

RISK FACTORS OF TYPE II DIABETES MELLITUS AMONG PEOPLE AGED 40 YEARS AND ABOVE IN BAN-NA MAKHUEA SUB-DISTRICT, SAHATSAKHAN DISTRICT, KALASIN PROVINCE, THAILAND

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ABSTRACT: This case-control study aims to explore the factors associated with type 2 diabetes mellitus (T2DM) among people aged 40 years and above in Ban-Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand. The structural questionnaire with face to face interview was used. Total respondents are 374 persons included people with T2DM 187 persons (93 male & 94 female) and 187 persons of people with non-DM (93 male & 94 female). Statistical analysis used logistic regression to explore the factors associated with type 2 diabetes mellitus. The results found that most of respondents were aged between 50-59 years (33.2 % of DM group and 34.8% of non-DM group). Over 70 % of them are married (77.5% of DM group and 76.5% of non-DM group). Majority of respondents were employee (56% of DM group & 52.4% of non-DM group), and education level below undergraduate (56.4% and 52.4% in DM and non-DM group, respectively). In term of Lifestyle behavior, eating behaviors was in good level (Good level = Eat meal complete the 5 basic food groups four days a week or above, and eat snacks, fried foods, salty food, sweet fizzy drinks less than four days a week) and performing physical activities of the respondents was at good level. The relating factors with T2DM in this community were age at first smoking. Respondents who start smoking at aged below 21 years old was 3 times more risk to develop diabetes than who start smoking at aged above 20 (aOR=3.099, 95% CI =1.309-7.338, *p-value* < 0.001). There was no different risk found between smoker and non-smoker, and current smoker and ex-smoker. The respondents who had diabetes parent or siblings was 6.278 times more risk of diabetes (aOR = 4.006, 95% CI = 2.555-6.283, *p-value* < 0.001) compared with respondents who did not had diabetes parent or sibling. Several factors were not statistically significant with T2DM. Only respondents who had diabetes parent or siblings and who started smoke at aged below 21 years related with T2DM. Thus, strategic planning or education program to promote diabetes screening and non-smoking behavior in the teenagers should be conducted. This information should use to educate younger people to avoid smoking. However, the quasi-experimental study should be conducted in the community for prevention and control of diabetes in the community.

Keywords: Diabetes mellitus, Risk factors, Adults, Thailand

INTRODUCTION

Diabetes mellitus (DM) has become a major public health problem with significant impact on health, quality of life and life span of individuals, as well as health care system [1]. Furthermore, it impose substantial burden on economic in form of a direct cost of medical services and an indirect

cost from work related [2]. It is amongst the 5th leading causes of death worldwide because of its serious complications and disability [1] and it will be the 3rd leading cause of death in 2030 [3].The prevalence of DM has increased markedly in the past decade [4].The increasing number of DM population has occurred because of population ageing and growth, as well as overweight/obesity, unhealthy diets and sedentary lifestyle. These latter factors are closely associated with urbanization and

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Table 1 Socio-demographic characteristics of the respondents (n=374)

Variables	Male		Female	
	DM (n=93)	Non-DM (n=93)	DM (n=94)	Non-DM (n=94)
Age (year)				
Mean (\pm SD)	57.27 \pm 12.16		55.93 \pm 11.86	
Marital status				
Single	3 (3.2%)	4 (4.3%)	4 (4.3%)	4 (4.3%)
Married	74 (79.6%)	72 (77.4%)	71 (75.5%)	71 (75.5%)
Widowed	16 (13.2%)	17 (18.3%)	19 (20.3%)	19 (20.3%)
Occupation				
Self-employed	6 (6.5%)	6 (6.5%)	8 (8.5%)	8 (8.5%)
Employee	55 (59.1%)	49 (52.7%)	50 (53.2%)	49 (52.1%)
Retired and housewife	11 (11.8%)	12 (13%)	10 (10.6%)	10 (10.6%)
Agriculturist	21 (22.6%)	26 (28.0%)	26 (27.7%)	27 (28.7%)
Education				
Below undergraduate	55 (59.1%)	50 (53.8%)	50 (53.2%)	49 (52.1%)
Undergraduate or higher	38 (40.9%)	43 (46.3%)	44 (46.8%)	45 (47.9%)
Monthly income (baht per month)				
\leq 10,000	30 (32.3%)	26 (28.0%)	26 (27.7%)	26 (27.7%)
10,001 – 15,000	32 (34.4%)	32 (34.4%)	31 (33.0%)	30 (31.9%)
15,001 – 20,000	12 (12.9%)	15 (16.1%)	14 (14.9%)	16 (17.0%)
20,001 – 25,000	13 (14.0%)	12 (12.9%)	15 (16.0%)	15 (16.0%)
$>$ 25,000	6 (6.4%)	8 (8.6%)	8 (8.6%)	7 (7.6%)

