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

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ปัจจัยเสี่ยงของโรคเบาหวานชนิดที่ 2 ในประชากรอายุ 40 ปีขึ้นไป ที่ตำบลนามะเขือ อำเภอสหัสขันธ์ จังหวัดกาฬสินธุ์ ประเทศไทย

นางสาวชลธิดา โยธารินทร์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
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Thesis Title	RISK FACTORS OF TYPE II DIABETES MELLITUS AMONG PEOPLE AGED 40 AND ABOVE IN BAN NA MAKHUEA SUB-DISTRICT SAHATSAKHAN DISTRICT KALASIN PROVINCE THAILAND
By	Miss Chonthida Yotharin
Field of Study	Public Health
Thesis Advisor	Tepanata Pumpaibool, Ph.D.

Accepted by the Faculty of College of Public Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

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ชลธิดา โยธารินทร์ : ปัจจัยเสี่ยงของโรคเบาหวานชนิดที่ 2 ในประชากรอายุ 40 ปีขึ้นไป ที่ตำบลนามะเขือ อำเภอสหัสขันธ์ จังหวัดกาฬสินธุ์ ประเทศไทย. (RISK FACTORS OF TYPE II DIABETES MELLITUS AMONG PEOPLE AGED 40 AND ABOVE IN BAN NA MAKHUEA SUB-DISTRICT SAHATSAKHAN DISTRICT KALASIN PROVINCE THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ. ดร.เทพนาฏ พุ่มไพบูลย์, 88 หน้า.

การศึกษาครั้งนี้เป็นการศึกษาหาปัจจัยเสี่ยง โดยเปรียบเทียบระหว่างกลุ่มที่เป็นเบาหวานชนิดที่ 2 และไม่เป็นเบาหวาน ในผู้ที่มีอายุตั้งแต่ 40 ปี ขึ้นไป ที่ตำบลบ้านนามะเขือ อำเภอสหัสขันธ์ จังหวัดกาฬสินธุ์ เพื่อนำข้อมูลที่ได้มาใช้ในการวางแผนการป้องกันการเกิดเบาหวานชนิดที่ 2 ในชุมชน ทำการเก็บข้อมูลโดยใช้แบบสอบถามประกอบไปด้วย ลักษณะทางประชากร วิถีชีวิต และสุขภาพ โดยทำการสัมภาษณ์ผู้ป่วยเบาหวานจำนวน 187 ราย และผู้ที่ไม่ป่วยเป็นเบาหวานจำนวน 187 ราย ใน 6 หมู่บ้าน รวมทั้งสิ้น 374 ราย จากนั้นใช้สถิติแบบพหุถดถอยวิเคราะห์หาปัจจัยที่มีความสัมพันธ์กับการเป็นเบาหวานชนิดที่ 2

จากการศึกษาพบว่ากลุ่มตัวอย่างส่วนใหญ่อยู่ในช่วงอายุ 50-59 ปี (33.2 % เป็นผู้ป่วยเบาหวาน และ 34.8% เป็นผู้ที่ไม่เป็นโรคเบาหวาน) มากกว่า 70 % ของกลุ่มตัวอย่างมีสถานภาพสมรส (77.5% ของผู้ที่เป็นเบาหวาน และ 76.5% ของผู้ที่ไม่เป็นเบาหวาน) ส่วนใหญ่ประกอบอาชีพรับจ้าง (56% ของผู้ที่เป็นเบาหวาน และ 52.4% ของผู้ที่ไม่เป็นเบาหวาน) จบการศึกษาต่ำกว่าปริญญาตรี (56.4% และ 52.4% ตามลำดับ) จากการศึกษาพฤติกรรมการดำรงชีวิต พบว่าประชากรในการศึกษามีพฤติกรรมการกินอยู่ในเกณฑ์ปานกลาง และออกกำลังกายในเกณฑ์ดี

และเมื่อศึกษาปัจจัยที่มีความสัมพันธ์กับการเป็นเบาหวานพบว่า คนที่มีญาติใกล้ชิดเป็นโรคเบาหวาน มีโอกาสเกิดโรคเบาหวานมากกว่า คนที่ไม่มีญาติใกล้ชิดเป็นโรคเบาหวาน ถึง 6 เท่า (OR=6.278, 95% CI=3.366-11.71, p-value<0.001) และคนที่เริ่มสูบบุหรี่เมื่ออายุน้อยกว่า 21 ปี มีโอกาสเกิดโรคเบาหวานมากกว่า ผู้ที่เริ่มสูบบุหรี่เมื่ออายุมากกว่า 20 ปี ถึง 2 เท่า (OR=2.369, 95% CI=1.416-3.964, p-value <0.001) แต่ไม่มีความแตกต่างระหว่างคนที่สูบบุหรี่และไม่สูบบุหรี่ และ คนที่สูบบุหรี่และเคยสูบบุหรี่

สรุปผลการศึกษาพบว่ามีญาติใกล้ชิดเป็นเบาหวาน และการเริ่มสูบบุหรี่เมื่ออายุน้อยกว่า 21 ปี มีผลต่อการเป็นเบาหวาน ดังนั้น จึงควรมีการวางแผน หรือจัดทำโครงการเพื่อให้ความรู้แก่วัยรุ่นในการไม่สูบบุหรี่ เพื่อประโยชน์ในการป้องกันโรคเบาหวานรวมทั้งโรคอื่น ๆ ด้วย อีกทั้งมีการจัดทำโครงการส่งเสริมการออกกำลังกาย ให้ความรู้เกี่ยวกับการป้องกันเบาหวานในชุมชน

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2556 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก .....

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CHONTHIDA YOTHARIN: RISK FACTORS OF TYPE II DIABETES MELLITUS AMONG PEOPLE AGED 40 AND ABOVE IN BAN NA MAKHUEA SUB-DISTRICT SAHATSAKHAN DISTRICT KALASIN PROVINCE THAILAND. ADVISOR: TEPANATA PUMPAIBOOL, Ph.D., pp 88.

This case-control study aims to explore the factors association with diabetes type 2 (DMT2) among people aged 40 years and over in Ban-Na Makhuea sub-district, Sahatsakhan district, Kalasin province. The structured questionnaire with face to face interview was used in this study to collect the socio-demographic characteristics, lifestyle and health status of the respondents. Total respondents were 374 persons included people with 187 DMT2 and 187 non-DM respondents from 6 villages of this sub-district. Analysis of the factors associated to DMT2 was performed using logistic regression.

The results found that most of respondents 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), 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 moderate level and performing physical activities of the respondents was at good level.

The relating factors with DMT2 in this study were history of DM in family and age at first smoking. Respondents who had diabetes parent or siblings was 6 times more risk of diabetes (OR = 4.006, 95% CI = 2.555-6.283, p-value < 0.001) compared with respondents who did not had diabetes parent and respondents who start smoking at aged below 21 years old was 2 times more risk to develop diabetes than who start smoking at aged above 20 (OR=2.369, 95% CI =1.416-3.964, p-value < 0.001). There was no different risk found between smoker and non-smoker, and current smoker and ex-smoker.

The finding was suggested that history of DM in family and start smoking at aged below 21 related with DMT2. Thus, strategic planning or education program to promote and non-smoking behavior in the teenager should be conducted. This would have benefit for diabetes and other non-communicable diseases prevention. Promoting regularly exercises and the knowledge of diabetes prevention should be provided to the community

Field of Study: Public Health Student's Signature .....

Academic Year: 2013 Advisor's Signature .....

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CHAPTER I

INTRODUCTION

1.1 Background and Rationale

Diabetes is commonly found and becomes the global health problem. Diabetes has the consequence in various kinds of organ systems. It is one of the four major cause of cardiovascular disease (CVD) (WHO, 2008). The result from diabetes will greatly increases the risks of macro- and micro vascular diseases (Saydah et al., 2002), with similar effects on Western (Kuller L et al., 2000) and Asian populations (Collaboration, 2002). Sixty-eight percent of heart diseases death related with diabetes (ADA, 2013). About 2 to 4 times of diabetes patients had stroke and they risk to blindness (ADA, 2013). According to World Health Organization's report, diabetes is likely to be an important leading cause of end-stage renal disease and blindness for numerous individuals with nerve disease/amputations (American Diabetes Association, 2004).

Technically, Diabetes is attributable to a variety of genetic, epigenetic, environmental and biological factors, many of which are uncontrollable. Socioeconomic-demographic factor is also a strong predictor of Diabetes. People with high socioeconomic tent to have more knowledge in taking care themselves, find a healthy diet to consume and better access to health care service (Annandale, 1998).

Moreover, social determinants, such as social and physical environments, availability of infrastructure, and accessibility to health services, all will create pathways or barriers to good health including advantage health behavior. These factors are affected by the distribution of power and resources. Thus, we can see the differences in the incidence, prevalence, diabetes morbidity, mortality and burden of diseases and other adverse health conditions that exist among specific population groups. According to the Thai National Institutes of Health, rural population in Thailand compared with urban counterparts, rural communities have higher rates of preventable conditions such as obesity, diabetes, cancer, and injury, and higher rates of related high-risk health behaviors such as smoking, physical inactivity, poor diet, and limited use of seatbelts than urban areas (Eberhardt and Pamuk, 2004, Hartley, 2004).

In general, there are many differences in rural, suburban, and urban life, including the differences in healthcare delivery, health promoting and infrastructure which can create different life outcomes for residents in these areas. These rural-

urban differences in health status, firstly, are compounded by the age structure of rural areas which tend to have a higher proportion of elderly residents. The elderly population will carry more of a burden from chronic conditions including the higher levels of poverty (Tunprayoon, 1989). Early studies in the U.S. showed a spatial mismatch of lower-income jobs and residences, prompting federal programs like Welfare-to-Work connecting workers with employment opportunities (Kawachi et al., 1999a).

In addition, we can see greater levels of non-active leisure time compared to more urban areas, while the increases in industrial agriculture have decreased the physicality of much rural work. Rural residents are more likely to be obese or overweight compared to suburban residents. Rates for tobacco use are higher in rural areas and access to behavior change support services is less. Thus, not only socioeconomic-demographic factor that lead people have diabetes, but also the changing of population's lifestyles or health behaviors such as exercise, diet, smoking and drug. We adopt culture from western lifestyle, which may include consuming high fat diets, more sweeten and salty foods, increasing tobacco smoking, alcohol drinking, and less physical activity as well. These factors lead to major cause of diabetes disease (Wilkinson and Marmot, 2002).

Some observational studies have shown that exercise may have an additional benefit for the treatment of type 2 diabetes, possibly through lowering body fat and reducing blood pressure (Wallberg et al., 1998), and several studies have produced some compelling evidences to show that regular physical exercise can serve to protect and decrease severity of type 2 diabetes (Frisch et al., 1986). Researcher found that exercise improves blood glucose control even without weight loss (Elliott and Naughton, 2006).

Diets commonly recommended for control blood glucose levels include low fat and high unrefined carbohydrate. The foods which have a low glycemic such as pasta products, oats, beans, some fruits and vegetables usually make weight loss. Recently, the effect of diets on preventing or delaying the progression of diabetes in the metabolic syndrome patients was reported (Riccardi and Rivellese, 2000).

There was a study showed that drinking moderate amounts of alcohol may actually lower the risk of diabetes. Nevertheless, drinking greater amounts of alcohol could cause chronic inflammation of the pancreas and affect to the ability of insulin secretion. This impairment of insulin secretion ultimately leads to diabetes. Furthermore, Tobacco use can increase blood sugar levels and lead to insulin

resistance. The more people do smoking, the greater increasing the risk of diabetes. Heavy smokers those who smoked more than 20 cigarettes a day could almost increase double their risk of developing diabetes, when compared with non-smokers (Selby, 2008). The other factors that could predict the diabetes among people are having history of diabetes in family and having gestational diabetes during pregnancy. These tended to increase the risk of developing type 2 diabetes and obesity.

Lifestyle of people in Northeast was different from other areas. Moreover, the number of diabetes patients gradually increase in this part of Thailand, thus, determination of the cause of diabetes is priority to be done. Kalasin, one province in Eastern Thailand had the estimated prevalence of diabetes among people aged 40 or above continually increase over the time especially in Sahatsakhan district, where was found the second rank of diabetes patients in Kalasin province (District Health Office, 2012). According to the record of district health service, the prevalence of diabetes in Sahatsakhan population stately increases every year. The number of diabetes patient increase from 4.5% in year 2007 to 9.0% in 2012 (District Health Office, 2012). Since the type 2 diabetes is a preventable disease, knowing the influencing factors are crucial for reduction of the disease prevalence in this area.

Thus, the purposes of this study were to identify type 2 diabetes conditions among people in Kalasin province which located in Northeastern Thailand, and to examine whether influencing factors including socio-demographic characteristics, lifestyle and history of health that could predict type 2 diabetes conditions.

1.2 Research Question

What were the risk factors related to type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province?

1.3 Objectives

General objective

To explore factors association with type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.

Specific objective

1. To determine socio-demographic characteristics, lifestyle behaviors and health status of study population in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.
2. To explore the relationship between socio-demographic characteristics and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.
3. To explore the relationship between lifestyle behaviors and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.
4. To explore the relationship between history of health and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.

1.4 Hypothesis

1. There was an association between socio-demographic characteristics and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.
2. There was an association between lifestyle behaviors and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province. Lifestyle behaviors included eating behaviors, exercise behaviors, smoking behaviors, alcohol drinking behaviors, and sleeping behaviors.
3. There was an association between history of health and type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.

1.5 Expected benefit of the study

1. The risk factors related to type 2 diabetes among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province would be identified.

2. The result of this study may be useful to policy makers and health providers for developing a strategic plan to prevent and control a diabetes mellitus type 2 in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.

1.6 Operational definitions

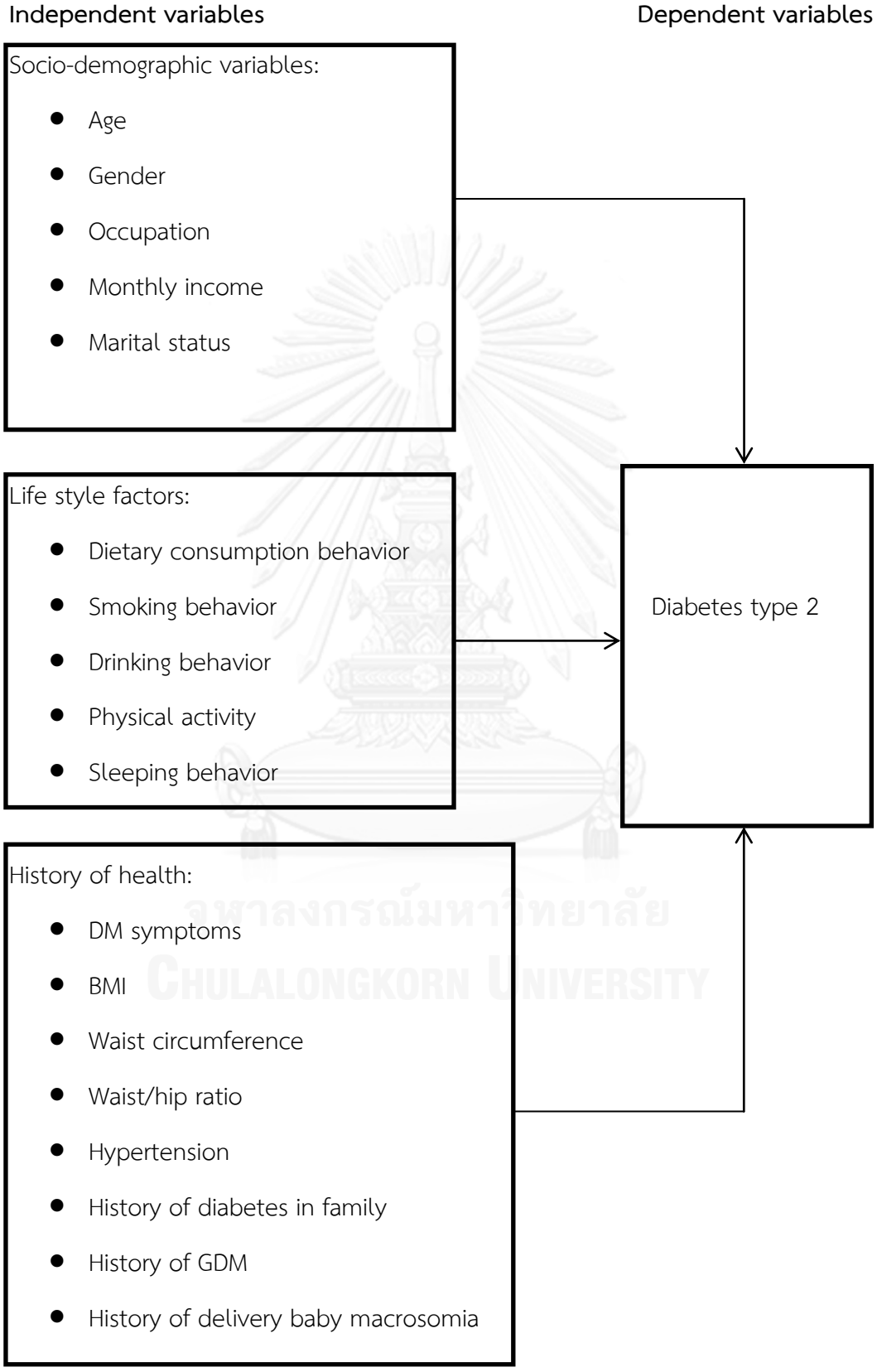
1. **Age** referred to the respondent's age at the time of interview.
2. **Gender** referred to the respondent's gender. It was classified into 2 groups; male and female.
3. **Education level** referred to the respondent's highest formal educational attainment. It was classified into 6 groups as none, primary school, secondary school or equal, university or equal, graduate school and others.
4. **Occupation** referred to the respondent's occupation. It was categorized into 7 groups; unemployed, housewife, agriculturist, an employee, self-employed, retired and others.
5. **Monthly income** referred to the respondent's income per month. This study divided it into 5 groups; less than 10,000 baht per month, 10,001-15,000 baht per month, 15,001-20,000 baht per month, 20,001-25,000 baht per month, and more than 25,000 baht per month.
6. **Marital status** referred to the respondent's marital status. It was classified into 6 groups; single, married, divorced, separated, and widowed.
7. **People with diabetes** referred to the respondent who had been diagnosed having diabetes by doctor. This diagnosis was done at least a month before the initiation of study. The data of diagnosed people could be retrieved from community health promotion center of Sahatsakhan district under permission.
8. **Gestational diabetes (GDM)** referred to the respondent who had diagnosed as having diabetes during pregnancy. This information was gotten from a self-report. Respondents also reported whether she delivered diabetes baby as her understanding.
9. **Hypertension (HT)** referred to the respondent's that had systolic blood pressure (SBP) equal or over 140 mmHg, and/or diastolic blood pressure (DBP) 90 mmHg or over. It was classified into present and absent of HT. Blood pressure was checked by the health providers using both right and left arms

of respondents after they took a rest after their arrival at health promotion center. The mean blood pressure was used in data analysis.

