

THE EFFECT OF SIX-MONTH AEROBIC EXERCISE AND HEALTH EDUCATION PROGRAM
INTERVENTION ON BODY COMPOSITION TO REDUCE VISCERAL FAT AND WAIST
CIRCUMFERENCE AMONG ARMY
MALE OFFICERS AT SUPPORT OFFICE ARMED FORCES DEVELOPMENT COMMAND:
QUASI-EXPERIMENTAL STUDY



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ผลของโปรแกรมออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกาย เพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ้ายสนับสนุนหน่วยบัญชาการทหารพัฒนา:

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พัทธม มาสกุล : ผลของโปรแกรมออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกายเพื่อลดไขมันในช่องท้อง และเส้นรอบเอวของทหารชายที่ฝ่ายสนับสนุนหน่วยบัญชาการทหารพัฒนา: การวิจัยกึ่งทดลองแบบมีกลุ่มควบคุม. (THE EFFECT OF SIX-MONTH AEROBIC EXERCISE AND HEALTH EDUCATION PROGRAM INTERVENTION ON BODY COMPOSITION TO REDUCE VISCERAL FAT AND WAIST CIRCUMFERENCE AMONG ARMYMALE OFFICERS AT SUPPORT OFFICE ARMED FORCES DEVELOPMENT COMMAND: QUASI-EXPERIMENTAL STUDY) อ.ที่ปรึกษาหลัก : รศ. ดร.กาญจนา รัชชิตริภูรัตน์

ภาวะน้ำหนักเกินและโรคอ้วนเป็นปัญหาสุขภาพที่สำคัญในประชากรทั่วโลกสอดคล้องกับรายงานการตรวจสุขภาพประจำปี 2559-2561 ของทหารชายฝ่ายสนับสนุน ในหน่วยบัญชาการทหารพัฒนาอีกทั้งพบว่ามีแนวโน้มของค่าดัชนีมวลกายเพิ่มขึ้นจากภาวะน้ำหนักเกินเกินมาตรฐานอย่างต่อเนื่องในทุก ๆ ปี การตรวจสุขภาพประจำปีในปี ยังพบอีกว่าไม่เคยมีการพัฒนาโปรแกรมการออกกำลังกายที่ใช้ลดภาวะไขมันในช่องท้องและเส้นรอบเอวร่วมกับการให้ความรู้ด้านสุขภาพเพื่อเป็นการป้องกันและแก้ไขภาวะดังกล่าว โปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอว อาจเป็นอีกหนึ่งทางเลือกที่ดีในการดูแลตนเองช่วยลดภาวะน้ำหนักเกินอันเป็นปัญหาด้านสุขภาพ งานวิจัยนี้เพื่อประเมินประสิทธิผลของโปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ่ายสนับสนุนหน่วยบัญชาการทหารพัฒนางานวิจัยนี้เป็นการวิจัยกึ่งทดลองชนิดมีกลุ่มควบคุม เจาะจงเลือกกลุ่มตัวอย่างจากผู้ที่มีสมัครใจเข้าร่วมโครงการและมีผลการตรวจสุขภาพประจำปี 2561 พบว่ามีภาวะน้ำหนักเกินมาตรฐานไม่มีปัญหาสุขภาพอื่น ทหารชาย 110 จากหน่วยสนับสนุนสองอาคารเขตพื้นที่ใกล้เคียงกันและสมัครใจเข้าร่วมโครงการ มีลักษณะทั่วไปทางกายภาพและค่าเฉลี่ยระหว่างกลุ่มไม่แตกต่างกันได้รับการคัดเลือกตามลำดับก่อนหลังจนครบจำนวนจากอาคารที่ 1 กลุ่มทดลอง (Intervention) (n=55) อาคารที่ 2 กลุ่มควบคุม (control) ทำกิจกรรมตามปกติ (n=55) ผู้วิจัย เก็บข้อมูลการเปลี่ยนแปลงองค์ประกอบของร่างกายและแบบสอบถามความรู้ก่อนและหลังการทดลองทั้งสองกลุ่ม โปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพที่ให้ออกในกลุ่มทดลอง แบ่งเป็นความรู้ในห้องเรียนในสัปดาห์แรกก่อนเริ่มการทดลองและเมื่อสิ้นสุดการทดลองโดยระหว่างกิจกรรมตลอด 6 เดือน ที่วิจัยได้จัดทำข้อมูลความรู้ให้สมาชิกในกลุ่มสามารถเข้าถึงความรู้ที่เกี่ยวข้องผ่าน LINE กลุ่ม และยังสามารถสอบถามโดยตรงในวันที่มีกิจกรรมกลุ่ม กลุ่มทดลองจะต้องเข้าร่วมกิจกรรมออกกำลังกายสัปดาห์ละ 3 ครั้งเป็นเวลาหกเดือน เพื่อเปรียบเทียบ (ค่าเฉลี่ย \pm SD) ภายในกลุ่ม ระหว่างกลุ่ม และการเปลี่ยนแปลงของทดลองและกลุ่มควบคุม ก่อนทดลอง หลังทดลองสามเดือนและหกเดือน พบว่าหลังการได้รับ โปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอว ส่งผลให้องค์ประกอบของร่างกายทุกส่วนในกลุ่มทดลองดีขึ้นสามารถลดเส้นรอบเอวและไขมันในช่องท้อง เพิ่มความรู้ในการดูแลตนเองอย่างเหมาะสมถูกต้อง ข้อมูลจากการทดลองพบว่า ในกลุ่มทดลอง 0,3,6 เดือน ค่าเฉลี่ยภายในกลุ่มทดลองอย่างมีนัยสำคัญ ($p=0.001^*$) เส้นรอบเอว 40.41 ± 2.92 (38.80 ± 2.99 เป็น 38.35 ± 2.83), ไขมันในช่องท้อง 13.49 ± 2.14 (13.08 ± 2.27 เป็น 12.82 ± 2.36) และความรู้ก่อนทดลอง 12.61 ± 6.14 (26.71 ± 5.86 เป็น 28.00 ± 4.46) ค่าเฉลี่ยภายในกลุ่มควบคุมเพิ่มขึ้นอย่างมีนัยสำคัญ ($p=0.001^*$) เส้นรอบเอว 39.33 ± 3.12 (39.44 ± 3.21 เป็น 39.89 ± 3.26), ไขมันในช่องท้อง 13.00 ± 2.59 (13.18 ± 2.50 เป็น 13.43 ± 2.42) ความรู้เกือบจะไม่มี การเปลี่ยนแปลง เมื่อเปรียบเทียบความแตกต่างของค่าเฉลี่ยระหว่างกลุ่มพบว่า เส้นรอบเอวและไขมันในช่องท้องลดลงในขณะที่กลุ่มควบคุมเพิ่มขึ้น คะแนนความรู้ในกลุ่มทดลองเพิ่มขึ้นในขณะที่กลุ่มควบคุมเกือบจะไม่มี การเปลี่ยนแปลง ซึ่งค่าเฉลี่ยช่วงเวลา 6 เดือน ของกลุ่มทดลองกับกลุ่มควบคุมมีความแตกต่างกันดังนี้ เส้นรอบเอวแตกต่างกัน (1.54) เซนติเมตร; ไขมันในช่องท้องแตกต่างกัน (0.61); และ คะแนนความรู้แตกต่างกัน (14.52) คะแนน โปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ่ายสนับสนุน หน่วยบัญชาการทหารพัฒนา สามารถ ลดไขมันในช่องท้อง เส้นรอบเอวและเพิ่มความรู้ด้านสุขภาพในการดูแลตนเองได้จริง จึงอาจเป็นอีกหนึ่งทางเลือกที่ดีในการดูแลตนเองจากภาวะน้ำหนักเกินอันเป็นปัญหาด้านสุขภาพ

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Patchamol Masakul : THE EFFECT OF SIX-MONTH AEROBIC EXERCISE AND HEALTH EDUCATION PROGRAM INTERVENTION ON BODY COMPOSITION TO REDUCE VISCERAL FAT AND WAIST CIRCUMFERENCE AMONG ARMYMALE OFFICERS AT SUPPORT OFFICE ARMED FORCES DEVELOPMENT COMMAND: QUASI-EXPERIMENTAL STUDY. Advisor: Assoc. Prof. KANCHANA RUNGSIHIRUNRAT, Ph.D.

Overweight and obesity are global pandemics consistent to the annual checkup of the army in support units from 2016 to 2018 found that the problem of continuously increasing BMI over the standard values. The six-month aerobic exercise and health education program intervention on body composition to reduce Visceral Fat and Waist Circumference among army male officer might have positive effects to help resolve this problem. To evaluate the effects of six-month aerobic exercise and health education program intervention on body composition to reduce Visceral Fat and Waist Circumference among army male officers at Support Office Armed Forces Development Command. Total 110 overweight adult participants at support units whose annual checkup report in 2018 was overweight without diseases met the inclusion criteria and voluntarily participated by purposive sampling techniques based on 2 separate locations in the same area. They were 2 groups: building one intervention group (n=55) received the six-month exercise program with the aerobic exercise and health education, performed it three times a week and received the knowledge through classroom lecture at baseline and the end of six-month and during the program from LINE groups whereas building two control group (n=55) did only leisure activities as usual. The Visceral Fat, the Waist Circumference (WC) were measured by the body composition analyzer (BIA) and the knowledge scores were measured by questionnaire in both groups at baseline, three-month and six-month. To compare (mean±SD) the intervention group and the control group within groups and between groups and changes among both groups at baseline, three-month and six-month found positive effects. This study found that the interactions of the visceral fat at all three time periods: baseline, three-month, six-month caused it to decrease continuously with statistically significant difference ($p=0.001^*$). The visceral fat at baseline, three-month, six-month had no statistical difference ($p=0.310$), ($p=0.833$), ($p=0.207$) respectively. This study found that the interactions of the waist circumference at all three time periods: baseline, three-month, six-month caused it to decrease continuously with statistically significant difference ($p=0.001^*$). The knowledge scores of health education at all three time periods: baseline, three-month, six-month caused it to increase continuously with statistically significant difference ($p=0.001^*$). The knowledge scores at baseline had no statistical difference ($p=0.631$); however, the scores at three-month and six-month had statistically significant difference ($p<0.001^*$), ($p<0.001^*$) respectively. Hence, the effects of six-month aerobic exercise and health education program intervention on body composition to reduce Visceral Fat and Waist Circumference among army male officers. The study suggests that this program integrated the knowledge on health education plus exercise to reduce waist circumference and visceral fat in the intervention group was improved.

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CHAPTER I

INTRODUCTION

1.1 Background and rationale

Overweight leading to obesity has become a major public health problem and epidemic in global population. In 2014, World Health Organization (WHO) declared it as the potential public health disaster of 21st century for the fact that more than 1.9 billion are obese, specifically 39% of adults amounting to nearly 600 million require urgent preventive measures to curb the problem [1, 2]. Overweight refers to weight which is over the threshold of a criterion standard or reference value. Criterion standards are calculated from the relation of weight to morbidity or mortality outcomes while reference values are derived from observed population distributions of recorded weight [3]. Obesity is a condition in which fat accumulates in the body [4]. Obesity is a result of a continuous imbalance between energy intake and energy expenditure [5]. Waist circumference (WC) is the most accurate, and also the best measure in the prediction one of Non communicable diseases as diabetic risk, although it has been difficult to quantify in terms of a threshold to apply. Predictive value is also likely to vary according to ethnicity and sex [6]. WC it is the key performance index commonly used as a screening tool to measure and characterize fat belly status, which is determined by placing a tape measured horizontally around the abdomen at the level of iliac crest. The height divided by two is the standard range of waist circumference. Another tool to measure abdominal obesity is the waist to hip ratio (WHR) for men which could define less than 0.9 as normal weight, 0.90-0.99 as overweight and more than 1.00 as obesity and for women less than 0.8 as normal weight, 0.8-0.84 as overweight and more than 0.85 as obesity based on WHO criteria. So, waist circumference and the waist to hip ratio are strongly related to metabolic risks and adverse outcomes (7) because the

values measured by these measurement tools which are not within the standard range may indicate increased risks of chronic diseases, overweight and obesity associated with Non-Communicable Diseases (NCDs) as new world syndromes in both developed and developing countries [7]. A related previous study was conducted on validity of self-reported abdominal obesity in Thai adults: a comparison of waist circumference, waist-to-hip ratio and waist-to-stature ratio. The researchers found that the sensitivity and specificity of self-reported waist circumference and self-reported waist to stature ratio as measures of abdominal obesity were superior to those of self-reported waist to hip ratio in both sexes. Based on the area-under-the-curve (AUC) analyses, waist circumference and waist to stature ratio were comparable and significantly higher than waist to hip ratio (0.80 in men; 0.76 in women; $p < 0.0001$). They concluded that waist circumference and waist to stature ratio seemed to be valid methods to measure abdominal obesity [8]. In Thailand, body mass index (BMI) is one of the most used screening tools for annual physical check-up to measure health status and characterize overweight and obesity status. A BMI less than 18.5 kg/m^2 is defined as underweight may need to gain weight; $18.5\text{-}22.9 \text{ kg/m}^2$ is defined as a healthy weight and should aim to stay that way. A BMI of $23\text{-}24.9 \text{ kg/m}^2$ is defined overweight. It is an idea to lose some weight for health's sake, or at least aim to prevent further weight gain, A BMI of $25\text{-}25.9 \text{ kg/m}^2$ defined as obese-I and means health is at risk and BMI $> 30 \text{ kg/m}^2$ is defined as obese-II and means your health is at risk. Losing weight will improve health (**Figure 1**).

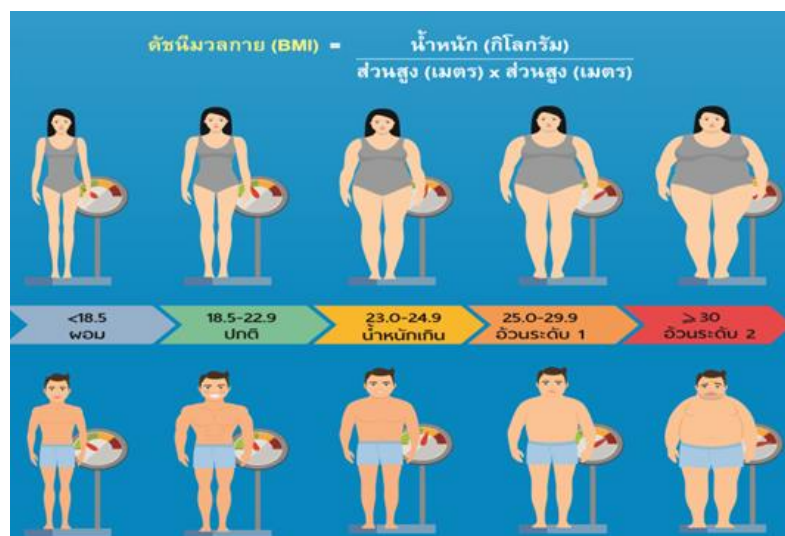


Figure 1. Body mass index (BMI)

Source: nutrition.anamai.moph.go.th/images/files/HLworkingage.pdf

However, another measurement tool which develops technology for measuring Visceral Adipose Tissue (VAT) accumulation risk by Bioelectrical Impedance Analysis (BIA) compared with image analysis by Magnetic Resonance Imaging (MRI) creating a higher correlation of more accurate VAT estimation is Body Composition Analyzer, which is safe, easy and highly precise by analyzing the body compositions including body water, muscle mass, lean body mass, bones and fat can measure obesity and overweight more accurately. This measurement tool called Body Composition Analyzer can analyze the body composition by measuring the resistance of low electrical voltage (1-2 volts) found in body tissues because body tissues have different levels of the resistance. This can allow the measurement tool to access the compositions of the whole body. Nowadays, in the Digital age, the measurement of body compositions can be conducted by a machine or an application in smartphone because both the machine and application can evaluate the body compositions of athletes and those of ordinary people. In particular, Body Composition Analyzer

evaluates fat percentage which can be calculated based on the age groups and different genders. So, males and females can be divided into 3 age groups: 20-39, 40-59 and 60-79. The data collected from each individual can be processed into under fat, healthy, over fat and obese. There is a common misconception that all body fat is bad. In truth, some body fat is needed to protect the person's health as well as supplying a reservoir of energy for performing various body functions. The total weight of body fat can be subdivided into three separate categories: essential body fat, reserve body fat and excess body fat. Weight of essential body fat is needed to protect the body from infectious diseases and to protect the internal organs from bruising damage. Weight of reserve body fat does not cause any medical risks and provides a reservoir of energy for use by the body. Excess body fat is over and above the combination of essential body fat plus reserve body fat. Excess body fat causes the risk of serious health problems such as strokes, heart attacks, diabetes and certain forms of cancer. Excess body fat stored in abdominal cavity and internal organs is called visceral fat. One of the health problems which excess visceral fat causes is long-lasting inflammation, which may increase the risk of chronic disease. The portal theory can help explain why it can be harmful [9]. The portal theory refers to a concept which explains that the liver is exposed to higher amounts of FFAs (free fatty acid) and/or pro-inflammatory factors which visceral adipose tissue releases directly into the portal vein causing the development of hepatic insulin resistance and hepatic steatosis. This concept is promoted by the fact that omental and mesenteric adipose tissue could have unique properties compared with subcutaneous adipose tissue such as altered production and secretion pattern of adipocytokines in obesity [10]. In addition, ectopic storage of fat in tissues found in liver and skeletal muscle seemed to play a major role in causing the insulin resistance and type 2 diabetes and a lower storage capacity particularly the one of portally drained adipose tissue could overload the liver with lipids leading to ectopic

fat accumulation [9]. Too much excess body fat stored in the body may lead to overweight which will become obesity which causes many health risks. The Policy and Strategy Section, Bureau of Non-Communicable Disease, Ministry of Public Health reported that the prevalence of NCDs behavioral risk factors namely overweight and obesity has increased continuously from 2005 to 2015. The prevalence of overweight increased from 16.1 (2005), 19.1 (2007), 21.3 (2010) to 30.5 (2015) while the prevalence of obesity increased from 3.0 (2005), 3.7 (2007), 4.4 (2010) to 7.5 (2015). In 2016, they are estimated to account for 71% of 5 million global deaths and 74% of all deaths in Thailand. According to the WHO's findings, it is found that over the last 10 years, they are the major causes of death among Thai population; 14 million are suffering and 300,000 passed away based on global mortality rate, all ages, both genders. The prevalence has been increasing constantly because of sedentary lifestyles, consuming too strong flavored food, stress accumulation [3].

Thai government is very concerned about the risks of the new world syndrome in health care. So, the goal of Thai government is to protect, to promote, to maintain health for well-being, to prevent disease, disability, and deaths as well as to evaluate health loss or health gap. WHO explains Disability-Adjusted Life Year (DALYs) as the sum of years of potential life lost due to premature mortality and the year of productivity life lost due to disability of Disability-Adjusted Life Years [11, 12]. In Thailand, DALYs is a key performance index in health gap which refers to quantifying Years of Life Lost due to premature mortality (YLLs) and Years of Life lost due to Disability (YLDs). It was found that DALYs of Thai population in 2556 was equal to 10.6 million years in which the health loss of males was 1.4 times higher than that of females (6.1 million years for males and 4.5 million years for females [13]. According to top 20 DALYs in 2014, NCDs were the top 2 in males second to traffic accidents while NCDs were the number 1 in females. According to the 5th survey of the health of Thai population through physical check-up in 2014, prevalence of

diabetes increased from 6.9 % in 2009 to 8.9% or 4.8 million people over the past 5 years with an average increase of 300,000 people per year while the prevalence of overweight rose from 34.7% in 2009 to 37.5%. It was found that social changes such as urbanization, marketing strategies, technologies and communication advancements all facilitated people and their lifestyle behaviors causing more people to suffer from NCDs [14]. The type of work as sedentary work includes government officials and non-government employees who have physical inactivity, the lack of exercise and nutritional deficiencies especially in urban areas causing the signs and symptoms of overweight and obesity leading to NCDs [3]. Preventive measures against risk of chronic disease, overweight and obesity can prevent NCDs. Thai government has offered health campaign policies to provide the health promotions as preventive measures. For example, in the year 2002 as “the Year of Health Promotion”, “the Power of Exercise” event was first held by the Ministry of Public Health. Recently, in 2016, a program was called ‘Flat belly to good health Policy’[15]. The government campaigns on health promotions have been implemented continuously in both governments sector, state enterprises and urban, rural areas. It seems that waist circumference, one of the key performance indexes, has not met the national government criteria yet. A high level of waist circumference refers to a high visceral fat because of physical inactivity. Referring to the portal theory, it explains that visceral fat is harmful and promotes long-lasting inflammation, which may increase the risk of chronic disease [16]. To prevent the risks of chronic disease, overweight, metabolic syndrome leading to NCDs, waist circumference and visceral fat should be in standard range while waist to hip ratio should be less than 0.9 [17-19] and visceral fat from body compositions analyzer should be less than 1.0 for male participants in this study. When the populations are healthy, the overall health of the whole population will reduce the burden of their family, health care providers and the expenses for medical treatments. Previous studies have been

carried out on eating behaviors. For instance, the researchers discovered that individuals living in high-socio-economic status (SES) communities were more concerned and selective about their healthy eating behaviors than those living in lower-socio-economic status communities [20]. Based on the findings from another previous study, the researchers found that there were four major issues under consideration which included food choices, quantities and portion control, physical activity and burden when the participants tried to maintain their weight [21]. The campaign by Thai Health Promotion Foundation has recommended a healthy portion per meal for Thai populations which is based on 2:1:1 plate model consisting of two parts of vegetables, one part of carbohydrate and one part of protein [22]. There are still other health promotion campaigns from Thai health to reduce the risks of office syndrome, NCDs including exercise campaigns called active living for all to promote physical exercise or posture changes to reduce risks of office syndrome during work [22].

Many studies and systematic reviews have been conducted on obesity, weight loss program, body composition and the effects of an aerobic exercise program which is any type of cardiovascular conditioning and uses oxygen. One of the systematic reviews investigated obesity, weight loss program, body composition and the effects of an aerobic exercise program without hypocaloric diet on body composition to reduce visceral fat [23]. The values and the benefits of exercise in workplace have become increasingly popular research topics among international researchers. It is believed that exercise during work hours can enhance productivity and performance of employees. For instance, a team of researchers from Leeds Metropolitan University conducted a research study on the effects of daytime exercise among office workers who can do exercise at a company gym. The researchers recruited volunteer employees from various companies as research participants and asked them to record their performance every day. Moreover, more

and more international companies encourage their employees to do regular exercise by imposing compulsory exercise at their workplace to promote productivity. To demonstrate, many international companies aim to promote productivity among employees. In Western region, the employees are asked to do weekly exercise in a gym near the headquarters. Regular exercise is a part of corporate culture. To support the benefits of regular exercise among employees, when employees did regular exercise on workdays, it benefited both the employer and the employee who became healthier and more focused. The researchers also suggested that after the employees did regular exercise, work place exercise could promote physical fitness which could reduce work absences. The research results revealed that the participants could have more effective time management, better communications with their colleagues and they became more productive. Most importantly, they felt more satisfied after they finished their work [14].

