

# Association between Socioeconomic Status and Diabetes Mellitus: The National Socioeconomics Survey, 2010 and 2012

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## ABSTRACT

**Introduction:** The prevalence of Diabetes Mellitus (DM) is increasing, globally. However, studies on the association between Socioeconomic Status (SES) factors and DM have mostly been conducted in specific areas with rather small sample sizes or not with nationally representative samples. Their results have also been inconclusive regarding whether SES has any influence on DM or not.

**Aim:** To determine the association between SES and DM in Thailand.

**Materials and Methods:** This study utilized the data from the National socioeconomics survey, a cross-sectional study conducted by the National Statistical Office (NSO) in 2010 and 2012. A total of 17,045 and 16,903 participants respectively who met the inclusion criteria were included in this study. The information was collected by face-to-face interview with structured questionnaires. Multilevel mixed-effects logistic regression analysis was performed to determine the potential

socioeconomic factors associated with DM.

**Results:** The prevalence of DM was 3.70% (95% CI: 3.36 to 4.05) and 8.11% (95%CI: 6.25 to 9.74) in 2010 and 2012 respectively and the prevalence of DM in 2012 was 1.36 times (95% CI: 1.25 to 1.48) when compared with 2010. The multilevel mixed-effects logistic regression observed that odds of having DM were significantly higher among those who aged 55-64 years old in 2010 and 65 years old or greater in 2012 (OR<sub>adj</sub> = 18.13; 95%CI: 9.11 to 36.08, OR<sub>adj</sub> 31.69; 95%CI: 20.78 to 48.33, respectively), females (OR<sub>adj</sub> = 2.09; 95%CI: 1.66 to 2.62, OR<sub>adj</sub> = 1.77; 95%CI: 1.54 to 2.05, respectively), and had lower education attainment (OR<sub>adj</sub> = 5.87; 95%CI: 4.70 to 7.33, OR<sub>adj</sub> = 1.22; 95%CI: 1.04 to 1.45, respectively) were also found to be associated with DM .

**Conclusion:** The study indicated that SES has been associated with DM. Those with female gender, old age and low educational attainment were vulnerable to DM.

**Keywords:** Education on Health, Health determinants, Multilevel mixed-effects logistic regression, Thailand

## INTRODUCTION

Diabetes is a serious, chronic disease due to either insufficient production of insulin from the pancreas, or ineffective utilization of the produced insulin by the body [1]. In 2012, 1.5 million deaths were attributed to diabetes worldwide whereas it not only ranked the eighth leading cause of death among both sexes but also the fifth leading cause of death in women [2]. Over the past decade, diabetes prevalence has risen faster in low-and middle-income countries than in high-income countries [3]. In 2014 the global prevalence of diabetes was estimated to be 9% among adults aged above 18-year-old [4,5]. Globally, 422 million adults were living with diabetes in 2014 compared to 108 million in 1980 [6].

DM is a common metabolic disorder that is increasing health burden in Thailand [7-10]. The estimated prevalence of DM in Thailand was approximately 8.3% (95% CI; 7.7 to 8.9) among adult >15 years with a higher prevalence in females 9.6 (95% CI; 8.9 to 10.4) than in males 6.5 (95% CI; 5.6 to 7.4), in 2003 [7,8]. Furthermore, the increased DM-related deaths were increased by almost 21.1% between 2012 and 2014 [7].

The risk factors of DM are likely to be multifactorial behavioural problems such as cigarette smoking, physical inactivity, intake of saturated fatty acids and sugar-sweetened beverages are known to be risk factors of DM [11]. Socioeconomic status (SES) is a total measure of an individual's or families economic and social position [12-14]. Some SES factors are identified as risk factors having an association with DM [14]. Specifically, these factors are gender,

age, marital status, level of education, income, occupation, region, residential area, the amount of remaining debt and current liability [15,16]. Each of these variables provides information regarding association of risks, and identifying their effects which helps us understand and address the socioeconomic inequalities in diabetes. Low SES and education level have been associated with the prevalence of DM [17]. However, there is still controversy whether DM is a disease of low SES or high SES or there is no relationship between them [18].

The Ministry of Public Health of Thailand is trying to monitor and control this disease for decades. It is generally acknowledged that impact on individual and society will reduce the labour productivity and will substantially increase the demand for health care services. SES and its constituent elements are recognized as determinant of chronic disease [19-21]. DM is a serious chronic disease with rapidly increasing number of patients, and has both direct and indirect impacts on the economy. However, studies on the association between SES and DM have mostly been conducted in specific areas with rather small sample sizes, not with nationally representative samples [19]. These results have also been inconclusive regarding whether SES has any influence on DM; therefore, a large-scale study is needed to investigate how SES is associated with DM. Therefore, this study aimed to explore an association between SES and DM which will help program manager to control DM in an effective manner and improve the health of the nation as a whole, was conducted in Thailand.

