DEVELOPMENT OF A MULTIMEDIA WEBSITE EDUCATIONAL TOOL FOR SELF-HELP MEAL PLANNING USING A CARBOHYDRATE COUNTING CONCEPT IN TYPE 1 DIABETIC ADOLESCENTS

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ABSTRACT

Type 1 diabetes is a chronic disease and is increasing globally in adolescents. Medical nutrition therapy focuses on achieving blood glucose control and maintains normal growth, which can be accomplished through individualized meal planning on an educational website. Especially, carbohydrate counting allows for flexibility in food choices thereby making it more acceptable for preventing complications and increasing quality of life. However, educational websites are not available for Thai diabetics. The Internet can be applied as an interesting tool to enhance favorable knowledge outcomes across a wide variety of learners.

The primary objective was to develop the KINPORDEE website: a diabetes educational website for self-help meal planning in type 1 diabetic adolescents. The secondary objective was to evaluate the effectiveness of the developed tool by measuring knowledge, attitudes regarding diabetes self-care and meal planning using carbohydrate counting, and individual carbohydrate intake. Moreover, the subject's perception and satisfaction with this developed diabetes educational website developing each individual's meal planning knowledge were also assessed.

The KINPORDEE website consists of general information about diabetes self-care management and self-help guidelines for meal planning using basic carbohydrate counting with many online applications such as a self-nutrition assessment, food photo gallery, food exchange list, exercises, daily food intake record and glucose monitor and record. Thirty-four subjects with type 1 diabetics aged 14.32 ± 2.34 years were recruited from Ramathibodi Hospital to assess the effectiveness of this tool for 6 weeks with 4 period assignments. Subjects were asked to complete assignments and record their daily food intake electronically to assess the amount of carbohydrate choices.

Both knowledge and attitude score significantly improved ($p<0.01$) between Pre-and Post evaluation. At the end of the study, most subjects showed high knowledge and attitude level, (76.5% and 64.7% respectively). Carbohydrate counting knowledge from each assignment revealed that about half of the subjects had a medium knowledge level; surprisingly they had a high knowledge level in the final class activities. Most subjects (73.5%) had a carbohydrate intake under the recommended daily amount, with a mean of 3.41±2.93 carb choices per day. There was no significant difference of carbohydrate goal intake compliance between the baseline and final period. Mean HbA1C level was not significantly changed by the end of the study. However, there was a significant difference in the glycemic control among good and poor glycemic control subjects. Eleven percent of subjects showed more than 1% HbA1C improvement with a mean of 7.02 ± 0.79%. Moreover, most subjects (79.4%) had a moderate website compliance level of 1.98±1.19 hours/week. A majority of the subjects gave positive feedback regarding the overall aspects of the developed website; they especially appreciated the flexibility offered by self-learning.

In conclusion, this diabetes educational website is an attractive self-learning tool for type 1 diabetic adolescents. It encourages a positive effect on self-efficacy of both diabetes and dietary self-care, especially through the carbohydrate counting concept. It's important that active participation of patients is encouraged through cooperation between family members and the health care team.

KEY WORDS: TYPE 1 DIABETES/ CARBOHYDRATE COUNTING/
WEB-BASED INSTRUCTION

292 Pages

การพัฒนาเครื่องมือสื่อการสอนผ่านระบบเวปไซด์มัลติมิเดียเพื่อการเรียนรู้และวางแผนการบริโภคอาหารด้วยตนเองจากเทคนิคการนับหน่วยคาร์โบไฮเดรตในผู้ป่วยวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

DEVELOPMENT OF A MULTIMEDIA WEBSITE EDUCATIONAL TOOL FOR SELF-HELP MEAL PLANNING USING A CARBOHYDRATE COUNTING CONCEPT IN TYPE 1 DIABETIC ADOLESCENTS

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บทคัดย่อ

โรคเบาหวานชนิดที่ 1 คือโรคไม่ติดต่อเรื้อรังซึ่งพบมากขึ้นในเด็กและวัยรุ่น โดยเป้าหมายของโภชนบำบัดทางการแพทย์สำหรับผู้ป่วยกลุ่มนี้มุ่งเน้นให้ผู้ป่วยสามารถควบคุมระดับน้ำตาลในเลือดให้อยู่ในเกณฑ์เหมาะสม และส่งเสริมให้มีการเจริญเติบโตตามปกติ ดังนั้นการวางแผนการบริโภคอาหารจึงเป็นปัจจัยที่สำคัญต่อการอยู่กับเบาหวานได้อย่างปกติสุข โดยเฉพาะอย่างยิ่งเทคนิคการนับหน่วยคาร์โบไฮเดรตซึ่งช่วยในการวางแผนการรับประทานอาหารที่เหมาะสม สามารถยืดหยุ่นและปรับใช้ให้เข้ากับชีวิตประจำวันได้ ในประเทศไทยสื่อการเรียนรู้เพื่อการดูแลตนเองของผู้ป่วยเบาหวานชนิดที่ 1 โดยเฉพาะอย่างยิ่งวิธีการวางแผนการบริโภคอาหารจากเทคนิคการนับหน่วยคาร์โบไฮเดรตนั้นยังไม่ค่อยแพร่หลาย ดังนั้น การนำเอาบทเรียนบนเครือข่ายอินเตอร์เน็ตซึ่งใช้เวิลด์ไวด์เว็บเป็นสื่อในการเรียนการสอนสำหรับผู้ป่วยเบาหวานโดยประกอบด้วยเนื้อหา รูปภาพประกอบและภาพเคลื่อนไหวต่างๆ ที่เหมาะกับผู้ป่วยเด็กและวัยรุ่น เพื่อให้เกิดผลลัพท์ที่เหมาะสมในการดูแลเบาหวานด้วยตนเองจากการวางแผนการบริโภคอาหารอย่างเหมาะสม

วัตถุประสงค์หลักของการศึกษานี้คือการพัฒนาเวปไซต์เพื่อการเรียนรู้ด้วยตนเองสำหรับผู้ป่วยเด็กและวัยรุ่นที่เป็นเบาหวานชนิดที่ 1 ที่มุ่งเน้นการดูแลเบาหวานและวางแผนการบริโภคอาหารด้วยตนเอง นอกจากนี้ยังได้ศึกษาประสิทธิภาพของสื่อการเรียนรู้ที่พัฒนาขึ้นโดยประเมินระดับความรู้ และทัศนคติของผู้ป่วยในการดูแลเบาหวานและวางแผนการบริโภคอาหารด้วยตนเองในการใช้เทคนิคการนับหน่วยคาร์โบไฮเดรตรวมทั้งการปฏิบัติตัวเกี่ยวกับการบริโภคอาหารควบคู่ไปกับการประเมินความพึงพอใจของเครื่องมือสื่อการสอนที่พัฒนาขึ้น

เวปไซต์ที่พัฒนาประกอบด้วยความรู้ทั่วไปเกี่ยวกับโรคเบาหวานและอาหารเพื่อสุขภาพโดยเน้นถึงแนวทางการวางแผนการบริโภคอาหารด้วยตนเองจากการใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต ซึ่งประกอบด้วยเมนูประยุกต์ต่างๆ ได้แก่ ประเมินภาวะโภชนาการด้วยตนเอง บันทึกการรับประทานอาหารประจำวันและระดับน้ำตาลในเลือด คลังภาพอาหาร รวมทั้งรายการอาหารแลกเปลี่ยน ผู้ป่วยเด็กและวัยรุ่นที่เป็นเบาหวานชนิดที่ 1 จำนวน 34 คน ซึ่งมีอายุเฉลี่ย 14.32 ± 2.34 ปี และเข้ารับการรักษาที่คลินิคผู้ป่วยนอก โรงพยาบาลรามาธิบดี ได้เข้าร่วมเป็นสมาชิกและเรียนรู้ผ่าน “กินพอดีเวปไซต์” (www.kinpordee.com) ใน 4 ช่วงเป็นระยะเวลา 6 สัปดาห์ เพื่อประเมินประสิทธิภาพของเวปไซต์ที่พัฒนาขึ้นจากการทำแบบฝึกหัดระหว่างสัปดาห์และเข้าร่วมกิจกรรมกลุ่มในอาทิตย์สุดท้าย ทั้งนี้ผู้ป่วยจะต้องบันทึกการรับประทานอาหารอย่างน้อยอาทิตย์ละ 3 วันผ่านระบบเวปไซต์เพื่อตรวจสอบจำนวนหน่วยคาร์โบไฮเดรตที่รับประทานในแต่ละวัน