10. **History of diabetes in family** referred to having diabetes parent or sibling. It was classified into present and absent of history of diabetes among first degree relative.
11. **Physical activity behaviors** referred to exercise behaviors including type of exercise, frequency of exercise, and times to spend in the exercise in the past 7 days. This study used the International Physical Activity Questionnaires (IPAQ) and the Institute of Medicine (IOM), 2002 to classified the level of physical activity which were two levels including enough physical activity (doing moderate activity $\geq$30 minutes per day and performing physical activity $\geq$4 days a week), and not enough physical activity.
12. **Alcohol consumed behaviors** referred to the behaviors of the respondent on drinking alcohol e.g., wine, sparkling wine, rice whisky, and other beverage containing 40 degree and over of alcohol. The behaviors of alcohol also included the current status of alcohol consumption, frequency of consumption in a week, and amount of consumption per time.
13. **Smoking status** referred to the respondent's behaviors of cigarette smoking presented into consume characteristics; lifetime abstainer, former/ex-smoker and current smoker, number of cigarette smoked per day and second hand smoker.
14. **Dietary consumption behavior** referred to eating behaviors of the respondent. It was defined as good or not good along with the standard of American Diabetes Association (ADA) (ADA, 2013).
15. **Body mass index (BMI)** referred to the measurement that was used to enhance the relationship of weight and height of a person. BMI was a ratio of weight in kilograms and height in meters by power of 2. This study classified BMI into 3 groups; underweight (BMI less than 18.5), normal (BMI 18.5-24.9) and overweight (BMI 25.0 or over).
16. **Waist circumference** was measured at the center between ribs last tooth on the top of the pelvis. The normal level of waist circumference in women was < 88 cm or < 34 inches and in men was < 102 cm or < 39 inches.

17. **Waist/hip ratio** referred to the measurement that was used to enhance the relationship of waist circumference and hip of a person. Waist/hip ratio was a ratio of waist circumference in centimeter and hip in centimeter. The normal level of waist/hip ratio in women was ≤0.85 and in men was ≤0.9.
18. **Sleep pattern** referred to the duration time counted in hour of sleep. The adult need to sleep 7 to 9 hours a day.

1.7 Conceptual framework



CHAPTER II

LITERATURE REVIEW

This chapter explained literature review related to the study. The relevance of concepts and researches were presented as following;

2.1 Theory of diabetes mellitus

2.1.1 Diabetes Mellitus background

2.1.2 Definition and classification of diabetes mellitus

2.1.3 Diagnosed for diabetes mellitus

2.1.4 Risk factors of type 2 diabetes

2.1.5 Preventions and controls of diabetes mellitus

2.2 Researches related with diabetes mellitus and factors association with its.

2.2.1 Socioeconomic-demographic factor

2.2.2 History of health

2.2.3 Lifestyle factors

2.1 Theory of diabetes mellitus

2.1.1 Diabetes mellitus background

Polyuric states resembling diabetes mellitus were described as early as 1550 BC in the ancient Egyptian papyrus discovered by George Ebers (Colagiuri et al., 2008). The term diabetes, which is from the Ionian Greek meaning 'to pass through,' was first used by Aretaeus of Cappadocia in the second century AD as a generic description of conditions causing increased urine output (National Institutes of Health, March 2013). The nineteenth century is the key century that has greatly contributed to the understanding of diabetes. Claude Bernard made numerous discoveries in the field of metabolism and diabetes as cited. It is described that the storage of glucose in the liver as a glycogen and the acute hyperglycemia that followed experimental damage of the medulla oblongata known as 'piqué' diabetes (Eko´e et al., 2008).

The prevalence of diabetes in Thai population has increased every year (figure 1). In 2012 prevalence of diabetes in Thai people age 40 or above was 9.6%. The distribution of diabetes cases was accounted for 7.6% in the central, 7.0% in northeastern, 5.7% in northern and 5% in southern (figure 2). Of 17.5% developed a complication (Thai Ministry of Public Health, 2012).

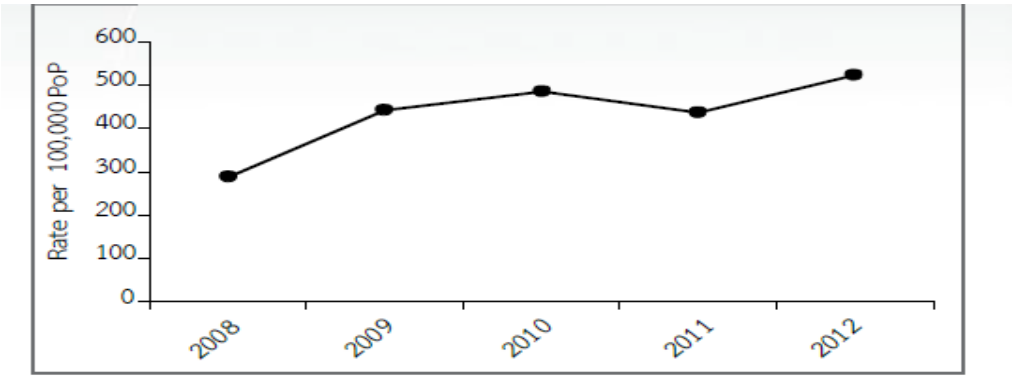


Figure 1: Incidence of registered diabetes per 100,000 populations, by year.

(Source: Thai Ministry of Public Health, 2012.)

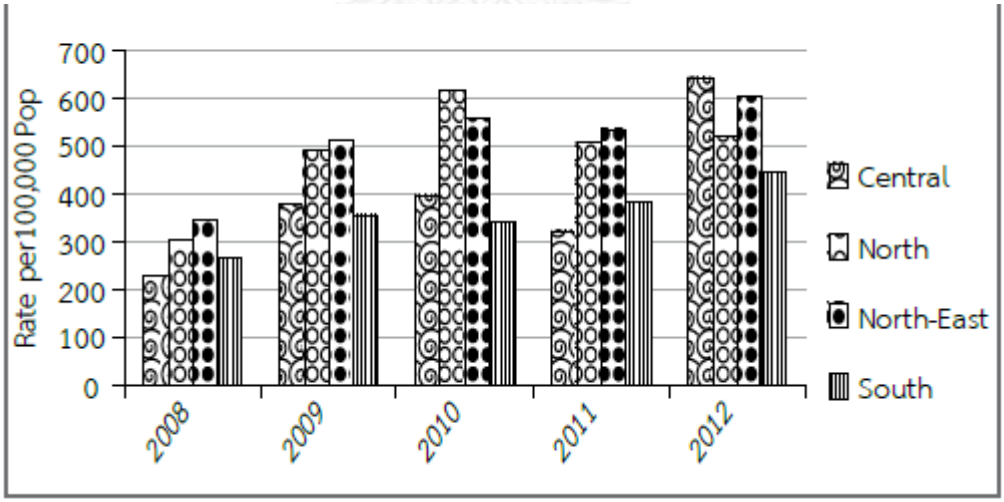


Figure 2: Reported cases of diabetes per 100,000 populations, by region, Thailand, 2008 – 2012.

(Source: Thai Ministry of Public Health, 2012.)

2.1.2 Definition and Classification of Diabetes Mellitus

DM refers to the sugar in the blood higher than body needed (National Institutes of Health, March 2013). The American Diabetes Association (ADA) gave the definition for DM as "Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels." (ADA, 2013).

The World Health Organization (WHO, 2013) defined diabetes as a chronic disease that occurs due to the pancreas lose a production of an insulin that it cause of less insulin in body. Insulin is a hormone that regulates blood sugar. Hyperglycemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels." (WHO, 2013)

Diabetes is a metabolism disorder resulting from an imbalance of an insulin using. Insulin is hormone that created from endocrine pancreases (mainly create insulin and glucagon), (Huxley et al., 2005).

Classification of Diabetes Mellitus

According to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) from "you guide to diabetes book"(2009), diabetes was classified into 3 major classes; 1) Type 1 Diabetes (T1D) or insulin-dependent diabetes mellitus (IDDM), usually have been first diagnosed among children and adolescents, the beta cells of the pancreas no longer make insulin because the body's immune system has attacked and destroyed them, 2) Type 2 Diabetes (T2D) or non-insulin-dependent diabetes mellitus (NIDDM), a condition in liver cells do not use insulin well. At first, the pancreas keeps up with the added demand by producing more insulin, but over time it will lose the ability to secrete enough insulin in response to food. This begins increase overweight and inactive chances of developing T2D, 3) Gestational Diabetes Mellitus (GDM) is caused by the hormones of pregnancy or a shortage of insulin after born baby diabetes usually goes away (National Institutes of Health, March 2013).

The similar classification defined by the American Diabetes Association, diabetes was also divided into 3 major classes; 1) Gestational diabetes mellitus (GDM), diabetes developed during pregnancy, pregnant women had diagnosed after

gestational age over 20 weeks and it may continue to be hyperglycemic after delivery, 2) Type 2 diabetes, it refers to person who acquires diabetes because of large doses of exogenous steroids and may become norm glycemic once the glucocorticoids are discontinued, but then may develop diabetes later after recurrent episodes of pancreatitis, 3) Type 1 diabetes, thus, for the clinician and patient, it is less important to label the particular type of diabetes than it is to understand the pathogenesis of the hyperglycemia and to treat it effectively (ADA, 2013).

WHO (2013) classified diabetes into 3 groups. 1) Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily administration of insulin. The cause of type 1 diabetes is not known and it is not preventable with current knowledge. 2) Type 2 diabetes (formerly called non-insulin-dependent or adult-onset) results from the body's ineffective use of insulin. 3) Gestational diabetes is hyperglycemia with onset or first recognition during pregnancy (WHO, 2013). Generally, diabetes was diagnosed into 2 classifications type 1 diabetes and type 2 diabetes. The differences in phenotype and genotype between type 1 and type 2- diabetes was shown in table 1.

Table 1: Comparison of Type 1 and Type 2 Diabetes (WHO, 2006)

	Type 1 diabetes	Type 2 diabetes
Phenotype	Onset primarily in childhood and adolescence	Onset predominantly after 40 years of age
	Often thin or normal weight	Often obese
	Prone to ketoacidosis	No ketoacidosis
	Insulin administration required for survival	Insulin administration not required for survival
	Pancreas is damaged by an autoimmune attack	Pancreas is not damaged by an autoimmune attack
	Absolute insulin deficiency	Relative insulin deficiency and/or insulin resistance

	Type 1 diabetes	Type 2 diabetes
	Treatment: insulin injections	Treatment: (1) healthy diet and increased exercise; (2) hypoglycemic tablets; (3) insulin injections
Genotype	Increased prevalence in relatives	Increased prevalence in relatives
	Identical twin studies: <50% concordance	Identical twin studies: usually above 70% concordance
	HLA association: Yes	HLA association: No

Source: WHO (2013)

2.1.3 Diagnosed for Diabetes Mellitus

It is more than a decade that the criteria of diabetes are based on the level of blood sugar level, however there were some discussions on the normal blood sugar level. The blood sugar level criteria have been changed since 1969 till 1999. Some experts defined diabetes as the impaired glucose tolerance condition. Impaired glucose tolerance (IGT) is defined by an elevated 2 hours plasma glucose concentration (≥140 and <200 mg/dl) after a 75 grams glucose load on the oral glucose tolerance test (OGTT) in the presence of an fasting plasma glucose (FPG) concentration <126 mg/dl (Nathan et al., 2007). Impaired fasting glucose (IFG) is now defined by an elevated fasting plasma glucose (FPG) concentration (≥100 and <126 mg/dl) (Nathan et al., 2007). FGP refers to the test measures blood glucose in a person who has not eaten anything for at least 8 hours (Harlan, 2007). There is another diagnose criteria to determine whether someone has a diabetes. These criteria are published by American Diabetes Association (ADA). The criteria is presented table 2.

Table 2: Blood sugar level (ADA, 2003)

	WHO 1999 mmol/l (mg/dl)	ADA 2003 mmol/l (mg/dl)
Diabetes		
Fasting glucose	≥7.0 (≥126.13)	≥7.0 (≥126.13)
2–h glucose	≥11.1 (≥198.20)	≥11.1 (≥198.20)
IGT		
Fasting glucose	<7.0 (≥126.13)	Not required
2–h glucose	≥ 7.8 (≥140.54) and <11.1 (<198.20)	≥ 7.8 (≥140.54) and <11.1 (<198.20)
IFG		
Fasting glucose	≥6.1 (109.91) and <7.0 (≥126.13)	5.6 to 6.9 (100.91 to 124.33)
2–h glucose	<7.8 (≥140.54) (measured recommended)	Measurement not recommended (but if measured, it should be <11.1 (<198.20)

Source: WHO (2006)

Symptoms of diabetes

The diabetes patient may show the symptoms as follows: thirst, polyuria, polydipsia, blurring of vision, weight loss and infections. In its most severe forms, ketoacidosis or an oncotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death. Most of the time, symptoms are not severe, or may be absent; therefore sometimes a patient in the beginning of diabetes (pre-diabetes) did not shows any symptoms, however his/her blood sugar level is higher than normal. (Eko´e et al., 2008). The usual clinical symptoms of diabetes mellitus, polyuria and polydipsia, are the direct result of the high blood glucose concentration. Weight loss in spite of polyphagia, ketoacidosis, visual

changes, skin infections, sepsis and pruritus belong to the same list of symptoms. With mild hyperglycemia, these cardinal symptoms are lacking (Eko´e et al., 2008).

In the early stages of type 2 diabetes mellitus, there are no symptoms until blood glucose levels exceed the "renal threshold" and glucose appears in the urine. Patients may first present with a complication such as neuropathy or retinopathy. People in high-risk groups, who are obese, who have a family history of type 2 diabetes, or who belong to high-risk ethnic groups (e.g. African American, native American, Hispanic, Pacific Islanders) should be screened for the disorder (Ann Kellett, 2013).

When the "renal threshold" for glucose (a blood glucose level of about 180 mg/dL), is exceeded for a significant portion of the day, the patient will have the classic symptoms of diabetes: excessive urination (polyuria) with consequent thirst and need to keep drinking (polydipsia). The loss of calories, due to the urinary glucose excretion, will lead to weight loss, and often a compensatory increase in appetite (polyphagia). The weight loss primarily is due to loss of muscle mass with conversion of amino acids into glucose, and causes weakness and fatigue (Ann Kellett, 2013, WHO, 2006). Persistent hyperglycemia can draw water into the eyes and cause visual blurring. This may persist for several weeks after correcting the hyperglycemia because of the slow diffusion of glucose out of the eyes (Mann and Toeller, 2008, WHO, 2006). Neuropathy may present with numbness, tingling or burning pain, first involving the ends of the longest nerves, i.e. those to the feet. Motor neuropathies are rare but may be acute in onset, often associated with pain, and may involve any nerve including the cranial nerves such as the coulometer nerve (Mann and Toeller, 2008, WHO, 2006).

