

Socioeconomic inequality in self-reported oral health status: The experience of Thailand after implementation of the Universal Coverage policy

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Objectives: This study aimed to quantify the extent to which socioeconomic-related inequality in self-reported oral health status among Thais is present after the country implemented the Universal Coverage policy and to decompose the determinants and their associations with inequality in self-reported oral health status in particular with the worse condition. **Design and Method:** The study employed a concentration index to measure socioeconomic-related inequality in self-reported oral health status, and the decomposition method to identify the determinants and their associations with inequality in oral health-related measures. Data from 32,748 Thai adults aged 15–75 years from the nationally representative Health & Welfare Survey and Socio-Economic Survey 2006 were used in analyses. **Results:** Reports of worse oral health status of the lower socioeconomic-status group were more common than their higher socioeconomic-status counterparts. The concentration index (equaling -0.208) corroborates the finding of pro-poor inequality in self-reported worse oral health. Decomposition analysis demonstrated certain demographic-, socioeconomic-, and geographic characteristics are particularly associated with poor-rich differences in self-reported oral health status among Thai adults. **Conclusions:** This study demonstrated socioeconomic-related inequality in oral health is discernable along the entire spectrum of socioeconomic status. Inequality in perceived oral health status among Thais is present even while the country has virtually achieved universality of health coverage. The study also indicates population subgroups, particularly the poor, should receive consideration for improving oral health status as revealed by underlying determinants.

Key words: Decomposition, determinants, inequality, self-reported oral health, Thailand, universal coverage

Introduction

The persistence of inequality in oral health is a universal phenomenon, notwithstanding concerted efforts to ameliorate such inequality (Petersen, 2003), and exists between high and low socioeconomic-status groups (Poulton *et al.*, 2002; Sabbah *et al.*, 2007; Sabbah *et al.*, 2009; Sanders *et al.*, 2006a; Wamala *et al.*, 2006). Therefore, reducing inequality in oral health across the social hierarchy is indicated as one of the principal global challenges for improving oral health among populations (Petersen, 2003). To achieve that goal, however, the action on social determinants of health needs to be addressed (Marmot *et al.*, 2006; the Commission on Social Determinants of Health/WHO, 2008). Because, to be successful in alleviating inequality in oral health, interventions need to be guided by frameworks which are developed from understanding the origins and processes underlying inequality in oral health termed ‘the social determinants of oral health inequality’ (Sisson, 2007; Watt, 2007).

In Thailand, inequalities in oral health among populations are well-entrenched. The prevalence of oral diseases, for example, was noticeable in deprived areas, and the oral health status of those belonging to the lower socioeconomic-status group was generally worse than their higher socioeconomic-status counterparts. Until recently, the poor have had *de facto* restricted access to health services. This was, *in part*, due to the inequality in the

health care system, as there was no universal insurance coverage and unevenly distributed resources across the country for providing oral care to facilitate the improvement of oral health status of the poor (Wibulpolprasert, 2005). The Thai Constitution states health is a basic right, and equal access to basic health services should be guaranteed. Indeed, the Thai government addressed this concern by introducing the ‘Universal Coverage’ (UC) policy in 2001, which was implemented nationwide in April, 2002. Currently, there are three major health insurance schemes (i.e. the Civil Servant Medical Benefit Scheme (CSMBS), the Social Security Scheme (SSS), and the Universal Coverage Scheme (UCS)) to provide health care including oral health care for the population with approximately 96 percent of Thais covered (Somkotra and Lagrada, 2008). Although these schemes differ somewhat, basic treatment (i.e., examination, restorations, periodontal treatment, and extractions) are covered in each of these schemes. Accordingly, the current Thai health system explicitly aims to eliminate inequality in terms of access to and utilization of oral health services, particularly among the poor who were previously uninsured and had financial barriers to obtaining care. However, a recent study reported inequality in oral health care utilization among Thais, and indicated a pro-rich utilization, i.e. the better-off utilize such care more often than do the less well-off (Somkotra and Detsomboonrat, 2009).