หลังการเรียนรู้พบว่าผู้ป่วยมีระดับความรู้และทัศนคติในการดูแลเบาหวานและการบริโภคอาหารด้วยตนเองเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ($p<0.01$) โดยผู้ป่วยส่วนใหญ่ (76.5% และ 64.7%) มีความรู้และทัศนคติในระดับสูงตามลำดับ อย่างไรก็ตามเมื่อประเมินผลคะแนนจากแบบฝึกหัดการวางแผนการบริโภคอาหารและการนับคาร์โบไฮเดรตรายสัปดาห์ พบว่าผู้ป่วยประมาณ 50% มีความรู้เฉลี่ยในระดับปานกลาง และมีคะแนนเฉลี่ยอยู่ในระดับสูงเมื่อเข้าร่วมกิจกรรมกลุ่ม จากการติดตามบันทึกการรับประทานของผู้ป่วยระหว่างการศึกษา พบว่าผู้ป่วยส่วนใหญ่ (73.5%) รับประทานคาร์โบไฮเดรตในปริมาณต่ำกว่าเป้าหมายโดยเฉลี่ย 3.41±2.93 หน่วยคาร์โบไฮเดรตต่อวัน และไม่พบความแตกต่างหลังสิ้นสุดศึกษา และจากการศึกษาการเปลี่ยนแปลงระดับฮีโมโกลบินเอวันซีเฉลี่ยไม่พบความแตกต่างอย่างมีนัยสำคัญ อย่างไรก็ตามพบว่ามีความแตกต่างของระดับฮีโมโกลบินเอวันซีหลังการศึกษาอย่างมีนัยสำคัญทางสถิติในผู้ป่วยกลุ่มที่ควบคุมได้ดีเมื่อเปรียบเทียบกับกลุ่มที่ควบคุมไม่ดี โดยพบผู้ป่วย 11.8% มีระดับฮีโมโกลบินเอวันซีลดลงมากกว่า 1% โดยมีค่าฮีโมโกลบินเอวันซีเฉลี่ย 7.02 ± 0.79% และพบว่าเป็นกลุ่มที่มักให้ความร่วมมือในการใช้งานและเรียนรู้ผ่านเวปไซต์อย่างสม่ำเสมอ และจากการกระตุ้นการเรียนรู้ด้วยตนเองของผู้ป่วยพบว่าผู้ป่วยส่วนใหญ่ (79.4%) ให้ความร่วมมือในการเรียนรู้ผ่านเวปไซต์โดยเฉลี่ย 1.98±1.19 ชั่วโมงต่ออาทิตย์ และยังพบว่าคะแนนความพึงพอใจของผู้ป่วยต่อเวปไซต์เพื่อให้ความรู้เบาหวานอยู่ในระดับดีถึงดีมากโดยเฉพาะอย่างยิ่งการจัดการระบบการเรียนรู้ด้วยตนเอง

ผลการศึกษานี้สรุปได้ว่า เวปไซต์เพื่อให้ความรู้เบาหวานนั้นเป็นที่ยอมรับในการนำไปประยุกต์ใช้ในการวางแผนการบริโภคอาหารด้วยตนเองโดยเฉพาะอย่างยิ่งเทคนิคการนับคาร์โบไฮเดรตในผู้ป่วยเบาหวานชนิดที่ 1 และยังช่วยกระตุ้นให้เกิดการเรียนรู้และทัศนคติในเชิงบวกในการดูแลเบาหวานและการเรียนรู้ออนไลน์ด้วยตนเอง อย่างไรก็ตามความร่วมมือจากทีมสุขภาพและครอบครัวนั้นเป็นสิ่งที่สำคัญอย่างมากที่จะช่วยกระตุ้นการเรียนรู้ด้วยตนเองของผู้ป่วย สื่อการเรียนรู้นี้อาจจะนำไปประยุกต์ใช้เป็นสื่อกลางในการให้ความรู้และเป็นแหล่งค้นคว้าเพื่อการควบคุมเบาหวานที่เหมาะสมกับเด็กและวัยรุ่นต่อไป

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CHAPTER I
INTRODUCTION

Type 1 diabetes was previously called insulin-dependent diabetes mellitus (IDDM), is now one of the most common non-communicable diseases globally that occurs in only 10-15% of all cases of diabetes especially the increasing incidence of childhood onset type 1 diabetes in many countries with an estimated overall annual increase of around 3% a year [1]. Type 1 diabetes is a chronic autoimmune disease, results from the cellular-mediated autoimmune destruction of pancreatic islet beta-cells which is the only cells in the body that produce an insulin hormone for regulating blood glucose [2,3]. Therefore, it causes the loss of insulin production which leads to elevate blood glucose level and restrict a tissue uptake of blood glucose. Finally, it leads to an absolute dependence on insulin treatment and high rate of complications typically occurring a relatively young ages that have poorer metabolic control than other age groups [4,5]. Uncontrolled diabetes often leads to life-threatening events that can cause both chronic and acute metabolic complications, including the biochemical imbalance leads to diabetic ketoacidosis (DKA) that happens predominantly in those with type 1 diabetes. DKA results from an absolute shortage of insulin; in response the body switches to burning fatty acids and producing acidic ketone bodies that cause most of the symptoms and complications [6]. Moreover, it may lead to the increasing disability, reduced life expectancy and enormous health costs for virtually every society [7].

From the incidence within 10 years, the total of approximately 430,000 prevalent cases of type 1 diabetes in childhood was shown that more than a quarter come from the South-East Asian (SEA) Region, and more than a fifth from the European (EUR) Region [1]. However, the incidence of type 1 diabetes in European children is increasing by about 4% a year, and is expected to continue to increase through 2020. In the United State (USA), it has been estimated that the yearly incidence of type 1 diabetes children is 3.7 to 20 per 100,000 with including more than

700,000 Americans.[8] Besides, the incidence in Thailand was reported to be as low as 0.2/100,000/year in last 20 years, especially 11-15 years population, whereas nowadays, the incidence is increased as 1.65/100,000/year [9]. Therefore, It was similar to the cumulative incidence rates among children and adolescents in other countries and places a particularly heavy burden on the individual, family and health services which are certain to be one of the most challenging health problems in the 21st century [10].

Because of type 1 diabetes is a chronic metabolic disorder that can be treated but cannot be cure nowadays. Medical nutrition therapy (MNT) plays a major role in the diabetes management, especially a self management education for children and adolescents with type 1 diabetes is very special and important for preventing, managing existing diabetes, or at least slowing the rate of diabetes development complications [11,12]. This approach is included the nutrition assessment, diabetes self-management knowledge and counseling which continue every 3 to 6 months [13]. The goal of MNT is to assist patients to design nutrition goals and intervention involving a matching of a meal-planning approach and insulin therapy carefully including control of physical activity. This approach has focused on achieving good metabolic function including glucose, HbA_1C and lipid level as near normal level as possible while avoiding serious complications during a therapy [4, 11]. Moreover, this nutrition management is essential to provide an adequate energy to ensure normal growth and development, and to integrate insulin regimens into usual eating and physical activity. Especially, children and adolescents with type 1 diabetes who are in a period of rapid biological change accompanied by increasing physical, cognitive and emotional maturity. Therefore, the intensive management and intimate taking care by the registered dietitian, physician and family are very important to facilitate a nutrition goal achievement. Aims of nutrition management are 1) to provide sufficient and appropriate energy intake and nutrients for optimal growth, development and good health, and 2) to prevent and treat acute complication such as hypoglycemia, hyperglycemia and illness [14]. Furthermore, the specific educational materials should be provided to patients as flexible guidelines which can be implemented and evaluated the outcomes by themselves and have ongoing monitoring by a health care team [15].

In the Diabetes Control and Complications Trial (DCCT), ten years follow-up prospective study acknowledgement in the United State, which was undertaken to demonstrate intensive diabetes treatment to delay the onset and slow the progression of diabetic complications. These analyses indicated relationship between the glycemic control and a continuously decreasing 1% HbA_1C levels leading to a 35% reduction of microvascular complications, a 18% reduction in combined fatal and nonfatal myocardial infractions and a 17% reduction in mortality. Besides, these results may improve the overall acute and chronic complications. To prevent diabetes complications and to live longer healthy life well with diabetes, the glycemic control should be improved for the optimal insulin adjustment including improvement in their physical and emotion in order to reduce in hospitalizations and annual health care costs [16,17]. In order to accomplish this goal, patients should be provided dietary knowledge and skills for changing lifestyle in order to improve quality of life.

Carbohydrate counting is one of the most interesting meal planning approaches, offering flexibility to give various food choices and many strategies for achieving a target blood glucose level [18]. The concept of carbohydrate counting focuses primarily on the carbohydrate content of food consumed because it is the main component of the diet that has the most effect postprandial blood glucose levels and insulin requirements. According to the recent research, the total amount of carbohydrate in a meal is more important than the type of carbohydrate that impact on postprandial glycemic control [19,20]. Therefore, this principal emphasizes on carbohydrate quantity and its distribution which demonstrates in the relationship between food, blood glucose level, amount of insulin dose and physical activity [19]. The total carbohydrate meal primarily determines the pre-meal insulin dosages requirement rather than the amount of protein and fat, in which it was shown that individuals who adjusted pre-meal insulin dosage base on carbohydrate content of meal had a significant lower HbA1c levels than those who did not adjust pre-meal insulin [21,22].

This graduated approach of carbohydrate counting that include two levels with progressive complexity: Basic and Advanced levels, The basic level introduces the concept of carbohydrate counting, encourages to maintain a carbohydrate consistency from meal and snack intake at similarly times each day. Furthermore, the

advanced level that focuses on improving glycemic control through the pattern management of the relationship among food intake, insulin dosage, physical activity and blood glucose levels, especially, children and adolescents with type 1 diabetes who use daily multiple insulin injections or the insulin-pump by matching the amount of short-or rapid-acting insulin with carbohydrate intake (carbohydrate-to-insulin ratios). The individual determines how to adjust pre-meal insulin when eating more or less than usual by using this ratio to offer greater flexibility in food choices and portion sizes [18]. Both two levels of carbohydrate counting can improve metabolic status and confidently improve diabetes self management [23,24]. Therefore, nutrition education and counseling about the individualized meal planning, especially in children and adolescents with type 1 diabetes is absolutely crucial for diabetes control and foundation of a good health.