Diabetes screening for type 2 diabetes (NIDDM)

Because of strong evidence that undiagnosed diabetes is highly prevalent, that it is associated with a high frequency of risk factors for complications, that there is a high prevalence of microvascular and macrovascular complications, and that treatment for hyperglycemia and other risk factors is available, screening for undiagnosed NIDDM would appear to be appropriate, particularly in groups at high risk for NIDDM. Screening for the purpose of reducing morbidity and mortality has been advocated in reviews of undiagnosed NIDDM, and the ADA position statement on screening describes a major objective of a community screening program as being

identification of individuals with one or more risk factors for diabetes (Colagiuri et al., 2008).

Screening can be interpreted as public health screening in the community but also simply as testing for diabetes in patients in the clinician's office. It is unlikely that symptomatic would be encountered in a screening situation, because severe symptoms characteristic of diabetes would likely have led such individuals to seek medical care and already be diagnosed as having diabetes. Several methods can be used for screening for asymptomatic undiagnosed NIDDM. For diagnosis of diabetes in an individual patient, a confirmatory test is required if the screening test is positive (Colagiuri et al., 2008, Maureen, 1995).

- The OGTT is the internationally recognized standard for diagnosing asymptomatic NIDDM. Screening by glucose challenge has the virtue that most individuals with 2-hour values 200 mg/dl will be confirmed to have NIDDM on a repeat OGTT, and they are at high risk for already having or for developing the complications of diabetes (Maureen, 1995).
- FPG appears to be an insensitive test in population screening for undiagnosed NIDDM. In the U.S. population, there is a broad distribution of FPG among adults with undiagnosed NIDDM and only ~26% of people age 20-74 years with undiagnosed NIDDM have fasting hyperglycemia (140 mg/dl) (Maureen, 1995).

Complications of diabetes

Acute complications

The acute metabolic complications of diabetes consist of diabetic ketoacidosis (DKA), hyperosmolar non-ketotic coma (HNC), lactic acidosis (LA), and hypoglycemia. DKA and HNC are related to insulin deficiency. Hypoglycemia results from the treatment of diabetes, either with oral agents or insulin. Although hypoglycemia may occur in conjunction with oral hypoglycemic therapy, it is more common in patients treated with insulin. LA is usually associated with other factors that may be related to diabetes, such as cardiovascular disease (acute myocardial infarction), hypoxia and excess lactic acid production (Fishbein and Palumbo, 1995, Eko´e et al., 2008). The detail explanation of each acute metabolic are as follows.

1. **Diabetes Ketoacidosis (DKA**) a common emergencies of patients with T1D caused by an imbalance of insulin result from a lack of insulin. The body uses

energy from fatty acids. The effects will be output as ketones in the blood. This symptoms may lead to stupor, coma and death (if absence of effective treatment).

2. **HNC** is clinically defined by the presence of relative insulin deficiency and hyperglycemia, usually the glucose level at >1,000 mg/dl, with associated elevated serum osmolality (>300 mosm/kg), dehydration, and stupor, progressing to coma if uncorrected, without the presence of ketosis or acidosis. These patients have sufficient circulating insulin to prevent lipolysis and ketosis.
3. **LA** consists of elevated lactic acid (lactic acidemia, 2.0 mmol/L) with acidosis (pH 7.3) and without ketoacidosis. There may be low levels of ketones present (1:4 on serum dilution, or beta hydroxybutyrate >0.4 but <0.6 mmol/L). Approximately half of the reported cases of LA have occurred in patients with diabetes.
4. **Hyperglycemia** is a condition in which an excessive amount of glucose in the blood plasma. Means high blood sugar exceeded the normal value is 70-99 mg / dL. This condition occurs when the body does not have enough insulin or cannot use the insulin it does have to change glucose into energy (WHO, 2006).
5. **Hypoglycemia** is the condition that the level of glucose in the blood has dropped below 72 mg/dl or 4 mmol/L. This occurs when there is too much insulin for the amount of food, or when glucose has been used up quickly during and after activity. A person with hypoglycemia may feel nervous, shaky, weak, and sweaty; have a headache, blurred vision and hunger.

Chronic complications

1. Cardiovascular disease (disease of the circulatory system): Diabetes accelerates the degeneration of the blood vessels throughout the body. When the blood vessels that feed the heart degenerate and have hyperlipidemia, it will result stenosis of the coronary arteries causing ischemic heart disease. On the other hand, if the blood vessels were obstructed, it will cause symptoms of myocardial infarction in people with DM (El-Kebbi and Engelgau, 1995, WHO, 2006, Clinic, 2013, DCCT/EDIC, 2005).

2. Diabetic retinopathy: it is caused by high blood sugar levels damaging the network of small blood vessels that supply blood in the retina. At the initial stage, the damage is limited to tiny bulges in the blood vessel walls. Gradually over time, the blood vessels that supply the macula, the most sensitive part of the retina, can become damaged. Blood and some of the substances in the blood will leak into the macula and make the macula edema, leading to some loss of vision. When the retinopathy reaches its most advanced stage, the blockage of blood vessels that supply retina occurs, the new blood vessels will start to form in an attempt to restore the supply of blood. Nevertheless, the new blood vessels are unstable and prone to bleeding leading to blurred and patchy vision because the bleeding obscures the sight. If the bleeding prolongs, scar tissue can be formed which can pull the retina out of the position and worsen the patient's vision i.e. the eye or retina degeneration, or see black dots floating back and forth and blindness (El-Kebbi and Engelgau, 1995, Khandekar et al., 2003).
3. Renal complications (Diabetic nephropathy): Diabetes can cause renal failure. Pathology of small blood vessels in glomeruli allow albumin leak out with filtrate, this made proximal tubule work harder. If this condition is still too long, patients often died within 3 years from first onset caused by renal failure (El-Kebbi and Engelgau, 1995, Clinic, 2013, Shehab et al., 2002).
4. Neurological complications (Diabetic neuropathy): Diabetes can make small blood vessels in the hands and the legs work not well. When a patient has a wound they will not know. And if patients with diabetes have higher level of glucose, it is a good food to these germs and then wound will rot and lead to diabetic ulcer and amputation. In men, there could be erectile dysfunction (impotence) (El-Kebbi and Engelgau, 1995, Clinic, 2013, Boulton, 2008).
5. Stroke (Cerebrovascular disease): Diabetes increases the risk of stroke and coronary artery diseases. The hardening of the arteries in the brain can cause paralyze (Clinic, 2013, Lees and Walters, 2005).
6. Dental disease: Periodontal (gum) disease is more common in people with diabetes. People aged 45 years or above with poorly controlled diabetes (Hba1c > 9%) were 2.9 times more likely to have severe periodontitis than people without diabetes. The likelihood was (4.6 times) even greater among smokers with poorly controlled diabetes (Clinic, 2013, El-Kebbi and Engelgau, 1995).

2.1.4 Risk factors of type 2 diabetes

Risk factors define as the factors that make more plausible to have a chance of developing a disease. Risk factors for diabetes depend on the type of DM. Several risk factors have been associated with type 2 diabetes included:

- **Age** is always a key factor because the risk of T2D increases steeply with age. People aged 40 or above have risk of T2D more than younger age. This could be caused by less exercise, losing muscle mass and gaining weight (Dianna J. Magliano et al., 2005).
- **BMI** is the second factor, reflecting overweight and obesity. The risk of T2D is greatly increased by excess weight (Dianna J. Magliano et al., 2005, Huxley et al., 2005).
- **Waist circumference** could be used to predict diabetes risk. People who have high body fat distribution in abdomen especially visceral fat carry a higher risk of T2D. In Asian ethnic, the waist circumference ≥ 80 cm or ≥ 32 inches in women and ≥ 90 cm or ≥ 36 inches in men increase the risk of T2D (Huxley et al., 2005).
- **Overweight/Obesity**. It means BMI of 25.0 or over. Cells become resistant to insulin if the body has more fatty tissue (Huxley et al., 2005).
- **Lack of exercise**. Exercise will help in weight control; take up glucose into energy and makes cells more sensitive to insulin. People will be having risk of T2D if doing exercise less than three times per week (Huxley et al., 2005).
- **History of diabetes in family**; having a close family member with DM will increase T2D risk.
- **Race** is also a predictor. However, the precise cause of having higher risk in some ethnic groups e.g. Asians, American Indians and Hispanics than others is still unknown (Ramachandran and Snehalatha, 2005).
- **History of GDM**. If women develop DM during pregnancy or deliver baby weight over 4,000 gm. They have high risk to develop T2D (Dianna J. Magliano et al., 2005).
- **Polycystic ovary disease**. This disease is a hormonal condition occurs in women between late adolescence and the menopause. Women with polycystic ovary disease are likely to have insulin resistance and they have a

greater risk of developing T2D. The symptoms of disease will show from abnormal menstruation and hyperandrogenism and IR (Dianna J. Magliano et al., 2005).

- **Hypertension**. People who have blood pressure over 140/90 mmHg have risk of T2D higher than people with normal pressure (Dianna J. Magliano et al., 2005).
- **Cholesterol level**. There is risk of having T2D if the cholesterol level is 200 mg/dL or over (Dianna J. Magliano et al., 2005).
- **Triglyceride level**. The risk of DM increases in people who have the triglyceride level 250 mg/dL or over (Dianna J. Magliano et al., 2005).
- **Diet.** Eating colorful vegetables and fresh non-sweet fruit at least one meal per week and avoid eating sweeten, salty and fatty foods will reduce the risk of developing T2D (Huxley et al., 2005).
- **Smoking**. Smoking increases chance of having T2D. 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 (Huxley et al., 2005).
- **Alcohol consumption**. Men should not drink more than two standard glasses per day and women should not drink more than one standard glass per day. One standard glass for beer is less than 360 cc, for wine does not exceed 150 cc and not exceeds 45 cc for whiskey. The frequency of drinking is not more than three days in one week (Dianna J. Magliano et al., 2005).
- **Gender**. Many studies showed the higher risk of T2D in men than in women but the results were unclear (Dianna J. Magliano et al., 2005).

2.1.5 Preventions and Control of Diabetes Mellitus

Diabetes is a chronic disease. It cannot be cured but need to control the disease throughout life. An effective control relies on the cooperation of the patient and relatives to do self-care instructions on a regular basis which are; 1) food control 2) exercise and 3) treatment with tablets and/or insulin. These are some recommendation published by American Diabetes Association (ADA, 2013).

1. Eating pattern; select the proper diet is important to control the blood sugar levels of diabetic patients. Food for patients with diabetes should enough for body energy. The recommendation for diabetes patients as following;

Eat meal complete the 5 basic food groups (Protein, carbohydrate, vitamin, fat and mineral).

- Eat foods with more fiber such as rice, crackers, whole grains cereals as the main food, eat vegetables, fruits and fish every day, choose lean meats and low fat foods, avoid sweet and salty.
- Limited ripens fruits such as mango and durian. It can eat as limited of energy a day.
- Avoid drinking Julie, coffee, and any alcohol.
- Drinking water 6-8 glasses a day.

2. Do exercise (Ekoʹe and Zimmet, 2005, ADA, 2013)

- Consultation of a doctor and a physical examination is needed before doing any exercise because some types of exercise are not safe for diabetes patients.
- Wear appropriate and fit well shoes for exercise, and must wear clean and dry socks at all times. Check the feet for redness or sores after exercising. Call the doctor if any sores do not heal.
- Warm up and stretch for 5 to 10 minutes before exercise. Then cool down for several minutes after exercise. For example, walk slowly at first, stretch, and then walk faster. Finish up by walking slowly again.
- Drink water before and after exercise to prevent dehydration.

Exercise recommendations

Data from various studies have allowed researchers to develop guidelines for the amount of exercise needed to create and maintain these health benefits. The American Diabetes Association (2004) found that the exercise recommended that people accumulate 30 minutes or more of at least moderate-intensity (60 to 74% of their maximum heart rate) physical activity on at least 5 (preferably all) days of the week, or at least 20 minutes of at least vigorous-intensity (75 to 85% of maximum heart rate) physical activity on 3 or more days per week (American Diabetes Association, 2004). In addition to these population-based studies, several

experimental studies led exercise scientists to examine the effect of intensity level as well as the minimum length of each bout of activity. A study by Wallberg-Henriksson revealed that several short bouts (e.g., three 10 minute bouts) of moderate-intensity to vigorous-intensity activity in a day produced similar improvements in health-related outcomes to one longer bout (e.g., one 30 minute bout) (Wallberg-Henriksson et al., 1998)

2.2 Researches related with diabetes mellitus and factors association with its

2.2.1 Socioeconomic-demographic factor

People differ by gender age marital status race/ethnicity, and also by socioeconomic characteristics, such as education or income and occupation. These factors will influence their health disparities among people. The result found respondents who having less than a high school education was associated with a two-fold higher mortality from diabetes, after controlling for age, gender, race/ethnicity, marital status, and body mass index, compared with adults with a college degree or higher education level (Collaboration, 2010). Furthermore, this study reported that people who have a family income below poverty level was associated with a twofold higher mortality after adjustments compared with adults with the highest family incomes (Robbins et al., 2005). Moreover, a study of American Cancer Society cohorts (1959–1972 and 1982–1996) found an inverse gradient for education and diabetes mortality for both time periods, but information on income or race/ethnicity was not included (Steenland et al., 2002). An analysis of the National Health Interview Survey (NHIS) and Linked Mortality Files data from 1987 to 1997 also found an inverse gradient for education and income associated with diabetes mortality (Rogers et al., 2003). According to the study investigate the association between socioeconomic status (SES) and incidence of diabetes (Robbins et al., 2005) found, among women, diabetes incidence was inversely associated with income measured as percent of the poverty level, education, and occupational status. On the other hand, among men, a trend toward lower diabetes incidence with higher income and higher education was evident but there was no inverse association of diabetes incidence with occupational status (Robbins et al., 2005). A study conducted in South Korea found that BMI (obesity and overweight sub-groups) was positively significant related with T2D. The odds ratio (OR) of obesity and overweight in male was lower than female for obesity and overweight. Moreover, a study in US showed that BMI was significantly related to the risk of diabetes after

controlling smoking, family history of diabetes and age (Wannamethree et al., 2000). Another research examined the prevalence of diabetes and pre-diabetes in 483 respondents, aged above 40 years old in Kiriratnikom district, Surat Thani province, Thailand. The results show that diabetes and pre-diabetes were found in male more than female, 5.2% (6.3% in men and 4.2% in women) and 9.5% (9.5% in men and 9.6% in women), respectively (Ruangwarcharin, 2007).

Moreover, the finding of other study found the prevalence of diagnosed diabetes among adult men has more than doubled over the past twenty-five years, from 3 percent of the population in the late 1970s to 7 percent. The prevalence of actual diabetes (including both diagnosed and undiagnosed cases) has also raised, though less dramatically (Robbins et al., 2005). The prevalence of diabetes compared by education group, the researcher found that high school dropouts were roughly sixty percent more likely to have diagnosed diabetes and twice as likely to have actual diabetes as men who have attended college. The improvement in diabetes detection over the past twenty-five years has been larger for college-educated men than for high school dropouts (Robbins et al., 2005). Roger and Hummer also examined the determinants of diabetes detection and treatment. Over time, race has become less important while education has become more important both in detection and successful management of diabetes. This finding suggested that education may increase patients' ability to adopt and adhere to complex new diabetes treatments. These treatments often require careful patient self-management on a daily basis - for example, patients must monitor their blood glucose levels, balance insulin injection doses with food intake and physical activity, and consult regularly with health care providers (Rogers and Hummer, 2003).

Moreover, the study in Sinakarin Hospital among people aged 35-75 years revealed that the modified Thai Diabetes Risk Score in male and female were not different. Hence, (Porntrakulphiphat et al., 2011, Porntrakulphiphat et al., 2012). Moreover, some risk factors i.e., high blood pressure, malnutrition (obesity), food intake, alcohol and smoking behavior are related to T2D. A study of Al-Moosa and colleagues conducted in subjects aged above 20 years old in Oman found that obesity, hypertension, age and education were significantly associated with diabetes (Al-Moosa et al., 2006). This finding is also similar to that of a research in Taiwan found that the malnutrition (obese, overweight) was significantly related to the incidence of T2D, and the adjusted relative risk (RR) showed 14.8 times higher for person who are over nutrition (Hwang et al., 2006). Moreover, a study conducted in Spain showed that occupation and sex were significantly related to the incidence of

metabolic syndrome, such as DM. They also found the prevalence of metabolic syndrome in male workers higher than in female workers and the prevalence increased with increasing age. The prevalence of metabolic syndrome varied in the different categories of occupational activity depending on the sex considered. This research arrived at conclusion that metabolic syndrome varies in the different categories of occupational activity and based on sex group (S´Anchez-Chaparro et al., 2008).

