Socioeconomic inequality and dental caries among Thai working age population
Analysis of Thailand National Oral Health Survey

Sirinthip Amornsuradech
*College of Public Health Sciences, Chulalongkorn University,
Bangkok, Thailand, and*
Warangkana Vejvithee
Dental Health Bureau, Ministry of Public Health, Bangkok, Thailand

Abstract

Purpose – The purpose of this paper is to determine the relationship between socioeconomic status (SES) and oral health among Thai adults.

Design/methodology/approach – This study is a cross-sectional analytical study using secondary data from the 7th Thailand National Oral Health Survey (2012). Age group 35–44 years old samples were used to represent the working age population. Oral health outcome was determined by untreated dental caries. SES was indicated by income, education and occupational groups. Demographic background, oral health-related behavior and access to dental service were adjusted for analysis. Binary logistic regression analysis was performed to determine the relationship between independent variables and oral health outcome.

Findings – People with lower education showed a higher odds ratio for having untreated dental caries before and after controlling for related variables. Those living in the north and northeast, using additional cleaning tools and going to the public provider for dental service also showed better oral health.

Research limitations/implications – The limitation of this study is that the cross-sectional study cannot indicate casual relationships. The national oral health survey was not designed to find relationships between factors. The access to data and measurement of SES was limited. The policy maker should emphasize on people with lower education which have a higher risk for dental caries to improve oral health in disadvantaged groups. Future research should include all related factors in the study including diet and knowledge about oral health. Moreover, oral health outcome is a long-term effect which accumulated through a lifetime. The social class might change over time and so do behaviors.

Originality/value – There is socioeconomic inequality in dental caries of Thai working age population.

Keywords Oral health, Dental caries, Socioeconomic inequality, Thai adult population

Paper type Short report

Introduction

Oral health is directly related to general health and quality of life[1]. Dental caries is one of the main oral health problems that affect people of all ages[2]. The global prevalence of untreated dental caries in the permanent teeth was about 35 percent, according to data in 2017[3].

Journal of Health Research
Vol. 33 No. 6, 2019
pp. 517-528
Emerald Publishing Limited
2586-940X
DOI 10.1108/JHR-03-2019-0060

One of the basic determinants that affect a population's oral health is socioeconomic status (SES). Socioeconomic inequality in oral health is defined as differences in the prevalence or incidence of oral health problems between individual people of higher and lower SES[4]. Environmental and socio-cultural risk factors also relate to oral health with intermediary risk factors such as behavior and oral health services[5]. The lower social classes are at greater risk of illness and mortality compared to their peers in a higher position[6]. Social inequality in oral health is a principal global challenge for improving oral health among populations in spite of attempts to reduce the gap across social hierarchies[5]. However, there are few studies focusing on socioeconomic inequality affecting the oral health status in developing countries including Thailand[7]. Research on inequalities in oral health could help to minimize the gap between the rich and the poor[8].

The Thailand National Oral Health Survey (TNOHS) is one means of obtaining data on the oral health status, behavior and risk factors of oral diseases in the Thai population[9]. Data from the survey are not only used in building oral health policy and programs, but also used in solving oral health problems at the national level and comparing the oral health condition, behavior and related risk factors with previous surveys at national and international levels. The TNOHS reports provide descriptive data of oral health status and related factors of all age groups and comparison between regions, which represent the oral health status of the Thai population.

This study aims to determine the relationship between the SES and oral health outcome of Thai adults using data from The 7th TNOHS (2012). It would provide more understanding of socio-behavioral determinants related to oral health and benefit policymakers involved in improving the status of oral health in Thailand. The study hypothesis is that:

H1. There is a relationship between SES and oral health among the Thai population.

Methods
Source of data
This study used secondary data from the 7th TNOHS which is a cross-sectional national survey conducted in 2012. A stratified multistage sampling technique was used in the survey. The data collection method for TNOHS included oral examination by licensed dentists and an interview. The oral examination was standardized and calibrated among the survey team following WHO Oral Health Survey Methods[10]. In the survey, index age groups were categorized based on different dentition and oral conditions, risk factors and behavior which varied by age group. There were seven age groups including 3, 5, 12, 15, 35-44, 60–69 and 80–89 years old. The population in this study included all samples from the 35–44 years old age group which represents the working age population. Permission to access and use the data was approved by the Dental Health Bureau, Ministry of Public Health, Thailand.