Diabetes self-management education is a critical element in providing patients with mechanisms necessary to manage the disease because a well controlled type 1 diabetes can reduce all complications. The several studies have been shown that the glycemic control improvement after the carbohydrate counting intervention have been given both in adults and adolescents in many countries [25,26,27]. In Thailand, there are many disease-management programs that provide specific tools and process to target patients through health care providers to educate nutritional care knowledge. Although, the carbohydrate counting is a new meal planning approach for glycemic control, but a few study of carbohydrate counting in Thailand have been shown that this approach can improve HbA1c level in type 1 diabetic children and adolescents [28]. However, there are not enough the tool that focuses on self-management meal planning with diabetic patients, especially the research to conduct the appropriate educational tool for self-help meal planning using carbohydrate counting concept. Some nutrition educational tools about food exchange list and carbohydrate counting are provided by dietitians to improve the self-dietary care knowledge for type 1 diabetes adolescents [29]. Moreover, Chaturawit C. [30] had developed the educational tool model for self-help meal planning in type 1 diabetics adolescents using carbohydrate counting concept which consists of the colorful carbohydrate counting booklets including the self-help guidelines for meal planning and the small book of food exchange lists for counting carbohydrate with the photographic food card

game for carbohydrate counting. The results showed that these educational tools and nutrition education can be the best quality approach to empower patients for increasing their knowledge and understanding of meal planning with dietary self-management skills and can also be applied to use in the daily life. Subsequently, the education tool for the advanced carbohydrate counting concept was developed by Jampathed S. [31] which consist of two colorful booklets; as "Booklet of meal planning using advanced carbohydrate counting concept**",** containing the overview knowledge about the pattern management for diabetes control and "A diary for food intake, blood glucose level, insulin dose and exercise record". The results had been shown that these nutrition education tool and nutrition education program improved the subjects' knowledge and improved a bit of glycemic control in some subjects and majority of the subject was agreed positively with this developed education tool and the education class.

For the practical diabetes class education, Bunnag A, et al. [32] had conducted the diabetes education program on the use of food exchange lists and carbohydrate counting in children and adolescent with type 1 diabetes during 5 days in the diabetic camp. The program comprised specific lectures, food demonstration and group practicing. The result had been shown that this kind of education program can help diabetic children using food exchange lists and carbohydrate counting more correctly. However, this study reported found that some patients lack of the basic nutrition knowledge, most of patients could not adjust the appropriate dietary and energy for their own meal plan for achieving the optimal blood glucose level. Therefore, the basic knowledge of nutrition plays the vital role with the selection of the appropriate educational tool for achieving the best outcomes in dietary self-care management.

Nowadays, Technology is an important tool in all disease managements and has actually become a critical element especially for the communication network including web-based, or internet applications. This technology can provided up-to-date ability for receiving information and can be a central database for patient information, especially, a modification of practical e-learning to educate patients which is delivered on a computer whether on CD-ROM and the internet. These approaches were designed to build knowledge and self-care skills related to individual goal as a learner content interaction. Therefore, the internet approach can be the interesting tool for enhancing

many elements of a self-care diabetes management program. Interestingly, the survey of the information and communication technology and household report in Thailand [33] had been found that about 59.5 million of over 6 years population, there was more than 15.4 million population (25.9%) can use computers and 8.5 million population (14.2%) were internet users, especially the most internet users had been found in Bangkok area. In the other hands, this survey had been found that the population age range in 6-14 years (57.0%), is the most internet user group and about half of internet usage was in 15-24 years population, consequently. Interestingly, the main objective internet usage was about the health education and industrial field. However, currently there is still lack of the internet approaches which absolutely focus on the nutrition management knowledge in deeply detail especially; the carbohydrate counting that is the most useful technique for self-help meal planning in the diabetes patients.

However, there were other related researches about the development of web-based care management system for self-help management in diabetic patients [34] which focused on reaching and maintaining optimal blood glucose and blood pressure levels on poor controlled diabetes patients The results had been shown that almost patients interested in the medical and nutrition knowledge via the web-based care management system and had more HbA_1C improvement. Moreover, over 60% of the patients felt that the provided information was the same or better than doctor usual care. They were enhanced to share experiences and continue follow-up with the health care providers by using a comprehensive network. From the result, the group of patients with improved follow-up care had significantly lower HbA_1C level than those with usual care. In addition, patients who adopt such a system and regularly exchange information with the health care providers via internet are likely to get important clinical benefits.

Hence, this study was designed to develop the educational multimedia website for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept. This new approach, modern and high technology providing on-time capability for receiving information, is very attractive to patients especially child and adolescent who are simultaneously in a physiopsychosocial changing period and need more flexibility in food choices and lifestyle. Therefore, it can be used to be an online self care-management instrument for meal planning and also e-learning exercises, food

exchange list reference and connective instrument between the patients and health care providers to support patient's need and achieve the optimal quality outcomes in clinical care. Moreover, the team approach can follow-up and evaluate the outcomes continuously via the web-based system as well. Patients can achieve the diabetes knowledge base for self-management and increase their confidence in applying the knowledge especially, carbohydrate counting concept to practical situations that allow variability of food choices in order to accomplish the treatment plan following MNT. Therefore, this study was conducted to 1) develop a nutrition educational tool using basic carbohydrate counting concept 2) determine the effectiveness of a nutrition educational tool and 3) determine the subject's satisfaction with the developed educational tool.

CHAPTER II
OBJECTIVES

General objective

To develop the multimedia diabetes educational website for self-help meal planning in type 1 diabetic children and adolescents using basic level of carbohydrate counting concept.

Specific objective

1. To construct the multimedia diabetes educational website for providing general diabetes knowledge information and self-help meal planning guidelines in type 1 diabetic children and adolescents using carbohydrate counting concept

2. To evaluate the effectiveness of the multimedia diabetes educational website in type 1 diabetic children and adolescents by;

2.1 Assessing the subject's knowledge and understanding of diabetes and meal planning using basic level of carbohydrate counting

2.2 Assessing the subject's accuracy in perception and conceptualization of basic carbohydrate counting

2.3 Assessing the subject's attitude about diabetes self-management

2.4 Assessing the subject's satisfaction with the multimedia diabetes educational website

3. To study the subject's current nutritional status via the multimedia diabetes educational website

Expected benefits and applications

1. Type 1 diabetic children and adolescents would be able to achieve the diabetes knowledge for self-management and increase their confidence in applying the knowledge especially, the basic carbohydrate counting concept to practical

situations that allow variability of food choices in order to accomplish the treatment plan following MNT

2. This approach is the research for developing educational tool using the interactive multimedia website that is able to support family for meal planning management and more in-depth self management guidelines to patient in a wide range of creative ways. Especially, in children and adolescent who prefer to be a self-learning center via the distance learning in order to applying with their cultures, social, economic background and lifestyle.

3. To facilitate and encourage the family's ability to support the diabetic patient's needs including their psychology and learning experience in order to contribute to higher quality of life and decrease health care expense.

4. A team approach by the physician, registered dietitian and health diabetes educator can further apply this diabetes educational website to use with type 1 diabetic patient and also can be modified to type 2 and gestational diabetes.

5. This diabetes educational website can be a useful guideline and reference reliable resource for health promotion to the public.

CHAPTER III
LITERATURE REVIEW

Literature reviews in this study were divided into main 4 parts as follows;

Part 1: Type 1 diabetes and diabetes management

Part 2: Carbohydrate counting in diabetes management

Part 3: Concept on web-based instruction and learning

Part 4: Development of nutrition education tool

Part 1: Type 1 diabetes and diabetes management

1.1 Epidemiology and incidence of type 1 diabetes

Diabetes is now one of the most common non-communicable diseases globally. It is the fourth or fifth leading cause of death in most developed countries and there is substantial evidence that it is epidemic in many developing and newly industrialized nations [1]. The epidemiology of type 1 diabetes has been reported in many countries, predominantly in children and adolescents, 15-18 years of age. The increase in incidence of patients with type 1 diabetes has been shown in countries having both high and low prevalence with an indication of a steeper increase in some countries with low prevalence. Although type 1 diabetes usually accounts for only a minority of the total burden of diabetes in a population, it is the predominant form of the disease in younger age groups in most developed countries. Analyses of cumulative incidence rates suggest that incidence is not increasing among young adults indicating rather a shift to a younger age at onset. The causes of these changes with time are unknown but the rapidity of the changes and the almost universally increasing trends in younger age groups are unlikely to be due to changes in the genetic background of the disease [35,36].

Interestingly, there are about 186,300 individuals < 20 years of age with diabetes in the U.S. Based on 2002–2003 data, the rate of new type 1 diabetes cases was 19.0 per 100,000 children [37]. In Thailand, the incidence of type 1 diabetes in

children aged 0-15 years was reported to be as low as 0.2 per 100,000 per year in 1984-1985. The survey in Bangkok, from 1991-1995 demonstrated the increasing numbers and was reported a significant incidence of 1.65/100,000/year. This number is equivalent to the incidence in the other Asian countries [10].

1.2 Definition and pathogenesis of type 1 diabetes

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia, which results from the absence or insufficient production of insulin. The predominant cause of hyperglycaemia in type 1 diabetes is an autoimmune destruction of the beta cells leading to absolute dependence on insulin treatment and a high rate of complications typically occurring at relatively young ages. Continuing destruction of β-cells leads to progressive loss of insulin-secretory reserve with, in order, loss of first phase insulin secretion in response to an intravenous glucose tolerance test, then to clinical diabetes when insulin secretion falls below a critical amount, and finally, in most but not all those with type 1 diabetes, to a state of absolute insulin deficiency [38]. However, current understanding of its etiology includes an interaction between a genetic predisposition to autoimmunity coupled with an external environmental trigger, including foods, toxins, and viruses [14]. With the insulin deficiency results in the onset of the classic symptoms of most children and adolescents with type 1 diabetes present with a several-week history of polyuria, polydipsia, polyphagia and weight loss despite increased appetite with hyperglycemia, glycouria, ketonemia and ketonuria [39]. After clinical diagnosis had frequently the correction of hyperglycemia, metabolic acidosis, and ketoacidosis. The honeymoon or remission period takes place. Endogenous insulin secretion is recovered for the short time, but not yet destroyed β-cells that regain functional capacity. During this period exogenous insulin requirements decrease dramatically for up to 1 year; however, the requirement for increasing exogenous insulin replacement is inevitable, these β-cells are destroyed more rapidly, when there is also less likelihood of a long remission period that lead to become more difficult for controlling blood glucose and within 5 to 10 years after clinical onset leading to completely β-cell loss and circulating islet cell antibodies can no longer be detected, resulting in total insulin deficiency [13,40].