The health care system itself is a determinant of health, influenced by and influencing, other determinants (the Commission on Social Determinants of Health/WHO, 2008). After the implementation of UC policy in Thailand, monitoring and assessment of health-related outcomes with respect to the equity-oriented goal are of interest. Recent studies have provided evidence of socioeconomic inequality in reported health morbidity (e.g., recent illness, chronic illness), and self-assessed health in particular with the worse condition, were concentrated more among poor Thais (Yiengprugsawan *et al.*, 2007, 2009). While, there is less evidence in Thailand demonstrating the situation of whether socioeconomic inequality in reported oral health status among populations is present, and the associations of underlying determinants with such inequality, the national oral health examination surveys recently revealed disparities in oral health status across the country (Department of Health/ Ministry of Public Health, 2008).

This study has sought to fill the information gap concerning socioeconomic inequalities in oral health-related outcomes, as currently present, after implementation of UC policy in Thailand. Some pertinent questions, i.e., “what is the distribution of socioeconomic inequality in self-reported oral health status among Thais?” and “how are the underlying determinants associated with inequality in oral health, if any evidence of inequality is discovered?” were raised. Therefore, the objectives of this study were two-fold: firstly, to quantify the extent of socioeconomic-related inequality in self-reported oral health status among Thai adults, and secondly, to decompose the determinants and their associations with socioeconomic-related inequality in self-reported oral health status.

To our knowledge, there has been limited study of the socioeconomic-related inequality in self-reported oral health status in the context of developing nations. Also, Thailand is an interesting case among developing countries as it has attempted to address concerns over inequalities in health-related outcome through its UC policy. In addition, it is a challenge for health policy makers to address the profound implications for improving the inequality in oral health through understanding and identifying the underlying determinants of inequality in oral health status.

Methods

Data and variables

The data were taken from a nationally representative Health and Welfare Survey (HWS) 2006, conducted as an accompaniment to the Socio-Economic Survey (SES) 2006 by the National Statistical Office of Thailand. This survey employed two-stage stratified sampling and survey weights to represent the country’s population. Data from 32,748 adults (aged 15-75 years) who completed a self-response interview were used in analyses.

To measure socioeconomic inequality in self-reported oral health status in this study, the observed oral health status was derived from HWS2006 based on the question ‘whether you had any oral health problem, oral pain/discomfort during the past month, and, if so, how was the condition’. This question had five response options:

1) ‘extreme’, 2) ‘severe’, 3) ‘moderate’, 4) ‘mild’, and 5) ‘not a problem’. The outcome measurement of interest here is whether the respondent had a worse oral health status during the past month. Thus a value of 1 was assigned if the respondent reported oral health status in category 1 or 2; a value of 0 was assigned for all other responses. This principal variable served as the proxy for self-reported oral health status in particular with the worse condition.

The potential deterministic variables used in the analyses were selected with respect to certain determinants as proposed in the literature (Marmot *et al.*, 2006, Nettleton, 2006, Yiengprugsawan *et al.*, 2007) and were available in the SES&HWS 2006 used in this study. These variables comprised: 1) demographic characteristics, i.e., age (categorized into four groups) and sex (male and female) which were then combined to be age-sex interaction categories, marital status (single, married, and widowed/separated/divorced); 2) geographic characteristics, i.e., geographic regions and type of municipality (rural or urban residency); and 3) socioeconomic characteristics, i.e., four levels of education, eight groups of occupations, and socioeconomic status. Furthermore, insurance entitlement comprising three groups of insurance schemes, together with no publicly-subsidized insurance entitlement was used as a reference category. Two oral health-related behaviours, i.e., whether utilizing dental care in the past twelve months, and smoking habits, were included in the analyses.

For the proxy of socioeconomic status, this study used household consumption, defined as monthly household food and non-food expenditures, which was recommended as the preferred measure of standard of living. In addition, to adjust for variation in the standard of living associated with the number and age composition of household members, household consumption was then divided by the equivalence scale, defined as $e_h = (A_h + 0.5K_h)^{0.75}$ where A_h is the number of adults in household and K_h is the number of children (aged 0-14 years), to derive the equivalent household consumption per household member. This variable was used to rank individual samples and to categorize them into quintiles- ranging from the poorest (Q1) to richest (Q5)- in this study (Somkotra and Lagrada, 2008; Somkotra and Detsomboonrat, 2009).

Measuring socioeconomic-related inequality in self-reported oral health status

Measuring inequality in health-related outcomes of interest across the distribution of socioeconomic status, although convenient, provides only a partial picture and is difficult to compare, for example, across types of socioeconomic indicators or different periods of assessment. This can be achieved by utilizing the health concentration index (CI) which has been used in the literature to measure socioeconomic-related inequality in health status. The CI can quantify the extent to which socioeconomic-related inequality in measured health parameters is present, including any health-related variables of interest, across socioeconomic strata. This approach was employed in this study.

