Female	792	52.2	645	51.0	225	55.7
Marital Status						
Previously married	83	5.5	284	22.5	N/A	N/A
Married	1215	80.0	919	72.8	N/A	N/A
Single	220	14.5	59	4.7	N/A	N/A
Area of residence						
Bangkok	134	8.8	120	9.5	30	7.4
Other urban	465	30.6	381	30.1	124	30.7
Rural	919	60.5	763	60.4	250	61.9
Region						
Central	317	20.9	302	23.9	89	22.0
North	257	16.9	253	20.0	98	24.3
Northeast	554	36.5	295	23.3	93	23.0
South	256	16.9	294	23.3	94	23.3
Bangkok	134	8.8	120	9.5	30	7.4
Having diabetes mellitus						
Yes	49	3.5	218	17.6	N/A	N/A
No	1370	96.5	1022	82.4	N/A	N/A
Behavior						
Frequency of tooth brushing						
less than 2 times/day	127	8.4	347	27.5	N/A	N/A
at least 2 times/day	1391	91.6	917	72.5	N/A	N/A
Use of fluoride tooth paste						
No	197	13.0	204	17.9	N/A	N/A
Yes	1317	87.0	938	82.1	N/A	N/A
Use additional cleaning tools						
No	1355	89.3	1225	96.9	N/A	N/A
Yes	163	10.7	39	3.1	N/A	N/A
Smoking status						
Smoker	422	27.8	366	29.0	N/A	N/A
Non-smoker	1096	72.2	898	71.0	N/A	N/A
Access to dental service						
Frequency of dental visit						
less than once a year	945	62.3	835	66.1	N/A	N/A
at least once a year	573	37.7	429	33.9	N/A	N/A
Place for dental service						
Public provider	443	76.0	347	81.5	N/A	N/A
Private provider	140	24.0	79	18.5	N/A	N/A
Health Insurance coverage						
CSMBS	206	13.8	199	15.9	N/A	N/A
SSS	226	15.2	12	1.0	N/A	N/A
UC	1058	71.0	1039	83.1	N/A	N/A
Oral health outcomes						
Dental caries						
0	984	64.8	653	51.7	259	64.1
≥ 1	534	35.2	611	48.3	145	35.9

Age groups (years old)	35-44		60-74		80-89	
	n=1518	%	n=1264	%	n=404	%
Periodontal status						
CPI< 3	1280	84.4	702	63.4	153	69.5
CPI ≥ 3	237	15.6	405	36.6	67	30.5
Missing teeth						
<5	1102	72.6	280	22.2	30	7.4
≥5	416	27.4	984	77.8	374	92.6
POP						
≥4	1423	93.7	547	43.3	63	15.6
<4	95	6.3	717	56.7	341	84.4
Missing front teeth						
0	1325	87.3	513	40.6	43	10.6
≥1	193	12.7	751	59.4	361	89.4
DMFT						
<10	1205	79.4	462	36.6	51	12.6
≥10	313	20.6	802	63.4	353	87.4

N/A: no data available due to no interview part for age group 80-89 years old in the TNOHS

[a] Low income= average income from 0 – 15,000 Baht/month, High income= average income from 15,001- above 50,000 Baht/month

[b] Others in occupational groups includes employee/government worker, associates of network/ clubs, elderly with income, studying and finding a job

[c] Age is presented in Mean and Standard Deviation (S.D.)

Next section of analysis are the binary logistic regression models including bivariate and multivariate analysis, which are presented in order by age groups. All the variables in different categories was analyzed separately first, then controlling for other variables in the same categories in a model and finally putting all the variables together in one model.

According to the conceptual framework, SES variables including income, education and occupation is the main outcome of the study. Personal background also consider as determinants and confounding factors for outcomes, so they need to include in the analysis. Behaviors and tobacco use play important roles in oral health outcomes, so the analysis could not be good without these variables. Access to dental service also relate to oral health outcomes in part of availability and coverage.

2. **Binary logistic Regression Analysis**

In this part of analysis, each independent variables were comparing by before and after they were put in models with other controlling variable to see how odds ratio(OR) and significant level change. Model 0 in each table present bivariate analysis with only each independent variable separately, in order to compare with other models. The measurements and cut point of all variables remain the same in age groups.

2.1 Age group 35-44 years old

This youngest age group shows more significant coefficient among the 3 age groups. All significant variables are shown in different outcomes. For SES variables, education and occupational group show significance in some almost all of the outcomes, while income show only in some outcomes. Age, gender and region of residence show significant coefficient more than other variable in background group. Teeth cleaning and smoking status show their significance in some particular outcomes. Among all outcomes, DMFT seems to show different direction for many independent variables.

Dental caries

Table 4 shows result from binary logistic regression analysis for dental caries age 35-44 years old, comparing between bivariate analysis for one variable and when putting in models with adjusted other variables. In model 1, all SES variables show significant effects on having at least 1 dental caries. Those who have lower education and lower income show more chance of having dental caries comparing to those in higher levels. Comparing with reference category (other occupational groups), housekeeper show highest odds ratio of having dental caries, following by wage-earner, business and agriculture. After adjusted for SES variables, only education remains its significance.

For background variables, only northeast region show significantly less OR than Bangkok. The odds ratio decreases but the significant level increase from * to *** after adjusted. Age, gender, marital status, area of residence and diabetes show insignificant result on dental caries.

All oral health behaviors alone show significant result. Brushing less than 2 times a day shows significantly higher odds of having cavities than those who brush 2 times a day. No use of fluoride toothpaste and additional cleaning tools in cleaning the teeth show significantly higher chance of dental caries before and after adjusted for other behavior variables. Smoking do not show difference for dental caries. After adjusted in model 3, only use of fluoride which increases the significant level and additional cleaning tools remain significant with slightly decreases in magnitude.

For access to dental services, dental visit and place for dental service do not show any significant results. People with Civil Servant Medical Benefit Scheme (CSMBS) show less OR than those with UC. But, after adjusted for other access variables in model 4, it also become insignificant.

After putting all variables together in model 5, only some variables remain the significance. Education increases the magnitude but decreases in significant level. While occupation show big drops in the OR and make business and housekeepers become to show better oral health, which may due to impact of other variables. Region of residence also show decline in OR for northeast and southern region. Place for dental service become significance after adjusted in model 5, with slightly decrease in magnitude. However, income, oral health behavior and having CSMBS as insurance become in significant in final model.

Table 4 Binary logistic regression models for having 1 or more dental caries in 35-44 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.375	*	1.135								1.345	
High income(ref)												
Education												
Primary complete or less	1.745	***	1.739	***							1.970	**
At least secondary complete (ref)												
Occupation												
Business	1.665	**	1.273								0.967	
Wage-earner /freelance	1.844	***	1.290								1.282	
Agriculture	1.227		0.822								0.624	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Housekeeper	1.927	**	1.294								0.876	
Others (ref)												
Personal Background												
Age	1.019				1.021						1.060	
Gender												
Male	0.866				0.887						0.610	
Female												
Marital Status												
Previously married	1.225				0.828						1.764	
Married	1.130				0.894						0.832	
Single (ref)												
Area of residence												
Bangkok	1.024				1.239						0.545	
Other urban	0.880				1.042						0.926	
Rural (ref)												
Region of residence												
Central	1.206				0.909						N/C	
North	0.951				0.739						0.615	
Northeast	0.674	*			0.531	***					0.438	*
South	1.286				N/C						0.458	**
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.665				0.685						1.082	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.507	*					1.385				1.380	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.403	*					1.388	*			1.157	
Yes(ref)												
Use of additional cleaning tools												
No	2.626	***					2.553	***			2.866	***
Yes(ref)												
Smoking status												
Smoker	1.146						0.938				1.710	
Non-Smoker (ref)												
Access												
Frequency of dental visit												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
less than once a year	1.098								0.963		1.170	
at least once a year (ref)												
Place for dental service												
Public provider	0.774								0.682		0.521	**
Private provider(ref)												
Health Insurance coverage												
CSMBS	0.622	**							0.533	**	1.016	
SSS	0.763								0.583	*	0.709	
UC(ref)												
			1517		1419		1514		570		543	
-2 Log likelihood			1929.337		1810.297		1931.521		715.642		625.777	
Cox & Snell R Square			0.025		0.018		0.021		0.020		0.102	
Nagelkerke R Square			0.035		0.024		0.029		0.027		0.142	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Model 5: adjusted for personal background, behavior and access

Periodontal status

Periodontal status presented by Community Periodontal Index (CPI) score equal or more than 3 which indicate more severe periodontal status and in risk of having periodontitis. From table 5, better income and education show higher OR than lower ones but with insignificance in all models. Occupation itself show insignificant result. But, after adjusted for all SES variables, 3 categories in occupational groups become significant but the odd ratios come closer to 1 indicating not much different between the comparing groups.

Only gender, marital status, and diabetes condition show significant results for bivariate analysis in personal background variables. Males have higher chance of having more severe periodontal status than females. When it is controlled for other variables in model 2, the significance disappear and OR reduced. People who are previously married show less OR of having severe periodontal status for 0.287 times comparing to single people. The OR slightly increases when controlling for other personal background variables. Diabetes status show significant results. People having diabetes show 2.233 times higher OR of having severe periodontal status than those who do not have. Moreover, the OR increases and remains significant after controlling for other variables.

Oral health behaviors unexpectedly show no significant effect in all model. However, Smokers show 1.502 times higher OR than non-smoker. The OR decreases a little and become insignificant after controlling for other variables in model 3.

Within insurance variables in model 4, CSMBS show significant lower risk for severe periodontal status than UC, but become insignificant when controlling for other access variables.

In model 5 with all variables together in one model, variables that remain obvious results are gender, which increases the magnitude from bivariate and strongly significant, while northern region and going to dental service less than once become significance with odds ratio of 0.254 and 2.534 accordingly. Occupation and age also remain the significance but the OR are close to 1.

Table 5 Binary logistic regression models for Community Periodontal Index (CPI) score 3 or more in 35-44 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.236		1.136								1.082	
High income(ref)												
Education												
Primary complete or less	1.329		1.308								1.461	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
At least secondary complete (ref)												
Occupation												
Business	1.269		1.103								1.038	
Wage-earner /freelance	1.271		1.047								0.944	
Agriculture	1.187		0.961								1.058	**
Housekeeper	1.162		0.936								0.924	*
Others (ref)												
Personal Background												
Age	1.039				1.056	*					1.061	***
Gender												
Male	1.427	*			1.322						1.568	***
Female												
Marital Status												
Previously married	0.287	*			0.301	*					0.333	
Married	0.840				0.832						0.673	
Single (ref)												
Area of residence												
Bangkok	0.959				0.600						0.624	
Other urban	1.265				1.234						1.066	
Rural (ref)												
Region of residence												
Central	0.635				0.371	***					N/C	
North	1.216				0.723						0.254	**
Northeast	1.221				0.719						0.476	
South	1.543				N/C						0.616	
Bangkok (ref)												
Having diabetes mellitus												
Yes	2.233	*			2.406	**					1.749	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.215						1.122				1.785	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.144						1.149				0.681	
Yes(ref)												
Use of additional cleaning tools												
No	1.365						1.276				1.100	
Yes(ref)												
Smoking status												
Smoker	1.502	**					1.465	*			0.836	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	1.151								2.194		2.534	
at least once a year (ref)												
Place for dental service												
Public provider	0.681								0.775		0.688	
Private provider(ref)												
Health Insurance coverage												
CSMBS	0.546	*							0.645		0.751	
SSS	0.936								1.264		1.578	
UC(ref)												
n			1516		1418		1513		570		543	
-2 Log likelihood			1309.878		1192.081		1304.741		467.752		424.488	
Cox & Snell R Square			0.003		0.027		0.006		0.009		0.047	
Nagelkerke R Square			0.005		0.046		0.010		0.017		0.083	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Missing teeth

Missing teeth is one outcome that indicate tooth loss. Table 6 shows odd ratios of having 5 or more missing teeth. Income and education do not show significance with this outcome before and after controlling for SES variable. However, people in agricultural groups show significantly less OR of having missing teeth more than 5 comparing to others category, while housekeeper show more OR when do not control for other variables. In model 1, business group become to show very significant OR of 0.333, while agriculture slightly decrease the magnitude.

For personal background, model 0 and model 2 do not change much. Age show significant but very little effect for this outcome. Male significantly have less OR of missing teeth than female in both models. Northeast also show significantly less OR than Bangkok and all other regions, but northern become significant with OR 0.661 in model 2.

Similar to periodontal status, behavior surprisingly show no significant result for missing teeth before and after adjusted in model 3. However, going to dentist less than once a year and use public provider show significantly less OR of having 5 or more missing teeth. After controlling for access variable in model 4, frequency of dental visit become insignificant while using public provider slightly decrease the effect with stronger significant level.

When putting all variables together, only public provider remains significant while those who are previously married and living in southern appear to be significant with OR 2.788 and 0.588 respectively. Occupation, other personal background and access variables become insignificance.

Table 6 Binary logistic regression models for missing 5 or more teeth in 35-44 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	0.862		1.202								1.095	
High income(ref)												
Education												
Primary complete or less	1.024		0.871								0.933	
At least secondary complete (ref)												
Occupation												
Business	1.207		1.124								0.874	
Wage-earner /freelance	1.067		0.987								0.821	
Agriculture	0.650	**	0.597	**							0.691	
Housekeeper	1.635	*	1.516								1.046	
Others (ref)												
Personal Background												
Age	1.073	***			1.084	***					1.042	
Gender												
Male	0.688	***			0.654	***					0.653	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Female												
Marital Status												
Previously married	0.998				0.943						2.788	*
Married	0.786				0.787						1.085	
Single (ref)												
Area of residence												
Bangkok	1.439				1.026						1.297	
Other urban	1.255				1.244						0.927	
Rural (ref)												
Region of residence												
Central	1.498				1.380						N/C	
North	0.721				0.661	*					1.380	
Northeast	0.376	***			0.349	***					1.249	
South	1.017				N/C						0.558	*
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.757				0.729						0.719	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	0.768						0.796				0.803	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.939						0.947				0.782	
Yes(ref)												
Use of additional cleaning tools												
No	0.713						0.736				0.945	
Yes(ref)												
Smoking status												
Smoker	0.880						0.906				1.167	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.568	***							0.717		0.934	
at least once a year (ref)												
Place for dental service												
Public provider	0.610	*							0.585	**	0.604	*
Private provider(ref)												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Health Insurance coverage												
CSMBS	1.048								0.823		0.702	
SSS	1.079								0.991		0.901	
UC(ref)												
n			1517		1419		1514		570		543	
-2 Log likelihood			1754.555		1568.977		1774.902		724.902		658.199	
Cox & Snell R Square			0.017		0.068		0.004		0.013		0.061	
Nagelkerke R Square			0.024		0.098		0.005		0.018		0.085	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Decayed, Missing and Filled Teeth (DMFT)

Total number of tooth decay, missing tooth and filled tooth added up to DMFT. People with higher DMFT experience more oral disease which result in dental caries, filling or extraction. This study use cut point of more than 10 DMFT. In table 7, the analysis show significant result but in the unexpected way. In model 0, lower income and lower education people show lower OR than those with higher income and education. Wage-earner and agriculture group also show significantly less OR than reference group, while business and housekeepers show almost no differences. The odds ratio of both occupational groups increase when putting all 3 variables in model 1, but the significance in income and education disappear.

Similar to previous oral health outcomes, male also show significantly less OR than female before and after adjusted in model 2. Previously married people show significantly less OR than single only in model 2, while married people also show similar result in both models. Unexpectedly, Living in Bangkok and other urban significantly have more chance to have higher DMFT than those in rural area. But, other

urban increases magnitude while Bangkok become insignificant after putting in model 2. Living in north and northeast region show less OR than Bangkok.