industrialization [5, 6]. The estimated number of population aged over 40 years affected by DM both in developed and developing countries is projected to grow to 72 and 228 million people by year 2025 [7, 8].

In Thailand, the incidence of death regarding to diabetes mellitus has continuing increased. Over 11.88% of death in 2011 caused by diabetes mellitus and it's increasing to 12.06% in 2012 and 14.93 % in 2013 [9]. In rural area as in Kalasin province, located in the northeast of Thailand, there was 6.2 % DM prevalence in year 2000 and gradually increased to 12.7% in 2012. Over 10 % of people aged 40 years and over was new diagnosed diabetes cases. This province became a third of highest prevalence of diabetes among the northeastern provinces [10]. Exploration of situation and factors related with diabetes is needed. Thus, this study aims to explore the factors included socio-demographics, lifestyle and health status associated with type 2 diabetes in Ban-Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand.

METHODS

The case-control study design was conducted in April 2014. The gender matching in case and control groups was done. Six villages of Ban-Na Makhuea sub-district that had the high prevalence of T2DM cases were selected. Three hundred and seventy-four participants (187 persons per group) aged 40 years

or above were enrolled from 6 villages using stratified random sampling technique. The residents of Ban-Na Makhuea sub-district who were diagnosed by medical doctor as T2DM patients were recruited into the case group while who were screened as non-diabetes were recruited into the control group. Participant recruitment was done by random selection from the name list of Ban-Na Makhuea sub-district health promotion center (rate of diabetes screening 70% of people aged 40 years or above). The sample size was calculated from Cochran's formula [11] where estimated DM prevalence in Kalasin province was 0.127 and allowable error in estimating prevalence was 0.05.

All 374 respondents (187 respondents in each group) were interviewed using the structured questionnaire which comprised of socio-demographic characteristics, lifestyle and health status and had the physical examination i.e., weight, height, waist circumference, hip circumference and blood pressure. The process of interview and physical examination were done after the respondent sign in the inform consent. The ethical approval was obtained from Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University (Code number 025.1/57). Data were cleaned and analyzed in SPSS version16 (Chulalongkorn University's license). The multiple logistic regression analysis was carried out to assess the association between the risk factors and diabetes.

Table 2 History of diabetes among respondents

Variables	Male		Female	
	DM (n=93)	Non-DM (n=93)	DM (n=94)	Non-DM (n=94)
Diabetes in family	31 (33.3%)	7 (7.5%)	32 (34.0%)	7 (7.4%)
History of GDM*			5 (5.6%)	3 (3.3%)
History of delivery macrosomia baby			5 (5.6%)	3 (3.3%)

*GDM = Gestational diabetes mellitus, ^Number of females=90 for both DM and Non-DM groups