2.2.2 History of health

Type 2 diabetes accounts for 90%–95% of all cases of diabetes and is a classic example of a multifactorial disease involving the complex interplay of modifiable and no modifiable risk factors, including family history, obesity (Kuller L et al., 2000). History of health in this study included history of GDM or delivery of baby over 4,000 gm., waist circumference and waist to hip ratio. The research that relate to relationship between history of health and diabetes will be as follow;

The research conducted in USA showed a family history of DM, genes, increased BMI, and current smoking status were significantly associated with the risk factors of T2D (Lyssenko et al., 2008). Similar results were shown in Duquette and Bach study. They found individuals who had diabetic history in family were at greater risk to develop diabetes. The result showed 58.5% of Michigan diabetes adults reported a family member with diabetes and 52.7%of respondents reported their provider collected their family history of diabetes (Duquette et al., 2007). Moreover, the researchers stated type 2 diabetes has a genetic component, so if one of our parents developed the condition we are at greater risk of developing it too. In addition, type 2 diabetes is another risk factor for the development of cardiovascular disease. Family history of a disease reflects shared environmental and behavioral risk factors and their interactions with genes as shown by the strong familial aggregation of many complex disorders (Annis et al., 2005). Also other study found a positive family history is a sensitive indicator of the presence of diabetes with much higher sensitivity than obesity, a well-established risk factor (Hariri et al., 2006).

In fact, family history is an independent risk factor for most common chronic diseases including cardiovascular disease, cancer, and type 2 diabetes (Arslanian et al., 2005). Furthermore, the study of relationship between family-centered and preventing coronary heart disease reported family history of coronary heart disease (CHD) is a significant predictor of an individual's risk for CHD even after adjusting for

an individual's own established risk factors, such as hypertension, smoking, and abnormal lipoprotein levels (Kardia et al., 2003). And the cohort research on the risk factors of diabetes was conducted among Thai adult 40 years old and above. The respondents were selected among Thai adult without DM at the beginning of survey, later on they were resurveyed within 12 years. The risk factors which related to the DM were gender, overweight, obese, abdominally obese, hypertension and having a parent or sibling with diabetes (Aekplakorn et al., 2006). Harri (2006) tried to evaluate the use of self-reported family medical history as a potential screening tool to identify people at-risk for diabetes. He found family history of diabetes is not only a risk factor for the disease but is also positively associated with risk awareness and risk-reducing behaviors. It may provide a useful screening tool for detection and prevention of diabetes (Hariri et al., 2006). The result showed that the prevalence of diagnosed diabetes, undiagnosed diabetes, and impaired fasting glucose were associated with greater age, BMI, waist-to-hip ratio, systolic blood pressure, total cholesterol, and serum creatinine levels. It was concluded that one-half of all cases are undiagnosed (Aekplakorn et al., 2003).

2.2.3 Lifestyle factors

Lifestyle and behavior are critical factors influencing people's health. Health-related behaviors, including health risk behaviors and health promoted behaviors, such as eating habits, smoking, alcohol consumption, drug abuse, exercise, etc. are determinants of health. This lifestyle of this study comprise of eating behaviors, smoking behaviors, alcohol consumed behaviors, physical activity behaviors and sleep pattern. Many studies in several countries showed that smoking have relationship with DM. Smoking induces insulin resistance, and cigarette smokers have been shown to be relatively glucose intolerant and dyslipidemia (Mann and Toeller, 2008). The studies among adults in USA found that smoking recently showed the inclining incidence of DM compared to never smoke (odds ratio of 2.66) (Foy et al., 2005).

Furthermore, the research in Oslo conducted to examine the relationship between exercise and smoking with the incidence of DM and other metabolic syndrome. This research employed adult man who participated in two cardiovascular screening that have different time at 28 years later from one to another screening (Karvonen et al., 2010). Cigarette smoking causes substantially increased risk of mortality from heart disease and stroke in both men and women. It is the most

important coronary heart disease risk factor for both young men and women. Among industrialized countries where smoking has been common, smoking is estimated to cause 22 percent for cardiovascular diseases and accounts for 4.5 million cardiovascular disease deaths (Solar and Irwin, 2010). The increase in smoking in developing countries contrasts sharply with the overall decline in many industrialized countries. Recent projections from the world health organization suggest that, by the year 2020, tobacco will become the largest single cause of death, accounting for 12.3 percent of global deaths. India, China, and countries in the Middle Eastern Crescent will by then have tobacco contributing to more than 12 percent of all deaths (Wardle et al., 1999). Breathing environmental tobacco smoke, including side stream and exhaled smoke from cigarettes, cigar and pipes; also causes serious health problem. Exposure to environmental tobacco smoke may also increase the risk of cardiovascular disease among non-smoker (World Health Organization, 2002c). Smoking increases the risk of cardiovascular disease mortality 2-3 fold. WHO MONICA project has shown that by reducing classical risk factors for cardiovascular disease like smoking, blood cholesterol, and blood pressure can be reduced almost 50 percent of CVD mortality (Willett et al., 2012).

According to the study investigate the association between socioeconomic status (SES) and incidence of diabetes (Robbins et al., 2005) found among women, diabetes incidence was inversely associated with diet, physical activity, and alcohol and tobacco use. Similar with the study about dietary and coronary disease found high red meat intake increases risk of CHD and that CHD risk may be reduced importantly by shifting sources of protein in the US diet (Bernstein, 2010). Furthermore, people who intake the fruit and vegetables, fish, and whole grains have lower risk of CHD and lower likelihood of developing hypertension (Shilpa and Katherine, 2011). Moreover, it is addressed for special interest in the association of some levels of intake with lower risks of coronary heart disease. Consumption of one or two drinks per day is associated with a reduction in risk of approximately 30 to 50 percent (Cutler et al., 2006). In addition, the study of the association between alcohol and cardiovascular health found the lower risk of light drinkers is due mostly to lower risk of the most common cardiovascular condition, coronary heart disease (CHD) (Klatsky, 2004). Similar with the study of effect of alcohol consumption on the risk of coronary heart found several cardiovascular biomarkers (higher levels of high density lipoprotein cholesterol and adiponectin and lower levels of fibrinogen) provide indirect coronary heart disease (Brien, 2011). However, other study found there is no relationship between the intake of vitamin C and T2D (Montonen et al.,

2004) and alcohol consumption and smoking were not associated with diabetes (Aekplakorn et al., 2006).

For physical activity, it could potentially contribute to primary (reducing initial occurrence), secondary (reversal), and tertiary (delay of medical complications) prevention and treatment of diabetes. Metabolic studies suggest that the major effect of physical activity is improved glucose transport and insulin sensitivity, some of which may be indirect effects of weight loss (Li, 2002). Similar with the cohort study found more than half the diabetic patients were in remission after a mean follow-up of six years. Improvement in glucose tolerance was associated with both weight reduction and increased fitness, and mortality was a third lower than the rest of the cohort who were no treated (Eriksson and Lindgarde, 1991). Physical activity was included in a randomized controlled study that compared diet with exercise for reducing the development of diabetes among adults in Da Qing, China, the result found all the intervention groups had lower rates of diabetes than the control group, independently of whether participants were lean or overweight (Foggin et al., 2001).

Some scholars find the relationship between sleeping and the diabetes mellitus. 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. After taking into account and adjusting for age, hypertension, smoking status, self-rated health status, education, and waist circumference, the increasing risk to become diabetes state was essential (Yaggi et al., 2006). Another supporting research conducted in USA. The result showed that among non-Hispanic whites and Hispanics, short sleep (sleep less than 7 hours) was associated with increased odds of diabetes, even adjusting for age, sex, IGT, clinical site, hypertension, family history of diabetes, smoking, education, and BMI (Beihl et al.,2009)

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design

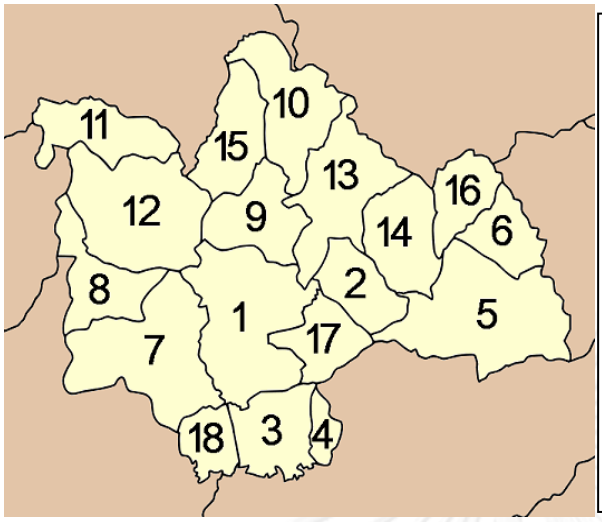
This case-control study was conducted to evaluate associations of risk factors with T2D in people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand.

3.2 Study Area

Kalasin province is located in the northeastern part of Thailand which its border connected with Sakon Nakhon and Udon Thani province in the north, Roi Ed province in the south, Khon Kaen and Maha Salakham province in the west and Mukdahan province in the east. Kalasin province has 11 districts among these districts, Sahatsakhan district had the highest number of diabetes patients thus this district was firstly selected to be the study area. After that Ban Na Makhuea sub-district, one of 9 sub-districts of Sahatsakhan district was purposively selected. This sub-district has 12 villages with total population of 5,354 and people aged 40 years or above are 1,312 (DOPA, 2012). According to the District Health Office of Kalasin province report, Ban Na Makhuea sub- district also has the highest number of diabetes cases, a total number of people with diabetes aged 40 years or above was 418 (189 males and 229 females) (DHO, 2012).

Figure 3: Map of the north eastern provinces, Thailand.

(Source: ISAN map.com, 2013: online)



1.	Mueang Kalasin	10.	Kham Muang
2.	Na Mon	11.	Tha Khantho
3.	Kamalasai	12.	Nong Kung Si
4.	Rong Kham	13.	Somdet
5.	Kuchinarai	14.	Huai Phueng
6.	Khao Wong	15.	Sam Chai
7.	Yang Talat	16.	Na Khu
8.	Huai Mek	17.	Don Chan
9.	Sahatsakhan	18.	Khong Chai

Figure 4: Map of Kalasin province, Thailand.

(Source: Kalasin.go.th, 2013: online)

3.3 Study Population

The male and female residents of Ban Na Makhuea sub-district who aged 40 years or above were recruited into the control group (non-diabetes) and the case (diabetes). The respondents who would be in the case group had to meet the following criteria;

Inclusion criteria of case (people with diabetes)

- The respondent was diagnosed as type 2-diabetes patient by medical doctor and the data was shown in health promotion's record.
- They were 40 years old or above.
- The respondents lived in Ban Na Makhuea sub-district during the study.
- The respondents could communicate with data collector individually.

The respondents who would be in the control group had to meet the following criteria;

Inclusion criteria of control (people without diabetes)

- They were screened by Ban Na Makhuea sub-district health promotion center in 2013 that did not have diabetes.

- They were 40 years or above.
- The respondents lived in Ban Na Makhuea sub-district during the study.
- The respondents could communicate with data collector individually.

People who had mental disorder, hearing problem, speech problem and/or unable to understand Thai language would not be recruited in the study.

3.4 Sample Size Calculation

According to data from District Health Office in 2012, the prevalence of type 2 diabetes in Kalasin province was 0.127 %. This prevalence would be used for sample size calculation.

The Cochran's formula (provided by Daniel 2005) was used for sample size calculation as shown below;

$$n = \frac{Z_{\alpha/2}^{2} pq}{d^2}$$

Where;

n = minimum sample size

α = level of significance (0.05)

$Z_{\alpha/2}$ = critical value for 95% confidence interval

= 1.96

p = estimated DM prevalence in Kalasin province

(District Health Office, 2012)

= 0.127

q = 1- P= 1- 0.127 = 0.873

d = allowable error in estimating prevalence

(margin of error)

= 0.05

Therefore;

$$n = \frac{1.96^2 (0.127) (0.873)}{0.05^2}$$

$$= 170 \text{ persons per group}$$

The 10% additional number or 17 respondents was added in each group for drop out. Therefore, the respondents with diabetes were 187 persons and the respondents without diabetes were 187 persons. All of total respondent were 374 persons.

3.5 Sampling Technique

The multi-stage sampling technique was used in this study.

(1) Sahatsakhan district was purposively selected due to its highest number of diabetes patient in this province.

(2) Ban Na Makhuea sub-district was also purposively selected because of the highest number of diabetes cases reported.

(3) Six of 12 villages of this sub-district which had the high prevalence of type 2 diabetic patients according to the medical data of Ban Na Makhuea sub-district health promotion center were selected.

(4) The number of diabetes patient in those 6 villages was shown below;

- Village 1, 49 residents, 23 males and 26 females;
- Village 7, 46 residents, 31 males and 15 females;
- Village 9, 41 residents, 13 males and 28 females;
- Village 3, 37 residents, 17 males and 20 females;
- Village 4, 34 residents, 14 males and 20 females;
- Village 2, 32 residents, 19 males and 13 females.

The final numbers of male and female diabetes residents were 117 and 122, respectively. Number of diabetes samples that would be randomly selected from each village was calculated by multiply the number of diabetes residents in each village with the proportion of number of calculated samples (187) and total number of diabetes respondents in 6 villages or 80% of residents with type 2 diabetes of each village.

(5) The residents with diabetes from each village whose name was in the medical data list of Ban Na Makhuea sub-district health promotion center were randomly selected by lottery method and recruited into the case group. The number of respondents from each village was shown below;

- Village 1, 38 respondents (22 males and 16 females)
- Village 7, 36 respondents (22 males and 14 females)
- Village 9, 32 respondents (12 males and 20 females)
- Village 3, 29 respondents (13 males and 16 females)
- Village 4, 27 respondents (12 males and 15 females)
- Village 2, 25 respondents (12 males and 13 females)

(6) For the control group recruitment, the same number of respondents as in the case group from the same six villages was used for sampling by lottery method. The respondents in the control group were diagnosed by medical doctor that they did not have diabetes in the diabetes screening last year.

To assess the medical data of the residents in Ban Na Makheua sub-district, the researcher asked for the permission to assess the name lists of residents with and without diabetes from the sub-district health promotion center. If there was the refusing to participants the study from the selected resident, a new name of resident would be picked up until the number of respondents reached 187 persons.

3.6 Measurement Tools

The structured questionnaire was used as a measurement tool to interview the respondents. The questionnaire used in this study was modified from the Modified models of Thai Diabetes Risk Score II (Siwakorn et al., 2011). It consisted of three parts as follows.

- Part I: Socio-demographic characteristics
- Part II: History and health behaviors
- Part III: Physical examination

Part I: Socio demographics

There were 6 questions in this part asking about general information i.e., age, gender, marital status, education level, occupation and monthly income.

Part II: History and health behaviors

There were 50 questions in this part asking about history of GDM or delivery of baby over 4,000 grams, history of diabetes in family, smoking behavior, alcohol consumption behavior, physical activity and sleeping habits and eating behavior.

Part III: Physical examination

There were 6 examinations in this part i.e., blood pressure, hip circumference, waist circumference, BMI, height, weight and 1 question asking about blood glucose levels (from the patient diary).

3.7 Validity and Reliability

Validity test:

Index of Item Objective Congruence (IOC) was used to measure the content validity of the questionnaire. The content of the questionnaire was checked by consulting 3 experts (Dr. Keadthiboon Kitjareanwanichkun, Dr. Theppakit Sukkee and Dr. Phattarapong Boonyagougoon). Their comments were incorporated in consultation with the advisor. The questionnaire was adjusted to obtain validity.

An Index of Item Objective Congruence (IOC) value of the questionnaire was 0.72.

Reliability test:

After the validation, this study tested reliability on pilot study by interviewing of 30 people who aged 40 years and over and live in Phu Sing sub-district, Sahatsakhan district, Kalasin province, Thailand. The result of reliability tested by using Cronbach's alpha was 0.68.

3.8 Data Collection

This research was determined risk factor associated with type 2 diabetes among people aged 40 and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand.

After getting the approval from the Ethics Review Committee, Health Sciences Group, Chulalongkorn University, the following steps were done.