For behavior and smoking status, not using extra tools such as dental floss and interdental brush and being smokers show less OR of having higher DMFT with strong significance before and after adjusted for other behavior variable in model 3. Going to dental service less than once also show less OR than the reference group. People with CSMBS significantly have higher DMFT than those with UC for 2.243 times. After putting in model 4, only CSMBS stay significant with reduced magnitude.

This outcome seems to show unexpected result in many variables. However, after put all variables in model 5, this outcome show only gender and region of residence with significance. Other variables that show significant in previous models become insignificant in this model.

Table 7 Binary logistic regression models for DMFT more than 10 in 35-44 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	0.629	**	0.792								0.904	
High income(ref)												
Education												
Primary complete or less	0.657	***	0.908								0.993	
At least secondary complete (ref)												
Occupation												
Business	0.981		1.051								1.146	
Wage-earner /freelance	0.576	**	0.644	*							1.006	
Agriculture	0.395	***	0.448	***							1.069	
Housekeeper	1.038		1.194								1.094	
Others (ref)												
Personal Background												
Age	1.031				1.048						1.010	
Gender												
Male	0.518	***			0.446	***					0.433	**
Female												
Marital Status												
Previously married	0.602				0.448	*					0.696	
Married	0.668	*			0.604	**					0.627	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Single (ref)												
Area of residence												
Bangkok	1.933	**			1.156						1.350	
Other urban	1.511	**			1.550	**					1.252	
Rural (ref)												
Region of residence												
Central	1.189				1.164						N/C	
North	0.489	**			0.440	***					1.048	
Northeast	0.268	***			0.256	***					0.837	
South	0.953				N/C						0.423	**
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.621				0.564						0.637	
No (ref)											1.010	
Behavior												
Frequency of tooth brushing												
less than 2 times/day	0.840						0.978				1.915	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.906						0.905				0.826	
Yes(ref)												
Use of additional cleaning tools												
No	0.318	***					0.338	***			0.699	
Yes(ref)												
Smoking status												
Smoker	0.608	***					0.663	**			0.765	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.364	***							0.875		1.055	
at least once a year (ref)												
Place for dental service												
Public provider	0.709								0.693		0.699	
Private provider(ref)												
Health Insurance coverage												
CSMBS	2.243	***							1.982	**	1.967	
SSS	1.201								1.053		1.058	
UC(ref)												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
n				1517		1419		1514		570	543	
-2 Log likelihood				1,497.357		1,324.393		1,495.428		694.938	607.947	
Cox & Snell R Square				0.029		0.089		0.031		0.025	0.111	
Nagelkerke R Square				0.045		0.138		0.048		0.035	0.156	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Posterior occluding pairs (POP)

Table 8 show odds ratio for posterior occluding pairs less than 4, which also indicating tooth loss. People with POP less than 4 could have less chewing ability. For lower income population, it show significantly more OR than higher income group for about 2 times. People who completed primary education also show more OR than those who complete at least secondary education. After adjusted for all SES variables in model 1, their odds ratio slightly decrease, but they are still significant. Doing business, wage-earner or freelance and housekeeper show significantly higher OR than the reference group. However, the OR decrease and become insignificant after adjusted.

Age is significantly related to OR of number of POP, implying that increasing in age could increase chance of losing pairs of functional teeth. Among regions, only northeast show significance with OR of 0.255 comparing to Bangkok. In model 2, northeast decrease the magnitude a little while central become significantly higher OR than Bangkok. Other background variables do not show obvious result.

Behavior variables do not show any significant result for this outcome. While access show only one variable with significant result. Among access variables, only people with CSMBS show significantly less OR than UC, but it become insignificant after adjusted with other variables.

For model 5, only age remain the significance, but southern region become significance with OR of 0.188.

Table 8 Binary logistic regression models for posterior occluding pairs (POP) less than 4 in 35-44 years old age group

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	2.483	*	2.173	*							4.218	
High income(ref)												
Education												
Primary complete or less	1.954	**	1.788	*							0.967	
At least secondary complete (ref)												
Occupation												
Business	2.386	*	1.706								0.495	
Wage-earner /freelance	2.012	*	1.146								0.902	
Agriculture	1.145		0.668								0.328	
Housekeeper	2.867	*	1.636								1.185	
Others (ref)												
Personal Background												
Age	1.176	***			1.208	***					1.263	**
Gender												
Male	0.896				0.832						0.600	
Female												
Marital Status												
Previously married	1.147				1.108						3.337	
Married	0.968				0.914						0.620	
Single (ref)												
Area of residence												
Bangkok	1.049				1.072						0.278	
Other urban	0.899				0.840						0.372	
Rural (ref)												
Region of residence												
Central	2.063				2.223	*						
North	1.109				1.055						1.465	
Northeast	0.255	**			0.235	***					0.557	
South	0.926										0.118	**
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.319				0.298						N/C	
No (ref)												
Behavior												
Frequency of tooth brushing												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
less than 2 times/day	1.313						1.223				1.966	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.868						0.863				0.452	
Yes(ref)												
Use of additional cleaning tools												
No	2.248						2.143				3.209	
Yes(ref)												
Smoking status												
Smoker	1.345						1.268				1.253	
Non-Smoker (ref)	1.313						1.223				1.966	
Access												
Frequency of dental visit												
less than once a year	0.947								2.218		5.936	
at least once a year (ref)												
Place for dental service												
Public provider	0.665								0.544		0.454	
Private provider(ref)												
Health Insurance coverage												
CSMBS	0.388	*							0.448		0.741	
SSS	0.725								0.611		0.634	
UC(ref)												
n			1517		1419		1514		570		543	
-2 Log likelihood			681.890		579.164		704.444		273.266		191.961	
Cox & Snell R Square			0.015		0.044		0.004		0.010		0.099	
Nagelkerke R Square			0.041		0.121		0.010		0.027		0.270	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Missing front teeth

For this outcome in table 9, only education show significant result among SES variables. Lower education people show higher odds than those with higher level with OR 1.438, but the significance disappear after adjusted with other variables in model 1.

For personal background variables, married people appears to show significantly less chance than single people only for multivariate analysis in model 2. Central region show higher OR than Bangkok but it become insignificant after controlling for other background. Age is significant but the OR is close to 1 that it might not tell the difference.

Similar to POP, behavior do not show any significant result for missing front teeth. Health insurance coverage somehow show some difference only after adjusted for all access variables in model 4. People with CSMBS and SSS show less OR compare to those with UC with OR 0.355 and 0.388. CSMBS and SSS are the only variables that show significance in model 5, with decline in magnitude.

Table 9 Binary logistic regression models for having 1 or more missing front teeth in 35-44 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.553		1.464								1.356	
High income(ref)												
Education												
Primary complete or less	1.438	*	1.362								0.969	
At least secondary complete (ref)												
Occupation												
Business	1.574		1.314								0.702	
Wage-earner /freelance	1.145		0.835								0.439	
Agriculture	1.226		0.912								0.500	
Housekeeper	1.826		1.339								0.935	
Others (ref)												
Personal Background												
Age	1.070	*			1.069	*					1.072	
Gender												
Male	0.969				0.957						1.293	
Female												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Marital Status												
Previously married	0.528				0.508						0.718	
Married	0.686				0.624	*					0.853	
Single (ref)												
Area of residence												
Bangkok	0.695				0.635						0.335	
Other urban	0.904				0.840						0.746	
Rural (ref)												
Region of residence												
Central	1.911	*			1.209						N/C	
North	1.767				1.195						0.751	
Northeast	0.923				0.666						1.031	
South	1.474				N/C						0.880	
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.972				0.966						1.082	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.404						1.394				2.314	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.101						1.089				0.820	
Yes(ref)												
Use of additional cleaning tools												
No	0.926						0.900				0.663	
Yes(ref)												
Smoking status												
Smoker	1.071						1.057				1.315	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.778								1.438		1.767	
at least once a year (ref)												
Place for dental service												
Public provider	0.743								0.569	*	0.603	
Private provider(ref)												
Health Insurance coverage												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
CSMBS	1.048								0.355	**	0.258	*
SSS	1.079								0.388	*	0.309	*
UC(ref)												
n			1517		1419		1514		570		543	
-2 Log likelihood			1,140.980		1,050.240		1,153.308		457.265		402.268	
Cox & Snell R Square			0.007		0.015		0.001		0.027		0.054	
Nagelkerke R Square			0.014		0.028		0.003		0.049		0.098	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Overall summary of bivariate relationship for age group 35-44 years old

This section is the summary of overall relationship from bivariate analysis of all 6 dependent variables. From table 10, income show higher OR in lower income group for dental caries and missing teeth. Education show strong significance in all outcomes except periodontal status and missing teeth. Occupational group show significant result for different groups on different outcomes. Age in general show almost no difference on the OR, while male show less OR than female except that of periodontal status. Marital status only show significance on periodontal status and DMFT. Area of residence almost show no significance except for DMFT with surprisingly higher OR for Bangkok and other urban than the rural. For region of residence, northeast show significantly less OR than Bangkok in almost all outcome. While having diabetes mellitus and smokers obviously shown more OR in having severe periodontal status. All behavior only show significance in the expected way for dental caries. However, DMFT unexpectedly shows different direction for behavior, smoking status and health insurance coverage. CSMBS show less OR than UC in many outcomes, while SSS show no significance.

Table 10 Overall bivariate analysis for independent variables, age group 35-44

Independent variables	Dental caries		Periodontal Status		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	1.375	*	1.236		0.862		0.629	**	2.483	*	1.553	
High income (Ref.)												
Education												
Primary complete or less	1.745	***	1.329		1.024		0.657	***	1.954	**	1.438	*
At least secondary complete (Ref.)												
Occupation												
Business	1.665	**	1.269		1.207		0.981		2.386	*	1.574	
Wage-earner/freelance	1.844	***	1.271		1.067		0.576	**	2.012	*	1.145	
Agriculture	1.227		1.187		0.650	**	0.395	***	1.145		1.226	
Housekeeper	1.927	**	1.162		1.635	*	1.038		2.867	*	1.826	
Others (Ref.)												
Age	1.019		1.039		1.073	***	1.031		1.176	***	1.070	*
Gender												
Male	0.866		1.427	*	0.688	***	0.518	***	0.896		0.969	
Female												
Marital Status												
Previously married	1.225		0.287	*	0.998		0.602		1.147		0.528	
Married	1.130		0.840		0.786		0.668	*	0.968		0.686	
Single (Ref.)												
Area of residence												
Bangkok	1.024		0.959		1.439		1.933	**	1.049		0.695	
Other urban	0.880		1.265		1.255		1.511	**	0.899		0.904	
Rural (Ref.)												
Region of residence												
Central	1.206		0.635		1.498		1.189		2.063		1.911	*
North	0.951		1.216		0.721		0.489	**	1.109		1.767	
Northeast	0.674		1.221		0.376	***	0.268	***	0.255	**	0.923	
South	1.286		1.543		1.017		0.953		0.926		1.474	
Bangkok (Ref.)												
Having diabetes mellitus												
Yes	0.665		2.233	*	0.757		0.621		0.319		0.972	
No (ref)												
Frequency of tooth brushing												
less than 2 times/day	1.507	*	1.215		0.768		0.840		1.313		1.404	
at least 2 times/day (Ref.)												
Use of fluoride tooth paste												
No	1.403	*	1.144		0.939		0.906		0.868		1.101	

Independent variables	Dental caries		Periodontal Status		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Yes(Ref.)												
Use of additional cleaning tools												
No	2.626	***	1.365		0.713		0.318	***	2.248		0.926	
Yes(Ref.)												
Smoking status												
Smoker	1.146		1.502	**	0.880		0.608	***	1.345		1.071	
Non-Smoker (Ref.)												
Frequency of dental visit												
less than once a year	1.098		1.151		0.568	***	0.364	***	0.947		0.778	
at least once a year (Ref.)												
Place for dental service												
Public provider	0.774		0.681		0.610	*	0.709		0.665		0.743	
Private provider(Ref.)												
Health Insurance coverage												
CSMBS	0.622	**	0.546	*	1.048		2.243	***	0.388	*	1.048	
SSS	0.763		0.936		1.079		1.201		0.725		1.079	
UC(Ref.)												

OR: odds ratio; Sig: significant level

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Overall multivariate models of dependent variables for age group 35-44 years old

Across all models, there are 57 coefficients estimated and comparing between bivariate and multivariate models. About 30 of them have a change in coefficient and become insignificant. While one of them decreases the significance level form *** to**. However, about 12 of all coefficients that are insignificant in bivariate models become significant in multivariate model.

From table 11 indicating all models after putting all independent variables in the one model. There are 16 coefficients estimated and comparing bivariate models and multivariate models. All income variables become insignificant, and almost all education except for that of dental caries which increase the coefficient to almost 2. Occupation also reduce the coefficient and left significance for only dental caries and periodontal status.

Age slightly increases its magnitude in some outcome, while some become insignificant. Male increases the coefficient and the significance for periodontal status, but decreases for DMFT and missing teeth. All marital status loss the significance but only missing teeth become significance. All region variable for every outcome decreases the magnitude, while some loss the significance also.

All behaviors and smoking status become insignificance. Frequency of dental visit obviously increase the coefficient with strong significance for periodontal status, but other outcome become insignificant.

Place for dental service decrease the magnitude for dental caries and missing teeth but become significance, while that of periodontal status slightly increases in magnitude. Health insurance coverage surprisingly loss the significance except missing front teeth which turn to show significant result.

Table 11 Overall Multivariate analysis of all independent variables in one model, age 35-44 years old

	Dental caries		**Periodontal**		**Missing teeth**		**DMFT**		**POP**		**Missing front teeth**	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	1.345		1.082		1.095		0.904		4.218		1.356	
High income (Ref.)												
Education												
Primary complete or less	1.970	**	1.461		0.933		0.993		0.967		0.969	
At least secondary complete (Ref.)												
Occupation												
Business	0.967		1.038		0.874		1.146		0.495		0.702	
Wage-earner/freelance	1.282		0.944		0.821		1.006		0.902		0.439	
Agriculture	0.624		1.058	**	0.691		1.069		0.328		0.500	
Housekeeper	0.876		0.924	*	1.046		1.094		1.185		0.935	
Others (Ref.)												
Age	1.060		1.061	***	1.042		1.010		1.263	**	1.072	
Gender												
Male	0.610		1.568	***	0.653		0.433	**	0.600		1.293	
Female												
Marital Status												
Previously married	1.764		0.333		2.788	*	0.696		3.337		0.718	
Married	0.832		0.673		1.085		0.627		0.620		0.853	
Single (Ref.)												

