RESEARCH AND DEVELOPMENT OF INTERACTIVE WEB-BASED EDUCATION ON NUTRITION FOR OVERWEIGHT AND OBESE THAI PEOPLE

TISANA CHANYACHAILERT

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Thesis
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RESEARCH AND DEVELOPMENT OF INTERACTIVE WEB-BASED EDUCATION ON NUTRITION FOR OVERWEIGHT AND OBESE THAI PEOPLE

.....
Miss. Tisana Chanyachailert
Candidate

.....
Assist. Prof. Sunard Taechangam,
Ph.D. (Clinical Science in Nutrition)
Major-advisor

.....
Assist. Prof. Chanida Pachotikarn,
Ph.D. (Human Nutrition)
Co-advisor

.....
Lect. Tanasanee Phienthrakul,
Ph.D. (Computer Engineering)
Co-advisor

.....
Assoc. Prof. Chailerd Pichitpornchai,
M.D., Ph.D. (Medicine)
Co-advisor

……..
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

……..
Assist. Prof. Wantanee Kriengsinyos,
Ph.D. (Nutritional Sciences)
Program Director
Master of Science Program in
Food and Nutrition for Development
Institute of Nutrition
Mahidol University

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science (Food and Nutrition for Development)
on
July 21, 2010

.....
Miss. Tisana Chanyachailert
Candidate

.....
Mr. Somkiat Geratikornsupuk,
M.D., Thai Board of Obstetic and Gynaecology., Thai Board of Family Medicine
Chair

.....
Assoc. Prof. Chailerd Pichitpornchai,
M.D., Ph.D. (Medicine)
Member

.....
Assist. Prof. Sunard Taechangam,
Ph.D. (Clinical Science in Nutrition)
Member

.....
Lect. Tanasanee Phienthrakul,
Ph.D. (Computer Engineering)
Member

.....
Assist. Prof. Chanida Pachotikarn,
Ph.D. (Human Nutrition)
Member

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Assoc. Prof. Visith Chavasit,
Ph.D. (Food Science)
Director
Institute of Nutrition
Mahidol University

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Tisana Chanyachailert

RESEARCH AND DEVELOPMENT OF INTERACTIVE WEB-BASED EDUCATION ON NUTRITION FOR OVERWEIGHT AND OBESE THAI PEOPLE

TISANA CHANYACHAILERT 5036322 NUFN/M

M.Sc. (FOOD AND NUTRITION FOR DEVELOPMENT)

THESIS ADVISORY COMMITTEE: SUNARD TAECHANGAM, PH.D., CHANIDA PACHOTIKARN, PH.D., CHAILERD PICHITPORNCHAI, M.D., PH.D, TANASANEE PHIENTHRAKUL, PH.D.

ABSTRACT

Obesity is a serious problem that increases the risk of major chronic disease and mortality. In Thailand, there are many educational tools for weight management, but they cannot reach large numbers of individuals in a timely and cost-effective manner.

The purpose of this study was to develop and evaluate the effectiveness of a nutrition educational tool based on the National Heart, Lung, and Blood Institute recommendations and health belief model. A multimedia nutritional education website named fitbymyself.com was developed. The contents include a home page, six lessons for weight management, exercises, web board, meal plan, calorie burn calculator, weight and food record, weight loss menu, personal folder, contact page and games. The six lessons for weight management present knowledge about obesity, including the definition and causes of obesity, chronic diseases related to obesity, food exchange, choosing low fat, low calorie diets in six food groups, food labels, calories in one-plate dishes, low fat shopping, low calorie diets, the benefits of regular exercise, and advice on aerobic exercise. The effectiveness of the educational tool was evaluated by 39 subjects from the selected bank (mean age of 42.67 ± 10.36 years). For 6 weeks, subjects were assigned to learn lessons, do exercises from the homework assignments, and record their weight and food intake.

After 6 weeks, the results of the study showed that the mean knowledge score of the subjects increased significantly compared to the baseline ($p<0.05$). Stages of change, dietary and exercise behavior scores also increased significantly ($p<0.05$). Weight, BMI and waist circumference decreased significantly ($p<0.05$) whereas percentage of fat and visceral fat did not significantly change. Total blood cholesterol, triglyceride level and systolic blood pressure significantly decreased ($p<0.05$) and HDL cholesterol significantly increased. However, fasting plasma glucose, LDL cholesterol and diastolic blood pressure were not significantly changed but were within the normal criteria. Mean daily energy, carbohydrate and fat intake decreased significantly ($p<0.05$) but the percentage of protein increased significantly ($p<0.05$) whereas the percentage of fat decreased significantly ($p<0.05$). The percentage of carbohydrates did not change and remained within the recommendation. Participants who accessed the website $\geq$ 3 times/week and also logged their food record $\geq$ once a week had more weight loss ($\geq$ 1 kg). Satisfaction scores of the subjects about the developed tool are at the “agree” and “strongly agree” level.

In conclusion, the developed nutritional education tool was acceptable as an effective learning tool for overweight and obese people that helped improve their knowledge and positive behavior. The frequency of accessing the website and frequency of logging dietary records was associated with weight loss.

KEY WORDS: OVERWEIGHT/ OBESITY/ WEBSITE/ WEIGHT LOSS

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การวิจัยและพัฒนาสื่อการสอนทางโภชนาการผ่านเว็บไซต์สำหรับคนไทยที่มีภาวะน้ำหนักเกิน และโรคอ้วน
RESEARCH AND DEVELOPMENT OF INTERACTIVE WEB-BASED EDUCATION ON NUTRITION FOR OVERWEIGHT AND OBESE THAI PEOPLE

ธิษณา จรรยาชัยเลิศ 5036322 NUFN/M

วท.ม. (อาหารและโภชนาการเพื่อการพัฒนา)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: สุนาฎ เตชางาม, Ph.D., ชนิดา ปโชติการ Ph.D., ชัยเลิศ พิชิตพรชัย, M.D., Ph.D., ธนัสนี เพียรตระกูล, Ph.D.

บทคัดย่อ

โรคอ้วนเป็นปัญหาสำคัญที่มีผลทำให้เกิดความเสี่ยงต่อการเกิดโรคเรื้อรังต่างๆและนำไปสู่อันตรายถึงชีวิต ปัจจุบันแม้ว่าในประเทศไทยจะมีการพัฒนารูปแบบการให้ความรู้เพื่อการลดน้ำหนักออกมาในหลายลักษณะ แต่ก็ยังไม่สามารถเข้าถึงผู้ที่มีภาวะน้ำหนักเกิน และโรคอ้วนได้ในวงกว้างที่ต้องการประหยัดเวลา และความคุ้มค่าในการลดน้ำหนัก

การศึกษานี้จึงมีวัตถุประสงค์เพื่อ พัฒนา และประเมินประสิทธิภาพสื่อการสอนทางโภชนาการผ่านเว็บไซต์เพื่อการลดน้ำหนักตามแนวทางของ National Heart, Lung, and Blood Institute และประยุกต์ใช้ทฤษฎีแบบแผนความเชื่อด้านสุขภาพ การศึกษานี้ได้พัฒนาสื่อการสอนทางโภชนาการผ่านทางเว็บไซต์เพื่อการลดน้ำหนักสำหรับผู้ใหญ่ขึ้น (www.fitbymyself.com) โดยเนื้อหาภายในเว็บไซต์ประกอบด้วยบทเรียน 6 บท เกี่ยวกับอาหารและการออกกำลังกายเพื่อลดน้ำหนัก แบบฝึกหัด ห้องสนทนา การวางแผนการรับประทานอาหาร การคำนวณการเผาผลาญพลังงานจากการเคลื่อนไหวร่างกาย การบันทึกน้ำหนักและการรับประทานอาหาร ตัวอย่างเมนูอาหารลดน้ำหนัก แฟ้มข้อมูลสมาชิก ห้องส่งคำถามถึงผู้ให้คำปรึกษา และเกม เนื้อหาในบทเรียน 6 บท ประกอบด้วย ความหมาย สาเหตุ และโรคเรื้อรังที่สัมพันธ์กับโรคอ้วน, รายการอาหารแลกเปลี่ยน, การเลือกรับประทานอาหารพลังงานต่ำไขมันต่ำในอาหาร 6 กลุ่ม, ฉลากโภชนาการ, พลังงานของอาหารจานเดียว, การเลือกซื้ออาหารพลังงานต่ำไขมันต่ำ, ประโยชน์ และคำแนะนำในการออกกำลังกายแบบแอโรบิค ได้ทดสอบและศึกษาประสิทธิภาพของสื่อการสอนกับพนักงานกรุงไทย สาขาสำนักงานใหญ่ จำนวน 39 คน (อายุเฉลี่ย 42.67 ± 10.36 ปี) เป็นเวลา 6 สัปดาห์ผู้เข้าร่วมโครงการ เรียนรู้บทเรียน ทำแบบฝึกหัด บันทึกน้ำหนัก และบันทึกการรับประทานอาหารผ่านทางเว็บไซต์

ภายหลัง 6 สัปดาห์ผลการทดลองพบว่า คะแนนความรู้ของผู้เข้าร่วมโครงการเพิ่มขึ้นอย่างมีนัยสำคัญ ($p<0.05$) ระดับ Stage of change และคะแนนพฤติกรรมการรับประทานอาหารและออกกำลังกายเพิ่มขึ้นอย่างมีนัยสำคัญ($p<0.05$) น้ำหนักตัว ดัชนีมวลกาย และเส้นรอบเอวลดลงอย่างมีนัยสำคัญ ($p<0.05$) ในขณะที่เปอร์เซ็นต์ไขมันทั้งหมดในร่างกาย และไขมันในช่องท้องมีแนวโน้มลดลงแต่ไม่พบความแตกต่างอย่างมีนัยสำคัญ คอเลสเตอรอลรวม ไตรกลีเซอไรด์ และความดันซิสทอลิก ลดลงอย่างมีนัยสำคัญ ($p<0.05$) ขณะที่เอช-ดี-แอล คลอเลสเตอรอล เพิ่มขึ้นอย่างมีนัยสำคัญ ($p<0.05$) ส่วนน้ำตาลก่อนอาหาร แอล-ดี-แอล คอเลสเตอรอล และความดันไดแอสทอลิกไม่เปลี่ยนแปลงอย่างมีนัยสำคัญ ค่าเฉลี่ยของพลังงาน คาร์โบไฮเดรต และไขมันจากอาหารที่บริโภคต่อวันลดลงอย่างมีนัยสำคัญ ($p<0.05$) ที่เปอร์เซ็นต์โปรตีนเพิ่มขึ้นอย่างมีนัยสำคัญ ($p<0.05$) ในขณะที่เปอร์เซ็นต์ไขมันลดลงอย่างมีนัยสำคัญ ($p<0.05$) นอกจากนี้พบว่าจำนวนการเข้าใช้งานเว็บไซต์มากกว่าหรือเท่ากับ 3 ครั้ง/สัปดาห์ และ การบันทึกการรับประทานอาหารมากกว่าหรือเท่ากับ 1 ครั้ง/สัปดาห์ มีความสัมพันธ์อย่างมีนัยสำคัญกับปริมาณน้ำหนักที่ลดลง มากกว่าหรือเท่ากับ 1 กิโลกรัม ใน 6 สัปดาห์ และคะแนนความพึงพอใจของผู้เข้าร่วมโครงการต่อการใช้สื่ออยู่ในระดับเห็นด้วยถึงเห็นด้วยมากที่สุด

ผลการศึกษานี้สรุปว่า ผู้ที่มีภาวะน้ำหนักเกินและโรคอ้วนมีความพึงพอใจในการใช้งานสื่อการสอนที่ได้พัฒนาขึ้น โดยมีระดับความรู้ ภาวะโภชนาการ พฤติกรรมการรับประทานอาหารและการออกกำลังกายเปลี่ยนแปลงไปในทางที่ดีขึ้น และพบว่าการลดลงของน้ำหนักมีความสัมพันธ์กับความถี่ในการเข้าใช้งานเว็บไซต์และความถี่ในการบันทึกการรับประทานอาหาร

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INTRODUCTION

Background

Overweight and obesity are serious problems of which attention need to be paid closely, because it does not only increase body fatness but also increases the risks of major chronic disease and mortality. Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Raising Body Mass Index (BMI) increases the risks of coronary heart disease, ischemic stroke, type 2 diabetes mellitus, and certain types of cancers such as cancer of breast, colon, prostate, endometrium, kidney and gall bladder [1].

The prevalence of overweight and obesity is commonly assessed by using body mass index (BMI). It is defined as the ratio of weight (kilogram) and the square of the height (meter).

WHO criteria define overweight as a BMI of at least 25 kg/m^2 and obesity as a BMI of at least 30 kg/m^2. In Asia, the risks of disease in all populations increase progressively in adult from BMI levels of 20–23 kg/m^2, while levels are 25–27 kg/m^2 across North America and Europe[1]. Therefore, BMI cut-offs in Asia for overweight (> 23.0 kg/m^2) and obesity (> 25.0 kg/m^2) are lower than North America and Europe criteria.

An increase in BMI results from an imbalance between energy intake and energy expenditure that are affected by genetic and environmental factors such as sedentary lifestyle, high fat, and fast foods [2].

The prevalence of overweight and obesity is increasing worldwide in both developed and developing countries. The report that was published in 2006, Prevalence of overweight and obesity in the United States in 1999-2004 [3], indicated that the prevalence of overweight and obesity in the United States remains high. The prevalence of obesity has continued to increase in men and the prevalence of overweight has continued to increase in children and adolescents. The recent study in

2005-2006 [4] indicated that more than one-third of U.S. adults were obese. This included 33.3% of men and 35.3% of women.

In Thailand, a study in 1985 [5], surveying 35-54-year-old Thai officials of the Electricity Generating Authority of Thailand (EGAT), found that 2.2% of the 2,703 men, and 3.0% of the 792 women, had a BMI > 30 kg/m^2 (grade II obesity), whereas BMI of 25-29.9 kg/m^2 (grade I obesity) were higher (23.3% in men and 18.4% in women).

In 1991, the first report on National Health Examination Survey of Thailand [6] was conducted in 13,300 adults, aged > 20 years. The results revealed that 12% of men and 19.5% of women had BMI 25-30 kg/m^2, whereas 1.7% of men and 5.6% of women had BMI >30 kg/m^2.

In 1997, the second report on National Health Examination Survey of Thailand [7] was conducted in 3,220 adults, aged 20-59 years. The results revealed that 19.2% of men and 33.9% of women had BMI 25-30 kg/m^2, whereas 3.5% of men and 8.8% of women had BMI >30 kg/m^2.

The study that was conducted in 2003-2004 [8] reported the analysis of sex differences in Body Mass Index among 19,200 Thai labor forces aged 15–60 years. The result indicated that the mean BMI of the Thai labor forces tends to increase steadily. The mean and standard deviation of BMI of the overall sample were 24.06 ± 4.42 kg/m^2, with males slightly leaner than females on the average (23.31 ± 4.08 kg/m^2 in male and 24.69 ± 4.60 kg/m^2 in female). The mean and standard deviation of female BMI were higher than its counterpart.

More importantly, the results related to socioeconomic status indicated that males with higher social classes were heavier when compared with those in the lower ones. In contrast, BMI and socioeconomic status were inversely associated among female labor forces.

In 2005, Napradit P et al. [9] conducted a cross-sectional study to determine the prevalence of overweight and obesity in 4,276 Royal Thai Army (RTA) personnel aged 20-60 years. The prevalence of overweight and obesity in RTA personnel were 27.1% and 4.9% respectively. Overweight were positively associated with age, male, and working in a combat unit. Current smoking was inversely associated with overweight and obesity, whereas physical activity > 3 times/wk was

inversely associated with obesity. Overweight and obesity were also associated with hypertension.

In 2007, Lohsoonthorn V et al. [10] reported the prevalence of metabolic syndrome among 1,339 Thai professional and office workers (535 men and 804 women) that was 15.2% and approximately 3 times more common among men than women (25.8% vs. 8.2%). Moreover, they found that men and women with metabolic syndrome were older and had lower education than the person with not metabolic syndrome.

The prevalence of overweight and obesity have been increasing in Thai population. It is not only personal health problems but also impacts work limitations and the economic costs of overweight and obesity. The study in 1986 to 1999 [11] indicated that obesity was associated with lower employment among men and women and increased work limitations. In 2002 [12], the study of national medical spending to overweight and obesity presented the costs attributing to obesity are $9.26 billion in the United States. These findings emphasize the urgent need to develop strategies for the detection, treatment, and prevention of overweight and obesity.

The rationale for the initial 10% goal is that a moderate weight loss of this magnitude can significantly decrease the severity of obesity-associated risk factors [13]. In 1992, Singh et al. [14] published results from a 1-year randomized controlled trial of a “cardioprotective diet” in East Indian patients hospitalized with recent myocardial infarction (mean age 50 years, mean BMI about 24 kg/m^2). The study found that those who lost at least 0.5 kg had a 50 percent lower incidence of cardiac events and a 54% lower risk of overall mortality compared with counterparts who lost < 0.5 kg.

In 1995, Williamson et al. [15] published a 12-year prospective observational study of weight loss and mortality that directly assessed weight loss intention. They analyzed data from 43,457 overweight (BMI > 27 kg/m^2), never-smoking, white women aged 40 to 64 years. Mortality ratios were compared between women who intentionally lost weight and those who had no change in weight. In women with obesity-related comorbidities, intentional weight loss of any amount was associated with a statistically significant 20 percent reduction in all-cause mortality, primarily due to a significant 40% to 50% reduction in mortality from obesity-related

cancers; diabetes-related mortality was also significantly reduced by 30% to 40% in those who intentionally lost weight.

In 2005-2007, Roberts et al. [16] studies in Dimona, Israel, in a workplace at a research center with an on-site medical clinic. The study was conducted in 104 volunteers (BMI 30.6 ±32 kg/m^2), aged 40-65 years. The volunteers received an energy intake of 1,500 kcal per day for women and 1,800 kcal per day for men, with 30% of calories from fat, 10% of calories from saturated fat, and an intake of 300 mg of cholesterol per day. After 2 years, they found the significant reduction of weight (decrease 3.3 kg), Waist circumference (decrease 2.8±4.3 cm.), blood pressure (systolic blood pressure decrease 4.3±11.8 mmHg and diastolic blood pressure decrease 0.9 ± 8.1 mmHg), and cholesterol (the relative reduction in the ratio of total cholesterol to high-density lipoprotein cholesterol was 12%).

Several studies present that health behavior theories are beneficial to weight loss success. In 1997, Thunyaharn T [17] reported the effectiveness of a nutrition education program to reduce blood lipid by the application of behavioral theories in obese male teenagers. The study compared two interventions, education group and education with behavior therapy group. In this study, Behavior therapies are health belief model and Bandura's social learning theory. After 6 months, the result indicated that the education with behavior therapy group had a significantly higher scores (ischemic heart disease knowledge test score) than the education group and loss weight 3 and 0.6 kg respectively.

In 2006, Maneegan A et al. [18] reported an application of health belief model, group process and social support to promote weight control among overweight children in primary schools, Maung Nakonsitammarat. The results of the study showed that health belief model, social support, eating behavior and exercise behavior of the experiment group (The experimental group participated in a twelve-week health promotion program) were significantly better than those of the control group. Body weight and triceps skinfold of the experiment group were significantly lower than those of control group.

Although, several interventions already exist to assist health professionals in managing obesity [19], it is difficult to reach a large numbers of overweight and obesity and obese individuals who are embarrassed about their weight to seek

treatment [20]. Therefore, the nutrition education via internet relating to weight loss is used as one of the choices for weight management in overweight and obese people.

Several studies have shown that using Internet technology can provide successful behavioral weight control. [21-23] For example, Southard et al. [24] studied to compare between Internet-based cardiac rehabilitation program group and usual care group. They studied in 104 patients with cardiovascular disease aged 62.3±10.6 years with a body mass index of 30.92 kg/m^2 (Internet-based cardiac rehabilitation program group) and 29.2 kg/m^2 (usual care group) After 6 months, the results indicated that cardiovascular events occurred fewer among the Internet-based cardiac rehabilitation program subjects (15.7%) than among the usual care subjects (4.1%). More weight loss occurred in the Internet-based cardiac rehabilitation program group (-1.63 kg) than in the usual care group (+0.21).

The study in 2001, Tate et al. [21] studied compare two interventions via Internet (education group and behavior therapy group) in 91 healthy, overweight adult hospital employees aged 40.9±10.6 years with a body mass index of 25-36 kg/m^2. After 6 months, they found that the behavior therapy group which received additional behavioral procedures, including a sequence of 24 weekly behavioral lessons via e-mail, weekly online submission of self-monitoring diaries with individualized therapist feedback via e-mail, and an online bulletin board, lost more weight than the education group. The mean weight less in behavior therapy group was 4.0±2.8 kg and weight loss in the education group was 1.7 ±2.7 kg. The study in 2003, Tate et al. [22] compare the effects of an Internet weight loss program alone vs with the addition of behavioral counseling via e-mail provided for 1 year to individuals at risk of type 2 diabetes. After 12 months, the result showed that the behavioral e-counseling group lost more weight than the basic Internet group. The mean weight less in behavior therapy group was 4.4±6.2 kg and weight loss in the education group was 2 ±5.7 kg. Two studies concluded that participants who were given a structured behavioral treatment program with weekly contact and individualized feedback had better weight loss compared with those given links to educational websites. Thus, the Internet and e-mail appear to be viable methods for delivery of structured behavioral weight loss programs.

According to the studies, educational websites with e-mail contact presented better weight loss compared with educational websites, but e-mail contact in the studies was a separate part and was not included in the website. If they had included e-mail contact in website, it would have provided more facility for user to contact counselor and lead to more successful weight management.

Now a day, several commercial Internet programs are now offered to the public [25] and some of them are proven by research. However, most of them are in English version, lack of Thai food database, Thai recipes for weight management, e-mail sending function and nutrition game.

In Thailand, Internet users grew over 100% in the last five years. The National Telecommunications Commission reported the number of Internet users in Thailand in 2007 to be around 13.15 million people [26-28]. The 2007 Information and communication technology survey and household report [29] found that the major area using internet was Bangkok area and 64% of people who use internet age range between 15-49 years. Moreover, using the internet to access websites to search information and follow news is very high (84.8%). The internet is growing and the number of user who search information such as health information also increase but most health websites on the Internet are less reliable. A study of dissemination of health information via Internet in 2004 reported that only 255 websites from 1,888 websites were on the reliability criteria and 56.7% of webmasters were not in the field of health career. Moreover, some websites gave health information with advertising products and were not screened inappropriate information and language.

In Thailand, most weight loss websites are less reliable and the effectiveness of the weight loss website for overweight and obese Thai people had not been studied. Therefore, this study was conducted to a multimedia weight loss website for overweight and obese people with the concept of low-calorie diets, increasing physical activity and following weight reduction and changing dietary behavior by graph and dietary record. The developed website consists of Thai food database, Thai food recipes, e-mail sending function and nutrition game. Learners can evaluate severity and the risk of diseases and realize the benefits of weight reduction. In addition, the health information, Thai food database and Thai food recipes come from many studies and reliable sources.

The developed website is one option for overweight and obese people who are too shy to see a counselor. It is also appropriate for people who seek for weight loss intervention with reducing time and travel expenses. This website is easy for internet users to access to nutrition education. Moreover, it is not only person who would like to lose weight but also healthy people who would like to get benefit from reliable nutrition information. In addition, the multimedia weight loss website would benefit for dietitian, nutrition educator, nutritionist and other persons in health care team that they can include it in the treatment and intervention for overweight and obese people.

CHAPTER II
OBJECTIVES

General objective

To develop and evaluate the effectiveness of multimedia website nutrition education tool for Thai overweight and obese people based on National Institutes of Health, National Heart, Lung, and Blood Institute (NHLBI) Recommendation and Health belief model.

Specific Objectives

1. To construct the multimedia website nutrition education tool for overweight and obese people.
2. To evaluate the effectiveness of the nutrition education tool by:
    - Assessing the subject's knowledge of nutrition for weight loss
    - Assessing the subject's dietary and exercise behavior score
    - Assessing the subject's stage of change
    - Assessing the subject's nutrition status
    - Assessing the subjects overall satisfaction with the developed education tool.

Research Hypothesis

The developed education tool can improve the knowledge and understanding of nutrition for overweight and obese people. The dietary and exercise behavior score, stage of change and nutrition status of subjects can be improved after self-learning.

Expected benefits and applications

The expected outcomes of the study are as follows:

- The developed website is served as reliable resource the benefits for overweight, obese people and any individuals who would like to learn about how to choose the appropriate diet and exercise.
- Overweight and obese people can assess nutrition status, plan weight loss diet and exercises by themselves.
- Overweight and obese people can lose and control their weight that will prevent chronic disease and reduce the health care cost.
- Dietitian and medical personnel can use the developed tool as a part of the treatment to prevent and alleviate problems caused by overweight and obesity.

CHAPTER III
LITERATURE REVIEW

In this chapter was divided in to 8 main parts as follows:

Part 1: Prevalence of overweight and obesity

Part 2: Classification of overweight and obesity

Part 3: Causes of overweight and obesity

Part 4: Health risks of overweight and obesity

Part 5: Weight management

Part 6: NHLBI Recommendation (National Heart, Lung, and Blood Institute Recommendation)

Part 7: Health behavioral theories

Part 8: Website and weight management

1. Prevalence of overweight and obesity

The prevalence of overweight and obesity is increasing worldwide in both developed and developing countries. The World Health Organization's latest projections indicate that globally in 2005 [30], approximately 1.6 billion adults (age more than 15 years) were overweight and at least 400 million adults were obese. The World Health Organization predicts there will be 2.3 billion overweight adults in the world by 2015 and more than 700 million of them will be obese. The report that was published in 2006, Prevalence of overweight and obesity in the United States in 1999-2004 [3], indicated that the prevalence of overweight and obesity in the United States remain high. The prevalence of obesity has continued to increase in men and the prevalence of overweight has continued to increase in children and adolescents. The recent study in 2005-2006 [4] indicated that more than one-third of U.S. adults were obese. This included 33.3% of men and 35.3% of women.

In Thailand, Data from three National Health examination surveys (NHES) have shown a secular trend, as the prevalence of obesity with body mass index ≥25 kg m^2 in adults increased from 13.0% in men and 23.2% in women in 1991 to 18.6% and 29.5% in 1997 and 22.4% and 34.3% in 2004 respectively [31]. A study in 1985 [5], surveying 35-54-year-old Thai officials of the Electricity Generating Authority of Thailand (EGAT), found that 2.2% of the 2,703 men, and 3.0% of the 792 women, had a BMI > 30 (grade II obesity), whereas BMI of 25-29.9 (grade I obesity) were higher (23.3% in men and 18.4% in women).

In 1991, the first report on National Health Examination Survey of Thailand [6] was conducted in 13,300 adults, aged > 20 years. The results revealed that 12% of men and 19.5% of women had BMI 25-30, whereas 1.7% of men and 5.6% of women had BMI >30. In 1997, the second report on National Health Examination Survey of Thailand [7] was conducted in 3,220 adults, aged 20-59 years. The results revealed that 19.2% of men and 33.9% of women had BMI 25-30, whereas 3.5% of men and 8.8% of women had BMI >30.

The study that was conducted in 2003-2004 [8] reported the Analysis of Sex Differences in Body Mass Index among 19,200 Thai Labor Forces aged 15–60 years. The result indicated that the mean BMI of the Thai labor forces tend to increase steadily. The mean and standard deviation of BMI of the overall sample were 24.06+4.42 kg/m^2, with males slightly leaner than females on the average (23.31+4.08 kg/m^2 in male and 24.69+4.60 kg/m^2 in female). The mean and standard deviation of female BMI were higher than its counterpart, except income (over 25,000 baht) and education (university educated). More importantly, results related to socioeconomic status indicated that males with higher social classes were heavier when compared with those in the lower ones. In contrast, BMI and socioeconomic status were inversely associated among female labor forces.

In 2005, Napradit P et al. [9] conducted a cross-sectional study to determine the prevalence of overweight and obesity in 4,276 Royal Thai Army personnel aged 20-60 years. The prevalence of overweight and obesity in RTA personnel were 27.1% and 4.9% respectively. Overweight were positively associated with age, male, and working in a combat unit. Current smoking was inversely associated with overweight and obesity, whereas physical activity > 3 times/wk was

inversely associated with obesity. Overweight and obesity were also associated with hypertension. In 2007, Lohsoonthorn V et al. [10] reported the prevalence of metabolic syndrome among 1,339 Thai professional and office workers (535 men and 804 women) that was 15.2% and approximately 3 times more common among men than women (25.8% vs. 8.2%). Moreover, they found that men and women who were metabolic syndrome were older and had lower education than the person who was not metabolic syndrome.

2. Classification of overweight and obesity

The prevalence of overweight and obesity is commonly assessed using body mass index (BMI). It is defined as the ratio of weight (kilogram) and the square of the height (meter). WHO criteria (Table 1) define overweight as a BMI of at least 25 kg/m^2 and obesity as a BMI of at least 30 kg/m^2. In Asia, the risks of disease in all populations increase progressively in adult from BMI levels of 20–23 kg/m^2, while levels are 25–27 kg/m^2 across North America and Europe[1]. Therefore, BMI cut-offs in Asia (Table 2) for overweight (> 23.0 kg/m^2) and obesity (> 25.0 kg/m^2) are lower than North America and Europe criteria. Moreover, Waist circumference is another clinically feasible measurement that may be used independently or in addition to BMI to assess weight-related health risk [32,33].

Table 1 Classification of overweight and obesity by BMI, Waist circumference, and associated disease risk [13]

Classification	BMI (kg/m^2)	Obesity Class	Disease risk* (relative to normal weight and waist circumference)	
			Men ≤ 102 cm (≤ 40 in) Women ≤ 88 cm (≤ 35 in)	> 102 cm (≤ 40 in) > 88 cm (≤ 35 in)
Underweight	< 18.5		-	-
Normal	18.5-24.9		-	-
Overweight	25.0-29.9		Increased	High
Obesity	30.0-34.9	I	High	Very high
	35.0-39.9	II	Very high	Very high
Extreme obesity	≥ 40	III	Extremely high	Extremely high

* Disease risk for type 2 diabetes, hypertension, and coronary heart disease.