Table 3 Smoking behavior and drinking behavior among the respondents

Variables	Male		Female	
	DM (n=93)	Non-DM (n=93)	DM (n=94)	Non-DM (n=94)
History of cigarette smoking				
Never smoke	22 (23.7%)	32 (34.4%)	25 (26.6%)	27 (28.7%)
Ex-smoker	36 (38.7%)	30 (32.3%)	34 (36.2%)	33 (35.1%)
Current smoker	35 (37.6%)	31 (33.3%)	35 (37.2%)	34 (36.2%)
Number of cigarette per day among current smokers				
≤10 cigarettes	24 (68.6%)	17 (54.8%)	21 (60.0%)	24 (70.6%)
>10 cigarettes	11 (31.4%)	14 (45.2%)	14 (40.0%)	10 (29.3%)
Age at first smoking among current smokers				
≤20 years	11 (31.4%)	1 (3.1%)	12 (34.3%)	8 (23.5%)
>20 years	24 (68.6%)	31 (96.9%)	23 (65.8%)	26 (76.4%)
Smoker in family member				
	23 (24.7%)	15 (16.1%)	15 (16.0%)	23 (24.5%)
History of alcohol drinking				
Ex-drinker	40 (43.0%)	35 (37.6%)	37 (39.4%)	36 (38.3%)
Current drinker	53 (57.0%)	52 (55.9%)	57 (60.6%)	58 (61.7%)
Never	0 (0%)	6 (6.5%)	0 (0%)	0 (0%)

RESULTS

Ninety three males and 94 females aged 40 years old or over were recruited into case and control groups. The mean age of respondents was 57.27±12.16 years for males and 55.93±11.86 years for females. The socio-demographic characteristics of male and female respondents in diabetes and non-diabetes groups were similar (Table 1). Majority of respondents are married. More than half of respondents in all groups are employees and one fourth of them are agriculturists. Interestingly, the around 45% of respondents in this rural area had the highest education level as undergraduate or higher. However, majority of their monthly income was less than 15,000 baht.

Only 7% of respondents in non-diabetes group reported the presence of diabetes family members both from male and female respondents while 34% of respondents in diabetes group possessed family members suffering from diabetes (Table 2). The frequency of experiencing with gestational diabetes during pregnancy and delivery macrosomia babies in diabetes women (5.6%) was higher than in non-diabetes women (3.3%).

In term of respondents' smoking behavior, proportions of female respondents in diabetes and

non-diabetes groups who had ever smoked were nearly equal while numbers of non-diabetes male respondents who had no experience of smoking were higher than that of diabetes male respondents (22 in 93 versus 30 in 93 person in non-diabetes and diabetes group, respectively). Among smokers, majority of respondents replied that they smoked 10 cigarettes or less in a past 7 days (68.6% of male and 60.0% of female in diabetes respondents, and 54.8% of male and 70.6% of female among non-diabetes respondents). Moreover, the study found that over 60% of respondents was started smoking at aged over 20 years (68.6% of male and 65.8% of female in diabetes group and 96.9% of male and 76.4% of female in non-diabetes). However, 31.4% of male and 34.3% of female in diabetes group and 3.1% of male and 23.5% of female in non-diabetes group was started smoking at aged less than 21 years. In term of second smoker, this study found that 24.7% of male and 16.0% of female in diabetes group and 16.1% of male and 24.5% of female in non-diabetes group replied that their family member smoked, as shown in the Table 3.

Over a half of respondents were current drinkers (57.0% of male and 60.6% of female in diabetes group and 55.9% of male and 61.7% of

Table 4 Sleep pattern and physical examination among the respondents

Variables	Male		Female	
	DM (n=93)	Non-DM (n=93)	DM (n=94)	Non-DM (n=94)
Sleeping hours in night time				
<6 hours	48 (51.6%)	47 (50.5%)	49 (52.1%)	48 (51.1%)
≥ 6	45 (48.4%)	46 (49.5%)	45 (47.9%)	46 (48.9%)
Incomplete sleep at night	46 (49.5%)	39 (41.9%)	38 (40.4%)	37 (39.4%)
Overweight (body mass index 25 or over)	56 (60.2%)	51 (54.8%)	52 (55.3%)	53 (56.4%)
High waist circumference (Male ≥102 cm, female ≥ 88 cm.)	0 (0.0%)	0 (0.0%)	56 (59.6%)	58 (61.7%)
Waist/hip ratio (Male >0.9, female >0.85)	90 (96.8%)	88 (94.6%)	94 (100.0%)	94 (100.0%)
High SBP* (≥140 mmHg)	9 (9.7%)	2 (2.2%)	8 (8.5%)	10 (10.6%)
High DBP* (≥90 mmHg)	2 (2.2%)	4 (4.3%)	10 (10.6%)	14 (14.9%)
High FBS* (≥126 mg%)	19 (20.4%)	29 (30.9%)	0 (0.0%)	0 (0.0%)

*SBP= systolic blood pressure, DBP= diastolic blood pressure, FBS= fasting blood sugar

female in non-diabetes). Only 6.5% of male in non-diabetes group was non-drinker (Table 3).