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Area of residence												
Bangkok	0.545		0.624		1.297		1.350		0.278		0.335	
Other urban	0.926		1.066		0.927		1.252		0.372		0.746	
Rural (Ref.)												
Region of residence												
Central	N/C		N/C		N/C		N/C		N/C		N/C	
North	0.615		0.254	**	1.380		1.048		1.465		0.751	
Northeast	0.438	*	0.476		1.249		0.837		0.557		1.031	
South	0.458	**	0.616		0.558	*	0.423	**	0.118	**	0.880	
Bangkok (Ref.)												
Having diabetes mellitus												
Yes	1.082		1.749		0.719		0.637		0.000	N/C	1.082	
No (ref)												
Frequency of tooth brushing												
less than 2 times/day	1.380		1.785		0.803		1.915		1.966		2.314	
at least 2 times/day (Ref.)												
Use of fluoride tooth paste												
No	1.157		0.681		0.782		0.826		0.452		0.820	
Yes(Ref.)												
Use of additional cleaning tools												
No	2.866		1.100		0.945		0.699		3.209		0.663	
Yes(Ref.)												
Smoking status												
Smoker	1.710		0.836		1.167		0.765		1.253		1.315	
Non-Smoker (Ref.)												
Frequency of dental visit												
less than once a year	1.170		2.534	***	0.934		1.055		5.936		1.767	
at least once a year (Ref.)												
Place for dental service												
Public provider	0.521	**	0.688	*	0.604	*	0.699		0.454		0.603	
Private provider												
Health Insurance coverage												
CSMBS	1.016		0.751		0.702		1.967		0.741		0.258	*
SSS	0.709		1.578		0.901		1.058		0.634		0.309	*
UC												

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
n	543		543		543		543		543		543	
-2 Log likelihood	625.777		424.488		658.199		607.947		191.961		402.268	
Cox & Snell R Square	0.102		0.047		0.061		0.111		0.099		0.054	
Nagelkerke R Square	0.142		0.083		0.085		0.156		0.270		0.098	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

2.2Age group 60-74 years old

The outcomes of this age group are different in some aspects comparing to 35-44 years old group. This age group show fewer significant coefficients in both bivariate and multivariate analysis. For SES variables, income, education and occupational group all show lower significance. Age show more significance in different outcomes, mostly for all involving tooth loss. Gender become in significant in all outcomes. Marital status show some significance result for married people, unlike the younger age which show more in previously married group. Area of residence also show more significance coefficient in more outcomes than the younger group which is significant only for DMFT. For behavior variables, brushing and cleaning are shown in different outcome different direction for dental caries and DMFT. Smoking also show significant in different outcome. Overall, younger age group show more coefficient effect in dental caries and periodontal status while this age group show more in tooth loss aspect.

Dental caries

Models analysis for dental caries is shown in table 12. From model 0, education itself show significant result that people with primary education have higher OR of having dental caries than those who finished secondary education for 1.611 times. Among occupational groups, only agricultural groups show significantly higher OR than the reference group. In model 1, education and occupational group are no longer significant and the OR decreases.

All personal background variables seems to have no significant result except for types of residence. People who live in other urban area show significantly less dental caries than those in rural for 0.708 times. When controlling for other variables in model 2, the significance remains and the magnitude increases.

In model 0, brushing alone show significant result that people who brush less than 2 times a day surprisingly show less dental caries than those who brush more than 2 time/day, unlike the obvious result for 35-44 years old. But, after controlling for all behavior variables in model 3, the result seems to have no significant difference. This result is not as expected and against the way it should be. It might be because frequency of brushing alone might not indicate the caries status. Diets, brushing technique, time of tooth brushing or other factors could also affect the outcomes.

Having Civil Servant Medical Benefit Scheme (CSMBS) as insurance show significantly lower OR than Universal Coverage (UC) for 0.621 times. However after controlling for other access variables, the OR decreases to 0.381 times and remains its significance. Social Security Scheme (SSS) for this age group seems to show extreme OR and high standard error, since the number of cases is very few that the program could not calculate the OR. This will be appearing in all outcomes for this age group for SSS variable.

In model 5, only CSMBS remain the same effect with other models, while other variables that was significant in model 0-4 become insignificant. Married people appears to be significantly higher OR than single, and southern region appear to show less OR than Bangkok.

Table 12 Binary logistic regression models for having 1 or more dental caries in 60-74 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.280		1.140								1.140	
High income(ref)												
Education												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Primary complete or less	1.611	*	1.441								1.154	
At least secondary complete (ref)												
Occupation												
Business	1.032		0.982								0.739	
Wage-earner /freelance	1.172		1.088								0.673	
Agriculture	1.389	*	1.305								0.926	
Housekeeper	1.298		1.228								0.681	
Others (ref)												
Personal Background												
Age	1.017				1.021						1.038	
Gender												
Male	0.924				0.874						0.927	
Female												
Marital Status												
Previously married	1.303				1.360						2.579	
Married	1.411				1.507						3.150	*
Single (ref)												
Area of residence												
Bangkok	0.828				0.876						0.473	
Other urban	0.708	**			0.714	**					0.696	
Rural (ref)												
Region of residence												
Central	1.028				0.971						N/C	
North	1.064				1.027						0.545	
Northeast	1.135				1.051						0.752	
South	1.082				N/C						0.453	
Bangkok (ref)												
Having diabetes mellitus												
Yes	0.856				0.874						1.162	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	0.571	***					1.019				0.919	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.874						0.878				0.826	
Yes(ref)												
Use of additional cleaning tools												
No	1.698						1.924				1.943	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Yes(ref)												
Smoking status												
Smoker	0.956						0.949				0.581	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	1.064								0.774		1.164	
at least once a year (ref)												
Place for dental service												
Public provider	1.354								1.389		1.216	
Private provider(ref)												
Health Insurance coverage												
CSMBS	0.621	**							0.381	***	0.386	**
SSS	5.029	*							N/C		N/C	
UC(ref)												
n			1264		1238		1142		423		388	
-2 Log likelihood			1,740.477		1,701.045		1,576.131		563.103		489.212	
Cox & Snell R Square			0.008		0.011		0.004		0.052		0.118	
Nagelkerke R Square			0.011		0.014		0.005		0.069		0.157	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Periodontal status

From table 13 show result for having CPI score of 3 or higher. For this age group, income and education show significance results on periodontal status. Lower income people show significantly almost 2 times higher odds of having more severe periodontal status than higher income. Education alone also shows obvious result. People with lower education show higher OR of having more severe periodontal status than higher education. The odds ratio of education and income decreases and that of

income slightly increases after controlling for all SES variables in model 1. Occupation seems to have no effect in this outcome.

For background variables, male show significantly higher OR than females only after controlling for other background variables in model 2. Bangkok and other urban area show insignificantly less OR of having severe periodontal status in their own models. After controlling for all other backgrounds Bangkok becomes significant with OR of 0.494, while other urban also becomes significant with OR 0.737.Central region shows lower OR and lowest OR among all regions. Other regions themselves, however, show higher odds ratio than Bangkok, but their OR decreases and become significant after controlling for all variables.

Behaviors and smoking status do not show significant result for periodontal status. CSMBS show significantly lowest OR comparing to UC. The OR significantly drops after adjustment. SSS, on the other hand, show higher OR than UC for 4.360 times but the OR decline to 1.659 and become insignificant with all other access variables. CSMBS is the only variable that show significant effect in model 5.

Table 13 Binary logistic regression models for Community Periodontal Index (CPI) score 3 or more in 60-74 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.957	**	1.767	*							1.839	
High income(ref)												
Education												
Primary complete or less	1.955	**	1.693	*							0.714	
At least secondary complete (ref)												
Occupation												
Business	1.054		0.974								0.816	
Wage-earner /freelance	1.229		1.051								0.768	
Agriculture	1.084		0.980								0.538	
Housekeeper	0.819		0.718								1.338	
Others (ref)												
Personal Background												
Age	0.996				0.999						0.977	
Gender												
Male	1.242				1.353	*					1.521	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Female												
Marital Status												
Previously married	1.091				0.924						1.175	
Married	1.276				0.920						0.966	
Single (ref)												
Area of residence												
Bangkok	0.695				0.494	**					0.393	
Other urban	0.792				0.737	*					0.680	
Rural (ref)												
Region of residence												
Central	0.598				0.337	***					N/C	
North	1.803	*			1.011						0.489	
Northeast	1.483				0.831						1.506	
South	1.803	*			N/C						0.906	
Bangkok (ref)												
Having diabetes mellitus												
Yes	1.121				1.212						1.665	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.281						1.278				1.339	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.302						1.300				1.658	
Yes(ref)												
Use of additional cleaning tools												
No	1.896						1.732				2.330	
Yes(ref)												
Smoking status												
Smoker	1.258						1.206				1.202	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	1.174								2.489		3.207	
at least once a year (ref)												
Place for dental service												
Public provider	1.557								1.483		1.284	
Private provider(ref)												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Health Insurance coverage												
CSMBS	0.622	*							0.333	***	0.356	*
SSS	4.360	*							1.659		3.263	
UC(ref)												
n			1107		1085		1081		383		371	
-2 Log likelihood			1,437.181		1371.506		1410.177		477.622		429.988	
Cox & Snell R Square			0.015		0.045		0.009		0.043		0.122	
Nagelkerke R Square			0.021		0.062		0.013		0.060		0.168	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Missing teeth

Income and education do not show interesting result for missing teeth. Almost all occupational groups show about the same OR which are close to 1. Only agriculture group show significant OR at 0.683 which is the lowest OR among all groups before adjusted. However, it almost show significance (p-value 0.051) in model 1.

When comparing model 0 and 2, age shows significant result but the odds ratios are very close 1. Types of residence show some unexpected results. People living in Bangkok show significantly 4.26 times higher OR of having more missing teeth compare to those in rural area. Other urban also show significantly higher OR than rural for 2.201 times. After controlling for all background behaviors, the OR of both Bangkok and other urban decreases, but still show significance. Region of residence alone show less OR of having more than 5 missing teeth compare to Bangkok. However, after adjusted in mode l2, central turns to lose its significance and show higher OR than Bangkok. On the other hand, Northern and Northeast still show significant result and increases the magnitude, but still lower than Bangkok. People

with diabetes seems to show more OR before and after adjusted for other background variables with decrease in coefficient.

In model 0 , going to dentist less than once a year show significantly lower OR than those who go to dentist at least once a year. The OR decreases to 0.241 and becomes insignificant in model 4 which controlled for other access variables. CSMBS for this age groups shows significantly higher missing teeth comparing to UC. However, the OR slightly decreases and become insignificant when adjusted for other variables.

For this outcome, income, education, age, gender, behavior and tobacco use show no significant result. Model 5 with all variables together seems to show significance only area of residence that Bangkok is almost 5 times higher OR than rural area.

Table 14 Binary logistic regression models for missing 5 or more teeth in 60-74 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	0.951		0.946								0.947	
High income(ref)												
Education												
Primary complete or less	0.728		0.808								1.371	
At least secondary complete (ref)												
Occupation												
Business	1.040		1.069								2.086	
Wage-earner /freelance	0.996		1.037								0.555	
Agriculture	0.683	*	0.708								1.299	
Housekeeper	1.098		1.131								2.711	
Others (ref)												
Personal Background												
Age	1.065	***			1.060	***					1.082	
Gender												
Male	0.775				0.789						0.851	
Female												
Marital Status												
Previously married	0.803				0.925						4.496	
Married	0.575				0.777						1.197	
Single (ref)												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Area of residence												
Bangkok	4.260	***			2.938	**					4.813	*
Other urban	2.201	***			2.122	***					1.805	
Rural (ref)												
Region of residence												
Central	0.481	*			1.384						N/C	
North	0.220	***			0.598	*					2.438	
Northeast	0.214	***			0.610	*					0.849	
South	0.355	**			N/C						0.719	
Bangkok (ref)												
Having diabetes mellitus												
Yes	1.794	**			1.526	*					0.975	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.148						0.757				1.637	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.202						1.215				1.185	
Yes(ref)												
Use of additional cleaning tools												
No	1.056						0.915				2.432	
Yes(ref)												
Smoking status												
Smoker	0.897						0.904				1.095	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.528	***							0.241		0.397	
at least once a year (ref)												
Place for dental service												
Public provider	0.859								0.907		1.466	
Private provider(ref)												
Health Insurance coverage												
CSMBS	1.544	*							1.484		2.339	
SSS	3.376								N/C		N/C	
UC(ref)												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
n			1264		1238		1142		423		388	
-2 Log likelihood			1,327.042		1,221.505		1,246.921		357.251		295.345	
Cox & Snell R Square			0.008		0.066		0.004		0.013		0.095	
Nagelkerke R Square			0.012		0.101		0.006		0.023		0.165	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Decayed, Missing and Filled Teeth (DMFT)

For DMFT outcome, only occupation show significance among SES variables. Similar to missing teeth result previously, agriculture group show less OR than the reference group, but other occupational group do not show significant difference.

Age doesn't show obvious difference for this outcome, even there is significance. Other background variable seems to show some effect. Married people show better number of DMFT comparing to single ones. Living in Bangkok show significantly more odds ratio than living in rural about two times, but after adjusted for all background, the OR decreases and become insignificant. Other urban also show significantly lower OR than those in rural before and after adjustment for all background behavior. For region of residence, both northern and northeast region show about similar OR which are less than Bangkok, while the other regions do not. Diabetes appears to show that people with diabetes show more OR than those without diabetes.

Among behavior variables, only brushing show significantly higher OR for those who brush less than 2 times/day. Frequency of dental visit also show significant result that going to dentist less than once a year show less OR than those who go to dentist at least once. However, both result become insignificant after adjusted for all variables in the same categories.

Personal background seems to have more effect in DMFT comparing to other groups of variables. After adjusted in model 5, only background variables remain significant with rise in OR area of residence and decline in that of region residence.

Table 15 Binary logistic regression models for Decayed Missing and Filled Teeth (DMFT) more than 10 in 60-74 years old age group

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	0.766		0.771								0.921	
High income(ref)												
Education												
Primary complete or less	0.717		0.847								0.801	
At least secondary complete (ref)												
Occupation												
Business	1.168		1.197								0.900	
Wage-earner /freelance	0.985		1.037								1.204	
Agriculture	0.652	**	0.671	**							0.854	
Housekeeper	0.901		0.942								1.289	
Others (ref)												
Personal Background												
Age	1.082	***			1.084	***					1.084	*
Gender												
Male	0.818				0.879						0.696	
Female												
Marital Status												
Previously married	0.684				0.767						0.552	
Married	0.429	**			0.524						0.323	
Single (ref)												
Area of residence												
Bangkok	2.328	***			1.287						0.879	
Other urban	1.876	***			1.850	***					1.998	*
Rural (ref)												
Region of residence												
Central	0.915				1.218						N/C	
North	0.332	***			0.416	***					0.954	
Northeast	0.339	***			0.430	***					0.366	**
South	0.746				N/C						0.308	***
Bangkok (ref)												
Having diabetes mellitus												
Yes	1.479	*			1.408	*					1.348	
No (ref)												
Behavior												

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Frequency of tooth brushing												
less than 2 times/day	1.496	**					0.884				1.869	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.994						0.995				1.129	
Yes(ref)												
Use of additional cleaning tools												
No	0.765						0.632				1.169	
Yes(ref)												
Smoking status												
Smoker	0.948						0.935				0.811	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.691	**							0.335		0.295	
at least once a year (ref)												
Place for dental service												
Public provider	1.038								1.107		1.690	
Private provider(ref)												
Health Insurance coverage												
CSMBS	1.376								1.502		1.145	
SSS	1.217								N/C		N/C	
UC(ref)												

n		1264	1238	1142	423	388
-2 Log likelihood		1,643.973	1,494.949	1,530.200	514.571	427.367
Cox & Snell R Square		0.012	0.100	0.003	0.017	0.141
Nagelkerke R Square		0.017	0.136	0.004	0.024	0.197

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Posterior occluding pairs (POP)

Result of this outcome is quite similar to DMFT. Income and education do not show interesting result. For occupational groups, only agriculture groups show significantly less chance to have less than 4 POP than the reference groups before and after adjusted for all variables.

Bangkok and other urban residents seems to have more OR of having less than 4 POP. But after adjusted, only other urban remain the significance. For region of residence, northern and northeast region show less OR ratio than Bangkok and other region with about the same effect in model 2.

Brushing less than two times a day and not using additional cleaning tools to clean the teeth show significantly higher OR only before adjusted for other behavior variables. For this outcome, access variables do not show any significance results.

In model 5, only age and region of residence show significant result. OR of age is close to 1 in all model. While northeast decrease magnitude and southern become significant in this model.