The internet is a popular method of communication which helps connect billions of people worldwide. Approximately 4.4 billion people seemed to be active internet users in April 2019, which accounted for 58% of the global population. In 2018, Asia was the region with the highest number of online users accounted for 2 billion people [24]. Social media management platform Hootsuite and global agency conducted a global digital report 2019 on the internet usage in Thailand and found Thailand ranked number 1 for mobile banking users, second for ownership of cryptocurrency and third in mobile commerce. From 69.24 million of total population, 92.33 million are mobile subscriptions; 57 million are internet users; 51 million active social media users and 49 million mobile social media users [25]. In urban and suburban society in Thailand, most people use the internet as a part of their daily lifestyle. It is known that urban society and living conditions are the factors which limit most people living in cities and suburban areas from physical activity and social face-to-face social interaction. In the age of communication in 21st century,

online communication plays a major role in connecting more than 4,000 million people worldwide through interposed and mass communication; smartphones are the main tools used to access the internet easier. The more smartphones people use, the more often they can access the social media. Nowadays, more than 3,000 people worldwide access and update social media through smartphones. The world's top 5 most popular applications are WhatsApp, Facebook, Viber, WeChat and Line. It was found that 46 from 51 million of Thai populations access social media regularly. The top 5 online activities they do are chat (77%), video (75%), games (66%), mobile banking (56%) and mobile map (64%). The most popular application among Thai populations is Line application [26]. However, the health promotion campaigns the government has introduced are interesting and beneficial but it was found that the reports of physical check-up over the last 3 years of Thai army male officers aged more than 35 years old who do sedentary work and lifestyles, consume fast food and street food as well as experience urban traffic congestion indicated overweight and obesity with the risks of diabetes type 2, cardiovascular disease and other NCDs found to become major health problems in this group. To reduce such risks found the reports of physical check-up of this group aged between 35 and 45 years old, the intervention program aims to lose waist circumference (WC), waist to hip ratio (WHR), body compositions for health benefits or to prevent further NCDs. The intervention program has integrated aerobic (cardio) exercise, health education developed from the health promotion campaigns by the government and the technology which Thai populations use regularly and are familiar with so that the intervention program can motivate, encourage participants and reduce stress among them. The activities from this intervention program will improve health and key performance index which can be measured by the innovation of Body Composition Analyzer which develops technology for measuring Visceral Adipose Tissue (VAT) accumulation risk by Bioelectrical Impedance Analysis (BIA) compared with image

analysis by Magnetic Resonance Imaging (MRI) creating a higher correlation of more accurate VAT estimation and which Thai army male officers have never known nor used before. This study aims to evaluate the effects of intervention on body composition to reduce visceral fat and waist circumference among Thai army male officers at Support Office Armed Forces Development Command under the exercise and health education program which integrates the relationship of colleagues and an exercise suitable for corporate culture by Line application.

1.2 Research gap

Army divides army officers into combat units which have daily physical training schedule and support units which require sedentary work such as working on computers and documents during office hours. There have been no known studies on the preventive measures against overweight among middle-aged male officers in support units. Based on the annual checkup reports from 2016 to 2018, it was found that there was a trend of a higher number of unhealthy BMI among army male officers in support units. However, there are limited studies which offer programs to study the effects of aerobic exercise and health education program on body composition parameters namely waist circumference and visceral fat, plus knowledge of health education to reduce visceral fat and waist circumference among Thai army male officers at Support Office Armed Forces Development Command which integrates the relationship of colleagues and an exercise suitable for corporate culture by Line application.

1.3 Research question

Are there the effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command?

1.4 Research objective

General objective:

To evaluate the effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command

Specific objectives:

1. To compare general characteristics of intervention and control group
2. To evaluate changes of visceral fat, waist circumference and knowledge score of health education before and after program among both groups
3. To compare changes of visceral fat, waist circumference and knowledge score of health education between intervention and control group after receiving the program
4. To compare changes of visceral fat, waist circumference and knowledge score of health education within intervention and control group after receiving the program
5. To compare changes of visceral fat, waist circumference between intervention and control group at base line, three-month and six-month

1.5 Research hypothesis

Ha: There are significant effects of visceral fat, waist circumference and knowledge score of health education before and after program among both groups

Ha: There are significant effects of visceral fat, waist circumference and knowledge score of health education between intervention and control group after receiving the program

Ha: There are significant effects of visceral fat, waist circumference and knowledge score of health education within intervention and control group after receiving the program

Ha: There are significant effects of visceral fat, waist circumference between intervention and control group at base line, three-month and six-month

1.6 Operational definitions

Age: Range between 35 and 45 years old of the participants who meet inclusion criteria.

Education: The highest formal education graduated by the participants.

Marital status: It indicates whether the participants are single, married, divorced or separated.

Income: It is the monthly revenue the participants earn from the government.

Alcohol consumption:

In this study, the participants will be required to answer their alcohol consumption under alcohol guidelines which recommend no more than six pints of beers or seven glasses of wine.

Food choices, quantities, or plate model:

This study will offer health education and introduce a plate model (2:1:1 ratio) which consists of 2 portions of vegetables, 1 portion of rice and 1 portion of lean meat/plate so that the participants will apply it into their daily food consumption without restricted diet under the program.

Six-months aerobic exercise and health education program:

The intervention program will be performed on Mondays, Wednesdays, and Fridays between 15.00 and 1600 p.m. This study will implement a six-month aerobic exercise in which the participants will practice four positions/session, three days/week (150 minutes/week) Plus Thai-style warm-ups, workout and cool-downs, the six-month exercise and health education program is a program which integrates the aerobic exercise together with health education. This exercise program consists of 10-minute Thai-style dynamic stretching for warm-up and cool-down, the four positions of the exercise namely squat, high knee, plank and jumping jacks. Health education consists of 3 parts: part 1 body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, part 2 Food choices and plate model, part 3 the benefits of aerobic exercise; it will be given to the intervention group in classroom and then the intervention group will be divided into nine groups; one group consisting of six-seven participants including the trained researchers' assistants as the team leaders who motivated, received feedbacks or suggestions from the participants, summarized them within their own groups and sent them together with group photos to the researchers' team through Line application during the program. Intervention group can access health education by line group to see the information and picture of three parts from exercise program.

Aerobic Exercise:

This study will implement a six-month aerobic fitness referred to the ability of a body to perform long low intensity workouts while the participants will practice

four positions/session as physical training exercise, three days/week (150 minutes/week) and warm-ups and cool-downs will use under Thai-style.

Body composition:

Body composition is a health-related component of physical fitness which applies to body waist circumference, weight and relative amount of muscle, fat, bone and water to other important tissues of the participants in this study.

Visceral fat:

It is body fat stored within the body, abdominal cavity and around many important internal organs including pancreas, the liver and intestines while subcutaneous fat is stored under skin, arms and legs. The optimum body fat is stored for protection against infectious diseases, fuel for energy but higher excess fat will be transferred to the higher amount of visceral fat individuals stored in their bodies, the higher risks of many health problems including type 2 diabetes which they will have. In this study, the report of eligible participants will show individual visceral fat analyzed by the body composition analyzer.

Waist circumference:

In this study, the reports of eligible participants from annual physical checkup in 2018 will show waist circumference which is not in the standard range. A possible indicator of visceral fat is to take a waistline measurement because the size of human belly is a reliable indicator of health risks related to visceral fat.

Army male officers at Support Office Armed Forces Development:

The army male officers at support units who had annual physical checkup in 2018 relevant to the inclusion criteria are the eligible participants at Support Office Armed Forces Development.

Body Composition Analyzer:

Body Composition Analyzer is the measurement tool which develops technology for measuring Visceral Adipose Tissue (VAT) accumulation risk by Bioelectrical Impedance Analysis (BIA) compared with image analysis by Magnetic Resonance Imaging (MRI) creating a higher correlation of more accurate VAT estimation. This research will use TANITA Body Composition Analyzer DC-360.

Leisure activities or usual exercise:

Refers to the physical activity of each unit considered by its nature and responsibilities Main combat sections have the combat training schedules with the objectives to promote physical and mental performance ready for missions. Support sections such as the support office armed force development command, each section is responsible for supporting administration such as financial documents and budgets. The officers under support sections manage their leisure time to do unplanned exercise or leisure activities depending on their workload and sports interests without any exercise program to support on Wednesday's afternoon (14.00-16.00).

Underlining disease or chronic illness in this study:

Disease or chronic illness includes cardiovascular disease, respiratory disease and other diseases affecting the ability to do exercise.

CHAPTER II

LITERATURE REVIEW

2.1 Overweight

The World Health Organization defines health as a “state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. According to World Health Statistics 2018, it revealed that although the risks of possible death from main NCDs as new world syndromes among global population aged between 30 and 79 declined slightly from 22% in 2000 to 18% in 2016, preventive measures to reduce key factors including unhealthy diet and physical inactivity would be required to achieve the SDG (Sustainable Development Goals) targets of reducing premature NCD mortality by one third in 2030 [13]. Unhealthy diet, physical inactivity and the lack of exercise among global populations may cause them to have body composition which is not within standard range to gain more weight resulting in overweight and obesity as the root causes of NCDs. WHO also refers overweight and obesity as “abnormal or excessive fat accumulation that presents a risk to health” [14]. WHO estimated that in 2016, more than 1.9 billion adults aged 18 years or older were overweight and of these over 650 million adults were obese. The worldwide prevalence of obesity almost tripled from 1875 to 2016 [27]. When people take in more calories they can burn on daily basis, they will become overweight. Excessive calories they gain will be stored as fat in various body parts. So, human bodies converse the fat in specialized fat cells known as adipose tissues through enlarging fat cells or creating more fat cells. People can lose weight by reducing food intake with low calories and doing regular exercise. As a result, people will become slimmer because fat cells shrink or become smaller [28].

There are more concerns over increasing overweight, obesity and diet-related health risks. Although Thailand has become one of the leaders in Southeast Asia

because of its urbanization and economic development, its setbacks along with such development include sedentary work, car use, a higher calorie-dense national diet which contains more salt, sugar and fat [29, 30] A recent study was conducted on relationship between 8-year weight change, body size, and health in a large cohort of adults in Thailand. The researchers concluded that weight change especially weight gain seemed to be correlated to negative health outcomes and could result in higher levels of body size. They suggested that health promotion programs should emphasize preventing weight gain and addressing adverse health effects [31].

According to WHO report in 2003, an imbalance between lower energy expenditure because of physical inactivity and an energy-dense, nutrient-poor diet could cause overweight, obesity and diet-related NCDs [32].

Thailand and other Asian countries are experiencing the situation called nutrition transition in which eating patterns are changing from a traditional Asian diet based on plant and minimally processed food to a more Westernized diet based on higher consumption of animal products and ultra-processed food with high levels of salt, more sugar, saturated fat and an increasing energy intake. Westernized diet is suitable for western people because of their socio-demographic and weather conditions [33]. Normally, human bodies need essential body fat to protect them from infectious diseases and internal organs from bruising damage. They also need reserve body fat to provide a fuel supply which is additional body fat and does not cause any medical risks. Asian people and western people require different levels of reserve body fat depending on socio-demographic and weather conditions. The amount of body fat which is over and above the combination of essential body fat and reserve body fat is called excess body fat which causes the risk of serious health problems. The excess body fat stored in abdominal cavity and internal is known as visceral fat but the excess body fat stored under the skin is known as subcutaneous fat. The balance of calories consumption is defined as how many calories human

body is required to take and burn depends on various factors including environment, daily physical activity, genetic makeup and rest energy expenditure. So, such balance is the key to good health and the prevention against overweight and obesity [34].

Energy balance constitutes three main components: energy intake, energy expenditure and energy storage. Humans may gain or lose body weight when energy intake is not equal to energy expenditure for a period of time. They use up energy through resting metabolic rate (RMR), an amount of energy required to sustain the body at rest; the thermic effect of food (TEF), the energy cost of absorbing and metabolizing food eaten and the energy expended via physical activity (EE_{pa}) RMR is based on body mass especially the amount of fat-free mass while TEF is based on the total food eaten; physical activity encompasses the amount of physical activity performed multiplied by the energy cost of that activity [35]. When energy intake is equal to energy expenditure, the body seems to be in energy balance and body energy is constant. However, when energy intake is higher than energy expenditure, a state of positive energy balance happens leading to an increase in body mass of which 60% to 80% is normally body fat [36]. A combination of behavioral and environmental risk factors may contribute to overweight, obesity and diet related NCDs. Behavioral risk factors are excessive dietary energy intake and dietary imbalances including food high in salt, more sugar, saturated fat but insufficient fruit and vegetables [3, 37].

Environmental risk factors such as highly energy-dense foods available to buy everywhere play a major role in dominating dietary behaviors [38]. There are various risk factors contributing to overweight and obesity. One of many related risk factors causing overweight and obesity is age. When people become older, they tend to eat less and become less hungry even if they are healthy. This condition of physiological, age-related reduction in appetite and energy intake is known as the anorexia of aging. Aging may be correlated to body weight gain in people who still have high food

intake despite their age-related decline in energy expenditure. Elderly people aged 70 years or over may experience weight loss because they do not consume enough to meet energy demands [39]. In fact, body weight seems to increase from early adult life to middle age, which demonstrates that food intake is higher than energy expenditure during this period. However, aging may decrease body weight in elderly people because of a lower level of food intake compared to energy expenditure in senior years. When they become older, they will have a constant increase in fat stores but a decline in fat-free mass because of the loss of skeletal muscle. So, elderly people may have more body fat than young adults [40]. The National Health Examination Surveys announced that the prevalence of obesity (body mass index (BMI) higher than 30 kg/m^2) among Thai male adults aged 20-59 years old increased from 1.7% in 1991 to 6.8% in 2009. A previous study reported the trends in the prevalence of obesity among young Thai men and associated factors from 2009 to 2016. The researchers recruited male conscripts as participants. They concluded that obesity could pose a serious problem among young Thai men but regular exercise should be performed so that it could slow down the process of obesity which will lead to NCDs [41].



2.2 Basal metabolic rate

The Basal Metabolic Rate (BMR) is the rate of energy expenditure of a person at rest and it eliminates the variable effect of physical activity. BMR accounts for 60% of the daily energy use for normal body cellular homeostasis, cardiac function and other nerve functions. It is related to body weight by the calculation: $\text{BMR (Cal/d)} = 24 \times \text{Body weight (kg)}$. A passive increase in energy expenditure happens when humans digest food. CJK Henry in 2015 referred to BMR as the daily rate of energy metabolism an individual needs to sustain in order to preserve the integrity of vital functions. The concept of basal metabolism was proposed to standardize

measurements so that individuals could be compared more accurately. BMR can be measured by a minimum rate of heat production without food consumption and extreme physical environments. According to the FOA/WHO/UNU report on Energy and Protein Requirements, it proposed two main purposes of determining energy requirements which were to give recommendations about the consumption level needed for populations to maintain and to offer diagnostic purposes for sufficient food needs in populations. So, a major aspect to estimate the total energy expenditure was to estimate BMR [42]. Body size is a major indicator of 24-hour energy expenditure and BMR, which is constant for short periods of time but energy intake can be high, medium or low each day [43]. The energy expenditure in adults constitutes 4 components including BMR, physical activity (22-30% of total energy expenditure), food induced thermogenesis (10-15% of total energy expenditure) and growth (less than 2%) [44].

A recent study was conducted to propose that adults with a higher BMR and higher energy requirements might display higher eating rates. The researchers concluded that the variations of participants' BMR seemed to be associated with eating rates [45]. Another study reported that adults with low BMRs did not gain more weight than those with high BMRs, which could be explained by individual differences in calories consumption or activity counterbalance variations in BMR as a risk factor for weight gain among Western population [46].

2.3 Relevant literature review on exercise

To prevent the root causes and reduce the risks of NCDs, regular physical exercise is essential to maintain weight and to stay healthy. In particular, physical exercise which is a good way to reduce visceral fat should include cardio exercise such as running, swimming and strength training such as squats, high knees, planks

and pushups [47]. A large body of research has been carried out to verify the effects of 3-month aerobic exercise programs. For instance, the study conducted a systematic review and meta-analysis of the effect of aerobic vs. resistance exercise training on visceral fat. The researchers pointed out that the location of excess adiposity especially a large amount of visceral adipose tissue (VAT) might be significant to determine the negative health effects of overweight and obesity [48]. The researchers evaluated the effects of aerobic exercise (AEx) and progressive resistance training (PRT) and to directly compare the efficacy of AEx and PRT for beneficial VAT modulation. The researchers suggested that aerobic exercise tended to be fundamental for exercise program to reduce VAT and aerobic exercise under present recommendations for overweight or obesity management might be adequate to modify VAT [48]. Another research study was done on a dose-response relation between aerobic exercise and visceral fat reduction: systematic review of clinical trials by Ohkawara in 2008. The researchers attempted to establish whether the reduction of visceral fat by aerobic exercise had a dose-response relationship. They discovered that minimum 10 MET (metabolic equivalents x h per week) x h/w in aerobic exercise including brisk walking, light jogging or stationary ergometer usage was necessary to reduce visceral fat. The results confirmed that there was possibly a dose-response relationship between aerobic exercise and visceral fat reduction in obese participants without metabolic-related disorders [49]. The study of investigated the preferential loss of visceral fat following aerobic exercise, measured by magnetic resonance imaging (MRI) [49]. The researchers aimed to study the influence of regular moderate exercise with no dietary intervention on adipose tissue distribution in non-obese healthy women. They concluded that moderate aerobic exercise over 6 months induced a preferential loss in visceral fat among non-obese healthy female participants and this could help to explain the health benefits related to regular and moderate physical activity[50]. The study determined the effect of exercise on

visceral adipose tissue in overweight adults through a systematic review and meta-analysis. The researchers aimed to describe the overall effect of exercise on visceral adipose tissue and to provide an overview of the effect of different exercise regimes, without caloric restriction, on visceral adipose tissue in obese participants. They concluded that an aerobic exercise program without restricted diet could provide positive effects to reduce visceral adipose tissue with more than 30 square centimeters among women and more than forty square centimeters among men after 12 weeks [51]. Exercise or physical activity through energy expenditure may affect the energy balance equation with its potential to create an energy deficit but energy expenditure also affects the control of appetite and energy intake. So, this dynamic interaction indicates that it will be complicated to predict the shift in energy balance and weight change. Exercise seems to have an effect on the biological mechanisms controlling appetite which is influenced by fat mass, fat-free mass, resting metabolic rate, gastric adjustment to ingested food, changes in episodic peptides such as insulin, ghrelin, CCK, GLP-1 and PYY as well as tonic peptides like leptin. Exercise could impact these components which lead to the drive to eat via the regulation of hunger and adjustments in post-prandial satiety via an interaction with food composition. So, the particular effects of exercise may be different among people based on their physiological characteristics as well as the duration and the intensity of exercise [52]. Overweight women who participated in structured physical activity were reported to gain benefits including weight loss, better strength and fitness, adherence and improvements in psychosocial health and well-being [53]. Another study investigated the experiences of an exercise intervention program which focused on group exercise, provided a framework to promote psychological needs, physical competence and skill acquisition among overweight female participants. The findings showed that the program could give the participants meaningful perspectives in relation to a physical activity program [54].

2.4 Body composition

From birth to adulthood, the chemical maturation of lean mass, a crucial part of body composition, happens but the relative ratio of the three major components namely water, protein and mineral changes depending on age and pubertal status. Body composition and growth are major components of health among individuals and populations. The significance of body fat for short-term and long-term health has become more central due to the widespread epidemic of overweight and obesity in children and adults [55].

Body composition is a health-related component of physical fitness which applies to body weight and relative amount of muscle, fat, bone and other important tissues of the body. The components are limited to fat and lean body mass (or fat free mass) and expressed as relative (percentage) and absolute (kilograms) [56]. Body composition stands for the components which make up the human body. So, body composition techniques tend to be much more accurate evaluations of the body compared to human weight or BMI. Such techniques could be used to reveal the relative proportion of fat and lean mass in the body [57] and to evaluate training or effectiveness of nutritional intervention [58].

Different methods are currently available to measure body composition but the most common techniques could be done by using the two-component (fat and fat-free mass) approach[59]. The techniques could be divided into two types which are direct and indirect measures. Direct analysis requires a corpse to be dissolved in chemical solution to separate its mixture of fat and fat-free components [60].So, indirect methods which are more widely used include skinfold thickness used to classify individuals into relative fatness and bioelectric impedance measurements and two component methods which could separate fat mass and fat free mass from the body [61]. Therefore, most body composition methodologies seem to be based on the assumptions concerning the density of body tissues, concentrations of water

and electrolytes and/or biological interrelationships between body tissues and components together with their distributions among healthy populations. However, similar assumptions tend to be inapplicable among obese populations or those with chronic disease since their metabolic and hormonal problems with co-morbid conditions [62].

2.5 Visceral Fat

Body fat is defined as “adipose tissue” in a scientific term. Human body requires body fat to protect his health, to secrete important hormones and to supply lipids from which the body creates energy so that human body can perform its functions [63, 64]. The total weight of body fat is divided into 3 different types which are essential body fat, reserve body fat and excess body fat. The essential body fat is needed to protect human body from infectious diseases and to protect the internal organs from bruising damage. The reserve body fat offers a supply of fuel ready to use by the body. The excess body fat is an extra amount of fat which is over the combination of the essential and reserve body fat could cause the risk of serious health problems including diabetes, strokes, heart attack and some forms of cancer. When the human body stores excess fat, individuals with excess fat may become overweight and the risks of death will increase sharply [65]. In fact, excess body fat could cause the condition of being overweight and obesity. It should be noted that being overweight does not mean an excess of body fat since body weight can consist of many factors such as body fat, muscle, bone density and water content. Therefore, highly muscular individuals are often classified as overweight [63, 64].

There are two types of adipose tissues: white and brown, both of which have histological and functional differences. White adipose tissue is subdivided into 2 types: subcutaneous and visceral (intra-abdominal). Subcutaneous adipose tissue can be found under the skin including the upper (abdominal, subscapular fat), and lower

(gluteal-femoral fat) body part and it preserves 80% of total body fat. Visceral fat can be found in the internal organs and consists of 20% of total body fat [66]. It is related to insulin resistance (IR), high blood pressure, triacylglycerol levels and higher risk of diabetes and cardiovascular diseases [67, 68]. Visceral fat is body fat stored within the abdominal cavity and around many important internal organs including pancreas, the liver and intestines while subcutaneous fat is stored under skin, arms and legs. Visceral fat is also considered as ‘active fat’ or ‘intra-abdominal fat’ since this type of fat can possibly affect how human hormones function. The higher amount of visceral fat individuals stored in their bodies, the higher risks of many health problems including type 2 diabetes they will have [68]. Storing some body fat is healthy and normal but excess visceral fat can be harmful as it causes serious health problems [47]. One of the health problems which it causes is long-lasting inflammation, which may increase the risk of chronic disease.

The “portal theory” can help explain why it can be harmful [10]. The ‘portal theory’ refers to a concept which explains that the liver is exposed to higher amounts of FFAs and/or pro-inflammatory factors which visceral adipose tissue releases directly into the portal vein causing the development of hepatic insulin resistance and hepatic steatosis. This concept is promoted by the fact that omental and mesenteric adipose tissue could have unique properties compared with subcutaneous adipose tissue such as altered production and secretion pattern of adipocytokines in obesity. In addition, ectopic storage of fat in tissues found in liver and skeletal muscle seemed to play a major role in causing the insulin resistance and type 2 diabetes and a lower storage capacity particularly the one of partially drained adipose tissue could overload the liver with lipids leading to ectopic fat accumulation [9]. The rate at which body fat accumulates varies from person to person and depends on many factors namely genetic factors and behavioral factors including excessive food intake and the lack of exercise. So, it would be difficult for

people to reduce body fat stored in the abdominal region but it seems that healthy diet and exercise can reduce stored fat including visceral fat [63]. A previous study on visceral fat and insulin resistance showed that white adipose tissue facilitates metabolic regulation by producing a wide range of hormones and cytokines known as adipokines. The quantity of adipokines created by adipose tissue in obese patients is both directly and indirectly associated with obesity-related pathology including cardiovascular disease, type 2 diabetes and inflammatory reaction. One of the mechanisms involving obesity, diabetes and cardiovascular diseases is inflammation found in visceral adipose tissue. The researchers proposed that obesity could be treated by conservative or non-surgical approaches or surgical bariatric procedures. Conservative approaches are considered as complex therapies which encompass cognitive behavioral therapy, diet therapy, nutritional education, more physical activity and pharmacotherapy. In contrast, surgical bariatric procedures could be performed only when body mass index value had to be over 40 or at least over 35 for the cases of serious obesity-related co-morbidities [69].