For a measure of socioeconomic inequality in the health variable (y), the CI takes a value of zero when there is no inequality. CI takes a negative value when there is pro-poor inequality in health-related variable, i.e., the health variable of interest is concentrated at a lower socioeconomic-status level. Conversely, a positive value indicates a concentration in a higher socioeconomic status. The minimum and maximum values of CI range from -1 to +1, which occur when the measured health variable is concentrated in the least and most advantageous persons, respectively. The computation for CI has been demonstrated in the literature (O'Donnell *et al.*, 2007; Somkotra and Detsomboonrat, 2009; van Doorslaer *et al.*, 2004; Yiengprugsawan *et al.*, 2007).

Along with the concentration index, the odds ratios (OR) and 95% confidence interval (95%CI) were computed using parameter estimates and their variances/covariances and obtained from a logistic regression model. This analysis was employed to shed light on the socioeconomic inequality across quintiles in self-reported oral health status with the worse condition.

Decomposing socioeconomic-related inequality in self-reported oral health status

Decomposing the measured degree of inequality into the contributions of explanatory variables can be achieved through the following linear additive model:

$$y = \alpha + \sum_i \beta_i x_i + \varepsilon \quad (\text{eq.1})$$

where y is the measured health variable, the x_i variables are potential health determinants, β_i are the regression coefficients and ε is an error term. Given the relationship between y and x_i in eq.1, the concentration index for y can then be written as:

$$CI_y = \sum_i (\beta_i \bar{x}_i / \mu) CI_{x_i} + GC_\varepsilon / \mu \quad (\text{eq.2})$$

where μ is the mean of y , and β_i , \bar{x}_i and CI_{x_i} are the coefficient regression, mean and concentration index of x_i respectively, and GC_ε is the concentration index for ε (i.e. the residual). In other words, CI_y is equal to a weighted sum of the concentration indices of x_i , where the weight equals the elasticity of y with respect to x_i , given as η_i , defined as $\eta_i = \beta_i \bar{x}_i / \mu$.

The decomposition method identifies how each determinant contributes to total inequality of the measured health variable through two meaningful parts. That is, i) its impact on health outcome (measured by η_i), and ii) its degree of unequal distribution across socioeconomic status (measured by CI_{x_i}). The sign of the deterministic contribution, such as a negative sign, can arise either because a deterministic variable is more prevalent among people of lower socioeconomic status together with its positive association with measured health, or the reverse. A *negative* contribution value means that the effect of the determinant is to *lower* the inequality that favors the better-off (i.e. to lower pro-rich inequality) whereas a positive contribution value has the opposite interpretation (O'Donnell *et al.*, 2007; van Doorslaer *et al.*, 2004; Yiengprugsawan *et al.*, 2007).

The decomposition method is based on a linear regression model, which may not be appropriate for a

binary variable such as the principal outcome variable examined here. However, it can be applied to non-linear estimation by using an approximation technique in which the marginal effect (dy/dx) will be obtained after regression, such as the logistic regression being used in this study (O'Donnell *et al.*, 2007; van Doorslaer *et al.*, 2004). The marginal effect gives the change in predicted probability associated with unit change in an explanatory variable. The positive/negative sign of the marginal effect demonstrates the positive/negative association with the outcome variable.

Sample weights were applied in all computations in order to make the results more representative of the country's population. STATA 9 was used to conduct all analyses.

Results

Self-reported oral health status among Thai adults varied across socioeconomic-status quintiles as revealed in Table 1. Assessing the principal-observed oral health variable, i.e., having worse oral health status during the past month, although the gradient was subtle, it decreased from the 1st- to the 5th quintile. The study found 1.01% of those belonging to lowest quintile reported an oral health status in worse condition, while only 0.53% in the highest quintile did so. The investigation of socioeconomic-related inequality through the measured CI revealed a significant negative CI value of -0.208 (Table 1) indicating a pro-poor inequality in self-reported worse oral health status. In other words, a worse oral health status during the past month was reported more often among those of lower socioeconomic status.