Socioeconomic variables
Income, education and occupational groups were used as indicators of SES. Income refers to average income per month separated by lower income (0–15,000 baht) and higher income (more than 15,000 baht). Education was indicated by the highest education level completed and was separated into completing primary education or lower and at least secondary education. Occupational groups were categorized as Personal Business, Wage-earner/freelance, Agriculture, Housekeeper and others.

Oral health variables
Evidence of untreated dental caries was used as an indicator of oral health status. Untreated caries indicates the prevalence of dental caries at the time of the survey. The outcome was categorized by the number of teeth with untreated dental caries which are "0 dental caries" and "1 or more dental caries."

Other related variables
Personal background variables. Personal background variables included age, gender, marital status, area of residence, region of residence and diabetes mellitus condition.

Behavioral variables. Factors related to oral health included individual and environmental factors[11]. Additionally, behavior also determined the social determinants of oral health[12]. Data from TNOHS also provided oral health-related behaviors from the interview including tooth brushing, use of fluoride toothpaste and use of additional cleaning tools. Tooth brushing was categorized into brushing at least two times a day or less than two times a day. Use of fluoride toothpaste was categorized into use or no use of fluoride toothpaste. Use of additional cleaning tools included those who use dental floss or an interdental brush. Smoking status refers to non-smokers and smokers which included former smoker and current smoker.

Access to dental service variables. Access to dental service was determined by the frequency of dental visits in the past year, type of dental service use (public or private provider) and health insurance coverage which include Civil Servant Medical Benefits Scheme (CSMBS), Social Security Scheme (SSS) and Universal Coverage (UC).

Ethical consideration
The study was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (COA No. 095/2018).

Statistical analysis
Data were analyzed with SPSS Software version 22, using Chulalongkorn University's license. Descriptive analysis was presented in frequency, percentage, for categorical variables and presented in mean and standard deviation for the continuous variable.

The relationship between SES and dental caries was determined by binary logistic regression. Bivariate analysis without controlling for other variables and multivariate analysis with control for different groups of independent variables were performed to assess changes in significance and the coefficient.

Results
A total of 1,518 eligible subjects were included in the study. Distributions of independent and dependent variables are shown in Table I. About fourth-fifths of the population had an average income at 0–15,000 baht per month. Almost 40 percent of the population had completed secondary education with agriculture being the most popular occupation. There were more females than males in this study with about 80.0 percent of them married. Distribution of area and region of residence were distributed according to the sample design. Few people at this age had diabetes. More than 85 percent brushed their teeth twice a day and used fluoride toothpaste, while only 10.7 percent used additional cleaning tools. About 27 percent were current smokers and former smokers. Surprisingly, only 37.7 percent went to the dentist in the past year. More than 70 percent went to a public provider indicating a high percentage of the population with UC coverage. For dental caries status, 35.2 percent of the population presented one or more dental caries.

Bivariate analysis
Table II shows the result from binary logistic regression analysis for dental caries age 35–44 years old. All SES variables presented significant effects of having at least one dental caries. Those who were educated to a lower level and had a lower income significantly showed more odds ratio (OR) of having dental caries compared to those at higher levels. In the comparison of occupations, housekeepers had the highest OR of having dental caries,

Variables	$n = 1{,}518$	%
SES		
Income per month (baht)		
0–15,000	1,242	81.9
> 15,000	275	18.1
Education		
Primary complete or lower	928	61.1
At least secondary complete	590	38.9
Occupation		
Business	191	12.6
Wage-earner/freelance	310	20.4
Agriculture	568	37.4
Housekeeper	90	5.9
Others[a]	359	23.6
Personal background		
Age[b] (mean ± SD)	39.58 ± 2.78	
Gender		
Male	726	47.8
Female	792	52.2
Marital status		
Previously married	83	5.5
Married	1,215	80.0
Single	220	14.5
Area of residence		
Bangkok	134	8.8
Other urban	465	30.6
Rural	919	60.5
Region of residence		
Central	317	20.9
North	257	16.9
Northeast	554	36.5
South	256	16.9
Bangkok	134	8.8
Having diabetes mellitus		
Yes	49	3.5
No	1,370	96.5
Behavior		
Frequency of tooth brushing		
Less than 2 times/day	127	8.4
At least 2 times/day	1,391	91.6
Use of fluoride toothpaste		
No	197	13.0
Yes	1,317	87.0
Use additional cleaning tools		
No	1,355	89.3
Yes	163	10.7
Smoking status		
Smoker	422	27.8
Non-smoker	1,096	72.2
Access to dental service		
Frequency of dental visit		
Less than once a year	945	62.3
At least once a year	573	37.7