Table 16 Binary logistic regression models for posterior occluding pairs (POP) less than 4 in 60-74 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.315		1.187								1.235	
High income(ref)												
Education												
Primary complete or less	1.199		1.318								1.225	
At least secondary complete (ref)												
Occupation												
Business	0.841		0.807								0.663	
Wage-earner /freelance	0.888		0.831								0.669	
Agriculture	0.670	**	0.636	**							0.742	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Housekeeper	0.935		0.888								1.512	
Others (ref)												
Personal Background												
Age	1.084	***			1.085	***					1.061	*
Gender												
Male	0.889				0.933						0.898	
Female												
Marital Status												
Previously married	1.224				1.340						1.420	
Married	0.815				0.961						0.942	
Single (ref)												
Area of residence												
Bangkok	1.512	*			0.965						0.575	
Other urban	1.580	***			1.528	**					1.470	
Rural (ref)												
Region of residence												
Central	1.194				1.229						N/C	
North	0.500	**			0.478	***					0.969	
Northeast	0.557	**			0.535	***					0.411	**
South	1.004				N/C						0.489	*
Bangkok (ref)												
Having diabetes mellitus												
Yes	1.270				1.250						0.953	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	1.540	***					0.801				1.115	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	1.022						1.032				1.024	
Yes(ref)												
Use of additional cleaning tools												
No	1.923	*					1.626				2.372	
Yes(ref)												
Smoking status												
Smoker	1.038						1.011				0.976	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.991								0.309		0.191	

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
at least once a year (ref)												
Place for dental service												
Public provider	1.033								1.072		1.321	
Private provider(ref)												
Health Insurance coverage												
CSMBS	1.139								0.993		0.948	
SSS	1.095								N/C		N/C	
UC(ref)												
			1264		1238		1142		423		388	
-2 Log likelihood			1717.203		1600.334		1,574.988		572.872		493.232	
Cox & Snell R Square			0.010		0.073		0.004		0.016		0.103	
Nagelkerke R Square			0.013		0.098		0.005		0.022		0.137	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation

Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition

Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.

Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Missing front teeth

From model 0 and 1, occupation seems to be the only variable to show significant result for having missing front teeth. Doing business and agriculture show about the same level of OR which are less than reference group in both models.

Similar with many other outcome for this age group, age seems to show significance but OR is close to 1. Northern and northeastern region show significantly less odds than Bangkok only after controlling for all other background variables in model 2. Other variables in this group do not show interesting result.

In model 0, brushing less than 2 times a day show two times higher OR than those who brush at least 1 times a day. Smokers also show higher OR than non-smokers. However, both variable become insignificant and their OR decline after adjusted for all behavior variables in model 3.

Frequency of dental visit show significantly less OR for less than once a year group, but become insignificant after adjusted in model 4. Other variables in access variable show no significant effect.

The variables that show significance in model 5 are other urban residents with increased in OR to 1.869, southern region which just show OR of 0.509 only in this model, visiting dental service and having CSMBS as health insurance coverage that show decline in their magnitude.

Table 17 Binary logistic regression models for having 1 or more front teeth in 60-74 years old age group

Independent variables	**Model 0**		**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES												
Income												
Low income	1.306		1.263								0.939	
High income(ref)												
Education												
Primary complete or less	1.071		1.143								0.514	
At least secondary complete (ref)												
Occupation												
Business	0.643	*	0.628	*							0.742	
Wage-earner /freelance	1.044		0.996								1.503	
Agriculture	0.674	**	0.656	**							1.266	
Housekeeper	0.705		0.676	*							1.246	
Others (ref)												
Personal Background												
Age	1.090	***			1.088	***					1.058	
Gender												
Male	1.114				1.126						1.067	
Female												
Marital Status												
Previously married	1.254				1.357						1.859	
Married	1.034				1.086						1.477	
Single (ref)												
Area of residence												
Bangkok	1.250				0.860						0.864	
Other urban	1.277				1.229						1.869	*
Rural (ref)												
Region of residence												
Central	1.159				1.093						N/C	
North	0.697				0.659	*					1.605	
Northeast	0.664				0.607	**					0.609	
South	1.033				N/C						0.509	*

Independent variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig
Bangkok (ref)												
Having diabetes mellitus												
Yes	1.218				1.258						0.668	
No (ref)												
Behavior												
Frequency of tooth brushing												
less than 2 times/day	2.140	***					1.227				1.684	
at least 2 times/day (ref)												
Use of fluoride tooth paste												
No	0.996						0.986				1.045	
Yes(ref)												
Use of additional cleaning tools												
No	1.406						1.072				1.274	
Yes(ref)												
Smoking status												
Smoker	1.285	*					1.226				1.004	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
less than once a year	0.710	**							0.201		0.083	*
at least once a year (ref)												
Place for dental service												
Public provider	1.356								1.373		1.652	
Private provider(ref)												
Health Insurance coverage												
CSMBS	0.815								0.773		0.419	*
SSS	0.330								0.502		0.377	
UC(ref)												
n			1264		1238		1142		423		388	
-2 Log likelihood			1,693.688		1,612.706		1,561.973		540.735		468.061	
Cox & Snell R Square			0.011		0.047		0.004		0.016		0.102	
Nagelkerke R Square			0.014		0.063		0.006		0.022		0.139	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 1: adjusted for income, education and occupation
Model 2: adjusted for age, gender, marital status, area of residence, region of residence and diabetes condition
Model 3: adjusted for frequency of tooth brushing, use of fluoride toothpaste, use of additional cleaning tools and smoking status.
Model 4: adjusted for frequency of dental visit, place for dental service and health insurance coverage

Overall Bivariate relationship for Age group 60-74 years old

Table 18 show overall bivariate analysis for all outcomes in age group 60-74 years old. Income and education show significance for dental caries and periodontal status. Among occupational group, agriculture group seems to show significantly less OR than the reference group except for dental caries. Age also show significance but the OR are close to 1. Only married show less OR than single for DMFT. Area of residence show that Bangkok and other urban show significantly higher OR than rural in many outcome, except for dental caries. Considering by region, every regions with significance show less OR than Bangkok except for periodontal status. Having diabetes show more OR for missing teeth and DMFT.

Tooth brushing less than 2 times a day present more OR for DMFT, POP and missing front teeth, but not dental caries. Not using additional cleaning tools show more OR for POP, while smoking show obvious result for missing front teeth. Going to dentist less than once a year show less OR for many outcome. For health insurance coverage, CSMBS show less OR than UC for dental caries and periodontal status but opposite for missing teeth. Even SSS show significance but the number of cases are very few that the analysis might not be able to calculate result correctly.

Table 18 Overall bivariate relationships for independent variables, age group 60-74

	Dental caries		**Periodontal**		**Missing teeth**		**DMFT**		**POP**		**Missing front teeth**	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	1.280		1.957	**	0.951		0.766		1.315		1.306	
High income (Ref.)												
Education												
Primary complete or less	1.611	*	1.955	**	0.728		0.717		1.199		1.071	
At least secondary complete (Ref.)												
Occupation												

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Business	1.032		1.054		1.040		1.168		0.841		0.643	*
Wage-earner/freelance	1.172		1.229		0.996		0.985		0.888		1.044	
Agriculture	1.389	*	1.084		0.683	*	0.652	**	0.670	**	0.674	**
Housekeeper	1.298		0.819		1.098		0.901		0.935		0.705	
Others (Ref.)												
Age	1.017		0.996		1.065	***	1.082	***	1.084	***	1.090	***
Gender												
Male	0.924		1.242		0.775		0.818		0.889		1.114	
Female												
Marital Status												
Previously married	1.303		1.091		0.803		0.684		1.224		1.254	
Married	1.411		1.276		0.575		0.429	**	0.815		1.034	
Single (Ref.)												
Area of residence												
Bangkok	0.828		0.695		4.260	***	2.328	***	1.512	*	1.250	
Other urban	0.708	**	0.792		2.201	***	1.876	***	1.580	***	1.277	
Rural (Ref.)												
Region of residence												
Central	1.028		0.598		0.481	*	0.915		1.194		1.159	
North	1.064		1.803	*	0.220	***	0.332	***	0.500	**	0.697	
Northeast	1.135		1.483		0.214	***	0.339	***	0.557	**	0.664	
South	1.082		1.803	*	0.355	**	0.746		1.004		1.033	
Bangkok (Ref.)												
Having diabetes mellitus												
Yes	0.856		1.121		1.794	**	1.479	*	1.270		1.218	
No (ref)												
Frequency of tooth brushing												
less than 2 times/day	0.571	***	1.281		1.148		1.496	**	1.540	***	2.140	***
at least 2 times/day (Ref.)												
Use of fluoride tooth paste												
No	0.874		1.302		1.202		0.994		1.022		0.996	
Yes(Ref.)												
Use of additional cleaning tools												
No	1.698		1.896		1.056		0.765		1.923	*	1.406	
Yes(Ref.)												
Smoking status												
Smoker	0.956		1.258		0.897		0.948		1.038		1.285	*
Non-Smoker (Ref.)												

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Frequency of dental visit												
less than once a year	1.064		1.174		0.528	***	0.691	**	0.991		0.710	**
at least once a year (Ref.)												
Place for dental service												
Public provider	1.354		1.557		0.859		1.038		1.033		1.356	
Private provider												
Health Insurance coverage												
CSMBS	0.621	**	0.622	*	1.544	*	1.376		1.139		0.815	
SSS	5.029	*	4.360	*	3.376		1.217		1.095		0.330	
		n=12										
UC												

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Overall multivariate analysis for independent variables for age group 60-74 years old

Among all 49 OR being compared in bivariate and multivariate analysis, there are 7 of those that have change in coefficients and reduction in significance level. Around 33 of those being compared become insignificant after multivariate analysis, while about 6 of them become significant.

All SES, behavior and smoking variables become insignificant after multivariate analysis. Age show significance in some outcome but show no different in OR. Only married people significantly show more OR than single for dental caries. Area of resident show significance only for DMFT and Missing front teeth that those in other urban show more OR of having bad outcome than those in rural area. All region other than Bangkok show less OR than Bangkok for dental caries, DMFT, POP and missing front teeth.

Frequency of dental visit show significant only missing front teeth before and after putting in the multivariate analysis. Only CSMBS show less OR than those with UC for dental caries and missing front teeth outcome.

Table 19 Overall Multivariate analysis of all independent variables in one model, age 60-74 years old

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	1.140		1.839		0.947		0.921		1.235		0.939	
High income (Ref.)												
Education												
Primary complete or less	1.154		0.714		1.371		0.801		1.225		0.514	
At least secondary complete(Ref.)												
Occupation												
Business	0.739		0.816		2.086		0.900		0.663		0.742	
Wage-earner/freelance	0.673		0.768		0.555		1.204		0.669		1.503	
Agriculture	0.926		0.538		1.299		0.854		0.742		1.266	
Housekeeper	0.681		1.338		2.711		1.289		1.512		1.246	
Others(Ref.)												
Age	1.038		0.977		1.082		1.084	*	1.061	*	1.058	
Gender												
Male	0.927		1.521		0.851		0.696		0.898		1.067	
Female(Ref.)												
Marital Status												
Previously married	2.579		1.175		4.496		0.552		1.420		1.859	
Married	3.150	*	0.966		1.197		0.323		0.942		1.477	
Single(Ref.)												
Area of residence												
Bangkok	0.473		0.393		4.813	*	0.879		0.575		0.864	
Other urban	0.696		0.680		1.805		1.998	*	1.470		1.869	*
Rural(Ref.)												
Region of residence												
Central	N/C		N/C		N/C		N/C		N/C		N/C	
North	0.545		0.489		2.438		0.954		0.969		1.605	
Northeast	0.752		1.506		0.849		0.366	**	0.411	**	0.609	
South	0.453	*	0.906		0.719		0.308	***	0.489	*	0.509	*
Bangkok(Ref.)												
Having diabetes mellitus												
Yes	1.162		1.665		0.975		1.348		0.953		0.668	
No (ref)												
Frequency of tooth brushing												
less than 2 times/day	0.919		1.339		1.637		1.869		1.115		1.684	
at least 2 times/day(Ref.)												
Use of fluoride tooth paste												
No	0.826		1.658		1.185		1.129		1.024		1.045	
Yes(Ref.)												

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Use of additional cleaning tools												
No	1.943		2.330		2.432		1.169		2.372		1.274	
Yes(Ref.)												
Smoking status												
Smoker	0.581		1.202		1.095		0.811		0.976		1.004	
Non-Smoker(Ref.)												
Frequency of dental visit												
less than once a year	1.164		3.207		0.397		0.295		0.191		0.083	*
at least once a year(Ref.)												
Place for dental service												
Public provider	1.216		1.284		1.466		1.690		1.321		1.652	
Private provider(Ref.)												
Health Insurance coverage												
CSMBS	0.386	**	0.356	*	2.339		1.145		0.948		0.419	*
SSS	N/C		3.263		N/C		N/C		N/C		0.377	
UC(Ref.)												
-2 Log likelihood	489.212		429.988		295.345		427.367		493.232		468.061	
Cox & Snell R Square	0.118		0.122		0.095		0.141		0.103		0.102	
Nagelkerke R Square	0.157		0.168		0.165		0.197		0.137		0.139	

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

2.3 Age group 80 - 89 years old

This age group had limited data due to there were no interview data available for 80 years old population. The only data included in the analysis are some socioeconomic and background variables. Behavior, tobacco use and access to dental service were not available. The comparison of models of are shown in table 20 and 21 which included three dependent variables in one table.

This age group show less significant coefficients than the 2 younger group, but more likely to 60-74 than to 35-44 years old. Education show significance in only missing front teeth, while occupational group do lose all the significance. Gender show no significant coefficient, like in 60-74 age group. Age is one variable that show

obvious significance in bivariate and multivariate which show about the same number of significance in the same outcome variables with 60-74 years old group. Area and region of residence show less coefficients that are significance.

Dental caries

From table 20, for dental caries, only other urban area show significantly lower OR of having 1 or more dental caries than rural area before and after controlling for all variables. Other independent variables seems to show no significant result.

Periodontal status

Before adjusting for all variables, the bivariate analysis show no significance result in all variables. However, after adjusted some significance results appear. Age show significant result implying more age show less OR of having severe periodontal status. Bangkok elderly show lower OR than those in rural area. For region of residence, northern regions show less OR than reference region, Bangkok.

Missing teeth

Missing teeth show no significant result at all for both bivariate and multivariate analysis. Maybe because of elderly at this age all have missing teeth more than 5.

Table 20 Binary logistic regression models for having 1 or more dental caries, Community Periodontal Index (CPI) score of 3 or higher and 5 or more missing teeth in 80-89 years old age group

Oral health outcomes	**Dental caries**				**Periodontal status**				**Missing teeth**			
	Model 0		**Model 6**		**Model 0**		**Model 6**		**Model 0**		**Model 6**	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig
SES												
Income												
Low income	N/A		N/A		N/A		N/A		N/A		N/A	
High income (Ref.)												
Education												
Primary complete or less	1.242		1.122		1.177		0.807		0.825		1.235	
At least secondary complete (Ref.)												
Occupation												
Business	0.597		0.805		0.000		N/C		N/C		65.22	

Oral health outcomes	Dental caries				Periodontal status				Missing teeth			
	Model 0		Model 6		Model 0		Model 6		Model 0		Model 6	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig
Wage-earner/freelance	3.585		3.263		0.000		N/C		N/C		N/C	
Agriculture	0.652		0.513		0.912		0.872		1.125		1.787	
Housekeeper	1.303		1.252		0.266		0.199		0.683		0.669	
Others (Ref.)												
Personal background												
Age	0.943		0.938		0.890		0.865	*	1.131		1.143	
Gender												
Male	1.079		1.052		0.866		0.808		0.781		0.843	
Female												
Marital Status												
Previously married	N/A		N/A		N/A		N/A		N/A		N/A	
Married												
Single (Ref.)												
Area of residence												
Bangkok	0.738		0.703		0.406		0.187	*	2.798		2.028	
Other urban	0.557	*	0.552	*	1.036		1.043		1.613		1.599	
Rural (Ref.)												
Region of residence												
Central	0.825		N/C		0.610		N/C		1.500		N/C	
North	1.111		0.682		2.667		0.127	***	0.247		2.475	
Northeast	1.444		0.9		3.232		0.647		0.286		0.399	
South	1.186		1.213		3.840		0.682		0.614		0.454	
Bangkok (Ref.)												
Having diabetes mellitus												
Yes	N/A		N/A		N/A		N/A		N/A		N/A	
No (ref)												
n			404				202				404	
-2 Log likelihood			513.184				244.057				197.972	
Cox & Snell R Square			0.035				0.113				0.038	
Nagelkerke R Square			0.048				0.160				0.093	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS, N/A: No data available due to no interview for age group 80-89 years old in the national survey

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 6: adjusted for education and occupation, age, gender, area of residence and region of residence

Decayed, Missing and Filled Teeth (DMFT)

Before adjusted, only age show significant result. But after adjusted. Region also show some significant result for northeast and southern with lower OR than Bangkok.