Along with the measure of socioeconomic inequality in self-reported worse oral health status, Table 2 reveals a decrease in the unadjusted odds ratio (OR) for self-reported worse oral health status from the lowest to the higher quintiles (Model 1). Compared with the highest quintile (as the reference group) those belonging to the lower quintile had a greater likelihood to report a worse oral health status. An adjustment for other determinants such as occupational-, educational-, and geographic characteristics (Model 2), or additional adjustment for demographic characteristics, insurance entitlement, dental care utilization and smoking habits (Model 3), tended to attenuate the magnitude of the odds ratios, and were consistent with flatter gradients. However, the odds ratios gradients across socioeconomic strata are manifest despite their lack of significance.

To determine how various determinants contributed to the inequality in oral health measured in this study (i.e. pro-poor inequality in self-reported worse oral health status), the decomposition analysis provided an explanation. First, Column A and Column B in Table 3 present means and CIs of a series of determinants representing the proportionate distribution of respondents across categories, and indicate the poor-rich distribution of determinants, respectively. The marginal effect of each determinant obtained from logistic regression yields a consistent sign with its beta coefficient. As mentioned in the Method section, the contribution of each determinant (Column D) is obtained from its marginal effect (Column C) multiplied by its mean (Column A) and CI (Column B), then divided by the mean of the observed oral health

Table 1. Distribution of self-reported oral health status among Thai adults across household quintiles (n=32,748)

self-reported oral health status in the past month prior to the survey	Adult-equivalent household consumption					Population average	CI
	poorest (Q1) (n=6343)	2 nd quintile (n=6394)	3 rd quintile (n=6489)	4 th quintile (n=6713)	richest (Q5) (n=6809)		
Whether having oral health problem, oral pain or discomfort (5 categories)							
1) extreme	0.13%	0.17%	0.20%	0.12%	0.15%	0.15%	-0.005
2) severe	0.88%	0.61%	0.42%	0.37%	0.38%	0.53%	-0.267
3) fair	2.36%	2.35%	2.20%	2.09%	1.73%	2.14%	-0.070
4) mild	7.02%	6.51%	5.66%	6.58%	7.26%	6.61%	-0.014
5) not a problem	89.61%	90.37%	91.52%	90.84%	90.48%	90.57%	0.004
Whether having worse oral health status (aggregated category 1&2)	1.01%	0.78%	0.62%	0.49%	0.53%	0.68%	-0.208

Note: **bold** indicates CI value with statistical significance at $p < 0.05$, the positive (negative) value of CI indicates pro-rich (pro-poor) socioeconomic-related inequality in oral health measures

Source: HWS & SES 2006

Table 2 Odds ratios (OR) with 95% confidence interval (95% CI) for the association between self-reported worse oral health status in the past month and socioeconomic-status quintiles, obtained from Multivariate Logistic Regression

Socioeconomic- status	Model 1	Model 2	Model 3
quintiles	OR (95% CI)	OR (95% CI)	OR (95% CI)
Poorest	2.7 (1.4, 5.2)	1.5 (0.6, 2.9)	1.8 (0.7, 4.3)
2 nd quintile	1.9 (0.9, 3.8)	1.2 (0.6, 2.3)	1.4 (0.7, 3.2)
3 rd quintile	1.6 (0.8, 3.2)	1.2 (0.5, 2.5)	1.4 (0.6, 2.9)
4 th quintile	0.9 (0.4, 2.0)	0.9 (0.4, 1.8)	1.0 (0.5, 2.3)
Richest (ref)	1.0	1.0	1.0

Model 1: unadjusted; model summary statistics Wald- $\chi^2 = 16.2$, $p < 0.001$

Model 2: adjusted for occupations, educations, and geographic characteristics; model summary statistics Wald- $\chi^2 = 63.5$, $p < 0.001$

Model 3: adjusted for occupations, educations, geographic characteristics, age-sex, marital status, insurance entitlement, dental care utilization and smoking habits; model summary statistics Wald- $\chi^2 = 295.03$, $p < 0.001$

outcome (i.e. self-reported worse oral health status which equals 0.0068). For instance, the sum of living standards contributed to the total inequality in a pro-poor direction (aggregated contribution equals -0.07) which principally resulted from the positive marginal effects particularly among the lower quintiles (1st and 2nd quintile). Those with a lower socioeconomic status were more likely to report their oral health status to be worse, together with the CI of these variables (revealing negative values), thereby rendering these deterministic contributions negative. Other determinants of interest were evaluated. Unsurprisingly, age-sex determinants contribute in a pro-poor direction. Middle aged adults and the elderly (either male or female) were more likely to experience worse oral health status in the past month (indicated by positive marginal effects), and these age-sex groups were more concentrated in the lower socioeconomic-status group (indicated by negative CI). With respect to geographic characteristics, comparing residents of the North, Northeast, and South regions with those residing in the Central region, the former were more likely to report a worse oral health status as indicated by