Therefore, diabetes is a chronic medical condition, meaning that although it can be controlled, it lasts a lifetime.

1.3 Diabetes complications

Diabetes is certain to be one of the most challenging health problems in the 21st century. This burden is not only resulting to health care costs, but also affect the indirect costs leading to loss of productivity from disability and prematurity. Long term uncontrolled diabetes has been associated with many complications that are classified into microvascular and macrovascular complications. Macrovascular complications include cardiovascular diseases such as heart attack, stroke, and peripheral vascular disease. Especially, the most common cause of death in people with type 1diabetes is cardiovascular disease, which is the cause of more than 50% of deaths. However, acute complications of diabetes, such as ketoacidosis, hyperosmolar coma, and hyperglycemia are the most common cause of death, representing about 13% [41].

Especially, Diabetes ketoacidosis (DKA) is a consequence of absolute insulin deficiency resulting in hyperglycemia and an accumulation of ketone bodies in the blood, with subsequent metabolic acidosis. The risk for morbidity and mortality is higher in severe DKA in type 1 diabetes children and adolescents. These patients require close health care team monitoring, frequently utilizing central venous and intra arterial pressure monitoring as well as frequent blood chemistry determinations to direct therapy [4].

Moreover, the morbidity associated with the chronic complications of diabetes also presents a significant public health problem that is microvascular complications are also believed to result from chronically elevated blood glucose levels include diabetes retinopathy that is an important cause of blindness and occurs as a result of long-term accumulated damage to the small blood vessels in retina, nephropathy that is damage to the nerves which affects up to 50% of people with diabetes, causing tingling, pain, numbness, or weakness in feet and hands. Especially, diabetes neuropathy that combined with reduced blood flow leading to chance of foot ulcers and eventually limb amputation. Interestingly, the risk for amputation in individuals with diabetes is substantially greater than that in people without diabetes;

diabetes accounts for greater than 60% of non traumatic lower-limb amputations in the United Stated [42]. Therefore, all diabetes complications are in resulting to increase disability, reduced life expectancy and enormous health costs for virtually societies.

1.4 Diagnostic Criteria for Diabetes Mellitus

The diagnosis of type 1 diabetes in children is usually straight-forward and requires little or no specialized test. For the asymptomatic child and adolescents who is screened because of high risk for diabetes, fasting plasma glucose (FPG) ≥126 mg/dl or a 2 hour plasma glucose or random glucose ≥ 200 mg/dl should be repeated on a second day to confirm the diagnosis. The patients with typical symptoms of diabetes such as polyuria, polydipsia, polyphagia, glycouria and weight loss with hyperglycemia and a random plasma glucose ≥ 200 does not require a repeat value on another day or any further testing to diagnosis diabetes [41]. However, Three ways to diagnose diabetes are possible, and each, in the absence of unequivocal hyperglycemia, must be confirmed, on a subsequent day, by any one of the three methods given in Table 1 and the use of the HbA1C for the diagnosis of diabetes is not recommended at this time [43].

Table 1 Criteria for the diagnosis of diabetes [44]

1. Fasting plasma glucose ≥ 126 mg/dl (7 mmol/l). Fasting is defined as no caloric intake for at least 8 h.

OR

2. Symptoms of diabetes and a casual plasma glucose ≥ 200 mg/dl (11.1 mmol/l) Casual is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.

OR

3. 2-h plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test. As described by the WHO, using 75 grams glucose load anhydrous glucose dissolved in water or 1.75 g/kg body weight if weight is < 18 kg.*

* *In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day.*

However, the theoretical treatment goal for children and adolescents with type 1 diabetes is to restore metabolic function as possible while avoiding serious complications of therapy, especially symptomatic hyper- and hypoglycemia. Moreover, the approach to care also incorporates more specific goals, such as the normalization of childhood and adolescents development and maintaining blood glucose values near normal according to the components of treatment which consist of diabetes education, appropriate insulin regimen, nutrition management, physical activity and exercise and the last, follow-up and evaluation [41].

1.5 Care of children and adolescents with type 1 Diabetes

1.5.1 Medical nutrition therapy and diabetes self care management

Medical nutrition therapy (MNT) for diabetes is integral total care and management process and by which nutrition care is provided for diabetic individuals and the specific lifestyle recommendations. MNT involves a includes: 1) an in-depth individualized nutrition assessment and diabetes self-management knowledge and skills; 2) identification and negotiation of individually designed nutrition goals; 3) nutrition intervention involving a careful match of both a meal-planning approach and education material to the patient's needs, with flexibility in mind to have the plan be implemented by the patient; and 4) evaluation of outcomes and ongoing monitoring. These four steps are necessary to assist patients in acquiring and maintaining the knowledge, skills, attitudes, behaviors and commitment to successfully meet the challenges of daily diabetes self-management [16]. However, recommendations should not only be based on scientific evidence but should also take into consideration lifestyle changes the individual can make and maintain. Cultural and ethnic preferences should be taken into account, and the person with diabetes should be involved in the decision making process [45].

Nutrition recommendations for children and adolescents with type 1 diabetes should focus on frequently monitoring glucose and A1C, weight and quality-of-life issues that is essential in evaluating the success of nutrition-related recommendations. If desired outcomes from MNT are not met, the changes in overall diabetes care and management should be recommended [46]. The American Diabetes Association (ADA) goal for medical nutrition therapy for diabetes included achieving

blood glucose goals and optimal metabolic outcomes as is safely possible to prevent or reduce the risk of diabetes complications, especially maintain normal growth and development without excessive hypoglycemia. This can be accomplished through individualized healthy food choices and meal planning, flexible insulin regimens and algorithms, self-blood glucose monitoring, physical activity and education-promoting decision-making based on outcomes [46,47].

However, management of type 1 diabetes, pride of place should be given to education, motivation and adaptation to empower the children and adolescents with type 1 diabetes to take control. That appropriate metabolic control is indeed achieved can be verified by regular HbA1c measurements [41]. The Diabetes Control and Complications Trial (DCCT) has unequivocally shown that intensive insulin therapy reduces the incidence of microvascular complications, seems reasonable to consider that HbA1c level between 6% and 7% is probably a reasonable target, permitting avoidance of late complications development without increasing the risk of severe hypoglycemia too much [17]. However, nutrition requirements for children and adolescents with diabetes appear to be similar to those of children and adolescents without diabetes. The careful consideration for child or adolescent's appetite must be used when determining energy requirements. It may be preferable to use a food and nutrition history of typical daily intake, providing that growth and development are normal, to determine an individual's child and adolescent's energy needs. Since energy requirements change with age, physical activity and growth rate, evaluation of height and weight, BMI and nutrition care plan are recommended at least every year. The weight gain and growth begins are recorded by height and weight on pediatric growth charts for good metabolic control. Therefore, the adequacy of energy intake should be adequate for growth and restricted if the child and adolescent becomes overweight [42].

1.5.2 Glycemic Control by age group

Children and adolescents are growing and developing, their ability to participate in self-management of diabetes varies with their changing motor development, cognitive abilities, and emotional maturation. Many studies have demonstrated that parental involvement is necessary throughout childhood and adolescence to assure appropriate self-management and metabolic control. However,

for patients with diabetes, the primary clinical indicator that provides evidence of improvement is the HbA1C level [48]. The most target recommendations for glycemic control have been based on data obtained from studies of adult patients with diabetes; the ideal goal of near normalization of blood glucose levels in children and adolescents is generally the same as that for adults.

Especially, the investigators in the DCCT were able to control diabetes in the adolescent group, age 13–19 years only at an approximate level 1% higher than that achieved by adults. That teenagers included in the DCCT were able to achieve a mean A1C level of 8.06% in an era before insulin lispro, insulin aspart, and insulin glargine were available suggests that good metabolic control is possible in at least some adolescents. Of note, however, several studies in the United States and Europe [49,50] have documented that mean A1C levels are generally >8.0% and with reduction comes a significant increase in the risk of severe hypoglycemia. Therefore, while an ideal target A1C identical to that for adults (<7%) could be recommended. However, the benefits of improved glycemic control in children must be balanced with careful consideration of their unique vulnerability to hypoglycemia and the potential of creating a feeling of failure in the patient and family. This level of metabolic control is not achievable in most adolescents. Therefore, according concerns leads to the general recommendation of <7.5% in this group [51]. Age-specific glycemic goals for type 1 diabetes are presented in Table 2.