Table I.
Distributions of
independent and
dependent variables

(*continued*)

Variables	$n = 1{,}518$	%
Place for dental service		
Public provider	443	76.0
Private provider	140	24.0
Health insurance coverage		
CSMBS	206	13.8
SSS	226	15.2
UC	1,058	71.0
Oral health outcome		
Dental caries		
0	984	64.8
≥1	534	35.2

Notes: [a]Others in occupational groups include employee/government worker, associates of network/clubs, elderly with income, studying and finding a job; [b]age is presented in mean ± standard deviation (SD); CSMBS, Civil Servant Medical Benefit Scheme; SSS, Social Security Scheme; UC, Universal Health Coverage

followed by wage-earners, business and agriculture employees. The personal background showed no significant OR.

Multivariate analysis
Table III shows the multivariate result of SES when controlling for each group of variables. Education obviously showed significant coefficients in all models, while income and occupation did not show any significance. This indicates that people with lower education were more at risk of developing dental caries while other SES variables showed no significant difference in having dental caries.

When controlling for two groups of variables at a time in Table IV, only some variables remained significant. In Model 7, where all variables were controlled, education increased the magnitude but decreased at a significant level. Use of additional cleaning tools was a significant advantage across with those who did not use additional cleaning tools showing higher OR than those who did. Furthermore, the north and northeast regions showed lower OR than Bangkok in all models.

Discussion
This study aimed to determine the relationship between SES and oral health outcome among Thai working age adults using data from the 7th TNOHS. Among all three SES variables, lower educated individuals showed a significantly higher risk for dental caries in the 35–44 years adult population as presented in table III and IV.

Similar to this study, 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[13]. A recent study of the Japanese population also found a higher risk for poor oral health in the lower education group[14]. However, for this study, income and occupational groups did not show significant result like other studies[15]. It might be because of the limited measurement in the survey.

Education could lead to health knowledge and increase cognitive skills for health-promoting behavior[16]. People with higher education are aware of their health more than those with a lower education level. Better education could also lead to high income and better occupation together with better social capital[17].

Independent variables	OR	Model 0 p-value	Sig.
SES			
Income per month(baht)			
0–15,000	1.375	0.028	*
> 15,000 (ref)			
Education			
Primary complete or less	1.745	< 0.000	***
At least secondary complete (ref)			
Occupation			
Business	1.665	0.007	**
Wage-earner/freelance	1.844	< 0.000	***
Agriculture	1.227	0.165	
Housekeeper	1.927	0.007	**
Others (ref)			
Personal background			
Age	1.019	0.329	
Gender			
Male	0.866	0.183	
Female			
Marital status			
Previously married	1.225	0.449	
Married	1.130	0.432	
Single (ref)			
Area of residence			
Bangkok	1.024	0.901	
Other urban	0.880	0.286	
Rural (ref)			
Region of residence			
Central	1.206	0.379	
North	0.951	0.821	
Northeast	0.674	0.052	
South	1.286	0.251	
Bangkok (ref)			
Having diabetes mellitus			
Yes	0.665	0.215	
No (ref)			
Behavior			
Frequency of tooth brushing			
Less than 2 times/day	1.507	0.029	*
At least 2 times/day (ref)			
Use of fluoride toothpaste			
No	1.403	0.030	*
Yes(ref)			
Use of additional cleaning tools			
No	2.626	< 0.000	***
Yes (ref)			
Smoking status			
Smoker	1.146	0.252	
Non-smoker (ref)			
Access			
Frequency of dental visit			
Less than once a year	1.098	0.401	
At least once a year (ref)			
Place for dental service			
Public provider	0.774	0.205	
Private provider (ref)			
Health insurance coverage			
CSMBS	0.622	0.005	**
SSS	0.763	0.084	
UC (ref)			

Table II.
Bivariate analysis using binary logistic regression for having one or more dental caries in 35–44 years old age group

