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นางสาวมยุรา กาญจนานุรักษ์

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RELATIONSHIPS BETWEEN BREAKFAST CONSUMPTION AND METABOLIC SYNDROME IN WORKING AGE POPULATION IN KANCHANABURI PROVINCE

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A Thesis Submitted in Partial Fulfillment of the Requirements

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มยุรา กาญจนานุรักษ์ : ความสัมพันธ์ระหว่างการบริโภคอาหารเช้าและกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี (RELATIONSHIPS BETWEEN BREAKFAST CONSUMPTION AND METABOLIC SYNDROME IN WORKING AGE POPULATION IN KANCHANABURI PROVINCE) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : ผศ.ดร. สุญาณี พงษ์ธนานิกร, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม : ผศ.ดร. กุลวรา เมฆสวรรค์, 111 หน้า.

การศึกษาครั้งนี้เป็นการศึกษาเชิงพรรณนา ณ จุดเวลาใดเวลาหนึ่ง มีวัตถุประสงค์เพื่อศึกษาความชุกของกลุ่มอาการเมแทบอลิก และความสัมพันธ์ระหว่างการบริโภคอาหารเช้ากับกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี มีผู้เข้าร่วมการวิจัยจำนวน 373 คน (ชาย 163 คน และหญิง 210 คน) การวินิจฉัยกลุ่มอาการเมแทบอลิกใช้เกณฑ์ของ National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) และ International Diabetes Federation (IDF) เก็บข้อมูลจากผลการตรวจวัดระดับชีวเคมีในเลือด ความดันโลหิต เส้นรอบเอว และแบบสอบถาม เพื่อประเมินความสัมพันธ์ระหว่างการบริโภคอาหารเช้ากับกลุ่มอาการเมแทบอลิกโดยใช้สถิติความถดถอยโลจิสติคเชิงพหุ

ผลการศึกษาพบความชุกของกลุ่มอาการเมแทบอลิก ตามเกณฑ์วินิจฉัยของ NCEP ATP III และ IDF เท่ากับร้อยละ 28.4 และ 22.5 ตามลำดับ จากการวิเคราะห์ความสัมพันธ์ระหว่างปัจจัยเสี่ยงต่างๆ กับกลุ่มอาการเมแทบอลิก พบว่าปัจจัยที่มีผลเพิ่มความเสี่ยงในการเกิดกลุ่มอาการเมแทบอลิก อย่างมีนัยสำคัญทางสถิติได้แก่ เพศหญิง (OR = 3.36, $p = 0.036$) อายุ 50-59 ปี (OR = 5.69, $p = 0.027$) การออกกำลังกายน้อย (OR = 2.98, $p = 0.024$) ภาวะอ้วน (OR = 12.89, $p < 0.001$) การบริโภคเครื่องดื่มที่เติมน้ำตาลมากกว่า 3 วันต่อสัปดาห์ (OR = 1.92, $p = 0.039$) การบริโภคนมไขมันต่ำน้อยกว่า 3 วันต่อสัปดาห์ (OR = 2.35, $p = 0.009$) และการงดอาหารมื้อเช้า (OR = 7.82, $p < 0.001$) นอกจากนี้พบว่าการงดอาหารมื้อเช้า ส่งผลให้เกิดความเสี่ยงต่อการมีรอบเอวขนาดใหญ่ (OR = 2.58, $p < 0.05$) ระดับไตรกลีเซอไรด์ในเลือดสูง (OR = 3.43, $p < 0.001$) และ ระดับน้ำตาลในเลือดสูง (OR = 2.66, $p < 0.05$) แต่ระดับเอช-ดี-แอลคอลเลสเตอรอลในเลือดต่ำ (OR = 4.24, $p < 0.001$) มากกว่าคนที่รับประทานอาหารมื้อเช้าทุกวัน ผลจากการศึกษานี้แสดงให้เห็นว่ารูปแบบบริโภคอาหาร โดยเฉพาะอย่างยิ่งการบริโภคอาหารมื้อเช้าเป็นปัจจัยที่มีความสำคัญต่อการเกิดกลุ่มอาการเมแทบอลิกของประชากรวัยทำงาน ดังนั้นควรมีการปรับเปลี่ยนรูปแบบการบริโภคอาหารได้แก่ การเพิ่มความถี่ในการบริโภคอาหารมื้อเช้า และนมไขมันต่ำ รวมทั้งลดการบริโภคเครื่องดื่มที่เติมน้ำตาลเพื่อลดความเสี่ยงต่อการเกิดกลุ่มอาการเมแทบอลิก

ภาควิชา……อาหารและเภสัชเคมี..... ลายมือชื่อนิสิต……....
สาขาวิชา อาหารเคมีและโภชนศาสตร์ทางการแพทย์ ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก……
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5376574133 : FOOD CHEMISTRY AND MEDICAL NUTRITION
KEYWORDS : METABOLIC SYNDROME / BREAKFAST CONSUMPTION

MAYURA KANCHANANURUK : RELATIONSHIPS BETWEEN BREAKFAST CONSUMPTION AND METABOLIC SYNDROME IN WORKING AGE POPULATION IN KANCHANABURI PROVINCE. ADVISOR : ASST. PROF. SUYANEE PONGTHANANIKORN, Dr.P.H., CO-ADVISOR : ASST. PROF. KULWARA MEKSAWAN, Ph.D., 111 pp.

This cross-sectional descriptive study aimed to examine the prevalence of metabolic syndrome and the relationship between breakfast consumption and metabolic syndrome in working age population in Kanchanaburi Province. There were 373 participants (163 males and 210 females). The diagnosis of metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) and International Diabetes Federation (IDF). The data were collected from blood biochemical test, blood pressure measurement, waist circumference measurement, and questionnaires for evaluating the relationship between breakfast consumption and metabolic syndrome by multiple logistic regression.

The results showed that the prevalence of metabolic syndrome defined by the NCEP ATP III and IDF were 28.4 and 22.5% respectively. The analysis of the relationship between risk factors and metabolic syndrome showed that the factors which were significantly associated with increased risk of developing metabolic syndrome included female (OR = 3.36, $p = 0.036$), age of 50-59 years (OR = 5.69, $p = 0.027$), physical inactivity (OR = 2.98, $p = 0.024$), obesity (OR = 12.89, $p < 0.001$), consumption of sugar-sweetened beverage more than three days per week (OR = 1.92, $p = 0.039$), intake of low-fat milk three days or less per week (OR = 2.35, $p = 0.009$), and skipping breakfast (OR = 7.82, $p < 0.001$). In addition, the study found that the individuals who did not eat breakfast had more risks of large waist circumference (OR = 2.58, $p < 0.05$), high blood triglyceride level (OR = 3.43, $p < 0.001$), and high blood glucose level (OR = 2.66, $p < 0.05$) but low blood HDL-cholesterol level (OR = 4.24, $p < 0.001$) than those who ate breakfast daily. This study illustrated that the dietary pattern, especially breakfast consumption, was an important factor that influenced the development of metabolic syndrome in working age population. Therefore, some dietary patterns should be modified, including an increase in frequency of consumption of breakfast and low-fat milk and a decrease in consumption of sugar-sweetened beverage to reduce the risk of metabolic syndrome.

Department : Food and Pharmaceutical Chemistry Student's Signature .....
Field of Study : Food Chemistry and Medical Nutrition Advisor's Signature .....
Academic Year : 2011 Co-advisor's Signature……

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LIST OF ABBREVIATIONS

et al.	et alia (and others)
CVD	cardiovascular disease
HDL-C	high-density lipoprotein cholesterol
modified-NCEP ATP III	modified National Cholesterol Education Program Adult Treatment Panel III
IDF	International Diabetes Federation
cm	centimeter
mg /dL	milligram per deciliter
mmHg	millimeter Hg
type 2 DM	type 2 diabetes mellitus
FFAs	Free fatty acid
WHO	World Health Organization
TG	triglycerides
p	*p*-value
BMI	body mass index
kg/m^2	kilogram per square meter
LDL-C	low-density lipoprotein cholesterol
ml	milliliter
SD	standard deviation
OR	odds ratio
95% CI	95% confidence interval
n	number
VLDL	very low-density lipoprotein
GIP	gastric inhibitory peptide
GLP-1	glucagon-like peptide-1
HTN	hypertension
DM	diabetes mellitus
kcal	kilocalorie
DRI	dietary reference intake
SBP	systolic blood pressure
DBP	diastolic blood pressure
VIF	variance inflation factor

CHAPTER I

INTRODUCTION

1.1 Background and Rationale

Metabolic syndrome is defined as a group of abnormalities such as visceral obesity, hyperglycemia, hypertension, and dyslipidemia (Grundy et al., 2005). Visceral obesity or intra-abdominal fat accumulation is linked to insulin resistance and proinflammatory state (Lee and Aronne, 2007), which are accounted for main risk factors of metabolic syndrome (Tarantino et al., 2009). People with metabolic syndrome are at increased risk of developing cardiovascular disease (CVD) and type 2 diabetes (Liberopoulos et al., 2005; Grundy, 2008). They are the major causes of mortality and health problem of non-communicable diseases.

Several studies in Asian population aged 20 years and over showed that the prevalence of metabolic syndrome was different in each country. The prevalences of metabolic syndrome in Japan, China, Singapore, Thailand, and India were about 11.5%, 13.2%, 14.1%, 12.8%, and 18.3% respectively (Nestel et al., 2007). The report of Thailand population health examination survey IV in population aged 15 years and over showed that the prevalences of visceral obesity in females and males were 18.6% and 45.0% respectively. The prevalence of hypertension, hyperglycemia, high triglyceride and low high-density lipoprotein cholesterol (HDL-C) level were 21.4%, 6.9%, 36.5%, and 46.6% respectively.(Ministry of Public Health, Health System Research Institute, 2009).

The prevalence of metabolic syndrome was different in each province. From survey, the prevalence of metabolic syndrome in Bangkok was 12.8%

(Lohsoonthorn, Lertmaharit, and Williams, 2007). The prevalences of metabolic syndrome in northeast provinces were 15.0% in Khon Kean (Pongchaiyakul et al., 2007), 24.0% in Surin (Wilaisakunyong, Deeying and Wongthimakorn, 2007), 17.0% in Nong Khai (Kaewtrakulpong, 2008), and 15.4 % in Nakhon Ratchasima (Sutadarat, Pongthananikorn, and Meksawan, 2010).

The etiology of the metabolic syndrome remains to be well understood. However, few studies found that the etiology might be genetic factors, excessive fat tissue and physical inactivity. These contribute to development of metabolic syndrome (Yanagisawa, and Leroith, 2010). It was reported that high consumption of saturated fatty acids, carbohydrate diet, salty diet, sweetened beverage, and low intake of fruits, vegetables and whole grains were associated with increased metabolic syndrome (Giugliano, Ceriello and Esposito, 2008). Moreover, skipping breakfast was associated with a significantly high risk of obesity. The people who skipped breakfast had four times the risk of obesity compared with those who consumed breakfast regularly (Ma et al., 2003). It was reported that people consuming a breakfast high in saturated fat had high expression of the pro-inflammatory cytokines and tumor necrosis factor-alpha which are accounted for important factors in the development of metabolic syndrome (Jimenez-Gomez et al., 2009; Tarantino et al., 2009).

In Asia, the rising prevalence of skipping breakfast has been reported in many countries such as Japan, Singapore, Korea, Palestine, and Australia (Horikawa et al., 2011). In Thailand, the rapid socioeconomic growth results in lifestyle changes, especially dietary habit including skipping breakfast, increased consumption of high-fat and high-carbohydrate diet, and reduced consumption of fruits and vegetables. These dietary habits promote the development of metabolic

syndrome. The National Statistical Office of Thailand studied the food consumption behavior in Thai population aged 6 years and over, the result showed that 69% of people aged 25-59 years skipped breakfast.

Regular breakfast consumption is associated with better health status at any age (Marangoni et al., 2009). Waking up in the morning after an overnight 8 hours fast without eating enough food will result in low blood sugar level. The body should be filled with food to supply glucose and fuel for the brain and provide other essential nutrients to maintain the energy level throughout the day. Moreover, regular breakfast consumption is associated with benefits including a better nutritional profile (Rampersaud et al. 2008; Barton et al., 2005), reduced body mass index (Yang, et al., 2006), weight loss (Henry, Newens, and Lightowler, 2009), and reduced risk of type 2 diabetes and CVD (Timlin, and Pereira, 2007).

Although numerous studies have examined the metabolic syndrome in Thailand, there were few studies about the association between breakfast consumption and metabolic syndrome. The purpose of this study was to determine the relationships between breakfast consumption and metabolic syndrome in a representative population of Kanchanaburi adults.

1.2 Objectives of the Study

The objectives of the study were to examine the prevalence of metabolic syndrome and to determine the relationship between breakfast consumption and metabolic syndrome in working age population in Kanchanaburi Province.

1.3 Research Variables

Dependent variable was the metabolic syndrome that consisted of 5 components: large waist circumference, high blood sugar, high serum triglycerides, low serum HDL- cholesterol, and high blood pressure.

Independent variables were the breakfast consumption and health behaviors (breakfast frequency, total energy intake, physical activity, cigarette smoking, alcohol consumption, etc.).

1.4 Scope of the Study

This research aimed to study among population aged 35 years and over in Kanchanaburi Province who received the annual health examination at Phaholpolpayuhasaena Hospital during December, 2011 through February, 2012.

1.5 Benefit of the Study

The data on the prevalence of metabolic syndrome and breakfast consumption in this study were useful for providing the nutritional data for health promotion and prevention of metabolic syndrome in the working age population.

CHAPTER II

LITERATURE REVIEW

2.1 Metabolic Syndrome

2.1.1 Definition

Metabolic syndrome is identified by the co-occurrence of risk factors such as visceral obesity, insulin resistance, elevated blood pressure, and dyslipidemia. These factors are also associated with the development of type 2 diabetes and cardiovascular disease (CVD) (Hwu et al., 2008). Two criteria for a diagnosis of metabolic syndrome are described by the Third Adult Treatment Panel (ATP III) of the National Cholesterol Education Program (NCEP) (Grundy et al., 2005) and International Diabetes Federation (IDF) (Alberti, Zimmet and Shaw, 2005). The five components of metabolic syndrome include i) high blood pressure, ii) high level of triglycerides, iii) high level of blood glucose, iv) low level of high-density lipoprotein cholesterol (HDL-C) and v) abdominal obesity. There is general agreement that the rising prevalence of metabolic syndrome is largely due to the increasing incidence of obesity (Giugliano et al., 2008). Abdominal obesity or visceral fat, is closely associated with insulin resistance and a low-grade pro-inflammatory state (Lee and Aronne, 2007), which are considered primary factors in the development of metabolic syndrome (Tarantino et al., 2009).

2.1.2 Pathogenesis

The exact etiology of metabolic syndrome remains obscure. However, it is believed that it is caused by a complex interaction between genetic and

environmental factors. Environmental factors include age, sex, family history, dietary patterns, level of physical activity, cigarette smoking, alcohol consumption, psychopathological conditions, obesity, and stress. These risk factors promote the development of abdominal obesity and insulin resistance which are dominant risk factors for metabolic syndrome (Baxter, Coyne and McClintock, 2006; Grundy et al., 2004b). Environmental factors that have been proposed to influence the development of insulin resistance are dietary composition, sedentary behavior patterns, and one's cognitive attitude toward food (Conus et al., 2004).

Several studies have investigated the risk factors for the presence of metabolic syndrome. Wu (2002) found that the risk factors influencing metabolic syndrome included high waist circumference and family history of metabolic syndrome. Diabetes was a significant risk factor in males as was hypertension in females. Ford, Giles, and Dietz (2002) found that the prevalence of metabolic syndrome increased with age. There was a prevalence of 6.7% in participants aged 20-29 years and 43.5% in participants aged 60-69 years. Park et al. (2003) found that approximately 22% of American adults had metabolic syndrome. It was significantly more prevalent among obese (60%) and overweight (22%) adults compared to those of normal weight (5%). Racial and ethnic differences have also been investigated. The same study found that metabolic syndrome was more prevalent in Mexican Americans (32%) compared to Whites (24%) and African-Americans (22%).

Abdominal obesity is the accumulation of abdominal fat resulting in a large waist circumference. There is a strong correlation between central obesity and CVD (Yusuf et al., 2004). Free fatty acids (FFAs) and lipid accumulation formed by visceral adiposity are mediators of insulin resistance and hypertension. FFAs are

released in abundance from an expanded adipose tissue mass. In the liver, FFAs result in increased production of glucose and triglycerides and secretion of very low-density lipoprotein (VLDL). Associated lipid/lipoprotein abnormalities include reduction in HDL-C and increase in low-density lipoprotein cholesterol (LDL-C). FFAs also reduce insulin sensitivity in muscle by inhibiting insulin-mediated glucose uptake. Associated defects include a reduction in glucose partitioning to glycogen and increased lipid accumulation. Elevated circulating glucose and FFAs increase pancreatic insulin secretion. Hyperinsulinemia may result in enhanced sodium reabsorption and sympathetic nervous system activity contributing to hypertension (Eckel, Grundy, and Zimmet, 2005). Increased FFAs are metabolized to triglycerides, which accounts for hypertriglyceridemia (DeFronzo and Ferrannini, 1991; Ruotolo and Howard, 2002). In addition, a reduction of lipoprotein lipase action in the peripheral tissues and liver leads to decreased clearance of VLDL and hypertriglyceridemia (Avramoglu, Qiu, and Adeli, 2003). The mechanism behind decreased HDL-C is not well understood, but it is thought to be secondary to the delayed metabolism of triglyceride-rich lipoproteins (Ruotolo and Howard, 2002). The increased triglyceride-rich LDL is rapidly lipolyzed by hepatic lipase to small dense LDL.

Based on strong connection between obesity and metabolic factors, NCEP ATP III defined metabolic syndrome as a cluster of metabolic complications of obesity (Grundy et al., 2004a). These conditions lead to a proinflammatory and prothrombotic state that can potentiate cardiovascular disease. The insulin resistance produced by excessive FFA exerts the paracrine and endocrine effects in the proinflammatory state. Decreases in the production of the antiinflammatory and

insulin-sensitizing cytokine adiponectin are also associated with metabolic syndrome and insulin resistance (Eckel et al., 2005). The presence of metabolic syndrome increases the risk of CVD and type 2diabetes. In addition, individuals with metabolic syndrome may be susceptible to other conditions such as polycystic ovary syndrome, fatty liver, nonalcoholic steatohepatitis, cholesterol gallstones, asthma, sleep disturbances, and some types of cancer (Grundy et al., 2004a).

2.1.3 Clinical diagnosis

From a clinical standpoint, the presence of metabolic syndrome identifies a person at increased risk for CVD and/or type 2 diabetes. In an effort to introduce metabolic syndrome into clinical practice, several expert groups have developed simple diagnostic criteria to be used in clinical practice to identify subjects with metabolic syndrome. World Health Organization Consultation for diabetes and its complications (WHO, 1999) and the National Cholesterol Education Program Expert Panel (NCEP, 2001) have formulated definitions of metabolic syndrome. The International Diabetes Federation (IDF) also published new criteria to identify subjects with metabolic syndrome (Alberti et al., 2005). The NCEP ATP III and the IDF criteria are widely considered useful for assessing the magnitude of metabolic syndrome in the general population (Pan, Yeh, and Weng, 2008; Pongchaiyakul et al., 2007).