Table 2 Plasma blood glucose and HbA1C goals for type 1 diabetes by age group [48]

Values by age	Plasma blood glucose Goal range (mg/dl)		HbA1C	Rationale
	Before meals	Bedtime/ overnight		
Toddlers & Pre-school (<6 years)	100-180	110-200	<8.5% (But >7.5%)	- High risk and vulnerability to hypoglycemia
School age (6-12 years)	90-180	100-180	<8%	- Risks of hypoglycemia & hypoglycemia
Adolescents & Young adults (13-19 years)	90-130	90-150	<7.5%*	- Developmental & psychological issues

Key concepts in setting glycemic goals:

- Goals should be individualized and lower goals may be reasonable based on benefit risk assessment
- Blood glucose goals should be higher than those listed above in children with frequent hypoglycemia or hypoglycemia unawareness
- Postprandial blood glucose values should be measured when there is a disparity between pre-prandial blood glucose values and HbA1C levels

*A lower goal (<7.0%) is reasonable if it can be achieved without excessive hypoglycemia

1.5.3 Appropriate Self-management by age group

Children and adolescents have characteristics and needs that dictate different standards of care. Because of they are growing and developing, their ability to participate in self-management of diabetes varies with changing motor development, cognitive abilities, and emotional maturation. In caring for the age-specific group with diabetes, professionals need to understand the importance of the normal stages of childhood and adolescent development and how they affect diabetes

management. For example, insulin doses based only on body size are likely to be incorrect because the consequences of hypoglycemic events are distinctly different between adults and children. Besides, risks for diabetic complications are likely influenced by puberty. Therefore, the targets of education need to be adjusted to the age and developmental stage of the patient with diabetes and must include the parent or caregiver. Some studies [52,53] have demonstrated that parental involvement is necessary throughout childhood and adolescence to assure appropriate self-management and metabolic control. The management priorities and issues in self-management are summarized in Table 3**.**

Table 3 Major developmental issues and their effect on children and adolescents with diabetes [45]

Development stage (Approximate ages)	**Normal developmental tasks**	**Type 1 diabetes management priorities**	**Family issues in type 1 diabetes management**
Older elementary School-age (8-11 years)	- Developing skills in athletic, cognitive, artistic, social areas - Consolidating self- esteem with respect to the peer group	- Making diabetes regimen flexible to allow for participants in school/peer activities - Child learning short- and long-term benefits of optimal control	- Maintaining parental insulin & blood glucose monitoring tasks while allowing for independent self- care for “special occasions” - Continue to educate school & other caregivers

Table 3 Major developmental issues and their effect on children and adolescents with diabetes (Cont.) [45]

Development stage (Approximate ages)	**Normal developmental tasks**	**Type 1 diabetes management priorities**	**Family issues in type1 diabetes management**
Early adolescence (12-15 years)	- Managing body changes - Developing a strong sense of self-identity	- Managing increased insulin requirements during puberty - Diabetes management & blood glucose control become more difficult - Weight & body image concerns	- Renegotiating parents & teen's roles in diabetes management to be acceptable to both - Learning coping skills to enhance ability to self-manage - Preventing & intervening with diabetes-related family conflict - Monitoring for signs of depression, eating disorders, risky behavior
Later adolescence (16-19 years)	- Establishing a sense of identity after high school (decision about location, social issues, work, education)	- Begin discussion of transition to a new diabetes team - Integrating diabetes into new lifestyle	- Supporting the transition to independence - Learning coping skills to enhance ability to self-manage - Preventing & intervening with diabetes-related family conflict - Monitoring for signs of depression, eating disorders, risky behavior

Nutrition for adolescents is considered especially vulnerable for several reasons because of the onset of puberty and hormonal changes that cause insulin resistance lead to the corresponding need for larger doses of insulin and the psychosocial challenges to achieving optimal metabolic control [54]. Most importantly, they have an increased demand for nutrients because of the dramatic increase in physical growth and development. Furthermore, they are also marked by feelings of ambivalence, impulsiveness, and mood swings as the struggle to separate from parents and the need to be accepted by peers that lead to the changes in their lifestyle and food habits affect nutrient intake and needs. In addition, adolescents have special nutrient needs associated with participation in sports or other situations common to adolescents [55]. They typically engage in experimentation and risk-taking behaviors that may adversely affect self-care and clinical outcomes. Thus, metabolic control tends to deteriorate in adolescence.

The general appropriate energy and macronutrient composition for adolescents is based on individual circumstances to meet their body's nutrient requirement and encourage normal growth. The diabetes dietary distribution recommends that 50-55% of total energy requirement from carbohydrate, 30-35% from fat and 15-20% from protein. Besides, the children and adolescents with their parent should learn how to determine food portion sizes, start with measuring food using measuring spoons, cups, and a food scale to provide the appropriate estimating of carbohydrate, protein, fat content from foods [63].

In addition, the nutrient intake patterns and anthropometric indices should be assessed every 3-6 months to ensure that the adequate growth is occurring. Consultation with a registered dietitian with experience in pediatric nutrition and diabetes is recommended [39,56]. Meal plans must be individualized to accommodate their food preferences, cultural influences, physical activity patterns, and family eating patterns and schedules. The intensive insulin regimens can provide flexibility for children and adolescents with diabetes to accommodate irregular meal times and schedules, varying appetite and varying activity levels [15].

Parent-adolescent conflict has been associated with poorer diabetes outcomes in several studies [57,58]. However, multifamily group intervention with parent simulation of diabetes has been demonstrated that the parents and children

negotiate responsibilities in diabetes management, and as these responsibilities change over time can assist youth to achieve better metabolic control and decreased parent-child conflict. Thus, continuing to involve parents appropriately, with shared management, is associated with improved control [59].

1.5.4 Diabetes Education

Education is best provided with sensitivity to the age and developmental stage of the youth, both with regard to the educational approach and content of the material delivered. Care of youth with type 1 diabetes is complex and time-consuming. In this age of managed care and cost-containment, few primary care diabetes team which consisting of a pediatric endocrinologist, a nurse educator, a dietitian and a mental health professional, possess the time to care for these patients and keep up with evolving therapies or new technologies [55]. The goal is to provide patients with the knowledge, skills, and motivation to incorporate self-management into their daily life. Therefore, education goals need to be tailored to the needs of the individual child or adolescent, especially, their family who should be provided up to date pediatric-specific education and support [42]. In addition, caregivers such as teachers, school nurse, and grandparents are integral to successful outcomes. (Figure 1)

Interestingly, young children including school-aged children who are unable to provide their own diabetes care, middle school and high school students should not be expected to independently provide all of their own diabetes management care. Thus, the education about how to care for a child and adolescent with diabetes must be provided to the entire family unit, emphasizing age and developmentally appropriate self-care and integrating this into the child's diabetes management [61]. The goal should be a gradual transition toward independence in management through middle school and high school. School-aged children with diabetes can begin to assume more of the daily diabetes management tasks, such as blood glucose testing and insulin injections with supervision and support from caring and knowledgeable adults. Especially, the pump treatment is increasingly being used in this age-group, and children can learn to bolus appropriately for standard carbohydrate meals. However, they will still need significant assistance and supervision for management decisions. Several studies have shown that a child's early and independent

participation in the diabetes regimen was significantly associated with poorer control [60].

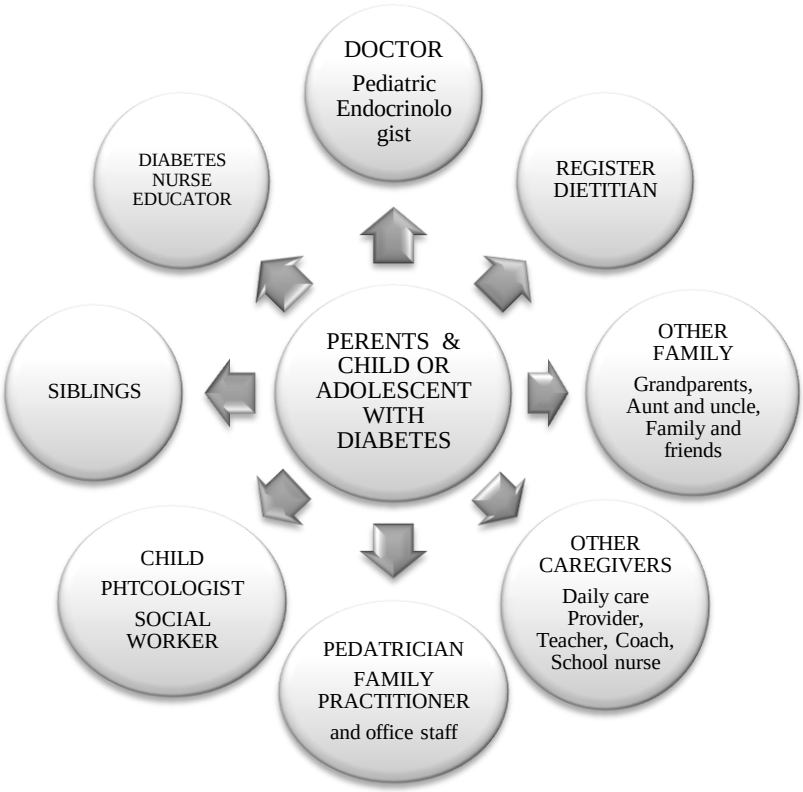

Figure 1 The diabetes healthcare team for the child or adolescent with diabetes

Studies in children and adolescents with type 1 diabetes have demonstrated that patient and family educational interventions need to be on-going, delivery of intensive diabetes case management and frequent telephone contact with the diabetes team, and both in-person care are associated with HbA1C improvement and reduced hospitalization rates for acute diabetes complication [61,62,63]. Therefore, education is the best provided with sensitivity to the age and developmental stage of the child and adolescent, with regard to both the educational approach and content of the educational program delivered [64,65].

In addition, the setting of this approach should personalize to the needs of youth and family, culturally sensitive and paced to accommodate individual needs. Education is not a one-time event that occurs at diagnosis. At diagnosis, curriculums

can focus on meaningful topics ranging from survival skills, to meal planning, to increase monitoring of blood glucose, to more in-depth self-management techniques and information [44]. Some studies have been recommended that effective nutrition interventions for children and adolescents should have a behavioral focus that will minimize the targeted risk factors, utilize theoretical framework, and consist of changes to the environment that provide adequate dose and include strategies that are developmentally and culturally appropriate [66,67]. Moreover, specific information they need for priority-setting and problem-solving, assisting them in identifying realistic targets for behavior changes, and providing ongoing emotional support and encouragement. Through these efforts, educators can improve patients' long-term ability to maintain an effective self-management regimen and help them avoid the emotional burnout that is common among young diabetes patients.

Proper diabetes education for patients and their family with type 1 diabetes is intense and complex, and requires educators with a set of skills including good communication, compassion, sensitivity, humor, and in-depth knowledge of childhood diabetes. Knowledge and skills should be evaluated regularly by the diabetes educator. However, to achieve the desired behavioral changes related to health and nutrition it will require the attainment of adequate knowledge, attitudes, skills and self-efficacy. [45] In other words, for children and adolescents to adopt and maintain health-enhancing behaviors, they need to have adequate knowledge of the health concern, attain the right attitudes to deal with the concern and possess the necessary skills and be self-efficacious to assume the health-enhancing behavior. Following training, educators show significant improvement in their counseling skills and in their attitudes toward supporting patient autonomy. The empowerment approach has been demonstrated to produce better patient outcomes than usual care, and another approach to empowering patients at the time of clinic visits also has been shown to improve glucose levels [68].