2.6 Waist circumference

A possible indicator of visceral fat is to take a waistline measurement because the size of human belly is a reliable indicator of health risks related to visceral fat [68]. Overweight and obesity are normally associated with larger amounts of intra-abdominal or visceral fat. A centralized fat is related to the deposition of intra-abdominal and subcutaneous abdominal adipose tissue [70]. Waist circumference could provide a basic measure of central fatness, which may be used as a predictor of negative outcomes including lipid profile or insulin resistance better than total fat. In adults, waist-hip ratio tends to be independently related to morbidity after the change for relative weight. So, the combination of relative weight and body shape offers a better estimate of the morbidity risks than either one only [71, 72].

Individuals with higher percentiles for waist circumference are classified as obese with higher risks for morbidity particularly type two diabetes and metabolic syndrome and mortality [73]. The standard formula of measuring waist circumference is individual height divided by two. The study conducted the prediction of whole-body fat percentage and visceral adipose tissue mass from five anthropometric variables including BMI, WHtR, waist-to-height ratio, waist circumference and waist-to-hip ratio. The researchers concluded that the best predictor of both %FM and VAT mass in men and women was WHtR (the waist-height ratio) determined by dividing individual's waist by his height. The WHtR metric could offer many advantages. It could be easier to calculate than BMI and it may work for general populations regardless of their age, race or gender. An individual can use a measuring tape or string to measure his height and fold it in half and check to see if it fits around his waist [74].

2.7 Waist-to-hip ratio

A previous study on central adiposity and the overweight risk paradox in aging investigated the associations between combined measurements of BMI and waist-to-hip ratio (WHR) with mortality and incident coronary artery disease (CAD). The researchers discovered that models which included BMI and WHR were more informative and accurate than models which included BMI only. The participants with a normal BMI but higher WHR had higher mortality compared to those with a lower WHR and overweight participants with a higher WHR could have much higher risks for all-cause of mortality compared to those with a normal BMI and lower WHR. So, BMI only could not classify older adults as being overweight because it could not detect central adiposity as an indicator of being overweight. The researchers suggested that controlling or decreasing adiposity may help increase the chances of aging well [75]. Another study was conducted on appropriate Body Mass Index and Waist-Hip Ratio

cutoff points for overweight and obesity in adults of Northeast China. The researchers used BMI and WHR as their measurement tools. The results revealed that WHR increased with age in both genders. The WHR of male participants were slightly larger than that of female participants [76]. Moreover, WHO guidelines in 2008 indicated that alternative measures including WC, WHR and waist-to-height ratio (WHtR) used to reflect abdominal obesity were found to be superior to BMI [7]. A study carried out in Chinese population stated that WC was found to be the best obesity measurement but WHR might be used as an alternative obesity indicator [77].

2.8 Resistance training

Resistance training refers to any exercise which causes human muscles to contract against an external resistance such as dumbbells, bricks, body weight in order to increase tone, strength, mass and endurance. The examples of resistance training include Olympic lifting, power lifting and weightlifting. It works by doing microscopic damage or tears to the muscle cells forcing the body to repair them and make them stronger [78, 79]. Previous studies verified that short sessions of regular resistance training at least two or three days a week may provide many health benefits including muscle mass for adults of all ages [80, 81]. Moreover, resistance training could have dual effects on resting metabolic rate. First, it requires an acute response causing tissue micro-trauma which needs large amounts of energy for muscle remodeling processes which will last for seventy-two hours after the training session. Second, it requires a continuous response because it could create greater muscle mass which needs more energy at rest to maintain ongoing tissues [82].

Various studies indicated that resting metabolic rate or basal metabolic rate increased significantly approximately 7% after many weeks of resistance training [83]. Concerning the overall body fat, the resistance training could help the participants lose approximately 1.8 kilograms of fat weight and gain approximately 1.4 kilograms

of lean weight [84]. The resistance training seemed to help reduce intra-abdominal or visceral fat among older women [85]. It could promote cardiovascular health [86] and lower the risks of metabolic syndrome[87]. So, the resistance training may be effective in promoting physical and mental health because various studies reported that it could create positive changes in self-esteem, a global concept of individual's view of himself, among cancer patients[88]and reduce depression symptoms among adults suffering from them [89].

2.9 Aerobic exercise

Aerobic exercise and cardio exercise may share the similar types of effect known as endurance training because both can help promote endurance, which helps keep human heart, lungs, circulatory system healthy and improve the overall physical fitness [90]. The exercises which are considered as aerobic and cardio range from swimming, jogging, running, dancing, bicycling, playing tennis because these exercises are aerobic as they provide strength, the ability to move around and physical fitness by improving the oxygen intake. Moreover, these exercises are cardio as they can help improve the heart rate. Both exercises are performed at the same time as the respiration rates and heart rate increase altogether. Aerobic fitness refers to the ability of a body to perform long low intensity workouts which does not include the power performance while cardiovascular fitness explains about the ability of your heart to pump blood to the muscles which require it, especially during the short intensity workouts and weight training. So, it is recommended that primary exercise which could provide the optimal aerobic and cardio fitness are running, jogging, swimming, cycling, high knees, jumping jacks, squats and so on [91]. In a previous study, the overweight and obese participants performed aerobic exercise sessions daily for 12 weeks. The researchers reported an average weight loss of approximately 3.3 kg and the average body fat was 3.3 kg as well but the change in

body composition varied considerably among the participants [92]. The effects of aerobic, resistance and combined aerobic and resistance training among adults with type 2 diabetes were determined in another study. After the participants performed the combined exercise intervention, the researchers found significant declines in body mass index (BMI), body weight and abdominal subcutaneous fat in both aerobic and resistance groups compared to control group [93].

A team of researchers conducted a clinical study to investigate the effect of moderate intensity of aerobic exercise (brisk walking with light logging) on the interactions between central abdominal adiposity, myocyte lipid content and insulin action in overweight and obese sedentary male participants. They performed the aerobic exercise 40 minutes per session, 4-5 days a week for at least 6 consecutive weeks. Exercise intensity was target at 55-70% Vo_{2max} measured by heart rate monitoring. The findings showed that central abdominal fat decreased by 5%; mean aerobic capacity increased by 11% while mean whole body insulin-stimulated glucose uptake and basal fat oxidation rate increased by 16% and 41%. The researchers concluded that a moderate-intensity aerobic exercise could improve aerobic capacity, reduce visceral fat and increase insulin sensitivity among overweight and obese sedentary male participants [94].

2.10 Health education

The World Health Organization has defined Health Education as "It comprises of consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills which are conducive to individual and community health" [95]. The 2000 Joint Committee on Health Education and Promotion Terminology referred to health education as "any combination of planned learning experiences

based on sound theories that provide individuals, groups and communities the opportunity to acquire information and the skills needed to make quality health decisions” [96]. Another definition was “any planned combination of learning experiences designed to predispose, enable and reinforce voluntary behavior conducive to health in individuals, groups and communities” [97].

Health education involves the continuum from disease prevention and promotion of optimal health to the detection of illness to treatment, rehabilitation, and long-term care. It encompasses infectious and chronic diseases together with attention to environmental issues. Health education can be promoted in most settings such as universities, schools, hospitals, shopping malls through mass media, the internet, and in health departments at all levels of government. Health education constitutes not only instructional activities and strategies to change individual health behavior but also organizational efforts, policy initiatives, economic supports, environmental activities, mass media and community-level programs. There are 5 levels of influence over health-related behaviors and conditions: 1) intrapersonal, or individual factors; 2) interpersonal factors; 3) institutional or organizational factors; 4) community factors and 5) public-policy factors [97]. Moreover, behavior affects and is affected by the social environment [97]. Health education mainly focuses on health behavior, which is a significant dependent variable in most research on the effect of health education intervention strategies. So, positive, informed changes in health behavior are the ultimate objectives of health education programs [98]. Health behavior refers to the actions of individuals, groups, and organizations as well as their determinants, correlates and consequences including social change, policy development and implementation, improved coping skills and better quality of life. Another definition of health behavior is those personal attributes including beliefs, expectations, motives, values, perceptions and other cognitive elements; personality characteristics namely affective and emotional

states and traits as well as overt behavior patterns, actions and habits related to health maintenance, health restoration and health improvement [98].

Health behavior is divided into 3 categories: preventive health behavior, illness behavior and sick-role behavior. Preventive health behavior means any activity performed by a person who believes in himself to be healthy and its purpose of preventing or detecting illness in an asymptomatic state. Illness behavior is any activity performed a person who views himself to be ill, to define the state of health and to find a suitable remedy. Sick-role behavior is any activity performed by a person who views himself to be ill and its purpose of recovering. It consists of receiving treatment from medical providers, which involves a wide range of dependent behavior and leads to the exemption from his usual responsibilities [99]. The study of Effects of Six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command: Quasi-experimental study will recruit the participants to perform preventive health behavior, which is one of the three categories of health behavior.

Attitude is defined as psychological construct, a mental and emotional entity that inheres in or characterizes a person. It influences the individual thoughts and actions [100]. In a previous study, attitude changes among many participants were paying more attention to health. For instance, they needed to be aware of the importance of nutrition and healthy surrounds, the danger of smoking, the importance of hygiene. They should be more health conscious by paying attention to their psychological health as well. Knowledge means familiarity, awareness or understanding of someone or something such as fact, information, descriptions or skills through experience or education by perceiving, discovering or learning. It also means a theoretical or practical understanding of a subject. It can be implicit or explicit, more or less formal or systematic. Health-related knowledge gains involved

more knowledge on safety, nutrition, hygiene, security, the harm of tobacco, how to avoid injuries and psychological knowledge including how to relieve anxiety and what is normal and abnormal [101].

2.11 Sample size calculation

The study conducted a quasi-experimental research study on “The effects of health promotion program and self-help group on preventive overweight behaviors among village health volunteers in LoeiNokTha district, Yasothon province”. The researchers recruited 43 participants divided into two groups which were an experimental group and a control group. The participants in the experimental group participated in the program. Regarding their findings, the mean scores of waist circumference of the experimental group before implementation, 4 weeks, 8 weeks and 12 weeks were significantly [102].

2.12 G*Power 3 statistical and power analysis program

Researcher conducted a research study on G*Power 3, a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. The researcher explained that G*Power was designed as a general stand-alone power analysis program for statistical tests widely used in social and behavioral research. So, G*Power 3 is a major extension of the previous versions. It provides three different but very similar routines to calculate power in the univariate approach for between effects, within effects and interactions. The researcher concluded that it seems to become a useful tool for empirical researchers and students of applied statistics and it is available for free [103].

2.13 Body Mass Index (BMI)

BMI has been used as a metric to define anthropometric height/weight characteristics among adults to categorize them into groups. Its interpretation is that it indicates an index of an individual's fatness. It is commonly used as a risk factor to determine the prevalence of several health issues and to plan public health policies because it is accepted in measuring certain types of body mass as a health issue. However, scientific evidence showed that BMI seems to be a poor indicator of body fat percent. In essence, BMI could not differentiate the information on the fat mass located in various body organs [104]. When BMI is used as an index of obesity, a problem arises because it could not separate body lean mass and body fat mass. This means that a person may have a high BMI but still have a very low-fat mass and vice versa [105].

Body Mass Index (BMI) is one of the most commonly used screening tools to measure and characterizes obesity status. A BMI of 25 to $<30 \text{ kg/m}^2$ is defined as overweight and BMI $> 30 \text{ kg/m}^2$ is classified as obesity [1]. Researcher investigated the limits of Body Mass Index (BMI) to detect obesity and predict body composition. Based on the research results, the researchers concluded that when impedance-derived body-fat mass was used as the criterion, people with BMI of at least 30 kg/m^2 were classified as obese. In contrast, a large number of people with a BMI below 30 kg/m^2 were also classified as obese but misclassified by BMI, which meant that the accuracy of the prediction was the lowest when the BMI was below 30 kg/m^2 . So, the researchers suggested that the measurement of body fat would be a more suitable method to measure obesity among people with a BMI below 30 kg/m^2 [106]. For screening in this study, the BMI of 23 kg/m^2 for the populations of Thailand is used as an appropriate cut-off level for being overweight supported a previous study [107].

2.14 Body composition analyzer

Body Composition Analyzer, which is safe, easy and highly precise by analyzing the body compositions including body water, muscle mass, fat mass, and bones by keying in the inputs such as body type, gender, age, height and clothes weight and which can measure the whole body accurately. It can analyze by measuring the resistance of low electrical voltage (1-2 volts) found in body tissues because body tissues have different levels of the resistance. This can allow the measurement tool to access the compositions of the whole body. Body Composition Analyzer is the measurement tool which develops technology for measuring Visceral Adipose Tissue (VAT) accumulation risk by Bioelectrical Impedance Analysis (BIA) compared with image analysis by Magnetic Resonance Imaging (MRI) creating a higher correlation of more accurate VAT estimation [108]. BIA has been more widely used to measure body composition since it is quite inexpensive, non-invasive and easy to operate. Because of its technological advancement and precise prediction equations, the body composition analysis by BIA could reveal similar levels of agreements with other standard methods or techniques [109, 110].

Current research has employed Body Composition Analyzer as the measurement tool. A team of researchers analyzed weight and body composition of the participants by applying BIA using the Tanita MC-780 multi-frequency segmental Body Composition Analyzer. They suggested that the ratio of Extracellular to Total Body Water might be used as the first, basic and fast index of water volume status in terms of nutritional status and water balance among older participants [111].

2.15 Healthy eating plate

Harvard Health Publishing together with nutrition experts at Harvard School of Public Health first introduced the Healthy Eating Plate in 2011. It provides a blueprint for eating a healthy meal and is similar to the U.S. government's MyPlate because it is simple and easy to understand. MyPlate is different from the Healthy Eating Plate since MyPlate does not inform consumers that whole grains are better for health than refined grains. In contrast, the Healthy Eating Plate reminds people to stay active as an important factor in weight control but MyPlate does not mention the importance of such activity. The Healthy Eating Plate is derived from reliable scientific study which indicates that a plant-based diet rich in vegetables, whole grains, healthy fats and healthy proteins could lower the risk of weight gain and chronic disease. The sections of the Healthy Eating Plate include vegetables, fruits, whole grains, healthy proteins, health oil and water. 1. People are recommended to consume a wide variety of vegetables. 2. They should consume a rainbow of fruits every day. 3. They should consume the whole grains such as oatmeal, whole wheat bread and brown rice. 4. They should consume healthy proteins including fish, poultry, beans, nuts which consist of healthful nutrients. 5. They should drink water, tea or coffee (with little or no sugar) and limit milk and dairy intake (1-2 servings per day), juice (1 small glass a day) and avoid sugary drinks [7, 34](**Figure 3**).

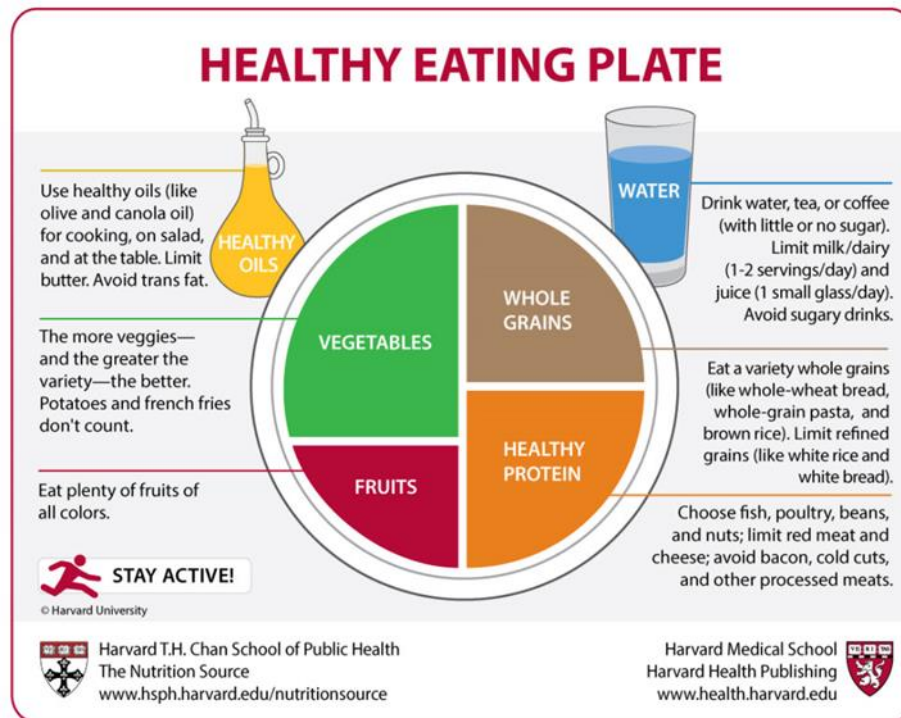


Figure 3. The Healthy Eating Plate

In Thailand, the 2:1:1 plate model was adapted from the US's Model called MyPlate to apply it to Thai food culture such as one single serving of rice with curry. One single serving portion will be a 9-inch plate divided into 4 sections: 2 sections of vegetables, 1 section of rice and 1 section of lean meat or protein added up with one small plate of low-sugar fresh fruits, 1-2 glasses of milk [22](Figure 4). This plate model is applied into this study so that the intervention group will learn how to select their own plate from the plate model education without restricted diet.

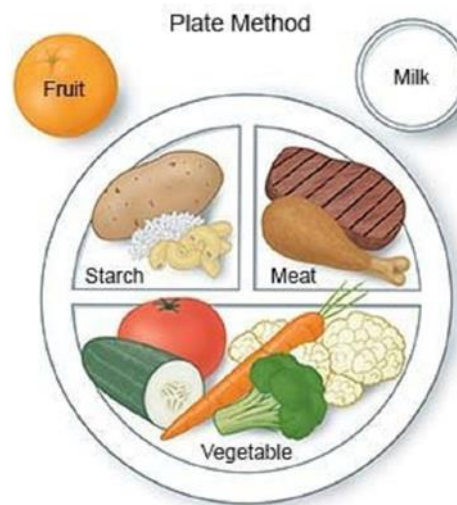


Figure 4. The 2:1:1 plate model

2.16 Smoking

There were more than twice as many smokers compared to obese people but recently there have been more obese people than smokers. From the review by the U.S. Surgeon General in 1990, it was found that 58%-87% of those quitters gained 4 pounds more than other smokers but it was rare to find the quitters who gained more than 20 pounds or more [112]. Smoking could affect body weight because of 2 main factors: preferences and the interdependence between smoking and eating behavior. Medical evidence has shown that nicotine tends to be an appetite suppressor acting on the central nervous system [113]. Its effect indicated that smoking may have a satiating effect on food consumption. Smokers who would smoke mainly in social contexts including bars, parties, restaurants or with others are called social smokers [114].

In addition, heavy smokers tended to be more obese. The co-existing relationship between smoking and eating behavior is mediated by personal preferences, lifestyle choices and social factors namely peer-pressure and the pleasure aspect of smoking and eating. The interdependence between smoking and

eating behavior was the result of medical evidence indicating that nicotine could accelerate metabolism which decreased weight accumulation, maintaining caloric intake [115]. Another previous study reported that nicotine administration could reduce body weight but increase it after the administration was terminated [116].

The researchers concluded that social smoking is a distinct pattern of tobacco use which is common among college students and may represent a stage in the uptake of smoking. They believed that smoking could be used as a way for weight control among teenagers because it could help them maintain weight [117]. The suggestions on smoking under the overweight risks are applied into this study so that the intervention group will learn how to avoid smoking without any restriction.

2.17 Alcohol consumption

Alcohol beverages could be correlated to overweight and obesity. Alcohol (ethanol) yields more energy per gram (29 kJ/g) than either protein (17 kJ/g) or CHO (16 kJ/g), which was second in the hierarchy to energy dense fat (37 kJ/g). The total energy contents of alcohol beverages are different based on the format divided into 3 groups: fermented beers and ciders, fermented wine and distilled spirits. The correlation between alcohol consumption and overweight could be found in studies in which alcohol consumption of heavy drinkers could possibly lead to overweight and obesity[118]. Alcohol guidelines in UK 2009 recommended that men and women who drink regularly should consume no more than 14 units a week which are equivalent to six pints of beers and seven glasses of wine [119]. With respect to recent literature, light-to-moderate alcohol intake may be less likely to be a risk factor for obesity than heavy drinking. However, heavy drinking and binge drinking could be more consistently associated with adiposity [120]. There seems to be positive association between beer consumption and measure of abdominal adiposity known as “beer belly” among men but there were inconsistent results among

women [121]. Mami Wakabayashi, et al. (2015) carried out a study on alcohol consumption patterns in Thailand and their relationship with NCDs. The researchers proposed that heavy alcohol consumption was possibly an established risk factor for NCDs. They concluded that heavy alcohol consumption of 4 glasses or more per occasion could be related to increased risk of NCDs among male populations in Thailand but most of the female populations were culturally protected from drinking [122].

Most crucial lifestyle factors related to overweight and obesity seemed to be food intake physical activity and alcohol consumption. A previous study investigated the association between skipping breakfast, physical inactivity, alcohol consumption as risk factors and overweight and obesity among teenaged participants. A higher risk of excessive alcohol consumption could be illustrated through the relation between excessive drinking behavior and overweight among the participants. The researchers concluded that skipping breakfast, physical inactivity and alcohol consumption were positively associated with overweight and obesity [123]. The suggestions on alcohol consumption under the overweight risks are applied into this study so that the intervention group will learn how to avoid drinking alcohol without any restriction.

2.18 Line application

Line application is an instant messaging application which was first introduced in Japan in June 2011. It was programmed to run on mobile and electronic devices. Line application offers various features including photo, text/voice chat, video and location sending, video/voice calls, group chat and timeline. It can be used in many languages such as French, German, Arabic, English, Japanese, Korean, Thai, Chinese, Turkish, Italian, Vietnam and so on. In 2013, there were 300 million registered Line users and the number of Line users had doubled to over 600 million in 2015 [124, 125].

A recent research report was conducted to study the impact of the Line Application Utilization on elderly lifestyle among the elderly in Bangpakong Sub-District, Chachoengsao Province. LINE application is free, convenient, real-time, and easy to use. The features of Line application include free voice call, videos & voice message, group chat, timeline on which users can update their status and post pictures, comments, LINE games, functions to add friends/contact [126]. Another phenomenological study aimed to describe and explain to using line application. Data were derived by in-depth interview and non-participant observation from 15 informants. All interviews were transcribed verbatim and analyzed by using content analysis. Finding revealed that 1) the participants of this study learned to use LINE application by themselves and receive some advice from friends and family, 2) LINE application created a virtual space where the participants in this study had interaction with their friends and families without any limitation from time and place, 3) LINE application became a part of life, 4) the participants could express their sympathy towards others through morning greeting, which implied that they were still fine and healthy, 5) LINE application seemed to have more advantages than disadvantages. LINE application could improve the application program which was suitable for other related studies on application usage [127].