There are differences in the details of the criteria established between the NCEP ATP III and the IDF. The NCEP ATP III considers that each metabolic component has equal importance, whereas the IDF proposes abdominal obesity as the most important condition. The NCEP ATP III uses waist circumference cutoff

points regardless of ethnicity which is inappropriate for the Thai population because Asians have a higher percentage of body fat at a lower BMI compared with Caucasians (Gurrici et al., 1998; Deurenberg-Yap, Chew, and Deurenbeg, 2002), while the IDF uses ethnic-specific cutoff points for waist circumference (Chatngern, 2008; Grundy et al., 2005). In Asia, the cutoff was redefined by the Steering Committee of the Regional office for the Western Pacific Region of the WHO, the International Association for the Study of Obesity and the International Obesity Task Force (WHO, 2000). Table 1 presents metabolic syndrome criteria defined by the NCEP ATP III and IDF.

2.1.4 Management

The goal of metabolic syndrome management is to reduce the risk of developing CVD and diabetes. The NCEP ATP III recommends that obesity should be the primary target of intervention for metabolic syndrome. First-line therapy should be weight reduction with reinforcement of lifestyle modification by a combination of calorie restriction and increased physical activity (Grundy et al., 2004a). Weight reduction is a major goal that can lead to the improvement of metabolic syndrome components (Fappa et al., 2008).

An initial target for weight reduction of 10 to 15% of body weight has been shown to improve insulin sensitivity and prevent type 2 diabetes and metabolic syndrome in adults with glucose intolerance (Grundy et al., 2005). Achieving the recommended amount of weight loss will reduce the severity of the components of metabolic syndrome (Grundy et al., 2004a; Grundy et al., 2005). Muzio et al. (2005) found that patients who lost weight more than 10% of their initial body weight

experienced greater reduction in metabolic syndrome components compared with those who lost weight less than 10%.

Table 1 The metabolic syndrome defined by the NCEP ATP III and IDF criteria.

Components	NCEP ATP III-modified three or more of the following criteria are considered positive for Metabolic syndrome	IDF central obesity and two of the following four factors are considered positive for Metabolic syndrome
Waist circumference		
Male	≥ 90 cm[a]	≥ 90 cm[b]
Female	≥ 80 cm[a]	≥ 80 cm[b]
Fasting plasma glucose	≥ 110 mg/dL Revised to: ≥ 100 mg/dL	≥ 100 mg/dL or previously diagnosed type 2 diabetes
Triglycerides (TG)	≥ 150 mg/dL	≥ 150 mg/dL or specific treatment
HDL-cholesterol		
Male	< 40 mg/dL	< 40 mg/dL
Female	< 50 mg/dL or specific treatment	< 50 mg/dL or specific treatment
Blood pressure	≥ 130/85 mmHg or on anti-hypertensive treatment	≥ 130/85 mmHg or on anti-hypertensive treatment

[a] The recommended ethnic-specific cut off points for Asian population according to WHO (Grundy et al., 2005; The World Health Organization Western Pacific Region et al., 2000)

[b] The recommended ethnic-specific cut off points according to IDF such as ≥ 90 cm in male and ≥ 80 cm in female for South Asian and Chinese, and Japanese and ≥ 94 cm in male and ≥ 80 cm in female for European (Alberti et al., 2005)

Knowler et al (2002) found that lifestyle intervention with consumption of low-fat, low-calorie diet and having moderate physical activity significantly reduced the incidence of diabetes among nondiabetic adults with elevated fasting or post-loaded glucose, compared to the placebo or adults who had moderate-intensity exercise (Thompson et al., 2003). A combination of calorie restriction and increased physical activity can improve individual metabolic syndrome components by promoting weight reduction (Christ et al., 2004). Similarly, Baxter et al. (2006) found that dietary and exercise therapies significantly reduced the progression of metabolic syndrome components. The diet that provides the most beneficial effects should be low in saturated fats, trans fats, cholesterol, sodium, and simple sugars, and high in fruits, vegetables and whole grains (Fappa et al., 2008; Grundy et al., 2005).

In summary, most of the lifestyle modifications, such as dietary changes and exercise have been shown to have a favorable effect on metabolic syndrome (Fappa et al., 2008). However, some patients may not be able to achieve the target lifestyle changes; therefore, drug treatment should be considered for specific abnormalities in these patients (Grundy et al., 2004a).

2.2 Prevalence of Metabolic Syndrome in Thailand

At the present time, the prevalence of metabolic syndrome is on the increase. The prevalence of obesity is increasing both in developed and developing countries, including Thailand. Several studies on the prevalence of metabolic syndrome in Thailand have been done over the past ten years. Boonyavarakul (2005) examined 400 rural Thais aged 35 and older. The prevalence of metabolic syndrome

was determined using the NCEP ATP III criteria with and without the modified waist circumference criteria for Asians. The results showed that this group had a prevalence of 18%, but this increased to 23% when using the modified Asian criteria for waist circumference. In 2006, Banthavan (2006) studied 270 people at Naresuan University with no history of hypertension, diabetes, or hyperlipidemia. The prevalence of metabolic syndrome was found to be 4.44% with no significant difference between males and females.

Several studies were conducted in 2007. A retrospective cohort study was examined in 3,499 employees at the Electricity Generating Authority of Thailand (Srisala, 2007). The study showed that the prevalence of metabolic syndrome defined by NCEP ATP III was 15.2%. In addition, the participants with metabolic syndrome had 2.09 times higher risk of morbidity from CVD when compared to the participants without metabolic syndrome. Using the modified NCEP ATP III criteria, Lohsoonthorn et al. (2007) looked at 1,339 professionals and office workers. They found that the prevalence of metabolic syndrome was 15.2% with a significantly higher rate among males (25.8%) than females (8.2%). Santibhavank (2007) conducted a study of 636 people aged 15-87 years in Nakhon Sawan Province and found that the prevalence of metabolic syndrome was 20.0% by NCEP ATP III standards, and 18.7% by IDF criteria. The study showed lower prevalence of metabolic syndrome in males than females, whereas younger people had lower prevalence of metabolic syndrome than older people.

Pongchaiyakul et al. (2007) did a study of 602 healthy participants, aged 20-90 years, at Srinagarin Hospital. Modified NCEP ATP III criteria were used to estimate the age and sex-specific prevalence of metabolic syndrome. In the study,

BMI ≥ 27 kg/m^2 for males and 25 kg/m^2 for females were used as criteria in place of waist circumference. The results showed that overall prevalence of metabolic syndrome was 15.0% with no significant difference between males (15.3%) and females (14.6%). Wilaisakunyong, et al. (2007) did a study of people aged 40-90 years. The results showed that the prevalence of metabolic syndrome was 24.4% while they also found significant associations between smoking and age with metabolic syndrome. Smokers in the study had 2.8 times higher risk of metabolic syndrome than non-smokers, and the group of 60 years and over had 2.6 times higher risk of metabolic syndrome than the 40-49 age group.

In 2008, Kaewtrakulpong conducted a survey of 1,004 people who had visited the health check-up clinic at Sri Chiang Mai Hospital in Nong Khai Province. The results showed that the prevalence of metabolic syndrome was 16.9% by NCEP ATP III and 15.0% by IDF criteria. From the study of 1,008 Ubon Rajathanee University personnel aged 20 years and over, the prevalence of metabolic syndrome was 6.2 % and 18.7 % when using WHO and IDF criteria respectively (Kaewpitoon, 2008). Tangpong et al. (2008) studied the prevalence of metabolic syndrome in 304 Walailak University personnel aged 25-65 years using NCEP ATP III criteria. The results showed that overall prevalence was 13.2% with a significant difference between males (9.9%) and females (3.3%). Most studies have found that the prevalence of metabolic syndrome in Thailand ranges from 10-30%. It was significantly higher in older age groups than younger. Moreover, prevalence in females was higher than in males.

2.3 Breakfast and Metabolic Syndrome

Several studies have been done on dietary patterns associated with metabolic syndrome. One of the interesting patterns noticed is breakfast consumption. Morgan, Zabik, and Stampley (1986) and Melanson et al. (2002) found that breakfast consumption could reduce total caloric intake during the day by reducing the amount of food consumed in subsequent meals in the day. This is possibly the result of more stable blood glucose levels established in breakfast consumers as compared with non-breakfast consumers. Eating a breakfast containing approximately 20% of total daily energy intake was inversely related to obesity. Martin et al. (2000) suggested that the caloric content of breakfast should be less than 25% of total daily energy intake. According to the Italian guidelines for correct nutrition (INRAN, 2003), breakfast should provide approximately 15-20% of daily caloric intake (15% if coupled with a mid-morning snack, and 20% without between-meal snacks). The regular consumption of breakfast providing 15-20% of daily caloric intake is associated with a higher likelihood of reaching the recommended dietary levels of some micronutrients and with reduced risks of obesity, cardiovascular events and diabetes (Timlin and Pereira, 2007). In addition, it is possible that breakfast consumption may control some risk factors. Moreover, several epidemiological observations reported many favorable metabolic effects of breakfast consumption on the lipid profile, glucose tolerance, and being overweight or obese which consequently lead to the reduction of risk for cardiovascular diseases and type 2 diabetes (Liu et al., 2003; Kochar, Djoussé, and Gaziano, 2007; Kaplan et al., 1987).

The composition of the breakfast meal is important (Ortega et al., 1996), in particular, the presence of high fiber foods, which contribute to the reduction of BMI (Ruxton and Kirk, 1997). A breakfast containing whole grain cereal, fruits and fiber may be protective against the onset of cardiovascular disorders and related mortality (Liu et al, 2003; Ortega, et al., 1996). It is possible that these types of food have been associated with a lower BMI (Newby et al., 2004; Song et al., 2005; Bazzano et al., 2005). In addition, sufficient time to eat breakfast is outstanding. One should take at least 20 minutes for each breakfast meal (Ortega et al., 1996). Cho et al. (2003) found that skipping breakfast is associated with a significantly higher BMI compared to eating cereal (ready to eat or cooked cereal) or quick breads for breakfast. One randomized crossover study found that women who ate higher-fiber, higher-fat breakfast meals had greater feelings of satiety and significantly higher cholecystokinin responses than those eating low-fat, low-fiber breakfast meals (Burton-Freeman, Davis, and Schneeman, 2002). Moreover, Blom et al (2005) found that the main components of a balanced breakfast (carbohydrates and fiber, mainly supplied by fruits, grains, and cereals) directly improved glucose metabolism and insulin response.

Eating a healthy breakfast induces a sense of fullness until the next meal. The resulting greater sense of satiety is responsible for lower caloric intake during subsequent meals. Clark et al (2006) found that a low glycemic load breakfast meal containing psyllium soluble fiber improved the postprandial glycemic, insulinemic, and free fatty acid (FFA) responses after breakfast, but not after lunch. It was suggested that breakfast foods such as whole-grain cereals and breads, milk products, and fruit may play a role in reducing the risks for metabolic syndrome

(Sahyoun et al., 2006; Baxter et al., 2006; Esmaillzadeh et al., 2007). Breakfast may mediate, in part, through the mechanism of insulin sensitivity because insulin resistance is a primary feature of metabolic syndrome (NCEP, 2002). Eating breakfast regularly, containing whole grain or low-fat milk, was associated with improved insulin sensitivity and higher glucose tolerance during the following meals, reduced circulating LDL cholesterol levels, diminished LDL oxidation, and decreased triglyceride concentrations (Farshchi, Taylor, and Macdonald, 2005). Similarly, Druce and Bloom (2006) and Bornet et al. (2007) found that complex carbohydrates consumed during breakfast, including bread, toasted bread, biscuits, and ready-to-eat breakfast cereals, affected the activity and release of gastric inhibitory peptide (GIP), glucagon-like peptide-1 (GLP-1) and colecystokinin (CCK). These hormones affect glycemic levels after a meal leading to a feeling of fullness. In addition, a balanced breakfast which includes significant amounts of protein and lipids essentially supplied by milk and dairy products also modulates ghrelin secretion, appetite (Foster-Schubert et al., 2008). The decrease in blood glucose level subsequent to the described metabolic changes may help in reducing the feeling of hunger (Ceriello et al., 2008). In one randomized crossover study conducted in overweight or obese American women, the subjects who ate a breakfast of eggs reported greater feelings of satiety and consumed less energy, carbohydrates, protein, and fat for lunch compared to the subjects who ate a bagel at breakfast (Vander wal et al., 2005).

In addition to the composition of breakfast, skipping breakfast also might lead to metabolic syndrome. Skipping breakfast has been associated with a higher BMI in adults (Cho et al., 2003; van der Heijden et al., 2007).It was also

linked to other cardiovascular risk factors such as lack of exercise, smoking,high blood pressure, and high serum total cholesterol (Sakata et al., 2001). Eating breakfast may positively impact circulating insulin levels. Moreover, it was found that people who skipped breakfast had higher fasting insulin levels as well as higher total cholesterol and LDL-C (Farshchi et al., 2005). Smith et al. (2010) found that adult skipping breakfast had a higher waist circumference, fasting glucose, insulin, total cholesterol, and LDL-cholesterol concentrations than those who ate breakfast. It is possible that skipping breakfast over a long period may alter the metabolism resulting in greater storage of fat. Therefore, skipping breakfast may be related to risk factors for several chronic diseases such as type 2 diabetes and CVD (Timlin and Pereira, 2007).

Another breakfast pattern that has been studied is the frequency of breakfast consumption. Several observational epidemiological studies provide good support for an inverse relationship between frequency of breakfast and relative body weight and obesity risk. Ma et al. (2003) found that the increased frequency of breakfast consumption (meals per week) was associated with reduced risk for obesity. Fiore et al. (2006) concluded that consuming breakfast everyday was associated with an increased likelihood of healthy weight levels compared with rarely or never eating breakfast. The previous studies suggested that a low frequency of breakfast consumption was associated with weight gain and the risk of obesity and chronic disease such as type 2 diabetes (Newby et al., 2004; Song et al., 2005; Timlin et al., 2008; Pereira et al., 2011). In summary, breakfast consumption is important for good health, especially because of its positive value against obesity and chronic diseases.

CHAPTER III

MATERIALS AND METHODS

3.1 Research Design

This research was an observational, cross-sectional descriptive study.

3.2 Participants

The participants were males and females aged 35 years and over in Kanchanaburi Province who received the annual health examination at Phaholpolpayuhasaena Hospital during December, 2011 through February, 2012. They could understand, read and write Thai. None of them were pregnant, lactating, disabled or had incomplete results of health examination. The study was approved by the Ethical Committee of the Faculty of Pharmaceutical Sciences, Chulalongkorn University (Protocol review No.11-33-017). The participants provided written informed consent before the data collection.

3.3 Sample Size

The number of participants enrolled in this study was calculated as follow:

$$n = \frac{(Z_{\alpha/2})^2 PQ}{d^2}$$

While n = number of sample

$Z_{\alpha/2}$ = the standard value under normal curve at 95% = 1.96

P = proportion of the prevalence of metabolic syndrome from Sutadarat et al., 2010 was 0.15

Q = 1-P

d = acceptable error allowable in estimating proportion in sample size and population = 0.05

The number of participants in this study was

$$n = \frac{(1.96)^2 (0.15) (0.85)}{(0.05)^2}$$

$$= 196$$

The number of participants was adjusted 20% for the error in collecting samples (R)

$$\text{sample size} = \frac{n}{(1-R)}$$

$$= \frac{196}{(1-0.2)}$$

$$= 245 \approx 250$$

3.4 Research Instruments

3.4.1 Tools for anthropometric assessment: weight and height analog scale apparatus and tape measure

3.4.2 Automatic blood pressure monitor (TERUMO ES-P 370, Japan)

3.4.3 Laboratory instruments for blood collection and blood chemical analysis

3.4.4 Food pictures for estimation of food quantity for the 24-hour dietary recall (Appendix A)

3.4.5 The information sheet and informed consent form (Appendix B)

3.4.6 The questionnaires (Appendix A)

Part I Demographic characteristics including gender, age, marital status, education, health behaviors.

Part II Breakfast pattern including frequency of breakfast consumption, reasons of skipping breakfast, pattern, and symptoms after skipping breakfast

Part III Food frequency questionnaire

The questionnaire included a food frequency questionnaire that was modified from Sutadarat et al. (2010) with 13 items and open label questions for information about use of dietary supplements. The questionnaire was based on 4 options for the frequency of intake for each food item (ranging from never or 1-3 days/month or 1-3 days/week, to ≥ 4 days/week). Food items were sugar-sweetened beverage, low-fat milk, bakery product, whole grain, fried food, vegetables, fruit, semi-instant, fish menu, salty processed food, and snack food.

Part IV The 24-hour dietary record

On the first day of the study, the participants filled out a menu with portion sizes of foods eaten in the 24-hour recall record form (Appendix A). The recorded data were analyzed the amount of nutrient intakes and calories using the Thai Nutrisurvey software developed for Thai food by the Division of Nutrition, Department of Health and Tropical Medicine, Mahidol University)

The part I, II, and III were proved by 5 experts for testing the content validity, and it was revised for obvious and suitable content according to the experts' recommendations. The part III was tested the reliability with the group of 30 persons who had similar characteristics to the study samples. The reliability was presented by Cronbach's alpha that was 0.72 (Appendix C)

3.5 Research Procedure

Data collection was performed with cooperation of a Health Checkup Unit, Phaholpolpayuhasaena Hospital. The participants who had undergone the health checkup must consent to participate in this study. The participants completed the questionnaires involving demographic data of the participants. According to age, the participants were divided in to four categorized: 30 to 39, 40 to 49, 50 to 59, and 60 or more years. Marital status was categorized as single, couple, and divorced or widowed. Educational level was categorized as high school and below, college, and master and over. Family history was based on the presence of diabetes mellitus, hypertension, and hyperlipidemia. Alcohol consumption was estimated from the usual daily intake alcohol beverages. The participants were asked about their average frequency (days per week) and amount (in ml) of alcoholic beverage ingested on a typical occasion or during a typical day. The average amount and frequency of alcoholic intake was converted to the amount of pure alcohol (in gram) consumed per day. The participants were divided into four groups by the amount of alcohol consumed: none, < 15 g/d, 15-30 g/day, and ≥30 g/day

Anthropometric measurement was performed in the morning before breakfast. Waist circumference was measured at the part of the trunk located umbilical level with standing position. Weight and height were measured without shoes using an analog scale (CAMRY®, China). Body mass index (BMI) was calculated as weight/height^2 (kg/m^2). The BMI cut-off points for overweight (≥ 23.0 kg/m^2) and obesity (≥ 25.0 kg/m^2) suggested for Asians (Deurenberg-Yap et al., 2002; Jia et al., 2002) were used to classify nutritional status of the participants. Blood pressure was measured with the participant in the seated position after each

participant had been rested for at least 10 minutes. Second measurement was performed for the participants who had high blood pressure after 10 minutes rest.