Notes: 95% CI; $n = 1,518$. SES, socioeconomic status; ref, reference; CSMBS, Civil Servant Medical Benefit Scheme; SSS, Social Security Scheme; UC, Universal Health Coverage; OR, odds ratio; Sig., significant level; N/C, not calculated due to automatic exclusion during analysis in SPSS. *$p \leqslant 0.05$; **$p \leqslant 0.01$; ***$p \leqslant 0.001$, level of significance of odds ratio

Independent variables	Model 1 OR	Model 1 p-value	Sig.	Model 2 OR	Model 2 p-value	Sig.	Model 3 OR	Model 3 p-value	Sig.
SES									
Income per month (baht)									
0–15,000	1.308	0.103		1.028	0.861		1.465	0.158	
> 15,000 (ref)									
Education									
Primary complete or less	1.765	< 0.000	***	1.644	< 0.000	***	2.361	< 0.000	***
At least secondary complete (ref)									
Occupation									
Business	1.250	0.288		1.191	0.391		0.828	0.649	
Wage-earner/freelance	1.238	0.277		1.170	0.404		1.119	0.749	
Agriculture	0.839	0.364		0.732	0.081		0.594	0.152	
Housekeeper	1.050	0.863		1.243	0.420		0.933	0.877	
Others (ref)									
Personal background									
Age	1.016	0.440							
Gender									
Male									
Female	0.964	0.761							
Marital status									
Previously married	1.141	0.647							
Married	0.942	0.725							
Single (ref)									
Area of residence									
Bangkok	0.705	0.150							
Other urban	0.962	0.784							
Rural (ref)									
Region of residence									
Central	0.802	0.226							
North	0.578	0.006	**						
Northeast	0.492	< 0.000	***						
South	N/C	N/C							
Bangkok (ref)									

(continued)

Table III.
Multivariate analysis
using binary logistic
regression for having
one or more dental
caries in 35–44 years
old age group (95% CI)

Table III.

Independent variables	Model 1 OR	Model 1 p-value	Model 1 Sig.	Model 2 OR	Model 2 p-value	Model 2 Sig.	Model 3 OR	Model 3 p-value	Model 3 Sig.
Having diabetes mellitus									
Yes	0.611	0.143							
No (ref)									
Behavior									
Frequency of tooth brushing									
Less than 2 times/day				1.360	0.110				
At least 2 times/day (ref)									
Use of fluoride toothpaste									
No				1.348	0.061				
Yes (ref)									
Use of additional cleaning tools									
No				2.278	< 0.000	***			
Yes (ref)									
Smoking status									
Smoker				1.072	0.574				
Non-smoker (ref)									
Access									
Frequency of dental visit									
Less than once a year							0.919	0.884	
At least once a year (ref)									
Place for dental service									
Public provider							0.676	0.074	
Private provider (ref)									
Health insurance coverage									
CSMBS							0.857	0.691	
SSS							0.639	0.179	
UC (ref)									
−2 Log likelihood	1,775.101			1,901.215			691.109		
Cox & Snell R^2	0.041			0.040			0.060		
Nagelkerke R^2	0.057			0.055			0.083		

Notes: SES, socioeconomic status; ref, reference; CSMBS, Civil Servant Medical Benefit Scheme; SSS, Social Security Scheme; UC, Universal Health Coverage; OR, odds ratio; Sig., significant level; N/C, not calculated due to automatic exclusion during analysis in SPSS. Model 1: SES variables adjusted for background variables; Model 2: SES variables adjusted for behavioral variables; Model 3: SES variables adjusted for access variables. *$p \leqslant 0.05$; **$p \leqslant 0.01$; ***$p \leqslant 0.001$, level of significance of odds ratio