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research design

This study was a quasi-experimental study of pre-test and post-test design between two groups with similar characteristics, it was designed to evaluate the effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command.

3.2 Study area

The study was conducted at the Support Office Armed Forces Development Command on Nawongprachapattana, Srirung District, Bangkok, Thailand.

3.3 Study period

The study period conducted for six months in 2019 after research ethics approval from Chulalongkorn University.

3.4 Study population

The study population was the army male officers at Support Office Armed Forces Development Command who work in at Bangkok, aged between 35 and 45 years old under inclusion criteria.

3.5 Sample size

The participants with similar characteristics were the army male officers at Support Office Armed Forces Development Command (from 2 different buildings 1.5 kilometer away from each other). The quasi-experimental study consists of 110 eligible participants who are between 35 and 45 years old divided into two groups. 55 participants were assigned into the intervention group while the other 55 participants were assigned into the control group (**Figure 5**). Sample size calculation to required minimum sample size was calculated by G-Power program.

The sample size calculation from waist circumference of previous study [128].

- Mean in this intervention group = 84.48 / SD in this intervention group = 3.91
- Mean in this control group = 86.98 / SD in this control group = 5.12
- G power program was run by Effect size=0.5488048

As a result of above calculation from G power program, the required sample size is 42. Assuming the chances, missing or drop out in the middle programed, 30% of total sample size was added to the above calculated sample size, $(42 \times 2) = 84$ participants.

$n = 42 + 12.6(30\% \text{ dropout}) = 55$ participants. The sample size needed = 55/group

Thus, the total sample size including both intervention and control group is $55 \times 2 = 110$

3.6 Inclusion and exclusion Criteria

Approach the commander of the study area under the report of annual checkup and got the permission to coordinate from an official in charge to screen potential research participants

Inclusion:

- Thai army male officers
- aged between 35 and 45 years old
- Waist circumference over than Height divided by two, BMI ≥ 23 kg/m² or waist to hip ratio is more than (0.9)
- Smartphones which can use Line application
- Physically healthy to exercise
- Willing to participate in this study

Exclusion:

- Underlining diseases or chronic illness [66] such as Heart disease Respiratory diseases or other system diseases that affect exercise.
- There are medical devices that are prohibited to exercise, such as pacemakers. Artificial joints, etc.
- The participants who cannot attend the exercise class more than 60 times from 72 times of the intervention will be excluded.
- The participants who perform other exercise during this program will be excluded

Flow diagram of the procedure 5

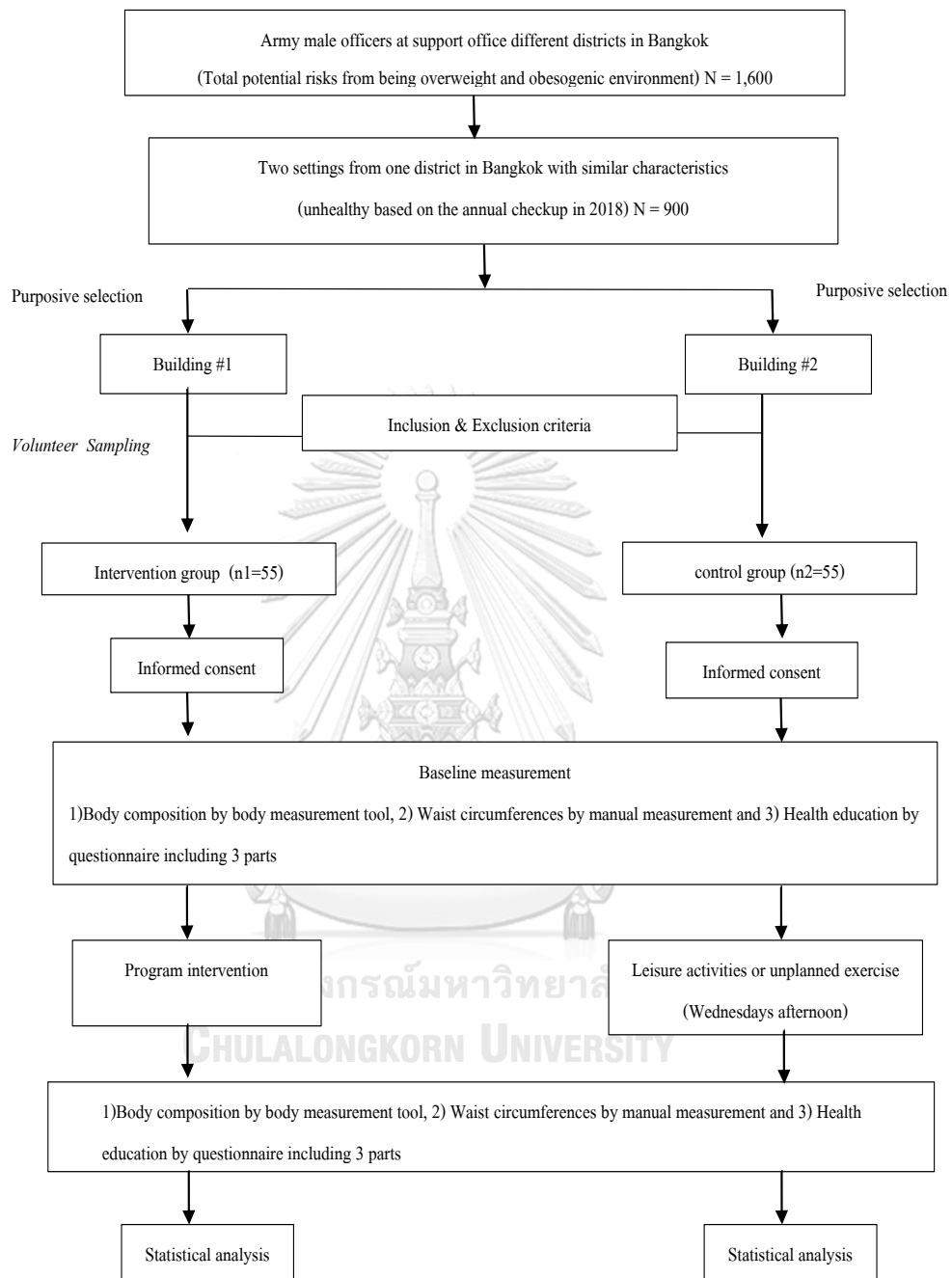


Figure 5. Flow diagram of the Procedure

3.7 Data collection procedure

A quasi experiment study which was use the purposive sampling techniques conducted among the potential participants' army male officers at Support Office Armed Forces Development Command Bangkok. The potential participants who meet the inclusion criteria were arrange by an official in charge and arrange for the researcher to meet them and potential participants willing to participate in this study pretest and posttest design between 2 groups with similar characteristics from two different buildings. The study divides the potential participants into two groups which are intervention group and control group. Data was collected at before (Pre) and after (Post) at 3th and 6th month of intervention program. They were performed the self-assessment in the questionnaires which are composed of 2 main sections of questionnaires as baseline:

Part I.

Socio-demographic and economic, lifestyle and health behaviors questionnaires (15 items).

Part II.

Health education questionnaires of the intervention program on 2 issues on

2.1 Health education knowledge questionnaires (30 items) related to body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR), food choices and plate model (2:1:1) and aerobic exercise.

2.2 Health education attitude and behaviors questionnaires (40 items) related to Attitude regarding exercise, food consumption, Exercise-related behaviors and Behavior about food consumption.

3.7.1 Control group

The researcher approached and followed the report of annual check-up, obesogenic lifestyle of potential groups of male Army aged between 35-45 years from annual check-up. The researcher approached the in-charge units where they work to recruit the volunteer participants until the sample size reached 55 participants per group body composition of the participants in control group were measured by Body composition Analyzer (Tanita DC360) at baseline, 3th and 6th month and they were performed the self-assessment questionnaires which are composed of 2 main sections of questionnaires:

Part I.

Socio-demographic and economic, lifestyle and health behaviours questionnaires (15 items).

Part II.

Health education questionnaires of the intervention program on 2 issues on

2.1 Health education knowledge questionnaires (30 items) related to body composition, body composition analyser, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR), food choices and plate model (2:1:1) and aerobic exercise.

2.2 Health education attitude and behaviours questionnaires (40 items) related to Attitude regarding exercise, food consumption, Exercise-related behaviours and behaviour about food consumption.

Participants in control group were received their Leisure activities or unplanned exercise (depending on their workload) by themselves only on Wednesdays afternoon (14.00-16.00) at Sports Complex Building 2 “Chobhuenchom”. Data was collected at baseline, then during the periods of 3 months and 6 months.



Figure 6. Army Sports Complex “Chobhuenchom”

3.7.2 Intervention group

The researcher approached and followed the report of annual check-up, obesogenic lifestyle of potential groups of male Army aged between 35-45 years from annual check-up. The researcher approached the in-charge units where they work to recruit the volunteer participants until the sample size reached 55 participants per group body composition of the participants in intervention group were measured by Body composition Analyzer (Tanita DC360) at baseline, 3th and 6th month and they were perform the self-assessment questionnaires which are composed of 2 main sections of questionnaires:

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Part II.

Health education questionnaires of the intervention program on 2 issues on

2.1 Health education knowledge questionnaires (30 items) related to body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR), food choices and plate model (2:1:1) and aerobic exercise.

2.2 Health education attitude and behaviours questionnaires (40 items) related to Attitude regarding exercise, food consumption, Exercise-

related behaviours and behaviour about food consumption. Participants in intervention group were received health education by researcher in classroom after finished the self-assessment questionnaires.

For the intervention group, the researcher considered the units and divided them into 9 small groups: 8 groups have 6 members each and the other group has 7 members body composition of the participants in intervention group will be measured the six-month exercise. Exercise programs and education manuals through advice from experts who combined aerobic and resistance exercise previously found to induce significant declines in abdominal subcutaneous fat (93). For the intervention group: time to participate on Mondays, Wednesdays, Fridays (15.00-16.00) at Army Sports Complex “AFDC” Building 1 at Aerobic room (**Figure 7**).

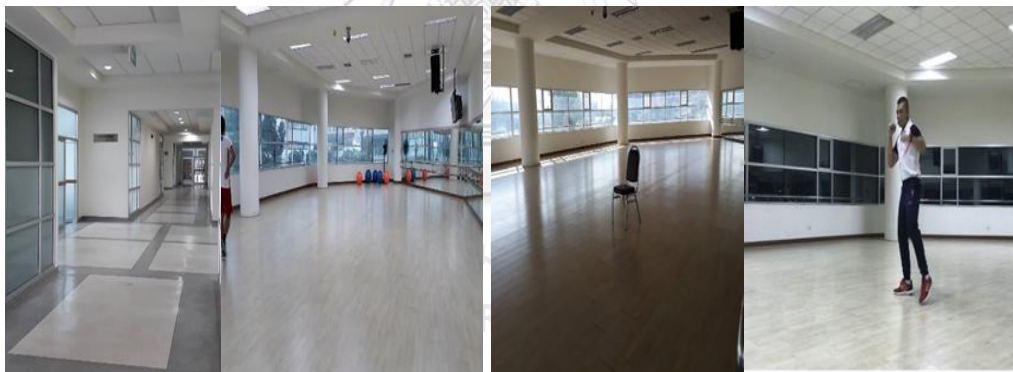


Figure 7. Army Sports Complex “AFDC” Aerobic room

3.8 Intervention program

Baseline at meeting room building 1

1. Body Composition of the participants were measured by Body Composition Analyzer (Tanita DC-360).

2. The health education program was given in the classroom by instructor/researchers' team at baseline, 3rd and 6th month. The health education program consists of 2 issues:

2.1 Health education knowledge questionnaires (30 items) related to body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR), food choices and plate model 45-60 mins (2:1:1) and aerobic exercise.

2.2 Health education attitude and behaviors questionnaires (40 items) related to Attitude regarding exercise, food consumption, Exercise-related behaviors and Behavior about food consumption.

The research assistants are the staff whom the researcher hires to be the research assistants. They consist of two registered nurses, two public health officers and a certified physical trainer. All of them are medical staff from the medical units under the support office armed forces development command. They were attended a training session and the researcher had demonstrated them the related topics. Then, the researcher was asked all of them to do these related topics namely using the body composition analyzer, measuring and recording waist circumference, waist-hip ratio, body composition and leading the positions of the exercise intervention including recording suggestions from the participants. The researcher was explained how to use Line application on chat page to motivate and receive suggestions from the participants note page to upload health education topics album page to upload the group pictures.

Week 1- Week 72: At army sport complex

- Fifty-five participants in the intervention group were divided into 9 groups (Eight groups have 6 members each and the other group has 7 members).
- Each group was selected their team leader (9 leaders in total). All team leaders were joined Line application group with the team of researchers (**Figure 8**).

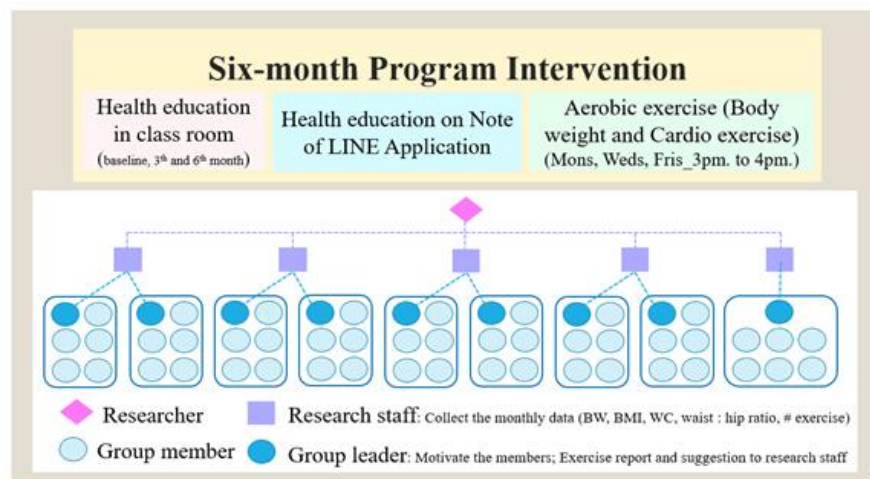
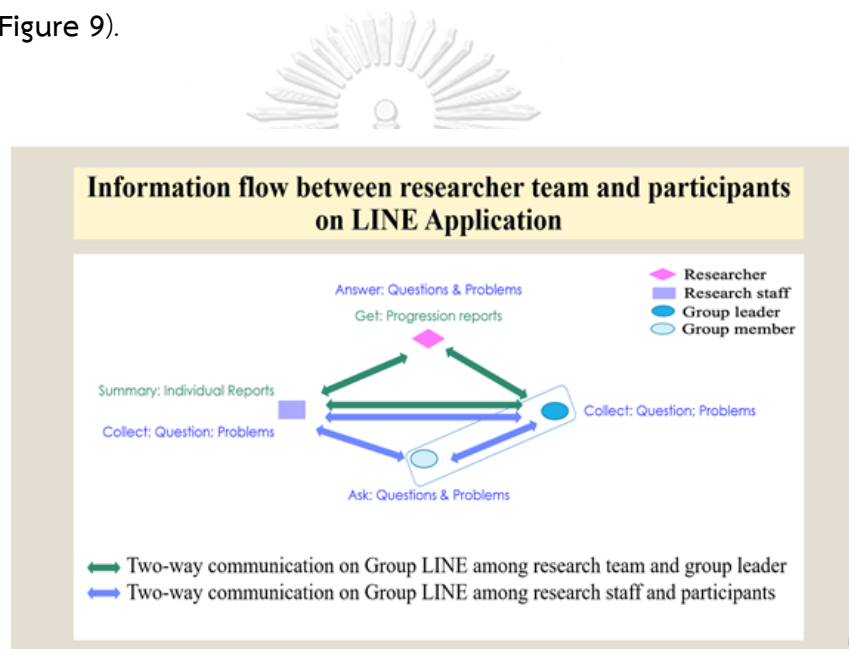


Figure 8. The overall program intervention

- Each group was selected a team leader as a representative who will organize its own Line group and who is responsible for coordinating, receiving feedback from exercise, reminding members to come for the body composition, the waist circumference, weight measurement and to do exercise set by the intervention program, researchers' team and group leaders was motivate participants to join the intervention program, who may offer their feedbacks or suggestions to the researchers' team. The researchers' team was collected some valuable data for analysis (Figure 9).



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Figure 9. Information flow

The researcher team was motivated in every group, give them the questions in every month to after exercise and researcher team was answered the question which related to the questionnaire and the answer of each month by specify under @(name) into nine group (Fifty-Five participants) on chat page.

Note page: Information of health education in classroom and contents.

Health education was performed at baseline before pre-test at 0 month.

After that, the health education was uploaded into Line application on note page

Album page: File pictures, video, and related photos of their groups from 1st month – 6th month of intervention program (Each group will have its own personal files in the research cabinet) (Figure10).



Figure 10. The example of Information detail on LINE group

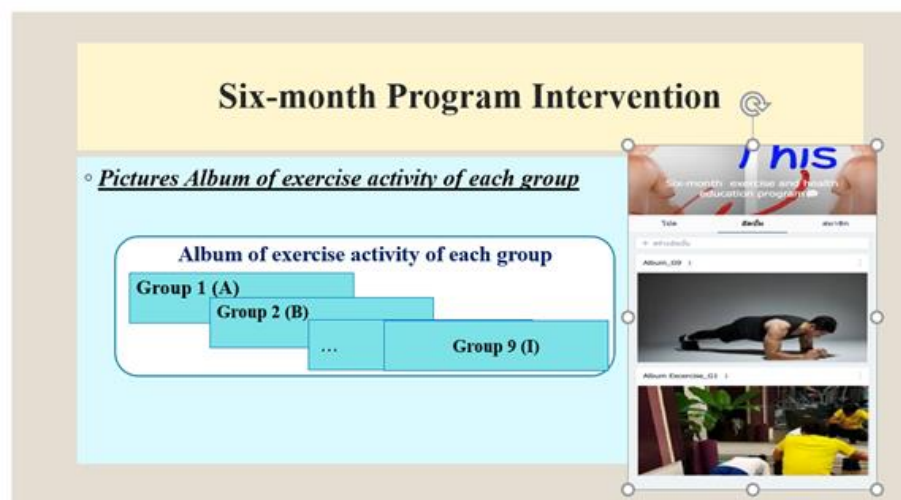


Figure 11. The example of Picture album on LINE group

Six-month Program Intervention

Health education in class room (baseline, 3 rd and 6 th month)	Health education on Note of LINE Application
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Topic 1 Health education about body composition, body composition analyser, body fat, risk of excess fat, visceral fat, body weight, waist circumference, BMI, waist to hip ratio, and total energy expenditure (TDEE)

Topic 2 Health education about food choices and plate model

Topic 3 Health education about exercise (Body weight and cardio exercise)

5

Figure 12. Health education topics

Each group was performed aerobic exercise at Complex “AFDC” Building at aerobic room. The aerobic exercise was trained body weight and aerobic exercise under the instructors who was certified physical trainer to be the leader and researcher’s team to be supervisors who will supervise and observe the intervention group all nine groups and join the exercise sessions in their Sports Complex “AFDC” Building at aerobic room. Participants were performed 3 days/week exercise on Mondays, Wednesdays, and Fridays between 15.00 and 16.00 p.m. for 150 min/week as follow:

Step1.

Ten-minute Thai-style dynamic stretching for warm-ups (**Figure 13**)



Figure 13. warm-ups exercise

Step 2.

Thirty-minute work-out aerobic exercise (body weight and cardio exercise) of four positions/session (squat, high knee, plank and jumping jacks) (**Figure 14**).

2.1. squat (8-10 times/set depending on individual’s physical fitness and rest 30 seconds, repeat including rest period and then continue for 3 sets).

2.2 high knee (30 -60 seconds/set depending on individual’s physical fitness and rest 30 seconds, repeat including rest period and then continue for 3 sets).

2.3. plank (30 -60 seconds/set depending on individual’s physical fitness and rest 30 seconds, repeat including rest period and then continue for 3 sets).

2.4. jumping jacks (30-60 seconds/set depending on individual's physical fitness and rest 30 seconds, repeat including rest period and then continue for 3 sets) (Figure 15).

Exercise Intervention Program


Aerobic exercise (based on body weight and cardio exercise) on Monday, Wednesday, Friday at 3pm. to 4 pm. (total 72 weeks)

Step 1 Warm-up Thai-style stretching (10 min.)

Step 2 Aerobic exercise (30 min.)

- 2.1 Squat (8-10 reps) rest 30 sec. continue for 3 sets
- 2.2 High knee (30-60 sec.) rest 30 sec. continue for 3 sets
- 2.3 Plank (30-60 sec.) rest 30 sec. continue for 3 sets
- 2.4 Jumping jack (30-60 sec.) rest 30 sec. continue for 3 sets

Step 3 Cool-down Thai-style stretching (10 min.)



Cardio exercise
Body weight exercise

7

Figure 14. Thirty-minute workout aerobic exercise

Step 3.

Ten-minute Thai-style dynamic stretching for cool-down (Figure 16).



Figure 15. Cool down exercise

The data was collected at baseline, 3rd month and 6th month for analysis.

3.9 Measurement tools

The questionnaire was divided into 2 major sections that include

Part I.

Socio-demographic and economic, lifestyle and health behaviors questionnaires composed of 15 items (appendix A). The closed-ended questionnaires developed by the researchers based on literature review comprise of age, education, marital status, income, alcohol consumption.

Part II.

Health education questionnaires of the intervention program composed of 70 items on 2 issues (Appendix B): (The questionnaire was modified from previous study [129-131].

Health education knowledge questionnaires related to body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR), food choices and plate model (2:1:1) and aerobic exercise. Health education knowledge questionnaires composed of 30 items of “True, False and not sure” questions. Correct answer = 1 point, Incorrect answer and Not Sure = 0 point criteria for health education knowledge level are scored according to bloom’s Classification [132].

≤ 60% (score 0-18)	= Low level of knowledge
61- 80% (score 19-24)	= Moderate level of knowledge
> 80% (score > 25)	= High level of knowledge

Health education attitude and behaviors questionnaires related to Attitude regarding exercise, food consumption, Exercise-related behaviors and Behavior about food consumption. Health education attitude and behaviors questionnaires composed of 40 items of “Agree, Disagree and Not sure” questions. An Average standard deviation (SD, X, min and max) from answer of Agree, Disagree and Not sure was presented. The health education was uploaded into Line application on note

page of intervention group only. The researcher team was motivated in every groups, give them the questions in every month after exercise and researcher team will give the answer which relate to the questionnaire the answer of each month by specify.

3. The report of the body composition analyzer (Appendix C)

3.10 Research instruments

1. Body waist circumference was measured and recorded with a portable stadiometer with an accuracy of 1 mm.

2. BMI was calculated as weight in kilograms divided by the height in square meters; the categories of overweight and obese are defined by using the cutoff values as described by Department of health, Thailand.

A BMI less than 18.5 kg/m² was defined as underweight may need to gain weight

A BMI of 18.5-22.9 kg/m² was defined as a healthy weight and should aim to stay that way.

A BMI of 23-24.9 kg/m² was defined overweight. It is an idea to lose some weight for health's sake, or at least aim to prevent further weight gain,

A BMI of 25-25.9 kg/m² was defined as obese-I and means health is at risk.