Venous blood sample (10 ml) was drawn from each participant in the morning after at least 8-10 hours of overnight fasting. Blood samples were analyzed at a central laboratory of Phaholpolpayuhasaena Hospital. Blood glucose, total cholesterol, triglycerides, and HDL-cholesterol concentrations were measured by enzymatic methods (Auto analyzer, ADVIA 1800; Siemens Healthcare). LDL-cholesterol was calculated using the Friedewald formula (Friedewald, Levy, and Fredrickson, 1972).

3.6 Data Analysis

Number, percentage, mean, and standard deviation (SD) were described for the demographic characteristics, health behaviors, breakfast pattern, and the prevalence rate of metabolic syndrome and components of the participants. The total daily energy intake and nutrient values from the 24-hour dietary recall were calculated by a computerized program (Thai Nutrisurvey, Division of Nutrition, Department of Health and Tropical Medicine, Mahidol University). The standard reference tables (Department of Health, Ministry of Public Health) were used to convert household portions to gram weights. Multivariate analysis was illustrated the relationship between breakfast pattern and metabolic syndrome by multiple logistic regression. Risk of the metabolic syndrome was presented by crude odds ratio (OR) and adjusted odd ratio and 95% confidence interval (95% CI). The difference was taken as statistically significant if the *p*-value was less than 0.05.

CHAPTER IV

RESULTS

The purpose of this study was to examine the prevalence of metabolic syndrome and the relationship between breakfast consumption and metabolic syndrome in working age population in Kanchanaburi Province who received annual health check-up program at Phaholpolpayuhasaena Hospital. The data were collected by the questionnaires and the results of health checkup from the annual health examination. A total of 385 persons were recruited into the study. Twelve participants were excluded because of incomplete data.

4.1 Characteristics of the participants and prevalence of metabolic syndrome

Demographic characteristics of the participants are shown in Tables 2 and 3. There were 373 persons participating in this study. One hundred and sixty-three (43.7%) participants were males, and 210 (56.3%) were females. The overall prevalence of the metabolic syndrome classified by the modified-NCEP ATP III and IDF criteria were 106 (28.4%) and 84 (22.5%) respectively. In addition, the prevalence of the metabolic syndrome was significantly higher in men (52.8%) than in women (47.2%) according to the modified-NCEP ATP III criteria. By the IDF criteria, the prevalence of the metabolic syndrome was higher in women (53.6%) than in men (46.4%).

The present study found that the participants with metabolic syndrome classified by both criteria had similar characteristics, including age and body mass index (BMI). The prevalence of metabolic syndrome increased with age. Based on the

modified NCEP ATP III criteria, it was found that 16.0% of the participants aged 30-39 years, 38.7% of the participants aged 40-49 year, and 43.4% of the participants aged 50-59 years had metabolic syndrome. When classified with the IDF criteria, the prevalence of metabolic syndrome in the 30-39, 40-49, and 50-59 years were 15.5%, 38.1%, and 45.2% respectively. Among the participants with BMI $\geq$ 25 kg/m^2, the prevalence of metabolic syndrome was 72.6 % and 81.0% based on the modified NCEP ATP III and IDF criteria respectively. Among the participants who were current smokers, the prevalence of metabolic syndrome by the modified NCEP ATP III was 30.2% and by the IDF criteria was 28.6%. The present study showed that the risks of developing metabolic syndrome were female (OR = 3.36, p = 0.036 for the modified NCEP ATP III criteria and OR = 6.99, p = 0.005 for the IDF criteria) and aged between 50-59 years old (OR = 5.69, p = 0.027 for the modified NCEP ATP III criteria and OR = 9.63, p = 0.014 for the IDF criteria).

The result showed that the participants with metabolic syndrome whose BMI $\geq$ 25 kg/m^2 had 12.89 and 56.57 times stronger risk of metabolic syndrome than those without metabolic syndrome according to the modified NCEP ATP III criteria ($p < 0.001$) and the IDF criteria ($p < 0.001$) respectively. According to the modified NCEP ATP III criteria, the participants who exercised less than 3 days a week had 2.98 times risk of metabolic syndrome than those who exercised 3 or more days a week (p = 0.024). With the IDF criteria, the participants who exercised less than 3 days a week was at risk of developing metabolic syndrome (OR= 4.72, p = 0.013).

Table 2 Demographic data and the risk for metabolic syndrome classified by the modified NCEP ATP III criteria (n = 373)

Characteristics	Metabolic syndrome (n = 106) Number (%)	Non-metabolic syndrome (n = 267) Number (%)	OR (95%CI)	p-value[1]
Prevalence	106 (28.4)	267 (71.6)		
Gender				
Male	56 (52.8)	107 (40.1)	1.00	
Female	50 (47.2)	160 (59.9)	3.36 (1.08-10.48)	0.036
Age (years)				
30-39	17 (16.0)	61 (22.8)	1.00	
40-49	41 (38.7)	133 (49.8)	1.69 (0.45-6.37)	0.440
50-59	46 (43.4)	70 (26.2)	5.69 (1.22-26.53)	0.027
≥ 60	2 (1.9)	3 (1.2)	18.21 (0.42-78.30)	0.130
Mean ± SD	47.92 ± 6.79	45.41 ± 6.73		
Marital status				
Single	15 (14.1)	51 (19.1)	1.00	
Couple	80 (75.5)	197 (73.8)	0.69 (0.20-2.36)	0.553
Divorce	11 (10.4)	19 (7.1)	0.33 (0.04-2.92)	0.320
Education level				
High school and below	43 (40.6)	78 (29.2)	1.00	
college	47 (44.3)	139 (52.1)	0.48 (0.16-1.44)	0.191
master and over	16 (15.1)	50 (18.7)	1.25 (0.28-5.66)	0.775
Occupation				
Government officer	81 (76.4)	220 (82.4)	1.00	
Office worker	4 (3.8)	10 (3.7)	3.82 (0.24-60.00)	0.341
Employee	18 (17.0)	29 (10.9)	2.96 (0.57-15.38)	0.198
Housewife/Retiree	3 (2.8)	8 (3.0)	0.17 (0.01-4.90)	0.302

Table 2 Demographic data and the risk for metabolic syndrome classified by the modified NCEP ATP III criteria (n = 373) (continued)

Characteristics	Metabolic syndrome (n = 106) Number (%)	Non-metabolic syndrome (n = 267) Number (%)	OR (95%CI)	p-value[1]
Body mass index (kg/m^2)				
< 23	14 (13.2)	145 (54.3)	1.00	
23-24.99	15 (14.2)	58 (21.7)	0.97 (0.23-4.15)	0.974
≥ 25	77 (72.6)	64 (24.0)	12.89 (3.6-46.07)	< 0.001
Exercise (days/week)				
3 or more	21 (19.8)	65 (24.3)	1.00	
Less than 3	85 (80.2)	202 (75.7)	2.98 (1.16-7.67)	0.024
Cigarette smoking				
Non-smoker	74 (69.8)	218 (81.6)	1.00	
Current smoker	32 (30.2)	49 (18.4)	1.11 (0.34-3.65)	0.861
Alcohol consumption				
Non-drinker	69 (65.1)	196 (73.4)	1.00	
Drinker	37 (34.9)	71 (26.6)	0.86 (0.27-2.73)	0.804
Time spent for sleeping (hours/night)				
8 or more	82 (77.4)	215 (80.5)	1.00	
Less than 8	24 (22.6)	52 (19.5)	1.05 (0.37-2.98)	0.927
Family history of HTN/DM/Dyslipidemia				
No	30 (28.3)	88 (33.0)	1.00	
Yes	76 (71.7)	179 (67.0)	1.35 (0.51-3.61)	0.547

[1] *p*-value was based on multiple logistic regression.
n = number; OR = odds ratio; 95% CI = 95% confidence interval; SD = standard deviation; HTN = hypertension; DM = Diabetes mellitus

Table 3 Demographic data and the risk for metabolic syndrome classified by the IDF criteria (n = 373)

Characteristics	Metabolic syndrome (n = 84) Number (%)	Non-metabolic syndrome (n = 289) Number (%)	OR (95%CI)	p-value[1]
Prevalence (%)	84 (22.5)	289 (77.5)		
Gender				
Male	39 (46.4)	124 (42.9)	1.00	
Female	45 (53.6)	165 (57.1)	6.99 (1.79-27.29)	0.005
Age (years)				
30-39	13 (15.5)	65 (22.5)	1.00	
40-49	32 (38.1)	142 (49.1)	2.66 (0.56-12.74)	0.220
50-59	38 (45.2)	78 (27.0)	9.63 (1.58-58.89)	0.014
≥ 60	1 (1.2)	4 (1.4)	29.70 (0.25-40.0)	0.166
Mean ± SD	47.92 ± 6.79	45.41 ± 6.73		
Marital status				
Single	9 (10.7)	57 (19.7)	1.00	
Couple	65 (77.4)	212 (73.4)	2.13 (0.41-11.16)	0.370
Divorce	10 (11.9)	20 (6.9)	4.19 (0.35-50.01)	0.258
Education level				
High school and below	31 (36.9)	90 (31.2)	1.00	
college	40 (47.6)	146 (50.5)	1.26 (0.37-4.28)	0.715
master and over	13 (15.5)	53 (18.3)	2.40 (0.40-14.47)	0.399
Occupation				
Government officer	65 (77.4)	236 (81.6)	1.00	
Office worker	3 (3.6)	11 (3.8)	2.92 (0.11-81.47)	0.528
Employee	15 (17.9)	32 (11.1)	2.45 (0.35-16.94)	0.364
Housewife/Retiree	1 (1.1)	10 (3.5)	0.01 (0.00-1.03)	0.051

Table 3 Demographic data and the risk for metabolic syndrome classified by the IDF criteria (n = 373) (continued)

Characteristics	Metabolic syndrome (n = 84) Number (%)	Non-metabolic syndrome (n = 289) Number (%)	OR (95%CI)	p-value[1]
Body mass index (kg/m^2)				
< 23	5 (6.0)	154 (53.2)	1.00	
23-24.99	11 (13.0)	62 (21.5)	4.53 (0.62-32.96)	0.135
≥ 25	68 (81.0)	73 (25.3)	56.57 (7.95-100)	<0.001
Exercise (days/week)				
3 or more	15 (17.9)	71 (24.6)	1.00	
Less than 3	69 (82.1)	218 (75.4)	4.72 (1.38-16.17)	0.013
Cigarette smoking				
Non-smoker	60 (71.4)	232 (80.3)	1.00	
Current smoker	24 (28.6)	57 (19.7)	2.16 (0.56-8.33)	0.263
Alcohol consumption				
Non-drinker	57 (67.9)	208 (72.0)	1.00	
Drinker	27 (32.1)	81 (28.0)	0.82 (0.24-2.80)	0.748
Time spent for sleeping (hours/night)				
8 or more	67 (79.8)	230 (79.6)	1.00	
Less than 8	17 (20.2)	59 (20.4)	2.50 (0.36-17.43)	0.356
Family history of HTN/ DM/Dyslipidemia				
No	22 (26.2)	96 (33.2)	1.00	
Yes	62 (73.8)	193 (66.8)	1.54 (0.50-4.74)	0.448

[1] *p*-value was based on multiple logistic regression.
n = number; OR = odds ratio; 95% CI = 95% confidence interval; SD = standard deviation; HTN = hypertension; DM = Diabetes mellitus

4.2 The prevalence of five components of the metabolic syndrome

The prevalence of each component of metabolic syndrome classified by the modified NCEP ATP III and IDF criteria are shown in Table 4. The three most common metabolic abnormalities by the modified NCEP ATP III criteria were high blood pressure (82.1%), large waist circumference (79.2%), and elevated triglyceride (69.8%). According to the IDF criteria, besides large waist circumference, the three most common metabolic abnormalities were high blood pressure (82.1%), elevated triglyceride (61.9%) and low HDL-C (50%).

The mean values of variables that are the components of metabolic syndrome classified by the modified NCEP ATPIII and IDF criteria are presented in Tables 5 and 6 respectively. The participants who did not have metabolic syndrome diagnosed by both criteria had significantly lower levels of glucose, triglycerides, and blood pressure, but higher levels of HDL-C, compared with those who had metabolic syndrome. The participants with metabolic syndrome classified by the modified NCEP ATP III criteria had higher levels of fasting plasma glucose and triglyceride but lower level of HDL-C in females than those classified by the IDF criteria. The participants with metabolic syndrome based on the IDF criteria had greater waist circumference, both in males and females, than those who were classified by the modified NCEP ATP III.

Table 4 The prevalence of each metabolic abnormality in the participants with metabolic syndrome classified by the modified NCEP ATP III and IDF criteria.

Variables	modified NCEP ATP III[1] (n = 106) Number (%)	IDF[2] (n = 84) Number (%)
Blood pressure		
≥ 130/85 mm Hg	87 (82.1)	69 (82.1)
Waist circumference		
≥ male 90 cm./female 80 cm.	84 (79.2)	84 (100)
Triglycerides		
≥150mg/dL or medication	74 (69.8)	52 (61.9)
Fasting plasma glucose		
≥ 100 mg/dL or medication	57 (53.8)	40 (47.6)
HDL- cholesterol		
male < 40 mg/dL/female < 50mg/dL		
or medication	54 (50.9)	42 (50.0)

[1]modified NCEP ATP III = modified- National Cholesterol Education Program Adult Treatment Panel III (Grundy et al., 2005)
[2]IDF = International Diabetes Federation (Alberti et al., 2005)

Table 5 The mean values of variables that are the components of metabolic syndrome classified by the modified NCEP ATPIII (n = 373)

Variables[1]	Metabolic syndrome (n = 106) mean ± SD.	Non-metabolic syndrome (n = 267) mean ± SD.	p-value[2]
Waist circumference (cm)			
Male	91.28 ± 7.75	81.46 ± 6.33	< 0.001
Female	87.89 ± 8.39	75.64 ± 7.05	< 0.001
Fasting plasma glucose (mg/dL)	107.65 ± 34.04	90.39 ± 10.27	< 0.001
Triglycerides (mg/dL)	201.69 ± 100.68	124.79 ± 95.50	< 0.001
HDL-C (mg/dL)			
Male	49.40 ± 10.97	61.05 ± 12.55	0.004
Female	46.25 ± 13.42	53.14 ± 14.57	< 0.001
Blood pressure (mmHg)			
Systolic	139.33 ± 17.04	122.06 ± 15.67	< 0.001
Diastolic	89.21 ± 11.53	78.61 ± 10.73	< 0.001
Body mass index (kg/m^2)	27.67 ± 5.08	23.00 ± 2.85	< 0.001

[1]Data were expressed as mean ± standard deviation (SD).
[2] *p*-value was based on independent t-test.
Modified-National Cholesterol Education Program Adult Treatment Panel III defined the diagnosis of the metabolic syndrome when three or more of the following risk factors were presented: (1) abdominal obesity (large waist circumference ≥ 90 cm for men and ≥ 80 cm for women) (2) triglyceride level ≥ 150 mg/dL, (3) HDL cholesterol level < 40 mg/dL in men and < 50 mg/dL in women, (4) blood pressure ≥ 130/85 mm Hg, (5) fasting plasma glucose ≥ 100 mg/dL.;
HDL-C= high-density lipoprotein-cholesterol

Table 6 The mean values of variables that are the components of metabolic syndrome classified by IDF criteria (n = 373)

Variables	Metabolic syndrome[1] (n = 84) mean ± SD.	Non-metabolic syndrome[1] (n = 289) mean ± SD.	p-value[2]
Waist circumference (cm)			
Male	95.14 ± 5.09	81.60 ± 6.16	< 0.001
Female	89.24 ± 7.66	75.64 ± 6.97	< 0.001
Fasting plasma glucose (mg/dL)	106.01 ± 33.30	92.18 ± 15.34	< 0.001
Triglycerides (mg/dL)	176.99 ± 77.11	137.83 ± 107.78	0.002
HDL-C (mg/dL)			
Male	46.89 ± 14.55	51.99 ± 14.35	0.056
Female	49.76 ± 11.36	60.60 ± 12.66	< 0.001
Blood pressure (mmHg)			
Systolic	139.70 ± 17.48	123.26 ± 16.19	< 0.001
Diastolic	89.65 ± 12.05	79.28 ± 10.87	< 0.001
Body mass index (kg/m^2)	28.75 ± 4.94	23.04 ± 2.87	< 0.001

[1]Data were expressed as mean ± standard deviation (SD).
[2] *p*-value was based on independent t-test.
IDF definition defined the diagnosis of the metabolic syndrome when person must have central adiposity (large waist circumference ≥ 90 cm for men and ≥ 80 cm for women), plus any two or more of the following four risk factors on (1) Elevated triglyceride level ≥ 150 mg/dL, (2) Low HDL cholesterol level < 40 mg/dL in men and < 50 mg/dL in women, (3) Elevated blood pressure ≥ 130/85mm Hg, (4) raised fasting plasma glucose ≥ 100 mg/dL.
HDL-C= high-density lipoprotein-cholesterol

4.3 Dietary pattern and metabolic syndrome

The results showed that the participants with metabolic syndrome was classified by the modified NCEP ATP III criteria had three potential risk factors including skipping breakfast at least one day a week, low-fat milk intake of three days or less a week, and sugar-sweetened beverage intake more than three days a week. When metabolic syndrome was classified by the IDF criteria, the risk factors were skipping breakfast at least one day a week and low-fat milk intake of three days or less a week (Tables 7 and 8).

Based on the modified NCEP ATP III criteria, the participants with metabolic syndrome who skipped breakfast at least one day per week and who did not have breakfast had 2.75 and 7.82 times respectively greater risk of metabolic syndrome than those who ate regularly breakfast ($p = 0.002$ for skipping breakfast at least one day per week and $p < 0.001$ for no breakfast). According to the IDF criteria, the participants with metabolic syndrome who skipped breakfast at least one day per week and who did not have breakfast had 2.47 and 6.65 times, respectively higher risk of metabolic syndrome than those who ate regularly breakfast ($p = 0.009$ for skipping breakfast and $p < 0.001$ for no breakfast). Moreover, the participants with metabolic syndrome who had low-fat milk intake three days or less a week had 2.35 and 2.04 times stronger risk of metabolic syndrome than those who had low-fat milk intake more than three days a week according to the modified NCEP ATP III criteria ($p = 0.009$) and the IDF criteria ($p = 0.047$) respectively. In addition, the participants with metabolic syndrome who drank sugar-sweetened beverage more than three days a

week had 1.92 times stronger risk of developing metabolic syndrome than those who drank sugar-sweetened beverage three days or less a week ($p = 0.039$).

The data of the 24-hour dietary recall of the participants were analyzed for total daily energy intake and distribution of calories intake from carbohydrate, protein and fat (Tables 9 and 10). The data of 30 participants were excluded because of data missing and unusual intake reporting. Therefore, the complete data were obtained from 343 participants for analysis. The total energy intake data were analyzed for examining the unreliable data by boxplot analysis (Appendix C). The results showed that there was no participant who reported unreliable total energy.