Independent variables	Model 4 OR	Model 4 p-value	Model 4 Sig.	Model 5 OR	Model 5 p-value	Model 5 Sig.	Model 6 OR	Model 6 p-value	Model 6 Sig.	Model 7 OR	Model 7 p-value	Model 7 Sig.
SES												
Income per month (baht)												
0–15,000	1.158	0.384		1.617	0.093		1.260	0.402		1.345	0.315	
>15,000 (ref)												
Education												
Primary complete or less	1.611	0.001	***	2.150	0.002	**	2.251	0.001	***	1.970	0.007	**
At least secondary complete (ref)												
Occupation												
Business	1.146	0.526		1.017	0.970		0.788	0.569		0.967	0.940	
Wage-earner /freelance	1.109	0.605		1.347	0.423		1.026	0.944		1.282	0.509	
Agriculture	0.771	0.187		0.636	0.236		0.542	0.096		0.624	0.225	
Housekeeper	0.947	0.849		0.881	0.791		0.942	0.896		0.876	0.784	
Others (ref)												
Personal background												
Age	1.019	0.371		1.055	0.123					1.060	0.103	
Gender												
Male	0.757	0.072		0.885	0.558					0.610	0.067	
Female												
Marital status												
Previously married	1.105	0.732		2.114	0.142					1.764	0.272	
Married	0.901	0.547		1.007	0.980					0.832	0.552	
Single (ref)												
Area of residence												
Bangkok	0.722	0.187		0.552	0.152					0.545	0.152	
Other urban	1.008	0.957		0.875	0.564					0.926	0.745	
Rural (ref)												
Region of residence												
Central	0.724	0.082		0.667	0.165					0.615	0.104	
North	0.530	0.002	**	0.471	0.032	*				0.438	0.022	*
Northeast	0.437	<0.000	***	0.526	0.018	*				0.458	0.006	**
South	N/C	N/C		N/C	N/C					N/C	N/C	
Bangkok (ref)												

(*continued*)

Table IV.
Multivariate analysis
using binary logistic
regression for having
one1 or more dental
caries in 35–44 years
old age group (95% CI)

Table IV.

Independent variables	Model 4 OR	Model 4 p-value	Model 4 Sig.	Model 5 OR	Model 5 p-value	Model 5 Sig.	Model 6 OR	Model 6 p-value	Model 6 Sig.	Model 7 OR	Model 7 p-value	Model 7 Sig.
Having diabetes mellitus												
Yes	0.619	0.158		1.025	0.963					1.082	0.886	
No (ref)												
Behavior												
Frequency of tooth brushing												
Less than 2 times/day	1.617	0.020	*				1.150	0.704		1.380	0.398	
At least 2 times/day (ref)												
Use of fluoride toothpaste												
No	1.367	0.063					1.171	0.565		1.157	0.614	
Yes (ref)												
Use of additional cleaning tools												
No	2.560	< 0.000	***				2.471	0.002	**	2.866	0.001	***
Yes (ref)												
Smoking status												
Smoker	1.321	0.093					1.133	0.588		1.710	0.077	
Non-Smoker (ref)												
Access												
Frequency of dental visit												
Less than once a year				1.121	0.848		0.954	0.936		1.170	0.797	
At least once a year (ref)												
Place for dental service												
Public provider				0.631	0.053		0.600	0.025	*	0.521	0.009	**
Private provider (ref)												
Health insurance coverage												
CSMBS				0.961	0.921		0.905	0.797		1.016	0.968	
SSS				0.706	0.318		0.641	0.187		0.709	0.330	
UC (ref)												
−2 Log likelihood	1,741.143			643.144			679.542			625.777		
Cox & Snell R^2	0.063			0.073			0.079			0.102		
Nagelkerke R^2	0.086			0.101			0.109			0.142		

Notes: SES, socioeconomic status; ref. reference; CSMBS, Civil Servant Medical Benefit Scheme; SSS, Social Security Scheme; UC, Universal Health Coverage; OR, odds ratio; Sig: significant level; N/C, not calculated due to automatic exclusion during analysis in SPSS. Model 4: SES variables adjusted for background and behavioral variables; Model 5: SES variables adjusted for background and access variables; Model 6: SES variables adjusted for behavioral and access variables; Model 7: SES variables adjusted for income, education, occupation, personal background, behavioral and access. *$p \leqslant 0.05$; **$p \leqslant 0.01$; ***$p \leqslant 0.001$, level of significance of odds ratio

The strength of this study is the reliable outcome variable due to actual oral examination and standardization by dentists which is better than using self-reporting or perception methods. Moreover, the sample was drawn from across regions and provinces across Thailand supplying a broad spectrum of the population. Furthermore, WHO methodology used in the survey makes it possible to compare the result and situation with other countries.

The limitation of this study is that it is a cross-sectional study which cannot tell the causal relationship. Moreover, the national oral health survey was designed to obtain oral health status of Thai population but not to find relationships between factors. The access to data was limited and the measurement of SES was also a limitation. Some related variables such as diet and knowledge about oral health were also not available in the survey.