## MATERIALS AND METHODS

**Study population:** This cross-sectional study used data from the National Socioeconomics Survey, a cross-sectional study conducted by the NSO in 2010 and 2012. The survey used a stratified two-stage random sampling design to select a nationally representative sample to respond to the structured questionnaire from all 76 provinces in Thailand. A total of 17,045 and 16,903 participants who met the inclusion criteria in 2010 and 2012 respectively, were included for the analysis.

The information was collected by face-to-face interview. The study population was selected randomly from all of Thai population aged 15 years old and above with diabetes mellitus which has been diagnosed by the physician in respective health institutions in the study area.

**Measurement of Outcome:** As per the International Classification of Disease and Related Health Problems 10<sup>th</sup> revision (ICD10), the primary outcome (DM) has been classified in to two categories: 1) Suffering from DM; and 2) doesn't suffering from DM which has been categorized by medical professionals on the basis of typical DM-like symptoms.

**Socioeconomic status:** The main indicators of SES in this study were included gender, age, marital status, education attainment, occupational, residential area, region, employment, current liabilities, monthly income, and remaining debt. Age was classified in to five categories: less than 35, 35 to 44, 45 to 54, 55 to 64, and 65 or greater [7,8]. Marital status was classified into three categories: single, married, and widowed/divorced/separated. The classification of education was based on the International Standard Classification of Education (ISCED) [22] and consisted of two categories: low education attainment levels (no education and primary education) and high education attainment levels (secondary education, postsecondary education, and tertiary education). Occupation was grouped into six categories: agriculture/fisheries, production (handicrafts/industry), trade/private business, government officer/state enterprise, personnel/employee in private sector, and general contractor/labour [23]. In addition, residential area was classified into two categories: rural and urban. Five regions were considered: Bangkok, Central, Northeast, North and South in Thailand. Employment and current liabilities were classified in two categories: yes or no. Whereas, monthly income (baht) were classified in two categories: Less than 10,001 and 10,001 or greater and remaining debt (baht) were classified into two categories: less than 150,001 and 150,001 or greater.

**Ethical consideration:** The written informed consent was taken from all the individuals after explaining the study objective. The Institutional Review Board (IRB) of the NSO approved this study protocol. Confidentiality of the data was fully assured. The Ethical Committee of Khon Kaen University approved (reference no. HE 582316) the exemption for ethical approval for this study. The NSO administrative board allowed the research team to use the data.

## STATISTICAL ANALYSIS

The characteristics of the participants were described as frequency and percentage for categorical variables and mean and standard deviation for continuous variables. Crude and adjusted odds ratios ( $OR_{adj}$ ) and their 95% confidence intervals (95% CI) were calculated by using simple logistic regression and multilevel mixed-effects logistic regression analysis to estimate the association between independent variables with DM. To obtain  $OR_{adj}$ , independent variables were tested their individual association with DM variables in bivariate model first, and then those variables with a p-value less than 0.25 were included in the multivariate modeling. Backward elimination was used as the method for variable selection to obtain the final model. All analyses were performed by using Stata software version 13.0 (Stata Corp, College Station, TX). The p-value less than 0.05 were considered as statistically significant.