It was found that the participants with metabolic syndrome classified by both modified-NCEP ATP III and IDF criteria had similar characteristics including total daily energy intakes and percentages of calories from carbohydrate, fat, and protein. All values of dietary intake were compared with dietary reference intake (DRI) for Thais (The committee on recommended daily allowances, 2003). The mean total daily energy intakes of the participants with metabolic syndrome classified by the modified-NCEP ATP III and IDF criteria were approximately 1,304.17 and 1,313.97 kcal respectively. The results indicated that the mean total daily energy intake of these participants was lower than the recommended values (1,550-2,150 kcal). The participants without metabolic syndrome also had similar characteristics to those with metabolic syndrome classified by both criteria.

The distribution of calories intake from carbohydrate and fat in the participants with metabolic syndrome classified by the modified NCEP ATPIII criteria were 50.53% and 29.74 % respectively, whereas in those classified by the IDF criteria were 50.41% and 30.05% respectively. The percentages of calories from

carbohydrate and fat of the subjects were in the recommended range (45-65% and 20-35% respectively). The percentages of calories from protein of the participants with metabolic syndrome classified by the modified NCEP ATP III and IDF criteria were approximately 18.79 and 18.64 respectively. These results indicated that the percentages of calories from protein of the participants were higher than the standard range (10-15%). Energy intake and the percentages of calories from macronutrients of the participants with and without metabolic syndrome were not different.

Table 7 The relationship between dietary pattern and metabolic syndrome classified by the modified NCEP ATP III criteria (n = 373)

Variables	Metabolic syndrome Number (%) (n = 106)	Non-metabolic syndrome Number (%) (n = 267)	OR (95% CI)	*p*-value[1]
Large meal intake				
Others	68 (64.2)	166 (62.2)	1.00	
Dinner	38 (35.8)	101 (37.8)	0.80 (0.44-1.44)	0.447
Frequency of eating breakfast (days)				
7	44 (41.5)	170 (63.7)	1.00	
1-6	36 (34.0)	77 (28.8)	2.75 (1.43-5.31)	0.002
0	26 (24.5)	20 (7.5)	7.82 (3.33-18.35)	< 0.001
Meal-made pattern				
Home-made	51 (48.1)	126 (47.2)	1.00	
Non home-made	47 (44.3)	116 (43.4)	1.16 (0.65-2.09)	0.615
Both	8 (7.6)	25 (10.4)	1.03 (0.38-2.78)	0.949
Repeated dietary type intake				
No	88 (83.0)	208 (77.9)	1.00	
Yes	18 (17.0)	59 (22.1)	0.61 (0.29-1.29)	0.196
Time between dinner and bedtime (hours)				
4or more	47 (44.3)	142 (53.2)	1.00	
Less than 4	59 (55.7)	125 (46.8)	1.24 (0.71-2.17)	0.441
Time spent on each meal (minutes/meal)				
15 or more	61 (57.5)	175 (65.5)	1.00	
Less than 15	45 (42.5)	92 (34.5)	1.57 (0.89-2.77)	0.123
Sugar-sweetened beverage (days/week)				
≤ 3	66 (62.3)	179 (67.0)	1.00	
> 3	40 (37.7)	88 (33.0)	1.92 (1.03-3.57)	0.039

Table 7 The relationship between dietary pattern and metabolic syndrome classified by the modified NCEP ATP III criteria (n = 373) (continued)

Variables	Metabolic syndrome Number (%) (n=106)	Non-metabolic syndrome Number (%) (n=267)	OR (95% CI)	*p*-value[1]
Coconut milk food intake (days/week)				
≤ 3	80 (75.5)	200 (74.9)	1.00	
> 3	26 (24.5)	67 (25.1)	0.90 (0.43-1.88)	0.775
Bakery product intake (days/week)				
≤ 3	78 (73.6)	197 (73.8)	1.00	
> 3	28 (26.4)	70 (26.2)	1.74 (0.88-3.43)	0.109
One dish meal (days/week)				
≤ 3	70 (66.0)	176 (65.9)	1.00	
> 3	36 (34.0)	91 (34.1)	0.73 (0.39-1.35)	0.309
Semi-instant food intake (days/week)				
≤ 3	87 (82.1)	213 (79.8)	1.00	
> 3	19 (17.9)	54 (20.2)	0.69 (0.28-1.71)	0.426
Salty processed food intake (days/week)				
≤ 3	82 (77.4)	201 (75.3)	1.00	
> 3	24 (22.6)	66 (24.7)	1.66 (0.71-3.86)	0.243
Low-fat milk intake (days/week)				
>3	28 (26.4)	113 (42.3)	1.00	
≤ 3	78 (73.6)	154 (57.7)	2.35 (1.24-4.47)	0.009
Whole grain intake (days/week)				
> 3	70 (66.0)	180 (67.4)	1.00	
≤ 3	36 (34.0)	87 (32.6)	0.81 (0.43-1.51)	0.504
Fruits intake (days/week)				
> 3	52 (49.1)	135 (50.6)	1.00	
≤ 3	54 (50.9)	132 (49.4)	1.27 (0.68-2.34)	0.453

Table 7 The relationship between dietary pattern and metabolic syndrome classified by the modified NCEP ATP III criteria (n = 373) (continued)

Variables	Metabolic syndrome Number (%) (n=106)	Non-metabolic syndrome Number (%) (n=267)	OR 95% CI	*p*-value[1]
Alcohol consumption (gram/day)				
none	69 (65.1)	196 (73.4)	1.00	
< 15	5 (4.7)	9 (3.4)	1.99 (0.53-7.55)	0.310
15-30	10 (9.4)	13 (4.9)	1.41 (0.47-4.22)	0.543
> 30	22 (20.8)	49 (18.3)	0.67 (0.32-1.40)	0.286

[1] *p*-value was based on multiple logistic regression.
n = number; OR = odds ratio; 95% CI = 95% confidence interval

Table 8 The relationship between dietary pattern and metabolic syndrome classified by the IDF criteria (n = 373)

Variables	Metabolic syndrome Number (%) (n = 84)	Non-metabolic syndrome Number (%) (n = 289)	OR (95% CI)	*p*-value[1]
Large meal intake				
Others	52 (61.9)	182 (63.0)	1.00	
Dinner	32 (38.1)	107 (37.0)	1.15 (0.63-2.08)	0.652
Frequency of eating breakfast (days)				
7	36 (42.9)	178 (61.6)	1.00	
1-6	28 (33.3)	85 (29.4)	2.47 (1.26-4.87)	0.009
0	20 (23.8)	26 (9.0)	6.65 (2.85-15.56)	< 0.001
Meal-made pattern				
Home-made	38 (45.2)	139 (48.0)	1.00	
Non home-made	38 (45.2)	125 (43.3)	1.21 (0.66-2.20)	0.538
Both	8 (9.6)	25 (8.7)	1.56 (0.59-4.13)	0.374
Repeated dietary type intake				
No	72 (85.7)	224 (77.5)	1.00	
Yes	12 (14.3)	65 (22.5)	0.48 (0.22-1.06)	0.070
Time between dinner and bedtime (hours)				
4 or more	39 (46.4)	150 (51.9)	1.00	
Less than 4	45 (53.6)	139 (48.1)	1.02 (0.58-1.79)	0.941
Time spent on each meal (minutes/meal)				
15 or more	47 (56.0)	189 (65.4)	1.00	
Less than 15	37 (44.0)	100 (34.6)	1.67 (0.95-2.97)	0.077
Sugar-sweetened beverage (days/week)				
≤ 3	52 (61.9)	193 (66.8)	1.00	
> 3	32 (38.1)	96 (33.2)	1.71 (0.91-3.19)	0.095

Table 8 The relationship between dietary pattern and metabolic syndrome classified by the IDF criteria (n = 373) (continued).

Variables	Metabolic syndrome Number (%) (n = 84)	Non-metabolic syndrome Number (%) (n = 289)	OR (95% CI)	*p*-value[1]
Bakery product intake (days/week)				
≤ 3	63 (75.0)	212 (73.4)	1.00	
> 3	21 (25.0)	77 (26.6)	1.34 (0.67-2.69)	0.404
One dish meal intake (days/week)				
≤ 3	56 (66.7)	190 (65.7)	1.00	
> 3	28 (33.3)	99 (34.3)	0.74 (0.40-1.38)	0.349
Coconut milk (days/week)				
≤ 3	63 (75.0)	217 (75.1)	1.00	
> 3	21 (25.0)	72 (24.9)	0.94 (0.45-1.98)	0.871
Salty processed food intake (days/week)				
≤ 3	65 (77.4)	218 (75.4)	1.00	
> 3	19 (22.6)	71 (24.6)	1.29 (0.53-3.17)	0.575
Semi-instant food intake (days/week)				
≤ 3	67 (79.8)	233 (80.6)	1.00	
> 3	17 (20.2)	56 (19.4)	1.09 (0.44-2.69)	0.848
Low-fat milk intake (days/week)				
>3	23 (27.4)	118 (40.8)	1.00	
≤ 3	61 (72.6)	171 (59.2)	2.04 (1.01-4.98)	0.047
Fruits intake (days/week)				
> 3	39 (46.4)	148 (51.2)	1.00	
≤ 3	45 (53.6)	141 (48.8)	1.27 (1.06-3.91)	0.062
Whole grain intake (days/week)				
> 3	52 (61.9)	198 (68.5)	1.00	
≤ 3	32 (38.1)	91 (31.5)	1.07 (0.58-1.98)	0.855

Table 8 The relationship between dietary pattern and metabolic syndrome classified by the IDF criteria (n = 373) (continued).

Variables	Metabolic syndrome Number (%) (n = 84)	Non-metabolic syndrome Number (%) (n = 289)	95% CI	p-value[1]
Alcohol consumption (gram/day)				
none	57 (67.9)	208 (72.0)	1.00	
< 15	3 (3.6)	11 (3.8)	1.36 (0.32-5.76)	0.679
15-30	7 (8.3)	16 (5.5)	0.89 (0.29-2.79)	0.413
> 30	17 (20.2)	54 (18.7)	0.71 (0.33-1.49)	0.356

[1] p-value was based on multiple logistic regression.
n = number; OR = odds ratio; 95% CI = 95% confidence interval

Table 9 The total daily energy intake and distribution of calories from carbohydrate, protein and fat in the participants with and without metabolic syndrome classified by the modified NCEP ATPIII (n* = 343).

Variables	metabolic syndrome[1] (n = 98)	non-metabolic syndrome[1] (n = 245)	*p*-value[2]
Total daily energy (kcal)	1304.17 ± 435.56	1264.02 ± 404.52	0.417
Carbohydrate			
grams/day	163.85 ± 61.91	165.45 ± 59.73	0.827
% of total calories	50.53 ± 10.10	52.76 ± 11.14	0.087
Protein			
grams/day	60.19 ± 27.52	55.36 ± 24.86	0.133
% of total calories	18.79 ± 7.19	17.65 ± 5.81	0.128
Fat			
grams/day	43.96 ± 22.40	42.47 ± 20.09	0.569
% of total calories	29.74 ± 8.94	29.74 ± 9.11	0.994

[1]Data were expressed as mean ± standard deviation (SD).
[2] *p*-value was based on independent t-test.
n = number; DRI = Dietary Reference Intake; kcal = kilocalorie
n*= The data of 30 participants were excluded because of incomplete data.

Table 10 The total daily energy intake and distribution of calories from carbohydrate, protein and fat in the participants with and without metabolic syndrome classified by IDF criteria (n* = 343).

Variables	metabolic syndrome[1] (n = 79)	non-metabolic syndrome[1] (n = 264)	*p*-value[2]
Total daily energy (kcal)	1313.97 ± 440.18	1263.97 ± 405.18	0.346
Carbohydrate			
grams/day	165.69 ± 64.88	164.78 ± 58.94	0.912
% of total calories	50.41 ± 10.19	52.63 ± 11.05	0.113
Protein			
grams/day	60.00 ± 27.88	55.76 ± 24.99	0.227
% of total calories	18.64 ± 7.68	17.78 ± 5.75	0.283
Fat			
grams/day	44.29 ± 21.50	42.48 ± 20.55	0.510
% of total calories	30.05 ± 8.71	29.65 ± 9.16	0.731

[1]Data were expressed as mean ± standard deviation (SD).
[2] *p*-value was based on independent t-test.
n = number; DRI = Dietary Reference Intake; kcal = kilocalories
n*= The data of 30 participants were excluded because of incomplete data.

4.4 Breakfast and metabolic syndrome

Demographic characteristics and dietary pattern of the participants (n = 373) classified by breakfast consumption are shown in Tables 11 and 12. The breakfast eaters were those who consumed breakfast regularly (n = 214), whereas the breakfast skippers were the participants who skipped breakfast at least once per week (n = 159). Most of the breakfast eaters were females (59.3%), 40-59 years old (82.2%), and non-drinkers (76.6%). The breakfast skippers were males (47.8%), young adults (26.4%), obese (46.5%), and alcohol drinkers (36.5%). After controlling the potential confounders (i.e., age, physical activity, and medical history), the results showed that males were more likely to skip breakfast than females (OR = 1.55, p = 0.047). Moreover, income more than 20,001 baht (OR = 4.59, p = 0.005), current drinkers (OR = 2.56, p = 0.033), and obesity (OR= 2.29, $p < 0.001$) were significantly associated with skipping breakfast. It was found that the participants with the age of 40-49 years were more likely to be breakfast eaters than skippers (OR = 0.54, p = 0.041). In this study, the breakfast skippers were significantly associated with consuming alcohol (p = 0.038).

The data of the 24-hour dietary recall of the participants (n = 343) classified by breakfast consumption are shown in Tables 13. They were analyzed for total daily energy intake and distribution of calories from carbohydrate, protein and fat and classified by breakfast frequency. Based on the frequency of breakfast consumption, the participants were divided into 3 groups including daily breakfast eaters (daily eating), irregular breakfast eaters (having breakfast 1-6 days a week, partial skipping), and daily skippers (absolute skipping). All values of dietary intake were compared with dietary reference intake (DRI) for Thais (The committee on

recommended daily allowances, 2003). The mean total daily energy intakes of the participants who ate breakfast regularly was 1,307.28 ± 392.27 kcal, those who skipped breakfast at least one day a week was 1,231.03 ± 438.75 kcal and those who did not eat breakfast were 1281.43 ± 484.50 kcal. The percentages of calories from breakfast carbohydrate, fat, and protein were 52.70, 29.26, and 18.15 respectively in daily breakfast eaters whereas irregular breakfast eaters were 50.17, 31.38, and 18.08 respectively. In addition, daily breakfast skippers were 54.23, 27.89, and 16.86 respectively. The results indicated that the total daily energy intake of the participants who were breakfast skippers was lower than the recommended value (1,550-2,150 kcal). The percentages of calories from carbohydrate and fat of those participants were in the recommended range (45-65% and 20-35% respectively). In addition, the percentage of calories from protein of those participants was higher than the recommended value (10-15%). Energy intake and the percentages of calories from carbohydrate, fat in breakfast eaters and breakfast skippers were not significantly different. However, the percentages of calories from protein in daily breakfast eaters and breakfast skippers were significantly different.

The prevalence and risk of developing metabolic syndrome in the participants (n = 373) classified by breakfast frequency are shown in Tables 14-17. Based on the frequency of breakfast consumption, the participants were divided into 3 groups including daily breakfast eaters (daily eating), irregular breakfast eaters (having breakfast 1-6 days a week, partial skipping), and daily skippers (absolute skipping) The results showed that the three most common metabolic abnormalities of the participants who were daily skippers were high blood pressure (63.0%), elevated triglyceride levels (60.9%), and large waist circumference (45.7%) (Table 14). It was

found that the daily skipper group not only had the highest serum triglyceride levels (190.30 ± 107.23 mg/dL), but also had lowest HDL-cholesterol levels (49.63 ± 14.69 mg/dL) (Table 15). Multivariate-adjusted odds ratio (95% CI) for metabolic abnormalities are presented in Table 16. The participants who did not eat breakfast showed larger waist circumference (OR = 2.58, $p < 0.05$), higher blood triglyceride level (OR = 3.43, $p < 0.001$), and higher blood glucose level (OR = 2.66, $p < 0.05$) but lower blood HDL-cholesterol level (OR = 4.24, $p < 0.001$) than those who ate breakfast daily.

The association between frequency of breakfast consumption and the prevalence of metabolic syndrome is presented in Table 17. The prevalence of metabolic syndrome defined by the modified NCEP ATP III criteria was 28.4 %. With this criteria, 20.6% of the daily breakfast eaters, 31.9% of the irregular breakfast eaters, and 56.5% of the daily skippers had metabolic syndrome. Moreover, the participants who ate breakfast irregularly and did not eat breakfast had 2.16 and 5.50 times respectively higher risk of developing metabolic syndrome than those who consumed breakfast regularly ($p = 0.014$ and $p < 0.001$ respectively). With the IDF criteria, it was found that the prevalence of metabolic syndrome was 22.5 %. There was 16.8 % of the daily breakfast eaters, 24.8 % of the irregular breakfast eaters and 43.5% of the daily skippers had metabolic syndrome. According to the IDF criteria, the participants who did not eat breakfast had 4.47 times higher risk of developing metabolic syndrome than those who consumed breakfast regularly ($p < 0.05$).