Regarding sleep pattern, for Sleeping hours at night time, the number of respondents both in diabetes and non-diabetes groups who sleep for less than 6 hours and who sleep for 6 hours or more was nearly equal. In part of incomplete sleep at night, the study found that less than 50.0% of the respondents both in diabetes and non-diabetes group reported that they usually had incomplete sleep at night (44.9% and 40.6%, respectively) as shown in Table 4.

Considering body mass index (BMI), overweight was found in 55.6% of respondents in control group and 57.8% in diabetes group. The number of overweight respondent in both groups either male or female was quite similar. In part of waist circumference, all of male respondents in both groups had normal waist circumference. Over 50% of female respondents in both groups had high waist circumference (59.6% in diabetes and 61.7% in non-diabetes group). For Waist/hip ratio, almost all of male respondents had high waist/hip ratio (96.8% of diabetes and 94.6% of non-diabetes). All female respondents had high waist/hip ratio. Regarding systolic blood pressure (SBP), almost all respondents had normal SBP (90.3% of male and 91.5% of female diabetes respondents and 97.8% of male and 89.4% of female non-diabetes respondents, respectively). The rest (7.8%) had high SBP. However, the prevalence of high SBP in non-diabetes female was not different from that of

diabetes female (9.7% and 8.5% of male and female diabetes respondents and 2.2% and 10.6% of male and female non-diabetes respondents, respectively). In contrast, the prevalence of high SBP in male diabetes respondents was slightly higher than that of male non-diabetes respondents.

Regarding diastolic blood pressure (DBP), most respondents either in diabetes group or non-diabetes group reported normal DBP. Only 8.0% of respondents had high DBP. Among these respondents with high DBP, female respondents tended to have high DBP more than male whether they had diabetes or non-diabetes (10.4% and 14.9% of female diabetes and non-diabetes and 2.2% and 4.3% of male diabetes and non-diabetes, respectively). All of non-diabetes respondents had normal fasting blood sugar level. On the contrary, 25.7% respondents with diabetes reported that (20.4% male and 30.9% female) they had high fasting blood sugar (FBS) as shown in Table 4.

Multiple logistic regression analyzed factors associated with diabetes, showed that socio-demographic characteristics include age, marital status, occupation, education, and family income had no association with diabetes. It was shown in the Table 5. However, this study found that age at first time of smoking was associated with diabetes.

Respondents who started smoke at aged less than 21 years had 2times more risk to develop diabetes than the non-smoker (aOR = 2.369, 95% CI = 1.416 – 3.964, *p-value* < 0.001). Over 6 times of

Table 5 Factors associated with diabetes by multiple logistic regression (n=374)