1. The researcher made an appointment with the staff of Ban Na Makhuea sub-district health promotion center.
2. Fifteen health volunteers were recruited as research assistants in data collection.
3. Researcher trained the technique of data collections to health volunteers. The topics of training were the interviewing technique, the meaning of each item in the questionnaire, and the ethical for data collector. One-day training was conducted at the Ban Na Makhuea sub-district health promotion center.
4. Researcher met local health officers in Ban Na Makhuea sub-district health promotion center and was trained them to plan for data collection.
5. Researcher sent the letter to the residents of villages in Ban Na Makhuea sub-district who were randomly selected by lottery method. The researcher would contact them later to make an appointment.
6. On the day of appointment, the researcher and well-trained health volunteer visited selected people at home. The researcher clarified the concepts of the research and informed the participant sign in an inform consent as agreement to include in this study.
7. After that, the researcher and team interviewed and measured the blood pressure, weight, height, waist circumference and hip circumference of the participant. This process took time around 30-45 minutes. At the end of the day, if there was anyone refused to participate in the study, the new name of resident in this village would be randomly pick up until the number of respondent met the expected number.
8. During data collection, researcher checked the completeness of questionnaire.
9. Data obtained from the interview was cleaned and then keyed to SPSS version 16. Double check of data entry was done by researcher and team.

3.9 Data Analysis

The licensed SPSS software for window version 16 was used for data analysis.

Descriptive statistics: including frequency, proportion, percentage, means, maximum, minimum and standard deviation were used to describe socio-demographic characteristics of participants.

Analytical statistics: Logistic regressions were used to identify the relationship between type 2 diabetes and potential risk factors. The significant level was set at p-value less than 0.05.

3.10 Ethical Consideration

1. This research study was submitted for ethical approval to Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University.
2. Informed Consent was written by respondent before data collection.
3. Respondent's information was kept confidentially.
4. The name of respondents was not shown.

CHAPTER IV

RESULTS

In this case-control study, aimed to identify type 2 diabetes risk factors among people aged 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province. The data of 187 people with type II diabetes (93 male and 94 female) and 187 people without diabetes (93 male and 94 female) residing in 6 villages of Ban Na Makhuea sub-district were collected by interview during April 2014. The list of villages and number of participants are shown in the table 3.

Table 3: The list of villages and number of participants

Villages	Male		Female		Total
	DM	Non-DM	DM	Non-DM	
1 Ban Na Makhuea	22	22	16	16	76
2 Khok Charoen	12	12	13	13	50
3 Pong Cheuak	13	13	16	16	58
4 Phonswang	12	12	15	15	54
7 Kam Dok Son	22	22	14	14	72
9 Don Chan	12	12	20	20	64
Total	93	93	94	94	374

4.1 The descriptive information

4.1.1 Socio-demographic characteristics of respondents

This part described the background characteristics of the respondents included age, gender, marital status, occupation, education and monthly income of respondents in each group. The results showed that the most (34.0%) of respondents were aged between 50-59 years (32.3% of male and 34 % of female in the diabetes group and 35.5% of male and 34% of female in non-diabetes group), followed by the age group of 40-49 years (30.7%; 25.8% of male and 33 % of female

in diabetes group and 31.2% of male and 33% of female of non-diabetes group), 60-69 years (21.4%; 24.7% of male and 20.2% of female in diabetes group and 20.4% of male and 20.2% of female in non-diabetes group) and aged above 69 years (14.0%; 17.2% of male and 12.8% of female in diabetes group and 12.9% of male and 12.8% of female in non-diabetes group) respectively. The proportions of male and female participants in diabetes and non-diabetes groups were not different in each age group as shown in Table 4.

Regarding to marital status, 77.0% of respondents are married (79.6% of male and 75.5% of female in diabetes group and 77.4% of male and 75.5% of female of non-diabetes group), 19.0% are widowed (13.2% of male and 20.3% female in diabetes group and 18.3% of male and 20.3% of female in non-diabetes group), and 4.0% are single (3.2% of male and 4.3% of female in diabetes group and 4.3 % of both male and female in non-diabetes group). There was no separated participant in this study (Table 4).

In term of occupational status, more than half of the respondents in both groups are employees (59.1% of male and 53.2% of female in diabetes group and 52.7 % of male and 52.1% of female in non-diabetes group). Nearly 30% of them are agriculturist (22.6% of male and 27.7% of female in diabetes group and 28.0% of male and 28.7% of female in non-diabetes group). The rest are retired or housewife (11.5%) and self-employed (7.5%) respectively (Table 4).

Over a half of respondents had the highest education in the primary school (56.1% of diabetes and 52.4% of non-diabetes respondents). Fifty-nine point one of male and 53.2% of female in diabetes group had the highest education level below the under graduate while 40.9% of male and 46.8% of female in this group graduated from the university or graduate school. In the non-diabetes, 53.8% of male and 52.1% of female had the highest education in the primary or secondary school level. Nearly 50% of male and female of this group graduated from the university or graduate school as shown in Table 4.

Most of respondents had monthly incomes between 10,001 – 15,000 THB, followed by less than or equal to 10,000 THB, 15,001 – 20,000 THB, 20,001 – 25,000 THB, and over 25,000 THB respectively. In diabetes group, over 30% of them replied that they had monthly income between 10,001-15,000 THB (34.4% of male and 33.0% of female) and follow by ≤10,000 THB a month (32.3% of male and 27.7% of female), 20,001-25,000 THB a month (14.0% and 16.0% of male and female, respectively), 15,001-20,000 THB a month (12.9% and 14.9% of male and female,

respectively), and over 25,000 THB a month. Among non-diabetes participants, their monthly income were 10,001-15,000 THB a month (34.4% of male and 31.9% of female), and following by ≤10,000 THB a month (28.0% and 27.7% in male and female, respectively), 15,001-20,000 THB a month (16.1% and 17.0% in male and female, respectively), 20,001-25,000 THB a month (12.9% and 16.0% in male and female, respectively), and over 25,000 THB a month as shown in Table 4.

Table 4: Socio-demographic characteristics of study population

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Age(years) (Median)	55		54	
— 40-49	24 (25.8%)	29 (31.2%)	31 (33.0%)	31 (33.0%)
— 50-59	30 (32.3%)	33 (35.5%)	32 (34.0%)	32 (34.0%)
— 60-69	23 (24.7%)	19 (20.4%)	19 (20.2%)	19 (20.2%)
— > 69	16 (17.2%)	12 (12.9%)	12 (12.8%)	12 (12.8%)
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%)

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
— Retired and Housewife	11 (11.8%)	12 (13.0%)	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 above	38 (40.9%)	43 (46.3%)	44 (46.8%)	45 (47.9%)
Monthly income (baht per month)				
— ≤ 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%)

4.1.2 Diabetes mellitus symptoms and DM in family

In considering the diabetic symptoms, the excessive voiding was reported from most of participants who had diabetes (78.6%). When taking the gender into account, the result showed no different proportion between male and female who having excessive voiding in diabetes group (79.6% of male and 77.7% of female). In a control group (non-diabetes people), only 20% of them had excessive voiding (23.7% of male and 20.2% of female). Regarding the excessive thirst commonly found in diabetes patients, over 50% of diabetes participants had this symptom (46.2% of

male and 59.6% of female). In non-diabetes group, all male replied that they had no experience with excessive thirst symptom while 43.6% of non-diabetes female used to have excessive thirst symptom in their life (Table 5).

In term of the weight loss, only 3.7% of the respondents who had no diabetes reported getting weight loss. The increasing number of weight loss was found in diabetes respondents especially in women, 27.7% of them ever lost their weight comparing with 6% of man with diabetes had this symptom. This result showed that women tend to get weight loss higher than men (Table 5).

Having diabetes parent or siblings is one of the risk factor of diabetes. There were 33.7% of respondents with diabetes replied that they have parent or siblings who diagnosed to be the diabetes mellitus patient (33.3% of male and 34.0% of female). On the other hand, small amount of respondents in non-diabetes group had the parents or sibling with diabetes mellitus (7.5% and 7.4% of male and female respectively) as shown in the table 5.

Table 5: Presence of diabetes mellitus symptoms and DM in family

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
DM symptoms				
• Excessive voiding	74 (79.6%)	22 (23.7%)	73 (77.7%)	19 (20.2%)
• Excessive thirst	43 (46.2%)	0 (0.0%)	56 (59.6%)	41 (43.6%)
• Weight loss	6 (6.5%)	0 (0.0%)	26 (27.7%)	7 (7.4%)
DM in family	31 (33.3%)	7 (7.5%)	32 (34.0%)	7 (7.4%)

4.1.3 Experience to gestational diabetes and delivery baby macrosomia in women

Among 90 diabetes women who ever got pregnant, only 5% of them had gestational diabetes and delivered baby macrosomia. The lower number of women who experience with gestational diabetes and delivery baby macrosomia was found in non-diabetes women (3.3%) as shown in Table 6. All women in both groups who had ever been GDM were delivered babies with macrosomia.

Table 6: Experience to gestational diabetes and delivery baby Macrosomia in women

Variables	Diabetes n=90	Without diabetes n=90
History of GDM	5 (5.6%)	3 (3.3%)
History of delivery baby macrosomia	5 (5.6%)	3 (3.3%)

4.1.4 Smoking behavior

Out of 374, 135 respondents (36.1%) in this study are current smokers while 35.6% and 28.3%are ex-smokers and never smokers. Interestingly, number of male and female current smokers in both groups is not different (37.6% of male and 37.2% of female in diabetes group and 33.3% of male and 36.2% of female in non-diabetes group, respectively). Most of current smokers (64.0%) smoke less than 11 cigarettes per day, 25.2% smoke 11-20 cigarettes per day, 6.7% smoke 21-30 cigarettes per day and only six respondents smoke more than 30 cigarettes a day (Table 7).

In diabetes group, there are 5.7% of them replied that they smoke more than 30 cigarettes per day (2.9% of female and 0% of male), 4.3% of them smoke 21-30 cigarettes per day (5.7% of male and 2.9% of female), 25.7% of them smoke 11-20 cigarettes per day (25.7% of male and female), and 64.3% of respondents smoke less than 11 cigarettes per day (68.6% of male and 60.0% of female). Most of respondents without diabetes (63.1%) smoke less than 11 cigarettes a day, 70.6% of non-diabetes women and 54.8 % of non-diabetes men. Nearly 25% of non-diabetes

respondents smoke 11-20 cigarettes per day (32.3% of male and 17.6% of female), 9.2% smoke 21-30 cigarettes per day (9.7% of male and 8.8% of female), and few of the non-diabetes respondents smoke more than 30 cigarettes per day (3.1% included 3.2% of male and 2.9% of female).

The respondents with diabetes mostly (65.7%) began smoking at age 21 – 30 years old (68.6% of male and 65.7% of female), however 32.9% of respondents reported that they started smoking at aged less than 20 years old (31.4% of male and 34.3% of female). The report did not show the difference in age of smoking between male and female. The respondents without diabetes also mostly (77.3%) began to smoke at age 21 – 30 years old, 13.6% reported that they started smoking at aged less than 20 years old (3.1% of male and 23.5% of female) and there were 9.1% of respondents that started smoking at aged more than 30 years old (17.6% of female and 0% of male). In the non-diabetes group, there were more women started smoking at early age than men (25% in women comparing with 3.1% in men) but still lower than in the diabetes group (37.5% in women and 34.4% in men) as shown in Table 7.

In term of presence of smoker in family member, there were 79.7% of diabetes group reported that they did not have family member who smoke (75.3% of male and 84.0% of female), and 20.3% of non-diabetes group also reported no smoker in their family member (83.9% of male and 75.5% of female). For respondents who had smoking-family member were found 20.3% in diabetes group (24.7% of male and 16.0% of female), and 20.3% in non-diabetes group (16.1% of male and 24.5% of female).

Table 7: Smoking behavior

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Smoking habit				
– Non 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%)

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
— Current smoke	35 (37.6%)	31 (33.3%)	35 (37.2%)	34 (36.2%)
• **Number of cigarette per day**				
— <11 cigarettes	24 (68.6%)	17 (54.8%)	21 (60.0%)	24 (70.6%)
— 11-20 cigarettes	9 (25.7%)	10 (32.3%)	9 (25.7%)	6 (17.6%)
— 21-30 cigarettes	2 (5.7%)	3 (9.7%)	1 (2.9%)	3 (8.8%)
— >30 cigarettes	0 (0.0%)	1 (3.2%)	4 (11.4%)	1 (2.9%)
Aged at first time of smoking				
— ≤ 20 years	11 (31.4%)	1 (3.1%)	12 (34.3%)	8 (23.5%)
— 21 – 30 years	24 (68.6%)	31 (96.9%)	22 (65.7%)	20 (58.8%)
— > 30 years	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (17.6%)
Smoker in family member	23 (24.7%)	15 (16.1 %)	15 (16.0%)	23 (24.5%)

4.1.5 Alcohol consumption behavior

As shown in table 8, nearly hundred percent of respondents ever drink alcohol left 1.6% never drink alcohol. Among these drinkers, 40.0% of them already quit drinking alcohol (41.2% in diabetes and 38.0% in non-diabetes group). Considering the gender of drinkers, number of female and male drinkers in both

diabetes and non-diabetes groups was quite similar, 60.6% and 57.0% in diabetes group and 61.7% and 55.9% in non-diabetes group, respectively.

The frequency of drinking, most respondents (94.5%) in diabetes, both male and female, consumed any kind of alcoholic beverage twice a week or less (94.3% of male and 94.7% of female), and 93.6% in non-diabetes group (94.2% of male and 93.1% of female). Considering the amount of alcoholic beverage consumed within one week, more than 80% of respondents in both gender in diabetes group and non-diabetes group consumed two glasses or less per day (Table 8).

Table 8: Alcohol consumption behavior

Variables	Diabetes		Without diabetes	
	Male n=93	Female n=94	Male n=93	Female n=94
History of drinking alcohol				
— Never	0 (0.0%)	6 (6.5%)	0 (0.0%)	0 (0.0%)
— 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%)
• **Frequency of drinking in a week**				
— ≤ 2 times	50 (94.3%)	49 (94.2%)	54 (94.7%)	54 (93.1%)
— > 2 times	3 (5.7%)	3 (5.8%)	3 (5.3%)	4 (6.9%)
• **Amount of beverage consumed within past 7 days (glasses/day)**				
— 0	10 (18.9%)	10 (19.2%)	11 (19.3%)	11 (19.0%)
— Up to 2	43 (81.1%)	42 (80.8%)	46 (80.7%)	47 (81.0%)

4.1.6 Physical activity of respondents

The physical activity was reported in term of moderate activity, enough activity (frequency 4 days or more in a week and duration 30 minute or more in a day), and not enough activity. The majority (97.32% in diabetes group and 95.72% in non-diabetes group) of both groups did moderate activity. When taking the gender into account, the result showed no different between male and female who did moderate activity (100% of male, 94.7% of female in diabetes group, and 95.3% of male, and 97.9% of female in non-diabetes group). In term of enough activity, half (59.3% in diabetes group and 51.3% in non-diabetes group) of the respondents in both groups did enough activity. When taking the gender into account, the result showed different between male and female who did enough activity (47.3% of male, 71.3% of female in diabetes group, and 65.6% of male, and 37.2% of female in non-diabetes group) as showed in Table 9.

Table 9: Physical activity of participants

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Moderate activity				
	93 (100%)	87 (93.5%)	89 (94.7%)	92 (97.9%)
• **Enough activity**				
	44 (47.3%)	61 (65.6%)	67 (71.3%)	35 (37.2%)

4.1.7 Sleeping pattern

Regarding sleep pattern, more than 50% of the respondents did not take sleep in day time (55.1% and 56.7% in diabetes and non-diabetes groups, respectively). When considering on gender, there was no different between male and female who never sleep in day time (54.8% of male and 55.3% of female in diabetes group and 57.0% of male and 56.4% of female in non-diabetes group) as shown in Table 10.

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. When taking gender into account, there was no difference in sleeping hours between male and female of both diabetes and non-diabetes groups as shown in Table 10.

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). Male respondents who had diabetes had incomplete sleep at night more than female (49.5% and 40.4%, respectively) and male respondent who did not have diabetes also showed incomplete sleep at night more than female (41.9% and 39.4%, respectively) as shown in Table 10.

Table 10: Sleep pattern of participants

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Sleeping hours in day time				
— 0	51 (54.8%)	53 (57.0%)	52 (55.3%)	53 (56.4%)
— Up to 2	42 (45.2%)	40 (43.0%)	42 (44.7%)	41 (43.6%)
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%)

4.1.8 Food consumption behaviors

Most of respondents ate completed 5 food groups 4 days a week or over (73.8%). When considering on gender, the result showed no difference on completed 5 food group consumption for 4 days or more (76.3% of male and 71.3% of female). In a non-diabetes group, the respondents replied that they ate completed 5 food groups 4 days a week or over (71.7%) and no difference in consumption between male and female was found (71.0% of male and 72.3% of female). Regarding vegetable consumption, there are no different of eating vegetable between diabetes and control group. Moreover, the data had been found respondents mostly ate vegetable 5-6 days a week in both diabetes and control group (73.8% and 72.2%, respectively). One fourth of respondents in both groups ate vegetable 4 days a week or less (22.5% and 24.1% in diabetes and control group, respectively) and only 3.7% of them in both diabetes and control group ate vegetable every day.