Posterior occluding pairs (POP)

Age and area of residence appears to show significant results. Other urban area show less OR of having less than 4 POP comparing to rural area. After controlling for all variables, other urban turns to show more OR than rural and region of residence seems to be significance. Northeast and southern show less OR than Bangkok.

Missing front teeth

Education is significantly related to missing front teeth. Elderly whose highest education is primary education or less show significantly 4 times higher OR of having at least one missing teeth comparing to those with at least secondary education complete, before and after adjusted for all variables. Age is only significant only before adjusted.

Table 21 Binary logistic regression models for having 10 or more Decayed Missing and Filled Teeth (DMFT), less than 4 posterior occluding pairs (POP) and 5 and 1 or more missing teeth in 80-89 years old age group

Oral health outcomes	**DMFT**				**POP**				**Missing front teeth**			
	Model 0		**Model 6**		**Model 0**		**Model 6**		**Model 0**		**Model 6**	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig
SES												
Income												
Low income	N/A		N/A		N/A		N/A		N/A		N/A	
High income (Ref.)												
Education												
Primary complete or less	0.988		1.599		0.793		1.802		4.187	*	4.695	*
At least secondary complete (Ref.)												
Occupation												
Business	N/C		N/C		N/C		N/C		N/C		N/C	

Oral health outcomes	DMFT				POP				Missing front teeth			
	Model 0		Model 6		Model 0		Model 6		Model 0		Model 6	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig
Wage-earner/freelance	0.290		0.520		2.741		0.690		N/C		N/C	
Agriculture	0.943		1.655		1.371		1.204		0.760		1.052	
Housekeeper	1.233		1.178		1.028		0.951		0.624		0.643	
Others (Ref.)												
Personal background												
Age	1.256	**	1.283	**	0.877	*	1.142	*	1.162	*	1.156	
Gender												
Male	0.881		0.957		1.263		0.873		0.735		0.769	
Female												
Marital Status												
Previously married	N/A		N/A		N/A		N/A		N/A		N/A	
Married												
Single (Ref.)												
Area of residence												
Bangkok	2.432		1.489		0.664		0.942		0.656		1.049	
Other urban	1.621		1.625		0.463	*	2.224	*	1.677		1.830	
Rural (Ref.)												
Region of residence												
Central	1.2		N/C		0.470		N/C		3.360		N/C	
North	0.247		1.266		2.472		1.323		1.107		1.680	
Northeast	0.344		0.245	**	1.560		0.250	**	1.867		0.564	
South	1.048		0.346	*	0.605		0.394	*	1.889		0.968	
Bangkok (Ref.)												
Having diabetes mellitus												
Yes	N/A		N/A		N/A		N/A		N/A		N/A	
No (ref)												
n			404				404				404	
-2 Log likelihood			272.974				317.131				254.450	
Cox & Snell R Square			0.079				0.078				0.047	
Nagelkerke R Square			0.149				0.134				0.096	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS, N/A: No data available due to no interview for age group 80-89 years old in the national survey
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Model 0: not adjusted for any other variables

Model 6: adjusted for education and occupation, age, gender, area of residence and region of residence

Overall Bivariate relationships for Age group 80-89 years old

Since there are limited variables which can include in the analysis. The included variables are education, occupation, age gender area of residence and region of residence. For bivariate analysis for this age group show not many significance result. Less education show 4 times more OR than high education. Age slightly show more OR for DMFT and missing front teeth, meaning the oral health decline through the increasing age. For area of residence, only other urban show significantly less OR than rural for dental caries and POP.

Table 22 Overall bivariate relationship for independent variables, age group 80-89 years old

	Dental caries		**Periodontal**		**Missing teeth**		**DMFT**		**POP**		**Missing front teeth**	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	N/A		N/A		N/A		N/A		N/A		N/A	
High income (Ref.)												
Education												
Primary complete or less	1.242		1.177		0.825		0.988		0.793		4.187	*
At least secondary complete (Ref.)												
Occupation												
Business	0.597		N/C		N/C		N/C		N/C		N/C	
Wage-earner/freelance	3.585		N/C		N/C		0.290		2.741		N/C	
Agriculture	0.652		0.912		1.125		0.943		1.371		0.760	
Housekeeper	1.303		0.266		0.683		1.233		1.028		0.624	
Others (Ref.)												
Age	0.943		0.890		1.131		1.256	**	0.877	*	1.162	*
Gender												
Male	1.079		0.866		0.781		0.881		1.263		0.735	
Female												
Marital Status												
Previously married	N/A		N/A		N/A		N/A		N/A		N/A	
Married	N/A		N/A		N/A		N/A		N/A		N/A	
Single (Ref.)												
Area of residence												
Bangkok	0.738		0.406		2.798		2.432		0.664		0.656	
Other urban	0.557	*	1.036		1.613		1.621		0.463	*	1.677	
Rural (Ref.)												
Region of residence												
Central	0.825		0.610		1.500		1.200		0.470		3.360	
North	1.111		2.667		0.247		0.247		2.472		1.107	

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Northeast	1.444		3.232		0.286		0.344		1.560		1.867	
South	1.186		3.840		0.614		1.048		0.605		1.889	
Bangkok (Ref.)												
Having diabetes mellitus												
No	N/A		N/A		N/A		N/A		N/A		N/A	
Yes (Ref.)												

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS, N/A: No data available due to no interview for age group 80-89 years old in the national survey
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Overall multivariate analysis for independent variables for age group 80-89 years old

For age group 80-89 years old. Not many coefficients show significant result. Among 13 coefficient being compared, there are 6 of them that reduced the magnitude and 1 of them become insignificant. On the other hand, 3 of the coefficients that was not significant at the first place become significant in multivariate analysis.

Education reduced the magnitude but still significant for missing front teeth outcome only. Age show significant result for DMFT and POP with increased magnitude, while that of periodontal outcome become significant in multivariate analysis with different direction. Bangkok as area of residence for periodontal outcome become significant result with lower odds, while other urban or POP increases in coefficient to 2.224. Region of residence for periodontal status, DMFT and POP become significance but with excluded central region in the analysis by the program.

Occupation and gender do not show any significant result in multivariate analysis in all dependent variables.

Table 23 Overall Multivariate analysis of all independent variables in one model, age 80-89 years old

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Income												
Low income	N/A		N/A		N/A		N/A		N/A		N/A	

	Dental caries		Periodontal		Missing teeth		DMFT		POP		Missing front teeth	
Independent variables	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
High income (Ref.)												
Education												
Primary complete or less	1.122		0.807		1.235		1.599		1.802		4.695	*
At least secondary complete (Ref.)												
Occupation												
Business	0.805		N/C		N/C		N/C		N/C		N/C	
Wage-earner/freelance	3.263		N/C		N/C		0.520		0.690		N/C	
Agriculture	0.513		0.872		1.787		1.655		1.204		1.052	
Housekeeper	1.252		0.199		0.669		1.178		0.951		0.643	
Others (Ref.)												
Age	0.938		0.865	*	1.143		1.283	**	1.142	*	1.156	
Gender												
Male	1.052		0.808		0.843		0.957		0.873		0.769	
Female												
Marital Status												
Previously married	N/A		N/A		N/A		N/A		N/A		N/A	
Married	N/A		N/A		N/A		N/A		N/A		N/A	
Single (Ref.)												
Area of residence												
Bangkok	0.703		0.187	*	2.028		1.489		0.942		1.049	
Other urban	0.552	*	1.043		1.599		1.625		2.224	*	1.830	
Rural (Ref.)												
Region of residence												
Central	N/A		N/A		N/A		N/A		N/A		N/A	
North	0.682		0.127	***	2.475		1.266		1.323		1.680	
Northeast	0.9		0.647		0.399		0.245	**	0.250	**	0.564	
South	1.213		0.682		0.454		0.346	*	0.394	*	0.968	
Bangkok (Ref.)												
Having diabetes mellitus												
No	N/A		N/A		N/A		N/A		N/A		N/A	
Yes (Ref.)												
n	404		202		404		404		404		404	
-2 Log likelihood	513.184		244.057		197.972		272.974		317.131		254.450	
Cox & Snell R Square	0.035		0.113		0.038		0.079		0.078		0.047	
Nagelkerke R Square	0.048		0.160		0.093		0.149		0.134		0.096	

OR: odds ratio; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS, N/A: No data available due to no interview for age group 80-89 years old in the national survey

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Since income and education show more interaction with oral health outcome more than occupation, so the further investigation was tested with interaction effect between income and education and then the interaction of education and income with controlled only behavior and access.

Interactions between income and education

The distribution table was analyzed using 2 by 2 table of high and low income and education to see the different between each group. The result turn out that the high income and higher education show lower percentage of having oral disease while low income and lower education group show higher percentage of having oral disease. So, the interaction effect of the 2 highest group and 2 lowest group was testing and put in model with income and education only.

The result turn to show no interaction effect for 35 years old, but there is only interaction effect for periodontal status of age 60-74 years old as Table 26 and 27 (see Appendix).

From table 26, after adding interactions in model I1, the interaction term, itself, show no significant result in all outcomes, but it reduces the OR of education in Model I1 to become significance. For DMFT, income become insignificant and education reduces the significant level. Education in POP also become insignificant.

From table 27, education decreases the magnitude but remain significant level after add interaction term. However, for periodontal status, income and education decrease the effect to become insignificant, while the high income and high education interaction term show significant result. So, the interaction terms did not include in the next part of further analysis.

Influence of income, education, behavior and access on oral health outcomes

This part of analysis talks about socioeconomic status (SES) effect when adjusted for different variables in models to see how education and income influence dental outcomes by exploring whether oral health behavior and access are involved. All tables are shown in the appendix.

Age 35-44 years old

Dental caries

As table 28, education show strong significant in all models even adjusted for behavior, access and both in model 7-10. After adding behavior variables in model 8, using fluoride toothpaste and additional cleaning tools show significant result. This could imply that having higher education involved in better oral health behavior and results in better dental caries status. Access show significant before and after adjusted for education for only place of dental service which show that public provider show better dental caries status.

Periodontal status

From table 29, income and education variables show no significance in all models. While only smoking status, which has been studied to worsen periodontal disease show significance in model 8. However, after adding access variable in model 10, smoking status lose its significance. This show that education might not have influence as smoking for periodontal status.

Missing teeth

Income and education also show no significant result for this outcome as in table 30. However, access in terms of place of dental service play some roles. People going to public provider show better missing teeth status than those who go to private provider, with no influence of income, education and behavior.

Decayed, Missing and Filled Teeth (DMFT)

From table 31, people with lower income and education show significantly lower OR for higher DMFT. But when adjusted for behavior and access it become insignificant and alter in magnitude. Using additional cleaning tools and smokers unexpectedly show significantly lower OR in both model 8 and 10. While, having CSMBS as health insurance coverage show 2 times higher OR than those in UC in all model. This imply that education and income might not influence DMFT, but behavior of using dental floss and smokers affect DMFT in the unexpected way. This is might be because DMFT is the sum up of decayed, missing and filled teeth which result from many reasons. From previous analysis, education seems to influence only dental caries but not periodontal status. People might lose their teeth from periodontal disease more

than dental caries. Also, people with more fillings which could accumulated thorough life also included in DMFT outcome.

Posterior occluding pairs (POP)

From table 32, people with low income show higher OR only when adjusted for access. While lower education show higher OR in only when not adjusted for any variables. Using public provider show significantly lower OR when adjusted for income, education and behavior. Education seems to show no effect on POP after controlling for other behavior and access.

Missing front teeth

Income, education seems to have no significant effect for missing front teeth as in table 33. But, health insurance of CSMBS and SSS show lower chance of having missing front teeth than those who have UC.

Age 60-74 years old

Dental caries

From table 34, education seems to lose the significant when adjusted with behavior and access. Among all models, people with CSMBS always show less OR of having dental caries. This show that income, education and behavior might not influence untreated dental carries as much as access, unlike dental caries in the younger age group.

Periodontal status

From table 35, income and education show significant higher OR for lower level people. After adjusted for behavior, income remain the effect but it disappear when adjusted for access. CSMBS show lower OR for this outcome even adjusted for income, education and behavior like dental caries in the same age group. Periodontal status might show the progression or severity of disease in older age. So it the SES show significant result for older age group but not young age group. Access is another important factor for older people. Having CSMBS show more effect over income or education.

Missing teeth, posterior occluding pairs (POP) and missing front teeth

From table 36, 38 and 39, all tooth loss outcome including missing teeth, POP and missing front teeth seems to show no effect of income, education, behavior and access in all models.

Decayed Missing and Filled Teeth (DMFT)

For DMFT in table 37, only smokers significantly show lower DMFT than those who do not smoke. Other variables seems to show no effect.

From further analysis above, education show that it influence behavior to result in better oral health outcome for dental caries. However for older age groups, health insurance coverage seems to show dominant effect over income or education.

To summarize, there are relationships between SES and oral health outcomes among Thai population. Oral health status including dental caries, periodontal status and tooth loss differ by socioeconomic groups. There are also relationships between related factors and oral health outcomes as shown in summary table 24 and 25.

Table 24 Summary table showing significance of each oral health outcome for all age groups combined

	Dental caries			Periodontal			Missing teeth			DMFT			POP			Missing front teeth		
Independent variables	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**
Income																		
Lower income	*		N/A		**	N/A			N/A	**		N/A	*		N/A			N/A
Higher income (ref)																		
Education																		
≤Primary complete	***	*		*	**					***			**			*		*
≥Secondary complete (ref)																		
Occupation																		
Business	**			**									*				*	
Wage-earner/freelance	***									**			*					
Agriculture		*		*			**	**		***	**			**			**	
Housekeeper	**						*						*				*	
Others(ref)																		
Age				***		*	***	***	**		***	**	***	***	*	*	***	*
Gender																		
Male				***	*		***			***								
Female(ref)																		
Marital Status																		
Previously married				*			*											
Married		*								*	**							**
Single(ref)																		
Area of residence																		
Bangkok					**	*		***		**	***			*				
Other urban		**	*		**			***		**	***			***	*		*	
Rural(ref)																		
Region																		
Central					***			*								*		
North				**	*	***		***		**	***		**	***			*	
Northeast	*						***	***		***	***	**	**	***			**	
South	**	*			*		*	**		**	***	*	**	*			*	
Bangkok(ref)																		

	Dental caries			Periodontal			Missing teeth			DMFT			POP			Missing front teeth		
Independent variables	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**	**35Y**	**60Y**	**80Y**
Having diabetes mellitus																		
No			N/A	*		N/A		**	N/A		*	N/A			N/A			N/A
Yes(ref)																		
Frequency of tooth brushing																		
< 2 times/day	*	***	N/A			N/A			N/A		**	N/A		***	N/A		***	N/A
≥ 2 times/day(ref)																		
Use of fluoride tooth paste																		
No	*		N/A			N/A			N/A			N/A			N/A			N/A
Yes(ref)																		
Use of additional tools																		
No	***		N/A			N/A			N/A	***		N/A		*	N/A			N/A
Yes(ref)																		
Smoking status																		
Smoker			N/A	**		N/A			N/A	***		N/A			N/A		*	N/A
Non-Smoker(ref)																		
Frequency of dental visit																		
< once a year			N/A	***		N/A	***	***	N/A	***	**	N/A			N/A		**	N/A
≥ once a year(ref)																		
Place for dental service																		
Public provider	**		N/A	*		N/A	*		N/A			N/A			N/A			N/A
Private provider(ref)																		
Health Insurance																		
CSMBS	**	**	N/A	*	***	N/A		*	N/A	***		N/A	*		N/A	*	*	N/A
SSS		*			*											*		
UC(ref)																		

Note: asterisks indicate the highest significance level found; *p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Table 25 Relationship of independent variables and each oral health outcomes

Independent Variables	Dental caries	Periodontal Status	Missing teeth	DMFT	POP	Missing front teeth
SES						
Income	+	+		+	+	
Education	+	+		+	+	+
Occupation	+	+	+	+	+	+
Personal Background						
Age		+	+	+	+	+
Gender		+	+	+		
Marital Status	+	+	+	+		+
Area of residence	+	+	+	+	+	+
Region	+	+	+	+	+	+
Having diabetes mellitus		+	+	+		
Behavior						
Frequency of tooth brushing	+			+	+	+
Use of fluoride tooth paste	+					
Use of dental floss or interdental brush	+			+	+	+
Smoking status		+		+		+
Access to dental service						
Frequency of dental visit		+	+	+		+
Place for dental service	+	+	+			
Health insurance coverage	+	+	+	+	+	+

+ refers to any relationship between independent variables to any age group in each outcome variable.