Characteristics	2010 (n=17,045)	2012 (n=16,903)
	Number (%)	Number (%)
<b>Gender</b>		
Male	7,915(46.4)	7,908(46.8)
Female	9,130(53.6)	8,995(53.2)
<b>Age (years)</b>		
Less than 35	5,789(34.0)	5,455(32.3)
35 – 44	3,443(20.2)	3,121(18.5)
45 – 54	3,242(19.0)	3,295(19.4)
55 – 64	2,299(13.5)	2,522(14.9)
65 or greater	2,272(13.3)	2,510(14.9)
Mean ± SD.	43.3 ± 17.7	44.4 ± 18.6
Median(Min:Max)	42 (15 : 100)	44 (15 : 99)
<b>Marital status</b>		
Married	10,855(63.7)	10,492(62.1)
Single	4,241(24.9)	4,143(24.5)
Widowed/divorced/separate	1,949(11.4)	2,268(13.4)
<b>Education attainment</b>		
Low	13,440(78.8)	8,609(50.9)
High	3,605(21.2)	8,294(49.1)
<b>Occupational</b>		
Agriculture/Fishing	4,254(25.0)	6,866 (40.6)
General Contractors/Labour	2,552(15.0)	4,961(29.4)
Personnel/Employee in private sector	3,482(20.4)	3,206(19.0)
Trade/Private business	5,892(34.6)	1,074(6.4)
Government officer /State enterprise	483(2.8)	490(2.9)
Production (crafts/industry)	382(2.2)	306(1.8)
<b>Residential area</b>		
Rural	10,915(64.0)	9,530(56.4)
Urban	6,130(36.0)	7,373 (43.6)
<b>Region</b>		
Northeast	4,818(28.3)	5,019(29.7)
Central	3,542(20.8)	3,584(21.2)
Northern	3,294(19.3)	3,192(18.9)
Bangkok	3,297(19.3)	2,970(17.6)
Southern	2,094(12.3)	2,138(12.7)
<b>Employment</b>		
Yes	12,368(72.6)	11,965(70.8)
No	4,677(27.4)	4,938(29.2)
<b>Current liabilities</b>		
No	12,217 (71.7)	12,823 (75.9)
Yes	4,828(28.3)	4,080(24.1)
<b>Monthly income (baht)</b>		
Less than 10,001	12,960 (76.0)	13,465(79.7)
10,001 or greater	4,085 (24.0)	3,438(20.3)
Mean ± SD.	11,271.4± 13,201.6	14,157.5 ± 6,974.8
Median (Min:Max)	7,300 (0:390,600)	9,000( 45:909,500)
<b>Remaining debt (baht)</b>		
Less than 150,001	3,344 (19.6)	2,618(15.49)
150,001 or greater	13,701 (80.4)	14,285(84.5)
Mean ± SD.	272,751± 2,113,564	268,789.5± 557,026.7
Median (Min:Max)	60,150 (300:1,500,000)	80,000 (350:9,000,000)

[Table/Fig-1]: Baseline characteristics of study population.

Characteristics	2010 (n=17,045)			2012 (n=16,903)		
	Crude OR	95%CI	p-value	Crude OR	95%CI	p-value
<b>Gender</b>			<b>&lt;0.001*</b>			<b>&lt;0.001*</b>
Male	1.00			1.00		
Female	2.68	2.14 to 3.34		1.89	1.65 to 2.18	
<b>Age(Years)</b>			<b>&lt;0.001*</b>			<b>&lt;0.001*</b>
Less than 35	1.00			1.00		
35 – 44	9.66	4.75 to 19.64		4.69	2.96 to 7.45	
45 – 54	23.83	12.08 to 47.02		14.03	9.24 to 21.32	
55 – 64	40.07	20.37 to 78.81		29.32	19.44 to 44.23	
65 or greater	34.24	17.34 to 67.60		36.60	24.33 to 55.07	
<b>Educational attainment</b>			<b>&lt;0.001*</b>			<b>0.001*</b>
High	1.00			1.00		
Low	9.82	7.94 to 12.14		3.04	2.63 to 3.53	
<b>Marital status</b>			<b>&lt;0.001*</b>			<b>&lt;0.078*</b>
Single	1.00			1.00		
Marriage	0.66	0.44 to 1.00		4.70	3.57 to 6.17	
Widow/ Divorce/ Separate	3.71	2.34 to 5.88		8.92	6.68 to 11.95	
<b>Occupational</b>			<b>&lt;0.001*</b>			<b>&lt;0.001*</b>
Agriculture/ fishing	1.00			1.00		
Production (Crafts/ Industry)	0.84	0.43 to 1.65		0.82	0.48 to 1.42	
Trade/Private business	0.76	0.50 to 1.15		0.82	0.48 to 0.93	
Personnel/ Employee in private sector	0.35	0.25 to 0.57		0.37	0.28 to 0.48	
Government officer/ State Enterprise	0.29	0.11 to 0.78		0.50	0.29 to 0.87	
General contractors / Labour	1.25	1.01 to 1.54		1.67	1.45 to 1.93	
<b>Residential area</b>			<b>0.983</b>			<b>0.153*</b>
Rural	1.00			1.00		
Urban	1.00	0.82 to 1.22		0.91	0.79 to 1.03	
<b>Region</b>			<b>0.578</b>			<b>&lt;0.001*</b>
Bangkok	1.00			1.00		
Central	0.84	0.62 to 1.14		0.68	0.56 to 0.84	
North	0.98	0.72 to 1.32		0.82	0.67 to 0.98	
Northeast	0.99	0.75 to 1.30		0.75	0.62 to 0.90	
South	0.80	0.56 to 1.15		0.53	0.41 to 0.68	
<b>Employment</b>			<b>&lt;0.001*</b>			<b>&lt;0.001*</b>
Yes	1.00			1.00		
No	0.61	0.50 to 0.75		2.17	1.91 to 2.48	
<b>Monthly income(baht)</b>			<b>0.023*</b>			<b>0.022*</b>