The respondents in diabetes group mostly ate fruits 5-6 days per week (73.8%). No different number of male and female diabetes respondents who ate fruits for 5-6 days per week was found (76.3% of male and 71.3% of female). In a control group (non-diabetes people), most of them replied that they ate fruits 5-6 days per week (72.0%, 72.0% in male and 72.3% in female).

Regarding consuming no recommended food for diabetes i.e. snacks, fried and grilled food, coconut milk product, fermented food, meat with fat, salty and sweeten food, most of male and female respondents both in diabetes and non-diabetes group consumed snacks less than 3 days a week (74.2% of male and 74.5% of female in diabetes group; 74.2% of male and 73.4% of female in non-diabetes group). For eating fried food, there was no difference in eating fried food between male and female, and between diabetes and non-diabetes group (Table 11).

Regarding eating grilled food, the data showed that majority of respondents ate grilled food 3-4 days a week (73.8% in both diabetes and non-diabetes groups). Most of the respondents ate food with coconut milk 3 days and more per week, either on diabetes group (77.5%) or non-diabetes group (78.6%). In the diabetes group, there were 75.3% of male and 79.8% of female who consumed food with coconut milk while in the non-diabetes group, there were 77.4% of male and 79.8% of female who consumed this kind of food for 3 days a week or more.

Most of the respondents eat fermented food 3 days or over per week, either on diabetes group (70.1%) or non-diabetes group (71.7%). In the diabetes groups there were 68.8% of male and 71.3% of female who consumed fermented food

while in the non-diabetes group there were 71% of male and 72.3% of female consumed fermented food 3 days per week or more.

It was found that more than 70% respondent consumed pork with fat 3-4 days per week, 73.1% male and 67.0% female in diabetes group and 71% male and 67% female in non-diabetes group. Most of the respondents ate beef with fat 3-4 days per week, either on diabetes group or non-diabetes group. In the diabetes group, there were 59.1% of male and 52.1% of female who consumed beef with fat. While in the non-diabetes there were 54.8% of male and 52.1% of female who consumed beef with fat. More than 50% of the respondents ate poultry with fat more than 4 days per week, either on diabetes group or non-diabetes group. In the diabetes group there were 52.7% of male and 58.5% of female who consumed poultry with fat. While in the non-diabetes there were 52.7% of male and 58.5% of female who consumed poultry with fat more than 4 days a week.

Regarding eating salty food, there was no different of eating salty food between male, and female and between diabetes and non-diabetes groups, most of them ate salty food more than 4 days per week. Considering eating sweeten food, both male and female respondents mostly reported that they ate sweeten food less than 3 days per week (81.7% of male and 80.9% of female in diabetes group while 80.6% of male and 80.9% of female in non-diabetes group) (Table 11).

Table 11: Frequency of food consumption in a week

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Completed 5 food groups				
— <4 days	22 (23.7%)	27 (29.0%)	27 (28.7%)	26 (27.7%)
— ≥4 days	71 (76.3%)	66 (71.0%)	67 (71.3%)	68 (72.3%)
Vegetables				
— ≤4 day	19 (20.4%)	23 (24.7%)	23 (24.5%)	22 (23.4%)

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
— 5-6 days	71 (76.3%)	67 (72.0%)	67 (71.3%)	68 (72.3%)
— Every day	3 (3.2%)	3 (3.2%)	4 (4.3%)	4 (4.3%)
Fruits				
— ≤4 day	19 (20.4%)	23 (24.7%)	23 (4.5%)	22 (23.4%)
— 5-6 days	71 (76.3%)	67 (72.0%)	67 (71.3%)	68 (72.3%)
— Every days	3 (3.2%)	3 (3.2%)	4 (4.3%)	4 (4.3%)
Snacks				
— <3 days	69 (74.2%)	69 (74.2%)	70 (74.5%)	69 (73.4%)
— ≥3 day	24 (25.8%)	24 (25.8%)	24 (25.5%)	25 (26.6%)
Fried food				
— <3 days	35 (37.6%)	39 (41.9%)	35 (37.2%)	33 (35.1%)
— ≥3 day	58 (62.4%)	54 (58.1%)	59 (62.8%)	61 (64.9%)
Grilled food				
— <3 days	15 (16.1%)	15 (16.1%)	13 (13.8%)	13 (13.8%)
— 3-4 days	69 (74.2%)	68 (73.1%)	69 (73.4%)	70 (74.5%)
— >4 days	9 (9.7%)	10 (10.8%)	12 (12.8%)	11 (11.7%)

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
Coconut milk product				
— <3 days	23 (24.7%)	21 (22.6%)	19 (20.2%)	19 (20.2%)
— ≥3 days	70 (75.3%)	72 (77.4%)	75 (79.8%)	75 (79.8%)
Fermented food				
— <3 days	29 (31.2%)	27 (29.0%)	27 (28.7%)	26 (27.7%)
— ≥3 days	64 (68.8%)	66 (71.0%)	67 (71.3%)	68 (72.3%)
Pork with fat				
— <3 days	7 (7.5%)	7 (7.5%)	7 (7.4%)	7 (7.4%)
— 3-4 days	68 (73.1%)	66 (71.0%)	63 (67.0%)	63 (67.0%)
— >4 days	18 (19.4%)	20 (21.5%)	24 (25.5%)	24 (25.5%)
Beef with fat				
— <3 days	7 (7.5%)	8 (8.6%)	7 (7.4%)	6 (6.4%)
— 3-4 days	55 (59.1%)	51 (54.8%)	49 (52.1%)	49 (52.1%)
— >4 days	31 (33.3%)	34 (36.6%)	38 (40.4%)	39 (41.5%)
Poultry with fat				
— ≤4 days	44 (47.3%)	44 (47.3%)	39 (41.5%)	39 (41.5%)

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
— >4 days	49 (52.7%)	49 (52.7%)	55 (58.5%)	55 (58.5%)
Salty food				
— ≤4 days	17 (18.3%)	17 (18.3%)	17 (18.1%)	18 (19.1%)
— >4 days	76 (81.7%)	76 (81.7%)	77 (81.9%)	76 (80.9%)
Sweeten food				
— <3 day	76 (81.7%)	75 (80.6%)	76 (80.9%)	76 (80.9%)
— 3-4 days	13 (14.0%)	15 (16.1%)	15 (16.0%)	15 (16.0%)
— >4 days	4 (4.3%)	3 (3.2%)	3 (3.2%)	3 (3.2%)

4.1.9 History of having hypertension and high cholesterol level

Among 374 respondents, 323 of them checked blood pressure in a past 2 years (81.2% of diabetes group and 91.4% of non-diabetes group). The study found that about 24.1% of male and 30.4% of female in diabetes patients had high blood pressure while in non-diabetes group, about 26.6% in male and 26.1% in female respondents had high blood pressure (Table 12).

Out of 374, 307 respondents had been checked their cholesterol level in the blood in past 2 years (76.7% of diabetes patients and 87.7% of non-diabetes group). Only 2.9% of male and 4.1% of female diabetes patients had been detected high cholesterol level. The same results were found in non-diabetes respondents, only 3.7% of male and 4.9% of female having history of high cholesterol in past 2 years as shown in Table 12.

Table 12: History of having hypertension and high cholesterol level

Variables	Male		Female	
	DM	Non-DM	DM	Non-DM
History of BP check-up				
	20/83 (24.10%)	21/79 (26.59%)	21/69 (30.43%)	24/92 (26.09%)
History of high cholesterol check-up				
	2/70 (2.9%)	3/82 (3.7%)	3/73 (4.1%)	4/82 (4.9%)

4.1.10 Physical examination

Considering BMI, overweight (BMI 25 or over) 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 (60.2% of male and 55.3% of female diabetes respondents and 54.8% of male and 56.4% of female non-diabetes respondents) as shown in Table 13.

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 of male respondents had high waist/hip ratio (96.8% of diabetes and 94.6% of non-diabetes). A hundred percent of 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 did 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 as shown in Table 13.

Regarding diastolic blood pressure (DBP), most respondents either in diabetes group or non-diabetes group reported normal DBP or DBP lower than 90 mmHg. Only 8.0% of respondents had high DBP (DBP≥90 mmHg). 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)

A hundred percent of non-diabetes respondents had normal fasting blood sugar level (<126 mg%). On the contrary, 25.7% respondents with diabetes reported that (20.4% male and 30.9% female) they had high FBS (≥ 126 mg%).

Table 13: Physical examination

Variables	Male		Female	
	DM n=93	Non-DM n=93	DM n=94	Non-DM n=94
BMI				
— Overweight (BMI 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%)
High waist/hip ratio (Male >0.9, female >0.85)	90 (96.8%)	88 (94.6%)	94 (100.0%)	94 (100.0%)
High systolic blood pressure (SBP) (SBP ≥140 mmHg)	9 (9.7%)	2 (2.2%)	8 (8.5%)	10 (10.6%)
High diastolic blood pressure (DBP) (DBP ≥90 mmHg)	2 (2.2%)	4 (4.3%)	10 (10.6%)	14 (14.9%)

Variables	Male		Female	
	DM	Non-DM	DM	Non-DM
	n=93	n=93	n=94	n=94
FBS				
— High FBS (≥126 mg%)				
	19	29	0	0
	(20.4%)	(30.9%)	(0.0%)	(0.0%)

Summary of physical examination of respondents in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province, was shown in Table 14, mean of the weight (kg) among respondents was 67.87 (SD=6.24), mean of the height was 161.55 centimeter (cm) (SD=5.03). Mean BMI (kg/m^2) of respondents was 27.08 (SD=9.61). Mean of waist circumference among respondents was 89.49 centimeter (cm) (SD=5.24), mean of hip circumference was 91.45 centimeter (cm) (SD=4.57), and waist/hip ratio was 0.99 (SD=0.06).

For blood pressure, mean systolic blood pressure of respondents was 127.58 mmHg (SD=9.607) while the average of diastolic blood pressure was 83.72 mmHg (SD=9.24). Mean of fasting blood sugar of respondents was and 125.58mg/dl (SD=63.105).

Table 14: Summary of physical examination

Variables	Mean ± SD
Weight (kg)	67.87±6.25
Height (cm)	161.55±5.03
BMI (kg/m^2)	27.08±9.61
Waist Circumference (cm)	89.49±5.24
Hip Circumference (cm)	91.45±4.57
Waist/hip ratio	0.99±0.06
Systolic Blood Pressure (mmHg)	127.58±9.61
Diastolic Blood Pressure (mmHg)	83.72±9.24
Fasting Blood Sugar (mg/dl)	125.58±63.11

4.2 Analysis of type 2 diabetes risk factors among residents of Ban Na Makhuea sub-district

Multiple logistic regressions was used to analyze the factors that could have impact on the diabetes mellitus in this population which are the socio-demographic characteristics, life style and health status factors of the participants in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province.

4.2.1 Socio-demographic characteristic

Socio-demographic characteristics included age, gender, marital status, occupational, education, and monthly income. The study found that aged groups of respondents was not statistical significant with diabetes (p-value > 0.05). However, the stronger positive association was found when the age of respondent increased. Respondents aged between 50-59 years was positive association with diabetes 1.041 times (OR = 1.041, 95% CI = 0.628 -1.724, p-value = 0.877) while compare with respondents aged between 40-49 years. Among people aged between 60-69 years was positive association with diabetes 1.206 times (OR = 1.206, 95% CI = 0.681 - 2.135, p-value = 0.521) and among people aged over 69 years was positive association with diabetes 1.273 time (OR = 1.273, 95% CI = 0.660 -2.454, p-value = 0.472). The relation of the gender and risk of diabetes could not be analyzed because male and female participants were not randomly selected. In part of marital status, the study found that there was no association between marital status and risk of diabetes (OR = 1.159, 95% CI = 0.409 – 3.280 p-value = 0.781 in married respondents; OR = 1.111, 95% CI = 0.364 – 3.392, p-value = 0.853 in widowed respondents when comparing with single respondents). Occupational status, the respondents who are agriculturists had slightly negative relation with diabetes risk but not statistic significant when compared with respondents who are housewife or retired (OR = 0.929, 95% CI = 0.454 – 1.900, p-value = 0.840). Other occupation had slightly positive but not statistic significant relation with diabetes (OR = 1.048, 95% CI = 0.404 – 2.714, p-value = 0.924 for the respondents who were self-employers; OR = 1.122, 95% CI = 0.581 – 2.168, p-value=0.731 for respondents who were employee). Education level, the respondents who had education level undergraduate or above tended to have lower risk to diabetes than respondents who had education level below undergraduate but not statistically significant (OR = 0.879, 95% CI = 0.585 – 1.320, p-value = 0.533). Monthly income, the study found that respondents who had

monthly income more than 10,000 Baht tended to have slightly lower risk to diabetes compared to that of the respondents who had monthly income lower than 10,000 Baht but it was not statistically significant (OR = 0.944, 95% CI = 0.564 – 1.579, p-value = 0.825 in monthly income between 10,000 and 15,000 Baht group; OR = 0.779, 95% CI = 0.409 – 1.482, p-value = 0.446 in monthly income between 15,001 and 20,000 Baht group; OR = 0.963, 95% CI = 0.503 – 1.844, p-value = 0.909 in monthly income between 20,001 and 25,000 Baht group; and OR = 0.867, 95% CI = 0.382 – 1.968, p-value = 0.732 in monthly income over 25,000 Baht group) as shown in Table 15.

Table 15: Multiple logistic regression analysis of the socio-demographic characteristic factors on DM

Variables	OR	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
— > 69 years	1.273	0.660-2.454	0.472
Gender			
— Male	1.00		
— Female	1.000	0.667-1.500	1.000
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
— Agriculturists	0.929	0.454-1.900	0.840

Variables	OR	95% CI	p-value
Education			
— Below undergraduate	1.00		
— Undergraduate or above	0.879	0.585-1.320	0.533
Monthly income (baht/month)			
— < 10,001	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

4.2.2 Life style factors

Life style factors included smoking behavior, drinking behavior, physical activity, sleeping quality, and diet behavior. The study found that the current smokers and ex-smokers had 1.352 and 1.395 times of risk to be diabetes than participant who never smoke but it was not statistically significant (OR = 1.352, 95% CI = 0.811-2.253, p-value = 0.247, OR = 1.395, 95%CI = 0.835-2.329, p-value 0.203 for current smokers and ex-smoker, respectively). Considering the number of cigarettes smoker consumed per day. The study found that the number of cigarette smoke of respondents was not statistical significant with diabetes (p-value > 0.05). The respondents who smoked up to 10 cigarettes per day was positive associated with diabetes 1.144 times (OR = 1.144, 95% CI = 0.699-1.874, p-value = 0.592) while the respondents who smoked more than 10 cigarettes per day was positive association with diabetes 1.086 times (OR = 1.086, 95% CI = 0.587 – 2.009, p-value=0.792) compared with respondents who non-smoke. Aged at first time of smoking, the study found that smokers who started smoking at younger age was statistical significant with diabetes. The respondents who started smoking aged 20 year old or less had 2.369 times more risk to develop diabetes than the non-smoker (OR=2.369, 95% CI = 1.416 – 3.964, p-value < 0.001). Unlike smokers who started smoking older than 20 year old, they were 0.696 times less likely to develop diabetes (OR=0.696, 95%CI = 0.40 – 1.187, p-value=0.183). Presence or not of smoker in family was not made the different chance to be diabetes (OR=0.946, 95% CI = 0.565 – 1.583, p-value=0.832). In term of drinking behavior, the study found that drinking behavior was not statistical

significant with diabetes (p-value > 0.05). The respondents who currently drink were 0.922 times less likely to get diabetes comparing to those who stop drinking but it was not statistical different (OR=0.922, 95% CI=0.608-1.399 p-value=0.703). Besides, drinking alcoholic beverage up to twice a week was likely to reduce risk of diabetes for 0.857 times comparing with non-drinker but it was not statistically significant (OR=0.857, 95% CI = 0.275-2.667, p-value=0.790). In contrast, drinking more than twice was slightly increased risk of diabetes for 1.010 times but it was not statistically significant (OR=1.010, 95% CI = 0.665-1.532, p-value= 0.964).

In part of physical activity, the study found that moderate activity of respondents was not statistical significant associated with diabetes (p-value > 0.05). The respondents who did not do moderate activity was less likely to be diabetes for 0.615 times (OR = 0.615, 95% CI = 0.197-1.915, p-value = 0.401) compared with respondents who did moderate activity. Furthermore, the study found that respondent who did enough physical activity per day was 0.722 times less likely to develop diabetes than those who did enough physical activities but it was not statistic significant (OR = 0.722, 95% CI = 0.480-1.087, p-value = 0.119).