A BMI > 30 kg/m² was defined as obese-II and means your health is at risk. Losing weight will improve health.

3. Body composition was measured by TANITA Body Composition Analyzer DC-360, which is safe, easy and highly precise by analyzing the body compositions including body water, muscle mass, fat mass, and bones by keying in the inputs such as body type, gender, age, height and clothes weight and which can measure the whole body accurately. It can analyze by measuring the resistance of low electrical voltage (1-2 volts) found in body tissues because body tissues have different levels of the resistance. This can allow the measurement tool to access the compositions

of the whole body. The results was showed by weight, fat%, fat mass, fat free mass, muscle mass, total body water, % of total body water, bone mass, basal metabolic rate, metabolic age, visceral fat rating, BMI, ideal body weight and degree of obesity. The analyzer can predict disability range of fat percentage and fat mass and provide each individual the indicator of the range scale of fat percentage, BMI, visceral fat rating, muscle mass and basal metabolic rate.

3.11 Validity and reliability

The questions were constructed randomly, and few corrections and amendments made to improve the questionnaire.

Content validity of questionnaire were established and reviewed by 5experts who have experience in this area using Item-Objective Congruence (IOC) to confirm internal consistency of questionnaireand IOC score = 0.8 of each item [133-135] from IOC score Part 1 = (0.9) IOC score Part 2 = (0.7) and IOC score Part 3 = (0.9)

Reliability tests were evaluated during pilot testing of 30 participants with similar characteristics. Internal consistency reliability used Cronbach's alpha coefficient with acceptable items having a cutoff point of 0.7 and above[133]. The questionnaires were created by the Ministry of Public Health and will be developed by the researchers and tested on 30 army male officers at the department of the Support Office Armed Forces Development Command.

3.12 Data analysis

The collected data was analyzed using SPSS software version 22.0 licensed from Chulalongkorn University.

1. Descriptive Statistics was performed using frequency, percentages mean, standard deviations (age, weight, height, education level, status, income, smoking, Alcohol drinking)

2. Chi-Square test was used to test homogeneity of nominal and ordinal variables between the intervention group and the control group (education level, status, income, smoking, Alcohol drinking)

3. Independent t-test was used to test the difference of continuous variables between intervention group and control group. (weight, BMI, WC, HC, WHR, fat%, fat mass, FFM, Muscle mass, TBW (kg), TBW (%), Bone Mass (kg), BMR (KJ), Visceral fat, Degree of Obesity(%), Knowledge of health education, Attitude of health education)

4. Mann-Whitney U was used to test the difference of continuous variables between intervention group and control group in term of non-normal distribution (number of cigarettes per day).

5. Repeated measure ANOVA was used to conduct the overall test whether there was at least one group which was different from the others, but it could not conclude which were different from each other. For this purpose, there were post-hoc tests which compared all groups two by two to determine which ones were different after adjusting for multiple comparisons of the visceral fat, the wrist circumference and knowledge score within and between intervention group and control group at baseline, three-month and six-month [136] .

3.13 Ethical consideration

Research proposal was submitted to The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University for ethical approval and was approved by The Research Ethics Review Committee for Research Involving Human Research Participants, Health Sciences Group, Chulalongkorn University, Thailand (COA No.258/2562).



CHAPTER IV

RESULT

This research was a quasi-experimental study of pre-test and post-test design between two groups with similar characteristics. This program required 24 weeks for the participants to complete. This research was conducted in Bangkok, Thailand. The participants were overweight army male officers aged between 35 and 45 years old who were selected by their medical department as the authorities based on the annual physical check-up report consistent to the inclusion criteria in this study. One hundred and ten participants from 55 of intervention group and 55 of control group selected by purposive sampling techniques. Their waist circumference was over height divided by two, BMI more than 23 kg/m^2 or the waist to hip ratio more than (0.9); they had their own smart phones and could use Line application to participating in this research. They were physically healthy to do exercise and willing to participate in this study. Their works which required using computers and processing paper documents during office hours from 8.00 to 16.00 were the main job responsibilities in both groups on Mondays to Fridays. The sample size calculation in this study was based on a previous study which investigated the exercise to reduce the waist circumference of village health volunteers by using G-Power program version 3.0.10. From the beginning of this program Body composition measured by TANITA Body composition Analyzer DC-360 consisted of 15 parameters and Questionnaire which were measured in both groups 110 participants were divided into 55 control and 55 Intervention. Only in the intervention group were divided into nine groups; one group consisting of 6-7 participants including the trained researchers' assistants as the team leaders who motivated, received feedbacks or suggestions from the participants, summarized them within their own

groups and sent them together with group photos to the researchers' team through Line application. There were unexpected situations after 21st weeks of this program: urgent fiscal budgeting and the pandemic situation under Thai Government Gazette issue 1 which followed WHO announcement on COVID-19. From 21st to 24th weeks, the intervention group continued to do the exercise at their own department/area which their department prepared at the same schedule time under the supervision of the team leaders who motivated, received feedbacks or suggestions from the participants, summarized them within their own groups and sent them together with group photos to the researchers' team through Line application as they had already participated in the program in sport complex building one. The participants in the control group did leisure activities of their own choices depending on their schedules at sport complex building two or other places from 21st to 24th weeks. After the program, there were a total number of 12 dropouts from both groups (6 dropouts each); therefore, there were 98 participants in total (49 participants in the intervention group and 49 participants in the control group).

The results were arranged by characteristics of participants and main outcomes as follows:

4.1. General characteristics of intervention and control group

4.2 Level of body composition (visceral fat, waist circumference) and knowledge score of health education at baseline among both groups.

4.3 Comparison within group, between group and interaction between group and time of the visceral fat and waist circumference, and the knowledge scores in intervention group and Control group at baseline, 3-month, and 6-month

4.3.1 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within the intervention group

4.3.2 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within the control group

4.3.3 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) between the intervention group and the control group

4.4 The mean change of waist circumference, visceral fat and health education scores (mean \pm SD) between Intervention group and Control group at baseline, three-month, six-month.

4.1 General characteristics of intervention and control group

The general characteristics of the participants were similar between both groups. There was no significant difference of general characteristics in **Table 1**. The results found that the average age of the participants was 39.35 ± 3.86 years old ($p=0.92$) with an average weight of 82.28 ± 11.22 kilograms ($p=0.23$). The average height was 171.44 ± 4.97 centimeters ($p=0.56$).

For the level of education, most of them had a bachelor's degree or higher, representing 50%, those with diploma accounting for 35.7% and those with high school education was 14.3% ($p=0.30$).

Regarding the marital status, 51% were married; 33.7% were single and 15.3% were divorced ($p=0.96$).

Their monthly income 15,000-25,000 baht accounted for 40.8% while those who earned 25,001-35,000 baht represented 31.6% and 27.6% earned 35,001-45,000 baht ($p=0.68$).

The majority who used to smoke and still smoked accounted for 51%; those who did not smoke were 49% ($p=1.00$). An average number of cigarettes per day were approximately 5-20 cigarettes ($p=0.20$).

They drank less than 6 glasses of alcohol per week, representing 80.6% while those who did more than 6 glasses per week were 19.4% ($p=0.79$).

For exercise, all the participants in both groups reported to do leisure activity only. Most of them who did it on Wednesday's afternoon accounted for 87.75% while the rest informed that they did not do exercise. Regarding the leisure activity preference, 69.6% preferred going to do exercise alone while 30.4% preferred going with a group of friends. For the place of exercise, 48.9% liked to do exercise in the park or outdoors; 35.9% did exercise at the gym or fitness center; those who did exercise at home were 15.2%.

Table 1. Participants characteristics at baseline intervention and control group.

Socio-demographic characteristics	Baseline		p-value
	Intervention Group	Control Group	
	(n=49)	(n=49)	
Age(years), mean±SD	39.31±3.87	39.39±3.88	0.92
Weight(kg.), mean±SD	83.65±10.79	80.90±11.54	0.23
Height(cm.), mean±SD	171.14±4.87	171.73±5.11	0.56
Education level, n(%)			
High School	7 (14.3)	7 (14.3)	
Diploma	14 (28.6)	21 (42.9)	0.30
Bachelor's degree or higher	28 (57.1)	21 (42.9)	
Status, n(%)			
Single	17 (34.7)	16 (32.7)	
Married	25 (51.0)	25 (51.0)	0.96
Divorce	7 (14.3)	8 (16.3)	
Income in Thai baht, n(%)			
15,000-25,000	18 (36.7)	22 (44.9)	
25,001-35,000	16 (32.7)	15 (30.6)	0.68
35,001-45,000	15 (30.6)	12 (24.5)	
Smoking, n(%)			

Socio-demographic characteristics	Baseline		p-value
	Intervention	Control	
	Group (n=49)	Group (n=49)	
Non-smoking	24 (49.0)	24 (49.0)	
Used to smoke & smoking	25 (24.5)	25 (51.0)	1.00
The number of cigarettes smoked per day, median (IOR)	10 (4, 20)	20 (12.5, 20)	0.20
Alcohol drinking, n(%)			
Drinking ≤ than 6 glasses/weeks	40 (81.60)	39 (79.6)	0.79
Drinking 6 glasses/week	9 (18.4)	10 (20.4)	

Data were analyzed with Chi-square test, Independent t-test and Mann-Whitney, *statistically significant at the 0.05 level ($\alpha=0.5$)

4.2 Level of body composition (visceral fat, waist circumference) and knowledge score of health education at baseline among both groups

Body composition of 15 parameters and health education questionnaires consisted of two issues: health education knowledge and health education attitudes which were compared in both groups.

The results at baseline of body composition and health education scores of the intervention group and the control group found had no statistically significant difference ($p>0.05$).

The body composition parameters (mean \pm SD) in the **intervention group** were shown in **Table 2**. The Body Weight was at 83.65 ± 10.79 kilograms; the Body Mass Index was at 28.51 ± 3.08 kilogram/m²; the Waist Circumference was at 40.41 ± 2.92 centimeters; the Hip circumference was at 40.79 ± 2.35 centimeters; the Waist Hip Ratio was at 0.96 ± 0.04 centimeters; the percent of Fat was at 26.09 ± 4.32 Percent; the Fat mass was at 22.18 ± 6.21 kilograms; the Fat Free Mass was at 61.40 ± 6.95 kilograms; the Muscle Mass was at 58.41 ± 6.35 kilograms; the Total Body Water was at 43.63 ± 5.35 kilograms; the percent of total Body Water was at 52.32 ± 3.19 percent; the Bone Mass was at 3.18 ± 0.32 kilograms; the BMR was at 7328.04 ± 917.38 (KJ); the Visceral Fat was at 13.49 ± 2.14 ; the Percent of Degree of Obesity was at 30.07 ± 13.70 Percent; the knowledge of health education was at 12.61 ± 6.14 points and the attitudes of health education were at 24.76 ± 4.79 points.

The body composition parameters (mean \pm SD) in the **control group** were shown in **Table 2**. The Body Weight was at 80.90 ± 11.54 kilograms; the Body Mass Index was at 27.42 ± 3.74 kilogram/m²; the Waist Circumference was at 39.33 ± 3.12 centimeters; the Hip circumference was at 41.28 ± 2.56 centimeters; the Waist Hip Ratio was at 0.95 ± 0.04 centimeters; the Percent of Fat was at 25.82 ± 4.63 Percent; the Fat mass was at 21.34 ± 6.79 kilograms; the Fat Free Mass was at 59.58 ± 5.58 kilograms;

the Muscle Mass was at 56.48 ± 5.30 kilograms; Total Body Water was at 41.73 ± 4.57 kilograms; the Percent of Total Body Water was at 51.62 ± 3.47 Percent; the Bone Mass was at 3.09 ± 0.28 kilograms; the BMR was at $7057.41(\text{KJ}) \pm 781.54$; the Visceral Fat was at 13.00 ± 2.59 ; the Percent of Degree of Obesity was at 26.95 ± 17.48 Percent; the knowledge of health education was at 13.20 ± 6.02 points and the attitudes of health education were at 25.27 ± 4.63 points.

The results showed that all the body composition parameters and health education scores of both groups (mean \pm SD) had no significant difference at baseline. The Body Weight was ($p=0.23$); the Body Mass Index was ($p=0.12$); the Waist Circumference was ($p=0.25$); the Hip circumference was ($p=0.30$); the Waist Hip Ratio was ($p=0.46$); the Percent of Fat was ($p=0.77$); the Fat Mass was ($p=0.53$); the Fat Free Mass was ($p=0.16$); the Muscle Mass was ($p=0.10$); Total Body Water was ($p=0.06$); the Percent of Total Body Water was ($p=0.30$); the Bone Mass was ($p=0.12$); the BMR (KJ) was ($p=0.12$); the Visceral Fat was ($p=0.12$); the Percent of Degree of Obesity was ($p=0.95$); the health education of knowledge and attitudes was ($p=0.63$) and ($p=0.59$) respectively.

Table 2. Comparison (mean±SD) of the body composition of 15 parameters and health education consisted of two issues between intervention and control group at baseline

Outcome variables	Baseline		p-value
	Intervention	Control	
	(n=49) mean±SD	(n=49) mean±SD	
Body composition:			
Weight (kg)	83.65±10.79	80.90±11.54	0.23
BMI (kg/m ²)	28.51±3.08	27.42±3.74	0.12
Waist circumference (cm)	40.41±2.92	39.33±3.12	0.25
Hip circumference (cm)	41.79±2.35	41.28±2.56	0.31
WHR(cm)	0.96±0.04	0.95±0.04	0.46
Fat (%)	26.09±4.32	25.82±4.63	0.77
Fat Mass (Kg)	22.18±6.21	21.34±6.79	0.53
FFM (Kg)	61.40±6.95	59.58±5.58	0.16
Muscle Mass (Kg)	58.41±6.35	56.48±5.30	0.10
TBW (Kg)	43.63±5.35	41.73±4.57	0.06
TBW (%)	52.32±3.19	51.62±3.47	0.30
Bone Mass (Kg)	3.18±0.32	3.09±0.28	0.12
BMR (KJ)	7,328.04±917.38	7,057.41±781.54	0.12

Outcome variables	Baseline		p-value
Visceral Fat rating	13.49±2.14	13.00±2.59	0.12
Degree of Obesity (%)	30.07±13.70	26.95±17.48	0.95
Health education			
Knowledge score	12.61±6.14	13.20±6.02	0.63
Attitude score	24.76±4.79	25.27±4.63	0.59

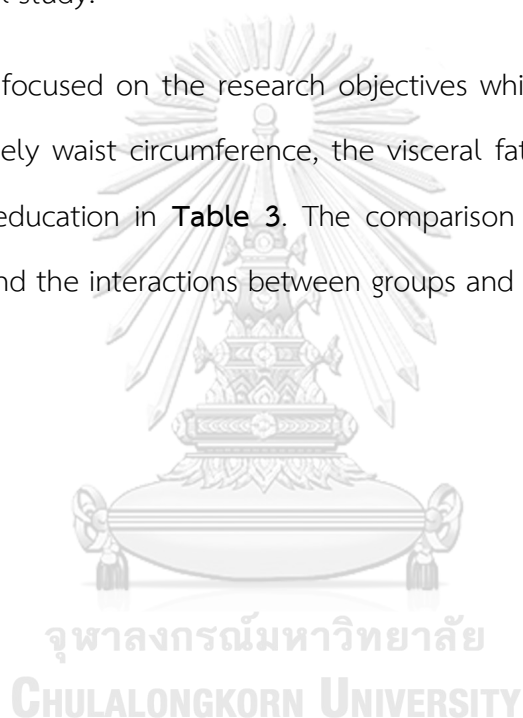
Data were analyzed with Independent simple t-test. p-value compare between-group*statistically significant at the 0.05 level ($\alpha=0.5$)



4.3 Comparison within group, between group and interaction between group and time of the visceral fat and waist circumference, and the knowledge scores in intervention group and control group at baseline, 3-month, and 6-month

The effect of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at support office Armed Forces Development Command: Quasi-experimental study.

This study focused on the research objectives which investigated only body compositions namely waist circumference, the visceral fat and only the knowledge scores of health education in **Table 3**. The comparison (mean±SD) within groups, between groups and the interactions between groups and time at baseline, 3-month, and 6-month



4.3.1 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within the intervention group

Comparison of waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within intervention group and control group was shown in **Table 3**.

The Waist Circumference at baseline was at 40.41 ± 2.92 , decreased to 38.80 ± 2.99 at three-month, decreased to 38.35 ± 2.83 at six-month; it had statistically significant decrease ($p<0.001^*$).

The Visceral Fat was at baseline was at 13.49 ± 2.14 , decreased to 13.08 ± 2.27 at three-month, decreased to 12.82 ± 2.36 at six-month; it had statistically significant decrease ($p<0.001^*$).

The knowledge scores at baseline were at 12.61 ± 6.14 , increased to 26.71 ± 5.86 at three-month, increased to 28.00 ± 4.46 at six-month; it had statistically significant increase ($p<0.001^*$).

The interactions of the Waist Circumference and the Visceral Fat at baseline, three-month, and six-month was decreased continuously with statistically significant difference ($p=0.001^*$) while the knowledge scores of health education at all three time periods: baseline, three-month, six-month, was increased continuously with statistically significant difference ($p=0.001^*$).

4.3.2 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within the control group

The Waist Circumference at baseline was at 39.33 ± 3.12 , increased to 39.44 ± 3.21 at three-month and increased to 39.89 ± 3.26 at six-month with statistically significant increase ($p<0.001^*$).

The Visceral Fat was at baseline was at 13.00 ± 2.59 , increased to 13.18 ± 2.50 at three-month and increased to 13.43 ± 2.42 at six-month with statistically significant increase ($p<0.001^*$).

The knowledge scores at baseline were 13.20 ± 6.02 , increased slightly to 13.47 ± 5.04 at three-month and remained stable at 13.47 ± 5.04 at six-month ($p=0.119$).

The interactions of the Waist Circumference at all three time periods: baseline, three-month, six-month was increased continuously with statistically significant difference ($p=0.001^*$). The interactions of the Visceral Fat at baseline to three-month had no statistically significant difference but the interaction from three-month to six-month and baseline to six-month was increased with statistically significant difference ($p=0.001^*$). The interactions of the knowledge scores at all three time periods: baseline, three-month, six-month had no statistically significant.

Table 3. Comparison of waist circumference, the visceral fat and the knowledge scores (mean \pm SD) within intervention group and control group

	Baseline (n=49)	3-month (n=49)	6-month (n=49)	p-value (b)	p-value (a)
	mean \pm SD	mean \pm SD	mean \pm SD		
Waist circumference:					
Intervention	40.41 \pm 2.92 ^{x,y}	38.80 \pm 2.99 ^{x,z}	38.35 \pm 2.83 ^{y,z}	<0.001*	<0.001*
Control	39.33 \pm 3.12 ^{x,y}	39.47 \pm 3.21 ^{x,z}	39.89 \pm 3.26 ^{y,z}	<0.001*	
Visceral fat:					
Intervention	13.49 \pm 2.14 ^{x,y}	13.08 \pm 2.27 ^{x,z}	12.82 \pm 2.36 ^{y,z}	<0.001*	<0.001*
Control	13.00 \pm 2.59 ^x	13.18 \pm 2.50 ^y	13.43 \pm 2.42 ^{x,y}	<0.001*	
Knowledge score:					
Intervention	12.61 \pm 6.14 ^{x,y}	26.71 \pm 5.86 ^{x,z}	28.00 \pm 4.46 ^{y,z}	<0.001*	<0.001*
Control	13.20 \pm 6.02	13.47 \pm 5.04	13.47 \pm 5.04	0.199	

Data were analyzed with two-way repeated measures ANOVA: Multiple Comparisons, Post-hoc Bonferroni.

Independent simple t-test. *Statistically significant at the 0.05 level ($\alpha=0.05$) P-value (a) interaction between group*time, P-value (b) compare within-group (the symbols of x, y, and z mean possible pairs after ANOVA - post-hoc tests).

4.3.3 The waist circumference, the visceral fat and the knowledge scores (mean \pm SD) between the intervention group and the control group

Comparison of waist circumference, the visceral fat and the knowledge scores (mean \pm SD) between intervention group and control group was shown in **Table 4**.

The waist circumference at baseline, three-month had no statistical difference ($p=0.246$), ($p=0.286$) respectively; however, the intervention group was decreased while the control group was increased. This made the statistical values at six-month have statistical difference with statistical significance ($p=0.014$).

The visceral fat at baseline, three-month, six-month had no statistical difference ($p=0.310$), ($p=0.833$), ($p=0.207$) respectively.

The knowledge scores at baseline had no statistical difference ($p=0.631$); however, the scores at three-month and six-month had statistically significant difference ($p<0.001^*$), ($p<0.001^*$) respectively.

Table 4. Comparison of waist circumference, the visceral fat and the knowledge scores (mean \pm SD) between intervention group and control group

	Baseline (n=49)	3-month (n=49)	6-month (n=49)
	mean \pm SD	mean \pm SD	mean \pm SD
Waist circumference:			
Intervention	40.41 \pm 2.92 ^{x,y}	38.80 \pm 2.99 ^{x,z}	38.35 \pm 2.83 ^{y,z}
Control	39.33 \pm 3.12 ^{x,y}	39.47 \pm 3.21 ^{x,z}	39.89 \pm 3.26 ^{y,z}
p-value (c)	0.246	0.286	0.014*
Visceral fat:			
Intervention	13.49 \pm 2.14 ^{x,y}	13.08 \pm 2.27 ^{x,z}	12.82 \pm 2.36 ^{y,z}
Control	13.00 \pm 2.59 ^x	13.18 \pm 2.50 ^y	13.43 \pm 2.42 ^{x,y}
p-value (c)	0.310	0.833	0.207
Knowledge score:			
Intervention	12.61 \pm 6.14 ^{x,y}	26.71 \pm 5.86 ^{x,z}	28.00 \pm 4.46 ^{y,z}
Control	13.20 \pm 6.02	13.47 \pm 5.04	13.47 \pm 5.04
p-value (c)	0.631	<0.001*	<0.001*

Data were analyzed with two-way repeated measures ANOVA: Multiple Comparisons, Post-hoc Bonferroni. Independent simple t-test. *Statistically significant at the 0.05 level ($\alpha=0.05$), P-value (the symbols of x, y, and z mean possible pairs after ANOVA - post-hoc tests) and P-value (c) compare between groups.

4.4 The mean change of waist circumference, visceral fat and health education scores (mean±SD) between Intervention group and Control group at baseline, three-month, six-month.

The mean change of waist circumference, visceral fat and health education scores (mean±SD) between intervention group and control group at baseline, three-month, six-month was shown in **Table 5**.

The comparison of mean differences of the waist circumference, the visceral Fat and the knowledge scores of health education between the intervention group and the control group found that the waist circumference and the visceral fat in the intervention group was decreased while those in the control group was increased; the knowledge scores of health education in the intervention group was increased whereas those of the control group at baseline to three-month, at baseline to six-month was very slightly increased and remained stable at three-month to six-month.

The mean differences (mean±SD) of the waist circumference in the intervention group at baseline to three-month was decreased to (-1.24±0.74), at three-month to six-month was decreased to (-0.44±0.55) and at baseline to six-month was decreased to (-1.69±0.77) whereas the control group at baseline to three-month was increased to 0.14±0.29, at three-month to six-month was increased to 0.42±0.50 and at baseline to six-month was increased to 0.56±0.52. The mean change of the waist circumference from baseline to six-month between the intervention group and the control group was 1.54 centimeters.