Table 11 Characteristics of the participants stratified by breakfast consumption (n = 373)

Variables	Breakfast Eater [1] (n = 214) Number (%)	Breakfast Skipper[2] (n = 159) Number (%)	Total (n = 373) Number (%)	OR (95% CI)	*p*-value[3]
Sex					
Females	127 (59.3)	83 (52.2)	210 (56.3)	1.00	
Males	87 (40.7)	76 (47.8)	163 (43.7)	1.55 (1.00-2.39)	0.047
Age (years)					
30-39	36 (16.9)	42 (26.4)	78 (20.9)	1.00	
40-49	104 (48.6)	70 (44.0)	174 (46.6)	0.54 (0.31-0.97)	0.041
50-59	72 (33.6)	44 (27.7)	116 (31.1)	0.55 (0.29-1.02)	0.058
≥ 60	2 (0.9)	3 (1.9)	5 (1.4)	1.83 (0.28-11.82)	0.527
Mean ± SD	46.45 ± 8.13	47.16 ± 9.08	46.82 ± 8.64		
Marital status					
Single	41 (19.2)	25 (15.7)	66 (17.7)	1.00	
Couple	156 (72.9)	121 (76.1)	277 (74.3)	1.29 (0.71-2.33)	0.407
Divorce/separate	17 (7.9)	13 (8.2)	30 (8.0)	1.24 (0.49-3.18)	0.651
Education level					
High school and below	70 (32.7)	51 (32.1)	121 (32.4)	1.00	
Bachelor	109 (50.9)	77 (48.4)	186 (49.9)	1.01 (0.62-1.66)	0.967
Master and over	35 (16.4)	31 (19.5)	66 (17.7)	1.19 (0.63-2.26)	0.600

Table 11 Characteristics of the participants stratified by breakfast consumption (n = 373) (continued)

Variables	Breakfast Eater [1] (n = 214) Number (%)	Breakfast Skipper[2] (n = 159) Number (%)	Total (n = 373) Number (%)	OR (95% CI)	*p*-value[3]
Occupation					
Housewife/Retire	8 (3.3)	4 (2.5)	12 (3.0)	1.00	
Office worker	9 (4.2)	5 (3.2)	14 (3.8)	0.88 (0.16-4.61)	0.876
Employee	31 (14.5)	16 (10.1)	47 (12.6)	0.81 (0.20-3.28)	0.770
Government officer	167 (78.0)	133 (84.2)	300 (80.6)	1.07 (0.30-3.78)	0.922
Income					
1,000 or less	25 (11.7)	11 (6.9)	36 (9.6)	1.00	
10,001-20,000	83 (38.8)	52 (32.7)	135 (36.2)	1.11 (0.49-2.52)	0.137
20,001 or more	106 (49.5)	96 (60.4)	202 (54.2)	4.59 (1.58-13.34)	0.005
Cigarette smoking					
Non-smoker	195 (91.1)	135 (84.5)	330 (88.5)	1.00	
Current smoker	19 (8.9)	24 (15.5)	43 (11.5)	1.53 (0.78-3.02)	0.217
Alcohol consumption					
Non-drinker	164 (76.6)	101 (63.5)	265 (71.0)	1.00	
Current Drinker	50 (23.4)	58 (36.5)	108 (29.0)	2.56 (1.08-6.09)	0.033
Time spent for sleeping (hours/day)					
8 or more	116 (54.2)	81 (50.9)	197 (52.8)	1.00	
Less than 8	98 (45.8)	78 (49.1)	176 (47.2)	1.21 (0.78-1.89)	0.400

Table 11 Characteristics of the participants stratified by breakfast consumption (n = 373) (continued)

Variables	Breakfast Eater [1] (n = 214) Number (%)	Breakfast Skipper[2] (n = 159) Number (%)	Total (n = 373) Number (%)	OR (95% CI)	*p*-value[3]
Family history of HTN/DM/dyslipidemia					
No	62 (29.0)	56 (35.2)	118 (31.6)	1.00	
Yes	152 (71.0)	103 (64.8)	255 (68.4)	0.72 (0.45-1.15)	0.168
Body mass index (kg/m^2)					
< 23	99 (46.3)	60 (37.7)	159 (42.6)	1.00	
23-24.99	48 (22.4)	25 (15.7)	73 (19.6)	0.93 (0.51-1.67)	0.756
≥ 25	67 (31.3)	74 (46.6)	141 (37.8)	2.29 (1.40-3.73)	0.001
Exercise (days/week)					
3 or more	57 (26.6)	29 (18.2)	86 (23.1)	1.00	
Less than 3	157 (73.4)	130 (81.8)	287 (76.9)	1.56 (0.93-2.64)	0.095

[1] Breakfast eater = the participant who had breakfast every day;

[2] Breakfast skipper = the participant who skipped breakfast 1 or more days a week;

[3] *p*-value was based on multiple logistic regression.

Table 12 The dietary pattern of the participants stratified by breakfast consumption (n = 373)

Variables	Breakfast Eater [1] (n = 214) Number (%)	Breakfast Skipper[2] (n = 159) Number (%)	*p*-value[3]
Large meal			
Others	138 (64.5)	96 (60.4)	0.417
Dinner	76 (35.5)	63 (39.6)	
Meal-made pattern			
Home-made	99 (46.3)	78 (49.1)	0.710
Non home-made	94 (43.9)	69 (43.4)	
Both	21 (9.8)	12 (7.5)	
Time between dinner and bedtime (hours)			
≥ 4	117 (54.7)	72 (45.3)	0.073
< 4	97 (45.3)	87 (54.7)	
Time spent on each meal (minutes/meal)			
≥ 15	130 (60.7)	106 (66.7)	0.241
< 15	84 (39.3)	53 (33.3)	
Water intake (glasses/day)			
≥ 8	92 (43.0)	61 (38.4)	0.369
< 8	122 (57.0)	98 (61.6)	
Alcohol consumption (gram/day)			
none	164 (76.6)	101 (63.5)	0.038
< 15	8 (3.7)	6 (3.8)	
15-30	10 (4.7)	13 (8.2)	
> 30	32 (15.0)	39 (24.5)	
Bakery product intake (days/week)			
≤ 3	157 (73.4)	118 (74.2)	0.854
> 3	57 (26.6)	41 (25.8)	

Table 12 The dietary pattern of the participants stratified by breakfast consumption (n = 373) (continued)

Variable	Breakfast Eater [1] (n = 214) Number (%)	Breakfast Skipper[2] (n = 159) Number (%)	*p*-value[3]
Sugar-sweetened beverage (days/week)			
≤3	144 (67.3)	101 (63.5)	0.448
> 3	70 (32.7)	58 (36.5)	
Salty processed food (days/week)			
≤ 3	156 (72.9)	127 (79.9)	0.119
>3	58 (27.1)	32 (20.1)	
Snack intake (days/week)			
≤ 3	162 (75.7)	122 (76.7)	0.818
> 3	52 (24.3)	37 (23.3)	
Fried food (days/week)			
≤ 3	125 (58.4)	92 (57.9)	0.915
> 3	89 (41.6)	67 (42.1)	
Semi-instant food (days/week)			
≤ 3	173 (80.8)	127 (79.9)	0.816
> 3	41 (19.2)	32 (20.1)	
Low-fat milk (days/week)			
> 3	84 (39.3)	54 (37.8)	0.503
≤ 3	130 (60.7)	102 (64.2)	
Whole grain (days/week)			
> 3	152 (71.0)	98 (61.6)	0.056
≤ 3	62 (29.0)	61 (38.4)	

[1] Breakfast eater = the participant who had breakfast every day;
[2] Breakfast skipper = the participant who skipped breakfast 1 or more days a week;
[3] *p*-value was based on Chi-square test.

Table 13 The total daily energy intake and distribution of calories from carbohydrate, protein and fat classified by breakfast frequency (n*=343)

Variables[1]	Daily eating[2] (n = 200) mean ± SD	Partial skipping[3] (n = 103) mean ± SD	Absolute skipping[4] (n = 40) mean ± SD	*p*-value[5]
Total daily energy (kcal)	1307.28 ± 392.27	1211.46 ± 420.52	1281.43 ± 484.54	0.160
Carbohydrate				
grams/day	171.31 ± 58.03[a]	1 49.79 ± 55.86[b]	172.55 ± 75.09[a]	0.009
% of total calories	52.70 ± 10.19	50.17 ± 11.23	54.23 ± 12.75	0.067
Protein				
grams/day	58.61 ± 26.24	54.19 ± 23.85	53.90 ± 27.37	0.280
% of total calories	18.15 ± 6.69	18.08 ± 5.47	16.86 ± 5.77	0.005
Fat				
grams/day	43.18 ± 19.38	43.49 ± 22.48	39.94 ± 23.020	0.058
% of total calories	29.26 ± 8.30	31.38 ± 9.28	27.89 ± 11.32	0.467
Breakfast energy (kcal)	381.29 ± 180.01[a]	310.41 ± 205.76[b]	0[c]	0.002
Breakfast[6] (%)	29.73 ± 13.61[a]	25.76 ± 18.47[a]	0[b]	0.035

[1]Data were expressed as mean ± standard deviation (SD). [2]Daily eating = breakfast eaters; [3] Partial skipping = irregular breakfast eaters (having breakfast 1-6 days a week); [4]Absolute skipping = daily skippers; [5]*p*-value was based on one way ANOVA compared with daily breakfast eater. [6]Breakfast (%) = ratio of breakfast energy to total daily energy intake; n = number; n*= The data of 30 participants were excluded because of incomplete data.

[a, b, c] The different letters in the same rows indicate statistically significant difference.

Table 14 The prevalence of each component in the metabolic syndrome classified by breakfast frequency (n = 373)

Metabolic syndrome components	Breakfast frequency				
	Daily eating[2] (n = 214) Number (%)	Partial skipping[2] (n = 113) Number (%)	*p*-value[4]	Absolute skipping[3] (n = 46) Number (%)	*p*-value[5]
Waist circumference (cm.)					
Male ≥ 90,Female ≥ 80	68 (31.8)	41 (36.3)	0.411	21 (45.7)	0.072
Male < 90, Female < 80	146 (68.2)	72 (63.7)		25 (54.3)	
Triglyceride level					
≥ 150 mg/dl	66 (30.8)	41 (36.3)	0.319	28 (60.9)	< 0.001
< 150 mg/dl	148 (69.2)	72 (63.7)		18 (39.1)	
Fasting blood glucose					
≥ 100 mg/dl	42 (19.6)	27 (23.9)	0.368	16 (34.8)	0.025
< 100 mg/dl	172 (80.4)	86 (76.1)		30 (65.2)	
High-density cholesterol					
Male < 40, Female <50	37 (17.3)	29 (25.7)	0.073	19 (41.3)	< 0.001
Male ≥ 40, Female ≥ 50	177 (82.7)	84 (74.3)		27 (58.7)	
Blood pressure					
≥ 130/85 mmHg	102 (47.7)	56 (49.6)	0.744	29 (63.0)	0.058
< 130/85 mmHg	112 (52.3)	57 (50.4)		17 (37.0)	

n = number
[1]Daily eating = breakfast eaters;
[2] Partial skipping = irregular breakfast eaters (having breakfast 1-6 days a week);
[3]Absolute skipping = daily skippers
[4]*p*-value was from chi-square test between daily breakfast eater and irregular breakfast eater.
[5]*p*-value was from chi-square test between daily breakfast eater and daily skippers.

Table 15 Components of metabolic syndrome classified by frequency of breakfast consumption (n = 373)

Variables[1]	Breakfast frequency			*p*-value[5]
	Daily eating[2] (n = 214)	Partial skipping[3] (n = 113)	Absolute skipping[4] (n = 46)	
Waist circumference (cm)	80.40 ± 9.09[a]	81.12 ± 8.63[a]	85.95 ± 10.20[b]	< 0.001
Male	84.90 ± 8.95	83.73 ± 6.61	86.52 ± 12.49	0.366
Female	77.31 ± 7.84[a]	79.19 ± 9.45[a]	85.05 ± 12.49[b]	0.002
Fasting plasma glucose (mg/dL)	93.99 ± 15.79	97.22 ± 30.92	96.65 ± 15.83	0.080
Triglycerides (mg/dL)	131.91 ± 87.72[a]	156.79 ± 120.89[b]	190.30 ± 107.23[c]	< 0.001
HDL-C (mg/dL)	56.07 ± 14.19[a]	55.16 ± 13.77[a]	49.63 ± 14.69[b]	0.020
Male	51.64 ± 15.22	51.54 ± 13.26	46.75 ± 14.16	0.307
Female	59.09 ± 12.63	57.83 ± 13.64	54.11 ± 14.76	0.274
Blood pressure (mmHg)				
Systolic	125.95 ± 17.97	127.41 ± 18.58	130.59 ± 15.02	0.266
Diastolic	80.86 ± 12.18	82.25 ± 11.15	83.63 ± 12.67	0.288
Body mass index (kg/m^2)	23.82 ± 3.75[a]	24.45 ± 4.00[a]	26.40 ± 5.72[b]	< 0.001
Weight (kg)	62.12 ± 11.89[a]	64.31 ± 11.96[a]	71.04 ± 13.80[b]	< 0.001

n= number; [1]Data were expressed as mean ± standard deviation (SD).

[2]Daily eating = breakfast eaters; [3] Partial skipping = irregular breakfast eaters (having breakfast 1-6 days a week);

[4]Absolute skipping = daily skippers; [5]*p*-value was based on one way ANOVA compared with daily breakfast eater.

[a, b, c] The different letters in the same rows indicate statistically significant difference.

Table 16 Odds Ratios (OR) for metabolic abnormalities classified by breakfast frequency (n = 373)

Metabolic abnormalities	Daily eating[1] (n = 214)	Partial skipping[2] (n = 113)		Absolute skipping[3] (n = 46)	
		OR	95%CI	OR	95%CI
Abdominal obesity					
M > 90 cm, F > 80 cm	1.00	1.49	(0.90-2.47)	2.58	(1.28-5.23)*
Hypertriglyceridemia					
≥ 150 mg/dl	1.00	1.42	(0.84-2.40)	3.43	(1.68-6.99)**
Low HDL cholesterol					
M < 40, F < 50 mg/dl	1.00	1.73	(0.98-3.04)	4.24	(2.05-8.75)**
Elevated blood pressure					
≥ 130/85 mm Hg	1.00	1.27	(0.77-2.11)	1.76	(0.86-3.59)
High fasting blood glucose					
≥ 100 mg /dl	1.00	1.77	(0.96-3.25)	2.66	(1.23-5.74)*
Metabolic syndrome					
3 or more risks	1.00	2.49	(1.40-4.24)*	7.49	(3.56-15.76)**

All logistic models were adjusted for age, gender, education, and physical activity.
[1]Daily eating = breakfast eaters; [2] Partial skipping = irregular breakfast eaters (having breakfast 1-6 days a week);
[3]Absolute skipping = daily skippers; **p*-value < 0.05; ***p*-value < 0.001

Table 17 Age-, gender-, marital status-, medicine use- and body mass index- adjusted odds ratio and 95% confidence intervals for metabolic syndrome classified by the modified NCEP ATP III and the IDF criteria by multiple logistic regression analysis (n = 373)

criteria	Breakfast frequency			
	Daily eating[1]	Partial skipping[2]	Absolute skipping[3]	Total
	(n = 214)	(n = 113)	(n = 46)	(n = 373)
NCEP ATP III				
Prevalence (%)	20.6	31.9	56.5	28.4
Adjusted OR	1.00	2.16*	5.50**	
95% CI		1.14-4.11	2.34-12.92	
IDF criteria				
Prevalence (%)	16.8	24.8	43.5	22.5
Adjusted OR	1.00	1.90	4.47*	
95% CI		0.86-3.80	1.66-12.04	

[1]Daily eating = breakfast eaters;
[2] Partial skipping = irregular breakfast eaters (having breakfast 1-6 days a week);
[3]Absolute skipping = daily skippers
*p-value < 0.05; **p-value < 0.001

4.5 Estimation of metabolic syndrome by some risk factors

A stepwise multiple regression analysis for the prediction of metabolic syndrome using variables revealed that frequencies of skipping breakfast and low-fat milk intake ≤ 3 days per week were positively significantly associated with metabolic syndrome (Tables 18 and 19). These variables were taken into the equation for prediction of the metabolic syndrome. The accuracy of prediction of this equation was 86.1% for the modified NCEP ATP III and 91.9% for the IDF criteria.

Table 18 The risk variables of metabolic syndrome according to the modified NCEP ATP III criteria after adjustment of age, gender, and body mass index.

Variables	β	S.E.	wald	df	Sig	Exp. (β)
Skipped breakfast ≥1day a week	1.229	0.39	9.913	1	0.002	3.42
Low-fat milk intake ≤ 3 days /week	1.004	0.41	5.918	1	0.015	2.73
constant of the equation	-13.849	2.16	41.19	1	0.001	

$$\text{Probability of metabolic syndrome} = \frac{1}{1+ e^{-(\beta_0 + \beta_1 X_1 \ \ldots + \beta_p X_p)}}$$ (Vanitbuncha, 2000)

While β_0 = constant of the equation

β_I ; i = 1,2,…,p = coefficients of the predictive variables

X = predictive variable

In this study, the metabolic syndrome was classified by the modified NCEP ATP III. The participants who skipped breakfast and consumed low-fat milk ≤ 3 days/week had 3.417 and 2.730 times respectively greater risk of developing metabolic syndrome.

Log (odds ratio) = -13.849 + 1.229 (skip (1)) + 1.004 (Low-fat milk (1))

$$\text{Probability of metabolic syndrome} = \frac{1}{1+ e^{- (-13.849+1.229 X_1 +1.004X_2)}}$$

While X_1 = frequency of skipping breakfast

(0 = 7 days a week, 1 = skip ≥ 1 days a week)

X_2 = frequency of low-fat milk intake

(0 = > 3 days a week, 1 = ≤ 3 days a week)

Table 19 The risk variables of metabolic syndrome according to the IDF criteria after adjustment of age, gender, and body mass index

Variables	β	S.E.	wald	df	Sig	Exp. (β)
Skipped breakfast ≥1day a week	1.215	0.478	6.460	1	0.011	3.37
Low-fat milk intake ≤ 3 days /week	1.248	0.510	5.977	1	0.014	3.48
constant of the equation	-17.244	2.486	48.11	1	0.001	

In this study, the metabolic syndrome was classified by the IDF criteria. The participants who skipped breakfast and consumed low-fat milk ≤ 3 days/week had 3.370 and 3.483 times respectively greater risk of developing metabolic syndrome.

Log (odds ratio) = - 17.244 + 1.215(skip (1)) + 1.248 (Low-fat milk (1))

$$\text{Probability of metabolic syndrome} = \frac{1}{1+ e^{- (-17.244+1.215 X_1 +1.248 X_2}}$$

While X_1 = frequency of skipping breakfast

(0 = 7 days a week, 1 = skip ≥ 1 days a week)

X_2 = frequency of low-fat milk intake

(0 = > 3 days a week, 1 = ≤ 3 days a week)

CHAPTER V

DISCUSSION

5.1 Characteristics of the participants and prevalence of metabolic syndrome

The present study investigated the metabolic syndrome in the working age population who visited the health check-up at Phaholpolpayuhasaena Hospital during December, 2011 through February, 2012. It was found that most of the participants with metabolic syndrome were males aged between 50-59 years, current smokers, and obese. These characteristics and prevalence were similar to the previous studies. Lohsoonthorn et al. (2007) studied in professional and office workers in Bangkok, Tangpong et al. (2008) studied in 304 persons of Walailak University, and Ho et al. (2011) studied in Taiwanese hospital employees. These investigators found that most of the participants with metabolic syndrome were males and older than those without metabolic syndrome. Lőpez Suărez et al. (2008) and Martinez et al. (2008) showed that the participants with metabolic syndrome were 50 years and older, and they were smokers. Wang et al. (2010) showed that the participants with metabolic syndrome were older and more likely to smoke tobacco than those without metabolic syndrome.

The prevalence of metabolic syndrome increased accordingly with age. These characteristics and prevalence were similar to those found in the previous studies. The results from the studies of Panagiotakos et al. (2007) in 3,042 Greek adults aged 18-89 years and Tangpong et al. (2008) in walailak university personnels suggested that older persons had higher prevalence of metabolic syndrome than younger persons. Kaewtrakulpong (2008) who studied in 1,004 persons in Nong Khai

Province also showed that older females had higher prevalence of metabolic syndrome than younger females.