Table 2 Co-morbidities risk associated with different levels of BMI and suggested waist circumference in adult Asians [34]

Classification	BMI (kg/m^2)	Risk of co-morbidities	
		Waist circumference	
		< 90 cm (men) < 80 cm (women)	≥ 90 cm (men) ≥ 80 cm (woman)
Underweight	< 18.5	Low (but increased risk of other clinical problems)	Average
Normal range	18.5-22.9	Average	Increased
Overweight:	≥ 23		
At risk	23.0-24.9	Increased	Moderate
Obese I	25.0-29.9	Moderate	Severe
Obese II	≥ 30	Severe	Very severe

3. Causes of overweight and obesity

Overweight and obesity is a chronic condition that develops as a result of a complex interaction between a person's genes and the environment characterized by long-term energy imbalance due to excessive caloric consumption, insufficient energy out put [sedentary lifestyle, low resting metabolic rate (RMR)] or both [35-38].

3.1 Genetic influences on overweight and obesity

It has been long known that the tendency to gain weight runs in families. However, family members share not only genes but, also diet and life style habits that may contribute to obesity. Separating these lifestyle factors from genetic one is often difficult, still, growing evidence points to heredity as a strong determinant factor of obesity [39].

Twin studies can also estimate the extent to which the family environment makes family members more similar than would be expected from their genetic relatedness [40]. In 1990, studies with identical twins reared apart suggest that the genetic contribution to BMI may be higher, i.e., about 70 percent [41]. There are several other studies of monozygotic twins reared apart that yielded remarkably consistent results [42].

A 1997 review of published adult twin and adoption studies found that variation in body mass index (BMI; in kg/m2) was largely due to heritable genetic differences [43]. Studies published since 1997 have reached the same conclusion, with heritability estimates in adults ranging from55%to85% [44-47]

In 2008, Wardle J. et al. carried out twin analyses of BMI and waist circumference (WC) in a UK sample of 5092 twin pairs aged 8–11 y. They concluded that genetic influences on BMI and abdominal adiposity are high in children born since the onset of the pediatric obesity epidemic. Most of the genetic effect on abdominal adiposity is common to BMI, but 40% is attributable to independent genetic influences [48].

Many studies have shown a correlation between heredity and fat. Some studies showed that when both parents were fat, 80% of their children, even if not raised by their genetic parents, were also fat. 40% was fat when one of the parents was obese and only 9% was fat when both parents were lean [49-50]

In women, the hereditary advantage is even more important. Newborn girls in all ethnic groups weight less at birth than newborn boys but have a higher percentage of body fat [51]. This trend continues as the child matures, with women having an average of two times the body fat of men [52].

3.2 Environmental influences on overweight and obesity

Recent hypotheses in the scientific community suggest the current obesity epidemic is being driven largely by environmental factors (e.g., high energy/high fat foods, fast food consumption, television watching, "super-sized" portions, etc.) rather than biological ones [53].

Environmental influences on overweight and obesity are primarily related to food intake and physical activity behaviors [54]. According to WHO (1997), the fundamental causes of the obesity epidemic are sedentary lifestyles and high-fat, energy-dense diets [55].

Diet is an important factor to be considered in obesity development and control. The composition of diet has a significant effect on relative weight [56]. In 2003, Muller D. et al. [57] elucidated the nutritional etiology of changes in body mass index (BMI; in kg/m^2) and waist circumference by dietary intake pattern in 459 healthy men and women participating in the ongoing Baltimore Longitudinal Study of

Aging. The result presented that consuming a diet high in fruit, vegetables, reduced-fat dairy, and whole grains and low in red and processed meat, fast food, and soda was associated with smaller gains in BMI and waist circumference.

In 2006, Hassapidou M. et al. [58] examined energy intake, energy expenditure, diet composition, and obesity of adolescents in Northern Greece. They reported 31% of boys and 21% of girls prevalence of overweight. Both overweight boys and girls reported a lower energy intake and lower mean daily carbohydrate, protein, and fat intake, expressed as grams per kilogram body weight compared with their non-overweight counterparts. Both overweight and non-overweight adolescents had higher than recommended fat intakes. Overweight boys had statistically lower fiber than non-overweight boys. Furthermore, overweight adolescents consumed more snacks (potato chips, chocolate bars, pizza, cheese pie, and cream pie), more sugar, jam, and honey, and fewer legumes, vegetables, and fruits than their non-overweight counterparts.

Intake of excess dietary fat has been implicated as a major cause of obesity for decades [59]. Fat provides more energy than protein and carbohydrate per unit weight therefore high-fat diet tend to be high-energy diet. Moreover, mechanistic and intervention studies support that fat possesses a lower satiating power than carbohydrate and protein, and a diet low in fat therefore decreases energy intake[60].

A recent WHO/FAO expert consultation report on diet, nutrition andprevention of chronic diseases, sets population nutrient goals and recommends intake of a minimum of 400 grams of fruits and vegetables per day for the prevention of chronic diseases such as heart diseases, cancer, diabetes and obesity. The report states that there is convincing evidence that fruits and vegetables decrease the risk for obesity [61]. A study on food intake patterns indicated that a diet rich in fruits and vegetables was associated with smaller gains in body mass index (BMI) [57].

In 2004, K He. et al. [62] examine the changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women, 74 063 female nurses aged 38–63 y, who were free of cardiovascular disease, cancer, and diabetes at baseline in 1984. The result presented During the 12-y follow-up, participants tended to gain weight with aging, but those with the largest increase in fruit and vegetable intake had a 24% of lower risk of becoming obese (BMI≥

30 kg/m^2) compared with those who had the largest decrease in intake after adjustment for age, physical activity, smoking, total energy intake, and other lifestyle variables. They concluded that increasing intake of fruits and vegetables may reduce long-term risk of obesity and weight gain among middle-aged women. In their natural state, fruits and vegetables provide fewer calories than other choices, especially if they replace foods high in fat [63-64].

In most of the developed and many of developing countries, there is an overall abundance of palatable and caloric-dense food. Additionally, the abundance of food in the supermarket, the availability of food sold at fast food restaurants and vending machines and the large portions of food served outside the home, promote high caloric consumption. Many of our socio-cultural traditions, especially at holidays or special occasions, promote overeating and preferential consumption of high caloric foods. For many people, even when caloric intake is not above the recommended level, the number of calories expended in physical activity is out of balance with calorie consumption. All this lead a person to be obese [65-66].

Lifestyle plays an important role both in development and control of obesity. A strong link exists between physical inactivity and weight gain. Multiple cohort and cross-sectional studies have shown an association between obesity and inactivity [67]. Numerous studies have shown that sedentary behaviors like watching television and playing computer games are associated with increased prevalence of obesity [68-69].

In, 1999 Martinez-Gonzalez et al. examined physical activity, sedentary lifestyle and obesity in a sample of 15 member countries of European Union and found a strong association of obesity and higher body weight with a sedentary lifestyle and lack of physical activities in adult population [70]. Similarly Hernandez et al. (1999) investigated the relation of obesity with physical activity, television programs and other forms of video viewing among 712 children’s, 9-16 years old, in Mexico City. They reported that prevalence of obesity was related with physical inactivity and television viewing [71].

Few studies have examined the association between sedentary behaviors such as prolonged television (TV) watching and obesity and diabetes. Using data from a large prospective cohort study, the Health Professionals' Follow-up Study, they have

demonstrated that increasing TV watching is strongly associated with obesity and weight gain, independent of diet and exercise [72]. It seems that reduced eating in front of the television is at least as important as increasing activity [73]. Increased TV viewing time was associated with increased index of energy intake, increased sweet snack and high-energy drink consumption, and deceased vegetable intake. [74]

Family plays a key role in enabling the development of obesity in family members. The sedentary lifestyle and family food environment is likely to exert important influences on young children's eating. The study in 2006 [74] assess the associations between the family food environment and a range of obesity-promoting dietary behaviors in 5–6-year-old children showed that several aspects of the family food environment were associated with dietary outcomes likely to promote fatness in children and parent's increased confidence in the adequacy of their child's diet was associated with increased consumption of sweet and savory snacks and decreased vegetable consumption.

In 2009, M. Vanhala evaluated the associates of obesity and overweight in 7-year-old children and found the prevalence of overweight was 16.7% and that of obesity 4.9%. Fifty-seven percent of the parents who had an overweight or obese child 7-year-old did not recognize their over weight. The factors associated with obesity were mother’s obesity, low physical activity, skipping breakfast, habitual overeating, father’s overweight and mother’s age over 40 years [75].

4. Health Risks of overweight and obesity

Several researches have shown that overweight and obesity lead to increase health risks that are associated with high morbidity and mortality. Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Raising Body Mass Index (BMI) increases the risks of coronary heart disease, type 2 diabetes mellitus, and certain types of cancers such as cancer of the breast, colon, prostate, endometrium, kidney and gallbladder [1].

4.1 Hypertension

The occurrence of hypertension rises with increasing body weight. Data from NHANES III [76] show that the age adjusted prevalence of high blood pressure increases progressively with higher levels of BMI in men and women. High blood pressure is defined as mean systolic blood pressure 140 mm Hg, or mean diastolic blood pressure 90 mm Hg, or currently taking antihypertensive medication. The prevalence of high blood pressure in adults with BMI 30 is 38.4 percent for men and 32.2 percent for women, respectively, compared with 18.2 percent for men and 16.5 percent for women with BMI< 25, a relative risk of 2.1 and 1.9 for men and women, respectively.

The large international study of salt (INTERSALT) [77] studied the relationship between body mass index (kg/m2) and blood pressure was studied in 10,079 men and women aged 20-59, sampled from 52 centers around the world. The result of the study reported that a 10 kg higher body weight is associated with 3.0 mm Hg higher systolic and 2.3 mm Hg higher diastolic blood pressure. These INTERSALT findings confirm the importance of the association between body weight and blood pressure. Differences of 2-3 mmHg in systolic blood pressure on a population basis have been shown to be associated with differences in stroke mortality rates of 6-9 per cent and in coronary death rates of 4-6 per cent.

A study of the effect of weight loss intervention on antihypertensive medication requirements in the hypertension optimal treatment (HOT) study [78] present that patients in the weight loss group used a significantly fewer number of medication steps than the control group at all time intervals except 3 months.

This study concluded that weight loss appears to be a useful tool in blood pressure management in patients who require medication to control their blood pressure.

4.2 Dyslipidemia

A meta-analysis of 70 weight loss studies has been published, which revealed beneficial effects of weight reduction on all serum lipid levels, including an increase in HDL cholesterol at a stabilized reduced weight [79].

Several large longitudinal studies provide evidence that overweight, obesity and weight gain are associated with increased cholesterol levels [80-82].

National Health and Nutrition Examination Survey III showed that high total cholesterol, defined as $\geq$240 mg/dl, related to BMI (Figure 1) [83].

At each BMI level, the prevalence of high blood cholesterol is greater in women than in men. Total cholesterol levels are usually higher in people with predominant abdominal obesity, defined as a waist-to-hip circumference ratio of $\geq$0.8 for women and $\geq$1.0 for men [84].

Many study showed the evidence of triglyceride levels associated with BMI, for both sexes and all age groups [85, 86, 87, 88]. Recently study showed that high levels of TG are strong clinical markers of greater extent of coronary artery disease in hypertensive patients [89].

The age-adjusted prevalence of low high-density lipoprotein (HDL)-cholesterol in relation to BMI levels, defined as < 35 mg/dl in men and < 45 mg/dl in women, based on NHANES III data, is shown in Figure 2 [83]. HDL-cholesterol levels at all ages and weights are lower in men than in women.

Longitudinal studies have found that changes in BMI are associated with changes in HDL-cholesterol. A BMI change of 1 unit is associated with an HDL-cholesterol change of 1.1 mg/dl for young adult men and an HDL cholesterol change of 0.69 mg/dl for young adult women [90].

Figure 1 NHANES III Age-Adjusted Prevalence of High Blood Cholesterol According to Body Mass Index [83]

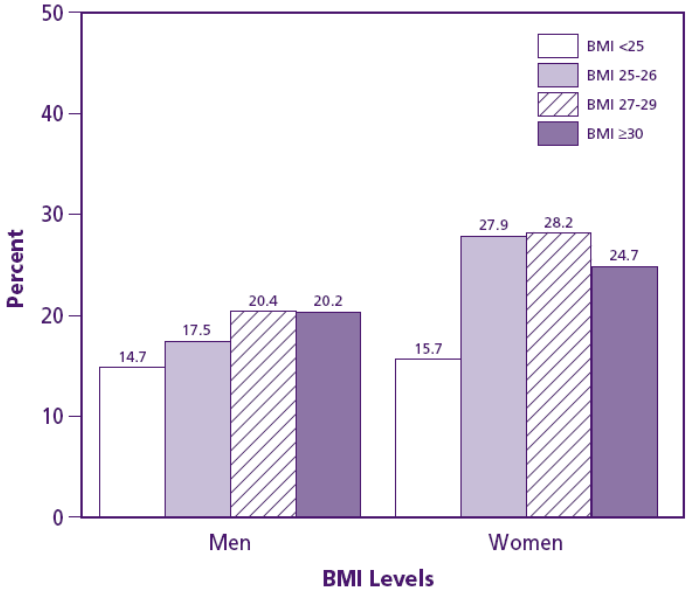
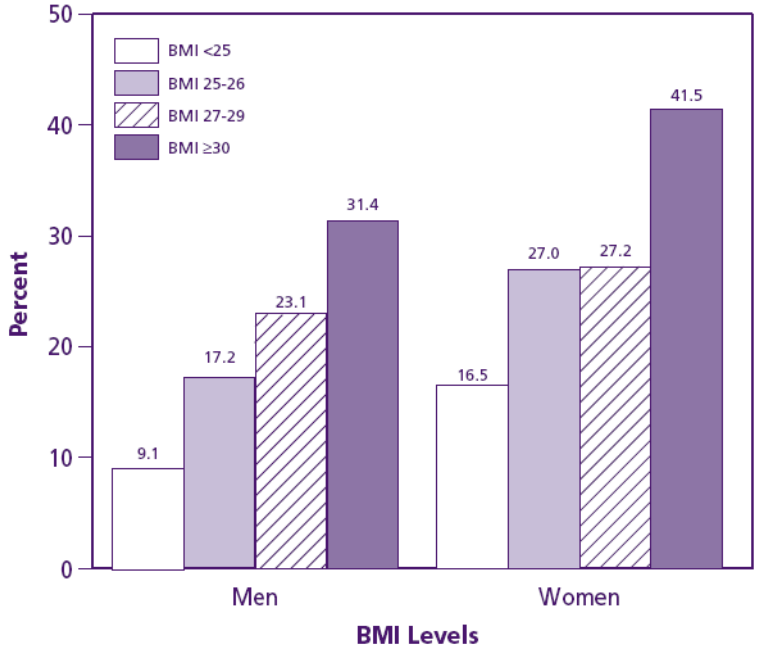


Figure 2 NHANES III Age-Adjusted Prevalence of Low HDL-Cholesterol According to Body Mass Index [83]



Source: Brown C. et al. Body Mass Index and the Prevalence of Risk Factors for Cardiovascular Disease (submitted for publication).

Cross-sectional data suggest that LDL-cholesterol levels are higher by 10 to 20 mg/dl in relation to a 10 unit difference in BMI, from levels of 20 to 30 kg/m^2. [85, 86] According to extensive epidemiological data, a 10 mg/dl rise in LDL-cholesterol corresponds to approximately a 10 percent increase in CHD risk over a period of 5 to 10 years [91].

4.3 Type 2 Diabetes Mellitus

The several prospective studies showed that increased risk of diabetes associated with weight increases [92-95]. In 1976, the Nurses' Health Study demonstrated a cohort of 113,861 US women aged. During 8 years of follow-up the study found that the risk of developing type 2 diabetes increases as BMI increases. Among women of average body mass index, 23-23.9 kg/m^2, the relative risk was 3.6 times that of women having a body mass index less than 22 kg/m^2 [96]. In addition, weight gain after age 18 associated with the development of type 2 diabetes in both men [97] and women [96]. The relative risk of diabetes increases by approximately 25 percent for each additional unit of BMI over 22 kg/m^2 [98].

Abdominal obesity is a major risk factor for type 2 diabetes. A cohort of 51,529 U.S. male health professionals, 40-75 years of age in 1986 found that absolute weight gain throughout adulthood were also significant independent risk factors for diabetes. The study suggested that waist circumference may be a better indicator than waist-to-hip ratio (WHR) of the relationship between abdominal adiposity and risk of diabetes [97].

4.4 Coronary Heart Disease

The relation between obesity and coronary heart disease risk was directly related to many chronic disease for example hypertension; dyslipidemia, particularly reductions in HDL cholesterol; and impaired glucose tolerance or non–insulin-dependent diabetes mellitus [93]. Overweight, obesity, and abdominal fat are also relate to increase morbidity and mortality from CHD [99, 100].

In a 14-year prospective study, middle-aged women with a BMI more than 23 but less than 25 had a 50% increase in risk of nonfatal or fatal coronary heart disease [101].

In Thailand, a cohort study with 17 years of follow-up in 2536 male employees from the Electricity aged between 35 to 59 years demonstrated that waist-to-height ratio

the best of the four indicators (BMI, waist circumference, waist-to-hip ratio, and waist-to-height ratio) to predict CHD events in Thai men [102].

4.5 Congestive Heart Failure

Studies showed that overweight and obesity identified as important and independent risk factors for congestive heart failure, CHF [103,104]. CHF is a frequent complication of severe obesity and a major cause of death. The duration of obesity is a strong predictor of CHF [105]. Data from the Bogalusa Heart Study presented that excess weight may lead to acquisition of left ventricular mass beyond that expected from normal growth [106]. These changes in the left ventricle are related to sudden death in obese patients [107]

4.6 Osteoarthritis

Osteoarthritis (OA) of the knee is a common cause of suffering and disability, especially in the elderly [108]. Several studies have been showed that not only elderly but also individuals who are overweight or obese increase their risk for the development of osteoarthritis [109-112] The recent study**,** 3585 people aged ≥55 years, showed that a high BMI (>27 kg/m^2) was associated with incident knee osteoarthritis and BMI is associated with progression of knee osteoarthritis [113]. The association between increased weight and the risk for development of knee osteoarthritis is stronger in women than in men [112].

A decrease in BMI of 2 units or more during a 10-year period decreased the odds for developing knee osteoarthritis by more than 50 percent; weight gain was associated with a slight increase in risk [114]. A population-based case-control study in three health districts of England (Southampton, Portsmouth and North Staffordshire) give strong support to public health initiatives aimed at reducing the burden of knee OA by controlling obesity [115].

4.7 Cancer

Colon cancer, many studies supported the hypothesis that excess body weight is a risk factor for colon cancer among both men and women [116-118]. In men, the relationship between obesity and total the risk of colon cancer death was stronger than in women [119]. The risk of colon cancer increase in men with high BMI [117,119,120]. Women who were high BMI and estrogen-positive, premenopausal or postmenopausal and taking estrogens, have an increased risk of

colon cancer similar to men with a high BMI [121]. Twice as many women with a BMI of > 29 kg/m2 had distal colon cancer as women with a BMI < 21 kg/m^2 [122].

Breast cancer, epidemiologic studies showed that obesity is directly related to mortality from breast cancer, predominantly in postmenopausal women [93]. Breast cancer mortality rates increased continually and substantially with increasing BMI. [123] Adult weight gain, specifically since menopause, increases the risk of breast cancer among postmenopausal women, whereas weight loss after menopause relates to decrease risk of breast cancer [124]. Obesity seems to increase the risk of breast cancer only among postmenopausal women who do not use menopausal hormones. Among women who use menopausal hormones, there is no significant difference in breast cancer risk between obese women and women of a healthy weight [125-128]. Another factor related to the higher breast cancer death rates in obese women is that breast cancer is more likely to be detected at a later stage in obese women than in lean women. This is because the detection of a breast tumor is more difficult in obese versus lean women [129].

Endometrial cancer, obesity increases the risk of endometrial cancer. The risk is three times higher among obese women (BMI $\geq$30 kg/m^2) compared to normal weight women [130]. Cohort Study shows that women who averaged an annual BMI gain $\geq$ 1% had an increased risk compared to women who maintained a stable adult BMI and the highest risk associated with BMI gain was observed among nulliparous women and postmenopausal women who never used hormone therapy. In addition, they conclude that adult obesity and increase in adiposity are risk factors for endometrial cancer; and the risk associated with these factors may vary across racial/ethnic groups [131].

Kidney cancer, studies confirmed that kidney cancer risk increased when BMI increased in both men [132] and women [133] A meta-analysis (1992-2008) found that a higher kidney cancer risk due to obesity in women than men. Increasing prevalence of obesity with higher proportion among women may be responsible for the rising incidence rates in women [133]. A meta-analysis, which found an equal association of risk among men and women, estimated the kidney cancer risk to be 36 percent higher for an overweight person and 84 percent higher for an obese person compared to those with a healthy weight [134].

Gallstones and gallbladder cancer, NHANES III data demonstrated the prevalence of gallstone disease among women increased from 9.4 percent in the first quartile of BMI to 25.5 percent in the fourth quartile of BMI. Among men, the prevalence of gallstone disease increased from 4.6 percent in the first quartile of BMI to 10.8 percent in the fourth quartile of BMI [135]. A cross-sectional study data, 174 Japanese men, suggest that BMI and WHR was significantly associated with an increased risk of both prevalent gallstones and postcholecystectomy. These findings concluded that obesity is associated with increased gallstone risk in men [136]. A case–control study which studied in 8485 Chinese women presented overweight and weight gain increase the risk of gallstone in women and the effects of overweight and weight gain on gallstone prevalence appear to be independent of each other [137]. Although gallstones are considered a strong risk factor for gallbladder cancer but most people with untreated gallstones are at low risk of developing the cancer [138] However, an increased risk of gallbladder cancer has been found to be associated with obesity, particularly among women [139, 140].

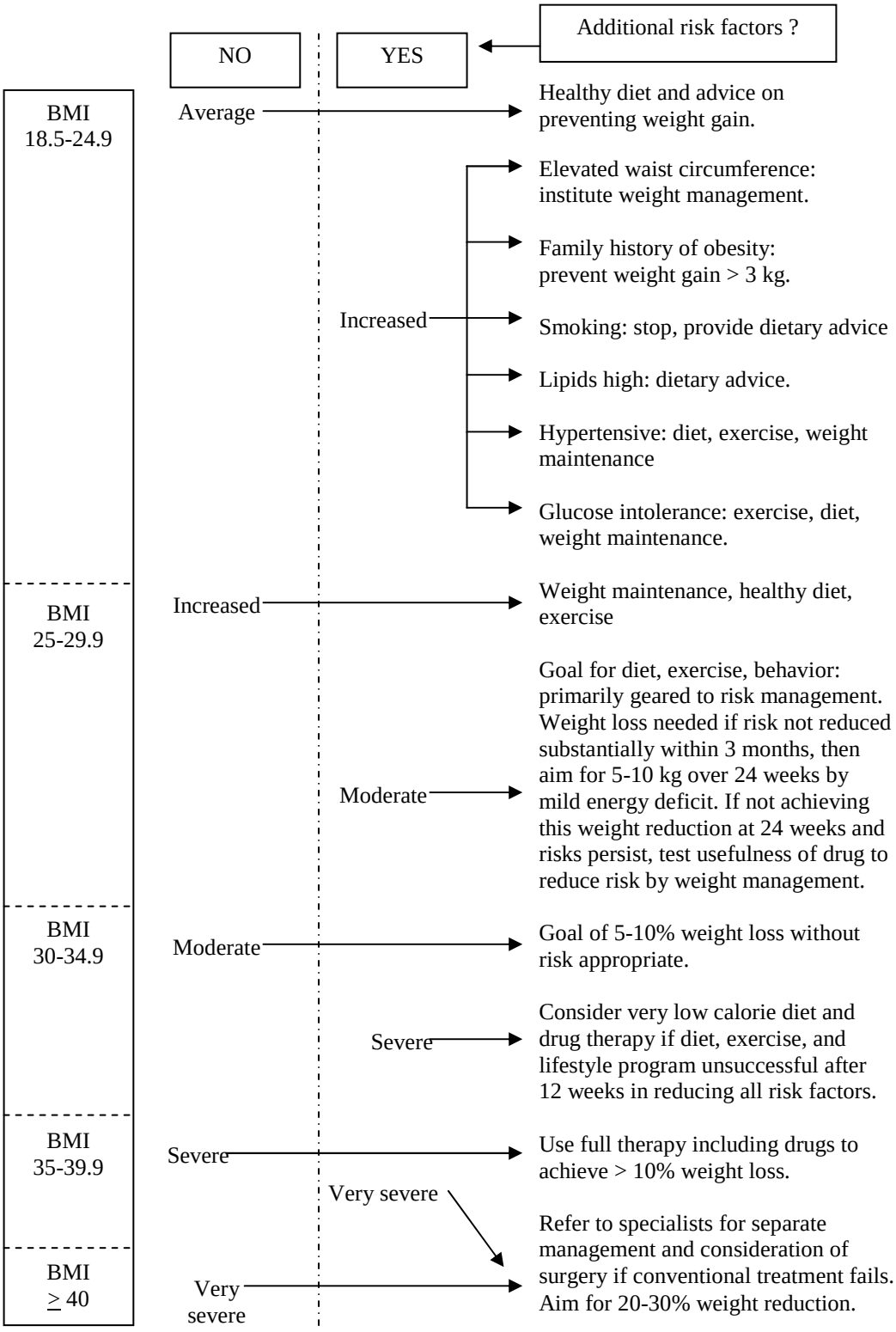
5. Weight Management

Effective weight control involves multiple techniques and strategies including dietary therapy, physical activity, behavior therapy, pharmacotherapy, and surgery as well as combinations of these strategies [37].

The numerous options for the weight management have the same goal of reducing weight to reduce the risk of major chronic disease and mortality. Obese people who lose 5%-10% of initial body weight are likely to improve their health in the short run by reducing the severity of the comorbidities associated with obesity and the people who lose weight significantly improves serum lipid parameters, blood pressure, and fasting blood glucose values [141].

Measurement of height and weight are used to calculate the BMI that is the initial step to assessment and seek the appropriate treatment.

Figure 3 Model with graded BMI and complicating factors and adds the appropriate treatment options. This monogram which was adopted in the World Health Organization monograph present the appropriate treatment with graded BMI and complicating factors [142].



5.1 Diets

5.1.1 Low-calorie diet (LCDs)

A low-calorie diet (LCD) defined as an energy deficit of 500–1,000 kcal/day and moderate-fat. The LCD recommended not only modifies calorie intake but also reduces saturated fat, total fat, and cholesterol intake in order to help lower high blood cholesterol levels. The diet also includes the current recommendations for sodium, calcium and fiber intakes. The NHLBI/ NAASO guide recommends LCDs of 1,000–1,200 kcal/day for most overweight women and 1,200–1,600 kcal/day for overweight men (and for women who exercise regularly or weigh ≥75 kg) [37, 143]. The recommended macronutrient composition of these diets is shown in Table 3.

Table 3 Low-calorie diet

Nutrient	**Recommended Intake**
Calories	Approximately 500 to 1,000 kcal/day reduction from usual intake
Total fat	30 percent or less of total calories
Saturated fatty acids	8 to 10 percent of total calories
Monounsaturated fatty acids	Up to 15 percent of total calories
Polyunsaturated fatty acids	Up to 10 percent of total calories
Cholesterol	< 300 mg/day
Protein	Approximately 15 percent of total calories
Carbohydrate	55 percent or more of total calories
Sodium chloride	No more than 100 mmol per day (approximately 2.4 g of sodium or approximately 6 g of sodium chloride)
Calcium	1,000 to 1,500 mg
Fiber	20 to 30 g

.

LCDs have been shown to reduce total body weight by an average of 8 percent over a period of 6 months, accompanied by significant reductions in waist circumference. Since these represents an average that includes

individuals who did not lose weight, an individual average goal of 10 percent is feasible. When weight loss occurs, the loss consists of about 75 percent fat and 25 percent lean tissue [145, 146]. In 2005, Fontana L et al. studied in Long-Term Effects of Low-Calorie Diet on the Metabolic Syndrome in Obese Nondiabetic Patients. They found that Body weight decreased by 8.5% after 6 months and was 9.9% lower than baseline at the end of the study. After 2 years, all of the components of the metabolic syndrome underwent a highly significant improvement and no cases of worsening blood glucose, triglycerides, or HDL cholesterol. They concluded that Low-Calorie Diet with only a modest reduction in calories is effective in the long-term management of the metabolic syndrome in obese nondiabetic patients, particularly in those who achieve a body weight reduction >10% [147].

5.1.2 Very-low-calorie diets (VLCDs)

Very-low-calorie diets (VLCDs) provide 200–800 kcal/day, with large amounts of protein (70–100 g/day) to preserve lean body mass. VLCDs are typically recommended for patients with a BMI ≥30 kg/m^2 who have failed to lose weight using an LCD [143]. VLCDs (less than 800 kcal/day) are not recommended for weight loss therapy because the deficits are too great, and nutritional inadequacies will occur unless VLCDs are supplemented with vitamins and minerals [37]. These diets produce weight losses of 15–25% in 8–16 weeks [148]. Clinical trials show that LCDs are just as effective as VLCDs in producing weight loss after 1 year [149]. VLCDs has been unsuccessful in achieving weight loss over the long term. Nine randomized control trials, including VLCD treatment with long-term weight maintenance, show a large variation in the initial weight loss regain percentage, which ranged from -7% to 122% at the 1-year follow-up to 26% to 121% at the 5-year follow-up [150]. The recent study showed that long-term consumption of a low-protein, low-calorie diet are associated with low plasma growth factors and hormones that are linked to an increased risk of cancer [151]. Successful behavior therapy is the key to long term maintenance of weight at a reduced level. Finally, patients using VLCDs are at increased risk for developing gallstones [37].