Variables	aOR	95% CI	p-value
Age			
40 -49 years	1.00		
50-59 years	1.041	0.628-1.724	0.877
60-69 years	1.206	0.681-2.135	0.521
≥ 70 years	1.273	0.660-2.454	0.472
Marital status			
Single	1.00		
Married	1.159	0.409-3.280	0.781
Widowed/separated/ divorces	1.111	0.364-3.392	0.853
Occupational			
Housewife/retried	1.00		
Self-employer	1.048	0.404-2.714	0.924
Employer	1.122	0.581-2.168	0.731
Agriculturist	0.929	0.454-1.900	0.840
Education			
Below undergraduate	1.00		
Undergraduate or higher	0.879	0.585-1.320	0.533
Total income in family			
< 10,001 baht/month	1.00		
10,001-15,000	0.944	0.564-1.579	0.825
15,001-20,000	0.779	0.409-1.482	0.446
20,001-25,000	0.963	0.503-1.844	0.909
>25,000	0.867	0.382-1.968	0.732
Diabetes in family			
No	1.00		
Yes	6.278	3.366-11.710	<0.001*
History of GDM*			
No	1.00		
Yes	1.706	0.395-7.362	0.474
History of delivery baby with macrosomia			
No	1.00		
Yes	1.706	0.395-7.362	0.474
History of cigarette smoking			
Never smoke	1.00		
Ex-smoker	1.395	0.835-2.329	0.203
Current smoker	1.352	0.811-2.253	0.247
Number of cigarette /day			
Non smoke	1.00		
≤10 cigarettes/day	1.144	0.699-1.874	0.592
>10 cigarettes/day	1.086	0.587-2.009	0.792
Age at first time of smoking			
Non smoke	1.00		
≤ 20 years	2.369	1.416-3.964	<0.001*
>20 years	0.696	0.40-1.187	0.183
Smoker in family member			
No	1.00		
Yes	0.946	0.565-1.583	0.832
History of drinking			
Ex-drinker	1.00		
Current drinker	0.922	0.608-1.399	0.703
Enough activity			
Yes	1.00		
No	0.722	0.480-1.087	0.119
Enough sleeping a day			
Yes	1.00		
No	0.958	0.639-1.437	0.836
Eating behavior			
Good	1.00		
Poor eating behaviors	0.922	0.526-1.614	0.775
Systolic blood pressure			
Normal	1.00		
High	1.458	0.676-3.145	0.336

Table 5 Factors associated with diabetes by multiple logistic regression (n=374) (cont.)

Variables	aOR	95% CI	p-value
Diastolic blood pressure			
Normal	1.00		
High	1.382	0.723-2.643	0.327
Body mass index			
Normal	1.00		
High	1.091	0.725-1.643	0.676
Waist circumference			
Normal	1.00		
High	1.025	0.665-1.577	0.912
Waist to hip ratio			
Normal	1.00		
High	0.593	0.140-2.520	0.479

*Multiple logistic regression, accepted level <0.05, GDM = Gestational Diabetes Mellitus

respondents who have diabetes in their family were association with diabetes (aOR = 6.278, 95% CI = 3.366-11.710, *p-value* < 0.05).

In term of alcohol drinking, this study shown that drinking behavior was not statistical association with diabetes (aOR = 0.922, 95% CI = 0.608-1.399, *p-value* >0.05). History of sleeping, respondents who did not enough sleep was not statistical association with diabetes (aOR = 0.958, 95%CI = 0.639-1.437, *p-value* > 0.05). Eating behaviors with diabetes, the results shown that poor eating behaviors of respondents was not statistical association with diabetes in the study area (aOR = 0.922, 95% CI = 0.526-1.614, *p-value* >0.05). Similar with BMI, waist circumference and waist to hip ratio, this study found that respondents with high BMI, high waist circumference and high waist to hip ratio was not statistical association with diabetes (aOR = 1.091, 95% CI = 0.725-1.643; aOR = 1.025, 95% CI = 0.665-1.577; aOR= 0.593, 95% CI = 0.140-2.520, *p-value* > 0.05, respectively).

DISCUSSIONS

The result showed that, socio-demographic characteristics included age, education, marital status, occupational status, and income was not significantly associated with diabetes in this study. In opposite with a study by Al-Moosa and colleagues in Oman found that a subject at 20 years old and above showed that age was positive associated with diabetes [12]. In part of gender, this study control gender (frequency gender matching), so gender was not statistical association with diabetes. The finding was related with the study in Sinakaran Hospital. The result revealed that the modified Thai Diabetes Risk Score in male and female were not different [13]. In opposite, the study of Sanchez-Chaparro the result showed that gender was significantly positive association related to the incidence of diabetes [14]. In term of education,

Collaboration was found that people who had less education level was statistical positive association with diabetes with complication two-fold [15]. Occupational status, a study of Sanchez-Chaparro showed that occupations were significantly related to diabetes [14]. In part of income, the study of Jessica & Sharon found that the respondents who have a family income below poverty level was positive associated with a two-fold higher mortality after adjustments compared with adults with the highest family incomes [16].