Considering enough sleeping hour per day, the study found that the respondents who had not enough sleeping hour per day was 0.958 times less likely to be diabetes (OR = 0.958, 95%CI = 0.639-1.437, p-value=0.836) compared with respondents who had enough sleeping hour per day. Eating behavior, the study found that the respondents who did not consumed good food was 0.922 times less likely to be diabetes (OR=0.922, 95% CI = 0.526-1.614, p-value=0.775) when compared with those who consumed good food as shown in the Table 16.

Table 16: Multiple logistic regression analysis of the lifestyle factors on DM

Variables	OR	95% CI	p-value
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

Variables	OR	95% CI	p-value
Aged at first time of smoking			
— Non-smokers	1.00		
— Smokers who started smoking younger (≤20 years old)	2.369	1.416-3.964	<0.001*
— Smokers who started smoking older (>20 years old)	0.696	0.40-1.187	0.183
Smoker in family member			
— No	1.00		
— Yes	0.946	0.565-1.583	0.832
Drinking			
— Ex-drinker	1.00		
— Current drinker	0.922	0.608-1.399	0.703
Frequency of drinking in a week			
— Non-drink	1.00		
— ≤ 2 times a week	0.857	0.275-2.667	0.790
— >2 times a week	1.010	0.665-1.532	0.964
Moderate activity			
— Yes	1.00		
— No	0.615	0.197-1.915	0.401
Enough activity			
— Yes	1.00		
— No	0.722	0.480-1.087	0.119
Enough Sleeping hour per day			
— Yes	1.00		
— No	0.958	0.639-1.437	0.836
Eating Behavior			
— Good	1.00		
— Not good	0.922	0.526-1.614	0.775

*p-value < 0.05

4.2.3 Health Status

Health status factors included DM in family, history of GDM, history of delivery baby macrosomia, history of BP check-up, systolic blood pressure, diastolic blood pressure, BMI, waist circumference and waist/hip ratio. The study found that history of DM in family was statistical significant associated with diabetes. The respondents who had diabetes parent or siblings was 6.278 times more risk of diabetes (OR = 4.006, 95% CI = 2.555-6.283, p-value < 0.001) compared with respondents who did not had diabetes parent or sibling. Moreover, some health status i.e., history of GDM, history of delivery baby macrosomia, history of blood pressure check-up, systolic blood pressure, diastolic blood pressure and BMI of respondents were associated with diabetes but not statistically significant. In term of history of GDM and history of delivery baby macrosomia, the study found that respondents who had history of GDM and delivery baby macrosomia were 1.706 times more risk of diabetes (OR = 1.706, 95% CI = 0.395-7.362, p-value=0.474). The history of BP check-up, the respondents who had history of high BP was positive association with diabetes 1.034 times (OR = 1.034, 95% CI = 0.631-1.695, p-value = 0.894). Physical examination, the respondents who had high systolic blood pressure was 1.458 times more risk to diabetes than respondents who did not had high systolic (OR = 1.458, 95% CI =0.676-3.145, p-value = 0.336). The respondents who had high diastolic blood pressure was positive association with diabetes 1.382 times (OR = 1.382, 95% CI =0.723-2.643, p-value = 0.327) compared with respondents who did not had high diastolic. Furthermore, the respondents who had high BMI was positive association with diabetes 1.091 times (OR=1.091, 95% CI = 0.725-1.643, p-value=0.676) compared with respondents who had normal BMI. In part of waist circumference, the risk of diabetes of respondents who had high waist circumference was comparable to those who had normal waist circumference (OR = 1.015, 95% CI = 0.976-1.005, p-value = 0.453). The respondents who had high waist/hip ratio was positive association with diabetes 2.447 times (OR = 2.447, 95% CI = 0.092-65.398, p-value = 0.593) compared with respondents who had normal waist/hip ratio as shown in the Table 17.

Table 17: Multiple logistic regression analysis of health status factors on DM

Variables	OR	95% CI	p-value
DM in family			
— No	1.00		
— Yes	6.278	3.366-11.71	<0.001*
History of GDM			
— No	1.00		
— Yes	1.706	0.395-7.362	0.474
History of delivery baby Macrosomia			
— No	1.00		
— Yes	1.706	0.395-7.362	0.474
History of BP check-up			
— Normal BP	1.00		
— High BP	1.034	0.631-1.695	0.894
Physical examination			
• **Systolic blood pressure**			
— Normal SBP	1.00		
— High SBP	1.458	0.676-3.145	0.336
• **Diastolic blood pressure**			
— Normal DBP	1.00		
— High DBP	1.382	0.723 - 2.643	0.327
• **BMI**			
— Normal BMI	1.00		
— High BMI	1.091	0.725-1.643	0.676
• **Waist circumference**			
— Normal waist circumference	1.00		
— High waist circumference	1.015	0.976-1.005	0.453
• **Waist/hip ratio**			
— Normal waist/hip ratio	1.00		
— High waist/hip ratio	2.447	0.092-65.398	0.593

*p-value < 0.05

CHAPTER V

DISCUSSION & CONCLUSION

5.1 Discussions

This study was conducted to explore the risk factors of type 2 diabetes among people aged 40 and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand.

5.1.1 Process of study

The design of this study was case-control study. It was efficient for exploring the factors association with diseases with a long latency period between exposure and disease manifestation like type 2 diabetes. Furthermore, a long follow up period (as compared to cohort studies) was not needed, cases were identified at the beginning of the study, and thus, the case-control study was cost-effective relative to other analytical studies and good for examining multiple exposures. However, case-control study also had weaknesses, case-control studies are limited to examining one outcome, susceptible to bias if not carefully designed, the temporal sequence between exposure and disease may be difficult to determine, incidence rates not usually calculable, poor choice for the study of rare exposures, and cannot assess effects of matching variables (Gardner et al., 1990). Therefore, the design and conduct of the study must be carefully considered as there are limited options for the control of bias during the analysis. A confounder is a factor associated independently with both the exposure and outcome, and can be a problem here where cases and controls differ with respect to a potential confounder (Gardner et al., 1990).

In addition, the effect of confounding factors must be reduced as much as possible. If the confounding factor still exists in the data, the balancing of this factor between case and control groups would be conducted so that it can be cancel out. In this study, gender was frequency matched between case and control groups. However, frequency matching induced selection bias thus, the appropriate statistics such as stratified analysis, Mantel – Haenzel Chi square, or conditional logistic regression (Multivariate analysis) had been used to analyses data. Thus, logistic regressions was used to analyses in this study (Armitage et al., 2002).

5.1.2 Factors Association with Diabetes from Logistic Regression

Socio-demographic characteristics included age, gender, education, marital status, occupational status, and income was not significantly associated with diabetes in this study. In term of age, in this study found that age was not significantly associated with diabetes, opposite to a study of Al-Moosa and colleagues in Oman found that a subject at 20 years old and above was significantly associated with diabetes (Al-Moosa et al., 2006). Also the study by S´Anchez-Chaparro showed that the prevalence of diabetes increased with age (S´Anchez-Chaparro et al., 2008).

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 Sinakarin Hospital. The result revealed that the modified Thai Diabetes Risk Score in male and female were not different (Porntrakulphiphat et al., 2011, Porntrakulphiphat et al., 2012). In opposite, the study of S´Anchez-Chaparro showed that gender was significantly related to the incidence of metabolic syndrome, such as DM, male tend to have risk to diabetes more than female (S´Anchez-Chaparro et al., 2008).

In term of education, this study found that respondents in any graduation background had no different risk to develop diabetes. In contrast, Collaboration (2010) was found that education of respondents was related with diabetes. They found that people who had less education level was statistical association with diabetes with complication two-fold (Collaboration, 2010). Occupational status, although, the result from this study did not show the significant relation between occupation and risk of diabetes but the agriculturist tended to have low risk when comparing to others. This may result from the different categories of occupational activities. A study of S´Anchez-Chaparro showed that occupation were significantly related to the incidence of metabolic syndrome, such as diabetes, the result from this study showed self-employed tended to have risk when compared to others (S´Anchez-Chaparro et al., 2008).

Monthly Income was not significant related to diabetes. This was not consistent with others which found that the respondents who have a family income below poverty level was tended to have risk with diabetes when compared to the highest family incomes (Robbins et al., 2005). For lifestyle factors which included diet behavior, smoking behavior, drinking behavior, physical activity, and sleeping quality. In term of diet behavior, drinking behavior, physical activity and sleeping quality in this study, these factors were not significantly associated with diabetes. This result

was similar with the study of Aekplakorn in term of drinking behavior which was not shown the significant association with diabetes (Aekplakorn et al., 2006). In contrast, Al-Moosa and colleagues found the relations between diabetes and diet behavior. The study found that the current smokers tended to had to be diabetes than respondents who never smoke (Al-Moosa et al., 2006). Besides, a randomized controlled study comparing the effect of diet and exercise in reducing the development of diabetes among adults in Da Qing, the result found all the intervention groups had lower rates of diabetes than the control group, independently of whether participants were lean or overweight (Foggin et al., 2001). The relation between physical activity and diabetes also found in Huxley's study and practicing exercise with high cariole regularly was recommended in order to maintain the fat cell and other cell that response to insulin and resulted in reduction of glucose level. People will be having risk of T2D if doing exercise less than three times per week (Huxley et al., 2005). In part of sleeping quality in this study was not significantly associated with diabetes but the respondents who had not enough sleeping hour had likely low risk of diabetes than those who had enough sleeping hour. This consistent with the study of Yaggi, the result showed 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 (Yaggi et al., 2006). The results were inconsistent with that of another research conducted in USA which showed that short sleep (sleep less than 7 hours) was associated with increased odds of diabetes, even adjusting for age, sex, IGT, clinical site, hypertension, family history of diabetes, smoking, education, and BMI (Beihl et al., 2009).

In term of smoking behavior, the respondents who started smoking at age 20 years old or less had higher risk than who started smoking at older age. However, significantly different odds were not found between smoking and non-smoking. The higher risk found in the younger age of start smoking was consistent with the studies among adults in USA found that smoking recently showed the inclining incidence of DM compared to never smoke (Foy et al., 2005). Smoking could increases the chance of having T2D, nicotine, the major active chemical in tobacco, had effects on insulin action and insulin secretion which indicate the impact on type 2 diabetes development. Thus, not smoking and avoid places with smoke were recommended (Huxley et al., 2005). According to the result of this study, it makes us more understand in the diabetes risk factors in this community and used in strategic

planning to reduce the diabetes among people by encourage people stop smoking especially in the teen agers.

Regarding to health status included DM symptoms, BMI, waist circumference, waist/hip ratio, hypertension, history of diabetes in family, history of GDM and history of delivery baby macrosomia. Only history of diabetes was significantly associated with diabetes in this study. For history of diabetes in family, having a close family member with DM could lead the higher risk of T2D because of diabetes is the genetic related disease. In fact, family history is an independent risk factor for most common chronic diseases including cardiovascular disease, cancer, and type 2 diabetes (Arslanian, Bacha, Saad, & Gungor, 2005). According to the study of Duquette and Bach, they found that individuals with a family history of diabetes were at greater risk for developing diabetes themselves. The result showed 58.5% of Michigan diabetes adults reported a family member with diabetes (Duquette, CGC, & Bach, 2007). In contrast, some researchers found only genetic factor could not effect to diabetes. It has to compound with other factors. According to the research of Harri (2006) tried to evaluate the use of self-reported family medical history as a potential screening tool to identify people at-risk for diabetes. He found family history of diabetes had an influence with risk factor for the disease and positively associated with risk awareness and risk-reducing behaviors. It may provide a useful screening tool for detection and prevention of diabetes (Hariri et al., 2006). Moreover, the result showed that the prevalence of diagnosed diabetes, undiagnosed diabetes, and impaired fasting glucose were associated with greater age, BMI, waist-to-hip ratio, systolic blood pressure, total cholesterol, and serum creatinine levels (Aekplakorn et al., 2003).

5.2 Conclusion

The respondents in this study aged 40 years and above. A half of respondents is female and married (77.0%). And they work as employee (54.3%). More than a half of respondents graduated from primary school and mostly has income 10,001-15,000 baht/month. A half of the respondents have had excessive voiding in the past (78.6%). One third of respondents reported having excessive thirst (37.4%). Only 10.04% of them were present that they lost weight in the past few months ago. Considering history of diabetes was found 20.6% of respondents had parent or siblings had diagnosed diabetes mellitus.

Regarding of diabetes related with hypertension, most of respondents have been checked blood pressure in a past 2 years (81.2% of diabetes group and 91.4%

of non-diabetes group). Furthermore, over 75 % of respondents used to check their blood pressure from health providers (76.7% of diabetes patients and 87.7% of non-diabetes group).

In this study, 36.1% of respondents were current smokers, 35.6% were ex-smokers, and 28.3% were non-smokers. Most of smokers reported that they smoked less than 11 cigarettes per day and most of them started smoked since they aged between 21 and 29 years (25.9%), 8.6% of them started smoking at the age less than 21 years and the rest started smoking when age were 30 years old (1.7%). The study found that 8.6 % of respondents have smoker in their family. In term of alcohol drinking, over 50% of respondents are currently drinker and 53.6% of them preferred drinking rice whisky (40 degree of alcohol). Nighty-four percent of them drank less than twice a week. About 80% of respondents drank an alcoholic beverage less than 2 glasses per day. This finding was similar with other studies that adult people in rural area drank alcoholic beverage less than 2 glasses in a time.

Regarding physical activity, more than 90% of people aged between 40 and over performed moderate activities (96.5%) and 57.3% of the respondents had enough activities. For sleeping pattern, over 40% of respondents replied that they were slept at daytime by less than 2 hours (11.2%) and 2 hours and over (32.9%). According to the study was conducted at rural area that most of respondents were employee followed by agriculturist, retried people, and self-employed the study found that they can relaxed and rest at daytime. Sleeping at night, half of sample presented that they slept less than 6 hours per day and used to wake up at night (42.8%). However, this study did not found that less hours of sleeping associated with diabetes.

Eating behaviors, most of respondents frequently ate 5 food groups more than 4 days per week (73.8%), over 75% of them consumed vegetables and fruits over 4 days a week. The respondent less frequently ate unhealthy food; they consumed snacks, fried food, and sweetly food less than 3 days. However, several respondents replied they ate more frequently of unhealthy food. Over 80% of them consumed grilled food over 3 days a week, about 78 % of them consumed coconut milk over 3 days a week, 70.9% of them consumed fermented food over 3 days a week, over 90% of them consumed pork and beef with fat over 3 days a week, 55.6% of them consumed chicken with fat over 4 days a week, and 81.8% of them consumed salty foods. While over a half of them were obesities due to their BMI over 29.5% (56.7%).

Multiple logistic regressions were used to explore the factors associated with diabetes in the study area. This study found that the respondents who started smoking at age 20 years old and less had higher risk than who started smoking at older age (OR=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

5.3 Limitations

1. The study data was collected from people aged 40 years and above in Ban Na Makhuea sub-district only; therefore, it cannot be able to generalize for all people in Thailand.
2. This study explored only risk factors of type 2 diabetes; therefore, it cannot be able to generalize for all type of diabetes mellitus.
3. People in Ban Na Makhuea sub-district are same ethnicity; therefore, the results of this study could not generalize with other ethnic group.
4. The study area is located in rural of Northeast of Thailand. The situation of diabetes and associated factors might not be the same in the urban area.

5.4 Recommendations

1. Regarding to the finding, start smoking at younger age are associated with diabetes. Awareness of unhealthy risk behaviors in younger people should be raised. The quasi-experimental studies on technique of awareness in young people are recommended.

Regarding to the high prevalence of diabetes mellitus in this study area and risk behaviors such as consuming unhealthy food still present in community, thus techniques of motivation toward changing of poor healthy behavior should be conducted in the study area.

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APPENDICES

Appendix A

Questionnaires (English version)

Prepare for master thesis entitle "Risk factors of type II diabetes mellitus among people age 40 years and above in Ban Na Makhuea sub-district, Sahatsakhan district, Kalasin province, Thailand.

The answer to this survey will be used to improve health program that might be benefit for you. Some questions are personal issues. Your answer will be kept completely confidential and will not be exposing for any other purposes. Please make every effort to answer each question as honest as possible. The interview should take about 30 – 45 minutes. If you have any questions please feel free to ask interviewer.