5.2 Physical Activity

An increase in physical activity is an important component of weight loss therapy since it leads to increased expenditure of energy [143]. Regular physical activity help people reach and maintain a healthy weight. Case studies have shown that people who exercise regularly are more successful in maintaining weight losses than are those who do not exercise [152,153]. A prospective cohort study reported that among women who consumed a usual diet and exercise regularly was associated with less weight gain among women whose BMI was lower than 25. Women successful in maintaining normal weight and gaining fewer than 2.3 kg over 13 years averaged approximately 60 minutes a day of moderate-intensity activity throughout the study [154]. Moreover, physical activity reduces elevated levels of CVD risk factors, including blood pressure and triglycerides, increases HDL-cholesterol, and improves glucose tolerance with or without weight loss [155].

Physical activity can be divided into two types: programmed and lifestyle. Programmed activity is typically planned, aerobic, and completed in a single bout (e.g., walking, biking, and aerobics classes). Lifestyle activity involves increasing energy expenditure throughout the day by methods such as using stairs rather than escalators or choosing a distant parking spot [143]. Initially, moderate levels of physical activity for 30 to 45 minutes, 3 to 5 days per week, should be encouraged. Extremely obese persons may need to start with simple exercises that can be intensified gradually. As the examples listed in Table 4 show, a moderate amount of physical activity can be achieved in a variety of ways [37]. Given these favorable findings, lifestyle activity would appear to be ideal for obese individuals who refuse to increase in physical activity.

Table 4 Examples of moderate amounts of physical activity*

Physical Activity	
Washing and waxing a car for 45-60 minutes	**Less Vigorous, More Time ****
Washing windows or floors for 45-60 minutes	
Playing volleyball for 45 minutes	
Playing touch football for 30-45 minutes	
Gardening for 30-45 minutes	
Walking 13⁄4 miles in 35 minutes (20 min/mile)	
Basketball (shooting baskets) for 30 minutes	
Bicycling 5 miles in 30 minutes	
Dancing fast (social) for 30 minutes	
Pushing a stroller 11⁄2 miles in 30 minutes	
Raking leaves for 30 minutes	
Walking 2 miles in 30 minutes (15 min/mile)	
Water aerobics for 30 minutes	
Swimming laps for 20 minutes	
Basketball (playing a game) for 15-20 minutes	
Bicycling 4 miles in 15 minutes	
Jumping rope for 15 minutes	
Running 11⁄2 miles in 15 minutes (10 min/mile)	
Stairwalking for 15 minutes	**More Vigorous, Less Time**

* A moderate amount of physical activity is roughly equivalent to physical activity that uses approximately 150 calories of energy per day, or 1,000 calories per week.

** Some activities can be performed at various intensities; the suggested durations correspond to expected intensity of effort.

5.3 Behavior Therapy

Behavioral treatment of obesity developed from the belief that obesity was the result of maladaptive eating and exercise habits, which could be corrected by the application of learning principles [156]. The treatment, as described below, helps patients identify cues that trigger inappropriate eating (and activity) and learn new responses to them [157,158].

Behavioral treatment usually includes multiple components, such as keeping food and activity records (ie, self-monitoring), controlling cues associated with eating (ie, stimulus control), nutrition education, slowing eating, physical activity, problem solving, and cognitive restructuring (ie, cognitive therapy) [157,158]. A review of randomized, controlled trials of behavior therapy for obesity conducted before 1975 and during 1978, 1984, and 1986 seemed to show that treatments were becoming more effective [159]. Studies published from 2000–2004 have produced similar results [160-162]. Studies have shown that two components, self-monitoring [163,164] and physical activity [165], are consistently associated with better weight control in the short- and long-term, respectively. Early studies found that patients spontaneously reduced calorie intake when daily diet records were kept. Patients who monitored their caloric intake and expenditure lost more weight than did those who did not use self-monitoring [166]. Several studies have found good correlations between self-monitoring and weight loss [166,167] and maintenance [168,169],

The goal of behavior therapy is to alter the eating and activity habits of an obese patient. Techniques for behavior therapy have been developed to assist patients in modifying their life habits [37].

5.4 Pharmacotherapy

Pharmacotherapy is recommended for individuals with a BMI $\geq$30 kg/m^2 or with a BMI $\geq$27 kg/m^2 in the presence of two or more obesity-related comorbidities (e.g., coronary heart disease, type 2 diabetes, or sleep apnea) and who cannot lose weight satisfactorily with more conservative approaches [37]. Two medications sibutramine (Meridia) and orlistat (Xenical) are approved by the Food and Drug Administration for the induction and maintenance of weight loss [170].

Sibutramine reduces food intake by inhibiting the reuptake of norepinephrine, dopamine and serotonin that is associated with reports of increased

satiation (i.e., fullness). Bray et al. evaluated different doses of Sibutramine during 24-week period [171]. They found a statistically significant weight lose at all doses (1, 5, 10, 15, 20, and 30 mg) compared with placebo. When used with an LCD, sibutramine (10–15 mg/day) produced a significantly greater loss of initial weight (7%) than an LCD plus placebo (2%) over the course of 1 year. [172] In the longest study of sibutramine, Jame et al. showed that 18 months after initial weight loss, 43% of the patients maintained $\geq$ 80% of their original weight loss vs 9% in the placebo group [173]. The side effects associated with sibutramine are dry mouth, anorexia, insomnia, increased blood pressure and pulse. However, sibutramine is not recommended for patients with uncontrolled hypertension or a history of coronary artery disease, arrhythmias, congestive heart failure, or stroke. It is also not recommended in combination with certain antidepressant agents, such as monoamine oxidase inhibitors or selective serotonin reuptake inhibitors [174].

. Orlistat is a gastric lipase inhibitor that blocks the absorption of about onethird of the fat contained in a meal [175]. On average, 120 mg of orlistat taken 3 times per day will decrease fat absorbtion by 30% [176]. In 2-years study, Devidson et al showed that there was less weight regain in patients maintained on the 360 mg per day dose of orlistat [177]. The side effects associated with orlistat, including fatty or oily stool, fecal urgency, oily spotting, increased defecation, fecal incontinence, flatus with discharge and oily evacuation. These symptoms are usually mild to moderate and decrease in frequency the longer the medication is continued [178].

5.5 Surgery

Weight loss surgery is an option for weight reduction in patients in whom other methods of treatment have failed and who have clinically severe obesity (a BMI $\geq$40, or a BMI $\geq$ 35 with comorbid conditions) [37]. Obesity related comorbid disease are conditions that worsen as weight increase. Comorbid conditions include type 2 diabetes mellitus, hypertension, hyperlipidemia, obstructive sleep apnea, urinary stress incontinence, gastroesophageal reflux disease and joint pain [178].

The two most common surgical procedures for obesity are vertical banded gastroplasty (VBG) and Roux-en-Y gastric bypass (RGB). Both entail isolating a small (15- to 30-ml) pouch of stomach with a line of staples, thereby drastically limiting food intake. In VBG, the pouch empties into the remaining stomach, where

the digestive process continues as normal. GB, however, not only restricts food intake, but also reduces absorption by bypassing the remaining stomach and 45–150 cm of small intestine [179]. Bariatric surgery produces average reductions of 25% (VBG) to 30% (GB) of initial weight [180] and significant improvements in hypertension, asthma, sleep apnea, and diabetes [181]. Randomized trials have shown that GB is associated with significantly better maintenance of weight loss than is VBG [182].

Individuals considering bariatric surgery must discuss risks and possible benefits with their doctor. Bariatric surgery has associated risks and long-term consequences and should be considered only one part of an approach to treating obesity. Long-term follow-up with doctors experienced in the care of patients having these procedures, as well as lifelong vitamin supplementation, is essential to avoid life-threatening complications [183].

6. NHLBI Recommendation (National Heart, Lung, and Blood Institute Recommendation)

This Guide was developed cooperatively by the North American Association for the Study of Obesity (NAASO) and the National Heart, Lung, and Blood Institute (NHLBI) [37]. It is based on the Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. NHLBI Recommendation promoted a combination of diet modification, increased physical activity, and behavior therapy can be effective.

Dietary Therapy, The diet should be a low-calorie diet (LCD) that should not be too low, less than 800 kcal/day. Caloric intake should be reduced by 500 to 1,000 calories per day (kcal/day) from the current level and the macronutrient composition of these diets is shown in Table 1. The guideline educated about food composition, labeling, preparation, and portion size which presented in the topic of Shopping—What To Look For, Low Calorie, Lower Fat Alternatives, Sample Reduced Calorie Menus, Food Exchange List, Food Preparation and Dining Out—How To Choose.

Physical activity for the obese patient should generally be increased slowly, with care taken to avoid injury. A wide variety of activities and/or household

chores, including walking, dancing, gardening, and team or individual sports, may help satisfy this goal. All adults should set a long-term goal to accumulate at least 30 minutes or more of moderate-intensity physical activity on most, and preferably all, days of the week. The guideline presented examples of moderate amounts of physical activity, overcoming obstacles to regular activity, health benefits from physical activity and two sample activity programs (jogging and walking program)

Behavior Therapy, Specific behavioral strategies include the following: self-monitoring, stress management, stimulus control, problem-solving, contingency management, cognitive restructuring, and social support. Behavioral therapies may be employed to promote adoption of diet and activity adjustments; these will be useful for a combined approach to therapy. The other tools presented in this guideline were weight record and weekly food diary.

7. Health behavioral theories

7.1 Stage of change

Stages of change (Transtheoretical) model developed by Prochaska and DiClemente [184]. The model's basic premise is that behavior change is a process, not an event. As a person attempts to change a behavior, he or she moves through five stages: precontemplation, contemplation, preparation, action, and maintenance (see Table 5.). Definitions of the stages vary slightly, depending on the behavior at issue. People at different points along this continuum have different informational needs, and benefit from interventions designed for their stage. The Stages of Change Model has been applied to a variety of individual behaviors, as well as to organizational change. The Model is circular, not linear. In other words, people do not systematically progress from one stage to the next, ultimately "graduating" from the behavior change process. Instead, they may enter the change process at any stage, relapse to an earlier stage, and begin the process once more. They may cycle through this process repeatedly, and the process can truncate at any point [185].

Table 5 Stage of change model

Stage	Definition
Precontemplation	Has no intention of taking action within the next six months
Contemplation	Intends to take action in the next six months
Preparation	Intends to take action within the next thirty days and has taken some behavioral steps in this direction
Action	Has changed behavior for less than six months
Maintenance	Has changed behavior for more than six months

7.2 Health belief model

The Health Belief Model (HBM) was one of the first theories of health behavior, and remains one of the most widely recognized in the field. It was developed in the 1950s by a group of U.S. Public Health Service social psychologists. They theorized that people's beliefs about whether or not they were susceptible to disease, and their perceptions of the benefits of trying to avoid it, influenced their readiness to act. The theory concludes that six main constructs influence people's decisions about whether to take action to prevent, screen for, and control illness. They argued that people are ready to act if they: Believe they are susceptible to the condition, Believe the condition has serious consequences, Believe taking action would reduce their susceptibility to the condition or its severity, Believe costs of taking action are outweighed by the benefits, Exposed to factors that prompt action (e.g., a television ad or a reminder from one's physician to get a mammogram) and Confident in their ability to successfully perform an action [185-188].

Several studies present that health behavior theories are beneficial to weight loss success. In 1997, Thunyaharn T. [17] reported the Effectiveness of a Nutrition Education Program to Reduce Blood Lipid by the Application of Behavioral Theories in Obese Male Teenagers. The study compared two interventions, education group and education with behavior therapy group. In this study, behavior therapies are Health Belief Model and Bandura's Social Learning Theory. After 6 months, the result indicated that the education with behavior therapy group had a

significantly higher scores (Ischemic heart disease knowledge test score) than the education group and loss weight 3 and 0.6 kg respectively.

In 2006, Maneegan A. et al. [18] reported an Application of Health Belief Model, Group Process and Social Support to Promote Weight Control Among Overweight Children in Primary Schools, Maung Nakonsitammarat. The results of the study showed that health belief model, social support, eating behavior and exerciser behavior of the experiment group (The experimental group participated in a twelve-week health promotion program) were significantly better than those of the control group. Body weight and Triceps skinfold of the experiment group were significantly lower than those of control group.

8. Website and weight management

The escalating obesity epidemic has prompted healthcare professionals to seek interventions that can reach large numbers of individuals in a timely and cost-effective manner. The Internet, with its growing audience, seems an obvious solution. Commercial weight loss programs already abound on the Internet [189]. Nowadays, the Internet continues to grow as a source of health information.

In 2010, 221 million people in the US will be online, about 71% of the total population. Their numbers will continue to grow, reaching 250 million in 2014—more than 77% of the population [190]. Recent survey data from the Pew Internet Project and the California HealthCare Foundation show that 44% of US adults living with chronic disease use the internet to find information or assistance in dealing with health or medical issues [191].

In Thailand, the Internet also continues to grow. Internet users grew over 100 per cent in the last five years. The National Telecommunications Commission reported the number of Internet users in Thailand in 2007 to be around 13.15 million people [26-27]. It is about 21.8% of the population, 61.54 million people from population survey in 2007 [28] and 32% of the working population age 15 to 59 years, 41.91 million people. The 2007 Information and communication technology survey and household report [29] found that the major area of using Internet was Bangkok area. Using Internet the most are the age range of 15-24 years (39.7%), 25-49 years (24.3%) and 6-14 years (19%) respectively. Using the Internet to access websites to

search information and follow news is very high (84.8%) and entering to websites to play game, send e-mail and buy products are about 22.7%, 18.4% and 1.4% respectively.

Computer-tailored nutrition education aimed at dietary change has been shown to be more effective than general nutrition education [192]. Internet-based tailored interventions that incorporate feedback have a greater immediate impact than does general nutrition information on changing dietary behaviors [193]. Several studies have shown that Internet and e-mail contact can provide successful behavioral weight control [21 –23].

In 2001-2002, Tate et al. [24] studies compare two interventions via internet (education group and behavior therapy group) in 91 healthy, overweight adult hospital employees aged 40.9±10.6 years with a body mass index of 25-36 kg/m^2. After 6 months, they found that the behavior therapy group lost more weight than the education group. The behavior therapy group lost a mean (SD) of 4±2.8 kg and weight loss in the education group was 1.7 ±2.7 kg. The study concluded that participants who were given a structured behavioral treatment program with weekly contact and individualized feedback had better weight loss compared with those given links to educational websites. Thus, the Internet and e-mail appear to be viable methods for delivery of structured behavioral weight loss programs.

In 2001-2002, Southard et al. [25] studies compare between internet-base cardiac rehab program group and usual care group. They studied in 104 patients with CVD aged 62.3±10.6 years with a body mass index of 30.92 (internet-base cardiac rehab program group) and 29.2 kg/m^2 (usual care group) After 6 months, the results indicate that fewer cardiovascular events occurred among the internet-base cardiac rehab program subjects (15.7%) than among the usual care subjects (4.1%). More weight loss occurred in the internet-base cardiac rehab program group (-1.63 kg) than in the usual care group (+0.21)

Using the terms “weight loss program” and “weight loss diet” on the Internet search engine Google obtained 678,000 results, a daunting number for anyone browsing the web in search of a weight loss solution. Miller et al. [194] examined the first 50 websites identified by an Internet search that they conducted for “weight loss

diets". They compared the content of those 50 sites with published guidelines for obesity management and found an enormous variation in relevance and quality [189].

Several commercial Internet programs are now offered to the public [195], for examples, Weight Watchers [196], Jenny Craig [197], Nutrisystem [198], Nutrio [199], eDiets [200], Optifast [201], Diet Center [202], Shape down [203], Diet Watch [204] and Cyberdiet.com [205].

The one exception was the study [206] that compared eDiets.com, a commercial program available on the Internet to the public, to a 16-lesson, step-by-step manual program, LEARN Program for Weight Management 2000 [207]. The study showed that participants in eDiets.com lost significantly of initial weight at week 16 ($0.9 \pm 3.2\%$) and week 52 ($1.1 \pm 4.0\%$) They concluded that participants in the manual group lost significantly ($p < 0.05$) more weight (at both times) than those treated by eDiets.com and there were no significant differences between groups in changes in cardiovascular risk factors or quality of life.

However, the nutrition education via internet relating to weight loss is used as one of the choices for weight management in overweight and obese people who are too shy to see a counselor or seeking weight loss intervention with reduce time and travel expenses. The nutrition education via internet is easy for Internet users to access the information that can reach large numbers of individuals in a timely and cost-effective manner.

CHAPTER IV
MATERIALS AND METHODS

This study was conducted to develop and evaluate the effectiveness of multimedia website nutrition education tool for overweight and obese Thai people.

The study's focus was to evaluate the subject's; 1) Knowledge of nutrition for weight loss 2) Dietary and exercise behavior score 3) Stage of change 4) Nutrition status 5) Overall satisfaction with the developed education tool. The baseline nutritional status of the selected subjects was also assessed.

Ethical consideration

The study was approved by the Committee on Human Rights Related to Research Involving Human Volunteers, Mahidol University, Thailand (appendix A). All the study subjects were voluntary and the time wasted by the subjects was compensated.

Study protocol

Phase 1: Development of the multimedia website nutrition education tool.

Phase 2: Evaluating the effectiveness of the educational tool by the experts.

Phase 3: Pilot study: Evaluating the effectiveness of the educational tool by ten subjects.

Phase 4: Evaluating the effectiveness of the educational tool by study subjects from the selected bank.

Phase 1: Development of the multimedia website nutrition education tool.

The developed website focuses on the participants to learn lessons for weight management by themselves via cartoon animation, video presentation and games. Moreover, the developed website consists of meal plan, calorie burn calculator, weight record, food record and weight loss menu.

This phase of the study involved the development of an educational tool and content validation by a committee of experts. Various questionnaires used in the study were also developed during this phase. Information about weight assessment, dietary approach and physical activity to develop multimedia website nutrition education tool were reviewed.

1.1 Research and preparation for developing tool

The contents of the tool were modified from reliable resources include:

- NHLBI Recommendation (National Heart, Lung, and Blood Institute Recommendation): The Practical Guide Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 2002 [37]
- The Thesis for the degree of master of science: Development of healthy low-energy density Thai diet for weight management [208]
- Handbook for food label and food labeling of food product [209]
- Handbook for Nutritive values of Thai foods [210]
- Thai food exchange list [211]
- Other book and researches [212-218]

1.2 Developing tool by applying health behavior theory

The health behavioral theory in this study is Health belief model [185,219-220]. Health Belief Model includes recognizing the risks of disease, awareness of the severity of the disease, realizing the benefits of treatment and motivation to practice. The nutrition education tool provided content and focus on self-learning. Learners can evaluate the severity and the risk of disease by themselves. When they realize the benefits of intervention, they will follow the advice by adjusting their food intake and exercise.

1.3 Planning and Development website

The structures of creation in web-pages include:

- Design diagram and website layout
- Management folder structure
- Design web-page
- Management of Inter- and intra-link connective function
- Creating website by EditPlus Text Editor, Adobe Flash CS4 and Adobe illustrator CS4 and Macromedia Flash CS4
- Register domain name (www.fitbymyself.com)
- Up load website file to web hosting server

1.4 Content and appearance of the educational tool

The multimedia website nutrition education tool was well illustrated with colorful pictures. The contents and structures of the website were created by EditPlus Text Editor and Adobe Flash CS4. The pictures were identified from several sources including the World Wide Web and created by Adobe illustrator CS4. The selection of word and font considered from the easy and sample to read and understanding. The text fonts were Tahoma and Microsoft Sans Serif. The sizing of text was mainly in 16 normal texts and bold in heading.

Website contents consist of

- Registration to log-in and log-out system
- Home page
- Lessons for weight management

Lesson 1: Let's explore yourself

- Definition and causes of obesity
- Chronic diseases relate to obesity and normal criteria of fasting plasma glucose, blood pressure and lipid profile.
- VDO presentation: “3 diseases that have high risk due to obesity”

Lesson 2: Let's learn food exchange

- VDO presentation: Food exchange including starches, vegetables, fruits, meat and fat

Lesson 3: How to eat low fat, low calorie diets

- Choosing low fat, low calorie diets in six food groups including starches, vegetables, fruits, meat, milk and fat

Lesson 4: How to choose food outside home

- Food labels
- Calories in one-plate dishes
- Shopping low fat, low calorie diets

Lesson 5: Benefits of regularly exercise

- Benefits of regularly exercise
- Overcoming barriers to exercise
- Calorie burn calculator

Lesson 6: Let's exercise

- Advice on exercise
- Aerobic exercise
- A sample walking program
- A sample jogging program

- Homework and Assignments
- Web-board

- Meal planning program
  - Planning by yourself
  - Planning with pattern (1,000-2,000 kcal)
- Weight and daily food record
- Weight loss menu (A low-energy density recipe book for weight management) [208]
  - 30 recipes for side dishes
  - 16 recipes for one-plate dishes
  - The example of 7-day weight loss menu.
- Personal folder
  - Personal's picture
  - Private data including name, nick name, age, height, weight, body mass index, e-mail)
  - Weight management chart
  - Data of planning by yourself
  - Data of daily food record
- Contact us
  - E-mail sending function
- Games
  - Challenging
  - Beware of sugar my friend

Phase 2: Evaluating the effectiveness of the educational tool by the experts.

2.1 Validation of nutritional knowledge test and multimedia website nutrition education tool

Experts assessed the accuracy and precision based on the content evaluation of the knowledge test and the education tool. They determined the exact structure of the media teaching of nutrition and then the opinion of all experts would be determined consistency of assessments by measuring Index of concordance (IOC) by using techniques of Rovineli and Hambleton [221].

The formula $IOC = \frac{\sum R}{N}$

IOC is index of concordance

+1 point	Ensure that any question based on objective measurement
0 point	Not sure any question based on objective measurement
+1 point	Ensure that any question not based on objective measurement

R is total scores opinions of experts

N is number of experts

IOC questions that are directly available from 0.5-1.00

IOC questions that are lower than 0.5 must update and is not available

2.2 Evaluating performance of the nutrition education tool by the experts

Experts evaluated the performance of the educational tool using the evaluating questionnaire (appendix B) that modified from questionnaire by Adisak Jindanukul [222]. The questionnaire consisted of 9 items including content and presentation, image and language, design screen, management of lessons, model used

in web board, model used in the topic: Let's plan to reduce weight, model used in the personal's folder, games and model used in contact with research.

The questionnaire was designed in 5 scales as follows:

1-2 points	:	the tool was inappropriate
3-4 points	:	the tool should to be adjusted
5-6 points	:	the tool was fair
7-8 points	:	the tool was good
9-10 point	:	the tool was very good

Phase 3: Pilot study: Evaluating the effectiveness of the educational tool by ten subjects.

3.1 Reliability of nutritional knowledge test

After modifying the test which was guided by experts, the test was assessed by mean of Kuder-Richard method with the trial of 10 people.

The formula $$r_{tt} = \frac{K}{K-1}\left[1- \frac{\sum pq}{s^2_t}\right]$$

And $$s^2_t = \frac{n\sum x^2-(\sum x)^2}{n(n-1)}$$

r_{tt} = the reliability score of the knowledge test

p = the proportion of subjects choosing correct answer in each item.

q = the proportion of subjects choosing wrong answer in each item.(q=1-p)

s^2_t = the variance of the total score on this assessment

K = the number of items on the test.

x = Total correct score

n = the number of subjects

Evaluation criteria are as follows:

0.80-1.0	Very high reliability
0.60-0.79	High reliability
0.40-0.59	Medium reliability
0.20-0.39	Low reliability
0.01-0.19	Very low reliability

3.2 Evaluating performance of the nutrition education tool

After, improving the nutrition education tool which was guided by experts, the performance of tool was be evaluated by using efficiency criterion E_1/E_2.
Then the researcher would make the discussion of the problems and defects with learners to intervention with the subjects to improve the tool.

Evaluating the performance of media for nutritional teaching aims to determine the effectiveness of teaching materials that can be used for learning. If performance is rated as 80/80 means that the total scores of exercises in each lesson equal to 80% of the full score and post-test scores after learning equal to 80% of the full score. The standard criteria is set at equal or more than 80/80.

The formula 1 $E_1 = \dfrac{\frac{\sum X}{N}}{A} \times 100$

The formula 2 $E_2 = \dfrac{\frac{\sum F}{N}}{B} \times 100$

E_1 = Performance measurement in lessons present as percentage

$\sum X$ = Total score of the learner from doing exercise

A = Full scores of exercises

N = number of learners

E_2 = Performance measurement in post-test present as percentage

$\sum F$ = Total score of the learner from doing post-test

B = Full scores of post-test

Phase 4: Evaluating the effectiveness of the educational tool by study subjects from the selected bank

4.1 Sample size calculation and subject selection

4.1.1 Sample size

The sample size was calculated by using an equation for single proportion as a major outcome variable was pre-test and post-test scores.

$$n = \left[\frac{z_\alpha \sqrt{\pi_0(1-\pi_0)} - z_\beta \sqrt{\pi_1(1-\pi_1)}}{\pi_1 - \pi_0} \right]^2$$

This study assumed 25% improvement of the knowledge from baseline proportion. The previous study of Maiburg et al. [223] presented the baseline knowledge score of overweight and obesity before treatment, 0.254 (25.4%).

N = Number of subjects

Z_α = 5% error (1.96)

Z_β = 95% of detecting a true difference (- 1.28)

π_0 = Baseline knowledge score 0.08 (From previous study)

π_1 = Proportion after giving education tool 0.45
(25% improve)

$\pi_1 - \pi_0$ = Expect probability of knowledge improvement 0.25
(25% expected)

$$n = \left[\frac{0.8532 + 0.64}{0.25} \right]^2$$

$$= 36$$

Additional 10% of the calculated sample size was used to overcome drop outs. Therefore, the total number of studied sample was 40.

4.1.2 Study population

Forty overweight and obese subjects were recruited from selected bank, age between 20-60 years.

4.1.3 Inclusion criteria:

- Adult male or female, age 20 years and older.
- Body Mass Index (BMI) equal or more than 23 kg/m^2
- Ability to use computer and internet
- Willingness to participate in the study.

4.1.4 Exclusion criteria:

- The person has type 2 diabetes, chronic kidney disease or heart disease.
- Pregnant or lactating woman
- Unwilling to participate in the study.

4.2 Instruments used to get the baseline characteristics of the subjects

4.2.1 Instruments for collecting subject's nutritional status

- Weighting scale was used to measure the body weight.
- Measuring tape was used to measure waist circumference.
- Digital sphygmomanometer model: Kenz-BPM SP1 was used to measure blood pressure.
- Omron HPF-326 Karada Scan Body composition Monitor was used to measure body composition.

4.2.2 Instruments used to get the baseline characteristics of the subjects

Questionnaires were used to obtain the baseline characteristic of the subjects (appendix C). The questionnaire was modified from Mananya Praseardsup's questionnaire [224]. Questionnaires consisted of personal data, family history of overweight and obesity, subjects' opinions on weight, stage of change and 3-day dietary record.

4.2.3 Instrument used for analyzing behavior questionnaires of the subjects

Behavior of subjects were assessed using Behavior control questionnaire (appendix D) developed by Mananya Praseardsup [224] which consisted of two part, part one is dietary behavior questionnaire with 35 questions and part two is exercise behavior questionnaires with 20 questions.

Frequency of subject's behavior was assessed which included five levels

Never	Never doing for 3 months ago.
Rarely	Doing 1 time per week or less for 3 months ago.
Sometimes	Doing 2 times per week for 3 months ago.
Often	Doing 3 times per week or less for 3 months ago.
Usually	Doing 4 times per week or more for 3 months ago.

Positive behaviors that promote weight reduction, including changes in eating behavior with 13 questions (1, 6, 8, 9, 11, 12, 13, 14, 16, 25, 26, 29, 35) and behavior of exercise with 17 questions (1, 2, 3, 4, 5, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)

The scoring system was

Never	:	1 point
Rarely	:	2 points
Sometimes	:	3 points
Often	:	4 points
Usually	:	5 points

Negative behaviors that do not promote weight reduction, including changes in eating behavior with 22 questions (2, 3, 4, 5, 7, 10, 15, 17, 18, 19, 20, 21, 22, 23, 24, 27, 30, 31, 32, 33, 34, 35) and behavior of exercise with 3 questions (6, 7, 9)

The scoring system was

Never	:	5 points
Rarely	:	4 points
Sometimes	:	3 points

Often	:	2 points
Usually	:	1 point

4.2.4 Instrument used for analyzing the subject's knowledge of nutrition for weight loss

The pre-test and post-test questionnaires (appendix E) were used to assess the knowledge of subjects before and after providing the nutrition education at week 0 and week 7. The questionnaire was a multiple choice question which consisted of 20 questions.