Characteristics	2010 (n=17,045)			2012 (n=16,903)		
	Crude OR	95%CI	p-value	Crude OR	95%CI	p-value
10,001 or greater	1.00			1.00		
Less than 10,001	0.37	0.19 to 0.73		0.43	0.33 to 0.55	
<b>Current liabilities</b>			<b>&lt;0.001*</b>			<b>&lt;0.001*</b>
No	1.00			1.00		
Yes	1.44	1.18 to 1.77		1.09	0.94 to 1.27	
<b>Remaining debt(baht)</b>			<b>0.133*</b>			<b>0.703</b>
Less than 150,001	1.00			1.00		
150,001 or greater	1.59	1.03 to 2.44		1.08	0.73 to 1.60	

**[Table/Fig-2]:** Crude odds ratios of having DM and their 95% confidence intervals for each factors in 2010 and 2012.

## RESULTS

**Characteristics of the study participants:** The baseline characteristics of 17,045 participants in 2010 and 16,903 participants in 2012 were as follows: about half of the participants were female (53.6% and 53.2%, respectively). More than half were married (63.7% and 62.1%). Nearly one third of them were aged less than 35-year-old (34.0% and 32.3%). Most of the participants had monthly household income less than 10,001 baht (76.0% and 79.7%). In addition, most of the participants had completed lower education (78.8% and 50.9%). Most of the participants were in the trade and private business in 2010 (34.6%) and agriculture/fishing in 2012 (40.6%). Furthermore, most of them were living in a rural area (64.0% and 56.4%). The highest proportion of participants was from the Northeast region (28.3% and 29.7%). Moreover, most of them were paid employed (72.6% and 70.8%) Most of them had no current liabilities (71.7% and 75.9%) and had the amount of remaining debt of 150,001 baht or greater (80.4% and 84.5%) [Table/Fig-1].

**Socioeconomic status influences with DM:** The bivariate analysis revealed that gender, age, educational attainment, marital status, occupational, employment, monthly income and the amount of current liability and that of remaining debt were significantly associated with DM in 2010. Similarly, in 2012, gender, age, educational attainment, marital status, occupation, residential area, region, employment, monthly income and the amount of current liability had the significant association with DM. [Table/Fig-2].

**Factors influencing Diabetes Mellitus between each category of factors: multivariate analysis in 2010 and 2012:** The final model after adjusting for covariates in our multilevel mixed-effects logistic regression analysis indicated that in both 2010 and 2012, the odds of having DM were significantly higher among those who aged 55-64 years old in 2010 and 65 years old or greater in 2012 (OR<sub>adj</sub> = 18.13; 95%CI: 9.11 to 36.08, OR<sub>adj</sub> 31.69; 95%CI: 20.79 to 48.33, respectively), females (OR<sub>adj</sub> = 2.09; 95%CI: 1.66 to 2.62, OR<sub>adj</sub> = 1.78; 95%CI: 1.54 to 2.05, respectively), and low education attainment (OR<sub>adj</sub> = 5.87; 95%CI: 4.70 to 7.33, OR<sub>adj</sub> = 1.22; 95%CI: 1.04 to 1.45, respectively) were also found to be associated with DM [Table/Fig-3] when controlled other covariates.

## DISCUSSION

The main finding was discussed according to the objective of the study as follows: the global prevalence of DM has grown from 4.7% in 1980 to 8.5% in 2014, the period that prevalence has increased or at best remained unchanged in every country [24,25]. This study found that the prevalence of DM in 2010 and 2012 were increased however the prevalence were lower than the rate of 8.9 % in 2015,

Factors	2010 (n=17,045)						2012 (n=16,903)					
	Number	% DM	Crude OR	Adjusted OR	95%CI	p-value	Number	% DM	Crude OR	Adjusted OR	95%CI	p-value
<b>Gender</b>						< 0.001						< 0.001
Male	7,915	1.34	1.00	1.00			7,908	3.9	1.00	1.00		
Female	9,130	3.50	2.68	2.09	1.66 to 2.62		8,995	7.2	1.89	1.78	1.54 to 2.05	
<b>Age (Years)</b>						< 0.001						< 0.001
Less than 35	5,789	0.16	1.00	1.00			5,455	0.46	1.00	1.00		
35 – 44	3,443	1.48	9.66	5.33	2.61 to 10.92		3,121	2.11	4.69	4.25	2.66 to 6.78	
45 – 54	3,242	3.58	23.83	11.29	5.66 to 22.49		3,295	6.07	14.04	12.49	8.14 to 19.15	
55 – 64	2,299	5.87	40.07	18.13	9.11 to 36.08		2,522	11.90	29.32	25.46	16.65 to 38.95	
65 or greater	2,272	5.06	34.24	17.48	8.77 to 34.82		2,510	14.42	36.60	31.69	20.79 to 48.33	
<b>Educational attainment</b>						< 0.001						0.014
High	3,605	0.92	1.00	1.00			8,294	2.94	1.00	1.00		
Low	13,440	8.38	9.82	5.87	4.70 to 7.33		8,609	8.44	3.04	1.22	1.04 to 1.45	