Part I: Socio-demographic and socio-economic data (select only one choice)

1. Age_____Years
2. Gender
   ( ) Male ( ) Female
3. Marital status
   ( ) Single ( ) Married
   ( ) Widowed ( ) Divorced
   ( ) Separated ( ) Others_____
4. Occupation
   ( ) Housewife ( ) Self-employed
   ( ) Employee ( ) Unemployed
   ( ) Retired ( ) agriculturist
   ( ) Others_____
5. Education
   ( ) None ( ) Primary school
   ( ) Secondary school or equal ( ) University or equal
   ( ) Graduate school ( ) Others_____
6. Income
   ( ) < 10,000 baht per month
   ( ) 10,001 – 15,000 baht per month
   ( ) 15,001 – 20,000 baht per month
   ( ) 20,001 – 25,000 baht per month
   ( ) > 25,000 baht per month

Part II: History and health behaviors (select only one choice)

7. Have you been diagnosed with diabetes?

( ) Yes, how long?_____

( ) No

8. Have you ever had diabetic symptoms?

- Excessive urine output ( ) yes ( ) no
- Excessive thirst ( ) yes ( ) no
- Weight loss ( ) yes ( ) no

9. Are there any parent or siblings that have diabetes mellitus?

( ) Yes, who_____

( ) No

10. Have you been diagnosed with hypertension?

( ) Yes

( ) No

( ) Never check

11. (For male and female who have never been pregnant, please skip to question no. 12)

History of GDM.

( ) Yes ( ) No

History of delivery of baby over 4,000 gm.

( ) Yes ( ) No

12. Have you been diagnosed with high cholesterol?

( ) No

( ) Never check

( ) Yes, Type of high cholesterol_____

date _____

Smoking behavior

13. Cigarette smoking

( ) Never (Skip to question no. 17)

( ) Former/ex-smoker, how long did you quit smoking_____

(Skip to question no. 17)

( ) Current smoking

14. During the past 30 days (1 month), how often did you smoke cigarettes?

( ) 1-2 times/week ( ) 3-4 times/ week

( ) ≥ 5 times/week

15. During the past 7 days, how many cigarettes did you smoke per day?

( ) Never ( ) 1 cigarettes or less

( ) 2 – 10 per day ( ) 11 – 20 per day

( ) 21 – 30 per day ( ) 31 or more

16. How old were you when you first smoked an entire cigarette?

( ) less than 10 years old

( ) 10 – 20 years old

( ) 21 – 30 years old

( ) more than 30 years old

17. In your family, is there someone that smoke cigarettes?

( ) No ( ) Yes, who_____

Alcohol consumption behavior

18. Alcohol consumption

( ) Never (Skip to question no. 21)

( ) Former/ex-drinker, how long did you quit drinking_____
(Skip to question no. 21)

( ) Current drinking

19. During the past 30 days (1 month), how often did you drink?

( ) 1-2 times/week ( ) 3-4 times/week

( ) ≥ 5 times/week

20. During the past 7 days, how many glasses did you drink each day?

( ) > 12 glass/day ( ) 8-12 glass/day

( ) 5-7 glass/day ( ) 3-4 glass/day

( ) 2-1glass/day ( ) Never

Physical Activity

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

21. During the last 7 days, on how many days did you do moderate physical activities like Chinese boxing, dance pole, carrying light loads, bicycling at a regular pace, or tennis? Do not include walking.

_____ Days per week

No moderate physical activities *Skip to question 23*

22. How much time did you usually spend doing moderate physical activities on one of those days?

_____ Hours per day

_____ Minutes per day

_____Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

23. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____ Days per week

No walking *Skip to question 25*

24. How much time did you usually spend walking on one of those days?

_____ Hours per day

_____ Minutes per day

_____Don't know/Not sure

Sleeping habits

Think about the time you spent on sleeping in the last 7 days.

25. How long do you sleep daily (in average)?

Day time:	( ) Never	( ) 1 hour
	( ) 2 hours	( ) 3 hours or more
Night time:	( ) 1-3 hours	( ) 4-5 hours
	( ) 6-7 hours	( ) 8 hours or more

26. I wake up sometimes when I sleep in the night time for going to toilet or drinking water?

( ) Yes ( ) No

Eating behavior

Mark / this in the answer by the fact.

Eating behavior	Frequency per week				
	(1) Every day	(2) 5–6 days	(3) 3–4 days	(4) 1–2 days	(5) Never
1. How often do you Eat meal complete the 5 basic food groups?					
2. How often do you eat vegetables?					
3. How often do you eat fruit?					
4. How often do you eat snacks?					
5. How often do you eat fried foods?					
6. How often do you eat grilled foods?					
7. How often do you eat soup with a mixture of coconut milk?					
8. How often do you eat fermented foods?					
9. How often do you eat pork with fat?					
10. How often do you eat beef with fat?					
11. How often do you eat chicken with fat?					
12. How often do you eat salty food?					
13. How often do you drink sweet fizzy drinks?					

Part III: Physical examination

1. Weight_____ Kg.
2. Height_____ cm
3. Body mass index (BMI)_____Kg/m^2
4. Waist circumference_____cm
5. Hip circumference_____cm
6. Blood pressure_____mmHg
7. Blood glucose levels (from the patient diary).

   Date_____

   FBS_____ mg %

Appendix B

Questionnaires (Thai version)

เตรียมความพร้อมสำหรับปริญญาโท วิทยานิพนธ์เรื่อง “ปัจจัยเสี่ยงของโรคเบาหวานชนิดที่ 2 ในประชากรอายุ 40 ขึ้นไป ที่ตำบลบ้านนามะเขือ อำเภอสหัสขันธ์ จังหวัดกาฬสินธุ์”

คำตอบของการสำรวจครั้งนี้จะนำไปใช้ในการปรับปรุงโปรแกรมสุขภาพที่อาจจะเป็นประโยชน์ต่อคุณในอนาคต บางคำถามเป็นคำถามส่วนบุคคล เพื่อให้ได้รับข้อมูลที่เป็นประโยชน์สูงสุด ผู้วิจัยจึงได้ถามคำถามนั้น แต่คำตอบของคุณจะถูกเก็บเป็นความลับและจะไม่ได้รับการเปิดเผยเพื่อวัตถุประสงค์อื่นใด กรุณาตอบคำถามตรงตามความเป็นจริง ในการสัมภาษณ์แต่ละครั้ง จะใช้เวลาประมาณ 30 - 45 นาที หากผู้ถูกสัมภาษณ์มีคำถามใด ๆ โปรดสอบถามผู้สัมภาษณ์ได้ตลอดการสัมภาษณ์

ส่วนที่ 1 ข้อมูลทางสังคมและประชากรศาสตร์ (เลือกตอบเพียงข้อใดข้อหนึ่ง)

1. อายุ_____ปี
2. เพศ ( ) ชาย ( ) หญิง
3. สถานภาพสมรส
   ( ) โสด ( ) สมรส
   ( ) หม้าย ( ) แยกกันอยู่
   ( ) หย่า ( ) อื่น ๆ (ระบุ)_____
4. อาชีพ
   ( ) แม่บ้าน ( ) กิจการส่วนตัว
   ( ) เกษรตกร ( ) ว่างงาน
   ( ) เกษียณอายุ ( ) ลูกจ้าง/พนักงานรัฐและเอกชน
   ( ) อื่น ๆ (ระบุ)_____
5. การศึกษาสูงสุด
   ( ) ไม่ได้เรียนหนังสือ ( ) ประถมศึกษา
   ( ) มัธยมศึกษาหรือเทียบเท่า ( ) ปริญาตรีหรือเทียบเท่า
   ( ) สูงกว่าปริญญาตรี ( ) อื่น ๆ (ระบุ)_____
6. รายได้
   ( ) < 10,000 บาท ต่อเดือน
   ( ) 10,001–15,000 บาท ต่อเดือน
   ( ) 15,001–20,000 บาท ต่อเดือน
   ( ) 20,001–25,000 บาท ต่อเดือน
   ( ) > 25,000 บาท ต่อเดือน

ส่วนที่ 2 ประวัติสุขภาพและพฤติกรรมสุขภาพ (เลือกตอบเพียงข้อใดข้อหนึ่ง)

7. ท่านเคยได้รับการวินิจฉัยว่าเป็นโรคเบาหวานหรือไม่

( ) เคย เมื่อกี่ปีที่แล้ว_____

( ) ไม่เคย

8. ท่านมีอาการดังต่อไปนี้หรือไม่

- ปัสสาวะบ่อย

( ) เคย ( ) ไม่เคย

- หิวน้ำบ่อย

( ) เคย ( ) ไม่เคย

- น้ำหนักลด

( ) เคย ( ) ไม่เคย

9. พ่อ แม่ พี่น้องของท่านมีใครเป็นเบาหวานบ้างไหม

( ) มี โปรดระบุ_____

( ) ไม่มี

10. ท่านเคยได้รับการวินิจฉัยว่าเป็นโรคความดันโลหิตสูงหรือไม่

( ) เคย

( ) ไม่เคย

( ) ไม่เคยตรวจ

11. สำหรับเพศชาย และเพศหญิงที่ไม่เคยตั้งครรภ์ โปรดข้ามไปข้อ 12

ท่านเคยมีประวัติเป็นเบาหวานขณะตั้งครรภ์หรือไม่

( ) ใช่ ( ) ไม่ใช่

ท่านเคยมีประวัติเคยคลอดบุตรที่มีน้ำหนักตัวมากกว่า 4,000 กรัม หรือไม่

12.ท่านเคยได้รับการวินิจฉัยว่าเป็นโรคไขมันในเลือดสูงหรือไม่

( ) ไม่เคย

( ) ไม่เคยตรวจ

( ) เคย, โปรดระบุ ชนิดของไขมันที่สูง_____

วันที่ตรวจเลือด _____

พฤติกรรมการสูบบุหรี่

13.พฤติกรรมการสูบบุหรี่ของท่าน

( ) ไม่เคยสูบบุหรี่ (ข้ามไปข้อ 17)

( ) เคย แต่เลิกสูบแล้วเป็นเวลา_____

(ข้ามไปข้อ 17)

( ) ปัจจุบันยังสูบบุหรี่

14. ในช่วง 30 วันที่ผ่านมา (1 เดือน) คุณสูบบุหรี่เฉลี่ยบ่อยแค่ไหน

( ) สูบสัปดาห์ละ1-2 ครั้ง

( ) สูบสัปดาห์ละ 3-4 ครั้ง

( ) สูบ ≥ 5 ครั้ง ต่อสัปดาห์

15. ในช่วง 7 วันที่ผ่านมา คุณสูบบุหรี่โดยเฉลี่ย วันละกี่มวน

( ) ไม่ได้สูบเลย ( ) สูบ ≤ 1 มวน

( ) สูบวันละ 2 – 10 มวน ( ) สูบวันละ 11 - 20 มวน

( ) สูบวันละ 21 – 30 มวน ( ) สูบ > 30 มวน

16. คุณเริ่มสูบบุหรี่ตั้งแต่อายุเท่าไร

( ) อายุน้อยกว่า 10 ปี ( ) อายุ 10-20 ปี

( ) อายุ 21-30 ปี ( ) อายุมากกว่า 30 ปี

17. ในครอบครัวของคุณมีใครสูบบุหรี่บ้างไหม

( ) ไม่มี

( ) มี โปรดระบุ ____

พฤติกรรมการดื่มแอลกอฮอล์

18. พฤติกรรมการดื่มเครื่องดื่มที่มีแอลกอฮอล์ของท่าน

( ) ไม่เคยดื่ม (ข้ามไปข้อ 21)

( ) เคยดื่ม แต่เลิกดื่มมานาน_____ (ข้ามไปข้อ 21)

( ) ปัจจุบันยังดื่มอยู่

19. ในช่วง 30 วันที่ผ่านมา (1 เดือน) คุณดื่มเครื่องดื่มที่มีแอลกอฮอล์บ่อยแค่ไหน

( ) ดื่ม สัปดาห์ละ1-2 ครั้ง

( ) ดื่ม สัปดาห์ละ3-4 ครั้ง

( ) ดื่ม ≥ 5 ครั้ง ต่อสัปดาห์

20. ในช่วง 7 วันที่ผ่านมา คุณดื่มเครื่องดื่มที่มีแอลกอฮอล์โดยเฉลี่ยวันละกี่แก้ว

( ) >12 แก้ว ต่อวัน ( ) 8-12 แก้ว ต่อวัน

( ) 5-7 แก้ว ต่อวัน ( ) 3-4 แก้ว ต่อวัน

( ) แก้ว 2-1 ต่อวัน ( ) ไม่ได้ดื่มเลย

พฤติกรรมการออกกำลังกาย

นึกถึงทุกกิจกรรมที่มีการใช้กล้ามเนื้อปานกลาง ที่คุณได้ทำใน 7 วันที่ผ่านมา กิจกรรมที่ใช้กล้ามเนื้อปานกลาง หมายถึงกิจกรรมที่ใช้พลังงานในระดับปานกลางและทำให้คุณหายใจค่อนข้างยากกว่าปกติ และเป็นกิจกรรมที่คุณทำต่อเนื่องกันอย่างน้อย 10 นาที

21. ในช่วง 7 วันที่ผ่านมาท่านทำกิจกรรมในการใช้กล้ามเนื้อปานกลาง เช่น รำมวยจีน รำไม้พลอง, แบกของระดับปานกลาง, เล่นเทนนิส, ปั่นจักรยานในระดับปกติ ไม่รวมถึงการเดิน บ่อยเพียงใด?

_____วันต่อสัปดาห์

ถ้าไม่มีกิจกรรมที่ใช้กล้ามเนื้อปานกลาง โปรดข้ามไปข้อ 23

22. ระยะเวลาที่ท่านทำกิจกรรมที่มีการใช้กล้ามเนื้อปานกลาง ในแต่ละครั้ง

_____ชั่วโมงต่อวัน

_____นาทีต่อวัน

_____ไม่แน่ใจ/ไม่ทราบ

นึกถึงเวลาที่คุณใช้เดิน ใน 7 วันที่ผ่าน ซึ่งรวมถึงที่ทำงาน ที่บ้าน และการเดิน ในการเดินทางไปยังสถานที่ต่าง ๆ

23. ในช่วง 7 วันที่ผ่านมาท่านเดินต่อเนื่องกัน อย่างน้อยเป็นระยะเวลา 10 นาที บ่อยเพียงใด

_____วันต่อสัปดาห์

ถ้าไม่มี โปรดข้ามไปข้อ 25

24. ระยะเวลาที่ท่านเดินแต่ละครั้ง

_____ชั่วโมงต่อวัน

_____นาทีต่อวัน

_____ไม่แน่ใจ/ไม่ทราบ

พฤติกรรมการนอนหลับ

นึกถึงการนอนหลับในช่วง 7 วันที่ผ่านมา

25. ระยะเวลาในการนอนหลับในแต่ละวันของท่าน

กลางวัน : ( ) ไม่เคย ( ) 1ชั่วโมง

( ) 2 ชั่วโมง ( ) ≥ 3 ชั่วโมง

กลางคืน : ( ) 1-3 ชั่วโมง ( ) 4 – 5 ชั่วโมง

( ) 6 – 7 ชั่วโมง ( ) ≥ 8 ชั่วโมง

26. ฉันตื่นนอนในช่วงเวลากลางคืนเพื่อเข้าห้องน้ำหรือดื่มน้ำ

( ) ใช่ ( ) ไม่ใช่

พฤติกรรมการบริโภคอาหาร

คำชี้แจง ให้ทำเครื่องหมาย √ นี้ลงในช่องคำตอบ ตามความเป็นจริง

พฤติกรรมการบริโภคอาหาร	ความถี่ของการบริโภค ต่อ สัปดาห์				
	(1) ทุกวัน	(2) 5-6 วัน	(3) 3-4 วัน	(4) 1-2 วัน	(5) ไม่เคย
1. กินอาหารครบ 5 หมู่					
2. กินผัก					
3. กินผลไม้					
4. กินขนม					
5. กินอาหารประเภททอด					
6. กินอาหารประเภทปิ้ง ย่าง					
7. กินแกงที่มีส่วนผสมของกะทิ					
8. กินอาหารหมักดอง					
9. กินหมูติดมัน					
10. กินเนื้อติดมัน					
11. กินไก่ติดมัน					
12. กินอาหารรสเค็ม					
13. ดื่มน้ำอัดลม					

ส่วนที่ 3 การตรวจร่างกาย

1. น้ำหนัก_____กิโลกรัม
2. ส่วนสูง_____เซนติเมตร
3. ดัชนีมวลกาย(BMI)_____kg/m^2
4. เส้นรอบเอว_____เซนติเมตร
5. เส้นรอบสะโพก_____เซนติเมตร
6. ความดันโลหิต_____มิลลิเมตรปรอท
7. ระดับน้ำตาลในเลือด (FBS), (ดูจากสมุดบันทึกครั้งล่าสุดของผู้ป่วย)

วันที่_____

ค่าที่ตรวจได้_____มิลลิกรัมเปอร์เซ็นต์

VITA

Name Miss Chonthida Yotharin

Date of birth December 03, 1981

Place of birth Kalasin province, Thailand

Education B.N.S (Bachelor of Nursing Science), Saint Louis College, Catholic Diocese of Bangkok, Thailand, 2004

Position and office Nurse at In-Patient Department,

Vibharam hospital, Bangkok, Thailand