The scoring system was

Right answer	:	1 point
Wrong answer	:	0 point
Total point	:	20 points

The scores were converted in terms of percentage and were classified into 3 levels as follows:

Low knowledge	:	< 50% correct
Medium knowledge	:	50-75% correct
High knowledge	:	> 75% correct

4.2.5 Instrument used for analyzing the subject's satisfaction with the developed educational tool

Subject's satisfaction questionnaire (appendix F) modified from questionnaire developed by Adisak Jindanukul [222] which consisted of 16 questions

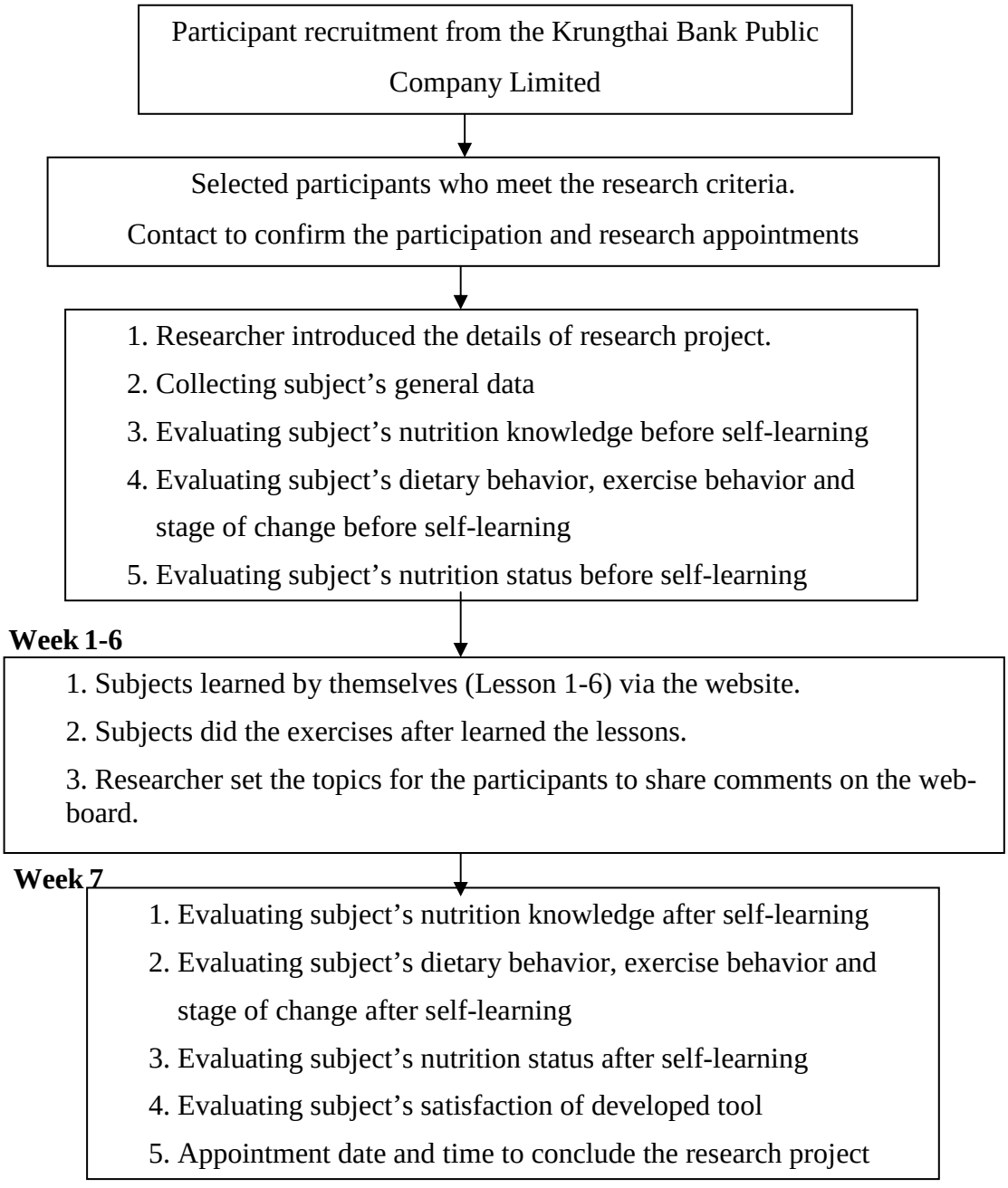
The questionnaire was designed in 5 scales as follows:

Strongly disagree	:	1 point
Disagree	:	2 points
Undecided	:	3 points
Agree	:	4 points
Strongly agree	:	5 points

4.3 Study design

After developing the multimedia website nutrition education tool (Phase1) and evaluating the effectiveness of the educational tool by the experts and ten subjects (Phase 2 and 3), the effectiveness of the educational tool was performed in subjects from the selected bank. The diagram as shown in Figure 4 presents the process of evaluation the effectiveness of the multimedia website nutrition education tool.

Figure 4 The diagram presents the process of evaluation the effectiveness of the multimedia website nutrition education tool by subjects from the selected bank.



4.3.1 Participant recruitment

Researcher announced and invited participants to participate in the research project by using poster. This process took about 1 month. When the recruitment completed, researcher contacted the participants to confirm the participation and research appointments.

4.3.2 The research appointments (First appointment)

The first appointment was attended at Krungthai Bank Public Company Limited. In the first meeting, the researcher introduced the details of research project, and explained how to do the 3-days food record. The participants were assessed their nutrition knowledge before self-learning. The questionnaires about general data, stage of change, dietary and exercise behavior were provided to each subject. This week, the researcher also collected anthropometric including weight, height, waist circumference, body composition, blood pressure and biochemical data.

Body Mass Index [34], the researcher collected the data to calculate body mass index (BMI) that would present the level of overweight and obesity. It is defined as the ratio of weight (kilogram) and the square of the height (meter). The evaluation criteria in the body mass index in term of the World Health was shown in Table 6

Waist circumference [34] is an index that indicated risk factors for chronic diseases and conditions associated with obesity. The evaluation criteria of waist circumference was shown in Table 7

Body composition [225-226]**,** Omron HBF-362 Karada Scan Body Composition Monitor was used to measure body fat percentage, visceral fat level, subcutaneous fat and skeletal muscle**.** A person steps onto the scale platform and grabs the hand display unit then inputs various personal information such as age, gender and height. Electrodes in the foot sensor pads and hand grips send a low, safe signal through the upper and lower body. Weight is calculated. This study monitored body fat percentage and visceral fat.

Body fat percentage located under the skin (subcutaneous), between the muscles (intramuscular) and around internal organs (visceral), this tissue serves to provide insulation against heat/cold, protective padding, energy and nutrient stores and proper functioning of hormonal and immune systems. Body Fat Percentage is a measure of the amount of body fat as a proportion of your total body weight. Excess

body fat is a risk factor for cardiovascular disease and can contribute to health conditions such as Diabetes, high blood pressure, sleep apnea and Osteoarthritis.

Visceral fat are the deep underlying fat stores located around the internal organs of the abdomen. Researchers at Johns Hopkins Medical Institutions found Visceral Fat to be likely to increase heart attack risk and may be a greater predictor of heart disease and diabetes than simple weight or body mass index (BMI). While paying attention to waist size is important, it is very difficult to measure the amount of visceral fat a person has with just a measuring tape and regular scale. Visceral Fat levels are relative and are not absolute values. The evaluation criteria of body fat percentage and visceral fat was shown in Table 8 and 9

Frame size [227], the researcher collected the data to calculate frame size which defined as the ratio of height (centimeter) and wrist circumference (centimeter). The evaluation criteria of frame size was shown in Table 10

Blood pressure (BP) [228] is a force exerted by circulating blood on the walls of blood vessels, and is one of the principal vital signs. During each heartbeat, BP varies between a maximum (systolic) and a minimum (diastolic) pressure. The mean BP, due to pumping by the heart and resistance in blood vessels, decreases as the circulating blood moves away from the heart through arteries. It decreases in the small arteries and arterioles, and continues to decrease as the blood moves through the capillaries and back to the heart through veins. The classification of blood pressure applied to adults aged 18 and older was presented in Table 11.

Biochemical Data [229-230] , the study focused on the biochemical data that associated obesity and chronic disease such as Fasting plasma glucose, Total cholesterol, Triglyceride, LDL-cholesterol and HDL-cholesterol. The base line biochemical data was collected from the annual health check of the participants. The normal criteria of biochemical data presents in Table 12.

Table 6 Classification of weight by BMI in age 20 years or more

Nutrition status	BMI (kg/m^2)
Under weight	< 18.5
Normal weight	18.5 - 22.9
Overweight	≥ 23
Risk of obesity	23 - 24.9
Obesity stage 1	25 - 29.9
Obesity stage 2	≥ 30

Source: World Health Organization The Asia-Pacific perspective Redefining Obesity and its treatment. February, 2000**.**

Table 7 Normal criteria of waist circumference in adult age 20 years or more

Sex	Normal criteria of waist circumference (cm.)
Male	≤ 90
Female	≤ 80

Source: World Health Organization The Asia-Pacific perspective Redefining Obesity and its treatment. February, 2000.

Table 8 Body fat percentage classification differs for men and women

Sex	Low	Normal	High	Very high
Male	5.0-9.9	10.0-19.9	20.0-24.9	25.0-50.0
Female	5.0-19.9	20.0-29.9	30.0-34.9	35.0-50.0

Table 9 Recommended visceral fat level for males and females

Sex	Normal	High
Males and Females	≤ 9	≥ 10

Source: The values for obesity judgment proposed by Mr. Lohman (1986) and Mr. Nagamine (1972).

Table 10 Frame size classification differs for males and females

Frame size	Males	Females
Small	> 10.4	> 11.0
Medium	9.6-10.4	10.1-11.0
Large	< 9.6	< 10.1

Source: Grant JP: Handbook of total parenteral nutrition, 1980.

Table 11 Classification of blood pressure applies to adults aged 18 and older

Classification	Blood Pressure (mmHg)	
	Systolic BP	**Diastolic BP**
Normal	< 120	< 80
Prehypertension	120-139	80-89
Stage 1 Hypertension	140-159	90-99
Stage 2 Hypertension	≥ 160	≥ 100

Source: Chobanian AV et al. and the National High Blood Pressure Education Program Coordinating Committee:The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure, JAMA 89: 2560, 2003.

Table 12 Normal criteria of biochemical data

Biochemical data	Normal criteria (mg/dl)
Fasting plasma glucose *	< 100
Total Cholesterol**	< 200
Triglyceride**	< 150
LDL Cholesterol**	< 130
HDL Cholesterol**	
Male	> 40
Female	> 50

Source: * American Diabetes Association: Diagnosis and classification of diabetes mellitus (Position Statement), Diabetes Care 30:S48, 2007.

** National Cholesterol Education Program, Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)

4.4.3 Self-learning via website (week 1–6)

The researcher informed username and password to participants via telephone. Participants received an assignment to learn 1 lesson a week and do assignments after learning the lesson. They could return to learn the same lessons and doing exercises as often as they needed. In addition, participants were asked to record their weight when access in website and record dietary intake at least twice times a week. The researcher would set interesting topics in web-board so that participants could exchange their ideas with other participants. They contracted the researcher through e-mail sending function in website. Learning through lessons and activities in each week was presented in Table 13-18.

Table 13 Objectives, Learning and Evaluation, week 1 (Lesson 1: Let's explore yourself)

Objective	Learning			Evaluation
	Contents	**Methods**	**Apply Theory**	
1. To realize the severity of obesity and risk of chronic diseases.	- Definition and causes of obesity - Chronic diseases relate to obesity and normal criteria of fasting plasma glucose, blood pressure and lipid profile.	- Flash animation - VDO presentation "3 diseases that have high risk due to obesity"	- Health Belief Model	- Exercise (7 points) - Evaluating knowledge as percentage and average.
2. To access the level of obesity by themselves.	- Definition and BMI Calculation - Table present the level of obesity	- Flash animation		
3. To exchange their ideas with other participants and realize the severity of obesity and risk of chronic diseases.	- Discuss in the topic "How do you feel your weight affects your health?"	- Setting topic for the participants to exchange their ideas		

Table 14 Objectives, Learning and Evaluation, week 2 (Lesson 2: Let's learn food exchange)

Objective	Learning	
	Contents	**Methods**
1. To learn food exchange list.	- Food exchange includes starches, vegetables, fruits, meat and fat	- VDO presentation “Let's learn food exchange”
2. To plan weight loss diet by themselves on meal planning program in the website.	- Meal planning program: planning by yourself	- Meal planning steps: 1. Adding food data in the program to calculate energy and nutrient intake a day. 2. Selecting target of reducing weight. 3. Selecting model with “planning by your self”. 4. Adding food data in the program to plan personal weight loss diet. 5. Saving data of the personal planning.
3. To plan weight loss diet with pattern on meal planning program in the website.	- Meal planning program: planning with pattern (1,000-2,000 kcal)	- Meal planning steps: 1. Adding food data in the program to calculate energy and nutrient intake a day. 2. Selecting target of reducing weight. 3. Selecting model with “planning with pattern”. 4. Selecting model with drinking milk or not drinking milk.

Table 15 Objectives, Learning and Evaluation, week 3 (Lesson 3: How to eat low fat, low calorie diets)

Objective	Learning		Evaluation
	Contents	**Methods**	
1. To select low fat, low calorie diets from six food groups.	- How to select low fat and low calorie diet in six food groups including starches, vegetables, fruits, milk and daily product, meat, and fat	- Flash animation	- Exercise (7 points) - Evaluating knowledge as percentage and average.
2. To learn low fat cooking tips.	- How to cooking with less oil	- Flash animation	
3. To exchange their ideas with other participants.	- Discuss in the topic "How do you control yourself to eat as energy goal?"	- Setting topic for the participants to exchange their ideas	

Table 16 Objectives, Learning and Evaluation, week 4 (Lesson 4: How to choose food outside home)

Objective	Learning		Evaluation
	Contents	**Methods**	
1. To learn food label.	- How to select low fat and low calorie diet in six food groups including starches, vegetables, fruits, milk and daily product, meat, and fat	- Flash animation	- Exercise (7 points) - Evaluating knowledge as percentage and average.
2. To learn calories in one-plate dishes.	- How to select low calorie diet in one-plate dishes	- Flash animation	
3. To learn calories in other food.	- Showing calorie in other food including bakeries, milk and daily product, ice-cream and beverages.	- Flash animation	
4. To exchange their ideas with other participants.	- Discuss in the topic “How much sugar in your favorite beverages?”	- Setting topic for the participants to exchange their ideas	

Table 17 Objectives, Learning and Evaluation, week 5 (Lesson 5: Benefits of regularly exercise)

Objective	Learning		Evaluation
	Contents	**Methods**	
1. To encourage the participants to exercise regularly.	- Benefits of regularly exercise. - Overcoming barriers to exercise - Calorie burn calculator	- Flash animation	-
2. To exchange their ideas with other participants.	- Discuss in the topic “How to increase your daily physical activity?”	- Setting topic for the participants to exchange their ideas	

Table 18 Objectives, Learning and Evaluation, week 6 (Lesson 6: Let's exercise)

Objective	Learning		Evaluation
	Contents	**Methods**	
1. To encourage the participants to exercise regularly.	- Advice on exercise - Aerobic exercise - A sample walking and jogging program	- Flash animation	- Exercise (7 points) - Evaluating knowledge as percentage and average
2. To exchange their ideas with other participants.	- Discuss in the topic “Sending the word to your friends to help motivate exercise”	- Setting topic for the participants to exchange their ideas	

4.4.4 After self-learning via website (week 7)

The participants were assessed their knowledge after self-learning and the same questionnaires including stage of change, dietary and exercise behavior were provided to each subject. In addition, the 3-days dietary record of each subject was performed at week 7. The researcher also collected anthropometric measurement data and biochemical data after self-learning.

4.5 Data analysis

All data were analyzed by using the Statistic Package for the Social Sciences/Personal computer (SPSS/PC) for window 16.0 and a difference of $p<0.05$ was considered to be a significant:

1. The personal information was determined as percentage, mean and standard deviation.
2. The score of the subject's knowledge, dietary and exercise behavior and stage of change were evaluated by paired t-test.
3. The anthropometric, biochemical data, body fat percentage, visceral fat and dietary intake were evaluated by paired t-test.
4. Relationship between weight reduction and frequency access the website and food record were evaluated by Chi-square.
5. Relationship between reasons to reduce weight and weight change were evaluated by Chi-square.
6. Correlation between total cholesterol, triglyceride, HDL-C, systolic blood pressure and weight reduction were evaluated by Pearson Correlation.
7. Correlation between age, frame size, dietary behavior score and exercise behavior score and weight change.

CHAPTER V
RESULTS

The study was conducted to develop a multimedia website nutrition education tool based on concept of NHLBI Recommendation and health believe model.

The study was divided into four phases. Phase one was the development of a multimedia website nutrition educational tool. Phase two, three and four were evaluating the effectiveness of the educational tool by experts, ten subjects and subjects from selected bank, respectively.

Phase 1: Development of the multimedia website nutrition education tool

The educational tool was developed as multimedia website by multi-programs for example EditPlus Text Editor, Adobe Flash CS4 and Adobe illustrator CS4. The website's name fitbymyself.com and was composed of 16 main page including home page, six lessons for weight management, exercises, web board, meal plan, calorie burn calculator, weight and food record, weight loss diet menu, personal's folder, contact us and games. The Internet program included a width of 1280 pixels and a length of 800 pixels. The text fonts were Tahoma and Microsoft Sans Serif. The sizing of text was mainly in 16 normal texts and bold in heading. Website contents was shown in Figure 5-15

Figure 5 Registration to log-in and log-out system

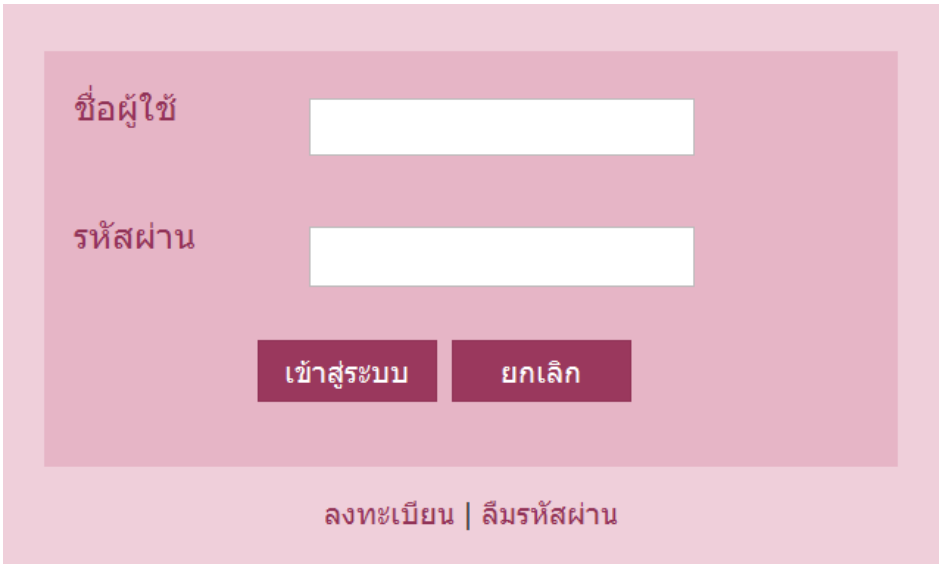


Figure 6 Home page of the website (www.fitbymyself.com)

Figure 7 Lesson 1: Let's explore yourself

Figure 8 Lesson 2: Let's learn food exchange

Figure 9 Lesson 3: How to eat low fat and low calorie diets

Figure 10 Lesson 4: How to choose food out side home

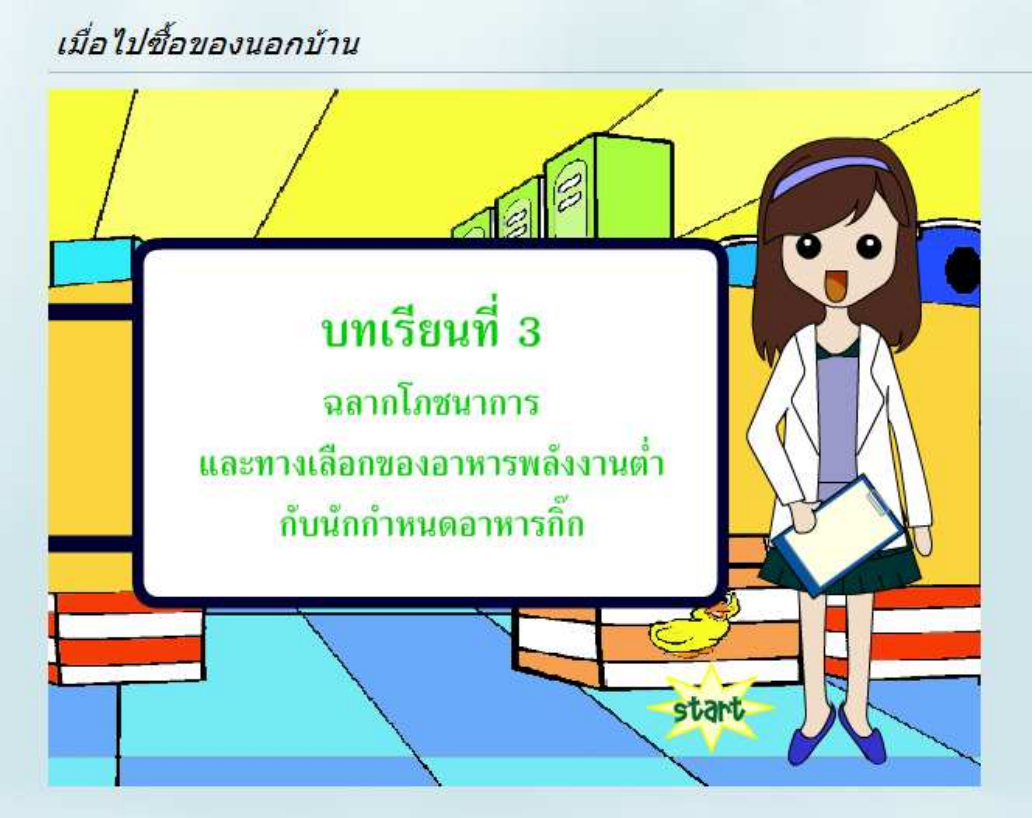


Figure 11 Lesson 5: Benefits of regularly exercise

Figure 12 Lesson 6: Let's exercise

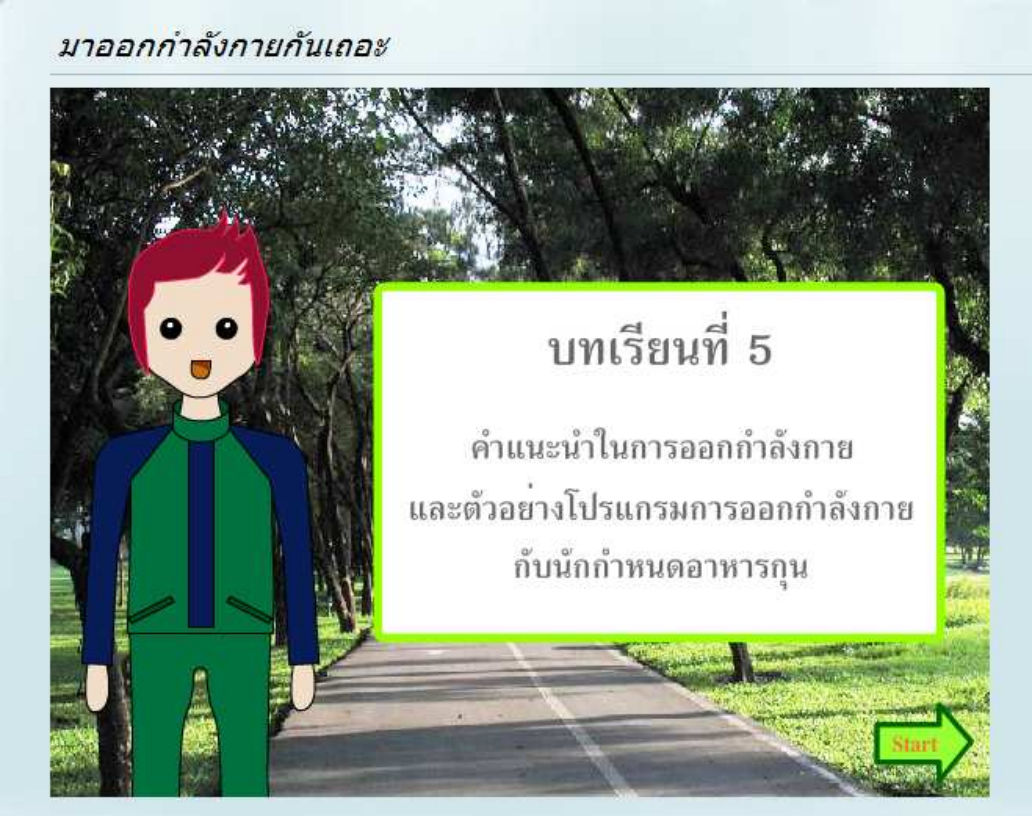


Figure 13 Games

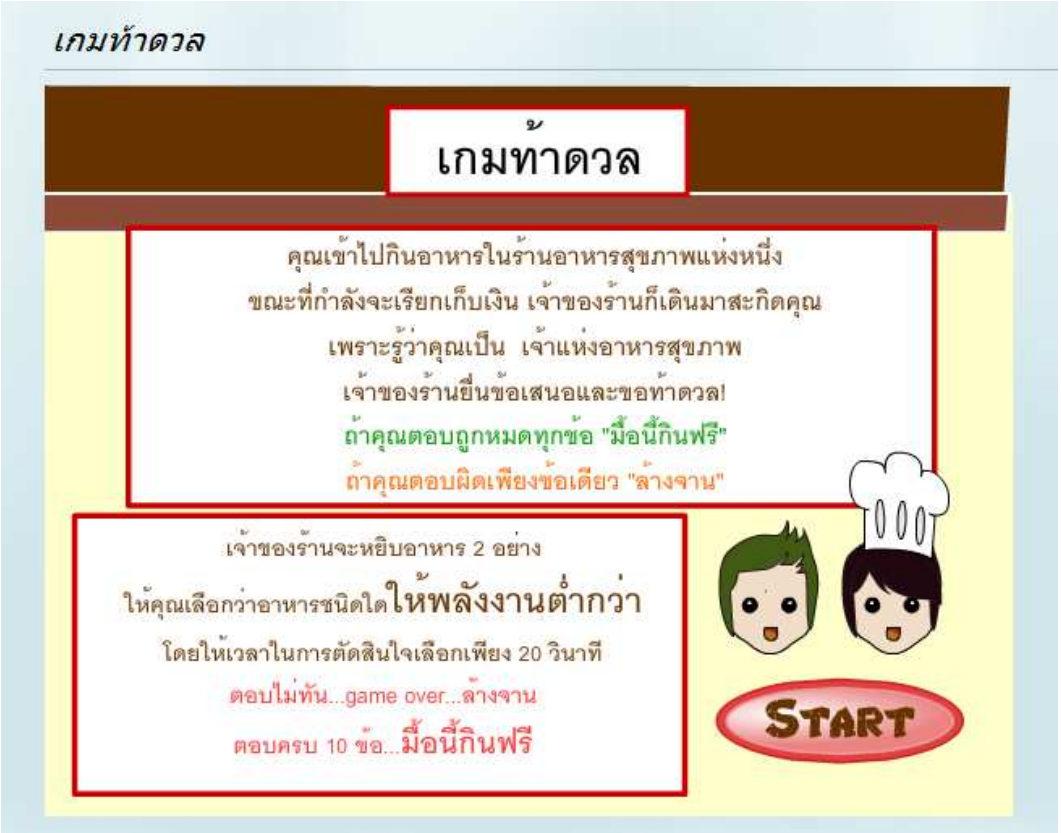
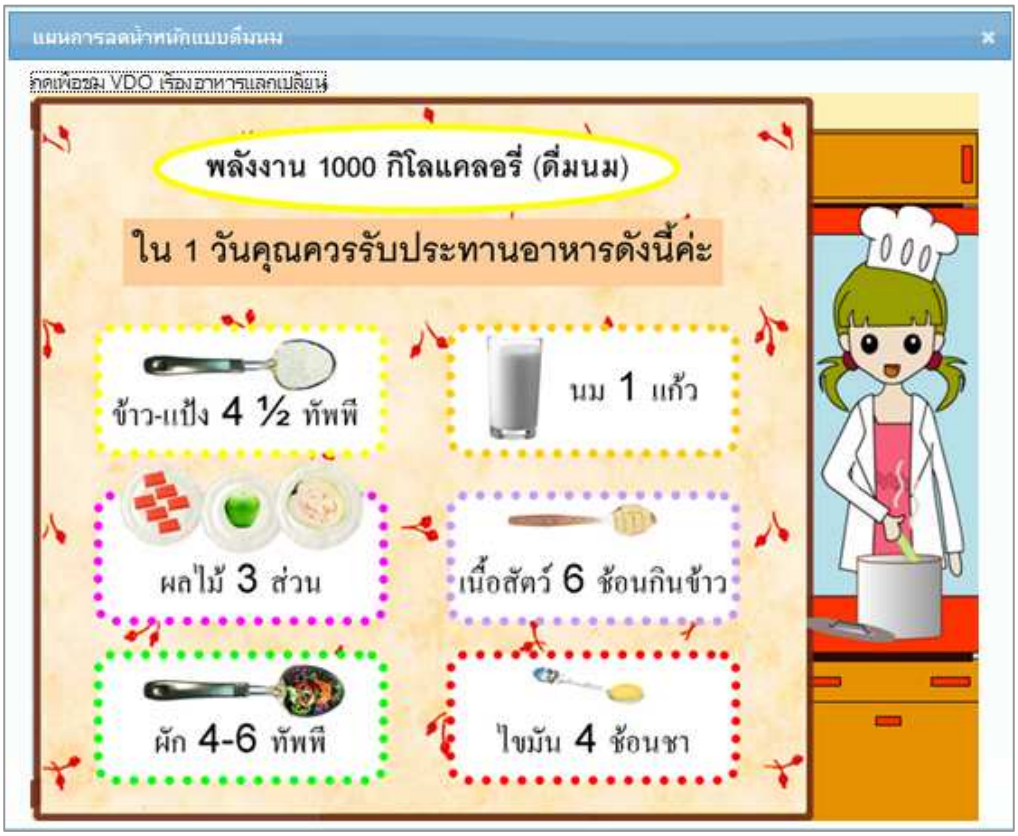