1.5.5 Physical activity and exercise

Children and adolescents with type 1 diabetes should need to be encouraged to participate in physical activity and sports. Physical activity helps them to have more energy, maintain a healthy weight and to generally feel good about

themselves. All level of physical activity, including leisure activities, recreational sports and competitive professional performance, can be performed by patients with type 1 diabetes who do not have any complications and are in good blood glucose control. However, planned or unplanned physical activity is one of the commonest causes of hypoglycemia in young people with type 1 diabetes, and intense physical activity sometimes causes hyperglycemia [69]. According to a recommendation, type 1 diabetes should exercise a minimum of four to five times per week at a low-to-moderate intensity, for about 30 to 40 minutes. In addition to aerobic exercise, it is important for type 1 diabetics to engage in strength training and flexibility exercises as well [70,71].

Regular physical activity is associated with immediate and long-term health benefits for children as well as to adults such as easier weight control, improved insulin efficiency, lipoprotein profile, reduces blood pressure, and enhanced psychological well-being. Active children are more likely to become active adults. As children age into adolescence, their physical activity declines because of increasing use of television and computer games that has resulted in decreased physical activity in American youth. In addition, school-based physical education programs have declined, particularly at the high school level.

Nutritional management of physical activity aims to prevent the potential hypoglycemic and hyperglycemic effects. Advice is also necessary to meet the nutritional requirements for sports performance in those individuals wishing to train and compete [71]. The careful instructions in self-management and the treatment of hypoglycemia, physical activity can be a safe and rewarding experience for the great majority of children and adolescents with type 1 diabetes. The types of sports in which children are involved may require frequent dose adjustments to allow the child to participate in school and individual sports. Initially, frequent blood glucose monitoring will be required to determine how to best adjust insulin and food for the sports activity [39]. Thus, the emphasis must be on adjusting the therapeutic regimen to allow safe participation in all forms of physical activity consistent with an individual’s desires and goals. Ultimately, all patients with diabetes should have the opportunity to benefit from the many valuable effects of physical activity [72].

1.5.6 Self-monitoring of blood glucose

Self-monitoring blood glucose (SMBG) is essential for identifying episodes of extremely high and low blood glucose (hyperglycaemia and hypoglycaemia) and extremely valuable among diabetes patients, especially, adolescents with type 1 diabetes who is a period of intense physical and psychosocial change that difficult to maintain a good metabolic control. Therefore, it is necessary for individuals to achieve optimal glycemic control. [73].

Moreover, there is a good correlation between frequency of monitoring and glycemic control. For children and adolescents with type 1 diabetes, four or more glucose monitoring tests per day are generally necessary. The multiple blood glucose measurements should be done each day to determine patterns of hypoglycemia and hyperglycemia and to provide data for insulin dose adjustments [73]. Additionally, they are usually counseled to administer insulin injections at the age of 10 to 12 years, monitor blood glucose at the age of 8 to 10 years, and comply with meal plans at the age of 12 to 14 years. Generally, pre-prandial blood glucose levels are important, but postprandial and overnight levels are also valuable in determining insulin dose adjustments [74]. There is a predictable relationship between postprandial blood glucose and HbA1c. Understanding this relationship will allow patients with diabetes and their healthcare providers set appropriate day-to-day postprandial blood glucose targets based on HbA1c goals [76, 83].

Glycemic control is best judged by the combination of the results of the patient's SMBG testing and the current glycosylated hemoglobin result. It should be used not only to assess the patient's control over the preceding 2–3 months but also as a check on the accuracy of the patient's self-reported results and the adequacy of the self-monitoring blood glucose testing schedule. Low HbA1c levels have been shown to delay the onset and to slow the progression of diabetes complications in adolescents [48]. Moreover, the continuous glucose monitoring (CGM) may be a supplemental tool to self-monitoring blood glucose in children and adolescents who had less strong HbA1c lowering and frequently hypoglycemic episodes. Table 4 contains the correlation between HbA1c levels and mean plasma glucose levels based on data from the Diabetes Control and Complications Trial (DCCT) [75].

Table 4 Correlation between HbA1c level and mean plasma glucose levels on multiple testing over 2–3 months [76]

HbA1c (%)	Mean plasma glucose	
	mg/dl	mmol/l
6	126	7.0
7	154	8.6
8	183	10.2
9	212	11.8
10	240	13.4
11	269	14.9
12	298	16.5

Estimates based on ADAG data of ~2,700 glucose measurements over 3 months per HbA1c measurement in 507 adults with type 1, type 2, and no diabetes. Correlation between HbA1c and average glucose: 0.92

Part 2: Carbohydrate counting in diabetes management

2.1 History of carbohydrate counting

For many years, counting carbohydrate was the one method in the United Kingdom. Then in the early 1990s, it received renewed interest after being used as 1 of 4 meal planning approaches in the Diabetes Control and Complications Trial (DCCT). This trial was the long-term study of type 1 diabetes patients that was found to be effective in meeting outcome goals and allowed flexibility in food choices [16]. In the 1994s, Carbohydrate counting also grew when the American Diabetes Association (ADA) used the Science supporting carb counting to make their Nutrition Recommendations [77].

2.2 Definition and principles of carbohydrate counting

Carbohydrate (CHO) counting is one of meal planning approach used with diabetic patients that focuses on carbohydrate consumption as the primary nutrient

affecting post-prandial glycemic response [19]. The carbohydrate begins to raise blood glucose within 15 minutes after initiation of food intake and is converted to nearly 100% glucose within 1-2 hours after consumption that has been faster than protein, which is within 2-4 hours, and fat within 4-6. While, the total glucose value of protein and fat was figured to be 58% and 10% respectively. The carbohydrate counting places concern on the total amount of carbohydrate consumption, rather than on the source or type of consumed carbohydrate [18, 20,78]. The evidence had shown that in type 1 patients with diabetes, the ingestion of a variety of starches or sucrose, both acutely and for up to 6 weeks, was shown to produce no significant differences in glycemic response if the total amount of carbohydrate is similar [19,21].

2.3 Level of carbohydrate counting

Two levels of carbohydrate-counting education have been defined as a basic and advanced. For basic carbohydrate counting introduces the concept of carbohydrate counting includes understanding the relationship among food, physical activity and blood glucose levels. This level encourages maintaining on the consistency in timing, type and amount of carbohydrate containing foods consumed at similar times each day. Additionally, the estimating of portion sizes skills are also key to understanding the concept of carbohydrate serving that are measured in grams that referred to one carbohydrate serving is equal to 15 grams of carbohydrate [23,24].

Advanced carbohydrate counting focuses on improving glycemic control through managing patterns, referred to the relationship among blood glucose level, food consumption, insulin injection, and physical activity. This level is suitable for diabetic patients who use multiple daily injections (MDI) of insulin or continuous subcutaneous insulin infusion (CSII) via an insulin pump. The individual determines how to adjust pre-meal insulin when intake more or less than usual by using insulin-to-carbohydrate ratio to offer greater flexibility in food choices and portion sizes [24]. All aspects of basic carbohydrate counting were applied to meet target blood glucose levels by understanding the action the basal-bolus insulin concept and daily food record [21, 23].

2.4 Basic carbohydrate counting

Carbohydrate counting is appropriate meal planning approach for all types of diabetes e.g. type 1, type 2, gestational diabetes mellitus who desire a less structured method of choosing foods or who have difficulty using their current meal planning approach or whose intake of carbohydrate is inconsistent [79,80,81].

Initially basic carbohydrate counting, the patients learn why carbohydrate intake consistency is important for controlling blood glucose levels. And they also learn about foods containing carbohydrate and the concept of carbohydrate choices, how to determine the amount of carbohydrate servings in a meal, use of the nutrition facts on food labels and how to use food lists to count carbohydrate as carbohydrate values are identified according to food groups. Moreover, patients are encouraged to keep daily food records and identify food portion sizes that they usually intake by weighing and measuring foods [22, 24].

The target range for carbohydrate at meals and sometimes snacks can be negotiated with the patients. For example, if patient's usual range is 40 to 90 gram of carbohydrate per meal, then an average of 55 to 65 gram per meal may be acceptable target range for the patients. During a trial period the patient works out with their carbohydrate target range and keeps records of food intake, blood glucose levels and physical activity [82]. However, the dietician's prescription for nutritional intervention should involve precise recommendations for meal timing, snacks, activity, and distribution of carbohydrates throughout the day. Furthermore, patient's follow-up contacted via telephone or in a person help determine whether the carbohydrate target range is working or if it needs to be renegotiated. These all activities are completed the patient's progression through carbohydrate counting. In such situations, patient's mastery of basic carbohydrate counting skills is absolutely essential and they desired more advanced skills continue to develop their record-keeping skills and learn to identify patterns of blood glucose levels that are related to their food, diabetes medications or insulin, and physical activity for pattern management in the advance.

2.5 Advanced carbohydrate counting

Advanced carbohydrate counting requires knowledge of insulin dosing based on the insulin-carbohydrate ratio as well as mastery of pattern management practices. Individuals who are adjusting insulin doses to the carbohydrate content of the meal must also learn the recommendations of the professional team for medication administration [83]. Medical staff should first review the patient's insulin requirements and the dietician's nutritional recommendations to accurately determine which instructional level will fulfill the patient's educational needs. Use of carbohydrate to insulin ratios allows the patients match the amount of short or rapid acting insulin given before meals with the amount of carbohydrate to be consumed. The carbohydrate-to-insulin ratios are determined by following a consistency meal plan while adjusting pre-meal insulin doses to meet target blood glucose levels. Based on a patient's carbohydrate intake, insulin doses, exercise and blood glucose records, a dietitian can calculate the carbohydrate-to-insulin ration [84]. Thus, if patients understand how to use these ratios, they can intake more or less carbohydrate than usual and adjust insulin accordingly.