positive marginal effects (Table 3). In addition, since more people residing in these regions (particularly the North and Northeast) are poor (negative CI values), the sum of the contribution was pro-poor. While urban residents yielded a negative association with self-reported worse oral health status, this determinant indicated the disproportionate concentration of the better-off, resulting in a negative value contribution. Therefore, the aggregated contributions of geographic determinants signify a pro-poor inequality. On the basis of occupations, when professional occupation was used as a reference, most of the categorized occupations were positively associated with self-reported worse oral health status. Within the agricultural group, which was also disproportionately in the lower socioeconomic group as indicated by a large negative CI, it principally contributed to inequality in a pro-poor direction. Interestingly, unhealthy behaviors (i.e., tobacco smoking) which were positively associated with reported oral health status as deteriorated, also contributed to a pro-poor inequality in the oral health outcome variable.

Table 3 Decomposition analysis of self-reported worse oral health status among Thai adults

<i>Deterministic variables (1=yes, 0= otherwise)</i>	<i>Mean of deterministic variables (\bar{x}_i) (Column A)</i>	<i>Concentration index of deterministic variables (CIx) (Column B)</i>	<i>Logistic regression¹</i>		<i>Deterministic contribution (Column D)</i>
			<i>Beta Coefficient</i>	<i>Marginal effect (dy/dx) (Column C)</i>	
<i>Socioeconomic characteristics</i>					
<i>Living standards</i>					
poorest	0.194	-0.900	0.56	0.0023	-0.059
2 nd quintile	0.195	-0.352	0.37	0.0014	-0.015
3 rd quintile	0.198	0.052	0.31	0.0012	0.002
4 th quintile	0.205	0.419	0.04	0.0001	0.002
5 th quintile (ref)	0.208	0.706			
			<i>Aggregated contribution</i>		-0.070(19.9%)
<i>Educational attainment</i>					
Up to primary	0.616	-0.179	-0.13	-0.0005	0.007
secondary	0.205	0.159	-0.29	-0.0009	-0.004
vocational	0.071	0.360	0.41	0.0017	0.006
tertiary (ref)	0.107	0.490			
			<i>Aggregated contribution</i>		0.009(2.7%)
<i>Occupation</i>					
Lower professional	0.027	0.494	0.75	0.0038	0.007
intermediate	0.168	0.241	0.21	0.0008	0.005
Agricultural/ fishery	0.207	-0.421	0.65*	0.0026*	-0.034
Lower technician	0.115	0.112	0.61	0.0027	0.005
elementary	0.092	-0.166	0.77	0.0037	-0.008
Economically inactive ¹	0.242	-0.012	0.52	0.0021	-0.001
Economically inactive ²	0.011	0.139	-1.63*	-0.0029*	-0.001
Professional (ref)	0.137	0.263			
			<i>Aggregated contribution</i>		-0.026 (7.5%)
<i>Demographic characteristics</i>					
<i>Gender and Age</i>					
Female aged 15-29 years	0.099	0.047	1.23*	0.0072*	0.005
Male aged 30-44 years	0.126	0.067	1.68*	0.0119*	0.015
Female aged 30-44 years	0.206	0.045	1.71*	0.0109*	0.015
Male aged 45-59 years	0.121	0.021	1.49*	0.0101*	0.004
Female aged 45-59 years	0.183	-0.019	1.86*	0.0138*	-0.007
Male aged 60 years and over	0.081	-0.149	1.84*	0.0159*	-0.028
Female aged 60 years and over	0.118	-0.146	2.00*	0.0181*	-0.046
Male aged 15-29 years (ref)	0.065	0.124			
			<i>Aggregated contribution</i>		-0.043(12.3%)
<i>Marital status</i>					
Married	0.645	-0.019	0.21	0.0007	-0.001
Widowed/separated/divorced	0.129	-0.045	0.83*	0.0040*	-0.003
Single (ref)	0.226	0.113			
			<i>Aggregated contribution</i>		-0.005 (1.3%)
<i>Geographic characteristics (resident in region)</i>					
Bangkok	0.059	0.805	-0.16	-0.0005	-0.003
Central (ref)	0.286	0.212			
Northeast	0.277	-0.305	0.62*	0.0025*	-0.030
South	0.136	0.083	0.95*	0.0049*	0.008
North	0.237	-0.149	0.72*	0.0032*	-0.017
Urban residency ³	0.602	0.164	-0.40*	-0.0013*	-0.19
			<i>Aggregated contribution</i>		-0.061(17.3%)
<i>Health insurance entitlement</i>					
UCS	0.685	-0.149	-0.82	-0.0036	0.054
SSS	0.099	0.476	-2.01*	-0.0040*	-0.027
CSMBS	0.173	0.259	-1.09*	-0.0028*	-0.018
No insurance (ref)	0.043	0.290			
			<i>Aggregated contribution</i>		0.008 (2.4%)
<i>Smoking habits</i>					
Current smoker	0.180	-0.084	0.28	0.0011	-0.002
Ex- smoker	0.064	0.010	1.10*	0.0065*	0.001
Non-smoker (ref)	0.756	0.019			
			<i>Aggregated contribution</i>		-0.001 (0.5%)
Dental care utilization	0.109	0.199	1.94*	0.0171*	0.054(15.4%)
residual					-0.073(20.8%)