Risk factors for metabolic syndrome in the present study were female, 50-59 years of age, obesity (BMI $\geq$ 25 kg/m^2), and infrequent exercise. These findings agreed with the previous studies. Studies by Santibhavank (2007) and Wang et al. (2010) indicated that the persons with older age were associated with a greater risk of metabolic syndrome for women, but not for men. Moreover, Miller and Mitchell (2006) found that older age, inactive lifestyle and obesity were important risk factors of metabolic syndrome.

Kannel and Wilson (1995) found that the prevalence of metabolic syndrome increased with age especially while passing from pre- to post-menopausal state. It was found that features of metabolic syndrome in women appeared to exacerbate with estrogen deficiency (Carr, 2003). Ebrahimpour et al. (2010) found that the metabolic syndrome exacerbated with the decrease in estrogen level through menopause. They concluded that elderly women were particularly at high risk for developing metabolic syndrome. Therefore, consideration of early prevention and therapy in this specific group is of great importance.

The present study found that the population in Kanchanaburi Province had high prevalences of hypertension, large waist circumference, and elevated triglyceride levels. There were similar to the previous studies. Lohsoonthorn et al. (2007) found that the most common health problem in the professional and office workers was hypertension. Chongsuvivatwong et al. (2008) found that the individuals in Bangkok and central provinces had hypertension, central obesity and high

triglyceride levels. Moreover, in Asian population, hypertension was found to be a common metabolic abnormality (Alexander et al., 2003; Tan et al., 2004).

5.2 Dietary pattern and metabolic syndrome

In the present study, the results indicated that three risk factors were significantly associated with metabolic syndrome. These risk factors were frequent breakfast skipping, low consumption of low-fat milk, and high sugar-sweetened beverage intake. The skipping breakfast was found to be one of the interesting risk factors for metabolic syndrome in this study. This result was consistent with the previous studies. Sakata et al. (2001) found that frequent breakfast skipping was related to cardiovascular disease risk factors such as high blood pressure and high serum total cholesterol. In addition, Farshchi et al. (2005) suggested that breakfast skipping might impair fasting lipid and postprandial insulin sensitivity, and the prolonged fasting state may lead to increased fat storage and weight gain. Frequent breakfast skipping was positively associated with chronic diseases such as type 2 diabetes and cardiovascular disease (Newby et al., 2004; Song et al., 2005; van der Heijden et al., 2007; Timlin and Pereira, 2007). Skipping breakfast was related to increased visceral fat (Alexander et al., 2009). Recently, Smith et al. (2010) studied population aged between 26-35 years by following them for 2 years. They found that the participants who skipped breakfast had larger waist circumference, higher BMI, fasting insulin, total cholesterol, and LDL-cholesterol concentrations than those who ate breakfast regularly. Therefore, skipping breakfast over a long period may have effect on cardiometabolic health.

Low-fat milk intake three days or less a week appeared to be a risk factor for metabolic syndrome in this study. This agreed with the previous studies.

Brooks et al. (2006) and Gonzalez et al. (2006) found that adequate dairy/calcium consumption in conjunction with controlled/reduced calories intake were associated with weight regulation. With high intake of calcium, calcium entering into the cells was reduced by decreasing concentrations of 1, 25-dihydroxyvitamin D. This inhibits fatty acid synthesis and stimulates lipolytic activity. Davies et al. (2000) showed that higher intake of low-fat dairy products was associated with lower gain in body weight and reductions in waist circumference, percentages of truncal fat and total body fat. Choi et al. (2005) found that daily consumption of low-fat milk was associated with 12% lower risk to develop type 2 diabetes. van Meijl and Mensink (2011) demonstrated that systolic blood pressure was decreased after drinking low-fat milk for 8 weeks. Moreover, Pereira et al. (2002) reported that dairy consumption was beneficial in reducing the risk of the metabolic syndrome.

This study found that drinking sugar-sweetened beverage more than three days a week was a risk factor of metabolic syndrome. This result was similar to the previous studies. Ludwig, Peterson, and Gortmaker (2001) found that sugar-sweetened beverage have been linked to dental caries, increased energy intake, weight gain, and type 2 diabetes. Moreover, soft drink consumption was associated with higher prevalence and incidence of multiple metabolic risk factors in middle-age (Dhingra et al., 2007). Malik et al. (2010) showed that the participants who consumed sugar-sweetened beverages 1-2 servings/day had 26 % greater risk of developing type 2diabetes than those who consumed sugar-sweetened beverages less than one serving/month or did not. In addition, it was reported that higher consumption of sugar-sweetened beverage was significantly associated with development of metabolic syndrome. de Koning et al. (2012) demonstrated that males aged 40-75

years who consumed sugar-sweetened beverages had increased risk of coronary heart disease and some adverse changes in lipids, inflammatory factors, and leptin.

5.3 Breakfast and metabolic syndrome

Most of the breakfast eaters were females, aged 40-49 years and normal BMI. They exercise regularly and sleep more than 8 hours a day. They were non-smoker and non-drinker. These characteristics were consistent with the previous studies. Song et al. (2005) found that breakfast consumers were significantly older female, and non-smoker, and they exercised, and tried to control weight, compare to breakfast non-consumers. Timlin et al. (2008) found that daily breakfast eaters were much more physically active than breakfast skippers. Moreover, regular breakfast eaters had lower mortality rates and trended to have lower BMI and less weight re-gain following weight loss (Merten, Williams, and Shriver 2009). Therefore, regular breakfast consumption was one of the strategies used for successful long-term weight maintenance (Wing and Phelan, 2005). Regular breakfast consumption can lead to increased satiety and reduced energy intake. Therefore, individuals who consume breakfast regularly may be at reduced risk for chronic diseases, particularly if the breakfast meal includes whole-grain products (Timlin and Pereira, 2007).

In this study, the important characteristics of the skipping breakfast group included males, age of 30-39 years, obesity, health-compromising behaviors such as smoking, physical inactivity, drinking alcohol, and poor sleeping. These results were similar to the previous studies. Skipping breakfast was relatively common among men (Shigeta et al., 2001). Skipping breakfast was associated with male, lack of exercise, smoking, poor sleeping, high BMI, high blood pressure, and high serum total cholesterol level. These were related to cardiovascular risk factors

(Sakata et al. 2001; Keski-Rahkonen et al., 2003; Kaneita et al. 2006 and Smith et al., 2010). In addition, Shigeta et al. (2001) found that skipping breakfast and insufficient sleep (< 6 hours) were associated with obesity and insulin resistance. The individuals with short sleeping times tended to have behavior of eating more, which can lead to obesity (Nishitani, Sakakibara, and Akiyama, 2006). Nishiyama et al. (1999) found that the combination of skipping breakfast and smoking was associated with the prevalence of diabetes. Smoking was common among breakfast skippers. It might suppress appetite in the morning, or interfere with the time allotted for breakfast. In addition, increased frequency of breakfast skipping was associated with increased smoking and decreased frequency of exercise (Keski-Rahkonen et al., 2003).

Berg et al. (2009) found that the omission of breakfast was likely to be compensated for overeating later in the day among obese people, thus they concluded that omitting breakfast was significantly associated with obesity. Frequent breakfast skipping was positively associated with weight gain and the risk of obesity (Newby et al., 2004; Song et al., 2005; van der Heijden et al., 2007). In addition, Serra-Majem et al. (2001) found that the individuals who skipped breakfast appeared to be at high risk for weight gain through these unhealthy eating habits. Increased snacking, lunch skipping, sedentary lifestyle, and obesity had been found to be more common in breakfast skippers than in breakfast eaters.

After potential confounders were adjusted, the present study showed that males were more likely to skip breakfast than females. In addition, income more than 20,001 baht, current alcohol drinking and obesity were significantly associated with skipping breakfast. Several studies found that the most common reasons given

for skipping were no time and no being hungry, while less common reason included being on a diet to lose weight (Singleton and Rhoads, 1982).

This study found the association between skipping breakfast with high alcoholic intake. Valencia-Martín, Galán, and Rodríguez-Artalejo (2011) showed that excessive drinkers (40 g alcohol/d in men and 24 g/d in women) were more likely to skip a meal, especially breakfast. It was consistent with the previous studies which revealed that more frequent alcohol use, infrequent exercise, and higher BMI were associated with breakfast skipping (Sakata et al., 2001 and Keski-Rahkonen et al., 2003). Skipping breakfast and alcohol consumption were associated with overweight and obesity (Croezen et al., 2009).

The present study showed that the participants who did not eat breakfast had dyslipidemia (including high triglyceride and low HDL-C levels), obesity, and weight gain. These characteristics were similar to those found in the previous studies. Ma et al. (2003) found that individuals who skipped breakfast at least once per week had 4.5 times increased risk of developing obesity. Moreover, increased frequency of breakfast skipping resulted in raised prevalence of obesity (Fujiwara, 2003; Ma et al., 2003; Huang et al., 2010). Timlin and Pereira (2007) found that frequency of breakfast was inversely associated with body weight and obesity.

The results of this study showed that the energy intake from breakfast was approximately 381.29 kcal or 29.73 % of total calories. Cotton et al. (1994) found that consumption of an energy-rich breakfast led to greater daily energy intake indicating that compensatory during subsequent meals did not occur. An increasing percentage of breakfast energy was associated with lower weight gain (Purslow et al.,

2008). However, the regular consumption of breakfast providing about 15-20 % of the daily caloric intake was associated with a reduced risk of developing obesity, cardiovascular events and diabetes (Marangoni et al., 2009).

In the present study, percentages of protein calories of daily eating, partial skipping and absolute skipping were 18.15, 18.08, and 16.86 respectively which were higher than the recommended range (10-15%). One study reported that the amount of normal-protein diet might not be associated with weight loss (Moran et al., 2003). Skov et al. (1999) revealed that after 6-months diets treatment, diets containing fat of 30% of total calories and diet high in protein (25% of total calories) could produce greater weight loss than diet with the recommended amount of protein (12% of total calories). Moreover, after 1 year of follow up, the high protein diet could reduce visceral fat. Westerterp-Plantenga et al. (2009) found that a high-protein diet led to a greater reduction in total energy intake, body weight, fat mass and preservation of lean body mass compared with a normal-protein diet. Johnston, Day, and Swan (2002) suggested that high protein intake could contribute to the efficacy of weight loss. In addition, Morenga et al. (2010) showed that a high protein diet was associated with greater fat loss and lower blood pressure when compared with a high carbohydrate, high fiber diet in high risk overweight and obese women. However, Mirmiran et al. (2012) found that high protein intake was associated with enhanced waist circumference and increased diastolic blood pressure.

Lejeune et al. (2006) showed that high protein intake led to acute or long-term alterations in perceived appetite, satiety and the appetite-regulating hormones ghrelin and peptide YY. The timing of protein consumption also appeared to influence its satiating property. Dietary protein consumed at breakfast led to greater

initial and sustained feelings of fullness compared with when it was consumed at lunch or dinner (Leidy et al., 2009). Protein is the most important macronutrient mediating satiety and leads to increased weight loss with retention of lean body mass. Therefore, the satiating effect of a high protein diet could be a key factor in weight loss and weight maintenance (Soenen and Plantenga, 2008).

The present study illustrated that there were seven potential risk factors. Two modifiable risk factors are gender-female and increased age. Behaviors related to the risk of acquiring metabolic syndrome included infrequent exercise, obesity, and skipping breakfast, low amount of low-fat milk intake and high consumption of sugar-sweetened beverages. After adjustment for age, gender, and body mass index, it was found that eating breakfast and low-fat milk consumption were independently associated with metabolic syndrome.

In aspect of breakfast skipping, this study showed that most of participants who skipped breakfast were males, young and obese. In addition, consuming alcohol was significantly associated with skipping breakfast. Increased triglycerides and decreased HDL-C were associated with daily skipping breakfast. Moreover, the frequency of breakfast consumption was inversely associated with metabolic syndrome and its components. In summary, gender, advanced age, infrequent exercise, obesity, and dietary pattern were the important factors that have a role in increasing or decreasing the risk of metabolic syndrome. Daily breakfast consumption and avoiding alcohol may reduce the risk of developing metabolic syndrome.

CHAPTER VI

CONCLUSION

This research was a cross-sectional study that determined the prevalence of metabolic syndrome and the relationship between breakfast consumption and metabolic syndrome in work-age population in Kanchanaburi Province. There were 373 participants (163 males and 210 females) enrolled in this study. The data were collected from blood pressure measurement, anthropometric evaluation, biochemical test, and questionnaires. The results showed that the prevalence of metabolic syndrome defined by the modified NCEP ATP III criteria, with the modified waist circumference cut off points for an Asian population, was 28.4% and by the IDF criteria was 22.5%. The analysis by the multiple logistic regression indicated that gender-female, 50-59 years of age, physical inactivity, and obesity were associated with metabolic syndrome. In addition, dietary pattern including skipping breakfast, consuming low-fat milk three days or less per week, and sugar-sweetened beverage more than three days a week were significantly high risk of developing metabolic syndrome. This study also showed that the frequency of breakfast was inversely associated with metabolic syndrome and its components. More effort should be given to promote a healthy lifestyle and dietary pattern for reducing risk of metabolic syndrome.

Recommendation for further research

This is the first study examining the relationships between breakfast consumption and metabolic syndrome in working age group. The only significant

breakfast pattern found in this study was skipping breakfast. The further study should explore other aspects of breakfast pattern such as type, quality and quantity of breakfast, and the duration of skipping breakfast. In addition, the relationships between metabolic syndrome and breakfast skipping in combination with other risk factors should be examined. The longitudinal observation may be conducted. Moreover, the intervention study is needed to evaluate the possibility of an important causal link between breakfast consumption and risk for metabolic syndrome, as well as for implementing generalized community based programs.

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APPENDICES

Appendix A

Questionnaire

แบบสอบถาม

โครงการวิจัยเรื่อง "ความสัมพันธ์ระหว่างการบริโภคอาหารเช้าและกลุ่มอาการ เมแทบอลิก ของประชากรวัยทำงานในจังหวัดกาญจนบุรี"

คำชี้แจง

โครงการวิจัยนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ระดับปริญญาโท ภาควิชาอาหารและเภสัชเคมี คณะเภสัชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โดยมีการเก็บข้อมูลผลการตรวจสุขภาพ และข้อมูลเกี่ยวกับแบบแผนการบริโภคอาหารของผู้ที่เข้ารับการตรวจสุขภาพจากโรงพยาบาลพหลพลพยุหเสนา ท่านเป็นผู้หนึ่งที่ได้รับคัดเลือกให้เป็นกลุ่มตัวอย่างของงานวิจัยในครั้งนี้ ผู้วิจัยจึงขอความกรุณาจากท่าน…

1. ลงนามแสดงความยินยอมใน "<u>ใบยินยอมด้วยความสมัครใจ</u>" เพื่อให้ผู้วิจัยสามารถนำผลการตรวจสุขภาพของท่าน (ผลการตรวจร่างกาย ผลการตรวจเลือด และข้อมูลต่างๆ ที่ ได้จากการตอบแบบสอบถาม) มาใช้วิเคราะห์ในโครงการวิจัยนี้
2. ขอให้ท่านตอบแบบสอบถาม โดยโปรดตอบให้ครบทุกข้อตามความเป็นจริง แบบสอบถามนี้ ประกอบด้วย 4 ส่วน ใช้เวลาประมาณ 20-30 นาที ได้แก่

   <u>ส่วนที่ 1</u> ข้อมูลทั่วไป มี 16 ข้อ

   <u>ส่วนที่ 2</u> ข้อมูลแบบแผนการบริโภคอาหาร มี 6 ข้อ

   <u>ส่วนที่ 3</u> แบบบันทึกความถี่ในการบริโภคอาหาร มี 13 ข้อ

   <u>ส่วนที่ 4</u> แบบบันทึกการบริโภคอาหารย้อนหลัง 24 ชั่วโมง

ทั้งนี้ ผลการตรวจสุขภาพของท่าน ผู้วิจัยจะติดตามจากโรงพยาบาลพหลพลพยุหเสนาด้วยตนเอง ผู้วิจัยขอรับรองว่าข้อมูลของท่านจะถูกเก็บเป็นความลับ และจะนำเสนอผลการวิจัยในลักษณะภาพรวมเท่านั้น ผู้วิจัยขอขอบคุณทุกท่านที่ให้ความร่วมมือมา ณ โอกาสนี้

เภสัชกรหญิง มยุรา กาญจนานุรักษ์
นิสิตปริญญาโท ภาควิชาอาหารและเภสัชเคมี
คณะเภสัชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ส่วนที่ 1 ข้อมูลทั่วไป

คำชี้แจง โปรดใส่เครื่องหมาย ✓ ลงในช่อง □ หรือเติมข้อความลงในช่องว่าง

1. เพศ

□ 1) ชาย □ 2) หญิง

2. อายุ..... ปี

3. สถานภาพสมรส

□ 1) โสด □ 2) คู่/สมรส □ 3) หย่า/แยก/หม้าย

4. ระดับการศึกษา

□ 1) ไม่ได้เรียนหนังสือ □ 2) ประถมศึกษา □ 3) มัธยมต้น/ปวช.

□ 4) มัธยมปลาย/ปวส. □ 5) ปริญญาตรี □ 6) สูงกว่าปริญญาตรี

□ 7) อื่นๆ ระบุ .....

5. อาชีพ

□ 1) ข้าราชการ/พนักงานรัฐวิสาหกิจ □ 2) พนักงานบริษัท □ 3) ลูกจ้าง

□ 4) แม่บ้าน/เกษียณ □ 5) ธุรกิจส่วนตัว/ค้าขาย

□ 6) อื่นๆ ระบุ.....

6. รายได้เฉลี่ยต่อเดือน .....บาท

7. ปกติท่าน นอนหลับ พักผ่อน เวลา ..... ตื่นนอนเวลา .....