In term of diet behavior, drinking behavior, physical activity and sleeping quality in this study was not significantly associated with diabetes. It was similar with the study from Aekplakorn, showed that drinking behavior was not associated with diabetes [17]. In contract, Al-Moosa was found that diet behavior and drinking behavior are related to diabetes [12]. Also the study by Foggin, the result showed that physical activity and diet behavior was reduced to develop of diabetes, the result found all the intervention groups had lower rates of diabetes than the control group [18]. It similar with the study from Huxley, finds in part of physical activity, people should recommendation-exercise practice with high cariole regularly in order to maintain the fat cell and other cell that response to insulin. To exercise will reduce the level of glucose. Exercise will help in weight control; take up glucose into energy and makes cells more sensitive to insulin. People will be having risk of type 2 diabetes, if doing exercise less than three times a week [19].

In part of sleeping quality in this study was not significantly associated with diabetes. In opposite with the study by Yaggi, the result found the risk of developing into diabetes for men who have sleeping duration 5 and 6 hours per night were twice, and while men who reporting sleep 8 hours per night were more than three times as likely to develop diabetes over the period of follow-up [20]. Another

supporting research conducted in US. The result showed that among non-hispanic whites and hispanics, short sleep (sleep less than 7 hours) was associated with increased odds of diabetes [21]. In term of smoking behavior, the respondents who started smoking at age 20 years old and less than had higher risk than who started smoking at older age. However, smoking or non-smoking was not significantly associated with diabetes in this study. Smoking could increase the chance of having type 2 diabetes, nicotine, the major active chemical in tobacco, had effects on insulin action and insulin secretion which indicate the impact on type 2 diabetes development. Should not smoking and avoid places with smoke [19]. According to the studies among adults in US found that smoking recently showed the inclining incidence of diabetes compared to never smoke [22]. Thus, this study make us more understand and could use as the policy to reduce the diabetes among people by encourage people to more exercise and stop smoking. Moreover, this study found smoker who started at younger age tend to have higher risk of diabetes than older smoker, to encourage exercise and smoking should be concentrated among younger group.

Regarding to history of health included BMI, waist circumference, waist to hip ratio, hypertension, having a close family member with diabetes, history of gestational diabetes mellitus (GDM) and history of delivery baby macrosomia. Only history of diabetes in family was significantly associated with diabetes in this study. For history of diabetes in family, having a close family member with diabetes could lead the higher risk of type 2 diabetes because of diabetes is the disease from genetic [23]. According to the study of Annis et al. [5] found family history related with diabetes. They found individuals with a family history of diabetes are at greater risk for developing diabetes themselves. In contract, some research found only genetic factor couldn't effect to diabetes. It has to compound with other factors. According to the research of Hariri [24] found family history of diabetes has an influence with risk factor for diabetes. Moreover, some study found that the prevalence of diabetes were positive associated with older age, BMI, waist-to-hip ratio and systolic blood pressure [25].

CONCLUSION

Socio-demographic characteristics, behaviors, and health factors were important to identify the association of diabetes but they were found not to be associated with diabetes in this study. Only history of family with diabetes and age at started smoking less

than 21 years old associated with diabetes. Multiple logistic regressions were used to explore the factors associated with diabetes in the study area. This study found that the respondents who started smoke at age less than 21 years had higher risk than who never smoke (aOR = 2.369, 95% CI = 1.416-3.964, *p-value* < 0.001). However, smoking or non-smoking had no different chance to be diabetes. Moreover, the respondents who had diabetes parents or siblings faced more risk to be diabetes (aOR = 6.278, 95% CI = 3.366-11.710, *p-value* < 0.05).

LIMITATION

A small sample size from the community might limit the generalizability of the study findings. The case control study design of the study limits our ability to make causal inferences. A few sample size of pregnancy with diabetes could not explore the factors associated with diabetes. Further research is needed to address these limitations.

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