Figure 14 Meal planning program: Planning with pattern


แผนการลดน้ำหนักแบบดื่มนม
กดเพื่อชม VDO เรื่องอาหารแลกเปลี่ยน
พลังงาน 1000 กิโลแคลอรี่ (ดื่มนม)
ใน 1 วันคุณควรรับประทานอาหารดังนี้ค่ะ
ข้าว-แป้ง 4 ½ ทัพพี
นม 1 แก้ว
ผลไม้ 3 ส่วน
เนื้อสัตว์ 6 ช้อนกินข้าว
ผัก 4-6 ทัพพี
ไขมัน 4 ช้อนชา

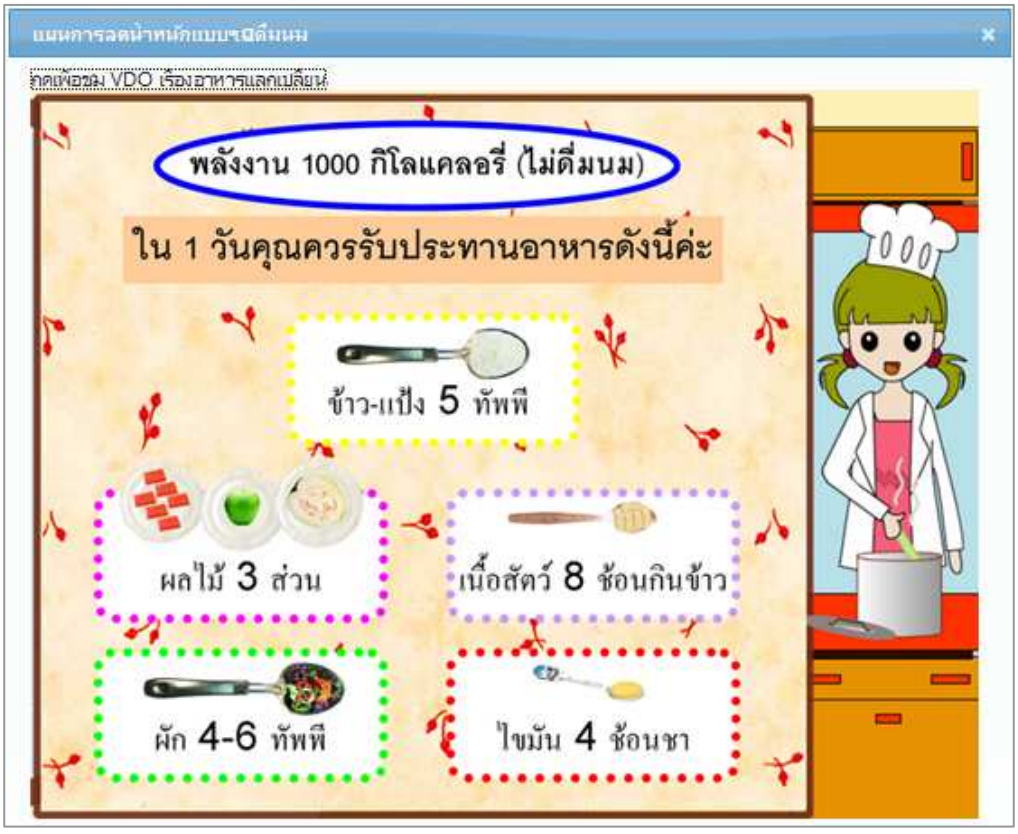

แผนการลดน้ำหนักแบบไม่ดื่มนม
กดเพื่อชม VDO เรื่องอาหารแลกเปลี่ยน
พลังงาน 1000 กิโลแคลอรี่ (ไม่ดื่มนม)
ใน 1 วันคุณควรรับประทานอาหารดังนี้ค่ะ
ข้าว-แป้ง 5 ทัพพี
ผลไม้ 3 ส่วน
เนื้อสัตว์ 8 ช้อนกินข้าว
ผัก 4-6 ทัพพี
ไขมัน 4 ช้อนชา

Figure 15 Meal planning program: Planning by yourself

3. เลือกรูปแบบการวางแผนลดน้ำหนัก

วางแผนแบบกำหนดเอง | วางแผนแบบกำหนดให้

วางแผนการรับประทานอาหาร ใน 1วัน เพื่อการลดน้ำหนัก

ค้นหาชื่ออาหารที่คุณรับประทาน ข้าว

กดเลือกมื้ออาหารและใส่ปริมาณอาหารที่รับประทาน

☑ ข้าวสวย (ข้าวขาว) (1 ทัพพี = 73.15 KCal)

พลังงานเป้าหมาย
= 1,000 กิโลแคลอรี่
พลังงานจากแผน
= 292.6 กิโลแคลอรี่
ขาด
= -707.4 กิโลแคลอรี่

เพิ่มรายการอาหารจนครบทุกมื้อใน 1 วัน และกดเพื่อคำนวณพลังงาน

รายการอาหาร	ปริมาณ	หน่วยอาหาร	พลังงาน	ลบ
มื้อเช้า ข้าวสวย (ข้าวขาว)	2	ทัพพี	146.3 KCal	☒
อาหารว่างเช้า				
มื้อกลางวัน ข้าวสวย (ข้าวขาว)	2	ทัพพี	146.3 KCal	☒
อาหารว่างบ่าย				
มื้อเย็น				
ก่อนนอน				

พลังงานที่ได้รับจากรายการอาหาร = 292.6 กิโลแคลอรี่

สารอาหาร		
สารอาหาร	ปริมาณที่เหมาะสม	ปริมาณที่ได้จากอาหารของคุณ
คาร์โบไฮเดรต	55%	91%
โปรตีน	15%	6.9%
ไขมัน	< 30%	2.1%
คลอเลสเตอรอล	< 300 มิลลิกรัม	0 มิลลิกรัม
โซเดียม	< 2400 มิลลิกรัม	74.8 มิลลิกรัม
ใยอาหาร	20-30 กรัม	0.4 กรัม
แคลเซี่ยม	1000-1500 มิลลิกรัม	13.2 มิลลิกรัม

● = น้อยเกินไป ● = เหมาะสม ● = มากเกินไป

Phase 2: Evaluating the effectiveness of the educational tool by the experts

2.1 Nutritional knowledge test

The experts assessed the validity of a knowledge test by means of IOC (Index of concordance), the result found that opinion of expert-level average scores in each question is 0.5-1.0. The scores showed that the queries test is directly applicable.

2.2 Multimedia website nutrition education tool

Experts evaluated the performance of the educational tool as good to very good level. The result was shown in the Table 19.

Table 19 Evaluating the performance of the educational tool

	Scores Mean ± SD	**Minimum scores**	**Maximum score**
1. The content and presentation	8.40 ± 1.07	7	10
2. The image and language	8.67 ± 1.03	8	10
3. The design screen	9.00 ± 0.33	8	10
4. The management of Lessons	7.25 ± 0.50	7	8
5. Model used in web board	7.50 ± 0.71	7	8
6. Model used in the topic "Let's plan to reduce weight"	8.50 ± 0.53	8	9
7. Model used in the personal's folder	8.25 ± 0.46	8	9
8. Games	8.50 ± 0.70	8	9
9. Contact with researcher	8.00 ± 0.00	8	8

Data are presented as mean ± SD, min, max

Meaning of scores; 1-2 points = Inappropriate, 3-4 points= Must improve,

5-6 points = Fair, 7-8 points = Good, 9-10 points = Very Good

Phase 3: Pilot study: Evaluating the effectiveness of the educational tool by ten subjects.

3.1 Nutritional knowledge test

The result presented the evaluating reliability of the knowledge test via total score of knowledge test, the proportion of subjects choosing correct answer and wrong answer in each item after learning via the website (Table 20). The calculation on reliability was shown in the following.

Table 20 Total score of knowledge test, the proportion of subjects choosing correct and wrong answer in each item after learning via the website

S / I	1	2	3	4	5	6	7	8	9	10	Total	p	q	pq
1	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
2	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
3	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
4	1	1	0	0	0	0	1	1	1	0	5	0.5	0.5	0.25
5	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
6	1	1	0	0	1	1	1	1	1	1	8	0.8	0.2	0.16
7	0	0	0	0	0	1	0	0	1	1	3	0.3	0.7	0.21
8	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
9	0	1	1	1	1	1	1	1	1	1	9	0.9	0.1	0.09
10	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
11	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
12	0	0	0	1	0	1	1	1	0	1	5	0.5	0.5	0.25
13	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
14	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
15	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
16	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
17	1	1	1	1	1	1	1	1	1	1	10	1.0	0.0	0.00
18	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
19	0	0	1	1	1	1	1	1	1	1	8	0.8	0.2	0.16
20	1	1	0	0	0	0	1	1	1	1	6	0.6	0.4	0.24
X	11	12	15	16	16	18	19	19	19	19	164			
X^2	121	144	225	256	256	324	361	361	361	361	2770			

TS= Subject, I= Item of knowledge test

The calculation on reliability score of the knowledge test can present below.

Kuder-Richardson Formula $r_{tt} = \frac{K}{K-1}\left[1- \frac{\sum pq}{s^2_t}\right]$

And $s^2_t = \frac{n\sum x^2-(\sum x)^2}{n(n-1)}$

r_{tt} = the reliability score of the knowledge test

p = the proportion of subjects choosing correct answer in each item.

q = the proportion of subjects choosing wrong answer in each item.(q=1-p)

s^2_t = the variance of the total score on this assessment

K = the number of items on the test.

x = Total score of knowledge test

n = the number of total subjects

Calculation; $s^2_t = \frac{n\sum x^2-(\sum x)^2}{n(n-1)}$

$= \frac{(10x2770)-(164)^2}{10(10-1)}$

$= 8.93$

Calculation; $r_{tt} = \frac{K}{K-1}\left[1- \frac{\sum pq}{s^2_t}\right]$

$= 1.0526 \times 0.7760$

$= 0.82$

Evaluation criteria are as follows:

0.80-1.0	Very high reliability
0.60-0.79	High reliability
0.40-0.59	Medium reliability
0.20-0.39	Low reliability
0.01-0.19	Very low reliability

Therefore, the reliability score of the knowledge test was 0.82 that was very high reliability

3.2. Multimedia website nutrition education tool

3.2.1 Evaluating performance of the nutrition education tool by using efficiency criterion E_1/E_2.

The result presented the performance of the nutrition education tool via the score of 4 exercise, total score of exercise and total score of knowledge test after learning via lesson in the website (Table 21) and the calculation on the performance was shown in the following.

Table 21 The score of 4 assignment, total score of assignment and total score of knowledge test after learning via lesson in the website

Subject	Assignment 1	Assignment 2	Assignment 3	Assignment 4	Total score of Assignment (28)	Total score of knowledge test (20)
1	5	6	7	6	24	11
2	5	4	6	7	22	12
3	5	4	5	6	20	15
4	6	5	6	6	23	16
5	6	5	6	6	23	16
6	5	5	6	6	22	18
7	5	6	6	7	24	19
8	5	5	6	6	22	19
9	4	6	5	7	22	19
10	6	6	6	7	25	19
					$\sum X = 227$	$\sum F = 164$

The calculation on the performance of the knowledge test can present below.

$$E_1 = \frac{\frac{\sum X}{N}}{A} \times 100$$

$$E_2 = \frac{\frac{\sum F}{N}}{B} \times 100$$

E_1= Performance measurement in lessons present as percentage

$\sum X$ = Total score of the learner from doing exercise

A= Full scores of exercises

N= number of learners

E_2= Performance measurement in post-test present as percentage

$\sum F$ = Total score of the learner from doing post-test

B= Full scores of post-test

Calculation;

$$E_1 = \frac{\frac{\sum X}{N}}{A} \times 100$$

$$= \frac{\frac{227}{10}}{28} \times 100$$

$$= 81.07$$

Calculation;

$$E_2 = \frac{\frac{\sum F}{N}}{B} \times 100$$

$$= \frac{\frac{164}{10}}{20} \times 100$$

$$= 82.00$$

Therefore, the nutrition education tool met the excellent level of the efficiency at E1/E2 equal 81.07/82.00 which was higher than criteria standard (E1/E2 equal 80/80). Then, media of teaching should be used for efficiency learning into assumption.

3.2.2 Evaluating subjects overall satisfaction of the developed education tool.

The results of ten subject's response are given in Table 22. The mean scores of ten subject's satisfaction responses given on the developed education tool were more than 4 and less than 5 which indicated that participates satisfaction level with the developed educational tool were somewhere between "Agree" to "Strongly agree".

Table 22 Mean scores of ten subject's satisfaction of the developed education tool

Questions	Scores Mean ± SD	Minimum scores	Maximum score
1. Learning through the website make you More interested in lessons.	4.10 ± 0.74	3	5
2. You have fun learning lessons.	4.30 ± 0.48	4	5
3. The lessons are easy to understand.	4.30 ± 0.48	4	5
4. The lessons are more colorful and attractive.	4.30 ± 0.67	3	5
5. The website appropriate for self-study.	4.40 ± 0.52	4	5
6. The lesson making you eager to learn more.	4.10 ± 0.57	3	5
7. Learning in this way allows you to understand lessons faster.	4.20 ± 0.42	4	5
8. Lessons give you more knowledge.	4.40 ± 0.52	4	5
9. You can control your own learning.	4.10 ± 0.32	4	5
10. You take part in activity on the website	4.10 ± 0.56	3	5
11. You can plan your diet to reduce weight.	4.00 ± 0.47	3	5
12. You have more positive attitude to exercise.	4.10 ± 0.74	3	5
13. You can plan your own exercise.	4.10 ± 0.58	3	5
14 You want this website to be released to the public.	4.60 ± 0.52	4	5
15. This study should be developed for other disease.	4.50 ± 0.53	4	5
16. This lesson is the need for current and future generations.	4.10 ± 0.32	4	5

Data are presented as mean ± SD, min, max

Meaning of scores; 1 point = Strongly disagree, 2 points= Disagree,

3 points = Undecided, 4 points = Agree, 5 points = Strongly agree

Phase 4: Evaluating the effectiveness of the educational tool by study subjects from the selected bank

4.1 Baseline data of the study subjects

4.1.1 Sample selection

The Phase 4 of the study was conducted at Krungthai Bank Public Company Limited. Initially 44 subjects were recruited for the study but only 39 completed the study. Two participants (4.55 %) dropped out of the study at week 2 because the lack of time while 3 participants (6.82%) didn't enter to the website and do assignments. No significant information was obtained from them. Therefore, only the data from remaining 39 participants were used to obtain the results.

4.1.2 Demographic characteristics

The demographic characteristics of the participants are given in Table 23. The total participants who took part in the study, 4 participants (10.3%) were male and 35 participants (89.7%) were female. The participants had a mean age of 42.67 ± 10.36 years. 18.0 % of the participants belonged to the age of 20- 30 and 15.4% of subjects aged between 31-40 age groups. 33.3% of the participants were aged between 41– 50 age groups and 33.3 % belonged to the 51–60 age groups. 53.8% of the participants were single and all of the participants were Buddhist. 92.3% of the participants had an education level of at least a Bachelor's degree while 13 % of the participants had the high school level education. 33.3% of the participants have average income more than 60,000 Bath/month. 74% of the participants were healthy while 25.6% had a chronic disease such as Hypertension, Dyslipidemia, Pre-diabetes, Gastritis and Allergy. Moreover, more than 50% of the participants had family history of chronic disease such as Type 2 Diabetes Mellitus (77.3%), Hypertension (36.4%), Heart disease (18.2%), Hyperdyslipidemia (13.6%) and others (31.8%). More than 80% of the participants, at least one person in family was overweight or obesity.

Table 23 Demographic characteristics

Characteristic	No. of subjects (n=39)	Percentage (%)
Gender		
Male	4	10.3
Female	35	89.7
Age Group (years)		
20-30	7	18.0
31-40	6	15.4
41-50	13	33.3
51-60	13	33.3
Mean= 42.67; SD= 10.36; Min= 22; Max= 57		
Status		
Single	21	53.8
Married	18	46.2
Religion		
Buddhism	32	100
Education Level		
High school or less	3	7.7
Bachelor's degree	21	53.8
Higher than Bachelor's degree	15	38.5
Average income per month (Bath)		
10,001-20,000	3	7.7
20,001-30,000	7	17.9
31,001-40,000	9	23.1
40,001-50,000	4	10.3
50,001-60,000	3	7.7
> 60,001	13	33.3

Data are presented in the number and the percentage (%).

Table 23 Demographic characteristics (continue)

Characteristic	No. of subjects (n=39)	Percentage (%)
Subject's chronic disease		
Do not have	29	74.4
Have at least one disease	10	25.6
Family history of chronic disease		
Do not have	17	43.6
Have at least one disease	22	56.4
22 subject (56.4%) who have family history of chronic disease		
Type 2 Diabetes Mellitus	17	77.3
Hypertension	8	36.4
Heart disease	4	18.2
Dyslipidemia	3	13.6
Others	7	31.8
Family history of overweight and obesity		
Do not have	4	10.3
Have at least one person in family (father, mother, sister or bother)	35	89.7

Data are presented in the number and the percentage (%).

4.1.3 Weight history and opinion on weight status

The weight history and opinion of the participants on their weight status are shown in Table 24. Fifteen participants (38.5%) correctly assessed the level of obesity, while 24 participants (61%) assessed the level of obesity incorrectly, 43.6% assessed higher than the actual status (all of them were female), whereas 17.9% assessed lower than the actual one (1 male and 6 females). More than 70% of the participants used to be teased about their weight. When asking subjects about their purposes to lose weight, there were many reasons to lose weight. It was about 94.9% of the participants wanted to be healthy, 79.5% would like to have a good shape,

64.1% wanted to move actively, 69.2% thought that it is convenient easy to buy clothes, 41.0% would like to have an attractive personality and 20.5% did not want to be teased. Moreover, twenty-three participants (59%) used to lose weight and more than 70% were successful.

Table 24 Weight history and opinion on weight status

Characteristic	No. of subjects	Percentage (%)
Evaluate their own obesity level		
Correct	15	38.5
Under estimate	7	17.9
Over estimate	17	43.6
Used to be teased about their weight		
Yes	30	76.9
No	9	23.1
Reasons to reduce weight		
To be healthy	37	94.9
To have a good shape	31	79.5
To move actively	25	64.1
To have an attractive personality	16	41.0
To be convenient buying for clothes	27	69.2
Do not want to be teased	8	20.5
Use to lose weight		
Yes (Successful weight loss 73.9%)	23	59.0
No	16	41.0

Data are presented in the number and the percentage (%)

4.2 The baseline nutritional status

The baseline nutritional status of the subjects included anthropometric data, dietary intake, biochemical data and blood pressure.

4.2.1 Anthropometric data

The baseline anthropometric data of subjects presents in Table 25. Mean weight of female was 65.41 ± 5.95 and it was 66.51 ± 6.58 kg in male. The result showed that male had an average weight higher than female.

Mean frame size of female was 10.40±0.46 and it was 10.45 ± 0.29 in male. Most of female (71.4%) had small size and 17.9% had large size whereas 50% of male has small size and medium size.

For the Body Mass Index, Mean score BMI of female was 26.17 ± 2.30 and it was 26.55 ± 1.46 in male. Moreover, 15 participants (38.5%) were overweight while 24 participants (61.5%) were obese. For female, 38.5% of them were overweight and 61.5% were obese whereas all of male were obese. The result showed that both female and male had the mean score of BMI higher than normal and male (100%) had proportion of obesity than female (57.3%).

When considering about waist circumference, the result showed that mean waist circumference of female was 85.76 ± 6.00 cm. and it was 92.73 ± 4.75 cm. in male. Moreover, most female (77.1%) and male (75.0%) had the mean score of waist circumference higher than normal.

Regarding to the visceral fat level, the result showed that male had mean score of visceral fat level (11.00 ± 1.15) was higher than normal criteria while female (8.14 ± 3.16) was in normal criteria. Moreover, when classified visceral fat level the result showed that 65.7% of female was in normal criteria, 28.6% were in high level and 5.7% were in very high level whereas 100% of male were in high level.

For the body fat percentage, mean score was higher in female (34.95 ± 3.27) than male (25.43 ± 1.86) and when classified body fat percentage level founding that 2.8% of the participants were in normal criteria, 41% were in high level and 56.4 % were in very high level. Most of female and male were in very high level (54.3% and 75.0%, respectively) and some of them were in high level (42.9% and 25.0%, respectively). But, only one female was in normal criteria (2.8%).

Table 25 Baseline anthropometric data of the subjects

Anthropometric Data	Total (39) n (%)	Female (35) n (%)	Male (4) n (%)	Normal criteria
Weight (kg)	66.51 ± 6.58	65.41 ± 5.95	76.15 ± 2.94	-
Height (cm)	159.28 ± 5.20	158.11 ± 3.86	169.50 ± 4.36	-
Frame size				
Mean	10.41±0.44	10.40±0.46	10.45±0.29	
Small Female: >11.0	5 (12.8%)	3 (8.6%)	-	
Male: >10.4		-	2 (50%)	
Medium Female: 10.1-11.0	27 (69.2%)	25 (71.4)	-	
Male: 9.6-10.4		-	2 (50%)	
Large Female: <10.1	7 (17.9%)	7 (17.9%)	-	
Male: <9.6		-	0 (0%)	
BMI (kg/m^2)				
Mean	26.21 ± 2.22	26.17 ± 2.30	26.55 ± 1.46	18.5-22.9kg/m^2 *
Overweight	15 (38.5%)	15 (38.5%)	0 (0%)	
Obesity	24 (61.5%)	20 (51.3%)	4 (100%)	
Waist circumference (cm)				<80cm.(F)*
Mean	86.47 ± 6.21	85.76 ± 6.00	92.73 ± 4.75	<90cm.(M)*
Normal	9 (23.1%)	8 (22.9%)	1 (25.0%)	
High	30 (85.7%)	27 (77.1%)	3 (75.0%)	
Visceral fat level				1-9 **
Mean	8.44 ± 3.14	8.14 ± 3.16	11.00 ± 1.15	
Normal (1-9)	23 (65.7%)	23 (65.7%)	0 (0%)	
High (10-14)	14 (35.9%)	10 (28.6%)	4 (100%)	
Very high (15-30)	2 (5.7%)	2 (5.7%)	0 (0%)	
Body fat				20.0-29.9 (F) **
Percentage (%)				10.0-19.9 (M) **
Mean	33.98 ± 4.29	34.95 ± 3.27	25.43 ± 1.86	
Normal				
Female: 20.0-29.9	1 (2.8%)	1 (2.8%)	-	
Male: 10.0-19.9		-	0 (0%)	
High				
Female: 30.0-34.9	16 (41.0%)	15 (42.9%)	-	
Male: 20.0-24.9		-	1 (25.0%)	
Very high				
Female: 35.0-50.0	22 (56.4 %)	19 (54.3%)	-	
Male: 25.0-50.0		-	3 (75.0%)	

Data are presented as mean ± SD

* Reference from World Health Organization The Asia-Pacific perspective Redefining Obesity and its treatment. February, 2000 [34].

** Reference from The values for obesity judgment proposed by Mr. Lohman (1986) and Mr. Nagamine, 1972 [20].

4.4.2 Dietary intake

The baseline dietary intakes of the subjects were presented in Table 26. Mean of energy intake was 1,900.1 ± 553.31 kcal/day with energy of 1,904 kcal/day in female and 1,865 kcal/day in male. The percentage of caloric distribution from carbohydrate: protein: fat were 55.43 ± 11.07: 11.22 ± 5.89: 30.75 ± 8.27 which presented moderate protein and but high percentage of fat intake. Cholesterol and sodium intake were in the normal criteria but dietary fiber and calcium intake were lower than the criteria.

Table 26 Baseline dietary intake of the subjects

Dietary intake	Total (n=39)	Female (n=35)	Male (n=4)	Healthy Food intake criteria*
Energy (kcal/day)	1,900.1 ± 553.31	1,904.0 ± 578.14	1,865.9 ± 296.84	-
Carbohydrate				
(kcal/day)	1,061.5 ± 413.38	1,053.8 ± 429.75	1,129.2 ± 254.08	-
(% kcal)	55.43 ± 11.07	54.85 ± 11.22	60.59 ± 9.26	55%
Protein				
(kcal/day)	214.72 ± 134.00	219.15 ± 133.80	175.96 ± 149.43	-
(% kcal)	11.22 ± 5.89	11.43 ± 5.71	9.43 ± 8.09	15%
Fat				
(kcal/day)	574.97 ± 212.00	581.07 ± 222.07	521.57 ± 78.50	-
(% kcal)	30.75 ± 8.27	31.03 ± 8.61	28.23 ± 3.92	< 30%
Cholesterol (mg)	211.82 ± 195.64	214.09 ± 194.85	191.97 ± 232.30	< 300
Sodium (mg/day)	1,671.9 1606.46	1,772.7 ± 1644.10	789.64 ± 947.51	< 2,400
Dietary fiber (g/day)	10.92 ± 10.75	11.38 ± 11.20	6.90 ± 4.01	20-30
Calcium (mg/day)	351.05 ± 310.03	355.45 ± 306.32	312.49 ± 389.72	1000-1500

Data are presented as mean ± SD

* Reference from National Institutes of Health, National Heart, Lung, and Blood Institute: The Practical Guide Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 2002 [37].

4.4.3 Biochemical data and blood pressure

The mean base line of fasting plasma glucose level (91.26 ± 12.10) was in the normal criteria but six participants (17.1%) had fasting plasma glucose level higher than the normal criteria.

The mean of total cholesterol (200.05± 33.07), triglyceride (121.44 ± 60.75) and LDL cholesterol level (124.95 ± 29.29) were also in the normal criteria but some participants had total cholesterol (48.7%), triglyceride (28.2%) and LDL cholesterol level (35.8%) higher than the normal criteria. For HDL-cholesterol level, female had mean HDL-cholesterol level (50.66 ± 11.03) higher than male (46.50± 11.09). Most female had HDL-cholesterol level (82.9%) in the normal criteria but most male had low level (75.0%)

Regarding to blood pressure, mean diastolic blood pressure (73.33 ± 9.61) was in the normal criteria but systolic blood pressure (125.23 ± 15.35) was higher than the normal criteria. However, 20.5% of participants had diastolic blood pressure higher than the normal criteria. The baseline biochemical data of the participants are shown in Table 27.

Table 27 Baseline biochemical and blood pressure data of the subjects

Variable	Total (39) n (%)	Female (35) n (%)	Male (4) n (%)	Normal criteria
Fasting plasma glucose (mg/dl)				
Mean	91.26 ± 12.10	91.97 ± 10.72	81.75 ± 4.27	< 100*
Normal	33 (84.6%)	29 (82.9%)	4 (100.0%)	
High	6 (17.1%)	6 (17.1%)	0 (0.0%)	
Total cholesterol (mg/dl)				
Mean	200.05± 33.07	200.20 ± 33.80	198.75 ± 29.98	< 200**
Normal	20 (51.3%)	17 (48.6%)	3 (75.0%)	
High	19 (48.7%)	18 (51.4%)	1 (25.0%)	
Triglyceride (mg/dl)				
Mean	121.44 ± 60.75	122.00 ± 63.13	116.50 ± 39.28	< 150**
Normal	28 (71.8%)	25 (71.4%)	3 (75.0%)	
High	11 (28.2%)	10 (25.0%)	1 (25.0%)	
HDL-C (mg/dl)				>40(M)**
Mean	50.23 ± 10.97	50.66 ± 11.03	46.50± 11.09	>50(F)**
Normal	30 (76.9%)	29 (82.9%)	1 (25.0%)	
Low	9 (23.1%)	6 (17.1%)	3 (75.0%)	
LDL-C (mg/dl)				
Mean	124.95 ± 29.29	124.49 ± 29.61	129.00 ± 30.08	< 130**
Normal	18 (46.2%)	16 (45.7%)	2 (50.0%)	
High	21 (35.8%)	19 (54.3%)	2 (50.0%)	
Systolic BP (mmHg)				
Mean	125.23 ± 15.35	124.83 ± 15.97	128.75 ± 8.85	< 120***
Normal	15 (38.5%)	14 (40.0%)	1 (25.0%)	
High	24 (61.5%)	21 (60.0%)	3 (75.0%)	
Diastolic BP (mmHg)				
Mean	73.33 ± 9.61	73.14 ± 9.87	75.00 ± 7.84	< 80***
Normal	31 (79.5%)	28 (80.0%)	3 (75.0%)	
High	8 (20.5%)	7 (20.0%)	1 (25.0%)	

Data are presented as mean ± SD

* Reference from American Diabetes Association: Diagnosis and classification of diabetes mellitus (Position Statement), Diabetes Care, 2007 [223].
** Reference from National Cholesterol Education Program, Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), 2002 [224]
*** Reference from Chobanian AV et al. and the National High Blood Pressure Education Program Coordinating Committee: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure, 2003 [222].

4.5 Changes of subject's nutrition status during 6 weeks study period

4.5.1 Anthropometric data

Weight and BMI decreased significantly after 6 weeks compared with the baseline (p<0.005). Mean weight reduction was 0.99±2.03 kg and maximum weight reduction was 6.5 kg. However, 33% of the participants gained weight and maximum weight gain was 2.2 kg. For the Body Mass Index, mean BMI reduction was 0.38±0.81 kg/m^2 and maximum BMI reduction was 2.60 kg/m^2. Moreover, the result showed that 43.6% of the participants were overweight and 56.4% of them were obese at week 7 and the percentages of obese participants were decrease from 61.5% to 56.4%.

Waist circumference decreased significantly after 6 weeks compared with the baseline (p<0.005) However, both female and male remained had mean waist circumference higher than the normal criteria (84.27±5.79 and 91.75±3.59, respectively). Mean waist circumference reduction was 1.44±2.8 cm. and maximum waist circumference reduction was 10 cm. in female and 2 cm.in male.

There were decreasing tendency of visceral fat level and body fat percentage and but the reduction was not significantly. The mean at week 7 of visceral fat level (8.15±2.93) and body fat percentage (33.40±4.49) remained higher than the normal criteria. However, percentage of normal visceral fat level was improved from 65.7% to 69.2% and percentage of normal body fat was improved from 2.8% to 8.6%. Mean, minimum and maximum of anthropometric data before and after the study are shown in Table 28.