The mean differences (mean±SD) of the visceral fat in the intervention group at baseline to three-month was decreased to (-0.41±0.86), at three-month to six-month was decreased to (-0.27±0.60) and at baseline to six-month was decreased to (-0.67±1.05) whereas the control group at baseline to three-month was increased to 0.18±0.37, at three-month to six-month was increased to 0.24±0.63 and at baseline

to six-month was increased to 0.43 ± 0.84 . The mean change of the visceral fat from baseline to six-month between the intervention group and the control group was 0.61.

The mean differences (mean \pm SD) of the knowledge scores on health education in the intervention group at baseline to three-month was increased to 14.10 ± 7.11 , at three-month to six-month was increased to 1.29 ± 2.99 and at baseline to six-month was increased to 15.39 ± 6.73 whereas the control group at baseline to three-month was increased slightly to 0.27 ± 1.43 , at three-month to six-month was remained the same at 0.00 ± 0.00 and at baseline to six-month was increased very slightly to 0.26 ± 1.43 . The mean change of the knowledge scores on health education from baseline to six-month between the intervention group and the control group was 14.53 points.

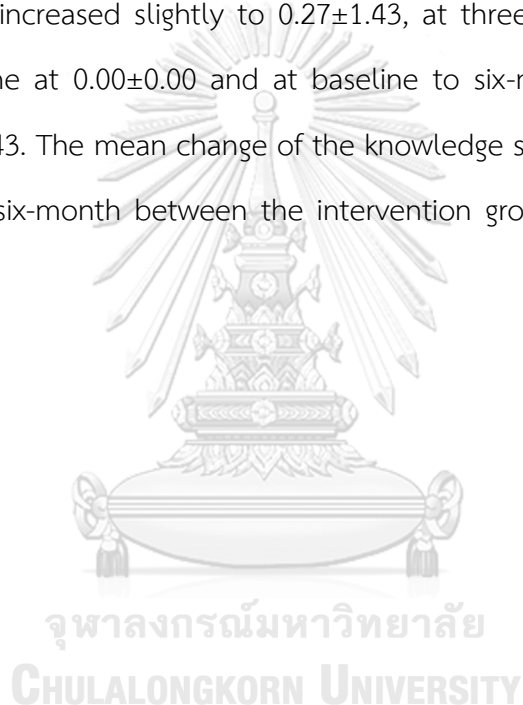


Table 5. The mean change of waist circumference, visceral fat and health education scores (mean±SD) between intervention group and control group at baseline, three-month, six-month.

	Baseline – Three-Month (n=49)	Three-Month Six-Month (n=49)	Baseline – Six-Month (n=49)	p-value
	mean±SD	mean±SD	mean±SD	
Waist circumference:				
Intervention	-1.24±0.74	-0.44±0.55	-1.69±0.77	<0.001*
Control	0.14±0.29	0.42±0.50	0.56±0.52	<0.001*
p-value	≤0.001*	≤0.001*	≤0.001*	
Visceral fat:				
Intervention	- 0.41±0.86	-0.27±0.60	-0.67±1.05	<0.001*
Control	0.18±0.37	0.24±0.63	0.43±0.84	<0.001*
p-value (c)	≤0.001*	≤0.001*	≤0.001*	
Knowledge score:				
Intervention	14.10±7.11	1.29±2.99	15.39±6.73	<0.001*
Control	0.27±1.43	0.00±0.00	0.26±1.43	0.199
p-value (c)	<0.001*	<0.001*	<0.001*	

Data were analyzed with independent simple t-test. *Statistically significant at the 0.05 level ($\alpha=0.05$)

CHAPTER V

DISCUSSION

The objective of this research was to evaluate the effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command in Bangkok using quasi-experimental study of pre-test and post-test design between two groups with similar characteristics. This program required 24 weeks for the participants to complete. According to the inclusion criteria, participants who had BMI more than 23 kg/m² or the waist to hip ratio more than 0.9, aged between 35 and 45 years old, had their own smart phones which could use Line application, physically healthy to do exercise and willing to participate were selected to participate in this research. One hundred and ten participants from 55 of intervention group and 55 of control group were selected by purposive sampling techniques.

Body composition measured by TANITA Body composition Analyzer DC-360 consisted of 15 parameters and Questionnaires were measured in both groups (pre-test) at baseline. Only in the intervention group were divided into 9 groups; one group consisting of 6-7 participants including the trained researchers' assistants as the team leaders who motivated, received feedbacks or suggestions from the participants, summarized them within their own groups and sent them together with group photos to the researchers' team through Line application. Unfortunately, there were unexpected situations after 21st weeks of this program due to the pandemic situation under Thai Government Gazette issue 1 which followed WHO announcement on COVID-19 [137]. However, the intervention group can continue to do the exercise during 21st to 24th weeks at their own department/area under the supervision of the team leaders and researcher through Line application which is the

advantage of our developed intervention program in this an-expected situation while the participants in the control group can do their leisure activities of their own choices depending on their schedules at any places from 21st to 24th weeks. After the program, there were a total number of 12 dropouts from both groups (6 dropouts each) therefore; there were total 98 participants, 49 participants in each group.

This chapter presents the topics of discussion based on the results in this study below.

- 5.1 Level of body composition (visceral fat, waist circumference) and knowledge score of health education at baseline among both groups.
- 5.2 The effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command
- 5.3 The effects of six-month aerobic exercise and health education program intervention on body composition to “reduce visceral fat”
- 5.4 The effects of six-month aerobic exercise and health education program intervention on body composition to “reduce waist circumference”
- 5.5 The effects of six-month aerobic exercise and health education program intervention to “increase knowledge scores”

5.1 Level of body composition (visceral fat, waist circumference) and knowledge score of health education at baseline among both groups.

The results showed that all the body composition parameters and health education scores of both groups (mean \pm SD) had no significant difference at baseline among both groups. Due to the general characteristics of the selected participants were similar and the main responsibilities jobs of all participants were computers staffs and processing paper documents during office hours from 8.00 to 16.00 during Mondays to Fridays, thus, the body composition parameters (Body Weight, Body Mass Index, Waist Circumference, Hip circumference, Waist Hip Ratio, Percent of Fat, Fat Mass, Fat Free Mass, Muscle Mass, Total Body Water, Percent of Total Body Water, Bone Mass, BMR (KJ), Visceral Fat, and Percent of Degree of Obesity) and the knowledge at baseline among both groups also quite similar. From birth to adulthood, the chemical maturation of lean mass, a crucial part of body composition, happens but the relative ratio of the three major components namely water, protein and mineral changes depending on age and pubertal status. Body composition and growth are major components of health among individuals and populations. The significance of body fat for short-term and long-term health has become more central due to the widespread epidemic of overweight and obesity in children and adults [55].

Body composition is a health-related component of physical fitness which applies to body weight and relative amount of muscle, fat, bone, and other important tissues of the body. The components are limited to fat and lean body mass (or fat free mass) and expressed as relative (percentage) and absolute (kilograms) [56]. Body composition stands for the components which make up the human body. So, body composition techniques tend to be much more accurate evaluations of the body compared to human weight or BMI. Such techniques could

be used to reveal the relative proportion of fat and lean mass in the body [57] and to evaluate training or effectiveness of nutritional intervention [58].

5.2 The effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command

The objectives of this study were focused on the body compositions (waist circumference and the visceral fat) and the knowledge scores of health education as shown in **Table 3**. The comparison (mean±SD) within groups, between groups and the interactions between groups at baseline, 3-month, and 6-month indicated that body composition in the intervention group was improved. Body composition is a health-related component of physical fitness which applies to body weight and relative amount of muscle, fat, bone and other important tissues of the body. The components are limited to fat and lean body mass (or fat free mass) and expressed as relative (percentage) and absolute (kilograms) (56). Body composition stands for the components which make up the human body. So, body composition techniques tend to be much more accurate evaluations of the body compared to human weight or BMI. Such techniques could be used to reveal the relative proportion of fat and lean mass in the body (57) and to evaluate training or effectiveness of nutritional intervention (58). The significance of body fat for short-term and long-term health has become more central due to the widespread epidemic of overweight and obesity in children and adults (55). One of the systematic reviews investigated obesity, weight loss program, body composition and the effects of an aerobic exercise program without hypocaloric diet on body composition to reduce visceral fat (23).

5.3. The effects of six-month aerobic exercise and health education program intervention on body composition to “reduce visceral fat”

This study found that the interactions of the visceral fat at all three time periods: baseline, three-month, six-month was decreased continuously with statistically significant difference ($p=0.001^*$). The visceral fat at baseline, three-month, six-month had no statistical difference ($p=0.310$), ($p=0.833$), ($p=0.207$) respectively as shown in Table 4.

The mean differences (mean \pm SD) of the visceral fat in the intervention group at baseline to three-month decreased to (- 0.41 \pm 0.86), at three-month to six-month decreased to (-0.27 \pm 0.60) and at baseline to six-month decreased to (-0.67 \pm 1.05) whereas the control group at baseline to three-month increased to 0.18 \pm 0.37, at three-month to six-month increased to 0.24 \pm 0.63 and at baseline to six-month increased to 0.43 \pm 0.84. The mean change of the visceral fat from baseline to six-month between the intervention group and the control group was 0.61.

The intervention materials directly affected to body composition to “reduce visceral fat”. There are some studies stated that when the human body stores excess fat, individuals with excess fat may become overweight and the risks of death will increase sharply (65). In fact, excess body fat could cause the condition of being overweight and obesity. It should be noted that being overweight does not mean an excess of body fat since body weight can consist of many factors such as body fat, muscle, bone density and water content. Therefore, highly muscular individuals are often classified as overweight (63, 64). A previous study on visceral fat and insulin resistance showed that white adipose tissue facilitates metabolic regulation by producing a wide range of hormones and cytokines known as adipokines. The quantity of adipokines created by adipose tissue in obese patients is both directly and indirectly associated with obesity-related pathology including cardiovascular

disease, type 2 diabetes and inflammatory reaction. One of the mechanisms involving obesity, diabetes and cardiovascular diseases is inflammation found in visceral adipose tissue. The researchers proposed that obesity could be treated by conservative or non-surgical approaches or surgical bariatric procedures. Conservative approaches are considered as complex therapies which encompass cognitive behavioral therapy, diet therapy, nutritional education, more physical activity and pharmacotherapy. In contrast, surgical bariatric procedures could be performed only when body mass index value had to be over 40 or at least over 35 for the cases of serious obesity-related comorbidities [69].

The reserve body fat offers a supply of fuel ready to use by the body. The excess body fat is an extra amount of fat which is over the combination of the essential and reserve body fat could cause the risk of serious health problems including diabetes, strokes, heart attack and some forms of cancer.

5.4 The effects of six-month aerobic exercise and health education program intervention on body composition to “reduce waist circumference”

This study found that the interactions of the waist circumference at all three time periods: baseline, three-month, six-month was decreased continuously with statistically significant difference ($p=0.001^*$) as shown in Table 4. The waist circumference at baseline, three-month had no statistical difference ($p=0.246$), ($p=0.286$) respectively; however, the intervention group was decreased while the control group was increased. This made the statistical values at six-month had statistical difference with statistical significance ($p=0.014$). The mean differences (Mean \pm SD) of the waist circumference in the intervention group at baseline to three-month decreased to (-1.24 ± 0.74) , at three-month to six-month decreased to (-0.44 ± 0.55) and at baseline to six-month decreased to (-1.69 ± 0.77) whereas the control group at baseline to three-month increased to 0.14 ± 0.29 , at three-month to six-month increased to 0.42 ± 0.50 and at baseline to six-month increased to 0.56 ± 0.52 . The mean change of the waist circumference from baseline to six-month between the intervention group and the control group was 1.54 centimeters.

The intervention materials directly affected to body composition to “reduce waist circumference”. There are some studies stated that waist circumference could provide a basic measure of central fatness, which may be used as a predictor of negative outcomes including lipid profile or insulin resistance better than total fat. In adults, waist-hip ratio tends to be independently related to morbidity after the change for relative weight. So, the combination of relative weight and body shape offers a better estimate of the morbidity risks than either one only (71, 72). Individuals with higher percentiles for waist circumference are classified as obese with higher risks for morbidity particularly type two diabetes and metabolic syndrome and mortality (73). The standard formula of measuring waist circumference

is individual height divided by two. The study conducted the prediction of whole-body fat percentage and visceral adipose tissue mass from five anthropometric variables including BMI, WHtR, waist-to-height ratio, waist circumference and waist-to-hip ratio. The researchers concluded that the best predictor of both %FM and VAT mass in men and women was WHtR (the waist-height ratio) determined by dividing individual's waist by his height. The WHtR metric could offer many advantages. It could be easier to calculate than BMI and it may work for general populations regardless of their age, race or gender. An individual can use a measuring tape or string to measure his height and fold it in half and check to see if it fits around his waist (74).



5.5 The effects of six-month aerobic exercise and health education program intervention to “increase knowledge scores”

The knowledge scores at all three time periods: baseline, three-month, six-month had not statistically significant as shown in **Table 3**. The knowledge scores of health education was increased continuously with statistically significant difference ($p=0.001^*$). The knowledge scores at baseline had no statistical difference ($p=0.631$); however, the scores at three-month and six-month had statistically significant difference ($p<0.001^*$), ($p<0.001^*$) respectively as shown in **Table 4**.

The mean differences (mean \pm SD) of the knowledge scores on health education in the intervention group at baseline to three-month increased to 14.10 ± 7.11 , at three-month to six-month increased to 1.29 ± 2.99 and at baseline to six-month increased to 15.39 ± 6.73 whereas the control group at baseline to three-month increased slightly to 0.27 ± 1.43 , at three-month to six-month was remained the same at 0.00 ± 0.00 and at baseline to six-month was increased very slightly to 0.26 ± 1.43 . The mean change of the knowledge scores on health education from baseline to six-month between the intervention group and the control group was 14.53 points

The intervention materials directly affected to increase knowledge scores. There are some studies stated that knowledge means familiarity, awareness or understanding of someone or something such as fact, information, descriptions or skills through experience or education by perceiving, discovering, or learning. It also means a theoretical or practical understanding of a subject. It can be implicit or explicit, formal or systematic. Health-related knowledge gains involved more knowledge on safety, nutrition, hygiene, security, the harm of tobacco, how to avoid injuries and psychological knowledge including how to relieve anxiety and what is normal and abnormal (101).

Health education involves the continuum from disease prevention and promotion of optimal health to the detection of illness to treatment, rehabilitation, and long-term care. It encompasses infectious and chronic diseases together with attention to environmental issues. Health education can be promoted in most settings such as universities, schools, hospitals, shopping malls through mass media, the internet, and in health departments at all levels of government. Health education constitutes not only instructional activities and strategies to change individual health behavior but also organizational efforts, policy initiatives, economic supports, environmental activities, mass media and community-level programs. There are 5 levels of influence over health-related behaviors and conditions: 1) intrapersonal, or individual factors; 2) interpersonal factors; 3) institutional or organizational factors; 4) community factors and 5) public-policy factors [97]. Moreover, behavior affects and is affected by the social environment [97]. Health education mainly focuses on health behavior, which is a significant dependent variable in most research on the effect of health education intervention strategies. So, positive, informed changes in health behavior are the ultimate objectives of health education programs [98]. Health behavior refers to the actions of individuals, groups, and organizations as well as their determinants, correlates and consequences including social change, policy development and implementation, improved coping skills and better quality of life. Another definition of health behavior is those personal attributes including beliefs, expectations, motives, values, perceptions and other cognitive elements; personality characteristics namely affective and emotional states and traits as well as overt behavior patterns, actions and habits related to health maintenance, health restoration and health improvement [98].

CHAPTER VI

CONCLUSION

6.1 Conclusion

The study was conducted to evaluate the effects of six-month aerobic exercise and health education program intervention on body composition to reduce visceral fat and waist circumference among army male officers at Support Office Armed Forces Development Command.

The intervention program was effective in reducing visceral fat and waist circumference significantly while increasing the knowledge scores of health education significantly in the intervention group.

The combination of standard health status and innovative technology called BIA could help the intervention group feel more motivated, gain better understanding and share mutual goals. This program integrated the knowledge on health education plus exercise types without any equipment, in which the participants could find relevant information through classroom, Line application and have self-evaluation related to the research objective.

The general characteristics, the body compositions parameters and health education scores in both groups at baseline were compared and the results found that both groups were similar and had no statistically significant difference ($p>0.05$). According to the objectives, this study found that the interactions of the visceral fat at all three time periods: baseline, three-month, six-month caused it to decrease continuously with statistically significant difference ($p=0.001^*$).

The visceral fat at baseline, three-month, six-month had no statistical difference ($p=0.310$), ($p=0.833$), ($p=0.207$) respectively. This study found that the interactions of the waist circumference at all three time periods: baseline, three-

month, six-month caused it to decrease continuously with statistically significant difference ($p=0.001^*$). This study found that the interactions of the knowledge scores at all three time periods: baseline, three-month, six-month had not statistically significant.

6.2 Limitations of this study

1. This study could not be generalized into elderly adults and/or people diagnosed with some chronic diseases affecting the exercise which must be done under the doctor's supervision.

2. The intervention was only conducted on army male officers at Support Office Armed Forces Development Command. Consequently, it results in the short-term effect which we cannot conclude our intervention has sustainability.

3. The personal budget was allocated for this study.

4. The study was conducted in the group of willing volunteers. So, it did not cover other groups.

6.3 Recommendations of this study

1. This research was the first studies which integrated innovative technology called BIA among overweight army male officers in Bangkok.

2. This study could reduce the KPI of standard health status (Waist Circumference) of the government campaigns and integrate innovative technology called BIA so that the participants felt more motivated, gained better understanding and shared mutual goals in maintaining better health status leading to normal and healthy body compositions based on the results.

3. We could continue to do the exercise and apply the plate model by themselves. This program integrated the knowledge on health education plus exercise types without any equipment, in which the participants could find relevant information and have self-evaluation suitable for social distancing

6.4 Benefit of this study

1. Participants should be more physically active and can improve their physical health under better shape from reducing visceral fat and waist circumference and better body composition according to the literature review on health behavior divided into 3 categories which include preventive health behavior, illness behavior and sick-role behavior.

2. This study was focused on preventive health behavior which means any activity performed by a person who believes in himself to be healthy and its purpose of preventing or detecting illness in an asymptomatic state.

3. The understanding and the individual actions of preventive health behavior can reduce the problems of unhealthy body compositions which will cause the diseases because of excess fat particularly visceral fat.

4. Based on the literature review of 5 levels of influence over health-related behaviors and conditions after the six-month intervention program from this study of health education and exercise, the participants will 1) understand how to learn and gain attitudes, skills and knowledge to prevent and return to exercise correctly and continuously or when they find that they gain weight for health benefits as their intrinsic motivation as intrapersonal, or individual factors.

5. Their intrinsic motivation as intrapersonal factors will create the interaction and bonding between group members and group leaders and among groups from

every department of the same building who have similar activities, workloads and the same career paths (from the intervention group) as interpersonal factors.

6. The six-month intervention program was promoted the interaction and bonding between healthy groups from different departments as interpersonal factors leading to institutions as institutional or organizational factors.

7. The strong and determined healthy groups from different departments as interpersonal factors will lead to institutions will transform into community as community factors.

8. The strong and determined community as community factor will satisfy their policies as public-policy factors which will become stable and sustainable.

9. This study may reduce the cost of medical treatment, nursing care as well as medication and result in good health and sustainability.





Appendix A

The Ethical Approval Documents

AF 02-12



คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย
254 อาคารจามจุรี 1 ชั้น 2 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330
โทรศัพท์: 0-2218-3202, 0-2218-3049 E-mail: eccu@chula.ac.th

COA No. 258/2562

ใบรับรองโครงการวิจัย

โครงการวิจัยที่ 183.1/62 : ผลของโปรแกรมการออกกำลังกายและความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบของร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ้ายสนับสนุนหน่วยบัญชาการทหารพัฒนา : การวิจัยกึ่งทดลองแบบมีกลุ่มควบคุม

ผู้วิจัยหลัก : ร้อยเอกหญิงพัชฌัน มาสกุล

หน่วยงาน : วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย

คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ได้พิจารณา โดยใช้หลัก ของ Belmont Report 1979, Declaration of Helsinki 2013, Council for International Organizations of Medical Sciences (CIOM) 2016, มาตรฐานคณะกรรมการจริยธรรมการวิจัยในคน (มคจค.) 2556, นโยบายแห่งชาติและแนวทางปฏิบัติการวิจัยในมนุษย์ 2558 อนุมัติให้ดำเนินการศึกษาวิจัย เรื่องดังกล่าวได้

ลงนาม ปรีดา ประชาน
(รองศาสตราจารย์ นายแพทย์ปรีดา ทิศนประดิษฐ์)
ประธาน

ลงนาม นันท์ ชัยชนะวงศาโรจน์
(ผู้ช่วยศาสตราจารย์ ดร.นันท์ ชัยชนะวงศาโรจน์)
กรรมการและเลขานุการ

วันที่รับรอง : 15 พฤศจิกายน 2562

วันหมดอายุ : 14 พฤศจิกายน 2563

เอกสารที่คณะกรรมการรับรอง

- 1) โครงการวิจัย
- 2) เอกสารข้อมูลสำหรับผู้มีส่วนร่วมในการวิจัยและหนังสือแสดงความยินยอมของผู้มีส่วนร่วมในการวิจัย
- 3) ผู้วิจัย 183.1/62
- 4) แบบสอบถาม 15 พ.ย. 2562
วันหมดอายุ 14 พ.ย. 2563

เงื่อนไข

1. ข้าพเจ้ารับทราบว่าเป็นการผิดจริยธรรม หากดำเนินการเก็บข้อมูลการวิจัยก่อนได้รับการอนุมัติจากคณะกรรมการพิจารณาจริยธรรมการวิจัย
2. หากใบรับรองโครงการวิจัยหมดอายุ การดำเนินการวิจัยต้องยุติ เมื่อต้องการต่ออายุต้องขออนุมัติใหม่ล่วงหน้าไม่ต่ำกว่า 1 เดือน พร้อมส่งรายงานความก้าวหน้าการวิจัย
3. ต้องดำเนินการวิจัยตามที่ระบุไว้ในโครงการวิจัยอย่างเคร่งครัด
4. ใช้เอกสารข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย ใบยินยอมของกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย และเอกสารเชิญเข้าร่วมวิจัย (ถ้ามี) เฉพาะที่ประกาศคณะกรรมการเท่านั้น
5. หากเกิดเหตุการณ์ไม่พึงประสงค์ร้ายแรงในสถานที่เก็บข้อมูลหรือข้อมูลจากคณะกรรมการ ต้องรายงานคณะกรรมการภายใน 5 วันทำการ
6. หากมีการเปลี่ยนแปลงการดำเนินการวิจัย ให้ส่งคณะกรรมการพิจารณารับรองก่อนดำเนินการ
7. โครงการวิจัยไม่เกิน 1 ปี ส่งแบบรายงานสิ้นสุดโครงการวิจัย (AF 02-14) และบทคัดย่อผลการวิจัยภายใน 30 วัน เมื่อโครงการวิจัยเสร็จสิ้น สำหรับโครงการวิจัยที่เป็นวิทยานิพนธ์ให้ส่งบทคัดย่อผลการวิจัย ภายใน 30 วัน เมื่อโครงการวิจัยเสร็จสิ้น

Appendix B
Questionnaire (English version)

Part I. Socio-demographic and Socio-economic questionnaire (15 items).