Note: * indicates significant at $p < 0.05$, number in parenthesis corresponds to the percentage share of deterministic contribution to total inequality, ¹ summary statistics of logistic regression (Wald- $\chi^2 = 179.2$, Pseudo $R^2 = 0.07$, $p < 0.000$, constant = -7.2); ² economically inactive1 (= housewife, student, retired) and economically inactive2 (=unemployed or looking for job); ³denotes the rural residency as reference category, no insurance denotes those adults who have not been registered or entitled to benefit from the publicly-subsidized scheme (i.e. the UCS), UCS = universal coverage scheme, SSS = social security scheme, CSMBS= civil servant medical benefit scheme

Source: HWS & SES 2006

By contrast, regardless of type of insurance scheme, negative values of the marginal effects of the insurance determinants were determined, indicating individuals entitled to services under one of the health insurance schemes were negatively associated with self-reported worse oral health status. The contributions of different types of insurance schemes vary, but the overall contribution revealed a positive sign, in addition to the dental attendance which revealed a positive-value contribution to total inequality, indicating these determinants tended to lower the pro-poor inequality.

Discussion

This study demonstrates socioeconomic-related inequality in the reported worse oral health status among Thai population is present, albeit with a small gradient across socioeconomic strata. The findings of this study are consistent with previous studies from other contexts which revealed socioeconomic inequality in oral health status where the oral health status of those belonging to the lower socioeconomic-status group are worse than their higher socioeconomic-status counterparts (Poulton *et al.*, 2002; Sabbah *et al.*, 2007; Sabbah *et al.*, 2009; Sanders *et al.*, 2006a; Wamala *et al.*, 2006). A study in Thailand revealed adverse health outcomes were mostly concentrated among the poor (i.e. pro-poor), and associated with particular population subgroups (Yiengprugsawan *et al.*, 2007; Yiengprugsawan *et al.*, 2009), in addition to the findings here, although the gradient of reported worse oral health status is not certain as pro-poor inequalities in health-related outcomes among Thais, these altogether provide additional evidence of pro-poor inequality in health-related outcomes among Thais. Furthermore, other determinants which correlate with socioeconomic characteristics, such as occupation, indicate the lower the socioeconomic status the greater the likelihood of reported-worse oral health status.

Geographic characteristics yielded some interesting results, as those living in the North and Northeast regions reported poorer oral health status. Indeed, these two regions have a greater proportion of the poor, particularly in the rural areas where resources for oral health care are scarce (Somkotra and Detsomboonrat, 2009). Also, age-gender determinants, particularly females in conjunction with being older, play a significant role in contribution to pro-poor inequality in self-reported worse oral health status. The findings are consistent with the pro-poor inequality in reported morbidity and deterioration in health among Thais (Yiengprugsawan *et al.*, 2007; Yiengprugsawan *et al.*, 2009). These findings enable more precise targeting of population subgroups, and encourages policy makers to give special consideration to them to improve inequality in adverse health outcomes.