Table 28 Mean, minimum and maximum of anthropometric data before and after the study

Anthropometric data	Baseline(39) n (%)	Week7(39) n (%)	difference	p-value	Normal criteria*
Weight (kg)					-
Mean	66.51±6.58	65.52±6.36	-0.99±2.03	0.004[a]	
Min	53.80	53.00	+2.20		
Max	80.50	76.00	- 6.50		
Weight reduction	-	26 (66.7%)	-		
Weight gain	-	13 (33.3%)	-		
BMI (kg/m^2)					18.5-22.9
Mean	26.21±2.22	25.83±2.25	-0.38±0.81	0.007 [a]	kg/m^2 *
Min	23.10	21.80	+ 1.00		
Max	30.00	29.70	-2.60		
Overweight	15 (38.5%)	17 (43.6%)	-		
Obesity	24 (61.5%)	22 (56.4%)	-		
Waist circumference (cm)					<80cm.(F)* <90cm.(M)*
Mean	86.47±6.21	85.04±6.03	-1.44±2.89	0.004[a]	
Female	85.76±6.00	84.27±5.79	-1.49+3.02	0.006[a]	
Male	92.73±4.75	91.75±3.59	-0.98±1.62	0.314	
Min					
Female	74.80	74.00	+5.00		
Male	89.00	89.00	+1.40		
Max					
Female	96.00	96.00	-10.00		
Male	99.00	97.00	-2.00		
Normal	9 (23.1%)	10 (25.6%)	-		
Female	8 (22.9%)	9 (25.7%)	-		
Male	1 (25.0%)	1 (25.0%)	-		
High	30 (76.9%)	29 (74.4%)	-		
Female	27 (77.1%)	26 (74.3%)	-		
Male	3 (75.0%)	3 (75.0%)	-		

Data are presented as mean ± SD

[a] Significant difference from baseline (P<0.05)

Table 28 Mean, minimum and maximum of anthropometric data before and after the study (continue)

Anthropometric data	Baseline(39) n (%)	Week7(39) n (%)	difference	p-value	Normal criteria*
Visceral fat level					1-9 **
Mean	8.44±3.14	8.15±2.93	-0.28±0.97	0.078	
Min	4.00	3.00	+ 1.00		
Max	16.00	14.00	- 3.00		
Normal (1-9)	23 (65.7%)	27 (69.2 %)	-		
High (10-14)	14 (35.9%)	12 (30.8%)	-		
Very high (15-30)	2 (5.7%)	0 (0.0%)	-		
Body fat percentage (%)					20.0-29.9 (F) **
Mean	33.98±4.29	33.40±4.49	-0.57±1.94	0.073	10.0-19.9
Min	22.80	22.80	-6.50		(M) **
Max	42.90	42.80	+ 4.80		
Normal	1 (2.8%)	3 (8.6%)	-		
Female: 20.0-29.9	1 (2.8%)	3 (8.6%)	-		
Male: 10.0-19.9	0 (0.0%)	0 (0.0%)	-		
High	16 (41.0%)	30 (76.9%)	-		
Female: 30.0-34.9	15 (42.9%)	18 (51.4%)	-		
Male: 20.0-24.9	1 (25.0%)	12 (50.0%)	-		
Very high	22 (56.4 %)	16 (41.0%)	-		
Female: 35.0-50.0	19 (54.3%)	14 (40.0%)	-		
Male: 25.0-50.0	3 (75.0%)	2 (2.8%)	-		

Data are presented as mean ± SD

[a] Significant difference from baseline ($P<0.05$)

Data are presented as mean ± SD

* Reference from World Health Organization The Asia-Pacific perspective Redefining Obesity and its treatment. February, 2000 [34].

** Reference from The values for obesity judgment proposed by Mr. Lohman (1986) and Mr. Nagamine, 1972 [20].

4.5.2 Dietary intake

Energy intake significantly decreased at week 7 compared with the baseline (p<0.005). There was significance difference in calories of carbohydrate from baseline to week 6 (p<0.005) while percentage caloric distribution of carbohydrate was not significant. Percentage caloric distribution of protein increased significantly (p<0.005) but calories of protein from baseline to week 6 was not significant. Percentage caloric distribution and calories of fat increased significantly at week 7 compared with baseline (p<0.005). Cholesterol, sodium, dietary fiber and calcium were not change significantly. Dietary intake of the subjects before and after the study are shown in Table 29.

Table 29 Mean dietary intake of the subjects before and after the study

Dietary intake	Baseline (n=39)	Week 7 (n=35)	p-value	Healthy Food intake criteria*
Energy (kcal/day)	1,900.1 ± 553.31	1,299.0 ± 430.85	0.000 [a]	-
Carbohydrate (kcal/day)	1,061.5 ± 413.38	780.45 ± 330.56	0.002 [a]	-
(% kcal)	55.43 ± 11.07	58.89 ± 11.22	0.156	55%
Protein (kcal/day)	214.72 ± 134.00	208.95 ± 77.83	0.817	-
(% kcal)	11.22 ± 5.89	16.60 ± 4.96	0.000 [a]	15%
Fat (kcal/day)	574.97 ± 212.00	309.64 ± 131.48	0.000 [a]	-
(% kcal)	30.75 ± 8.27	24.55 ± 8.71	0.001 [a]	< 30%
Cholesterol (mg/d)	211.82 ± 195.64	206.40 ± 139.92	0.880	< 300
Sodium (mg/d)	1,671.9 ± 1606.46	1,559.1 ± 1,352.75	0.712	< 2,400
Dietary fiber (g/d)	10.92 ± 10.75	10.56 ± 6.98	0.872	20-30
Calcium (mg/d)	351.05 ± 310.03	444.29 ± 346.79	0.280	1000-1500

Data are presented as mean ± SD

* Reference from National Institutes of Health, National Heart, Lung, and Blood Institute: The Practical Guide Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 2002 [37].

4.5.3 Biochemical data and blood pressure

Total cholesterol, triglyceride and systolic blood pressure significantly decreased at week 7 compared with baseline (p<0.005). The mean total cholesterol (192.28 $\pm$ 26.18) and triglyceride (97.11 $\pm$ 38.22) remained in the normal criteria whereas the mean systolic blood pressure (118.10 $\pm$ 11.74) decreased from high level to the normal criteria. Moreover, the participants who had high level of cholesterol decrease from 48.7% to 41.0%. High level of triglyceride and systolic blood pressure also decreased from 28.2% to 12.8% and 61.5% to 41.0%, respectively. In addition, the reduction of total cholesterol, triglyceride and systolic blood pressure was -7.7 $\pm$ 23.45 mg/dl, -24.33 $\pm$ 42.27 mg/dl and -7.13 $\pm$ 9.89 mmHg, respectively.

When considering the good cholesterol as HDL cholesterol the results showed that HDL cholesterol significantly increase (+3.82 $\pm$ 6.22 mg/dl) but did not significantly increase in male. However, the mean of HDL cholesterol in both female and male (54.74$\pm$10.38 and 48.00$\pm$8.83, respectively) remained in the normal criteria. Moreover, both female and male who had low level of HDL cholesterol were decrease from 17.1% to 8.6% and 75.0 to 50.0%, respectively.

According to fasting plasma glucose, LDL cholesterol and diastolic blood pressure, the results showed that the mean of them were not significant change at week 7 but all of them remained in the normal criteria (91.97 $\pm$ 10.72, 118.72 $\pm$ 25.11 and 70.56 $\pm$ 9.00, respectively). Mean biochemical data of subjects before and after the study are shown in Table 30.

Table 30 Mean biochemical data of subjects before and after the study

Variable	Baseline (n=39)	Week 7 (n=39)	difference	p-value	Normal criteria
Fasting plasma glucose (mg/dl)					< 100*
Mean	91.26 ± 12.10	91.97 ± 10.72	+0.72±9.19	0.628	
Normal	33 (84.6%)	33 (84.6%)	-		
High	6 (17.1%)	6 (17.1%)	-		
Total cholesterol (mg/dl)					< 200
Mean	200.05± 33.07	192.28 ± 26.18	-7.7±23.45	0.045[a]	**
Normal	20 (51.3%)	23 (59.0%)	-		
High	19 (48.7%)	16 (41.0%)	-		
Triglyceride (mg/dl)					< 150
Mean	121.44 ± 60.75	97.11 ± 38.22	24.33±42.27	0.001[a]	**
Normal	28 (71.8%)	34 (87.2%)	-		
High	11 (28.2%)	5 (12.8%)	-		
HDL-C (mg/dl)					>40(M)
Mean	50.23 ± 10.97	54.05 ± 10.39	+3.82±6.22	0.000[a]	**
Female	50.66 ± 11.03	54.74±10.38	+3.82±6.22	0.000[a]	>50(F)
Male	46.50± 11.09	48.00±8.83	+1.5±5.20	0.112	**
Normal	30 (76.9%)	34 (87.2%)	-		
Female	29 (82.9%)	32 (91.4%)	-		
Male	1 (25.0%)	2 (50.0%)	-		
Low	9 (23.1%)	5 (12.8%)	-		
Female	6 (17.1%)	3 (8.6%)	-		
Male	3 (75.0%)	2 (50.0%)	-		
LDL-C (mg/dl)					< 130
Mean	124.95 ± 29.29	118.72 ± 25.11	-6.16±20.09	0.060	**
Normal	18 (46.2%)	23 (59.0%)	-		
High	21 (35.8%)	16 (41.0%)	-		
Systolic BP (mmHg)					< 120
Mean	125.23 ± 15.35	118.10 ± 11.74	-7.13±9.89	0.000[a]	***
Normal	15 (38.5%)	23 (59.0%)	-		
High	24 (61.5%)	16 (41.0%)	-		
Diastolic BP (mmHg)					< 80
Mean	73.33 ± 9.61	70.56 ± 9.00	-4.56±15.15	0.125	***
Normal	31 (79.5%)	31 (79.5%)	-		
High	8 (20.5%)	8 (20.5%)	-		

Data are presented as mean ± SD

* Reference from American Diabetes Association: Diagnosis and classification of diabetes mellitus (Position Statement), Diabetes Care, 2007 [223].

** Reference from National Cholesterol Education Program, Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), 2002 [224]

*** Reference from Chobanian AV et al. and the National High Blood Pressure Education Program Coordinating Committee: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure, 2003 [222].

4.6 Changes of subject's nutrition knowledge

4.6.1 Nutrition knowledge from homework assignment

The mean scores of homework assignment (4 exercises) increased significantly at post-test compared with pre-test (p<0.05). Mean scores of subject's nutrition knowledge on nutrition education from pre-test and post-test homework assignment in each week are shown in Table 31. The level of knowledge scores was divided in 3 level; low level (< 50% correct), medium level (50-75% correct) and high level (>75% correct).

Mean pre-test and post-test score of assignment 1 were in the range of medium level. Before self-learning 7.7% of participants had high level and improve to 28.2% after self-learning. 35.9% of participants had low level at pre-test and after self-learning the percentage reduced to 20.5%.

Mean pre-test score assignment 2 was in the range of medium level and improve to high level. Before self-learning 17.9% of participants had high level and improve to 71.8% after self-learning. 38.5% of participants had low level at pre-test and after self-learning the percentage reduced to 7.7%.

Mean pre-test score assignment 3 was in the range of low level and improve to high level. Before self-learning none of participants had high level and improve to 43.6% after self-learning. 87.2% of participants had low level at pre-test and after self-learning the percentage reduced to 23.1%.

Mean pre-test score assignment 4 was in the range of low level and improve to high level. Before self-learning none of participants had high level and improve to 64.1% after self-learning. 87.2% of participants had low level at pre-test and after self-learning the percentage reduced to 0%.

Frequency and percentage of the subject's knowledge on nutrition education from pre-test and post-test homework assignment are shown in Table 32.

Table 31 Mean scores of subject's nutrition knowledge from pre-test and post-test homework assignment

Exercise	Pre-test	Post-test	P-value[a]
1. Let's explore yourself	3.79±1.40	4.69±1.24	0.001
2. How to eat low fat, low calorie diets	3.87±1.72	5.72±1.39	0.000
3. How to choose food out side home	2.05±1.41	4.82±1.41	0.000
4. Let's exercise	2.26±1.09	5.62±1.20	0.000

Data are present as mean $\pm$ SD

[a] Significant difference from pre-test ($p<0.05$)

Table 32 Frequency and percentage of the subject's nutrition knowledge from pre-test and post-test homework assignment

Level		Pre-test		Post-test	
		n	%	n	%
Assignment 1	Low	14	35.9	8	20.5
	Medium	22	56.4	20	51.3
	High	3	7.7	11	28.2
Assignment 2	Low	15	38.5	3	7.7
	Medium	17	43.6	8	20.5
	High	7	17.9	28	71.8
Assignment 3	Low	34	87.2	9	23.1
	Medium	5	12.8	1	33.3
	High	0	0.0	17	43.6
Assignment 4	Low	34	87.2	0	0.0
	Medium	5	12.8	14	35.9
	High	0	0.0	25	64.1

4.6.2 Knowledge of nutrition between pre-test (week 0) and post-test (week 7)

The mean scores of nutrition knowledge increased significantly at post-test compared with pre-test ($p<0.005$). Mean scores of subject's nutrition knowledge from pre-test and post-test in week 0 and week 7 are shown in Table 33.

The level of knowledge scores was divided in 3 level; low level (< 50% correct), medium level (50-75% correct) and high level (>75% correct). Before self-learning 2.6% of participants had high level and improve to 43.6% after self-learning. 46.2% of participants had low level at pre-test and after self-learning the percentage reduced to 2.6%. Frequency and percentage of the subject's nutrition knowledge level from pre-test and post-test in week 0 and week 7 are shown in Table 34.

Table 33 Mean scores of subject's nutrition knowledge from pre-test and post-test in week 0 and week 7

Pre-test (week 0)	Post-test (week 7)	P-value[a]
9.72 ± 3.45	14.62 ± 3.28	0.000

Data are present as mean ± SD

[a] Significant difference from pre-test ($p<0.05$)

Table 34 Frequency and percentage of the subject's nutrition knowledge level from pre-test and post-test in week 0 and week 7

Level	Pre-test (week 0)		Post-test (week 7)	
	n	%	n	%
Low	18	46.2	1	2.6
Medium	20	51.3	21	53.8
High	1	2.6	17	43.6

4.7 Changes of subject's score on exercise and dietary behavior

Behavior control questionnaire by Mananya Praseardsup [219] consisted of two parts, part one is dietary behavior questionnaire include 35 questions and part two is exercise behavior questionnaires included 20 questions. Higher score of behavior control indicated higher positive behavior on exercise and dietary. The mean scores of exercise and dietary behavior increased significantly at post-test compared with pre-test ($p<0.05$). Mean scores of subject's score on exercise and dietary behavior are shown in Table 35. The level of exercise and dietary behavior scores were divided in 3 levels; low level (< 50% correct), medium level (50-75% correct) and high level (>75% correct). According to the exercise behavior scores, none of participant had high score before and after self-learning whereas 23.1% of the participants had medium score at baseline and improved to 41.0% after self-learning. For the dietary behavior scores, 79.5% of participants had high score and improve to 94.9% after self-learning whereas 2.6% of participants had low score at baseline and no low score after self-learning. Frequency and percentage of the subject's score on exercise and dietary behavior at week 0 and week 7 are shown in Table 36.

Table 35 Mean of subject's score on exercise and dietary behavior

Behavior score	Pre-test	Post-test	P-value[a]
Exercise	42.49 ± 7.30	47.97 ± 7.39	0.000
Dietary	102.87 ± 15.80	111.03 ± 10.18	0.002

Data are present as mean ± SD

[a] Significant difference from pre-test ($p<0.05$)

Table 36 Frequency and percentage of the subject's score on exercise and dietary behavior at week 0 and week 7

Level	Pre-test		Post-test	
	n	%	n	%
Exercise behavior				
Low	30	76.9	23	59.0
Medium	9	23.1	16	41.0
High	0	0.0	0	0.0
Dietary behavior				
Low	1	2.6	0	0.0
Medium	7	17.9	2	5.1
High	31	79.5	37	94.9

4.8 Changes of subject's score on stage of change

The level of subject's score on stage of change is divided in 5 stage; stage 1 is precontemplation (Do not intended to lose weight in the next 6 months)**,** stage 2 is contemplation (Intended to lose weight in the next 6 months)**,** stage 3 is preparation (Intends to lose weight within the next thirty days and has taken some behavioral steps in this direction), stage 4 is action (has changed behavior for less than six months, such as reducing dietary fat, reducing portions and exercising, and had started to lose weight, less than 5% of the baseline weight) and stage 5 is maintenance (has changed behavior for more than six months).

After using website, the results presented that none of the participants was in precontemplation stage and 20.5%, 7.7%, 61.1% and 7.7% of the participants were in contemplation stage, preparation stage, actions stage and maintenance stage, respectively. These results are presented in Table 37**.** Mean scores of stage of change increased significantly at post-test compared with pre-test (p<0.05) and mean pre-test score were in the range of stage 3 and improve to stage 4. Mean scores of subject's score on stage of change before and after the study are shown in Table 38.

Table 37 Frequency and percentage of stage of change of the subject before and after the study

Stage of change	Week 0 No. of subjects (%)	Week 7 No. of subjects (%)
Precontemplation stage	4 (10.3)	0 (0)
Contemplation stage	16 (41.0)	8 (20.5)
Preparation stage	10 (25.6)	3 (7.7)
Actions stage	8 (20.5)	25 (61.1)
Maintenance stage	1 (2.6)	3 (7.7)

Table 38 Mean subject's score on stage of change before and after the study

Week 0	Week 7	P-value[a]
2.64 $\pm$ 1.01	3.59 $\pm$ 0.91	0.000

Data are present as mean $\pm$ SD

[a] Significant difference from pre-test (p<0.05)

4.9 Subject's satisfaction of the developed education tool

The subject's satisfaction questionnaire of 16 questions related to website content, website motivation and subject's opinion on website. The scores were range in 5 scales including strongly disagree, disagree, undecided, agree and strongly agree. Mean scores were more than 4 and less than 5 in each question.

According to the website content, most participants agreed that the website is colorful and attractive (56.4%). Most of them (56.4%) agreed with learning thought the website can stimulate them more interested in lessons. They also agreed that the lessons are easy to understand (64.1%) and make them understand faster (54.6%). Most participants (48.7%) strongly agree that lessons in the website were gave them more knowledge. The mean score presented that they can do self learning (4.08 ± 0.70), plan their own diet (4.03 ± 0.63) and exercise (4.07 ± 0.58) to reduce weight and always take part in activity on the website. They concluded that (51.3%) the website was appropriate for self-study.

For the website motivation, most participant agree that learning via website were fun (56.4%), make them eager (56.4%) to learn more and motivated them (53.8%) to have more positive attitude to exercise.

Regarding to the subject's opinion on the website, most participants strongly agreed that this website should be released to the public in the future (53.8%), there should be develop the similar website for other diseases (51.3). Moreover they agree that the website is the need for current and future generations (56.4%).

Mean scores of 39 subject's satisfaction of the developed education tool are shown in Table 39.

Table 39 Mean scores of 39 subject's satisfaction of the developed education tool

Questions	* Option level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
1. Website content						
1.1 The website are colorful and attractive	0 (0)	0 (0)	4 (10.3)	22 (56.4)	13 (33.3)	4.23 ± 0.63
1.2 Learning through the website make you more interested in lessons.	0 (0)	0 (0)	6 (15.4)	22 (56.4)	11 (28.2)	4.13 ± 0.66
1.3 The lessons are easy to understand	0 (0)	0 (0)	2 (5.1)	25 (64.1)	12 (30.8)	4.26 ± 0.55
1.4 Learning in this way allows you to understand lessons faster	0 (0)	1 (2.6)	4 (10.3)	22 (54.6)	12 (30.8)	4.15 ± 0.71
1.5 Lessons give you more knowledge	0 (0)	0 (0)	3 (7.7)	17 (43.6)	19 (48.7)	4.41 ± 0.64
1.6 You can control your own learning.	0 (0)	0 (0)	8 (20.5)	20 (51.3)	11 (28.2)	4.08 ± 0.70
1.7 You can plan your diet to reduce weight.	0 (0)	0 (0)	7 (17.9)	24 (61.5)	8 (20.5)	4.03 ± 0.63
1.8 You can plan your own exercise.	0 (0)	0 (0)	5 (12.8)	26 (66.7)	8 (20.5)	4.07 ± 0.58
1.9 You take part in activity on the website	0 (0)	1 (2.6)	7 (17.9)	20 (51.3)	11 (28.2)	4.05 ± 0.76
1.10 The website appropriate for self-study	0 (0)	0 (0)	1 (2.2)	20 (51.3)	18 (46.2)	4.44 ± 0.55

Data are presented as mean ± SD

Meaning of scores; 1 point = Strongly disagree, 2 points= Disagree,

3 points = Undecided, 4 points = Agree, 5 points = Strongly agree

Table 39 Mean scores of 39 subject's satisfaction of the developed education tool (continue)

Questions	* Option level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
2. Website motivation						
2.1 You have fun learning lessons.	0 (0)	0 (0)	6 (15.4)	22 (56.4)	11 (28.2)	4.13 ± 0.66
2.2 The lesson making you eager to learn more	0 (0)	1 (2.6)	6 (15.4)	22 (56.4)	10 (25.6)	4.05 ± 0.72
2.3. You have more positive attitude to exercise.	0 (0)	0 (0)	5 (12.8)	21 (53.8)	13 (33.3)	4.21 ± 0.66
3. Subject's opinion on website						
3.1 You want this website to be released to the public.	0 (0)	0 (0)	3 (7.7)	15 (38.5)	21 (53.8)	4.46 ± 0.64
3.2 This study should be developed for other disease	0 (0)	0 (0)	4 (10.3)	15 (38.5)	20 (51.3)	4.41 ± 0.68
3.3 This lesson is the need for current and future generations	0 (0)	0 (0)	1 (2.6)	22 (56.4)	16 (41.0)	4.38 ± 0.54

Data are presented as mean ± SD

Meaning of scores; 1 point = Strongly disagree, 2 points= Disagree,

3 points = Undecided, 4 points = Agree, 5 points = Strongly agree

4.10 Relationship between frequency of access the website, frequency of food record and weight reduction.

Most of the of the participants (68.4%) who accessed the website ≥ 3 times/week were in the group of weight reduction ≥ 1 kg whereas 70% of subjects accessed the website < 3 times/week were in the group of weight reduction < 1 kg. In addition, more than 70% of the participants who recorded food intake ≥ 1 times/week were in the group of weight reduction ≥ 1 kg and 60% of the participants who recorded food intake < 1 times/wk were in the group of weight reduction < 1 kg. Therefore, frequency of access the website and food record are significantly related to the reduction of weight (p<0.05, Chi-square) as shown in Table 40.

Table 40 Relationship between frequency of access the website, frequency of food record and weight reduction

Parameters	Group of Weight reduction ≥ 1 kg (n=19)	Group of Weight reduction < 1 kg (n=20)	Chi-square	p-value
Frequency of access the website				
≥ 3 times/wk	13 (68.4%)	6 (30.0%)	5.757	0.015[a]
< 3 times/wk	6 (31.6%)	14 (70.0%)		
Frequency of food record				
≥ 1 times/wk	14 (73.7%)	8 (40.0%)	4.496	0.034[a]
< 1 times/wk	5 (26.3%)	12 (60.0%)		

Data are presented in the number and the percentage (%) is shown in the parenthesis

[a] Significant difference between group (p<0.05), Chi-square

4.11 Correlation between total cholesterol, triglyceride, HDL-C, systolic blood pressure and weight reduction.

At week 7, the results of thirty nine participants showed that total cholesterol, triglyceride and systolic blood pressure significantly decreased compared with baseline (p<0.05) whereas HDL cholesterol significantly increase (p<0.05). However, the correlation between the reduction of total cholesterol, triglyceride, HDL-C, and weight reduction weight were not found but the correlation between systolic blood pressure and weight reduction was positive relationship (r=0.396, p<0.05). The correlation between total cholesterol, triglyceride, HDL-C, systolic blood pressure and weight reduction are shown in Table 41.

Table 41 Correlation between total cholesterol, triglyceride, HDL-C, systolic blood pressure and weight reduction

Parameters	Pearson Correlation	P-value
Total cholesterol	0.140	0.497
Triglyceride	-0.023	0.910
HDL-C	-0.006	0.979
Systolic blood pressure	0.396	0.045[a]

[a] Correlation is significant at the 0.05 level (2-tailed).

4.12 Correlation between age, frame size, dietary behavior score and exercise behavior score and weight change

The results of twenty six participants who loosed weight showed that the correlation of age and frame size with weight reduction was not found. Moreover, the correlation between the increment of dietary behavior score and weight reduction was positive relationship (r=0.473, p<0.05) whereas the correlation between the increment of exercise behavior score and weight reduction was not found. Regarding to thirteen participants who gained weight, the results showed that the correlation of age, frame size and the increment of dietary behavior and exercise behavior score with weight reduction was not found. The correlation between age, frame size, dietary behavior score and exercise behavior score and weight change are shown in Table 42.

Table 42 Correlation between age, frame size, dietary behavior score and exercise behavior score and weight change

Parameters	Pearson Correlation	P-value
Age		
Weight reduction (n=26)	-0.320	0.111
Weight gain (n=13)	0.190	0.535
Frame size		
Weight reduction (n=26)	0.044	0.830
Weight gain (n=13)	0.020	0.949
Dietary behavior score		
Weight reduction (n=26)	0.479	0.013[a]
Weight gain (n=13)	-0.760	0.806
Exercise behavior score		
Weight reduction (n=26)	0.312	0.120
Weight gain (n=13)	-0.038	0.901

[a] Correlation is significant at the 0.05 level (2-tailed).

4.13 Relationship between reasons to reduce weight and weight change

The relationship between reason to reduce weight and weight change was not found in both groups (weight reduction group and weight gain group). The results showed that 92.3% of the participants in weight reduction group wanted to be healthy, 73.1% would like to have a good shape, 69.2% wanted to move actively, 61.5% thought that it is convenient easy to buy clothes, 46.2% would like to have an attractive personality and 23.1% did not want to be teased. Regarding to weight gain group, the percentage of reasons to reduce weight was similar to weight reduction group. The results showed that 100.0% of the participant in weight reduction group wanted to be healthy, 92.3% would like to have a good shape, 53.8% wanted to move actively, 38.5% thought that it is convenient easy to buy clothes, 30.8% would like to have an attractive personality and 16.9% did not want to be teased. The correlation

between age, frame size, dietary behavior score and exercise behavior score and weight change are shown in Table 43.

Table 43 Relationship between reasons to reduce weight and weight change

Reason to reduce weight	Group of Weight reduction (n=26)	Group of Weight gain (n=13)	Chi-square	p-value
To be healthy				
Yes	24 (92.3%)	13 (100.0%)	1.054	0.305
No	2 (7.7%)	0 (0.0%)		
To have a good shape				
Yes	19 (73.1%)	12 (92.3%)	1.966	0.161
No	7 (26.9%)	1 (7.7%)		
To move actively				
Yes	18 (69.2%)	7 (53.8%)	0.891	0.345
No	8 (30.8%)	6 (46.2%)		
To have an attractive personality				
Yes	12 (46.2%)	4 (30.8%)	0.848	0.354
No	14 (53.8%)	9 (69.2%)		
To be convenient buying for clothes				
Yes	16 (61.5%)	10 (38.5%)	2.167	0.141
No	11 (84.6%)	2 (15.4%)		
Do not want to be teased				
Yes	6 (23.1%)	20 (16.9%)	0.315	0.575
No	2 (15.4%)	11 (84.6%)		

CHAPTER VI
DISCUSSION

The study was conducted to develop a multimedia website nutrition education tool based on concept of NHLBI Recommendation and health belief model.

This chapter discusses the results and findings of the study in a sequence that is similar to the results section (chapter 5).

Development of the multimedia website nutrition education tool

The educational tool was developed as a multimedia website on concept of NHLBI Recommendation (National Heart, Lung, and Blood Institute Recommendation) and health belief model.

The purposes of creating the website were to modify their diets to achieve a moderate reduction in caloric intake with appropriate macronutrient composition and increase in physical activity through the website.

Therefore, in order to achieve these purposes the website was designed to have many key components, including six lessons for weight management, web-board, e-mail sending function to researcher (contract us), meal plan, weight loss menu, calorie burn calculator, weight and food record.

Moreover, health behavioral theories with health belief model were applied in the study to stimulate the participants to lose more weight. Health Belief Model includes the recognition of the risks of disease, awareness of the severity of the disease, realize the benefits of treatment and motivation to practice. The developed nutrition education tool provided content and focus on self-learning. Learners can evaluate the severity and the risk of disease by themselves. When they realize the benefits of treatment, they would modify their behavior on food intake and exercise. In addition, researcher encourages learners to exchange ideas on the theme that researcher created each week in the web-board so that the subject have the opportunity to exchange experience with each other and can resolve their problem.

Six lessons for weight management consists of lesson 1 is how to assess weight and risk of chronic disease, lesson 2-4 are how to choose an appropriate diet for weight lose and lesson 5-6 are how to increase physical activity and a sample exercise program. All these lessons are presented in the form of colorful cartoon, animations, audio, video presentation and games. Several studies [231-236] showed that illustration in educational tool is important for learning and satisfaction.

Evidence is scant that illustrations in text facilitate understanding when the text is read by the subjects themselves (Readence & Moore, 1981). Koenke and Otto [231] reported that comprehension of main ideas was enhanced by illustrations. Similarly, Haring and Fry (1979) showed that illustrations aid memory of information located high in a text's idea hierarchy [231-232]. Findings of a study by Savangchat S. [233] who developed a self-care manual for health fat eating suggested that the participants in that study also preferred the illustrations to be photographs followed by cartoons and then drawings. The self-help guidelines for meal planning using carbohydrate counting developed by Wibunrattanasri N. [234] were written and illustrated in black and white. The suggestion of this study, most participants preferred color in both the fonts and the illustrations used. The comments were also found in many other previous studies [235, 236].