8. โดยปกติ ท่านออกกำลังกายหรือไม่

□ 1) ไม่ได้ออกกำลังกาย

□ 2) ออกกำลังกายน้อยกว่าสัปดาห์ละ 3 ครั้ง

□ 3) ออกกำลังกายสัปดาห์ละ 3 ครั้งๆละ.....นาที

□ 4) ออกกำลังกายมากกว่าสัปดาห์ละ 3 ครั้งๆละ.....นาที

9. โดยปกติ การทำงานของท่านมี อิริยาบถส่วนใหญ่ เป็นแบบใด

□ 1) นั่งหรือยืน อาจเดินบ้างแต่ไม่เกินครั้งละ 10 นาที

□ 2) ออกแรงปานกลาง (ออกแรงจนหายใจเร็วขึ้น เหนื่อยเล็กน้อย) ตั้งแต่ครั้งละ 10 นาที ขึ้นไปเช่นเดินไปเดินมาในที่ทำงาน ทำครัว ถือของเบาๆ

□ 3) ใช้กำลังมาก หรือยกสิ่งของที่มีน้ำหนักมาก ตั้งแต่ครั้งละ 10 นาทีขึ้นไป เช่น งานก่อสร้าง ขุดดิน ทำนา สวน ไร่

□ 4) ไม่ได้ทำงาน

10. โดยปกติ ท่านเดินทางไปทำงาน ไปธุระนอกบ้าน ด้วยวิธีใด

☐ 1) นั่งรถยนต์ อาจเดินบ้าง แต่ไม่เกินครั้งละ 10 นาที

☐ 2) เดินเท้าหรือขี่จักรยานอย่างต่อเนื่องเป็นเวลาตั้งแต่ 10 นาทีขึ้นไป สัปดาห์ละ……วัน

11. ท่านสูบบุหรี่ หรือไม่

☐ 1) ไม่เคยสูบ

☐ 2) เคยสูบจำนวน…....มวนต่อวัน แต่เลิกแล้ว

☐ 3) สูบ จำนวน…....มวนต่อวัน

12. ท่านดื่มเครื่องดื่มแอลกอฮอล์ หรือไม่

☐ 1) ไม่ดื่ม

☐ 2) ดื่มแอลกอฮอล์ –ชนิดใดบ้าง

☐ 2.1) เบียร์ วันละ …..…… กระป๋อง (360 ซีซี)

☐ 2.2) สุรา วันละ …..…… เป็ก (45 ซีซี)

☐ 2.3) ไวน์ วันละ …..…… แก้ว (150 ซีซี)

3) ดื่มเครื่องดื่มแอลกอฮอล์ บ่อยแค่ไหน

☐ กินทุกวัน ☐ 5-6 วัน ☐ 3-4 วัน ☐ 1-2 วัน ☐ 1-2 ครั้ง/เดือน

13. ท่านดื่มน้ำเปล่าวันละ……..แก้ว (1 แก้ว = 250 ซีซี)

14. โดยปกติ การรับประทานอาหารของท่านเป็นแบบใด (ตอบได้มากกว่า 1 ข้อ)

☐ 1) มักรับประทานอาหารซ้ำๆ กันทุกวัน

☐ 2) รับประทานอาหารมื้อเย็นห่างจากเวลานอน <u>น้อยกว่า</u> 4 ชั่วโมง

☐ 3) ใช้เวลาในการรับประทานอาหารแต่ละมื้อ <u>น้อยกว่า</u> 15 นาที

☐ 4) อื่นๆ ระบุ ……..

15. ปัจจุบันท่านรับประทานยารักษาโรคใดบ้าง

☐ 1) ไม่มี ☐ 2) โรคเบาหวาน ☐ 3) โรคไขมันในเลือดสูง

☐ 4) โรคความดันโลหิตสูง ☐ 5) โรคหัวใจ ☐ 6) โรคอื่นๆ ระบุ.....

16. ท่านมีญาติสายตรงเป็นโรคต่อไปนี้หรือไม่ โปรดระบุว่าเป็นใคร

	พ่อแม่	พี่น้อง	ปู่ย่า	ตายาย
☐ 1) ไม่มี				
☐ 2) โรคความดันโลหิตสูง				
☐ 3) โรคเบาหวาน				
☐ 4) โรคไขมันในเลือดสูง				

☐ 5) อื่นๆ ระบุ.....

<u>ส่วนที่ 2</u> ข้อมูลแบบแผนการบริโภคอาหารเช้า

<u>คำชี้แจง</u> โปรดใส่เครื่องหมาย ✓ ลงในช่อง ☐ หรือเติมข้อความลงในช่องว่าง

17. ปกติใน 1 สัปดาห์ ท่านรับประทานอาหารมื้อเช้ากี่วัน ?

☐ ไม่เคยรับประทาน ☐ 1 วัน ☐ 2 วัน ☐ 3 วัน ☐ 4 วัน ☐ 5 วัน ☐ 6 วัน ☐ 7 วัน

18. สาเหตุที่ไม่เคยรับประทานอาหารเช้า หรือทานน้อยกว่า 3 วัน เพราะ (ตอบมากกว่า 1 ข้อ)

☐ 1) ไม่หิว

☐ 2) ตื่นสาย

☐ 3) ไม่มีเวลารับประทานหรือเตรียมอาหาร

☐ 4) ต้องการลดความอ้วน

☐ 5) ตื่นมารับประทานอาหารมื้อดึกแล้ว

☐ 6) หลังรับประทานอาหารมื้อเช้าแล้วเกิดอาการ ปวดท้อง คลื่นไส้ อาเจียน หรือ ท้องเสีย

☐ 7) อื่นๆระบุ……

19. ปกติท่านรับประทานอาหารมื้อใด ใน<u>ปริมาณมากที่สุด</u> (ตอบได้มากกว่า 1 ข้อ)

☐ 1) มื้อเช้า (5:00-9:00 น.)

☐ 2) มื้อกลางวัน (ประมาณ 12:00-13:00 น.)

☐ 3) มื้อเย็น (ประมาณ 17:00-20:30 น.)

☐ 4) มื้อดึก (ประมาณ 21:00-23:00 น.)

☐ 5) มื้ออื่นๆ ระบุ ……เวลาประมาณ…….น.

20. ถ้าท่าน <u>*ไม่*</u> รับประทานอาหารมื้อเช้า ท่านจะมีอาการอย่างไรบ้าง (ตอบมากกว่า 1 ข้อ)

☐ 1) ไม่มีอาการอะไรผิดปกติ ☐ 2) ปวดศีรษะ หงุดหงิดง่าย

☐ 3) ไม่มีสมาธิในการทำงาน หรือ ความจำไม่ดี ☐ 4) ปวดท้อง คลื่นไส้-อาเจียน

☐ 5) ท้องผูก อุจจาระแข็ง ☐ 6) รู้สึกหิวเร็วขึ้น

☐ 7) กินจุบจิบมากขึ้น น้ำหนักเพิ่มขึ้น ☐ 8) กินมื้อกลางวันหรือมื้อเย็นมาก

☐ 9) ตื่นขึ้นมากินอาหารกลางดึกบ่อยขึ้น ☐ 10) อื่นๆ ระบุ ……

ผู้ที่ไม่ได้รับประทานอาหารเช้า ไม่ต้องตอบข้อ 21-22

21. โดยส่วนใหญ่ ในตอนเช้าท่านรับประทานอาหารแบบใด

☐ 1) ปรุงอาหารเองที่บ้าน ☐ 2) ซื้ออาหารปรุงสำเร็จมารับประทานที่บ้าน

☐ 3) รับประทานอาหารนอกบ้าน ☐ 4) อื่นๆ ระบุ .....

22. ชนิดของอาหารเช้าที่ท่านรับประทาน สำหรับผู้ที่รับประทานมากกว่า 1 วัน/สัปดาห์

- ☐ 1) ไข่ดาว หมูแฮม เบคอน
- ☐ 2) ข้าวต้มเครื่อง โจ๊ก
- ☐ 3) อาหารจานเดียว ข้าวมันไก่ ข้าวหมูแดง ข้าวขาหมู
- ☐ 4) ก๋วยเตี๋ยว วุ้นเส้นเย็นตาโฟ
- ☐ 5) ธัญพืชไม่ขัดสี เช่น ข้าวโอ๊ต ข้าวซ้อมมือ ข้าวกล้อง
- ☐ 6) ปาท๋องโก่
- ☐ 7) ขนมปังปิ้งทาเนย เค้ก แซนวิชแฮม โดนัท แพนเค้ก
- ☐ 8) ข้าวเหนียวหมูปิ้ง
- ☐ 9) สลัดผัก หรือ ผลไม้ หรือ น้ำผลไม้
- ☐10) ข้าวราดกับข้าว
- ☐11) เครื่องดื่มร้อน เช่น กาแฟ ชา
- ☐12) นมพร่องมันเนย หรือขาด มันเนยหรือนมถั่วเหลือง
- ☐13) อื่นๆ ระบุ ……..

ส่วนที่ 3 แบบบันทึกความถี่และชนิดของการบริโภคอาหาร

คำชี้แจง ในระหว่าง 1 สัปดาห์ ท่านรับประทานอาหารและเครื่องดื่มชนิดต่างๆ บ่อยครั้งเพียงใด รับประทานปริมาณเท่าไร โดยดูจากโมเดลภาพเปรียบเทียบกับที่กำหนด และโปรดใส่เครื่องหมาย ✓ ลงในช่องว่าง แต่ละข้อเลือกเพียง 2 คำตอบ

กลุ่มอาหาร	**4 วันขึ้นไป ต่อ สัปดาห์**	**1 - 3 วัน ต่อ สัปดาห์**	**1 - 3 วัน ต่อ เดือน**	**ไม่เคย**
1. เครื่องดื่มเติมน้ำตาล-นมข้นหวาน เช่น ชาใส่นม-น้ำตาล หรือชาขวดยี่ห้อต่างๆ คาปูชิโน ลาเต้ หรือกาแฟนมพร้อมดื่ม หรือ มอคค่าหรือ โอวัลติน ไมโล หรือ เครื่องดื่มรสมอลต์แบบสำเร็จรูป 3 in 1				
2. นมไขมันต่ำ เช่น นมพร่องมันเนย ขาดมันเนย นมธัญพืช เช่น นมถั่วเหลือง นมงาดำ นมข้าวกล้อง				
3. อาหารที่มีแป้ง-เนย สูง เช่น ขนมปังปิ้งทาเนยโรยน้ำตาล เค้ก คุกกี้ โดนัท พาย วอฟเฟิล และ ครัวซอง				
4. ข้าวกล้อง ข้าวซ้อมมือ ขนมปังโฮลวีต ข้าวโอ๊ต ข้าวเหนียว ขนมจีน เส้นหมี่ เส้นใหญ่ บะหมี่ ขนมปังขาว วุ้นเส้น				
5. อาหารจานเดียว เช่น ข้าวมันไก่ ข้าวขาหมู ข้าวเลือดหมู โจ๊ก				
6. อาหารทอด อาหารมัน เช่น หมูทอด ไก่ทอด ไข่เจียว ทอดมัน				
7. ผักต่างๆ เช่น ผักสด ผักนึ่ง ผักลวก ผักใบเขียว ผักโขม บรอกโคลี กะหล่ำปลี ดอกกะหล่ำ มะเขือเทศ หัวหอม ฯลฯ				
8. ผลไม้สด ฝรั่ง ส้ม มะละกอ แอปเปิ้ล สาลี่ มะม่วงดิบ ชมพู่ แตงโม				
10. อาหารกึ่งสำเร็จรูป เช่น บะหมี่กึ่งสำเร็จรูป โจ๊กกึ่งสำเร็จรูป ฯลฯ				
11. เมนูปลา เช่น ปลาทู ปลากะพง ปลาช่อน ปลาซาร์ดีน ปลาอินทรี ปลาทูน่า ปลาแซลมอน (เนื้อปลาไม่รวมหนัง)				
12. อาหารแปรรูป-ใส่เกลือ เช่น เนื้อเค็ม ปลาเค็ม ไข่เค็ม ปลาร้า กะปิ ผัก-ผลไม้ดอง ไส้กรอก แฮม แหนม อาหารกระป๋อง กุนเชียง				
13. ขนมกินเล่น เช่น มันฝรั่งทอด ถั่วทอด ข้าวเกรียบกุ้ง ปาท่องโก๋ ฯลฯ				

ส่วนที่ 4 แบบบันทึกการบริโภคอาหารย้อนหลัง 24 ชั่วโมง ตัวอย่างที่ □□□

คำชี้แจง กรุณาบันทึก อาหาร เครื่องดื่ม และขนมทุกชนิด ที่ท่านรับประทานเมื่อวานนี้ตลอดทั้งวัน

วันที่บันทึก ……. เดือน ……..…….. พ.ศ. ……

มื้ออาหาร	**สถานที่ รับประทาน เวลา**	**รายการอาหาร**	**ส่วนประกอบ (คร่าวๆ)**	**ปริมาณที่รับประทาน** (ระบุเป็นหน่วยที่ใช้ในครัวเรือน เช่น ถ้วย ทัพพี ช้อนโต๊ะ ช้อนชา แก้ว มิลลิลิตร ชิ้น ลูก ผล ฯลฯ)
ตัวอย่าง		ก๋วยเตี๋ยวปลา	เส้นใหญ่,เนื้อปลา,ถั่วงอก	2 ทัพพี, 4 ช้อนโต๊ะ, 1
มื้อเย็น	**ร้านอาหาร**	ขนมปังราดนมข้นหวาน	ขนมปังโฮลวีท, นมข้น	2 แผ่น,นมข้นหวาน 5
	19:00 น.	น้ำแดง	น้ำแดง	น้ำแดง 3 ช้อนชา
		สับปะรด	สับปะรด	8 ชิ้น
เช้า				
อาหารว่างมื้อ				
กลางวัน				
เย็น				
ค่ำ				

อาหารที่รับประทาน ☐ เหมือนปกติ ☐ น้อยกว่าปกติ เพราะ ……

☐ มากกว่าปกติ เพราะ

ภาพตัวอย่างเพื่อใช้กะประมาณปริมาณอาหารที่รับประทาน

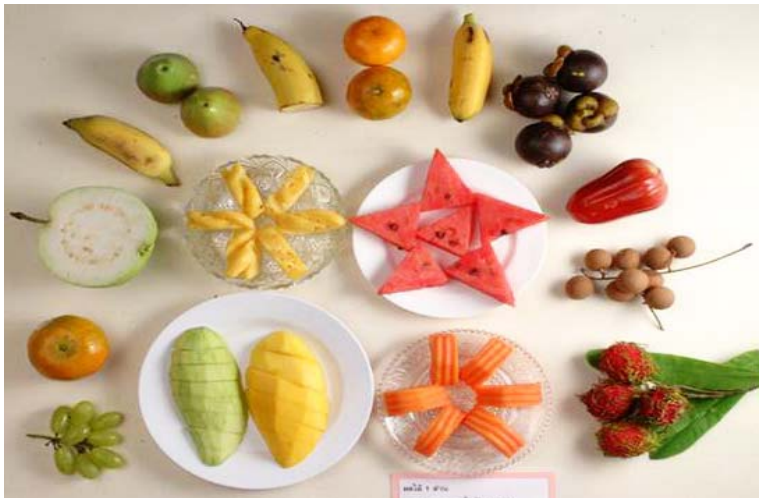
สำหรับบันทึกการบริโภคอาหารย้อนหลัง 24 ชั่วโมง

(ระบุเป็นหน่วยที่ใช้ในครัวเรือน เช่น ถ้วย ทัพพี ช้อนโต๊ะ ช้อนชา แก้ว มิลลิลิตร ชิ้น ลูก ผล ฯลฯ)

กลุ่มข้าว-แป้ง เช่น ข้าวสวย 1 ทัพพี = 5 ช้อนกินข้าว

กลุ่มเนื้อสัตว์ เช่น เนื้อสัตว์ 1 ช้อนกินข้าว = ปลาทู ½ ตัว = ไข่ ½ ฟอง = ตับ 1 ช้อนกินข้าว = ลูกชิ้น 2 ลูก เป็นต้น

กลุ่มผัก เช่น ผัก 1 ทัพพี



กลุ่มผลไม้ ผลไม้ 1 ส่วน = ผลไม้ขนาดเล็ก 6-8 ผล (เช่น ลำไย องุ่น) = ผลไม้ขนาดกลาง 1-2 ผล (เช่น ชมพู่ ส้ม) = ผลไม้ขนาดใหญ่ 6-8 ชิ้น (เช่น มะม่วง มะละกอ แตงโม สับปะรด)

กลุ่มนม เช่น นม 1 กล่อง

กลุ่มเครื่องดื่ม เช่น เบียร์ 1 แก้ว

กลุ่มขนมกินเล่น เช่น ปาท่องโก๋ 1 ตัว

ภาพแสดง: ตัวอย่างอาหารสำหรับประมาณปริมาณอาหารที่บริโภค (Damapong, 2007)

Appendix B

- **Approval of certificate from Faculty of Pharmaceutical Sciences Chulalongkorn University**
- **Information sheet for participants**
- **Consent form**

Protocol Review No. 11 – 33 - 017

Study Protocol Approval

The Ethics Committee of The Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok, Thailand has approved the following study to be carried out according to the protocol dated and/ or amended as follows:

Study Title: Relationships between breakfast consumption and metabolic syndrome in working age population in Kanchanaburi Province

Study Code:

Centre: CHULALONGKORN UNIVERSITY

Principal Investigator : Mayura Kanchananuruk

A list of the Ethics Committee members and positions present at the Ethics Committee meeting on the date of approval of this study has been attached.

This Study Protocol Approval Form will be forwarded to the Principal Investigator.

Chairman of Ethics Committee: .....

(Parkpoom Tengamnuay, Ph.D.)

Secretary of Ethics Committee: .....

(Suyanee Pongthananikorn, Ph.D.)