CHAPTER V

Discussion

This study aims to determine relationship between socioeconomic status and oral health outcome among Thai population. The 7th TNOHS provide individual data in demographic, socioeconomic position and oral health related factors.

SES and oral health outcomes

Among all 3 socioeconomic status, education seems to show most obvious and significant results. Lower education people apparently shows higher risk for oral diseases especially dental caries in adult population age 35-44 years old. Similarly for dental caries and periodontal status in elderly age 60-74 years old and missing front teeth in the oldest group. DMFT in younger age group show different result. Lower education group and income show more number of DMFT. Income show only significance in some outcomes including dental caries and posterior occluding pairs in young age group and periodontal status in middle age group. The results are different for DMFT with other study in Germany using National (Geyer et al., 2010).

Study of Thai population also show that there was socioeconomic inequality in oral health. Lower SES group showed worse self-rated oral health status than the higher SES group (Somkotra, 2011). One study of Thai elderly also show that social inequality relates to number of remaining teeth(Srisilapanan et al., 2016). Recent study of Japanese population also found higher risk for poor oral health in lower education group(Murakami, Ohkubo, Nakamura, et al., 2018).

Education could lead to health knowledge and increase cognitive skills for health promoting behavior (Cutler & Lleras-Muney, 2010). People with higher education are aware of their health more than those with lower level. They also know how to find and get knowledge. Better education could also led to high income and better occupation together with better social capital (Abel, 2008). Higher income people can reach the facilities such as dental service easier and can effort treatment cost more than those with lower income.

In younger age group, occupational group show different result among outcomes. Business groups also show risk for dental caries, and POP for young age

group but show lower risk for missing front teeth in age 60-74. They have to take care of their personal character so the front teeth are things for esthetic involving in reliability and personal looks. Wage-earner seems to show higher OR in all outcome like dental caries and POP that significant except DMFT. Housekeeper show appears to show highest risk among all occupation. Obviously in dental caries, missing teeth and POP result. Agriculture group shows lower risk for tooth loss as seen in missing teeth for young age and all outcome involving with tooth loss like POP missing teeth and missing front teeth in elderly group. On the other hand, it shows higher risk of having dental caries. DMFT tends to show similar result to missing teeth because missing teeth counted as one component of DMFT. Also, DMFT included decayed, missing, and filled teeth. Filled teeth might be from other causes other than dental caries and missing teeth might be from other reasons such as tooth fracture.

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Similarly, education also showed the strongest associations with dental outcome in one Spanish study for SES inequality. When assessing the role of potential mediators such as behavioral and psychosocial characteristics, associations did not disappear. When including the three indicators of socioeconomic position in the model, attenuated education and income gradients remained and the occupation-related gradient disappeared (Capurro & Davidsen, 2017). There are also social inequalities in self-reported tooth loss and treatment needs in adult using household wealth index present in other low- and middle- income countries (Bhandari et al., 2016).

In this study, income and occupation did not show obvious result for oral health status like other studies. Occupation was expected to show better result for better income group like business but the measurements was limited to conclude or categorized the occupation. Income was also expected to show good oral health for higher income group. The result show better oral health status in higher income group, but not significant. This might also because of limitation in measurements or the distribution from the data.

Other related factors

Background and oral health outcomes

Age relates to higher risk of having oral disease but in very small effect. It is because oral disease takes times to develop by exposing to biological and environmental factors and the severity to reach the critical point, so the critical point appears in older age. It is apparently in tooth loss which is cumulative and irreversible(W.M. Thomson, 2012).

Gender effect only young age group with higher risk for periodontal disease for male than female. Oppositely, male seems to have less tooth loss and DMFT than female. One study about sociodemographic factors in Korea also found that male had more remaining teeth than female (Song, Han, Choi, Ryu, & Park, 2016). For young population, female might take care of themselves more than me. This may be because of physical strength and eating behavior. Male usually do not consume sweets as much as female.

Marital status show different result for different outcome. Previously married people seems to have lower risk for periodontal disease but higher risk for missing teeth comparing to single people in younger age group. On the other hand for 60-74 age group, married people show higher risk for dental caries but lower DMFT. Ones study in Japan found that unmarried women with lower education relates to increased risk of poor oral health, while married ones with lower income associated with more risk of poor oral health, particularly among housewife (Murakami, Ohkubo, & Hashimoto, 2018).

For area of residence, Bangkok and other urban seems to show higher risk for DMFT in both group and tooth loss variables in 60-74 age group. It show expected result only for dental caries for 60-74 age group and also periodontal status for oldest age group. People who live in urban area, compare to those in rural, could reach to health service and other facilities supporting good health. Also, urban people might have more opportunity to have better income from more various jobs. Surprisingly that people in other region show lower risk for many dental outcomes comparing to Bangkok, especially northern and northeast that mostly show significance.

However, urban people like in Bangkok should have had better oral health than other area since they can access to dental service more and have more income. The results turn out to be different, might be because of different culture and availability of cariogenic food (food that producing or promoting the development of tooth decay). People in Bangkok and urban area could reach to health facility easier than those in rural, but they can also easily reach to food or that causes oral health problem such as sugar-sweeten beverage and snacks. The eating behavior of urban people also tend to consume sugars more than rural area. One study showed that most industrialized countries show higher DMFT values than developing countries of Africa and Asia. (Poul Erik Petersen, Bourgeois, Ogawa, Estupinan-Day, & Ndiaye, 2005)

For difference outcome in regions, northern part of Thailand seems to have more mineral including fluoride in the water more than other region. Some people have problems with too much fluoride causes fluorosis condition. In central of Thailand, there might be some area with less access to dental service. Southern of Thailand are diverted in belief, culture and religion which might affect oral health and behavior also. As the 6th and th 7th TNOHS survey report in 2007 and 2012 a report higher DMFT in Bangkok and other urban, but lower in Northeast (Bureau of Dental Health, 2013; Dental Health Division, 2008). It is also because of different culture in different region of Thailand.

Diabetes show expected result for higher risk of periodontal disease in those who have diabetes in younger age group and more missing teeth in 60-74 years old. Since diabetes related to inflammation process and relates to periodontitis which could result in tooth loss in older age(Tavares et al., 2014).

Behavior and oral health outcomes

Behavior show expected result for dental caries in younger age group. Better oral hygiene practice show lower risk for dental caries in 35 years old group and DMFT and POP in older age group. However, there are some unexpected result in DMFT of 35 years old and dental caries for 60 years old.

For oral health behavior, it shows expected results for dental caries, but no effect for other outcome. As brushing daily is necessary to remove plaque and bacteria from

oral cavity, it is obviously seen that people who regularly brush their teeth at least twice a day have better dental caries status. Moreover, using dental floss or interdental brush could significantly reduce dental caries, since those tools helps cleaning the area which toothbrush cannot reach such as in between the teeth. Fluoride toothpaste also help to make the teeth stronger and prevent tooth decay, but it has no effect on the gum. However, brushing and using additional tools technique are also important for effectiveness of oral hygiene practice. Moreover, oral disease is multi-factorial. Food and cleaning technique also play roles in the disease which needed time to progress. People can change brushing behavior, and types of toothpaste through life. Also, fluoride alone cannot protect dental caries or other oral disease effectively.

One study was found that after adjusting for behaviors, the association between oral health and socioeconomic indicators decreases but did not disappear. It implies that improvement in health-related behaviors may better, but cannot get rid of socioeconomic disparities in oral health, and suggest the presence of more complex determinants of these disparities which should be addressed by oral health preventive policies (Sabbah et al., 2009)

Smokers show expected result for having more risk to periodontal disease in 35 years old and missing front teeth in 60-74 years old population, since smoking could have bad affect tissue around the teeth which include gum and the supporting bone underneath the gum and also saliva which could worsen the disease (Eman Allam et al., 2011). Smoking could also reflect some behavior related to oral health of the person. People who smoke seems to concern about health less than people who do not smoke or quite smoking. But, for DMFT result in younger age group, it show unexpected result. It might be because of smoking effect people who smoke for a period of time and the dose of smoking also effect, so number of cigarettes should be consider.

Access and oral health outcomes

For frequency of dental visits, people who go to dentist less than once in the past year show higher risk for periodontal disease for people age 35-44 years old. However, many other outcome are difference including missing teeth and DMFT in this age group and older age group and missing front teeth.

Frequency of dental visit might not indicate better oral health since some people go to dentist more than once for continuation of their treatment (Holde, Baker, & Jönsson, 2018). Moreover, comparing to people who do not go to dentist, they still have better oral health outcome. A study also found that patient with dental visit yearly have no different in prevalence of severity of periodontitis (Holde, Oscarson, Trovik, Tillberg, & Jönsson, 2017).

Using public provider show lower risk for all disease comparing to using private provider in younger age group. Private providers mostly have higher cost of service and less waiting time than public ones. However, this study might show some result from the past year, which that person might have symptoms and didn't want to go to public provider to wait for long time. So, they might choose private clinic instead for relieving the symptoms.

Dental insurance might not have significant result but there are some difference in level of dental caries. People with CSMBS show lower risk comparing to those with UC except for Missing teeth in older age group and DMFT in younger age group. Another study also show that people with CSMBS and SSS show higher dental service use than UC population (Jaichuen, 2017).The explanation is that people with UC can use their insurance in the specific public hospital only, otherwise the cost would not be covered. Since more than half of Thai population are covered by UC, this results in long waiting time due to high number of patients but limited dental workforce. People with SSS also have more choices for going to dental service, but the fund for dental fee was limited. On the other hand, people with CSMBS are covered for dental service or cost for any public hospital (Jaichuen, 2016).

Strength and limitations

The strength of this study is that all the outcome variables are reliable due to real oral examination by licensed dentists and standardization which is better than measuring self-report oral health or perception from subjects. This study could represent Thai population at some point as area and region since the sample was drawn multi-stage sampling technique. The methodology used in the survey followed WHO method which could compare result or situation with other countries.

The limitation of this study is that it was a cross-sectional studies which cannot indicate the casual relationship. Thailand National Oral Health Survey was designed to present oral health status, but not to find relationships between etiological factors that affect disease distribution or severity, so some etiological factors were not enough to reduce bias of the confounder. Some variables that might have influence on dependent variables were missing and not complete including diets and some other variables for age 80-89 years old. There were no data for children so it might not be representing the whole population of Thailand. It could represent only the adult and elderly. The face-to-face interview of the survey might cause some bias especially behavior of oral hygiene practice. The sample might answered the way interviewers' preference (Lavrakas, 2008).

Also, proportion of male and female are intentional to collect in the equal proportion which is not quite generalizable especially for elderly that would get female more than male from sampling since women live longer than men, so this point should be aware. Another point is that the survey was separated by age group so the analysis had to follow the available data. The age is not continuous so the representativeness for age is not normal. Distribution of oral health outcomes in 3 age groups were different, so the cut point was based on the distribution to have enough cases to compare between age groups

Data also had some limitations. Level of measurements in the survey also had some limitation which causes inconsistent results. Occupational groups in this study might not be good representative for SES since the categories was too brief and not specific the position. The data was 2012 quite not up to date, but it was the latest version available at the time of the study. Access to complete data was also limited.

Recommendation

Since SES related to oral health status, especially education, policy maker should focus on people with lower education to improve the oral health status of disadvantaged group. Increase coverage and improve service for all Thai population equally is also need to be considered.

Policy makers involving in the future survey should improve quality of data collection in terms of better and more standardized tools for socioeconomic

measurement and including all related factors and also knowledge about oral health. The data should also be more accessible for people for benefit of research in the future.

For future research, the researchers who want to use data of the survey should know the limitation and remind that oral health outcome is a long term effect which accumulated through life time. Social class and behaviors might also change over time. Doing multilevel analysis or life course study could expand the understanding about the relationship between socioeconomic status and oral health outcome.

Conclusion

SES relates to oral health indicate socioeconomic inequality in oral health for Thai population. Education is the most obvious factors among socioeconomic variables comparing to income and occupation. Behavior and access plays roles in the only some outcomes. Other related variables that relate to oral health including personal background for different outcomes including gender, area of residence, region of residence some behavior and health insurance coverage.

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Appendix

1. Interview form of the 7th National Oral Health Survey, Thailand

Age group 35-44 years old

ID □-□□-□□□□

แบบสัมภาษณ์กลุ่มอายุ 35-44 ปี
โครงการสำรวจสภาวะสุขภาพช่องปากแห่งชาติ ครั้งที่ 7 พ.ศ.2555

ตำบล.....อำเภอ.....จังหวัด.....
ผู้สัมภาษณ์..... วัน เดือน ปี ที่สัมภาษณ์ ...../.....2555.

ส่วนที่ 1 : ข้อมูลทั่วไป ทำเครื่องหมาย ✕ หน้าคำตอบที่ท่านเลือก

1 อายุนับถึงวันเกิดครั้งสุดท้าย.....ปี □□

2 เพศ [1] ชาย [2] หญิง □

3 ศาสนา [1] พุทธ [2] อิสลาม [3] คริสต์ [4] อื่นๆ(ระบุ.....) □

4 สถานภาพสมรส [1] โสด [2] สมรส [3] หม้าย [4] หย่าร้าง [5] แยกกันอยู่ □

5 อาชีพหลักหรืองานที่ใช้เวลาทำส่วนใหญ่ (ให้บันทึกลักษณะงาน/อาชีพหลักที่ทำ) □□

[01] ทำธุรกิจส่วนตัว โดยเป็นนายจ้าง
[02] ทำธุรกิจส่วนตัว โดยไม่มีลูกจ้าง
[03] ช่วยธุรกิจในครัวเรือน โดยไม่ได้รับค่าจ้าง
[04] พนักงาน ลูกจ้างรัฐบาล/รัฐวิสาหกิจ
[05] รับจ้าง
[06] เกษตรกร
[07] แม่บ้าน/ทำงานบ้าน
[08] การรวมกลุ่มเครือข่าย/ชมรมต่างๆ
[09] เรียนหนังสือ
[10] ผู้สูงอายุ ที่ไม่ได้ทำงานโดยมีรายได้
[11] กำลังหางานทำ
[12] อื่นๆ (ระบุ.....)