Furthermore, patients continue to develop their record keeping skills and learn to identify patterns of blood glucose levels that related to their food, diabetes medications and physical activity. Finding these blood glucose patterns, interpreting them and taking appropriate action is called "pattern management". However, blood glucose results are an important measure of success at all levels of carbohydrate counting. Patients need to monitor and record their blood glucose levels. Target blood glucose levels should be determined by the clients and the health care team and may include goals for pre meal and post meal levels [85].

2.6 A critical step of carbohydrate counting

A critical step in teaching carbohydrate counting is to convince the patients of the value of developing accurate portion control skills. Interestingly, both two carbohydrate counting levels emphasize a portion control and recommend a useful teaching method such as "food lab" and use of a variety of carbohydrate resource tools and publications. Patients should practice weighing and measuring actual foods and

figuring carbohydrate content in an individual or group setting. The recommended tools that can be helpful for the portion control and counting carbohydrate including measuring cups and spoons, food scales, food package level and food exchange list books. Patients also learn how to use labels and carbohydrate resource books [24].

Using of exchange list can also help patients learn how to count carbohydrates in different kind of food accurately. Foods that contain carbohydrate are starches, starchy vegetables, fruits, milk, and desserts which are counted in grams and usually translated into "carbohydrate choice" or "carb" while "1 carbohydrate choice as equivalence as 15 grams carbohydrate". The starch, fruit and milk groups contain similar amounts of carbohydrate as shown in Table 5, one carbohydrate choice is equal one starch or one fruit or one milk [86]. In the other hands, patients are suggested to substitute a serving of starch for fruit or milk serving.

Furthermore, mastery of advanced carbohydrate counting, patients need to continue developing skills in estimating carbohydrate amounts and practicing portion control gradually, so that they will be precise in matching their insulin doses to their anticipated carbohydrate intake.

Table 5 The average amount of carbohydrate, protein and fat content of exchange lists food groups [79]

Food groups	Carbohydrate (grams)	Carbohydrate choice	Protein (grams)	Fat (grams)
1 Starch /Bread	18	1	2	1 or less
1 Fruit	15	1	0	0
1 Milk, Skim	12	1	8	0-3
1 Vegetables	5	1/3	2	0
1 Meat and meat substitute (lean)	0	0	7	3
1 Fat	0	0	0	5

Using the nutrition facts label on most packaged foods can help with carbohydrate counting. The most important information patient need for carbohydrate counting is the serving size and total carbohydrate [87]. As the Figure 2, this food

serving size contains 46 gram of carbohydrate then one cup of this product equals to 3 carbohydrate choices or 3 carbs.

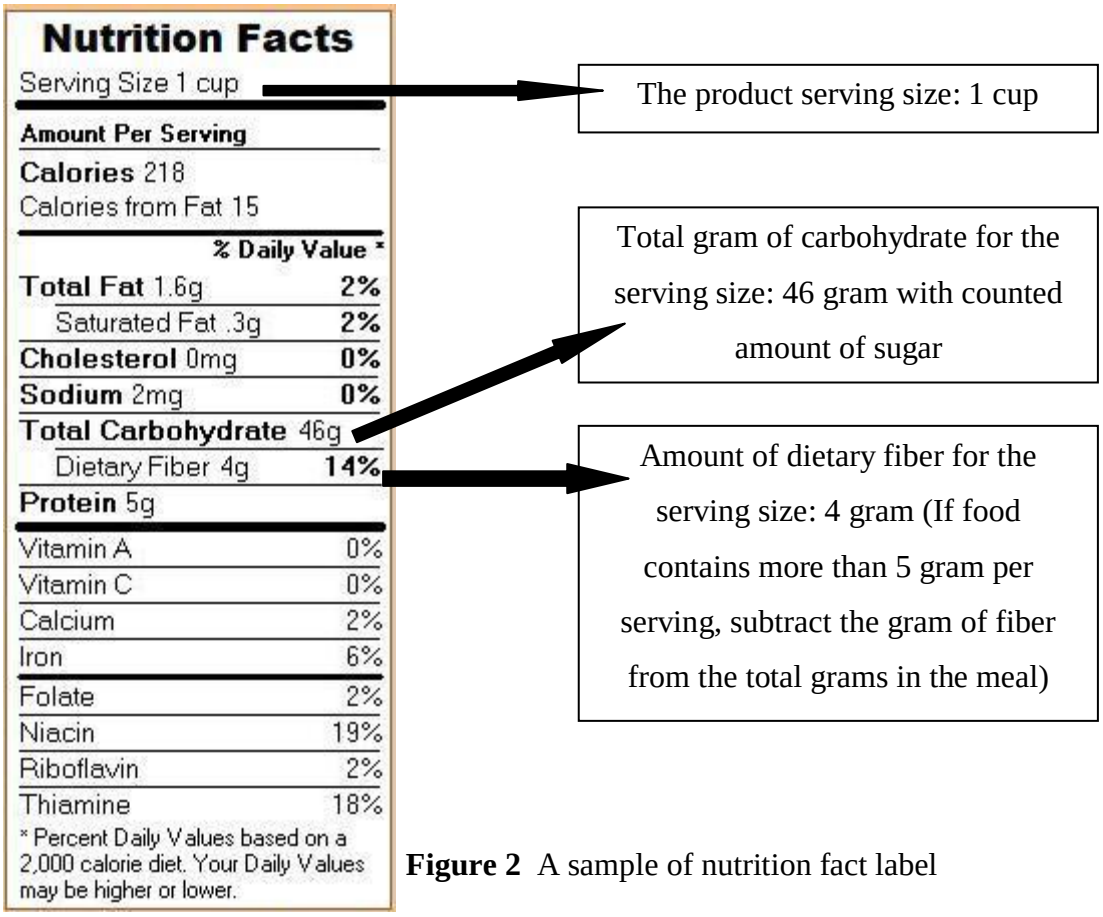

Figure 2 A sample of nutrition fact label

According to Figure 2, in summary, the total amount of carbohydrate includes starch, sugars and fiber. However, if 6 gram of dietary fiber contains in this product, then it should be subtracted from the total carbohydrate generally. The total carbohydrate per one serving is equal to 46 gram carbohydrate, subtract with 6 gram fiber or totally 40 gram available carbohydrate [88]. Nevertheless, children and adolescents with diabetes are encouraged to choose a variety of fiber-containing foods such as legumes, fiber-rich cereals that contain a soluble fiber in vegetables, legumes and fruit may be particularly useful in helping to reduce lipid levels. The new recommendation about 2.8–3.4 gram of fiber per mega joule tends to give a higher amount of fiber per day, because they provide vitamins, minerals, and other substances important for good health. Moreover, there are data suggesting that consuming a high-fiber diet at least 50 gram fiber per day leads to reduce glycemia, hyperinsulinemia,

and lipemia in subjects with diabetes. Moreover, fiber should be increased slowly in the diet to prevent abdominal discomfort [69].

Additionally, sugar alcohols that one group of ingredients in sugar-free foods. Interestingly, they are neither sugar nor alcohol and contain on average half the calories or 2 calories per gram. Polyols can replace sugars or fat to produce food lower in calories. Sugar alcohol tends to have laxative side effect, especially in children. Therefore, counting carbohydrate should count as carbohydrate only half of the total grams of sugar alcohols [21,77]

The lists examples of common carbohydrate servings are present in Table 6. Interestingly, vegetable group also contain carbohydrate but generally in smaller amounts. The green and leafy vegetables only count as a carbohydrate if large amounts are eaten, such as a main meal that consists primarily of a large salad or a plate of cooked vegetables. However, starchy vegetables such as pumpkins, potatoes or corn are considered as a carbohydrate serving. A free food is defined as any food or drink that contains less than 20 calories and 5 g or less of carbohydrate per servings.

Table 6 Examples of carbohydrate servings [88,89,90]

Starch	**Starchy Vegetables**
• 1 slice bread	• 1/2 cup corn or a 5-6″ corn
• 1/3 cup rice	• 1/2 cup mashed potatoes
• 1/4 cup sticky rice	• 1/2 cup green peas
• 3/4 cup dry cereal	• 1 small (2″ or 3oz) baked potato
• 1/2 cup noodle	• 1 cup cooked pumpkin

Note: - 1 carbohydrate serving =15 g of carbohydrate = 1 carb choice
- 1 ½ cups cooked or 3 cups raw non starchy vegetables at a meal, that is equal to one carbohydrate choice.

Table 6 Examples of carbohydrate servings (Cont.) [92-94]

Fruit	**Milk and yogurt**
• 1 apple or other small fresh fruit • 1 medium guava • 1/2 medium banana • 12-15 grapes or strawberry • 1/2 cup juice	• 1 cup fat free and reduced fat milk • 6 oz. cup yogurt, plain
Sweets/Desserts	**Combination/Mixed Foods**
• 1 brownie, 2″×2″ • 1 cake, 2″×2″ • 3 cookies, 1″ across • 1/2 cup ice cream • 1 tbsp honey, table sugar, regular jam or syrup	• 1 slice (⅛ pizza) medium, thin crust, pizza • 1 cup soup: cream, noodle, rice, vegetable

Note: - 1 carbohydrate serving =15 g of carbohydrate = 1 carb choice
- 1 ½ cups cooked or 3 cups raw non starchy vegetables at a meal, that is equal to one carbohydrate choice.