**[Table/Fig-3]:** Adjusted Odds ratios (OR<sub>adj</sub>) of having diabetes and their 95% confidence intervals for each factor adjusted for all other factors presented in the table using multilevel mixed-effects logistic regression, 2010 and 2012.

\*OR<sub>adj</sub> when control of marital status, occupational, residential area, region, employment, monthly income, and current liabilities variables.

documented in the previous annual record of the Ministry of Public Health of Thailand [25].

Our multivariate analysis observed that females had a higher prevalence of DM than males in both years. Many studies have also indicated a higher DM prevalence among females than males [26,27]. In earlier research, impaired glucose tolerance has generally been found to be more common among women than among men [28,29]. In general, women have a smaller mass of muscle than men and therefore less muscle available for the uptake of the fixed glucose load (75 g) used in the oral glucose-tolerance test [30]. Women also have relatively high levels of oestrogen and progesterone, both of which can reduce whole-body insulin sensitivity [31]. Furthermore, a study revealed that the prevalence of physical inactive women was less than men in all regions classified by World Health Organization (WHO) i.e., 27% of women and 20% of men respectively [5]. While in Thailand, the prevalence of physical inactive women was less than men, with 16.4% of women and 12.8% of men [32]. In addition, the use of statin medication in postmenopausal women is associated with an increased risk for DM [33].

In this study, the age group of 65-74-year-old had significantly higher odds of suffering from DM. Almost a half of all deaths attributable to high blood glucose level occur before the age of 70-year-old [6]. The proportion of deaths attributed to high blood glucose was found to be the highest after the age of 50 years old for both sexes in middle income countries. However, the proportion of deaths attributable to high blood glucose for both sexes was highest in the age group of 60-79-year-old apart from high-income countries [6]. Aging is one of the important risk factors for metabolic disorders, including obesity, impaired glucose tolerance, and type-2 diabetes [34,35]. Many literatures documented that the prevalence of type 2 diabetes increases with age (the older adults are more prone to have type 2 diabetes twice than that of middle-aged adults) and reaches the highest rate at the age of 60-74-year-old [36,37]. The progressive deterioration in most endocrine functions, usually due to aging, may be responsible for serious disturbances of metabolic homeostasis [38,39]. In fact, an impaired glucose tolerance is a well-known feature of aging in both humans and experimental animals [40].

In this study, the results revealed that there was a significant association between the level of education and DM. Particularly the lower educational attainment were found to have the high prevalence, 8.38% and 8.44% of year 2010 and 2012, respectively. The previous studies documented increasing prevalence of DM with decreasing educational achievement [41]. Moreover, studies from both developing and developed countries have found inverse associations between DM and educational level and household

socioeconomic status. It is possibly because the better-educated people were likely to be more health-conscious [42,43]. The knowledge attained through education is likely to gain the higher receptiveness to health information and appropriate communication with health personnel. It was found that the lower the educational level, the higher the risk of getting T2DM [44]. Low educational attainment may influence the diet quality, physical inactivity, and unhealthy behaviours possibly affecting the clustering of diabetes [45]. In contrast, the individuals who attained the higher education may be considered to have more information regarding prevention, enabling them a higher ability to change their lifestyle towards healthy behaviour and effective utilization of health care systems [46]. The strength of this study is the large sample size of nationally representative samples. Therefore, the results could be generalized for Thai population. The results from current study could provide the baseline evidence for further related researches and formulating policies.

## LIMITATION

This study had a few limitations. Although, the finding of this study showed influences of SES on DM however, some variables such as body mass index, history of family illness were not included in the study. It should be recommended to collect the health related behavioural information in upcoming nationwide survey.

## CONCLUSION

This study found the low educational attainment was associated with DM in Thais. In addition, other SES factors or other covariates including: gender, age, occupational, region, employment, monthly income and the amount of current liability were significantly associated with DM.

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