6 รายได้ของท่าน เฉลี่ยต่อเดือน □

[0] ไม่มีรายได้
[1] รายได้ 1–5,000 บาท
[2] รายได้ 5,001- 15,000 บาท
[3] รายได้ 15,001- 30,000 บาท
[4] รายได้ 30,001- 50,000 บาท
[5] รายได้ ตั้งแต่ 50,001 บาทขึ้นไป

7 การศึกษา (ระบุการศึกษาขั้นสูงสุด)

[0] ไม่เคยเรียน
[1] ประถมศึกษา
[2] มัธยมศึกษาตอนต้น
[3] มัธยมศึกษาตอนปลาย /ปวช.
[4] ปวส./อนุปริญญา
[5] ปริญญาตรี
[6] สูงกว่าปริญญาตรี

8 ท่านมีโรคประจำตัวหรือโรคทางระบบ ที่แพทย์ระบุ หรือไม่

8.1 เบาหวาน	[0] ไม่มี	[1] มี	[2] ไม่รู้ ไม่เคยตรวจ
8.2 ความดันโลหิตสูง	[0] ไม่มี	[1] มี	[2] ไม่รู้ ไม่เคยตรวจ
8.3 โรคหัวใจและหลอดเลือด	[0] ไม่มี	[1] มี	[2] ไม่รู้ ไม่เคยตรวจ
8.4 ภูมิแพ้	[0] ไม่มี	[1] มี	[2] ไม่รู้ ไม่เคยตรวจ
8.5 ซึมเศร้า	[0] ไม่มี	[1] มี	[2] ไม่รู้ ไม่เคยตรวจ

8.6 อื่น ๆ (ระบุ.....)

สำนักทันตสาธารณสุข กรมอนามัย กระทรวงสาธารณสุข

ส่วนที่ 2 : พฤติกรรมทันตสุขภาพ กาเครื่องหมาย ✕ หน้าคำตอบที่ใกล้ความเป็นจริงมากที่สุด

<u>พฤติกรรมการทำความสะอาดช่องปาก</u>

1. ท่านมีสภาพช่องปากเป็นอย่างไร
   - [0] ไม่มีทั้งฟันแท้และฟันเทียมในช่องปาก
   - [1] ใส่ฟันเทียมทั้งปาก
   - [2] มีฟันแท้ผสมฟันเทียมบางส่วน
   - [3] มีฟันแท้อย่างเดียว

2. ท่านทำความสะอาด "ช่องปาก" ด้วยวิธีใดเป็นประจำ (**เลือกตอบวิธีที่ทำประจำ เพียง 1 ข้อ**) และทำเวลาใดบ้าง (ตอบได้มากกว่า 1 ข้อ) ☐ 0-4
   - [0] ไม่ได้ทำอะไรเลย
   - [1] บ้วนปาก [ ] หลังตื่นนอนเช้า [ ] หลังมื้อเช้า [ ] หลังมื้อเที่ยง [ ] หลังมื้อเย็น [ ] ก่อนนอน(ไม่กิน/ดื่มต่อ) ☐☐
   - [2] ใช้มือถู [ ] หลังตื่นนอนเช้า [ ] หลังมื้อเช้า [ ] หลังมื้อเที่ยง [ ] หลังมื้อเย็น [ ] ก่อนนอน(ไม่กิน/ดื่มต่อ) ☐☐
   - [3] ใช้แปรงสีฟันถู [ ] หลังตื่นนอนเช้า [ ] หลังมื้อเช้า [ ] หลังมื้อเที่ยง [ ] หลังมื้อเย็น [ ] ก่อนนอน(ไม่กิน/ดื่มต่อ)
   - [4] อื่นๆ [ ] หลังตื่นนอนเช้า [ ] หลังมื้อเช้า [ ] หลังมื้อเที่ยง [ ] หลังมื้อเย็น [ ] ก่อนนอน(ไม่กิน/ดื่มต่อ) ☐ 0, 1

   ระบุ.....

3. กรณี "**มีฟันแท้ในช่องปาก**" และ "**ตอบว่าใช้แปรงสีฟัน ในข้อ 2**" แปรงสีฟันที่ใช้ในปัจจุบันมีลักษณะขนแปรงเป็นแบบใด ☐
   - [1] นุ่มพิเศษ [2] นุ่ม [3] ปานกลาง [4] แข็ง [5] ไม่ทราบ/ไม่แน่ใจ

4. กรณี "**มีฟันแท้ในช่องปาก**" และ "**ตอบว่าใช้แปรงสีฟัน ในข้อ 2**" ท่านใช้อุปกรณ์เสริมชนิดใดร่วมกับการแปรงฟันด้วยหรือไม่ ☐
   - [0] ไม่ได้ใช้เพิ่ม
   - [1] ใช้ไหมขัดฟัน [2] ใช้แปรงซอกฟัน [3] ใช้ไม้จิ้มฟัน [4] ใช้ยาบ้วนปาก/น้ำเกลือ
   - [5] อื่นๆ ระบุ.. .....

5. กรณี **มีฟันแท้ในช่องปาก** ปัจจุบันท่านใช้ยาสีฟันยี่ห้ออะไร (ตอบชนิดที่ใช้บ่อยที่สุด 1 ชนิด) ☐☐

[01] คอลเกต	[11] โคโดโม	[21] ซิสเทมมา
[02] ไกล้ชิด	[12] ออรัล บี	[22] ไบโอเทค
[03] ฟลูออคาริล	[13] ไพโอดอลทิล	[23] วิเศษนิยม
[04] พาโรดอนแท็ก	[14] เซนโซดายน์	[24] ดอกบัวคู่
[05] พาโรดอนแท็ก เอฟ	[15] เซนโซดายน์ เอฟ	[25] ดอกบัวคู่ เอฟ
[06] ซอลท์	[16] เอม	[26] จาเป่า
[07] ซอลท์ เอฟ	[17] กิฟฟารีน	[27] เกลือ
[08] แอมเวย์	[18] สุพรีเดิร์ม	[28] ไม่ใช้ยาสีฟัน
[09] เป๊ปโซเดนท์	[19] ออรัลเมท	[29] ผลิตภัณฑ์ชาวบ้านทำเอง ยี่ห้อ.....
[10] ดาร์ลี่	[20] ซื่อสัตย์	[30] อื่นๆ ยี่ห้อ.....

6. กรณี "**ใส่ฟันเทียมชนิดถอดได้**" ท่านทำความสะอาด "ฟันเทียม" อย่างไรเป็นประจำ ☐
   - [0] ไม่ได้ทำอะไรเลย [1] แปรงฟันเทียม [2] ล้างน้ำเปล่า [3] ล้างน้ำยาสำหรับฟันเทียม
   - [4] อื่นๆ.....

พฤติกรรมอื่นที่เกี่ยวข้อง

7. ท่านสูบบุหรี่หรือไม่ ☐ 0-2
   [0] ไม่สูบบุหรี่
   [1] เคยสูบ เคยสูบเป็นระยะเวลา.....ปี.....เดือน เฉลี่ยวันละ.....มวน ☐☐
   (ปัจจุบันเลิกแล้วนาน.....ปี.....เดือน)
   [2] ยังสูบบุหรี่จนถึงปัจจุบัน สูบมาระยะเวลา.....ปี.....เดือน เฉลี่ยวันละ.....มวน ☐☐
   (pack-yr)

8. ท่านเคี้ยวหมากหรือไม่ ☐
   [0] ไม่เคี้ยวหมาก
   [1] เคยเคี้ยว ปัจจุบันเลิกแล้ว
   [2] ยังเคี้ยวหมากอยู่

ส่วนที่ 3 : การรับรู้ และการใช้บริการทันตสุขภาพ กาเครื่องหมาย ✕ หน้าคำตอบที่ใกล้ความเป็นจริงมากที่สุด

1. ท่านประเมินสุขภาพช่องปากของท่าน อยู่ในระดับใด ☐
   [1] แย่มาก [2] แย่ [3] ปานกลาง [4] ดี [5] ดีมาก

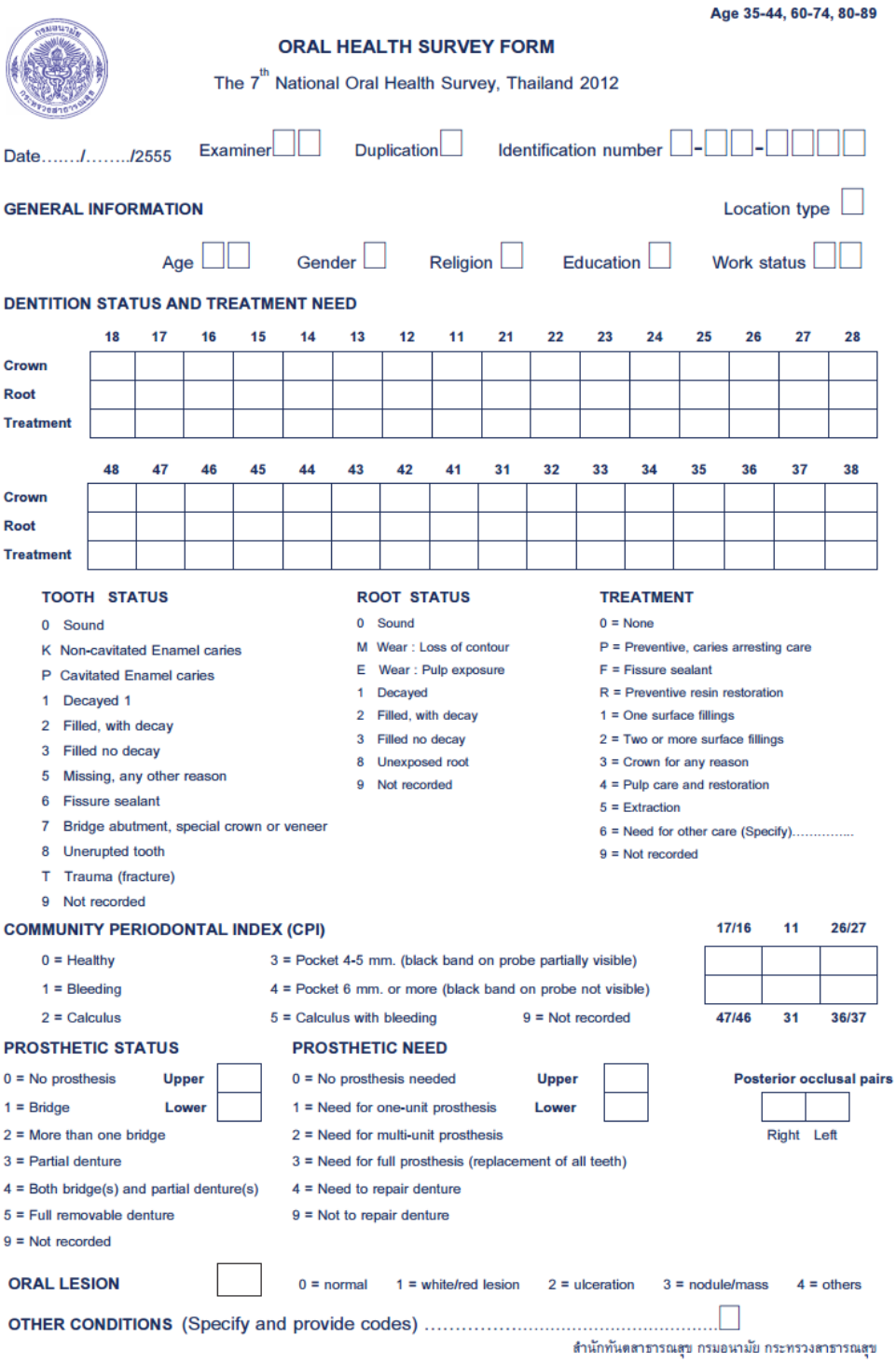
2. ท่านเคยได้รับความรู้เกี่ยวกับสุขภาพช่องปากจากแหล่งใดบ้าง (ตอบได้มากกว่า 1 ข้อ) 0 ,1
   [ ] โทรทัศน์ [ ] วิทยุ วิทยุชุมชน ☐☐
   [ ] หอกระจายข่าว [ ] โปสเตอร์ แผ่นพับ สิ่งพิมพ์ ☐☐
   [ ] เว็บไซต์ [ ] บิดา มารดา ญาติพี่น้อง ☐☐
   [ ] เพื่อน [ ] บุคลากรสาธารณสุข ☐☐
   [ ] อาสาสมัครสาธารณสุข [ ] อื่น ๆ ระบุ..... ☐☐

3. **ในรอบปีที่ผ่านมา** ท่านเคยไปหา หมอฟัน(ทันตแพทย์/เจ้าพนักงานทันตสาธารณสุข) บ้างหรือไม่ ☐
   [0] ไม่เคยไป (ให้ถามต่อข้อ 4 และ ข้อ 7)
   [1] เคยไป ระบุจำนวน .....ครั้ง. (ข้ามไปถามข้อ 5-7)
   [2] จำไม่ได้

4. กรณี **ไม่เคยไป**หาหมอฟันในรอบปีที่ผ่านมา เหตุผล **ที่ไม่ไป** คือ.... (ตอบได้มากกว่า 1 ข้อ) 0 , 1
   [ ] ไม่มีเวลา [ ] ไม่มีใครพาไป ☐☐
   [ ] ไม่มีเงิน [ ] ไม่มีอาการผิดปกติ ☐☐
   [ ] กลัวการทำฟัน [ ] กลัวประสาทเสีย ☐☐
   [ ] รอให้มีอาการมากก่อน [ ] อื่นๆระบุ..... ☐☐

5. กรณี **เคยไป**หาหมอฟันในรอบปีที่ผ่านมา เหตุผลที่**ไป** คือ..... (ตอบได้มากกว่า 1 ข้อ) [ ] ต้องการตรวจเช็ค ยังไม่มีอาการ [ ] ต้องการใส่ฟันเทียม [ ] รู้สึกมี ฟันผุ/มีจุดดำบนตัวฟัน [ ] รู้สึก ปวดฟัน/เสียวฟัน [ ] รู้สึก มีหินปูน [ ] รู้สึก มีเหงือกอักเสบ มีเลือดออกง่าย [ ] รู้สึก มีอาการบวม / มีหนอง [ ] อื่น ระบุ.....	0 , 1 ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
6. กรณี **เคยไป**หาหมอฟันในรอบปีที่ผ่านมา ท่านไปหาหมอฟันที่ไหนบ้าง (ตอบได้มากกว่า 1 ข้อ) [ ] หน่วยเคลื่อนที่ ที่มีทันตแพทย์ ทันตบุคลากรจากหน่วยงานของรัฐ [ ] รพ.สต /PCU [ ] โรงพยาบาลชุมชน [ ] โรงพยาบาลจังหวัด/ โรงพยาบาลศูนย์/ศูนย์อนามัย [ ] คลินิก/ โรงพยาบาลเอกชน [ ] อื่นๆ ระบุ.....	0 , 1 ☐ ☐ ☐ ☐ ☐ ☐
7 ปัจจุบัน ท่านมีสวัสดิการด้านการรักษาพยาบาลต่อไปนี้หรือไม่ (ตอบได้มากกว่า 1 ข้อ) [ ] สิทธิเบิกค่ารักษาจากหน่วยราชการ/รัฐวิสาหกิจ [ ] บัตรรับรองสิทธิการรักษา (ประกันสังคม) [ ] บัตรประกันสุขภาพถ้วนหน้า (30 บาท) [ ] สวัสดิการจัดโดยบริษัท/นายจ้าง [ ] บัตรประกันสุขภาพเอกชน	0 , 1 ☐ ☐ ☐ ☐ ☐