Full in the blank or mark \checkmark in the blank that consist with your data.

1. Age Years

2. Body weight.....kg

3. High..... cm

4. BMI.....

5. Waist and hip ratio () specify.....() uncertain

6. Education

() high school () Dipoma () Bachelor's degree or higher

7. Marital status

() single () married () separate/ divorce/widow

8. Family of income

() 15,000 -25,000 Baht () 25,001-35,000 Baht. () 35,001-45,000 Baht.

9. Affiliation

() Office of the chief of Defense forces

() Office of Armed Force development command

() Office of Maintenance.

() Office of joint civil affaires

- Office of Medical support
- Office of joint intelligence
- Office of joint personal
- Office of joint of communication
- Office of Technician
- Office of finance department

10. Smoking

- non smoking
- Quit Smoking (what kind of cigarette)
- How longyear.....month
- Smoking (what kind of cigarette)
- How many (per day).....

11. Alcohol consumption

- non-alcohol drinking 1-6 glasses/week more than 6 glasses/week

12. How often of exercise per week.

- non-exercise At least 1 time/ week At least 2-3times a week

Please skip question 13-14. If you answered that you didn't exercise regularly every week.

13. Normally, if you go to exercise, who would you go with? / How many people are you exercising with?

Alone

Going with family or friend between 2-4 person

Going with family or group friend more than 5 person

14. What exercise did you do on Wednesday afternoon? (Army sport day)

(Answer more than one question)

no	Type of sport	Remark
1	walk	
2	jogging	
3	spin	
4	Playing sports such as table tennis, badminton, tennis, football, etc	
5	Other please remark	

15. Where do you go to exercise?

at home sports Center or Fitness Public Garden /Park near the house

Part II. Health education questionnaires of the intervention program (70 items) on 2 issues:

2.1 Health education knowledge questionnaires (30 items)

2.2 Health attitudes and behaviors questionnaires (40 items)

2.1 Health education knowledge questionnaires (30 items): related to

2.1.1 Body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR) (10 items).

2.1.2 Food choices and plate model 2:1:1 (10 items).

2.1.3 Exercise (10 items).

Fill in the blank or mark ✓ that is the correct answer.

No	Question	True	False	Not sure
1	<p>2.1.1 Body composition, body composition analyzer, body fat, risk of excess fat and visceral fat, Total energy Expenditure (TDEE), Basal Metabolic Rate (BMR)</p> <p>The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in meters (BMI= 18.5-22.9 is the normal weight)</p>			
2	<p>Body composition is a health-related component of physical fitness which applies to body weight and relative amount of muscle, fat, bone and other important tissues of the body.</p>			
3	<p>Body Composition Analyzer is the measurement tool which develops technology for measuring Visceral Adipose Tissue (VAT) accumulation risk by Bioelectrical Impedance Analysis (BIA) by</p>			

	measuring the resistance of low electrical voltage (1-2 volts) found in body tissues			
4	The total weight of body fat can be subdivided into three separate categories. All three categories of body fat are bad.			
5	To reduce fat in the abdomen, should pay attention to Get enough sleep at seven o'clock a day, drink enough water calculated from body weight divided by two, eating a balanced diet. And exercise correctly and appropriately			
6	Three separate categories consist of essential fat to protect the body from infectious diseases, reserve fat to provide a reservoir of fuel and excess fat. Excess fat is over the combination of essential body fat plus reserve body fat.			
7	Visceral fat or Visceral Adipose Tissue (VAT) is the fat located in abdominal area. High levels of visceral fat and trunk fat are significantly proven to be associated with increased risk of			

	developing lifestyle-related diseases such as metabolic syndrome and diabetes type 2.			
8	The standard formula of measuring waist circumference is individual height divided by 2.			
9	In particular, physical exercise which is a good way to reduce visceral fat should include cardio exercise such as running, swimming and strength training such as squats, high knees, planks, Jumping jack and pushups			
10	Weight loss planning That exceeds standards To be successful, it is necessary to understand the daily balance of energy and energy intake. Therefore, the basal metabolic rate (BMR) and the extra energy that is generated from daily activities (TDEE) must be balanced with the energy received.			
No	Question 2.1.2 Food choices and plate model (2:1:1)	True	False	Not sure

11	<p>Sweetened beverages or sugar-extracted juices, soft drinks, sweet drinks, sweet herbal juices, coffee and sweet iced tea can affect overweight</p> <p>if: Drink 2-3 days a week (Begin risk)</p> <p>Drink 4-5 days a week (at risk) and drinking 6-7 days a week (very risky)</p>			
12	<p>The consumption of food and the appropriate amount of calories for each person Means that all types of food should be properly and completely controlled according to the principles of nutrition and correct dietary habits after Consideration of dietary intake is a simple matter starting with gender, height, weight, age and daily activities combined with the calculation of food per meal?</p>			
13	<p>Plate model is recommended food consumption/plate/meal which consists 2 portions of vegetables, 1 portion of rice and 1 portion of lean meat/plate and the food is still</p>			

	delicious but more vegetables are added. (Aroi-Thea-Derm-Pherm-Term-Khu-Phak)			
14	Thailand has a food model for one dish. / Per meal. The dish is 9 inches in size and the 2: 1: 1 recipe has been modified from a model from the United States called MyPlate for use in Thai food culture such as serving with curry rice.			
15	Plate model can be added by a small plate of not too sweet but fresh fruit such as guava and apple after each meal.			
16	The food based on plate model can provide 400 calories/meal			
17	High levels of visceral fat and trunk fat are significantly proven to be associated with increased risk of developing lifestyle-related diseases such as metabolic syndrome and diabetes type two. Aerobic exercise can reduce the risk but the combination of exercise and plate model can be more sustainable for the			

	prevention against the risk.			
18	<p>Plate model (2:1:1 ratio) means two portions of vegetables, one portion of rice and 1 portion of lean meat/plate</p> <p>So, One portion of rice or wheat can be whole grain rice, sticky rice, noodle and whole grain bread</p>			
19	<p>Plate model (2:1:1 ratio) means two portions of vegetables, one portion of rice and 1 portion of lean meat/plate</p> <p>So, one portion of lean meat can be meat without skin or fat, fish seafood, chicken without skin, eggs and soybeans. Bacon, ham, and pork belly are not included in one portion of meat based on plate model (2:1:1 ratio).</p>			
20	<p>In Thailand, the 2:1:1 plate model was adapted from the US's Model called MyPlate to apply it to Thai food culture such as one single serving of rice with curry. One single serving portion will</p>			

	be a 9-inch plate divided into 4 sections: 2 sections of vegetables, 1 section of rice and 1 section of lean meat or protein added up with one small plate of low-sugar fresh fruits, 1-2 glasses of milk.			
No	<p style="text-align: center;">Question</p> <p style="text-align: center;">2.1.3 Aerobic Exercise</p>	True	False	Not sure
21	Environment where people live, work or study influences their health status including overweight. In particular, “obesogenic” environment promotes people to consume more but do less physical exercise because modern technology and facilities facilitate human living conditions.			
22	One of the most effective methods to lose weight safely and to stay healthy is doing physical exercise. So, the suggests that people should do moderate-intensity exercise for at			

	least 150 minutes a week			
23	Inactivity particularly prevalent among sedentary workers is one of well-established causes of obesity and a potential to chronic diseases.			
24	A simple but safe method to lose weight safely and permanently is to do physical exercise. To lose weight effectively, people need to incorporate more physical exercise into daily life			
25	The first step to consider when people have to lose weight is to calculate how many calories people need to consume every day, people should skip(TDEE)			
26	People who do regular exercise may display the high level of exercise and motivation based on intensity, time/duration and frequency of healthy exercise (FITT).			

27	People should warm up and cool down before and after doing exercise to reduce possible injuries.			
28	Oxygen-based exercise, also known as aerobic exercise, in the program consists of strength training and muscle building, such as using the body's weight. Is the total weight of balance or movement and movement that affects the heart rate faster to the heart rate will increase by 60% -85% compared to the maximum heart rate. Which can reduce visceral fat and waist and prevent chronic diseases such as squat, jumping jacks, high knee and plank.			
29	The Basal Metabolic Rate (BMR) is the rate of energy expenditure of a person at rest. It is most of the daily energy use for normal body cellular homeostasis, cardiac function and other nerve functions which will function better.			
30	The goal of aerobic exercise is to enable the			

	<p>body to use the oxygen, with the body responding as follows:</p> <ul style="list-style-type: none">- The respiratory system will work harder and stronger In order to bring enough oxygen into the body enough to purify the blood that needs more circulation- The heart rate will be faster in order to pump blood to the muscles- Blood vessels will expand. To allow blood to be fed to various parts of the body efficiently			
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2.2 Health attitudes and behaviors questionnaires (40 items): related to

2.2.1 Attitude regarding exercise (10 items)

2.2.2 Attitudes about food consumption (10 items)

2.2.3 Exercise-related behaviors (10 items)

2.2.4 Behavior about food consumption (10 items)

Fill mark ✓ in the box that best matches your feelings / opinions of exercise.

No	Question	Agree	Disagree	Not sure
	2.2.1 Attitude regarding exercise			
1	Exercise makes unnecessary expenses.			
2	Healthy people do not need to exercise.			
3	People with congenital diseases should consult a doctor before exercising.			
4	Exercise increases oxygen consumption and metabolism in the body.			
5	Exercise should choose the program that is suitable for gender and age and Proper			

	exercise will reduce injuries and will make you more confident.			
6	The exercise with friends makes exercise longer.			
7	Should exercise at least 30 minutes at a time, 3 days per week, Exercise should consist of 3 sessions: warm up, physical training and relaxation.			
8	Regular exercise helps to slow down the deterioration of the body. The benefits of regular exercise cause less sick leave.			
9	Exercise is a free time to benefit.			
10	Good exercise should have a rest period of at least 2 days per week.			
No	<p style="text-align: center;">Question</p> <p style="text-align: center;">2.2.2 Attitudes about food consumption</p>	Agree	Disagree	Not sure
11	Eating when hungry Will make you eat more food And receive a lot of nutrients as			

	well			
12	You tend to like snacking between meals.			
13	You should not drink sweet or fruit drink such as carbonated water, sweetened water, sweet green tea, sweet herbal water, coffee tea, milk ice tea.			
14	Men should eat foods that are high in fat to increase muscle tone.			
15	Your salty eating behavior such as add seasonings/ fish sauce make your life unhealthy.			
16	<p>Environmental factors that determine food consumption behavior There are physical factors and social environmental factors.</p> <p>Physical factors: facilities such as convenience stores in the community such as Seven Eleven, Lotus Big C, etc. Social environment factors:</p>			

	<p>1. Pattern, behavior, traditions Principles of religion, culture affecting food consumption behavior.</p> <p>2. Understanding and use of sufficiency economy for health occur.</p> <p>3. Media propaganda in various products.</p>			
17	<p>You add sugar to food and beverages. Because thinking that sugar makes you feel fresh</p>			
18	<p>Do you think that warming up the food will spoil the taste and not tasty?</p>			
19	<p>You like to eat fish more than beef because you think fish is useful.</p>			
20	<p>You like to eat spicy food because it makes the food feel delicious and flavorful</p>			
No	<p style="text-align: center;">Question</p> <p style="text-align: center;">2.2.3 Exercise-related behaviors</p>	Agree	Disagree	Not sure

21	You wear clothes that are suitable for exercise.			
22	You respect the rules and accept the agency agreement that oversees the place and conducts exercise.			
23	You do not stop exercising suddenly, will gradually reduce the speed.			
24	You have exercised after eating for at least three hours.			
25	You eat foods that are good for exercise.			
26	You stop exercising when your ankles sprains, bruises and cold compresses with ice.			
27	You hold your pulse before and after exercise.			
28	You will exercise until you feel racers, fast heartbeat			

29	You stretch out the muscles every time after exercise.			
30	You have an athlete who is fond and is a role model for exercising.			
No	<p style="text-align: center;">Question</p> <p style="text-align: center;">2.2.4 Behavior about food consumption</p>	Agree	Disagree	Not sure
31	You eat rice alternately with starchy foods for certain meals.			
32	You often eat unhealthy snacks.			
33	You often eat fast food, such as hamburgers, pizzerias and donuts.			
34	You eat more than 3 meals a day.			
35	You eat fried food almost every day.			
36	You often eat instant noodles instead of one main meal.			
37	You often eat pickled fruit.			

38	You often drink alcohol beverages.			
39	You eat vegetables and fruits almost every day.			
40	You drink at least 8-10 glasses of clean water per day.			



Appendix C
Questionnaire (Thai version)

แบบสอบถาม

ความรู้ด้านสุขภาพในช่วงเวลา 6 เดือนต่อองค์ประกอบของร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ่ายสนับสนุนหน่วยบัญชาการทหารพัฒนา

ส่วนที่ 1: ข้อมูลทั่วไปทางสังคมและเศรษฐกิจและข้อมูลส่วนตัวเต็มหรือกาเครื่องหมาย✓ในช่องว่างที่ประกอบด้วยข้อมูลของผู้ตอบแบบสอบถาม

1. อายุ ปี

2. น้ำหนักตัว..... ก.ก.

3. ส่วนสูง..... ซม.

4. ค่าดัชนีมวลกาย

()¹ไม่ทราบ

()²ไม่แน่ใจ

()³ระบุ.....

5. อัตราส่วนเอวและสะโพก

()¹ไม่ทราบ

()²ไม่แน่ใจ

()³ระบุ.....

6. การศึกษาสูงสุด

()¹มัธยมศึกษา

()²อนุปริญญา/ประกาศนียบัตร

()³ปริญญาตรีขึ้นไป

7. สถานภาพสมรส



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

- ()¹โสด
- ()²แต่งงาน
- ()³หย่าร้าง/แยกกันอยู่/หม้าย

8. รายได้ของครอบครัว(บาท/เดือน)

- ()¹ 15,000-25,000 บาท
- ()²25,001-35,000 บาท
- ()³35,001-45,000 บาท.

คุณทำงานในหน่วยงานใด

- ()¹สนง. ทหารพัฒนา /สทพ.
- ()²สนง. ทหารพัฒนา
- ()³สนง.กองซ่อมบำรุง
- ()⁴ สนง กองช่าง/กองกิจการพลเรือน
- ()⁵สนง กองแพทย์
- ()⁶ สนง กองยุทธการ ทหาร
- ()⁷สนง กองกำลังพล
- ()⁸สนง กองข่าว
- ()⁹ สนง กองส่งกำลังบำรุง
- ()¹⁰สนง.กองช่าง
- ()¹⁰สนง กองการสื่อสาร

10.คุณเคยสูบบุหรี่ ซิการ์ หรือบุหรี่ไฟฟ้าหรือไม่?

- ()¹ ไม่เคยสูบบุหรี่
- ()² เคยสูบบุหรี่แต่เลิกแล้ว โปรดระบุระยะเวลาที่เลิกสูบบุหรี่.....เดือน.....
- ()³สูบบุหรี่ โปรดระบุจำนวนที่สูบต่อวัน.....

11. คุณเคยดื่มแอลกอฮอล์บ้างไหม?

- ()¹ ไม่ดื่มเครื่องดื่มที่มีแอลกอฮอล์
- ()²ดื่มที่1-6 แก้ว / สัปดาห์

()³ ตี้มมากกว่า 6 แก้ว / สัปดาห์

12. คุณออกกำลังกายบ่อยแค่ไหนต่อสัปดาห์?

()¹ ไม่ออกกำลังกาย

()² ออกกำลังกายในวัน Army sport day ถ้ามีเวลา/ทำไม่สม่ำเสมอ

()³ ออกกำลังกายอย่างน้อย 2-3 ครั้งต่อสัปดาห์ทำสม่ำเสมอ

โปรดข้ามคำถามที่ 13-15 ถ้าคุณตอบว่าคุณไม่ได้ออกกำลังกาย

13. ปกติถ้าคุณไปออกกำลังกายคุณจะไปกับใคร/มีสมาชิกร่วมออกกำลังกายกับคุณกี่คน?

()¹ ไปเพียงคนเดียว

()² ไปกับครอบครัวหรือกลุ่มเพื่อนมากกว่า 2-4 คน

()³ ไปกับครอบครัวหรือกลุ่มเพื่อนมากกว่า 5 คน

14. กีฬาที่คุณเลือกออกกำลังกายในทุกบ่ายวันพุธ (วันกีฬากองทัพบก)

(ตอบได้มากกว่าหนึ่งข้อ)

()¹ เดินเร็ว

()² วิ่งออกกำลังกาย

()³ ปั่นจักรยาน

()⁴ เล่นกีฬาเป็นทีมเช่น ปิงปอง ตะกร้อ แบดมินตัน เทนนิส หรือฟุตบอล

()⁵ อื่นๆโปรดระบุ

15. สถานที่ที่คุณออกกำลังกายบ่อยที่สุดคือที่ใด?

()¹ ที่บ้าน

()² ศูนย์กีฬาหรือฟิตเนส

()³ สวนสาธารณะใกล้บ้าน

.....

**ส่วนที่สอง แบบสอบถามความรู้ด้านสุขภาพความรู้ด้านสุขภาพในช่วงเวลา6เดือนต่อ
องค์ประกอบของร่างกายเพื่อลดไขมันในช่องท้องและเส้นรอบเอวของทหารชายที่ฝ่ายสนับสนุน
หน่วยบัญชาการทหารพัฒนา**

จำนวน 70 ข้อ ใน 2 ประเด็น:

1.แบบสอบถามความรู้ด้านสุขภาพ (รวมทั้งหมด 30 ข้อ)

- 1.1 องค์ประกอบของร่างกาย, เครื่องวิเคราะห์องค์ประกอบของร่างกาย, ไขมันในร่างกาย, ความเสี่ยงของไขมันส่วนเกิน และ ไขมันในอวัยวะภายใน, อัตราการเผาผลาญพื้นฐาน (BMR) และ พลังงานเสริมที่เกิดขึ้นจากกิจกรรมที่ทำในแต่ละวัน (TDEE) (10 ข้อ)
- 1.2การเลือกอาหารและแบบจำลองPlate Model 2:1:1 (10 ข้อ)
- 1.3 การออกกำลังกายแบบที่ร่างกายใช้ออกซิเจน (แอโรบิก) (10 ข้อ)

2.แบบสอบถามเกี่ยวกับทัศนคติด้านสุขภาพ(รวมทั้งหมด 40 ข้อ)

- 2.1ทัศนคติเกี่ยวกับการออกกำลังกาย (10 ข้อ)
 - 2.2ทัศนคติเกี่ยวกับการบริโภคอาหาร (10 ข้อ)
 - 2.3พฤติกรรมเกี่ยวกับการออกกำลังกาย (10 ข้อ)
 - 2.4พฤติกรรมเกี่ยวกับการบริโภคอาหาร (10 ข้อ)
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2.1 ประเด็นที่ 1แบบสอบถามความรู้ด้านสุขภาพ (รวมทั้งหมด 30 ข้อ)

- 1.1 องค์ประกอบของร่างกาย, เครื่องวิเคราะห์องค์ประกอบของร่างกาย, ไขมันในร่างกาย, ความเสี่ยงของไขมันส่วนเกิน และ ไขมันในอวัยวะภายใน, อัตราการเผาผลาญพื้นฐาน (BMR) และ พลังงานเสริมที่เกิดขึ้นจากกิจกรรมที่ทำในแต่ละวัน (TDEE) (10 ข้อ)
- 1.2การเลือกอาหารและแบบจำลองPlate Model 2:1:1 (10 ข้อ)
- 1.3 การออกกำลังกายแบบที่ร่างกายใช้ออกซิเจน (แอโรบิก) (10 ข้อ)

ให้ใส่เครื่องหมาย✓ซึ่งเป็นคำตอบที่ถูกต้อง

ข้อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
1	1.ดัรรชนีมวลกายเป็นค่าที่ได้จากน้ำหนักและส่วนสูงของร่างกายแต่ละบุคคล มีหน่วยเป็นกิโลกรัมหารด้วยส่วนสูงเป็นเมตรยกกำลังสอง และแสดงในหน่วย กิโลกรัม/เมตรกำลังสองค่าดัรรชนีมวลกายหรือ BMI ปกติจะอยู่ในช่วง 18.5-22.9 kg/m ²			
ข้อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
2	องค์ประกอบของร่างกาย เกี่ยวข้องกับสุขภาพและสมรรถภาพทางกายน้ำหนักตัวมีความสัมพันธ์กับปริมาณของกล้ามเนื้อ, ไขมัน, กระดูกและเนื้อเยื่อที่สำคัญอื่น ๆ ของร่างกาย			
3	Body composition analyzer. เป็นเครื่องมือที่ใช้ตรวจวัดองค์ประกอบของร่างกายโดยใช้เทคโนโลยีการตรวจด้วยหลัก Bioelectrical Impedance Analysis (BIA) โดยการใช้กระแสไฟขนาดต่ำๆที่ 1-2 โวลต์เพื่อตรวจสอบความต้านทานผ่านเนื้อเยื่อของร่างกาย สามารถตรวจวัดส่วนประกอบของร่างกายที่ทำได้อย่างรวดเร็ว ปลอดภัย และมีความเที่ยงตรงสูง สามารถวัดส่วนประกอบของร่างกายได้ละเอียด โดยวิเคราะห์แยกส่วนประกอบของร่างกายออกเป็น 4 ส่วน คือ ส่วนของน้ำ กล้ามเนื้อ กระดูก และไขมัน ซึ่งช่วยให้ประเมินความอ้วนผอมได้แม่นยำมากขึ้น เครื่องมือนี้สามารถใช้วัดความการสะสมของไขมันที่อยู่ในอวัยวะภายในในช่องท้อง หรือที่เรียกว่า Visceral Adipose Tissue (VAT) ได้ด้วย			
4	น้ำหนักรวมของไขมันภายในร่างกายเป็นผลรวมของไขมันจากสามประเภทและไขมันทั้งสามประเภทในร่างกายทั้งหมดเป็นไขมันที่ไม่มีข้อดี			
5	การลดปริมาณไขมันในช่องท้อง ควรให้ความสำคัญกับการ การนอนหลับให้เพียงพออย่างน้อยวันละ 7 ชม. การดื่มน้ำให้พอเพียง (โดยคิดปริมาณน้ำที่ดื่มต่อวันโดยเอาปริมาณน้ำหนักตัวหารด้วยสอง) การรับประทานอาหารถูกสัดส่วน และการออกกำลังกายอย่างถูกต้องเหมาะสม			
6	ไขมันสามประเภทประกอบด้วยไขมันที่จำเป็นในการปกป้องร่างกายจากเชื้อโรคหรือการติดเชื้อ ไขมันสำรองทำหน้าที่สะสมพลังงานไว้ใช้เมื่อจำเป็น และไขมันส่วนเกินเป็นไขมันที่เกิดจากการสะสมมากเกินไปจนเป็นอันตรายต่อสุขภาพ			
7	ไขมันที่สะสมในอวัยวะภายในหรือไขมันที่อยู่ในบริเวณท้องถ้ามีอยู่ในร่างกาย			