Date of Approval: December 9, 2011

Date of Approval Expiration: December 9, 2012

คำชี้แจงสำหรับอาสาสมัครที่เข้าร่วมการวิจัย (Patient or Participant Information Sheet)

ชื่อโครงการศึกษาวิจัยเรื่อง (ภาษาไทย)	ความสัมพันธ์ระหว่างการบริโภคอาหารเช้าและกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี
(ภาษาอังกฤษ)	RELATIONSHIPS BETWEEN BREAKFAST CONSUMPTION AND METABOLIC SYNDROME IN WORKING AGE POPULATION IN KANCHANABURI PROVINCE
ชื่อผู้วิจัยหลัก (ภาษาไทย)	นางสาว มยุรา กาญจนานุรักษ์
(ภาษาอังกฤษ)	MISS MAYURA KANCHANANURUK
หน่วยงานที่ทำการศึกษาวิจัย	โรงพยาบาลพหลพลพยุหเสนา
โทรศัพท์ (สามารถติดต่อได้ 24ชั่วโมง)	08-7996-0190

ท่านได้รับเชิญให้เข้าร่วมการศึกษาวิจัยเรื่องความสัมพันธ์ระหว่างการบริโภคอาหารเช้าและกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี ก่อนที่ท่านจะตัดสินใจให้ความยินยอมเข้าร่วมการศึกษาวิจัยนี้ ผู้วิจัยใคร่ขอชี้แจงรายละเอียดของโครงการวิจัยให้ท่านทราบ และขอให้ท่านกรุณาอ่านข้อมูลต่อไปนี้ด้วยความรอบคอบ และสอบถามถึงข้อสงสัยต่างๆ โดยไม่ลังเล ก่อนลงนามแสดงความยินยอมเข้าร่วมโครงการวิจัยใน “ใบยินยอมด้วยความสมัครใจ”โดยผู้วิจัยจะขอทำการเก็บผลการตรวจสุขภาพของท่าน (เช่น ความดันโลหิต ระดับน้ำตาล และระดับไขมันในเลือด) และข้อมูลต่างๆ ที่ได้จากการตอบแบบสอบถามของท่าน) ผู้วิจัยจะดำเนินการเป็นขั้นตอนดังที่ได้ชี้แจงให้ทราบข้างต้น ขั้นตอนนี้เป็น**“กระบวนการให้คำยินยอม”**

1. บทนำ

กลุ่มอาการเมแทบอลิก หรือภาวะอ้วนลงพุง คือ กลุ่มอาการผิดปกติต่างๆ ได้แก่ เส้นรอบเอวเกินมาตรฐาน ระดับน้ำตาลในเลือดสูง ระดับไตรกลีเซอไรด์ในเลือดสูง ระดับเอช-ดี-แอล คอเลสเตอรอลในเลือดต่ำ และความดันโลหิตสูง ผู้ที่มีความผิดปกติ 3 ข้อใน 5 ข้อนี้ ถือว่าเป็นภาวะอ้วนลงพุง ตามเกณฑ์ของ National Cholesterol Education Program ATP III ซึ่งภาวะดังกล่าวเป็นปัจจัยเสี่ยงที่ทำให้เกิดโรคหัวใจและหลอดเลือด และโรคเบาหวานได้

ปัจจุบันพฤติกรรมการบริโภคอาหารของคนไทยเปลี่ยนแปลงไปจากเดิม โดยจากการสำรวจการบริโภคอาหารของประชากร พ.ศ. 2552 พบว่าอาหารเช้าเป็นมื้อที่มีการงดมากที่สุด

ในประชากรไทยที่มีอายุระหว่าง 25 – 59 ปี ซึ่งอยู่ในวัยทำงาน และอาศัยอยู่ในเขตเมืองที่ต้องรีบเร่งไปทำงานให้ตรงเวลา หรือไม่มีเวลาในการจัดเตรียมอาหารเช้า หรือกลัวน้ำหนักเพิ่มขึ้น จึงทำให้มีการละเลยในการรับประทานอาหารมื้อเช้า หรืออาจรับประทานอาหารเช้าตามความสะดวก เช่น กาแฟเพียง 1 ถ้วย หรือขนมปัง 1 แผ่นเท่านั้น ซึ่งส่งผลทำให้ได้รับพลังงานและสารอาหารไม่เพียงพอต่อความต้องการของร่างกาย จึงนำมาสู่อาการหิว หงุดหงิดง่าย ไม่มีสมาธิ และขาดเรี่ยวแรงในการทำงาน และในการอดอาหารมื้อเช้า มีแนวโน้มที่จะรับประทานอาหารที่มีแป้ง น้ำตาล และไขมันในปริมาณที่สูงขึ้นในมื้อถัดไป เช่นการรับประทานอาหารมื้อเย็นและมื้อดึกมากขึ้น จนทำให้เกิดโรคภัยไข้เจ็บต่างๆตามมา เช่น การเกิดภาวะน้ำหนักเกิน และอ้วน การดื้อต่ออินซูลิน ความดันโลหิตสูง ระดับไขมันในเลือดผิดปกติ ซึ่งทำให้เกิดกลุ่มอาการเมแทบอลิก และจากการศึกษางานวิจัยพบว่าการอดอาหารเช้ามีความสัมพันธ์กับสุขภาพที่ไม่พึงประสงค์ เช่นนอนไม่หลับ ความดันโลหิตที่เพิ่มขึ้น และพฤติกรรมที่มีผลกระทบต่อสุขภาพ เช่น การสูบบุหรี่ การดื่มสุรา และการขาดการออกกำลังกาย สิ่งเหล่านี้ล้วนเป็นปัจจัยเสี่ยงสำคัญต่อการเกิดโรคหัวใจและหลอดเลือด ซึ่งพบเป็นอันดับต้นๆของการเสียชีวิตของคนไทย

ในปัจจุบันยังไม่มีข้อมูลที่เกี่ยวกับการบริโภคอาหารเช้าของคนไทยต่อความเสี่ยงในการเกิดกลุ่มอาการเมแทบอลิก แต่ยังมีข้อมูลที่ศึกษาถึงพฤติกรรมการบริโภคอาหารเช้าของบุคลากรที่ทำงานในมหาวิทยาลัยมหิดลวิทยาเขตศาลายา ดังนั้นงานวิจัยนี้จึงทำการศึกษาหาความชุกและรูปแบบการบริโภคอาหารเช้าที่มีผลต่อการเกิดกลุ่มอาการเมแทบอลิกของประชา กรวัยทำงานในจังหวัดกาญจนบุรี เพื่อใช้เป็นข้อมูลพื้นฐานทางโภชนาการสำหรับเป็นแนว ทางในการดูแล และป้องกันกลุ่มอาการเมแทบอลิกในคนไทยต่อไป

2. วัตถุประสงค์ของการวิจัย

1. ความชุกของกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี
2. รูปแบบการบริโภคอาหารเช้าในกลุ่มประชากรวัยทำงานที่มีและไม่มีกลุ่มอาการเมแทบอลิก

3. วิธีการศึกษาวิจัย

จำนวนผู้ที่เข้าร่วมการวิจัย ประมาณ 250 คน

ผู้วิจัยขอให้ท่านปฏิบัติตามขั้นตอน ดังนี้

1. ท่านทำการตอบแบบสอบถามข้อมูลทั่วไป ข้อมูลรูปแบบการบริโภคอาหารเช้า ข้อมูลความถี่ในการบริโภคอาหาร บันทึกการบริโภคอาหารย้อนหลัง 24 ชั่วโมง และการประเมินกิจกรรมทางกาย จำนวนแบบสอบถามมีทั้งหมด 6 หน้า จำนวน 50 ข้อ เวลาในการทำแบบสอบถามประมาณ 20-30 นาที

2. ผู้เข้าร่วมการวิจัยที่เข้ารับการตรวจสุขภาพประจำปี จะได้รับการชั่งน้ำหนัก วัดส่วนสูง วัดเส้นรอบเอวผ่านสะดือ โดยผู้วิจัยจะเป็นผู้วัด

3. ผู้วิจัยติดตามผลการตรวจสุขภาพของผู้เข้าร่วมการวิจัย โดยรวบรวมข้อมูลความดันโลหิตจากแฟ้มประวัติผู้ป่วย และติดตามผลการตรวจระดับไขมันในเส้นเลือด ได้แก่ ไขมันคอเลสเตอรอล ไตรกลีเซอไรด์ แอล ดี แอล เอช ดี แอล และระดับน้ำตาลในเลือดขณะอดอาหารจากห้องตรวจหรือห้องปฏิบัติการ

4. ความเสี่ยง ความไม่สบาย และผลข้างเคียงที่อาจเกิดขึ้น

มีความเสี่ยงเล็กน้อย เนื่องจากการวิจัยนี้เป็นการตอบแบบสอบถามที่มีจำนวนข้อที่สอบถามค่อนข้างมากอาจทำให้ท่านรู้สึกหงุดหงิดบ้าง

5. ผลประโยชน์ที่อาจจะได้รับ

ได้ข้อมูลความชุกของกลุ่มอาการเมแทบอลิกของประชากรวัยทำงานในจังหวัดกาญจนบุรี และแนวโน้มการบริโภคอาหารเช้าที่ทำให้เกิดหรือป้องกันการเกิดกลุ่มอาการเมแทบอลิก ซึ่งใช้เป็นแนวทางในการรณรงค์ส่งเสริมการบริโภคอาหาร เพื่อสุขภาพที่ดีต่อไป

6. ทางเลือกอื่นในการรักษา

ไม่มี

7. ค่าใช้จ่ายและค่าชดเชย

ไม่มีค่าตอบแทนในการเข้าร่วมการวิจัย

8. เงินชดเชยสำหรับการบาดเจ็บหรืออันตรายที่อาจเกิดขึ้น

ไม่มี

9. สิทธิในการถอนตัวออกจากการศึกษาวิจัย

ท่านมีสิทธิในการถอนตัวออกจากการเข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบใดๆทั้งสิ้น

10. การรักษาความลับของบันทึกทางการแพทย์ และข้อมูลการศึกษาวิจัย

ข้อมูลของท่านจะถูกเก็บเป็นความลับ และจะเปิดเผยในรูปสรุปผลการวิจัย

11. การเปิดเผยข้อมูลการศึกษาวิจัย

เปิดเผยต่อผู้มีหน้าที่ที่เกี่ยวข้องกับการสนับสนุนและกำกับดูแลการวิจัยเท่านั้น

12. การสอบถามข้อสงสัย

ในกรณีที่มีปัญหาหรือข้อสงสัย ท่านสามารถติดต่อผู้วิจัย : เภสัชกรหญิง มยุรา- กาญจนานุรักษ์ กลุ่มงานเภสัชกรรม โรงพยาบาลพหลพลพยุหเสนา โทรศัพท์ที่ทำงาน 0-3462-2999 โทรศัพท์เคลื่อนที่ 08-7996-0190 (ติดต่อได้ 24 ชั่วโมง)

ใบยินยอม

(Consent Form)

การศึกษาวิจัยเรื่อง (ภาษาไทย) ความสัมพันธ์ระหว่างการบริโภคอาหารเช้าและกลุ่มอาการเมแทบอลิก ของประชากรวัยทำงานในจังหวัดกาญจนบุรี

(ภาษาอังกฤษ) RELATIONSHIPS BETWEEN BREAKFAST CONSUMPTION AND METABOLIC SYNDROME IN WORKING AGE POPULATION IN KANCHANABURI PROVINCE

วันให้คำยินยอม วันที่..... เดือน..... พ.ศ. .....

ข้าพเจ้า (นาย/ นาง/ นางสาว) .....นามสกุล .....บ้านเลขที่ .....

ซอย .....ถนน .....แขวง/ ตำบล……..เขต/ อำเภอ .....จังหวัด…….รหัสไปรษณีย์ …….....

ก่อนที่จะลงนามในใบยินยอมให้ทำการวิจัยนี้ **ข้าพเจ้าได้รับเอกสารข้อมูลคำอธิบาย หรือคำชี้แจงสำหรับอาสาสมัครที่เข้าร่วมการวิจัย** จากผู้วิจัยให้ทราบถึงวัตถุประสงค์ของการวิจัย วิธีวิจัย อันตรายหรืออาการข้างเคียงที่อาจเกิดขึ้นจากการวิจัยหรือจากยาที่ใช้ รวมทั้งประโยชน์ที่เกิดขึ้นจากการวิจัยอย่างละเอียดและมีความเข้าใจดีแล้ว

ผู้วิจัยได้ตอบคำถามต่างๆ ที่ข้าพเจ้าสงสัยด้วยความเต็มใจ ไม่ปิดบัง ไม่ซ้อนเร้น จนข้าพเจ้าพอใจ

ข้าพเจ้าเข้าร่วมโครงการนี้โดยความสมัครใจและมีสิทธิที่จะบอกเลิกการเข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยการบอกเลิกจะไม่มีผลต่อการรักษาโรคที่ข้าพเจ้าจะได้รับต่อไป

ผู้วิจัยรับรองว่า**"จะเก็บข้อมูลเฉพาะเกี่ยวกับตัวข้าพเจ้าไว้เป็นความลับ และจะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัย"** เท่านั้น

ในการวิจัยครั้งนี้ ข้าพเจ้ายอมให้ผู้วิจัยนำผลการตรวจร่างกาย ผลการตรวจเลือด และข้อมูลต่างๆ ที่ได้จากการสัมภาษณ์หรือการตอบแบบสอบถามการวิจัย มาใช้วิเคราะห์ในโครงการวิจัยนี้

โดยสามารถติดต่อผู้วิจัยได้ที่ 08-7996-0190 หรือ 0-3462-2999 ต่อ ฝ่ายเภสัชกรรมโรงพยาบาลพหลพลพยุหเสนา โดยบุคคลที่รับผิดชอบเรื่องนี้คือ ภญ.มยุรา กาญจนานุรักษ์ และเบอร์โทรศัพท์ 02-218-8256 ของคณะกรรมการจริยธรรม ฝ่ายวิจัย คณะเภสัชศาสตร์ จุฬาฯ ไว้ด้วยเพื่อการร้องเรียนกรณีที่ไม่ปฏิบัติตามคำชี้แจงแก่อาสาสมัคร

ข้าพเจ้าได้อ่านข้อความข้างต้นแล้ว และมีความเข้าใจดีทุกประการ จึงได้ลงนามในใบยินยอมนี้ด้วยความเต็มใจ พร้อมกันนี้ข้าพเจ้าได้รับสำเนาเอกสารแสดงความยินยอมเข้าร่วมการวิจัยที่ข้าพเจ้าได้ลงนามและวันที่และเอกสารข้อมูลคำอธิบายสำหรับผู้เข้าร่วมโครงการวิจัยแล้ว 1 ชุด

ลงนาม ..... ผู้ให้ความยินยอม

(.....) ชื่อตัวบรรจง

วันที่ .....เดือน .....พ.ศ.....

ลงนาม ..... ผู้วิจัย

ลงนาม ..... พยาน

ลงนาม ..... พยาน

หมายเหตุ ในกรณีที่ผู้เข้าร่วมการวิจัยไม่สามารถอ่านออกเขียนได้ จะให้ใช้พิมพ์ลายนิ้วมือ โดยมีพยานลงนาม 2 คน

Appendix C

Data analyses

Data analyses

The data analyses used in this study included:

1. Content validity test

The content validity test is one of the questionnaire's quality examinations. In this study, all parts of questionnaire were proved by 5 experts for testing content validity. Then, the questionnaire was revised for clearer content and suitability according to the experts' recommendations. Finally, the questionnaire was divided into 4 parts that consisted of part 1: demographic characteristics (16 items), part 2: dietary pattern (6 items), part 3: food frequency questionnaire (14 items), and part 4: the 24-hour dietary recall.

2. Reliability test

The reliability test is one of the questionnaire's quality examinations. The Cronbach's alpha is a popular technique for reliability test. The Cronbach's alpha normally ranges between 0-1 and the acceptable reliability of questionnaire should have the Cronbach's alpha more than 0.70 (George and Mallery, 2003). In this study, the reliability of food frequency questionnaire was tested with the group of 30 persons who had similar characteristics to the study samples. The reliability was presented by Cronbach's alpha that was 0.72. This value indicated that the food frequency questionnaire had an acceptable reliability. Thus, this questionnaire was suitable for data collection

3. Boxplot analysis

In this study, the 24-hour dietary recall was used for estimating the total daily energy intake, breakfast energy intake and its distribution. The standard household measuring by food model was used to estimating the portion sizes. However, the data obtained from the 24-hour dietary recall may have overestimated, because the participants could not remember or make too low/high an estimate their dietary intakes.

Thus, the boxplot analysis was used for excluding the unreliable total energy intake data that were extreme outlier (more than third quartile + 3 interquartile range or less than first quartile-3 interquartile range). The result showed that no participant reported the unreliable total energy intake data (Figure C-1). Therefore, the data of all participants could be taken into the analysis.

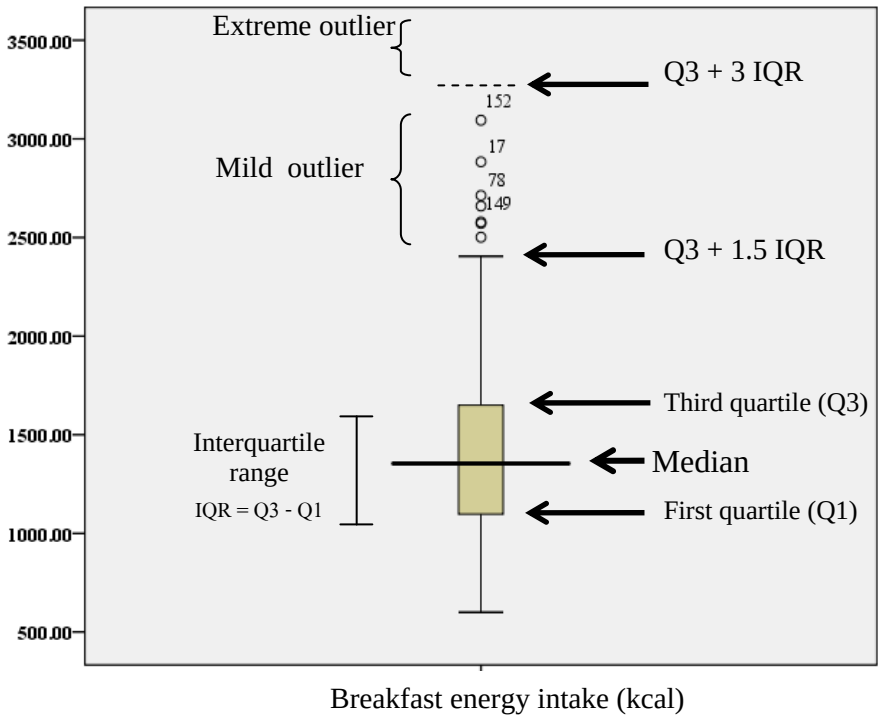


Figure C-1 The boxplot analysis

4. Multicollinearity test

For the multiple logistic regression analysis, there is the condition that the predictive variables should not have multicollinearity. The multicollinearity makes it difficult to determine whether predictor is important in a regression equation. Therefore, multicollinearity among predictive variables was assessed by tolerance and variance inflation factor (VIF).

Tolerance was used to examine the strength of the linear relationship among predictive variables that was used as a measure of collinearity.

Tolerance is simple ($1-R^2$), therefore a tolerance of 0 indicates a perfect collinearity that can range from 0.00-1.00. Tolerance values of 0.10 or less means that multicollinearity may be a problem

VIF is the index for analysis of multicollinearity. It measures the effect of other predictive indicators on regression coefficient. VIF is inversely related to the tolerance value. A usual threshold of VIF values is 10.0. This value corresponds to a tolerance of 0.10 that indicates a high degree of collinearity or multicollinearity among the independent variables (Temcharoen, 2001).

In this study, the results showed that all predictive variables had no multicollinearity, tolerance was higher than 0.10 and VIF was lower than 10.0 (Table C-1).

Table C-1 Multicollinearity test by tolerance and VIF among predictive variables

	Collinearity statistics	
Variables	**Tolerance**	**VIF**
Skipping breakfast	0.860	1.163
Large meal intake	0.837	1.195
Meal-made pattern	0.895	1.117
Repeated dietary type intake	0.839	1.192
Time between dinner and bedtime	0.897	1.115
Time spent on each meal	0.941	1.063
Alcohol consumption	0.843	1.186
Fish intake	0.673	1.486
Whole grain	0.694	1.442
Bakery product intake	0.821	1.218
Fried food intake	0.565	1.768
Coconut milk food intake	0.499	2.004
Vegetables intake	0.545	1.833
Fruits intake	0.533	1.875
Whole grain intake	0.694	1.442
One dish food intake	0.849	1.179
Semi-instant food intake	0.562	1.778
Salty processed food intake	0.529	1.891
High-sugar beverage intake	0.745	1.342
Snack intake	0.468	2.137
Calorie from carbohydrate	0.586	1.705
Calorie from protein	0.745	1.343
Calorie from fat	0.727	1.376

VIF - variance inflation factor

BIOGRAPHY

NAME	Miss Mayura Kanchananuruk
DATE OF BIRTH	November 30, 1976
PLACE OF BIRTH	Kanchanaburi Thailand
INSTITUTIONS ATTENDED	Silapakorn University, 1995-2000; Bachelor of Science in Pharmacy Chulalongkorn University, 2010-2012; Master of Science in Pharmacy (Food Chemistry and Medical Nutrition)
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RESEARCH ARTICLE	The association between breakfast skipping combined with alcohol consumption and the risk of metabolic syndrome. Journal of health research. volume 26, No.3 (June), 2012 139-143