Not only illustrations in the educational tool affect the efficiency of learning, but teaching in other forms via computer and internet can be useful as well. Voughan [237] and Fu [238] claimed that the term “multimedia” does not only include computer softwares and CDs, but also the use of videos, slides as well as overhead projector equipments. As such, any teaching via the use of various media can be considered as multimedia teaching. Other studies also proved that multimedia teaching can help students to gain knowledge more effectively [239-240]. This study developed a multimedia website nutrition education tool by using colorful illustrations and various media. The developed multimedia website improves participant’s knowledge and satisfaction gets the high score.

Web-board and e-mail sending function are use to share opinions and ask questions to expert in numerous websites. Several studies have shown that not only face-to-face weight loss support but also Internet and e-mail contact can provide successful behavioral weight control [21 –23]. Web-board is a tool that use for

discussion and exchange of ideas between participants while e-mail sending function was used for sending message from participants to the researcher. This study, the researcher set interesting topics in web-board and ask participants to exchange their ideas with the others. Web-board resulted in a good relationship between participants. They would be learned within a group of people in the same status that lead to intrinsic motivation to learn and behavior change. Participants would learn about feelings and thoughts of people in the group and got some ideas to solve problems or improve their quality of life

Participants who have problems or questions can send messages to researcher all the time via e-mail sending function in the website. Answers would be reply in 1 day after sending. Consultation via e-mail sending function is useful to reduce weight because counselor can understand the problem of participants through each question and provide appropriate assistances and advices for individual. The quick answers via e-mail sending function save time and money. Participants do not meet the counselor face-to-face that lead participants to ask more questions and take the advices to adjust for their effective weight loss.

Meal plan, weight loss menu, calorie burn calculator, weight and food record are common in weight loss website [24-25, 241] which are very important tools for self-learning and self-monitoring. This study created meal plan into 2 forms. The first one was “Meal planning by yourself”, participants could create their meal plan by themselves by adding food and drinks in the program then program would calculate calorie intake and amount of main nutrients consumed a day. Participants would adjust their own menu plan to achieve calorie goal and recommended nutrients. The second meal plan program was “Planning with pattern” which provided calories 1,000-2,000 kcal. Format prescribed in each energy level is appropriate proportions of nutrients as shown in the amount of exchange in 6 food groups (rice-starch, meat, fat, dairy products, fruits and vegetables). Weight loss menu (A low-energy density recipe book for weight management) was developed by Nuttiga S.[208]. The menu consists of 30 recipes for side dishes and 16 recipes for one-plate dishes. It provided information about nutritive value, serving size and cooking method that may useful for the participants to learn how to cook a low-energy density diet. Calorie burn calculator, weight and food record and personal’s folder were the effective tool that use for self-

monitoring, particularly food record that was very useful for the participants to monitoring their dietary behavior.

Demographic characteristics

The total of 39 participants took part in the study. The majority of participants were female (89.7%) and more than 50% of them were single. The most of them have had high education level and high income. Moreover, they had a mean age of 42.67 ± 10.36 years and most of them aged between 41-60 years (66.6%). This results were the same as the study in 2010 that conducted in 6,445 Thais adults (18–70 years). The recent study showed that women who were older, had higher education, were not in a marriage-like relationship and were in semi-professional occupation were at greater risk for being overweight and obese. However, age was positively associated with being overweight in both genders. [242] In addition, the present finding also showed that participants aged between 46–55 years old had the highest risk of being overweight and/or obese, which may be due to the weight gain from life transitions during that time such as retirement [243] or menopause [244].

Many included adult subjects in an internet weight loss program [24-25]. Tate et al. [24] studies compare two interventions via internet (education group and behavior therapy group) in 91 healthy, overweight adult hospital employees aged 40.9±10.6 years with a body mass index of 25-36 kg/m^2. It was the same as the study in 2002, Southard et al. [25] studies compare between internet-base cardiac rehab program group and usual care group. They studied in 104 patients aged 62.3±10.6 years with a body mass index of 30.92 (internet-base cardiac rehab program group) and 29.2 kg/m^2 (usual care group). Several studied interested in overweight and obesity adult because nowadays, many reports show that overweight and obesity are growing in adult and also need to play attention. [4, 30].

Regarding to the chronic disease, most of overweight and obese participants (74%) did not have any chronic disease but more than 50% of the participants had family history of chronic disease such as Type 2 Diabetes Mellitus, hypertension, heart disease and dyslipidemia. Moreover, it was found that most of the participants (89.7%), at least one person in family was overweight or obese. The previous study [245] showed that person who have family history of obesity and other

chronic disease may have a higher risk of developing that disease than those without such a family member. Family history of chronic disease is the factor that can not change but behavior factors of the participants are changeable therefore if the participants did not change their behavior and did not control their weight, they would likely to get chronic diseases in the future.

Weight history and opinion on weight status

More than 60% of the participants assessed the level of obesity incorrectly and most participants (43.6%) who over estimated on their weight status were females while males under estimated on their weight status. The result shows that overweight and obese people overestimate their BMI and females were more likely than male to perceive themselves as "too fat". The result is consistent with previous studies [246-250] Mikolajczyk R et al. [246] found that most female students described their weight as "just right" at a BMI <20 kg/m^2, which is in the low range of normal BMI, whereas most male students described their weight as "just right" at a BMI around 24 kg/m^2, which is in the upper range of normal BMI. They concluded that female students were more likely than male students to perceive themselves as "too fat", while male students were more likely to perceive themselves as "too thin".

The study reported that more than 70% of the participants used to be teased about their weight. More than 50% of the subjects (59%) used to lose weight. There are many reasons to lose weight. 94.9% of the participants wanted to be healthy, 79.5% would like to have a good shape, 64.1% wanted to move actively, 69.2% thought that it was convenient easy to buy clothes, 41.0% would like to have an attractive personality and 20.5% did not want to be teased. According to the results, most participants have the experience of being losing weight and the most reason to lose weight was “to be healthy”. Moreover, the relationship between reason to reduce weight and weight change was not found in both groups (weight reduction group and weight gain group). The results showed that two groups was no difference about reasons to lose weight. In addition, the main reason to lose weight in both groups was to be healthy followed by having a good shape, to move actively, to be convenient to buy clothes, to have an attractive personality and not to be teased.

Stage of change

At baseline, 41% of the participants were in the contemplation stage meaning they intended to lose weight in the 6 month. After the study, there was the progress through different stages and most participants (61.1%) changed to the action stage. The result means that they has changed behavior and had started to lose weight during the study. Moreover, the mean scores of stage of change also increased significantly after the study which were in the range of stage 3 (Preparation) and improve to stage 4 (Action). The improvement of subject's stage of change also indicated that after learning via website most of them had modified their behavior and had started to lose weight. The result was supported from the previous study [251] which showed that education was one of the significant predictors of the stage of change. Moreover, several studies showed that education about the recognition of the risks of disease, the severity of the disease, the benefits of treatment and the attractive tool seem to be the factors that can change the stage of behavior. [17, 18,185]

Anthropometric data

Weight, BMI and waist circumference decreased significantly after 6 weeks compared to the baseline. Mean scores of weight and waist circumference reduction were approximately 1 kg and 1.44 cm., respectively. There were decreasing tendency of body fat percentage and visceral fat level but the reduction was not significantly.

Previous study showed that weight reduction related to decreasing of BMI, waist circumference, body fat percentage and visceral fat [21-25, 252].

The result of this study agree with the studies of internet weight loss website which reported that weight, BMI and waist circumference decreased significantly during 3 to 12 months [21-25].

Tate DF et al. [24] assigned a 6-month weight loss program to participants in 2 group Internet education and Internet behavior therapy. Participants in the behavior therapy group received additional behavioral procedures, including a sequence of 24 weekly behavioral lessons via e-mail, weekly online submission of self-monitoring diaries with individualized therapist feedback via e-mail, and an online bulletin board. The results showed that the behavior therapy group lost more

weight than the education group (p=0.005). The behavior therapy group lost approximately 4.0 kg by 3 months and 4.1 kg by 6 months. Weight loss in the education group was approximately 1.7 kg at 3 months and 1.6 kg by 6 months. Changes in waist circumference were also greater in the behavior therapy group than in the education group at both 3 months (p=.001) and 6 months (p=0.005). The waist reduction in the behavior therapy group was approximately 5.3 cm at 3 months and 4.6 cm by 6 months. In the behavior education group, waist reduction was approximately 2.1 and 2.3, respectively.

The same as body fat percentage and visceral fat that were reported decreased significantly after 6 months. Jack w at el. reported that weight reduction from caloric restriction (1,200 kcal/day) reduces anthropometrically measured subcutaneous fat proportionally more in peripheral than in central regions [250].

This study differs from the other studies which may be due to the shorter duration (6 weeks) so it should have further study to determine the effectiveness of the website in a longer period to see the effect of weight, waist circumference, body fat percentage and visceral fat.

Dietary intake

The baseline dietary intakes of the subject presented percentage of protein was a little bit lower than the normal criteria but percentage fat intake was higher than normal criteria. Cholesterol and sodium intake were in the normal criteria but dietary fiber and calcium were lower than the criteria

After 6 weeks of self-learning, this study found that energy, carbohydrate and fat intake decreased significantly compare to the baseline. However, cholesterol, sodium, dietary fiber and calcium intake were no change. In addition, percentage of protein was increase and fat was decrease significantly with in the recommendation while percentage of carbohydrate did not change and remained in the recommendation. These results indicated that after learning via the developed weight loss website, most participants changed their dietary intake. They had an appropriate percent distribution of main nutrients and also decrease intake of food providing calories from carbohydrate and fat.

The results similar to the previous study [16], Roberts CK et al. reported that low fat diet, restricted-calorie diet group had lower intake of carbohydrate and total fat and percentage of protein and fat were increase and decreased, respectively, during 6 to 12 months.

Biochemical data and blood pressure

At baseline, mean of fasting plasma glucose, total cholesterol, triglyceride, HDL cholesterol and LDL cholesterol level were in the normal level. Mean of diastolic blood pressure was also in the normal criteria but Systolic blood pressure was higher than the criteria.

After 6 weeks of self-learning, total cholesterol, triglyceride and systolic blood pressure were significantly decreased. The reduction of total cholesterol, triglyceride and systolic blood pressure were approximately -7.7 mg/dl, -24.33 mg/dl and -7.13 mmHg, respectively. HDL cholesterol was significantly increased (+3.82 $\pm$ 6.22). However, fasting plasma glucose, LDL cholesterol and diastolic blood pressure were not significant change at week 7 but all of them were in the normal criteria.

A meta-analysis of 70 weight loss studies at baseline and the end of the study, which revealed beneficial effects of weight reduction on all serum lipid levels, including an increase in HDL cholesterol at a stabilized reduced weight [79].

Roberts et al. [16] studies in Dimona, Israel, in a workplace at a research center with an on-site medical clinic. The study was conducted in 104 volunteers (BMI 30.6 ±32), aged 40-65 years. The volunteers received an energy intake of 1,500 kcal per day for women and 1,800 kcal per day for men, with 30% of calories from fat, 10% of calories from saturated fat, and an intake of 300 mg of cholesterol per day. After 2 years, they found the significant reduction of weight (decrease 3.3 kg), Waist circumference (decrease 2.8±4.3 cm.), Blood pressure (Systolic blood pressure decrease 4.3±11.8 mmHg and Diastolic blood pressure decrease 0.9 ± 8.1 mmHg), Cholesterol (The relative reduction in the ratio of total cholesterol to high-density lipoprotein cholesterol was 12%)

Many studies confirm that appropriate weight loss is the key to improve all serum lipid levels, blood pressure, fasting plasma glucose as well as reduce the risk of chronic diseases in the future [77-79, 89-90].

Knowledge of nutrition from homework assignment and nutrition test

According to the knowledge of nutrition from homework**,** the mean scores of homework assignment (4 exercises) increased significantly at post-test compared to pre-test.

Exercise 1 (Let's explore yourself), contents consists of causes of overweight and obesity, classifications of Body Mass Index (BMI) and risk of chronic diseases. Mean pre-test and post-test score of exercise 1 were in the range of medium level. Before self-learning, only 7.7% of participants had high knowledge level and improve to 28.2% after self-learning whereas 35.9% of participants had low level at pre-test and after self-learning the percentage reduced to 20.5%.

Exercise 2 (How to eat low fat, low calorie diets), contents is about choosing low fat and low calorie diets in six food groups including starches, vegetables, fruits, meat, milk and fat. Mean pre-test score exercise 2 was in the range of medium knowledge level (43.6%) and improve to high level after self-learning. There are 17.9% of participants had high knowledge level and improve to 71.8% after self-learning whereas 38.5% of participants had low level at pre-test and after self-learning it reduced to 7.7%.

Exercise 3 (How to choose food out side home), contents consists of food label, calories in one-plate dishes and shopping low fat and low calorie diets. Mean pre-test score exercise 3 was in the range of low knowledge level and improve to high level. Before self-learning none of participants had high level and improve to 43.6% after self-learning. 87.2% of participants had low level at pre-test and reduced to 23.1% after self-learning.

Exercise 4 (Let's exercise), contents consists of advice on exercise, aerobic exercise a sample walking and jogging program. Mean pre-test score exercise 4 was in the range of low level and improve to high level. Before self-learning none of participants had high knowledge level and improve to 64.1% after self-learning. 87.2% of participants had low level at pre-test and reduced to 0% after self-learning

Based on pre-test score of the four practice exercises, the result showed that most participants had knowledge score in low level in exercise 3 and 4 while knowledge score in exercise 1 and 2 were in medium level. The results indicated that

most overweight and obese people in this study have little knowledge about food purchasing and eating out based on nutrition labels, calories in one-plate dishes as well as calories in their snacks and drink. They also have not much knowledge about Arabic exercise and moderate exercise for weight loss. The results were supported from the previous study which concluded that most overweight and obese people lack of basic nutrition knowledge about obesity and knowledge about appropriated exercise for weight management [253-255]. Moreover, the lack of knowledge leads to being obesity whereas the greater nutritional knowledge leads to lower probability of being obese.[256] The recent report suggested that the current obesity epidemic is being driven largely by many risk of poor behavior for example, high energy/high fat foods, fast food consumption, television watching and "super-sized" portions [53].

According to the knowledge of nutrition test**,** the mean scores of nutrition knowledge increased significantly at post-test (week 7) compared to pre-test (week 0). Before self-learning 2.6% of participants had high level and improve to 43.6% after self-learning whereas 46.2% of participants had low level at pre-test and reduced to 2.6% after self-learning. However, mean scores of nutrition knowledge increased significantly at post-test compared with pre-test. This result was the same as many previous studies which presented the improvement of subject's knowledge score after learning via the education tool. The study of Jampathed S. [257] presented that after learning nutrition education via educational tool for self-help meal planning, the percentage of knowledge score was improved.

Changes of subject's score on exercise and dietary behavior

The mean scores of exercise and dietary behavior increased significantly at post-test compared with pre-test. The results indicated that after self-learning via weight loss website, participants increase exercise, physical activity as well as improve their dietary behavior for example increase frequency of food record, reduce frequency of eating fast food and choose an appropriated food and drink. These results related to the previous study [224] that conducted in twenty obesity adolescent age between 13-15 years at Santirat wittayalai school. The result showed that after subjects were educated by the researcher and took part in the developed program, they improved significantly the scores of exercise and dietary behavior. They conclude that

the improvement of score indicating subjects can change their behavior control of weight management in the way of better. The result was also supported from several studies [22-23] which have showed that education on internet and e-mail contact can improve the behavior of weight control in overweight and obese people.

Subject's satisfaction of the developed education tool

Related to the subject's satisfaction with the developed weight loss website which was presented in 16 questions associated to website content, website motivation and subject's opinion on website. The scores were range in 5 scales including strongly disagree, disagree, undecided, agree and strongly agree. Mean scores were more than 4 and less than 5 in each question. According to the 16 questions, all of them evaluate agreement presenting in agree and strongly agree. The result presented they pleasure to use the developed website to control their weight. Most participants agreed that the website is more colorful and attractive and most of them also agreed that learning thought the website can make them more interested in lessons. The result was the same as the previous studies [231-236] which showed that colorful and attractive education tool related to high score of subject's satisfaction. They concluded that illustration in educational tool is important for learning and satisfaction of learners. Moreover, the finding of a study by Wibunrattanasri N. [234] who developed The self-help guidelines for meal planning using carbohydrate counting suggest that most participants preferred color in both the fonts and the illustrations used. When considering about understanding of participants, the result found that most of them agreed that the lessons are easy to understand, gave them more knowledge and learning in this way allows them to understand faster. The result was support from the previous study, Koenke and Otto [231] indicated that comprehension of main ideas is enhanced by attractive tool for example illustrations. Moreover, most participants strongly agreed with comment that this website should be released to the public in the future and the education on website is the need for current and future generations.

Relationship between frequency of access the website, frequency of food record and weight reduction

The results indicated that participants who reduced weight $\geq$ 1 kg during 6 weeks were accessed the website $\geq$ 3 time/week. It is the same as frequency of food record, participant reduced weight $\geq$ 1 kg during 6 weeks have frequency of food record $\geq$ 1 times/week. It seemed to be that the more they access the website and record diet intake, the more weight they lost. These results are consistent with the previous studies. Bennett GG at el. [258] conducted a 12-week randomized controlled trial to evaluate the short-term efficacy of a web-based weight loss intervention among 101 primary care patients with obesity and hypertension. The intervention's approach promoted moderate weight loss at 12 weeks, though greater weight loss was observed among those with higher levels of website utilization. Several studies have found good correlations between self-monitoring and weight loss [166,167] and maintenance [168,169]. The frequency of dietary self-monitoring is an important predictor of success with weight loss. Streit et al. [259] reported that monthly as well as cumulative weight loss was directly related to the number of days in which food records were kept. Baker & Kirschenbaum [260] found in their research that the more consistently participants self-monitored the more weight they lost and that the accuracy of the information was not as important as self-focusing attention on the behavior. Many study indicated that self-monitoring of food intake is associated with a decrease in food intake and subsequent weight loss. Therefore, when it comes to weight management, consistent self-monitoring seems to contribute to the desired outcome of weight loss more than accurate self-monitoring [261-263].

Correlation between total cholesterol, triglyceride, HDL-C, systolic blood pressure and weight reduction

The correlation between total cholesterol, triglyceride, HDL-C, and weight reduction were not found whereas the correlation between systolic blood pressure and weight reduction was positive relationship. Because of mean total cholesterol, triglyceride and HDL-C were in the normal criteria at baseline whereas mean systolic blood pressure was in the high level. Mean total cholesterol, triglyceride and HDL-C

were in the normal criteria at baseline therefore, weight reduction had little effect on change in blood lipid levels. For systolic blood pressure, mean systolic blood pressure was in the high level at baseline and significantly decrease at week 7. The positive relationship between systolic blood pressure and weight reduction was the same as the previous study which presented that weight loss has been shown to reduce blood pressure in overweight hypertensive patients [264-265] and in overweight persons with high blood pressure [266-267].

Correlation between age, frame size, dietary behavior score and exercise behavior score and weight change

The results of twenty six participants who loosed weight showed that the correlation of age and frame size with weight reduction was not found. This result indicated that there was no relationship between weight reduction and age and also frame size in this study. It is interesting that the weight loss in the younger did not differ when compared with the older and the genetic factor as frame size did not relate amount of weight reduction whereas the increment of dietary behavior showed the positive relationship with weight reduction. This result indicated that participants who improved their dietary behavior led to lose more weight and the environmental factor as dietary behavior associated with weight reduction more than genetic factor as frame size. Moreover, there was no relationship between exercise behavior and weight reduction. According to the exercise behavior score at week 7, the score significantly increase but none of participant had high score and most of them (59%) still had low score. The resulted indicated that most participants improved exercise behavior but was not enough to cause weight reduction. In conclusion, the developed nutritional education tool can convince the participants to improve their dietary behavior and led them to lose weight.

CHAPTER VII
CONCLUSION

The study is conducted to develop a multimedia website nutrition education tool based on concept of NHLBI Recommendation and health belief model and to evaluated the effectiveness of the developed educational tool by experts.

The multimedia website nutrition educational tool named fitbymyself.com which was composed of 16 main pages including home page, six lessons for weight management, exercises, web board, meal plan, calorie burn calculator, weight and food record, weight loss menu, personal's folder, contact us and games. Six lessons for weight management presented knowledge about obesity, dietary and exercise, definition and causes of obesity, chronic diseases relate to obesity, food exchange, choosing low fat, low calorie diets in six food groups, food labels, calories in one-plate dishes, shopping low fat, low calorie diets, benefits of regularly exercise, advice on exercise, aerobic exercise, walking and jogging programs.

The six weeks nutrition education model was designed for 39 overweight and obese people to evaluate the subject's knowledge of nutrition for weight loss, stage of change, nutrition status, dietary and exercise behavior and the overall satisfaction of the subjects with the developed education tool were also determined.

The subjects learn by themselves and can contract the researcher and the other participants via the developed website.

The results from the study, showed that

1. The developed multimedia website nutrition educational tool could improve the knowledge of overweight and obese people.

2. Stage of change of the subjects improved significantly compared with the baseline.

3. Weight, BMI and waist circumference decreased significantly after 6 weeks compared to the baseline. There were a tendency of lower body fat percentage and visceral fat level but no significant change.

4. Total cholesterol, triglyceride and systolic blood pressure were significantly decreased. HDL cholesterol was significantly increased whereas fasting plasma glucose, LDL cholesterol and diastolic blood pressure were not significant change after 6 week but all of them were in the normal level.

5. Energy, carbohydrate and fat intake decreased significantly. Percentage of protein intake was increased significantly and percentage of fat intake was decreased significantly in the recommendation while percentage of carbohydrate did not change and remained in the recommendation.

6. Dietary and exercise behavior increased significantly after 6 weeks compared to the baseline.

7. Most participants were satisfied and agree that the developed website provides benefits in reducing weight and they would like this website to be released to the public in the future.

8. The relationship between weight loss and frequency of access the website and food record were found. Participants who reduced weight $\geq$ 1 kg during 6 weeks were accessed the website $\geq$ 3 time/week. It is the same as frequency of food record, participants reduced weight $\geq$ 1 kg during 6 weeks have frequency of food record $\geq$ 1 times/week.

In conclusion, the developed multimedia website nutrition educational tool is acceptable as an attractive learning tool for adult overweight and obese people and help to improve the knowledge and understanding of nutrition for weight management. Learning via the developed multimedia website can improve stage of change, dietary and exercise behavior and nutrition status. In addition, the result

supported that the more participants access the website and do diet record, the more weight they lost.

Recommendations for further study

1. Evaluation of the effectiveness of the developed website nutrition educational tool should be conducted for weight loss and weight maintenance in a longer time with a larger sample size.

2. The developed website nutrition education should be compared to traditional education in order to determine the results of weigh loss between the two interventions.

3. The developed website nutrition educational tool should be studied and applied for overweight and obese people with chronic diseases (type 2 diabetes, hypertension, dyslipidemia).

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APPENDICES

APPENDIX A

COA. No. MU-IRB 2009/290.2611

Documentary Proof of Mahidol University Institutional Review Board

Title of Project: Research and Development of Interactive Web-based Education on Nutrition for Overweight and Obese Thai People (Thesis for Master Degree)

Principle Investigator: Miss Tisana Chanyachailert

Name of Institution: Institute of Nutrition

Approval includes: 1) MU-IRB Submission form version received date 24 November 2009
2) Participant Information Sheet version date 24 November 2009
3) Informed Consent form version 24 November 2009
4) Questionnaire version received date 24 November 2009

Mahidol University Institutional Review Board is in full compliance with International Guidelines for Human Research Protection such as Declaration of Helsinki, The Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

Date of Approval: 26 November 2009

Date of Expiration: 25 November 2010

Signature of Chairman: .....
(Professor Shusee Visalyaputra)

Signature of Head of the Institute: .....
(Associate Professor Sansanee Chaiyaroj)
Vice President for Research and Academic Affairs

Office of the President, Mahidol University, 999 Phuttamonthon 4 Rd., Salaya, Phuttamonthon District, Nakhon Pathom 73170. Tel. (662) 8496223-5 Fax. (662) 8496223

APPENDIX B

แบบสรุปการประเมินคุณภาพสื่อการสอนทางโภชนาการผ่านอินเทอร์เน็ต สำหรับผู้เชี่ยวชาญ

คำชี้แจง: โปรดแสดงความคิดเห็น โดยกาเครื่องหมาย X ลงในช่องระดับความคิดเห็นตา ความหมายของระดับคุณภาพของสื่อการสอนทางโภชนาการผ่านอินเทอร์เน็ต

ซึ่งกำหนดเกณฑ์ตัดสินคุณภาพเป็น 5 ระดับ ดังนี้
ระดับ 9-10 หมายถึง ดีมาก ระดับ 7-8 หมายถึง ระดับดี ระดับ 5-6 หมายถึง พอใช้
ระดับ 3-4 หมายถึง ควรปรับปรุง ระดับ 1-2 หมายถึง ไม่เหมาะสม

รายการประเมิน	ระดับความคิดเห็น									
	ดีมาก		ดี		พอใช้		ปรับปรุง		ไม่เหมาะสม	
	10	9	8	7	6	5	4	3	2	1
1. เนื้อหา และการนำเสนอ										
1.1 เนื้อหาในบทเรียนครอบคลุมวัตถุประสงค์										
1.2 ความถูกต้องของเนื้อหา										
1.3 การจัดลำดับเนื้อหามีความเหมาะสม										
1.4 ความน่าสนใจของเนื้อหาบทเรียน										
1.5 เนื้อหาเหมาะสมสำหรับผู้เรียน										

รายการประเมิน	ระดับความคิดเห็น									
	ดีมาก		ดี		พอใช้		ปรับปรุง		ไม่เหมาะสม	
	10	9	8	7	6	5	4	3	2	1
2. ภาพ และการใช้ภาษา										
2.1 ภาพที่ใช้ประกอบบทเรียนตรงตามเนื้อหา										
2.2 ภาพที่ใช้ประกอบบทเรียนสามารถดึงดูดความสนใจของผู้เรียน										
2.3 การสื่อความหมายและภาษาที่ใช้มีความเหมาะสม										
3. การออกแบบจอภาพ										
3.1 แบบอักษรชัดเจน										
3.2 ขนาดตัวอักษรเหมาะสม										
3.3 สีตัวอักษรเหมาะสม										
3.4 สีพื้นจอภาพเหมาะสม										
4. การจัดการในบทเรียน										
4.1 ความต่อเนื่องของการนำเสนอเนื้อหา										
4.2 ผู้เรียนมีส่วนร่วมกับบทเรียน										
5. รูปแบบการใช้งานในห้องสนทนา										
6. รูปแบบการใช้งานในหัวข้อมาวางแผนการลดน้ำหนักกันเถอะ										
6.1 วางแผนการลดน้ำหนัก										
6.2 การเผาผลาญพลังงาน										
6.3 บันทึกการรับประทานอาหาร										
6.4 เมนูอาหารลดน้ำหนัก										

รายการประเมิน	ระดับความคิดเห็น									
	ดีมาก		ดี		พอใช้		ปรับปรุง		ไม่เหมาะสม	
	10	9	8	7	6	5	4	3	2	1
7. รูปแบบการใช้งานในแฟ้มข้อมูล										
7.1 การแสดงข้อมูลส่วนตัว										
7.2 กราฟบันทึกน้ำหนักที่เปลี่ยนแปลง										
7.4 การบันทึกข้อมูลรูปแบบการวางแผนการลดน้ำหนัก										
7.5 การบันทึกข้อมูลอาหารที่รับประทานในแต่ละวัน										
8. เกม										
9. การติดต่อกับผู้วิจัย										

ข้อเสนอแนะ……

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ลงชื่อ……ผู้ประเมิน

(……..)

APPENDIX C

แบบสอบถามประวัติเบื้องต้น

คำชี้แจง กรุณากรอกข้อความลงในช่องว่าง และ/หรือเลือกคำตอบหน้าข้อความที่ตรงกับความเป็นจริงของท่านมากที่สุด

ก. ข้อมูลทั่วไป

1. ชื่อ……. นามสกุล…… เพศ ( ) ชาย () หญิง
   วัน/เดือน/ปีเกิด……อายุ……

2. สถานภาพ ( ) โสด ( ) สมรส

3. ศาสนา ( ) พุทธ ( ) คริสต์
   ( ) อิสลาม ( ) อื่นๆระบุ…….

4. วุฒิการศึกษา ( ) ประถมศึกษา ( ) มัธยมศึกษาตอนต้น
   ( ) มัธยมศึกษาตอนปลาย/ปวช. ( ) ประถมศึกษา
   ( ) ปริญญาตรี ( ) สูงกว่าปริญญาตรี
   ( ) อื่นๆ ระบุ…….

5. อาชีพ ( ) รับราชการ ( ) รัฐวิสาหกิจ
   ( ) พนักงานบริษัท ( ) ค้าขาย/ธุรกิจส่วนตัว
   ( ) รับจ้าง/อาชีพอิสระ ( ) นักศึกษา
   ( ) อื่นๆ ระบุ…….....

6. รายได้เฉลี่ย (บาท/เดือน) ( ) ≤ 10,000 ( ) 10,001-20,000
( ) 20,001-30,000 ( ) 30,001-40,000
( ) 40,001-50,000 ( ) 50,001-60,000
( ) ≥ 60,001

ข. ประวัติโรคประจำตัวในครอบครัว

1. ท่านมีโรคประจำตัวหรือไม่

□ ไม่มี □ มี ระบุ……..