	ระดับสูงได้รับการพิสูจน์แล้วว่าเกี่ยวข้องกับความเสี่ยงที่เพิ่มขึ้นของโรคที่เกี่ยวข้องกับการดำเนินชีวิตเช่นโรคเมตาบอลิซึมและโรคเบาหวานประเภทที่สอง			
8	มาตรฐานของการวัดรอบเอวคือความสูงของแต่ละบุคคลหารด้วยสอง			
9	การออกกำลังกายทั้งการออกกำลังกายแบบคาร์ดิโอ เช่นการวิ่งหรือ การว่ายน้ำ และการฝึกความแข็งแรงโดยการสร้างกล้ามเนื้อเช่นการใช้น้ำหนักตัวของผู้ทำ เป็นน้ำหนักมวลรวมในการทรงตัวหรือที่เรียกว่า planking และการวิดพื้น การออกกำลังกายทั้งสองรูปแบบใช้เป็นวิธีในการลดการสะสมของไขมันที่อยู่ในอวัยวะภายใน			
ข้อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
10	การวางแผนการลดน้ำหนักน้ำหนักตัวที่เกินจากมาตรฐานจะสำเร็จได้ต้องทำความเข้าใจการปรับสมดุลการใช้พลังงานและการรับพลังงานในแต่ละวัน ดังนั้นอัตรา การเผาผลาญพื้นฐาน (BMR) และ พลังงานเสริมที่เกิดขึ้นจากกิจกรรมที่ทำในแต่ละวัน(TDEE) ต้องสมดุลกับพลังงานที่ได้รับมา			
11	เครื่องดื่มรสหวานหรือน้ำผลไม้แยกจากผสมน้ำตาลรสหวาน, น้ำอัดลม, น้ำหวาน, ชาเขียวหวาน, น้ำสมุนไพรหวานกาแฟผสมครีมเทียมรสหวาน, ชานมเย็นรสหวาน เป็นต้น ดื่ม 2-3 วันต่อสัปดาห์ (เริ่มต้นที่มีความเสี่ยง) ดื่ม 4-5 วันต่อสัปดาห์ (มีความเสี่ยง) และดื่ม 6-7 วันต่อสัปดาห์ (มีเสี่ยงมาก)			
12	12การบริโภคอาหารและปริมาณแคลอรีที่เหมาะสมของแต่ละบุคคล หมายถึงควรควบคุมการรับประทานอาหารทุกชนิดอย่างเหมาะสมครบถ้วนตามหลักโภชนาการ และปรับพฤติกรรมกรบริโภคอาหารอย่างถูกต้องหลัง การพิจารณาการบริโภคอาหารมีหลักการง่ายๆเริ่มจากเพศ ความสูง น้ำหนัก อายุ และกิจกรรมที่ทำในแต่ละวันร่วมกับการคำนวณอาหารต่อหนึ่งมื้อ			
13	มีการแนะนำให้ใช้การคำนวณอาหารต่อหนึ่งมื้ออย่างง่ายซึ่งดัดแปลงให้เหมาะสมกับวัฒนธรรมการบริโภคแบบไทย(ข้าวราดแกง)ประกอบด้วยผัก 2 ส่วนข้าว 1			

	ส่วนและเนื้อสัตว์ไม่ติดมัน 1 ส่วนภายใต้สโลแกนอร่อยเท่าเดิมเพิ่มเติมคือผัก			
14	ประเทศไทยได้รูปแบบแบบจำลองอาหารสำหรับหนึ่งจาน /ต่อหนึ่งมือโดยงานจะมีขนาด 9 นิ้วและสูตร 2: 1: 1 ถูกดัดแปลงจากแบบจำลองมาจากสหรัฐอเมริกาที่ชื่อว่า MyPlate เพื่อใช้กับวัฒนธรรมอาหารไทยเช่นการเสิร์ฟข้าวราดแกง			
15	การคำนวณอาหารต่อหนึ่งมือสามารถเพิ่มผลไม้จานเล็ก ๆ ที่ไม่หวานเกินไป แต่ผลไม้สดเช่นฝรั่งและแอปเปิ้ลหลังอาหารแต่ละมือ			
16	การคำนวณอาหารต่อหนึ่งมือคร่าวๆควรให้พลังงาน400แคลอรี /มือ			
17	ไขมันที่สะสมอยู่ในอวัยวะภายในได้รับการพิสูจน์แล้วว่ามีความสัมพันธ์กับความเสี่ยงที่จะก่อให้เกิดโรคระบบเมตาบอลิซึมและโรคเบาหวานประเภท2 การออกกำลังกายสามารถลดความเสี่ยง หากแต่การผสมผสานระหว่างกับแบบจำลองอาหาร2:1:1สำหรับหนึ่งจาน /ต่อหนึ่งมือจะยังสามารถช่วยป้องกันความเสี่ยงต่อการเกิดโรคได้ยั่งยืนมากขึ้น			
ชื่อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
18	แบบจำลองงานอาหารอัตราส่วน 2: 1: 1หมายถึงผักสองส่วนส่วนข้าวหนึ่งส่วนและเนื้อไม่ติดมันหนึ่งส่วน ดังนั้นข้าว,ข้าวสาลีส่วนหนึ่งอาจเป็นข้าว,ธัญพืช,เส้นก๋วยเตี๋ยวและขนมปังธัญพืชจัดให้ได้หนึ่งในส่วนในหนึ่งมือ			
19	แบบจำลองงานอาหารอัตราส่วน 2: 1: 1 ประกอบไปด้วย ผักสองส่วน ข้าวหนึ่งส่วนและเนื้อไม่ติดมันหนึ่งส่วน ดังนั้นเนื้อไม่ติดมันหนึ่งส่วนอาจเป็นเนื้อสัตว์ที่ไม่ติดหนังหรือติดมัน,อาหารทะเล,ปลา,ไก่ที่ไม่ติดหนังหรือติดมัน,ไข่และถั่วเหลือง จัดให้ได้หนึ่งในส่วนในหนึ่งมือ โดยที่ไม่รวมเนื้อสัตว์ติดมัน,เบคอนแฮมและหมูสามชั้น			
20	ในประเทศไทยแบบจำลองงานอาหารอัตราส่วน 2: 1: 1 ที่ถูกดัดแปลงจากแบบจำลองของสหรัฐอเมริกาที่ชื่อว่า MyPlate เพื่อใช้กับวัฒนธรรมอาหารไทยนั้นในการเสิร์ฟอาหารตามสั่งแบบข้าวราดแกง ท่านจะสามารถสั่งอาหารจากร้านข้าว			

	แกงโดยการประมาธอาหารการในหนึ่งงานขนาด 9 นิ้ว ว่าท่านจะเลือกรับประทาน ผัก 2 ส่วนแบบใด ข้าว 1 ส่วนแบบใดและเนื้อสัตว์ 1 ส่วนแบบใด หากท่านรู้สึกทิว ภายหลังการออกกำลังกายในช่วงเย็น ท่านอาจจะเพิ่มการรับประทานผลไม้สดจาก เช่นฝรั่ง 1 ผลเล็กหรือเลือกที่จะดื่มมรสจืด อีกหนึ่งแก้วได้			
21	ในปัจจุบันอิทธิพลต่อสุขภาพและภาวะน้ำหนักเกิน ที่เรียกว่า "obesogenic" ส่งเสริมให้คนบริโภคมากขึ้น แต่ออกกำลังกายน้อยลง เพราะเราพึ่งพาเทคโนโลยี และสิ่งอำนวยความสะดวกที่ทันสมัยช่วยให้สภาพความเป็นอยู่ของมนุษย์ดีขึ้น			
22	หนึ่งในวิธีที่มีประสิทธิภาพที่สุดในการลดน้ำหนักอย่างปลอดภัยและเพื่อสุขภาพที่ดี คือการออกกำลังกาย ดังนั้นจึงมีข้อเสนอแนะว่าคนควรออกกำลังกายระดับปาน กลางอย่างน้อย 150 นาทีต่อสัปดาห์			
23	การไม่ขยับร่างกายโดยเฉพาะอย่างยิ่งในหมู่คนทำงานประจำเป็นหนึ่งในสาเหตุของ โรคอ้วนและมีแนวโน้มที่จะเป็นโรคเรื้อรังในกลุ่มโรค			
24	วิธีที่ง่ายในการลดน้ำหนัก และความเสี่ยงต่อการเกิดภาวะโรคเรื้อรังอย่างปลอดภัย และถาวรคือการออกกำลังกายอย่างถูกต้อง การลดน้ำหนักอย่างมีประสิทธิภาพ จำเป็นต้องทำอย่างสม่ำเสมอต่อเนื่องจนรวมการออกกำลังกายเข้าเป็นกิจวัตรใน ชีวิตประจำวัน			
ชื่อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
25	ขั้นตอนแรกที่ต้องพิจารณาเมื่อต้องการลดน้ำหนักคือการคำนวณจำนวนแคลอรี ต้องการในการบริโภคและพลังงานที่ใช้ในแต่ละวัน เพื่อเพิ่มการใช้พลังงานที่ได้รับ ในการออกกำลังกาย			
26	ผู้ที่ออกกำลังกายเป็นประจำ จะมีแรงจูงใจในการออกกำลังกายระดับสูง โดย พิจารณาจากความหนักหน่วงของการออกกำลังกาย ระยะเวลาและความถี่ของการ ออกกำลังกาย			
27	ควรอุ่นร่างกาย,ยืดและคลายกล้ามเนื้อ ก่อนและหลังออกกำลังกายเพื่อลดอาการ บาดเจ็บเพื่อเป็นการปรับการทำงานของร่างกาย			
28	การออกกำลังกายแบบใช้ออกซิเจนหรือเรียกว่าการออกกำลังกายแบบแอโรบิกใน โปรแกรมจะประกอบด้วยการศึกษาความแข็งแรงและการสร้างกล้ามเนื้อโดยเช่นการ ใช้น้ำหนักตัวของผู้ทำ เป็นน้ำหนักมวลรวมในการทรงตัวหรือเรียกว่าและการการ ขยับเขยื้อนร่างกายซึ่งมีผลต่ออัตราการเต้นของหัวใจที่เร็วขึ้นถึงระดับการเต้นของ หัวใจจะเพิ่มขึ้น 60% -85% เมื่อเทียบกับอัตราการเต้นของหัวใจสูงสุด) ซึ่งสามารถ			

	ลดไขมันอวัยวะภายในและรอบเอวและป้องกันโรคเรื้อรัง ได้แก่ สควอทและกระโดดตบ			
29	การออกกำลังกายแบบแอโรบิกจะทำให้หัวใจเต้นเร็วขึ้นอัตราสูงถึง 15 นาที 45 นาทีอย่างน้อย 3 ครั้งต่อสัปดาห์มากถึง 5 ครั้งสามารถช่วยเพิ่มอัตราการเผาผลาญพื้นฐาน (BMR) ซึ่งเพิ่มการเผาผลาญเพื่อเผาผลาญพลังงานมากขึ้น Basal Metabolic Rate (BMR) เป็นอัตราพลังงานที่ใช้ในชีวิตประจำวันเพื่อความสมดุลปกติของเซลล์ในร่างกาย, การทำงานของหัวใจและระบบประสาทอื่น ๆ ที่จะทำงานได้ดีขึ้น			
30	เป้าหมายของการออกกำลังกายแบบแอโรบิกคือการทำให้ออกซิเจนมากที่สุด - ระบบทางเดินหายใจจะทำงานหนักขึ้นและแข็งแรงขึ้นเพื่อที่จะนำออกซิเจนเข้าสู่ร่างกายมากพอเพียงพอที่จะไปฟอกเลือดที่ต้องการการไหลเวียนมากขึ้น - อัตราการเต้นของหัวใจจะเร็วขึ้นเพื่อที่จะสูบฉีดเลือดไปยังกล้ามเนื้อ - เส้นเลือดใหญ่และเล็กจะขยายตัวเพื่อให้เลือดไปเลี้ยงส่วนต่างๆของร่างกายได้อย่างมีประสิทธิภาพ			

ประเด็นที่ 2. แบบสอบถามเกี่ยวกับทัศนคติด้านสุขภาพ (รวมทั้งหมด 40 ข้อ)

2.1 ทัศนคติเกี่ยวกับการออกกำลังกาย (10 ข้อ)

2.2 ทักษะเกี่ยวกับการบริโภคอาหาร (10 ข้อ)

2.3 พฤติกรรมเกี่ยวกับการออกกำลังกาย (10 ข้อ)

2.4 พฤติกรรมเกี่ยวกับการบริโภคอาหาร (10 ข้อ)

ใส่เครื่องหมายลงในกล่องที่ตรงกับความรู้สึก / ความคิดเห็นของการออกกำลังกายของคุณมากที่สุด

ข้อ	คำถาม	เห็นด้วย	ไม่เห็นด้วย	ไม่แน่ใจ	ไม่เห็นด้วย
1	การออกกำลังกายทำให้เสียค่าใช้จ่ายโดยไม่จำเป็น				
2	ผู้มีสุขภาพแข็งแรงดีไม่จำเป็นต้องออกกำลังกาย				
3	ผู้มีโรคประจำตัวควรปรึกษาแพทย์ก่อนออกกำลังกาย				
4	การออกกำลังกายช่วยเพิ่มปริมาณการใช้ออกซิเจนและการเผาผลาญในร่างกาย				
5	การออกกำลังกายควรเลือกโปรแกรมที่เหมาะสมกับเพศและอายุและชนิดที่เหมาะสมเพื่อให้บรรลุวัตถุประสงค์ของการออกกำลังกาย,ลดการบาดเจ็บและจะทำให้มั่นใจในการออกกำลังกายมากขึ้น				
6	การมีเพื่อนออกกำลังกายด้วยทำให้ออกกำลังกายได้นานยิ่งขึ้น				
7	ควรออกกำลังกายอย่างน้อยครั้งละ 30 นาที 3 วันต่อสัปดาห์และควรประกอบด้วย 3 ขั้นตอนคืออบอุ่นร่างกายการออกกำลังกายและการผ่อนคลายยืดเหยียดกล้ามเนื้อ				
8	การออกกำลังกายเป็นประจำจะช่วยเหลือความเสื่อมของร่างกาย ทำให้กลับคืนและประโยชน์ของการออกกำลังกายเป็นประจำทำให้ลาป่วยน้อยลง				
9	การออกกำลังกายเป็นการใช้เวลาว่างให้เป็นประโยชน์.				
10	การออกกำลังกายที่ดีควรมีการพักผ่อนอย่างน้อยสองวันต่อสัปดาห์				
11	การรับประทานอาหารเมื่อหิวจัดจะทำให้รับประทาน อาหารได้มากและได้รับสารอาหารมากตามไปด้วย				
12	คุณมักชอบรับประทานขนมขบเคี้ยวระหว่างมื้ออาหาร				

13	คุณไม่ควรดื่มเครื่องดื่มรสหวานหรือน้ำผลไม้เช่นน้ำอัดลม, น้ำหวาน, ชาเขียวหวาน, น้ำสมุนไพรรสหวาน, ชาหรือกาแฟรสหวานและใส่ครีมเทียม, ชานมไข่มุกเป็นประจำ			
14	คุณเลือกซื้ออาหารตามที่คุณชอบ			
ชื่อ	คำถาม	เห็นด้วย	ไม่แน่ใจ	ไม่เห็นด้วย
15	การรับประทานอาหารรสเค็ม เติมน้ำปลาทำให้คุณสุขภาพไม่ดี			
16	ปัจจัยที่สามารถกำหนดพฤติกรรมบริโภคอาหารเช่นปัจจัยทางกายภาพและปัจจัยสิ่งแวดล้อมทางสังคมตัวอย่างปัจจัยทางกายภาพ: สิ่งอำนวยความสะดวกเช่นร้านสะดวกซื้อในชุมชนเช่น Seven Eleven, Lotus Big C เป็นต้น ปัจจัยสภาพแวดล้อมทางสังคม: เช่นพฤติกรรม, ประเพณีหลักการศาสนา วัฒนธรรมที่มีผลต่อพฤติกรรมบริโภคอาหารหรือความเข้าใจเกี่ยวกับและการใช้เศรษฐกิจพอเพียงเพื่อสุขภาพที่เกิดขึ้นหรือสื่อโฆษณาชวนเชื่อในผลิตภัณฑ์ต่าง ๆ ทำให้บริโภคมากขึ้น เป็นต้น			
17	คุณใส่น้ำตาลในอาหารและเครื่องดื่ม เพราะคิดว่าน้ำตาลทำให้รู้สึกสดชื่น			
18	คุณคิดว่าอาหารอุ่นอาหารจะทำให้อาหารเสียรสชาติและไม่อร่อย			
19	คุณชอบรับประทานเนื้อปลามากกว่าเนื้อวัวเพราะคิดว่าเนื้อปลามีประโยชน์			
20	ท่านชอบรับประทานทานอาหารรสจัดเพราะทำให้รู้สึกว่าการอาหารอร่อยและมีรสชาติ			
ชื่อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
21	คุณสวมเครื่องแต่งกายเหมาะสมกับการออกกำลังกาย			
22	คุณเคารพกติกาและยอมรับข้อตกลง จนท. ที่ดูแลสถานที่และนำการออกกำลังกาย			

23	คุณไม่หยุดออกกำลังกายกระทั่งหันหันที่หันใดจะค่อยๆผ่อนความเร็วลง			
24	คุณออกกำลังกายกลางแจ้งกินอาหารมาแล้วอย่างน้อยสามชั่วโมง			
25	คุณรับประทานอาหารที่มีประโยชน์เหมาะสมกับการออกกำลังกาย			
26	คุณหยุดออกกำลังกายเมื่อข้อเท้าพลิก เคล็ด ขัดยอกฟกช้ำ และทำการ ประคบเย็นด้วยน้ำแข็ง			
27	คุณจับชีพจรตนเองก่อนและหลังออกกำลังกาย			
28	คุณจะออกกำลังกายจนรู้สึกเหนื่อย หอบ หัวใจเต้นเร็ว			
29	คุณเหยียดคลายกล้ามเนื้อทุกครั้งหลังการออกกำลังกายเพื่อให้ร่างกาย กลับสู่ภาวะปกติ			
30	คุณนำท่าของนักกีฬาที่ชื่นชอบมาเป็นแบบในการออกกำลังกาย			
31	คุณกินข้าวสลับกับอาหารประเภทแป้งเป็นบางมื้อ			
32	คุณกินอาหารว่างประเภทขนมบรรจุถุงสำเร็จรูป			
ชื่อ	คำถาม	ใช่	ไม่แน่ใจ	ไม่ใช่
33	คุณคุณกินอาหารฟาสต์ฟู้ด เช่น แฮมเบอร์เกอร์ พิซซ่า โดนัท			
34	กินอาหารมากกว่าวันละ 3 มื้อ			
35	คุณกินอาหารประเภททอด			
36	คุณกินขนมปังที่สำเร็จรูปแทนอาหารมื้อหลักมื้อใดมื้อหนึ่ง			
37	คุณกินผลไม้แช่อิ่ม			
38	คุณดื่มเครื่องดื่มที่มีส่วนผสมของแอลกอฮอล์			
39	คุณกินผักและผลไม้			
40	คุณดื่มน้ำสะอาดอย่างน้อยวันละ 8-10แก้ว			

Appendix C

The report of the body composition analyzer

รูปแบบการพิมพ์ผล "การวิเคราะห์องค์ประกอบภายในร่างกาย"
- เติมรูปแบบมาตรฐาน - ที่เครื่องได้ตั้งค่าเริ่มต้น

ชื่อและประเภทเครื่องซึ่งนำผล

น้ำหนักร่างกาย

- วัดน้ำหนักในร่างกาย

มวลไขมัน

- มวลไขมันรวมทั้งหมดในร่างกาย

มวลกล้ามเนื้อ

- ใช้ค่าส่วนประกอบ กล้ามเนื้อรวม ไขมัน กล้ามเนื้อหัวใจ และค่าอื่นเพื่อสร้างสมการคำนวณน้ำหนักกล้ามเนื้อที่แท้จริง

% ไขมันในร่างกาย

BMR*

- หลังจากวัดองค์ประกอบร่างกายเรียบร้อยแล้ว จะใช้ค่าร่างกายที่วัดได้มาคำนวณ BMR โดยอิงตามสมการของ Harris-Benedict หรือ Mifflin-St. Jeor

ไขมันที่เกาะในอวัยวะภายใน*

- ค่าไขมันที่เกาะในอวัยวะภายในจะสัมพันธ์กับความเสี่ยงของโรคหลอดเลือดหัวใจ

น้ำหนักร่างกายที่เหมาะสม*

- น้ำหนักที่เหมาะสมจะขึ้นอยู่กับน้ำหนักตัวและอายุ (โดยมีค่าปกติที่ 22)

% ระดับความอ้วน*

- ค่าความอ้วน = $\frac{\text{น้ำหนักไขมันในร่างกาย}}{\text{น้ำหนักตัวทั้งหมด}} \times 100$

ข้อมูล Bioelectrical

- แสดงค่าการนำไฟฟ้าของร่างกาย ซึ่งสัมพันธ์กับปริมาณไขมันในร่างกาย

TANITA

MODEL: BC-127N

20/ JAN / 2016 20:15:58

INPUT ID NO: 000001234567890
 USER TYPE: STAGARD
 HEIGHT: 170 CM
 AGE: 20
 GENDER: M
 CLOTHES WEIGHT: 1.5KG

MEASUREMENT

WEIGHT: 60.0kg
 FAT %: 10.0%
 FAT MASS: 6.0kg
 FFMI: 2.0kg/m²
 MUSCLE MASS: 54.0kg
 TBW %: 58.0%
 TBW: 34.8kg
 BONE MASS: 3.0kg
 BMD: 0.108g/cm³
 VISCERAL FAT RATING: 0

WEIGHT & BODY FAT RATING

FAT %: 10.0 - 10.0%
 FAT MASS: 6.0 - 6.0kg

WEIGHT

TARGET BWT: 60.0kg
 Predicted weight: 72.4kg
 Predicted fat mass: 10.6kg
 FAT TOL: 10.6kg

Consult your physician before using any weight management program. Do not use for children. Please refer to the instruction manual for details.

PERCENTAGE

FAT %: 10.0%
 VISCERAL FAT RATING: 0

MUSCLE MASS

FFMI: 2.0

PHYSIQUE RATING

CRUEL

BIOELECTRICAL DATA

B: 250.0
 R: 450.0
 X: -10.0

ตัวเลขที่ปรากฏ

- ค่าที่ปรากฏบนหน้าจอเครื่อง

% ไขมัน

- เปอร์เซ็นต์ไขมันทั้งหมดในร่างกาย

ร่างกายที่ปราศจากไขมัน

- มวลกล้ามเนื้อและกระดูก

ไขมันในอวัยวะ

- ปริมาณไขมันที่เกาะในอวัยวะภายใน

น้ำหนักที่ถูกต้อง*

- ค่าที่แสดงบนหน้าจอเครื่อง

อัตราการเผาผลาญที่แนะนำ*

- ค่าที่แนะนำสำหรับการเผาผลาญพลังงาน

ดัชนีมวลกาย

- ค่าที่แสดงบนหน้าจอเครื่อง

จะคำนวณดัชนีมวลกายที่แม่นยำขึ้นโดยใช้ค่าไขมันในร่างกายรวมทั้งมวลกระดูก

สำหรับคนที่มีดัชนีมวลกายสูงหรือต่ำกว่าเกณฑ์ ค่าที่แสดงจะแตกต่างกันไป

ค่าที่แสดงจะแตกต่างกันไปขึ้นอยู่กับค่าที่แสดงบนหน้าจอเครื่อง

* สำหรับ อายุ 18-99 ปีเท่านั้น

⚠️ **คำเตือน:** กรุณาอ่านคู่มือการใช้งานก่อนใช้เครื่องทุกครั้ง และอย่าใช้เครื่องวัดร่างกายของคุณหากมีอาการบาดเจ็บหรือโรคประจำตัว

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