2. Oral health survey form of the 7th National Oral Health Survey, Thailand



Age 35-44, 60-74, 80-89

ORAL HEALTH SURVEY FORM

The 7th National Oral Health Survey, Thailand 2012

Date...../...../2555 Examiner☐☐ Duplication☐ Identification number ☐-☐☐-☐☐☐☐

GENERAL INFORMATION Location type ☐

Age ☐☐ Gender ☐ Religion ☐ Education ☐ Work status ☐☐

DENTITION STATUS AND TREATMENT NEED

	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Crown																
Root																
Treatment																

	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Crown																
Root																
Treatment																

TOOTH STATUS

0 Sound
K Non-cavitated Enamel caries
P Cavitated Enamel caries
1 Decayed 1
2 Filled, with decay
3 Filled no decay
5 Missing, any other reason
6 Fissure sealant
7 Bridge abutment, special crown or veneer
8 Unerupted tooth
T Trauma (fracture)
9 Not recorded

ROOT STATUS

0 Sound
M Wear : Loss of contour
E Wear : Pulp exposure
1 Decayed
2 Filled, with decay
3 Filled no decay
8 Unexposed root
9 Not recorded

TREATMENT

0 = None
P = Preventive, caries arresting care
F = Fissure sealant
R = Preventive resin restoration
1 = One surface fillings
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

COMMUNITY PERIODONTAL INDEX (CPI)

0 = Healthy
1 = Bleeding
2 = Calculus
3 = Pocket 4-5 mm. (black band on probe partially visible)
4 = Pocket 6 mm. or more (black band on probe not visible)
5 = Calculus with bleeding
9 = Not recorded

17/16	11	26/27
47/46	31	36/37

PROSTHETIC STATUS

0 = No prosthesis
1 = Bridge
2 = More than one bridge
3 = Partial denture
4 = Both bridge(s) and partial denture(s)
5 = Full removable denture
9 = Not recorded

Upper ☐ Lower ☐

PROSTHETIC NEED

0 = No prosthesis needed
1 = Need for one-unit prosthesis
2 = Need for multi-unit prosthesis
3 = Need for full prosthesis (replacement of all teeth)
4 = Need to repair denture
9 = Not to repair denture

Upper ☐ Lower ☐

Posterior occlusal pairs ☐☐ Right Left

ORAL LESION ☐ 0 = normal 1 = white/red lesion 2 = ulceration 3 = nodule/mass 4 = others

OTHER CONDITIONS (Specify and provide codes) .....☐

สำนักทันตสาธารณสุข กรมอนามัย กระทรวงสาธารณสุข

3. Tables showing interactions of income and education of oral health outcomes

Table 26 Effect of interaction between income and education on oral health outcomes, age 35-44 years old

	Dental caries				Periodontal				Missing teeth				DMFT				POP				Missing front teeth			
	Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig.
Income																								
Low income	1.14		0.847		1.126		0.768		0.844		0.657		0.711	*	0.753		2.066		1.375		1.403		1.032	
High income(ref)																								
Education																								
Primary complete or less	1.699	***	1.543	***	1.297		1.142	*	1.06		0.977		0.707	**	0.719	*	1.689	*	1.522		1.331		1.217	
At least secondary complete(ref)																								
Interaction of income and education																								
(High income)*(High education)			1.694				2.033				1.521				0.916				2.471				1.769	
Low income)*(Low education) e			N/C				N/C				N/C				N/C				N/C				N/C	
(High income)*(Low education)and																								
(Low income)*(High education) (ref)																								

OR: odds ratio from binary logistic regression analysis; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS,

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

Table 27Effect of interaction between income and education on oral health outcomes, age 60-74 years old

	Dental caries				Periodontal				Missing teeth				DMFT				POP				Missing front teeth			
	Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1		Model I0		Model I1	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig	OR	Sig.
Income																								
Low income	1.122		1.007		1.681	*	1.237		1.045		1.029		0.833		0.795		1.27		1.078		1.309		1.122	
High income(ref)																								
Education																								
Primary complete or less	1.562	*	1.417		1.703	*	1.293		0.719		0.753		0.753		0.723		1.123		0.973		0.994		0.865	
At least secondary complete(ref)																								
Interaction of income and education																								
(High income)*(High education)			1.482				4.381	*			1.064				1.181				1.754				1.697	
Low income)*(Low education) e			N/C				N/C				N/C				N/C				N/C				N/C	
(High income)*(Low education)and (Low income)*(High education) (ref)																								

OR: odds ratio from binary logistic regression analysis; Sig: significant level; N/C: not calculated due to automatic exclusion during analysis in SPSS,

*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio

4. Tables showing influence of behavior and access in income and education on oral health outcomes for age group 35-44 years old

Table 28 Influence of behavior and access in income and education on dental caries for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.140		1.023		1.510		1.308	
High income(ref)								
Education								
Primary complete or less	1.699	***	1.544	***	2.273	***	2.145	***
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.326				1.198	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.374	*			1.172	
Yes(ref)								
Use of additional cleaning tools								
No			2.168	***			2.344	**
Yes(ref)								
Smoking status								
Smoker			1.068				1.173	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.916		0.942	
at least once a year (ref)								
Place for dental service								
Public provider					0.647	*	0.579	*
Private provider(ref)								
Health Insurance coverage								
CSMBS					1.084		1.200	
SSS					0.821		0.847	
UC(ref)								
n	1517		1513		569		569	
-2 Log likelihood	1,942.664		1916.371		697.062		686.13	
Cox & Snell R Square	0.017		0.031		0.05		0.068	
Nagelkerke R Square	0.023		0.042		0.069		0.094	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 29 Influence of behavior and access in income and education on periodontal status for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.126		1.098		1.049		0.988	
High income(ref)								
Education								
Primary complete or less	1.297		1.260		1.213		1.209	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.089				1.702	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.139				0.716	
Yes(ref)								
Use of additional cleaning tools								
No			1.139				1.064	
Yes(ref)								
Smoking status								
Smoker			1.469	*			1.312	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					2.172		2.215	
at least once a year (ref)								
Place for dental service								
Public provider					0.771		0.741	
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.746		0.728	
SSS					1.376		1.409	
UC(ref)								
n	1516		1512		569		569	
-2 Log likelihood	1,310.385		1301.455		466.957		463.556	
Cox & Snell R Square	0.003		0.008		0.01		0.016	
Nagelkerke R Square	0.005		0.013		0.018		0.029	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 30 Influence of behavior and access in income and education on missing teeth for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	0.844		0.900		1.091		1.111	
High income(ref)								
Education								
Primary complete or less	1.060		1.119		1.086		1.109	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			0.796				0.890	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.947				0.837	
Yes(ref)								
Use of additional cleaning tools								
No			0.727				0.908	
Yes(ref)								
Smoking status								
Smoker			0.896				0.874	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.717		0.714	
at least once a year (ref)								
Place for dental service								
Public provider					0.579	**	0.575	**
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.911		0.899	
SSS					1.033		1.035	
UC(ref)								
n	1517		1513		569		569	
-2 Log likelihood	1,779.037		1771.177		722.346		721.25	
Cox & Snell R Square	0.001		0.004		0.014		0.016	
Nagelkerke R Square	0.001		0.006		0.019		0.022	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 31 Influence of behavior and access in income and education on Decayed Missing and Filled Teeth (DMFT) for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	0.711	*	0.850		0.910		0.966	
High income(ref)								
Education								
Primary complete or less	0.707	**	0.818		1.179		1.252	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.019				1.687	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.912				0.855	
Yes(ref)								
Use of additional cleaning tools								
No			0.380	***			0.583	*
Yes(ref)								
Smoking status								
Smoker			0.651	**			0.509	**
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.882		0.844	
at least once a year (ref)								
Place for dental service								
Public provider					0.685		0.682	
Private provider(ref)								
Health Insurance coverage								
CSMBS					2.131	**	2.084	*
SSS					1.153		1.163	
UC(ref)								
n	1517		1513		569		569	
-2 Log likelihood	1,526.367		1487.675		691.58		676.56	
Cox & Snell R Square	0.010		0.034		0.027		0.052	
Nagelkerke R Square	0.016		0.053		0.038		0.073	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 32 Influence of behavior and access in income and education on Posterior occluding pairs (POP) for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	2.066		1.958		5.065	*	4.163	
High income(ref)								
Education								
Primary complete or less	1.689	*	1.616		1.368		1.312	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.152				1.577	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.856				1.004	
Yes(ref)								
Use of additional cleaning tools								
No			1.529				2.268	
Yes(ref)								
Smoking status								
Smoker			1.226				0.978	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					2.183		2.298	
at least once a year (ref)								
Place for dental service								
Public provider					0.503		0.449	*
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.962		0.997	
SSS					0.689		0.739	
UC(ref)								
n	1517		1513		569		569	
-2 Log likelihood	692.791		689.928		260.536		257.89	
Cox & Snell R Square	0.008		0.01		0.023		0.028	
Nagelkerke R Square	0.021		0.026		0.06		0.072	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 33 Influence of behavior and access in income and education on missing front teeth for age group 35-44 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.403		1.464		1.409		1.425	
High income(ref)								
Education								
Primary complete or less	1.331		1.371		0.919		0.949	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.334				1.922	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.085				0.830	
Yes(ref)								
Use of additional cleaning tools								
No			0.718				0.696	
Yes(ref)								
Smoking status								
Smoker			1.037				1.427	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					1.448		1.433	
at least once a year (ref)								
Place for dental service								
Public provider					0.558	*	0.574	
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.395	*	0.363	*
SSS					0.372	*	0.369	*
UC(ref)								
n	1517		1513		569		569	
-2 Log likelihood	1,145.312		1141.265		452.686		447.70	
Cox & Snell R Square	0.005		0.007		0.029		0.037	
Nagelkerke R Square	0.009		0.012		0.051		0.066	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

5. Tables showing influence of behavior and access in income and education on oral health outcomes for age group 60-74 years old

Table 34 Influence of behavior and access in income and education on dental caries for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.122		1.318		0.986		1.113	
High income(ref)								
Education								
Primary complete or less	1.562	*	1.491		1.220		1.074	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			0.997				1.090	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.876				0.838	
Yes(ref)								
Use of additional cleaning tools								
No			1.614				2.277	
Yes(ref)								
Smoking status								
Smoker			0.948				0.621	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.780		1.039	
at least once a year (ref)								
Place for dental service								
Public provider					1.381		1.421	
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.414	**	0.461	*
SSS					N/C		N/C	
UC(ref)								
n	1264		1142		423		397	
-2 Log likelihood	1,744.878		1569.573		562.773		522.57	
Cox & Snell R Square	0.005		0.01		0.052		0.067	
Nagelkerke R Square	0.006		0.013		0.07		0.09	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 35 Influence of behavior and access in income and education on periodontal status for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.681	*	1.704	*	1.937		1.926	
High income(ref)								
Education								
Primary complete or less	1.703	*	1.585		0.972		0.819	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.252				1.408	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.290				1.713	
Yes(ref)								
Use of additional cleaning tools								
No			1.401				2.031	
Yes(ref)								
Smoking status								
Smoker			1.212				1.374	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					2.555		3.506	
at least once a year (ref)								
Place for dental service								
Public provider					1.457		1.353	
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.406	*	0.425	*
SSS					1.606		2.386	
UC(ref)								
n	1107		1081		383		379	
-2 Log likelihood	1,440.966		1399.508		475.184		460.67	
Cox & Snell R Square	0.012		0.019		0.05		0.074	
Nagelkerke R Square	0.016		0.026		0.068		0.103	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 36 Influence of behavior and access in income and education on missing teeth for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.045		0.985		1.612		1.448	
High income(ref)								
Education								
Primary complete or less	0.719		0.702		1.116		0.968	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			0.770				1.063	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.208				0.969	
Yes(ref)								
Use of additional cleaning tools								
No			1.033				1.229	
Yes(ref)								
Smoking status								
Smoker			0.907				0.778	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.245		0.386	
at least once a year (ref)								
Place for dental service								
Public provider					0.893		0.940	
Private provider(ref)								
Health Insurance coverage								
CSMBS					1.878		1.805	
SSS					N/C		N/C	
UC(ref)								
n	1264		1142		423		397	
-2 Log likelihood	1,335.217		1245.05		356.012		338.91	
Cox & Snell R Square	0.001		0.006		0.016		0.013	
Nagelkerke R Square	0.002		0.008		0.028		0.022	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 37 Influence of behavior and access in income and education on Decayed, Missing and Filled Teeth (DMFT) for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	0.833		0.792		1.320		1.221	
High income(ref)								
Education								
Primary complete or less	0.753		0.742		0.666		0.612	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			0.898				1.301	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.997				1.083	
Yes(ref)								
Use of additional cleaning tools								
No			0.722				0.888	
Yes(ref)								
Smoking status								
Smoker			0.935				0.603	*
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.335		0.498	
at least once a year (ref)								
Place for dental service								
Public provider					1.114		1.162	
Private provider(ref)								
Health Insurance coverage								
CSMBS					1.383		1.296	
SSS					N/C		N/C	
UC(ref)								
n	1264		1142		423		397	
-2 Log likelihood	1,656.531		1526.526		513.218		485.30	
Cox & Snell R Square	0.002		0.006		0.02		0.031	
Nagelkerke R Square	0.003		0.008		0.029		0.043	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 38 Influence of behavior and access in income and education on posterior occluding pairs (POP) for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.270		1.210		1.770		1.549	
High income(ref)								
Education								
Primary complete or less	1.123		1.022		1.306		1.038	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			0.799				0.853	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			1.026				1.046	
Yes(ref)								
Use of additional cleaning tools								
No			1.567				1.966	
Yes(ref)								
Smoking status								
Smoker			1.013				0.859	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.318		0.404	
at least once a year (ref)								
Place for dental service								
Public provider					1.053		1.076	
Private provider(ref)								
Health Insurance coverage								
CSMBS					1.360		1.199	
SSS					N/C		N/C	
UC(ref)								
n	1264		1142		423		397	
-2 Log likelihood	1,727.264		1574.141		1574.141		536.12	
Cox & Snell R Square	0.002		0.004		0.004		0.029	
Nagelkerke R Square	0.002		0.006		0.006		0.038	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

Table 39 Influence of behavior and access in income and education on missing front teeth for age group 60-74 years old

Independent variables	Model 7		Model 8		Model 9		Model 10	
	OR	Sig	OR	Sig	OR	Sig	OR	Sig
SES								
Income								
Low income	1.309		1.284		1.248		1.160	
High income(ref)								
Education								
Primary complete or less	0.994		0.880		0.722		0.565	
At least secondary complete (ref)								
Behavior								
Frequency of tooth brushing								
less than 2 times/day			1.233				1.540	
at least 2 times/day (ref)								
Use of fluoride tooth paste								
No			0.977				1.016	
Yes(ref)								
Use of additional cleaning tools								
No			1.078				1.158	
Yes(ref)								
Smoking status								
Smoker			1.231				1.109	
Non-Smoker (ref)								
Access								
Frequency of dental visit								
less than once a year					0.198		0.278	
at least once a year (ref)								
Place for dental service								
Public provider					1.380		1.407	
Private provider(ref)								
Health Insurance coverage								
CSMBS					0.719		0.636	
SSS					0.504		0.630	
UC(ref)								
n	1264		1142		423		397	
-2 Log likelihood	1,705.530		1560.67		539.774		510.74	
Cox & Snell R Square	0.001		0.005		0.019		0.026	
Nagelkerke R Square	0.002		0.007		0.025		0.035	

OR: odds ratio from binary logistic regression analysis;
N/C: not calculated due to in atypical error in SPSS
*p < 0.05, ** p < 0.01, ***p < 0.001, level of significance of odds ratio
Model 7: Income and education variables
Model 8: Income and education variables adjusted for Behavioral variables
Model 9: Income and education variables adjusted for Access variables
Model 10 Income and education variables adjusted for Behavioral and Access variables

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