2. คนในครอบครัวของท่านมีโรคประจำตัวหรือไม่ □ ไม่มี(ข้ามไปข้อ ค.) □ มี

3. คนในครอบครัวของท่านคือใคร และมีโรคประจำตัวอะไร

( ) บิดา/มารดา ระบุ……/……
( ) ปู่/ย่า ระบุ……/……
( ) ตา/ยาย ระบุ……/……
( ) ญาติ ระบุ……/……

ค. ประวัติน้ำหนักในครอบครัว

1. ปัจจุบันท่านอาศัยอยู่กับ ( ) บิดามารดา ( ) ญาติ ( ) อื่นๆระบุ……
จำนวนคนที่อาศัยอยู่ในบ้านเดียวกัน.....คน (รวมทั้งตัวท่านด้วย)

2. ความคิดเห็นของท่านจากการประเมินรูปร่างของคนในครอบครัว

น้ำหนัก (กก.)/ส่วนสูง (ซม.)	อ้วน	ปกติ	ผอม
บิดา……/……	( )	( )	( )
มารดา……/……	( )	( )	( )

จำนวนพี่น้อง (พ่อแม่เดียวกัน)……...คน อ้วน……คน
ปกติ……คน
ผอม……คน

<u>ง. ประวัติการลดน้ำหนัก</u>

1. ท่านเคยลดน้ำหนักหรือไม่ ( ) เคย ลดน้ำหนักด้วยวิธีใด ระบุ……..
ระยะเวลาในการลดน้ำหนัก…….เดือน……..ปี
( ) ไม่เคย (ข้ามไปข้อ จ.)

2. ผลการลดน้ำหนักเป็นอย่างไร
( ) น้ำหนักลดลง…….กก. ( ) น้ำหนักไม่ลดลง ( ) น้ำหนักเพิ่มขึ้น…….กก.

3. ระหว่างที่ลดน้ำหนักท่านรู้สึกอย่างไร (ตอบได้มากกว่า 1 ข้อ)
( ) หิวโหย ( ) เบื่ออาหาร ( ) หงุดหงิด ( ) สบายๆ ( ) อื่นๆ ระบุ……...

<u>จ. ความคิดเห็นเกี่ยวกับน้ำหนักตัว</u>

1. ขณะนี้ท่านคิดว่าน้ำหนักตัวอยู่ในระดับใด
( ) ปกติ ( ) อ้วนเล็กน้อย ( ) อ้วนปานกลาง ( ) อ้วนมาก

2. ท่านเคยถูกเพื่อนล้อเลียนเกี่ยวกับความอ้วนหรือไม่
( ) เคย ( ) ไม่เคย (ข้ามไปข้อ 4)

3. ถ้าเคยถูกล้อเลียนท่านรู้สึกอย่างไร
( ) เฉยๆ ( ) โกรธ ( ) ไม่ชอบ ( ) อื่นๆ ระบุ……

4. เหตุผลที่ต้องการลดน้ำหนักได้แก่อะไรบ้าง <u>(ตอบได้มากกว่า 1 ข้อ)</u>
( ) ต้องการมีสุขภาพแข็งแรง
( ) ต้องการมีรูปร่างสมส่วนสวยงาม
( ) ต้องการมีความคล่องตัวในการเคลื่อนไหว
( ) เพื่อเสริมสร้างบุคลิกภาพให้เป็นที่ดึงดูดใจ
( ) เพื่อสะดวกในการเลือกซื้อเสื้อผ้า แต่งตัวได้สวยงาม
( ) ไม่ต้องการถูกเพื่อนล้อเลียน
( ) อื่นๆ ระบุ……..

ฉ. ความคิดเห็นเรื่องการลดน้ำหนักก่อนการเข้าร่วมโครงการ (ตอบเพียง 1 ข้อ)

( ) ยังไม่มีความคิดที่จะลดน้ำหนักใน 6 เดือนข้างหน้าแต่ต้องการเข้าร่วมโครงการวิจัยเพื่อค้นคว้าหาความรู้เพิ่มเติม

( ) มีความคิดที่จะลดน้ำหนักใน 6 เดือนข้างหน้า และต้องการเข้าร่วมโครงการวิจัยเพื่อค้นคว้าหาความรู้เพิ่มเติม

( ) วางแผนที่จะลดน้ำหนักอยู่แล้ว ระบุช่วงเวลา_____

( ) กำลังลดน้ำหนักโดยควบคุมอาหารและ หรือเพิ่มการออกกำลังกาย

( ) น้ำหนักลดลงจากเดิม และ/หรือ ยังคงน้ำหนักที่ลดได้มากกว่า 6 เดือน

แบบบันทึกการบริโภคอาหาร 3 วัน

รายการอาหารวันที่ _____ ถึงวันที่ _____

ข้อแนะนำในการบันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง :

1. แบบบันทึกการบริโภคอาหาร 3 วัน จะต้องครอบคลุมการบริโภคทั้งในวันธรรมดาและวันหยุดสุดสัปดาห์ ดังนั้นจึงขอความร่วมมือให้บันทึกการบริโภคอาหารในวันธรรมดาเป็นเวลา 2 วัน และในวันหยุดเสาร์-อาทิตย์ เป็นเวลา 1 วัน
2. บันทึกอาหารทุกชนิดรวมทั้งขนมและเครื่องดื่มที่รับประทานตลอดวัน ตั้งแต่ตื่นนอน จนเข้านอน (บันทึกเฉพาะปริมาณที่รับประทานเท่านั้น)
3. บันทึกอาหารที่รับประทานทั้งที่บ้านและนอกบ้าน
4. ข้อความต่อไปนี้เป็นสิ่งจำเป็นในการบันทึก
    - ระบุส่วนประกอบของอาหารแต่ละชนิด พร้อมทั้งปริมาณหรือปริมาตร โดยของแข็งให้ ขนาดเล็ก กลาง ใหญ่ หรือขนาดกว้าง ยาวของอาหาร ยกตัวอย่างเช่น ผัดเปรี้ยวหวาน: ควรระบุว่า รับประทานแตงกวาประมาณ 4 ช้อนโต๊ะ (หรือ 1 ทัพพี) มะเขือเทศ 2 ช้อนโต๊ะ เนื้อหมู 2 ช้อนโต๊ะ หรือระบุว่ารับประทานแตงกวาประมาณครึ่งลูกใหญ่ มะเขือเทศ 1 ลูกเล็ก เนื้อหมู 5 ชิ้น ขนาดชิ้นละ 1x2 ซม. เครื่องดื่ม: ควรระบุเป็นปริมาตร หรือขนาด เช่น โคล่า 1 ขวดกลาง หรือ 290 ซีซี เป็นต้น
    - ระบุเป็นช้อนตวงหรือทัพพี ส่วนของเหลวให้ระบุปริมาตรเป็นซีซี หรือระบุตามที่ตวง-วัดที่ใช้อยู่ ที่บ้านถ้าไม่สามารถประมาณปริมาณได้ให้พยายามบันทึกในรูปขนาดทดแทน เช่น อาหารที่รับประทานปรุงอย่างไร เช่น ปลาทูทอด ไก่ย่าง ไข่ต้ม
    - การเติมน้ำตาล น้ำเชื่อมหรือกะทิลงในเครื่องดื่ม อาหารของหวานชนิดต่างๆ ให้ระบุปริมาณด้วย เช่น น้ำตาล 2 ช้อนชา ในกาแฟ 1 ถ้วย

ตัวอย่างการบันทึกอาหาร

แบบบันทึกอาหารที่รับประทานใน 24 ชั่วโมง

วันที่ อังคาร ที่ 20 มกราคม 2553

มื้ออาหาร และสถานที่	***เวลา***	**ประเภท**	**ส่วนประกอบอาหาร**	**ปริมาณ**
เช้า	7.00 น.	ขนมปังทาแยม	ขนมปัง	2 แผ่น
ที่บ้าน			แยมสตรอเบอรี่	2 ช้อนโต๊ะ
		ไข่ดาว	ไข่ไก่	1 ฟอง
		กาแฟ	กาแฟ	1 ช้อนชา
			ครีมเทียม	2 ช้อนชา
			น้ำตาล	2 ช้อนชา
เที่ยง	12.10 น.	บะหมี่น้ำ	บะหมี่	2 ก้อน
ที่ทำงาน			หมูสับ	2 ช้อนโต๊ะ
			ลูกชิ้น	2 ลูก
			กระเทียมเจียว	1 ช้อนโต๊ะ
		เปปซี่	เปปซี่ กระป๋อง	1 กระป๋อง, 325 cc.
อาหารว่าง	14.30 น.	ฝรั่ง	ฝรั่ง	1 ผลกลาง
ที่ทำงาน		สัปปะรด	สัปปะรด ขนาด 5 x 13 ซม.	1 ชิ้น
			เกลือ+น้ำตาล	2 ช้อนโต๊ะ
เย็น	18.30 น.	ข้าวกระเพราไก่	ข้าวสวย	3 ทัพพี
ที่บ้าน			เนื้อไก่สับ	2 ช้อนโต๊ะ
		ไข่ดาว	ไข่ไก่	1 ฟอง
			น้ำมันรำข้าว	3 ช้อนโต๊ะ
		นม	นมพร่องมันเนย	1 กล่อง, 250 cc.

คำแนะนำ: แถบสเกล สำหรับเปรียบเทียบขนาด (กว้าง-ยาว) หน่วยเป็น ซม. โดยเทียบช่องละ 1 เซนติเมตร จากขอบทั้ง 2 ขอบของอาหารชิ้นนั้น

1	2	3	4	5	6	7	8	9	10	11	12	13	14

<u>แบบบันทึกอาหารที่รับประทานใน 24 ชั่วโมง (บันทึก 3 วัน)</u>

วันที่ _____

มื้ออาหาร และสถานที่	***เวลา***	**ประเภท**	**อาหาร**	**ปริมาณ**

<u>คำแนะนำ:</u> แถบสเกล สำหรับเปรียบเทียบขนาด (กว้าง-ยาว) หน่วยเป็น ซม. โดยเทียบช่องละ 1 เซนติเมตร จากขอบทั้ง 2 ขอบของอาหารชิ้นนั้น

1	2	3	4	5	6	7	8	9	10	11	12	13	14

APPENDIX D

แบบสอบถามพฤติกรรมการควบคุมตนเองเพื่อการลดน้ำหนัก

คำชี้แจงในการตอบแบบสอบถาม

ข้อความในแบบสอบถามนี้ไม่มีข้อใดถูกหรือผิด เป็นแบบสอบถามที่ต้องการทราบการกระทำหรือปฏิบัติตน ด้านการออกกำลังกาย และการรับประทานอาหาร ของผู้ที่มีภาวะน้ำหนักเกินและโรคอ้วน ขอให้ท่านพิจารณาว่าท่านกระทำหรือปฏิบัติตนในแต่ละข้อมีความถี่มากน้อยเพียงใดตามความเป็นจริง เพื่อประโยชน์ในการวิจัย

โปรดอ่านข้อความในแต่ละข้อแล้วทำเครื่องหมาย X ลงในช่องหลังข้อความข้อความที่ตรงกับการปฏิบัติของท่านเพียงข้อละ 1 คำตอบ และกรุณาตอบทุกข้อ การเลือกตอบมีเกณฑ์ดังนี้

ไม่เคยเลย	หมายถึง ในระยะ 3 เดือนที่ผ่านมาไม่เคยทำเลย
นานๆครั้ง	หมายถึง ในระยะ 3 เดือนที่ผ่านมาเคยทำสัปดาห์ละ 1 ครั้ง หรือน้อยกว่า
บางครั้ง	หมายถึง ในระยะ 3 เดือนที่ผ่านมาเคยทำสัปดาห์ละ 2 ครั้ง
บ่อยครั้ง	หมายถึง ในระยะ 3 เดือนที่ผ่านมาเคยทำสัปดาห์ละ 3 ครั้ง
ประจำ	หมายถึง ในระยะ 3 เดือนที่ผ่านมาเคยทำสัปดาห์ละ 4 ครั้งขึ้นไป

ตัวอย่าง

กิจกรรม	**ความถี่ของพฤติกรรม**				
	ไม่เคยเลย	**นานๆครั้ง**	**บางครั้ง**	**บ่อยครั้ง**	**ประจำ**
ไปดูหนังกับเพื่อน		X			

ก. แบบสอบถามพฤติกรรมการออกกำลังกาย

คำชี้แจง ทำเครื่องหมาย X ลงในช่องที่ตรงกับตัวท่านมากที่สุด

กิจกรรม	ความถี่ของพฤติกรรม				
	ไม่เคยเลย	นานๆครั้ง	บางครั้ง	บ่อยครั้ง	ประจำ
1. ออกกำลังกายอย่างน้อยครั้งละ 15 นาที					
2. เดินขึ้นลงบันไดแทนการใช้ลิฟท์					
3. ออกกำลังกายพร้อมๆเพื่อน					
4. ออกกำลังกายคนเดียว					
5. มีความสุขในการออกกำลังกาย					
6. รู้สึกเกียจคร้านในการออกกำลังกาย					
7. รู้สึกเบื่อหน่ายในการออกกำลังกาย					
8. หลังออกกำลังกายจะดื่มน้ำเปล่า					
9. หลังออกกำลังกายจะดื่มน้ำอัดลม น้ำผลไม้รสหวาน หรือน้ำหวาน					
10. ออกกำลังกายด้วยการเดินเร็วๆ นานกว่า 30 นาที					
11. ออกกำลังกายด้วยการวิ่งนานกว่า 30 นาที					
12. ออกกำลังกายด้วยการขี่จักรยาน นานกว่า 30 นาที					
13. ออกกำลังกายด้วยการเล่นปิงปอง วิ่ง นาน กว่า 30 นาที					
14. ออกกำลังกายด้วยการเล่นแบดมินตัน วิ่งนานกว่า 30 นาที					

กิจกรรม	ความถี่ของพฤติกรรม				
	ไม่เคยเลย	นานๆครั้ง	บางครั้ง	บ่อยครั้ง	ประจำ
15. ออกกำลังกายด้วยการเล่นเทนนิสนานกว่า 30 นาที 16. ออกกำลังกายด้วยการเล่นฟุตบอลนานกว่า 30 นาที 17. ออกกำลังกายด้วยการว่ายน้ำนานกว่า 30 นาที 18. ออกกำลังกายด้วยการทำกายบริหารนานกว่า 30 นาที 19. ออกกำลังกายด้วยการวิดพื้นนานกว่า 30 นาที 20. ทำงานบ้าน รดน้ำต้นไม้นานมากกว่า 30 นาที					

ข. แบบสอบถามพฤติกรรมการรับประทานอาหาร

คำชี้แจง ทำเครื่องหมาย X ลงในช่องที่ตรงกับตัวท่านมากที่สุด

กิจกรรม	ความถี่ของพฤติกรรม				
	ไม่เคยเลย	นานๆครั้ง	บางครั้ง	บ่อยครั้ง	ประจำ
1. จดบันทึกการกินอาหารทุกวัน					
2. ให้รางวัลตนเองด้วยการกิน					
3. กินอาหารขณะดูโทรทัศน์ ดูวีดีโอ					
4. กินอาหารตามร้านอาหารที่ชอบ					
5. กินอาหารกับคนรู้ใจ หรือเพื่อนสนิท					
6. กินอาหารเฉพาะที่ห้องครัวหรือโต๊ะอาหาร					
7. กินอาหารหมดจานทุกครั้ง					
8. ขณะกินอาหารไม่ทำกิจกรรมอื่น (ยกเว้นพูดคุย)					
9. เหลืออาหารติดจานไว้บ้าง					
10. เคี้ยวอาหารไม่ละเอียดรีบกลืน					
11. กินอาหารช้าเคี้ยวละเอียดก่อนกลืน					
12. ลุกจากโต๊ะอาหารทันทีหลังอิ่มแล้ว					
13. ดื่มน้ำเปล่าก่อนกินอาหาร					
14. กินอาหารเมื่อรู้สึกหิวเท่านั้น					
15. ไม่เคยปฏิเสธการกินเมื่อถูกชวน					
16. กินอาหารอิ่มก่อนคนอื่น					
17. กินอาหารหรือดื่มเครื่องดื่มก่อนนอน					
18. กินอาหารว่าง					
19. กินอาหารจานด่วน(Fast Food) เช่น แม็คโดนัลด์ เคเอฟซี พิซซ่า					

กิจกรรม	ความถี่ของพฤติกรรม				
	ไม่เคยเลย	นานๆครั้ง	บางครั้ง	บ่อยครั้ง	ประจำ
20. ดื่มน้ำอัดลมชนิดต่างๆ น้ำผลไม้หรือน้ำหวาน 21. กินขนมกรุบกรอบ ขนมซอง ขนมถุง 22. กินขนมหวานชนิดต่างๆ 23. กินอาหารทอด ผัด อาหารมันๆ 24. กินอาหารคาวที่ใส่กะทิ 25. กินอาหารที่มีไขมันน้อย เช่น น้ำพริก ผักลวก แกงจืด แกงส้ม ต้มยำ 26. กินผักและผลไม้ที่มีเส้นใยและกากอาหารมาก เช่น ส้ม สับปะรด ชมพู่ ฝรั่ง 27. กินเนื้อสัตว์ติดมัน เช่น ขาหมูพะโล้ หมูกรอบ คอหมูย่าง 28. กินเนื้อสัตว์ไม่ติดมัน เช่น สันใน หมู สันในไก่ 29. ดื่มนมพร่องมันเนยแทนนมจืด 30. อดอาหารมื้อเช้าหรือเย็นเพื่อลดน้ำหนัก 31. เก็บตุนอาหารไว้กิน 32. กินอาหารอิ่มเป็นคนสุดท้าย 33. เมื่อรู้สึกเซ็ง เครียด หรือวิตกกังวล มักจะกินอาหารเพื่อให้เกิดความสุข 34. ดื่มนมรสหวาน (เช่นนมเปรี้ยว นมรสช็อคโกแล็ต สตอเบอรี่) 35. ดื่มนมรสจืด					

APPENDIX E

แบบประเมินความรู้

<u>โครงการวิจัยเรื่อง</u> การวิจัยและพัฒนาสื่อการสอนทางโภชนาการผ่านเว็บไซต์สำหรับคนไทยที่มีภาวะน้ำหนักเกินและโรคอ้วน

จงทำเครื่องหมาย X เลือกคำตอบที่ถูกต้องเพียงคำตอบเดียว

ข้อ 1. โรคอ้วนมีสาเหตุมาจากการกินที่ไม่สมดุลหมายความว่าอย่างไร?

ก. พลังงานที่กิน <u>มากกว่า</u> พลังงานที่ใช้

ข. พลังงานที่กิน <u>น้อยกว่า</u> พลังงานที่ใช้

ค. พลังงานที่กิน <u>เท่ากับ</u> พลังงานที่ใช้

ง. ผิดทุกข้อ

ข้อ 2. ชายและหญิงควรมีเส้นรอบเอวเท่าใด?

ก. $\leq$ 85 เซนติเมตร ในชาย และ $\leq$ 95 เซนติเมตร ในหญิง

ข. $\leq$ 95 เซนติเมตร ในชาย และ $\leq$ 85 เซนติเมตร ในหญิง

ค. $\leq$ 80 เซนติเมตร ในชาย และ $\leq$ 90 เซนติเมตร ในหญิง

ง. $\leq$ 90 เซนติเมตร ในชาย และ $\leq$ 80 เซนติเมตร ในหญิง

ข้อ 3. ค่าดัชนีมวลกาย (BMI) สามารถคำนวณได้จากสูตรใด?

ก. น้ำหนัก(กิโลกรัม)/ส่วนสูง^2 (เซนติเมตร)

ข. น้ำหนัก(กิโลกรัม)/ส่วนสูง (เซนติเมตร)

ค. น้ำหนัก(กิโลกรัม)/ส่วนสูง^2 (เมตร)

ง. น้ำหนัก(กิโลกรัม)/ส่วนสูง (เมตร)

ข้อ 4. แก้วมี BMI=23 หมายความว่าอย่างไร?

ก. แก้วมีน้ำหนักต่ำกว่าปกติ
ข. แก้วมีน้ำหนักปกติ
ค. แก้วมีภาวะน้ำหนักเกิน
ง. แก้วเป็นโรคอ้วนระดับที่ 1

ข้อ 5. ผู้ที่มีภาวะน้ำหนักเกิน และผู้ที่เป็นโรคอ้วนมีความเสี่ยงที่จะเป็นโรคใดต่อไปนี้?

ก. โรคเบาหวาน และ โรคไขมันในเลือดสูง
ข. โรคหัวใจ และ โรคเส้นเลือดในสมองตีบ
ค. โรคนิ่วในถุงน้ำดี และ โรคความดันโลหิตสูง
ง. ทุกโรคเป็นความเสี่ยงของโรคอ้วน

ข้อ 6. ข้อใดแสดงค่าปกติ ?

ก. คลอเลสเตอรอลรวม (Total cholesterol) < 200 mg/dL
ข. เอชดีแอล โคเลสเตอรอล (HDL-C) > 40 mg/dL ในเพศชาย
ค. ไตรกลีเซอไรด์ (TG) < 150 mg/dL
ง. ถูกทุกข้อ

ข้อ 7. ระดับน้ำตาลก่อนอาหาร (Fasting Plasma Glucose, FPG) ที่ต่ำที่สุดเท่าใดที่แสดงว่าเป็นโรคเบาหวาน?

ก. 90 mg/dL
ข. 100 mg/dL
ค. 150 mg/dL
ง. 200 mg/dL

ข้อ 8. ข้าว-แป้งชนิดใดให้พลังงานต่ำที่สุดในปริมาณที่เท่ากัน?

ก. ข้าวสวย
ข. วุ้นเส้น
ค. ก๋วยเตี๋ยวเส้นใหญ่
ง. ข้าวเหนียว

ข้อ 9. ข้อใดจัดเป็นอาหารที่มีคลอเลสเตอรอลต่ำที่สุด?

ก. เครื่องในสัตว์

ข. ไข่ขาว

ค. ไส้กรอกไก่

ง. ไข่ปลา

ข้อ 10. เลือกดื่มนมชนิดใดให้พลังงานต่ำที่สุด?

ก. นมเปรี้ยวรสส้ม 1 แก้ว

ข. นมรสหวานชนิดพร่องมันเนย 1 แก้ว

ค. นมรสจืดชนิดขาดมันเนย 1 แก้ว

ง. นมผสมธัญพืช 1 แก้ว

ข้อ 11. ข้อใดผิด?

ก. ผักใบเขียวให้พลังงานต่ำ ใยอาหารสูง ช่วยให้อิ่มและช่วยลดการดูดซึมไขมัน

ข. ฟักทองเป็นผักที่มีประโยชน์และสามารถรับประทานได้ไม่จำกัด

ค. แตงกวา บวบ ผักบุ้ง และใบโหระพาให้พลังงานต่ำ สามารถรับประทานได้ไม่จำกัด

ง. ข้าวโพด 1 ฝักใหญ่ให้พลังงานเท่ากับข้าว 2 ทัพพี

ข้อ 12. ข้อใดถูกต้อง?

ก. น้ำมันรำข้าวและน้ำมันปาล์มประกอบด้วยไขมันที่มีประโยชน์ชนิดเดียวกัน

ข. เบคอนเป็นอาหารประเภทเนื้อสัตว์

ค. ไข่ดาวให้พลังงานมากกว่าไข่เจียว

ง. ถั่วลิสง 10 เม็ดให้พลังงานเท่ากับน้ำมัน 1 ช้อนชา

ข้อ 13. รับประทานผลไม้แบบไหน ให้น้ำตาลต่ำที่สุด ?

ก. น้ำองุ่นแท้ 100% 1 แก้ว

ข. ส้มเขียวหวานผลใหญ่ 1 ผล

ค. น้ำฝรั่งแท้ 100% 1 แก้ว

ง. ฝรั่งดองผลกลาง 1 ผล

ข้อ 14. ข้อใดไม่ใช่เนื้อสัตว์ไขมันสูง?

ก. หมูยอ
ข. ไส้กรอกไก่
ค. กุนเชียง
ง. ทุกข้อจัดเป็นเนื้อสัตว์ไขมันสูง

ข้อมูลโภชนาการ 1		
หนึ่งหน่วยบริโภค: ½ ซอง (18 กรัม) จำนวนหน่วยบริโภคต่อซอง: ประมาณ 2		
คุณค่าทางโภชนาการต่อหนึ่งหน่วยบริโภค พลังงานทั้งหมด 100 กิโลแคลอรี่ (พลังงานจากไขมัน 60 กิโลแคลอรี่)		
		ร้อยละของปริมาณที่แนะนำต่อวัน
ไขมันทั้งหมด	6 ก.	9%
ไขมันอิ่มตัว	4 ก.	20%
คลอเลสเตอรอล	0 มก.	20%

ข้อ 15. จากฉลากโภชนาการ1 เมื่อรับประทานขนมถุงนี้หมดถุง ร่างกายจะได้รับพลังงานทั้งหมดเท่าไร?

ก. 60 กิโลแคลอรี
ข. 100 กิโลแคลอรี
ค. 160 กิโลแคลอรี
ง. 200 กิโลแคลอรี

ข้อ 16. จากฉลากโภชนาการ1 เมื่อรับประทานขนมถุงนี้หมดถุง ร่างกายจะได้รับไขมันทั้งหมดเท่าไหร่ ?

ก. 18 กรัม

ข. 12 กรัม

ค. 9 กรัม

ง. 6 กรัม

ข้อมูลโภชนาการ2		
หนึ่งหน่วยบริโภค: 1/5 กล่อง (200 มล.) จำนวนหน่วยบริโภคต่อกล่อง: 5		
คุณค่าทางโภชนาการต่อหนึ่งหน่วยบริโภค พลังงานทั้งหมด 10 กิโลแคลอรี่ (พลังงานจากไขมัน 0 กิโลแคลอรี่)		
		ร้อยละของปริมาณที่แนะนำต่อวัน
คาร์โบไฮเดรต น้ำตาล 25 กรัม	27 ก.	9%

ข้อ 17. จากฉลากโภชนาการ2 เมื่อดื่มน้ำผลไม้ชนิดนี้ 1 แก้ว (200 มล.) ร่างกายจะได้รับน้ำตาลทั้งหมดกี่กรัม?

ก. 25 กรัม

ข. 50 กรัม

ค. 75 กรัม

ง. 125 กรัม

ข้อ 18. จากฉลากโภชนาการ2 เมื่อดื่มน้ำผลไม้ชนิดนี้1 แก้ว (200 มล.) ร่างกายจะได้รับน้ำตาลทั้งหมดประมาณกี่ช้อนชา?

ก. 4 ช้อนชา

ข. 5 ช้อนชา

ค. 6 ช้อนชา

ง. 8 ช้อนชา

ข้อ 19. ข้อใดถูกต้อง?

ก. สลัดน้ำข้นให้พลังงานมากกว่าสลัดน้ำใส

ข. ควรเลือกซื้อรับประทานอาหารสด มากกว่าอาหารแปรรูป

ค. บะหมี่ต้มยำหมูสับให้พลังงานมากกว่าเส้นหมี่ลูกชิ้นน้ำ

ง. ถูกทุกข้อ

ข้อ 20. อาหารในข้อใดให้พลังงานต่ำที่สุด?

ก. ก๋วยเตี๋ยวหลอด

ข. ขนมจีนน้ำเงี้ยว

ค. ข้าวคลุกกะปิ

ง. ข้าวไข่เจียวหมูสับ

APPENDIX F

แบบประเมินความพึงพอใจของผู้เข้าร่วมโครงการวิจัยที่มีต่อสื่อการสอนทางโภชนาการเพื่อการลดน้ำหนักผ่านทางเว็บไซต์

คำชี้แจง ให้ทำเครื่องหมาย x ในช่องระดับความคิดเห็น

5= เห็นด้วยมากที่สุด 4= เห็นด้วยมาก 3= ไม่แน่ใจ 2= ไม่เห็นด้วย 1= ไม่เห็นด้วยอย่างยิ่ง

ลำดับ	รายการ	ระดับความคิดเห็น				
		5	4	3	2	1
1	การเรียนด้วยสื่อการสอนผ่านทางเว็บไซต์ทำให้ท่านสนใจบทเรียนมากขึ้น					
2	ท่านรู้สึกสนุกกับบทเรียน					
3	บทเรียนมีลำดับขั้นตอนเข้าใจง่าย					
4	บทเรียนมีสีสันและการเคลื่อนไหวชวนติดตาม					
5	บทเรียนแบบนี้ทำให้สามารถศึกษาด้วยตนเองได้					
6	บทเรียนทำให้ท่านรู้สึกกระตือรือล้นในการเรียนมากขึ้น					
7	ท่านอยากให้ใช้สื่อการสอนนี้เผยแพร่ให้กับบุคคลทั่วไป					
8	การเรียนแบบนี้ควรที่จะมีการพัฒนาสำหรับโรคอื่นๆ					
9	การเรียนด้วยวิธีนี้ทำให้ท่านเข้าใจบทเรียนได้เร็วขึ้น					
10	บทเรียนแบบนี้มีความจำเป็นสำหรับยุคปัจจุบันและอนาคต					
11	บทเรียนทำให้ท่านมีความรู้มากขึ้น					
12	ท่านสามารถควบคุมการเรียนด้วยตนเองได้					
13	ท่านมีส่วนร่วมในการปฏิบัติกิจกรรม					
14	ท่านสามารถวางแผนการรับประทานอาหารเพื่อการลดน้ำหนักได้ด้วยตนเอง					
15	ท่านมีทัศนคติที่ดีต่อการออกกำลังกายมากขึ้น					
16	ท่านสามารถวางแผนการออกกำลังกายได้ด้วยตนเอง					

BIOGRAPHY

NAME	Miss. Tisana Chanyachailert
DATE OF BIRTH	September 8, 1984
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Chulalongkorn University, 2002 – 2006: Bachelor of Science (Chemistry) Mahidol University, 2007-2010: Master of Science (Food and nutrition for development)
HOME ADDRESS	133/25 Soi. Prasoet Manukit 29, Prasoet Manukit Road, Ladprao, Bangkok 10230
E-MAIL ADDRESS	tisane 734@hotmail.com