Policymakers should focus on people with lower education who have a higher risk of dental caries to improve oral health in disadvantaged groups. Future research should include all related factors in the study including diet. Moreover, future surveys should also include all related factors and knowledge about oral health. Furthermore, oral health outcome is a long-term study that requires data accumulated through a lifetime. Because an individual's behaviors and social class might change over time, it is important to draw attention to this clause too. Performing multilevel analyses or studies of a population's entire life could expand the understanding of the relationship[18].

Conclusion
SES related to dental caries indicates socioeconomic inequality in oral health amongst Thai working age adults. Education was the most significant factor among socioeconomic variables compared to income and occupation. Area of residence, oral health-related behavior and access to dental service also related to oral health. However, this study could not indicate causal relationships and lack of some related variables. Future policy should emphasize support for disadvantaged groups to improve their oral health.

References

1. Allen PF. Assessment of oral health related quality of life. Health Qual Life Outcomes. 2003 Sep 8; 1: 40 doi: 10.1186/1477-7525-1-40.

2. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, et al. Global burden of oral conditions in 1990-2010: a systematic analysis. J Dent Res. 2013 Jul; 92(7): 592-7.

3. Frencken JE, Sharma P, Stenhouse L, Green D, Laverty D, Dietrich T. Global epidemiology of dental caries and severe periodontitis – a comprehensive review. J Clin Periodontol. 2017 Mar; 44(S18): S94-105.

4. Locker D, Ford J. Using area-based measures of socioeconomic status in dental health services research. J Public Health Dent. 1996; 56(2): 69-75.

5. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol. 2003 Dec; 31(S1): 3-23.

6. Wilkinson R, Marmot M. Social determinants of health: the solid facts. Copenhagen: WHO Regional Office for Europe; 2003.

7. Somkotra T. Socioeconomic inequality in self-reported oral health status: the experience of Thailand after implementation of the Universal Coverage policy2011. Community Dent Health. 2011 Jun; 28(2): 136-42.

8. Petersen PE, Kwan S. Equity, social determinants and public health programmes – the case of oral health. Community Dent Oral Epidemiol. 2011 Dec; 39(6): 481-7.

9. Thailand, Bureau of Dental Health. Report on the seventh national oral health survey of Thailand 2012. Nonthaburi: Department of Health, Ministry of Public Health; 2013.

10. World Health Organization (WHO). Oral health surveys basic methods. 4th ed. Geneva: WHO; 1997.

11. Gupta E, Robinson PG, Marya CM, Baker SR. Oral health inequalities: relationships between environmental and individual factors. J Dent Res. 2015 Oct; 94(10): 1362-8.

12. Newton JT, Bower EJ. The social determinants of oral health: new approaches to conceptualizing and researching complex causal networks. Community Dent Oral Epidemiol. 2005 Feb; 33(1): 25-34.

13. Capurro DA, Davidsen M. Socioeconomic inequalities in dental health among middle-aged adults and the role of behavioral and psychosocial factors: evidence from the Spanish National Health Survey. Int J Equity Health. 2017 Feb; 16(1): 34 doi: 10.1186/s12939-017-0529-7.

14. Murakami K, Ohkubo T, Nakamura M, Ninomiya T, Ojima T, Shirai K, et al. Socioeconomic inequalities in oral health among middle-aged and elderly Japanese: NIPPON DATA2010. J Epidemiol. 2018; 28(S3): S59-65.

15. Geyer S, Schneller T, Micheelis W. Social gradients and cumulative effects of income and education on dental health in the Fourth German Oral Health Study. Community Dent Oral Epidemiol. 2010 Apr; 38(2): 120-8.

16. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. J Health Econ. 2010 Jan; 29(1): 1-28.

17. Abel T. Cultural capital and social inequality in health. J Epidemiol Community Health. 2008 Jul; 62(7): e13.

18. Broadbent JM, Zeng J, Foster Page LA, Baker SR, Ramrakha S, Thomson WM. Oral health-related beliefs, behaviors, and outcomes through the life course. J Dent Res. 2016 Jul; 95(7): 808-13.

Corresponding author
Sirinthip Amornsuradech can be contacted at: sirinthip.amo@mahidol.edu