Furthermore, previous studies suggested reducing barriers to obtaining care or promoting equitable access to health services tends to attenuate the socioeconomic inequality in oral health (Donaldson *et al.*, 2008; Wamala *et al.*, 2006). However, studies indicate dental attendance accounts for little, if any, of socioeconomic gradient in oral health; it can lessen but does not eliminate disparities in oral health (Sabbah *et al.*, 2009; Sanders *et al.*, 2006b). Despite the improvement of access to oral health

services through universal health insurance coverage, socioeconomic inequality in oral health among Thais has been observed. The potential explanation of the finding here may be further substantiated by the backdrop of a persistence of socioeconomic inequality in oral health care utilization among Thais even after the implementation of the UC policy as it is still favorable to the better-off (Somkotra and Detsomboonrat, 2009). Nonetheless, the evidence here is insufficient to definitively conclude that better access to oral health care utilization diminishes oral health status disparity, even when the aggregated contribution of insurance entitlement and dental attendance yields positive values, i.e. it tends to lessen the pro-poor inequality.

Additionally, unfavorable health-related behaviors, such as smoking, tend to be more prevalent in population subgroups at the lower than at the higher end of social hierarchy. The former may experience a higher level of psycho-social stress and anxiety than those with higher socioeconomic status, resulting in greater exposure to poor health practices (Marmot and Wilkinson, 2006). This study reveals smoking is associated with reported worse oral health status, consistent with another study (Wamala *et al.*, 2006). Hence smoking cessation programmes at health facilities by dental health personnel, along with the principal programs of controlling tobacco consumption in Thailand may alleviate the inequality in worse oral health status.

Although this study cannot precisely identify cause and consequence, the associations between self-reported oral health and determinants can be useful in the development of policy in Thailand or some other countries which may have a similar context of population subgroups such as lower socioeconomic-status groups in the society who need more attention to their health concerns.

It is important to take into account the possible limitations which require a cautious interpretation of the results. The first issue to be considered regarding the nature of the data is that inevitably there will be heterogeneity in the self reporting of oral health status as perceptions of health may depend on expectations about health; hence the assessment may have limited the validity of the oral health-related variable. If these expectations differ systemically across the population, comparison across subgroups using subjective health measures may lead to some improbable health gradients. Also, a short reference period for reporting oral health status might potentially be subject to bias due to infrequent occurrence of oral health problems, but may decrease recall bias. Second, using the decomposition method which provides an explanation of the associations between determinants and the degree of inequality, thus substantial implications can be drawn from the approach for development of a more effective strategy or intervention to reducing inequality. However, the analyses are based on a cross-sectional survey which introduces the problem of temporal ambiguity and inability to establish causal relationship. Third, the inequality in oral health measured in this study relied on a subjective measurement which has become a recent focus of interest as reflected in the increasing number of studies in the literature (Sabbah *et al.*, 2007; Sanders *et al.*, 2006a). However, reported oral health status in this study represents only the reported oral health morbid-

ity. Further studies should emphasize self-assessed oral health or use the positive outcomes of the oral health approach as recommended and used in contemporary studies which may improve and fill gaps in the information of measuring oral health-related outcomes (Locker and Gibson, 2006; Sabbah *et al.*, 2007; Sabbah *et al.*, 2009; Sanders *et al.*, 2006a).

In conclusion, achieving sustainable oral health improvements and alleviating oral health inequality requires a re-oriented approach which addresses the underlying social determinants of oral health. Therefore, understanding and identifying the underlying root causes of the problem allows for policy changes which will improve oral health inequalities more effectively (Sisson, 2007; the Commission on Social Determinants of Health/ WHO, 2008; Watt, 2007). The study demonstrates socioeconomic inequality in oral health is discernible along the entire spectrum of socioeconomic strata, not only between the highest and the lowest of the social hierarchy. Also, inequality in oral health status among Thais is present even when the country has virtually achieved universal health coverage. The study also indicates there are particular population subgroups (e.g., the lower socioeconomic-status groups) who need to be given consideration in improving the inequality in oral health status among population.

Acknowledgement

This research was supported by Chulalongkorn University Research Fund which the authors gratefully acknowledge. The authors are grateful to the National Statistical Office, Thailand. The constructive comments from two anonymous reviewers that help the authors to improve the paper considerably, and are acknowledged with gratitude.

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