2.6 Research related to carbohydrate counting

Carbohydrate counting is a meal planning which mostly applied as nutrition intervention in several studies, aimed to improved glycemic control and slow risk of diabetes complications. The Diabetes Control and Complications Trial (DCCT) Research had determined carbohydrate counting as one of four nutrition interventions for people with diabetes. Dietary behaviors associated with improved glycemic control in the Diabetes Control and Complications (DCCT) Trial [91] included adherence to diet, of which carbohydrate consistency and portion control are key factors, and management of changes in food intake by adjusting insulin dose or by matching insulin to food, using carbohydrate-to-insulin ratios. These and other diet-related behaviors were related to lowering of the level of the glycosylated hemoglobin, HbA1C, which effectively delayed the onset and slowed the progression of microvascular complications such as diabetic retinopathy, nephropathy and europathy

in patients with type 1 diabetes mellitus. The beneficial effects of intensive therapy in the type 1 diabetes mellitus adolescents were similar to those in the entire DCCT cohort [16,92,93].

Carbohydrates are a major determinant of post-prandial blood glucose in the diet of people with Type 1 diabetes mellitus, but patients frequently fail to evaluate CHO food content. Poor education is thought to contribute heavily to this failure. Now and then, carbohydrate counting was provided for type 1 diabetic patient in characteristic of an education, training program purposed for increasing the knowledge and skill of using carbohydrate to improve glycemic control. Bruttomesso D. [25] evaluated the teaching and training program on carbohydrate counting to improve dietary knowledge in forty-eight type 1 diabetic subjects who attended 4 interactive meetings held at monthly intervals. The targets of the course were: 1) Identify sources of CHO, fats and proteins; 2) Count carbohydrate and to split them among meals; 3) to assume carbohydrate -rich foods without changing daily calorie or carbohydrate intake; 4) Modify the diet so as to correct hypoglycaemic events. To evaluate the effect of the course, subjects completed a 7-day food record and answered a questionnaire covering the targets of the course at baseline, at the end of the course and 7 months later. After the course dietary knowledge improved significantly. The number of subjects, who weighed foods, estimated carbohydrate food content and correctly distributed carbohydrate among meals also increased. After the course subjects reacted better when faced with hypoglycaemia. The knowledge acquired persisted 7 months after the end of the course. Therefore, this study concludes that a simple teaching program can improve diet knowledge in Type 1 diabetics and establish a sustained habit of counting carbohydrate.

In addition to the improving glycemic control, meal planning approach must assist families to learn the effect of food on blood glucose levels. The system must also be comprehensible and one that can be implemented within the context of the family's lifestyle and consuming patterns. There is some evidence that total carbohydrate content of meals and snacks is the most important in determining the postprandial glucose response and, thus, in determining the pre meal insulin dosage. Therefore, carbohydrate counting has been found in to be safe as well as provide better quality of life for patients as showed in the several study. Dose Adjustment For

Normal Eating (DAFNE) study group provided the skills to enable patients to replace insulin by matching to desired carbohydrate intake on a meal of adult patients with type 1 diabetes who had moderate or poor glycemic control. This five days program were evaluated both glycemic control and quality of life. Moreover, the DAFNE study for diabetes patients was a comprehensive education package using daily injections (MDI) and insulin to carbohydrate ratios, and showed a modest improvement in glycemic control without worsening severe hypoglycemia or cardiovascular risk and improved dietary freedom and quality of life [94]. Additionally, recent interventions of structured education programs including insulin to carbohydrate ratios have been piloted in younger people with type 1 diabetes. Some of these showed improved glycemic control, others not, but all reported improved quality of life outcomes [71].

Additionally, carbohydrate counting is probably the most precise and flexible meal planning approach available, especially for those with type 1 diabetes. The carbohydrate quantification is used to adjust pre-meal insulin in intensive insulin regimens. However, the precision in carbohydrate quantification required to maintain postprandial glycaemic control is unknown. C.E. Smart, K. Ross [95] determined the effect of a 10 gram variation in carbohydrate amount, with an individually calculated insulin dose for 60 gram carbohydrate, on postprandial glycaemic control. Thirty-one children and adolescents consumed test lunches of equal macronutrient content, differing only in carbohydrate quantity (50, 60, 70 gram carbohydrate). For each participant, the insulin dose was the same for each meal, based on their usual insulin to carbohydrate ratio for 60 gram carbohydrate and continuous glucose monitoring was used. As results, both CSII and MDI subjects demonstrated no difference in postprandial blood glucose levels for comparable carbohydrate loads and hypoglycaemic episodes were not significantly different. This study demonstrates that an individually calculated insulin dose for meals with ±10 gram variations in carbohydrate amount results in maintenance of postprandial blood glucose levels. Precise carbohydrate counting in gram increments appears unnecessary to maintain postprandial blood glucose control in children and adolescents using intensive insulin therapy. Therefore, education programs that teach adjustments in insulin dose for carbohydrate intake without using precise grams, have demonstrated improved quality of life and glycaemic outcomes.

Diabetes self-management education (DMSE) is an essential component of care to achieve the outcomes desired by the person with diabetes, the diabetes educator, and health care team. Diabetes is a self-managed chronic disease requiring those who are affected to be active and informed participants in their own health care. [96] Interestingly, Experience gained in the Diabetes Control and Complications Trial (DCCT) suggests that patients who acquired strong diabetes problem-solving skills tended to report more flexible lifestyles and more favorable diabetes-related quality of life compared with patients who lacked these skills. In the other hands, American Diabetes Association (ADA) includes diabetes problem-solving skills among its standards for recognition of diabetes education programs. The primary clinical implication of the findings reported is that youths with type 1 diabetes from families in which the primary diabetes caregiver has deficient diabetes problem-solving skills may be at elevated risk of poor glycemic control [97].

Thomas D., et al [99] reported that, although older youths demonstrated more sophisticated diabetes problem-solving skills in social situations, compared with younger children they were more likely to avoid utilization of their diabetes problem-solving skills in favor of behaviors that are perceived by them as more likely to yield peer affiliation and acceptance. Thus, adolescents who face social dilemmas pitting optimal diabetes management against peer affiliation and acceptance will tend to behave in accord with the latter priority.

Keefner K. et al. [98] studied the personal experience with self-monitoring of blood glucose (SMBG) and carbohydrate counting to evaluate attitudes and beliefs about diabetes self-care in diabetes subjects who enrolled in intensive three-day elective diabetes care course. They were required to monitor serum glucose and count carbohydrate intake for the duration of the course. Following the course, enhancing knowledge and skills require subjects to gain practical hands-on experience and changed many of their attitudes and beliefs about diabetes.

The satisfaction on carbohydrate counting was evaluated by Hissa A.S. et, al. [99] studied in fifty patients with type 1diabetes who were enrolled for carbohydrate counting within six months and answered a questionnaire related to the lifestyle. The results showed that answers were favorable in more than 80% to requirements related to the choice of the number of meals, to eat out, schedules of

meals and social and daily activities, glycemic miniaturization and interest in reading food labels. Additionally, about 60% to 80% answered favorably to topics related to the choice of the food type, the amount of food, the consumption of food rich in sugar and the participation of last minute activities. They found the participants' opinion, carbohydrate counting is a very well accepted procedure, allowing a better lifestyle.

Improving diabetes care especially for type 1 diabetic children and adolescents requires behavioral and educational programs to provide the support and motivation necessary to integrate the complex demands of diabetes self management into daily life. Although, systematic reviews have shown that educational and psychosocial interventions have small to medium beneficial effects on glycemic and behavioral outcomes, however carbohydrate counting was implemented in teaching and training program for improved glycemic control e.g. the development of an innovative education curriculum for 11-16 yr old children. Especially, the focus group discussions were conducted with children with type 1 diabetes mellitus and their families to contribute to content and design. Moreover, secondary school teachers also worked with experienced pediatric diabetes staff advising on educational content and teaching format. Therefore, carbohydrate counting was a session for developed diabetes self management skill in children, the conclusion showed that the collaborative working between health professionals, school teachers and families has resulted in an age-appropriate curriculum, which employs validated educational techniques [100]. Furthermore**,** Families, Adolescents and Children's Teamwork study (FACTS), a family-centered structured education program for integrating group-based diabetes education into routine care, enhance parental responsibility for self management and improve glycemic, showed that session of food enjoyment with carbohydrate counting were set as an educational activity and had potential benefits on parental involvement and glycemic control [101]. Besides, carbohydrate counting course were provided for children and adolescents with type 1 diabetes mellitus aged 11-16 years through The Kids in Control of food (KICK-OFF) training course. Educational evaluation indicated the course was appropriate and consistent, although there were no change in glycemic control (HbA1C), BMI or episodes of hypoglycemia, but quality of life and satisfaction with treatment were improved [102].

In Thailand, a few carbohydrate counting tool were developed. Wibunrattanasri N. [103] developed and evaluated the self-help guidelines for meal planning using carbohydrate counting in patients with type 2 diabetes who received the guidelines with only one session of introduction. The 20 pages booklet was developed and the evaluation of the appropriate guidelines was conducted by using interviewing after seven days of implementation. The satisfaction with the guidelines and understanding of carbohydrate counting record found that subjects had a positive response absolutely, however result found that most of the subjects understood this approach at a medium level, which did not enable them to count carbohydrate intake correctly and guideline content did not cover detail for carbohydrate counting learning.

Furthermore, the carbohydrate counting concept for children and adolescents in diabetes education were found to be more benefits. Bunnag A, et al. [34] evaluated of diabetic education program on the use of food exchange lists and carbohydrate counting in type 1 diabetic children. They found the education program helps diabetic children use food exchange lists and carbohydrate counting more correctly.

In the other hands, the development of carbohydrate counting tool especially for type 1 diabetes patients were created for various points. Chaturawit C. [32] developed the educational tool model for self-help meal planning in type 1 diabetic adolescents using basic carbohydrate counting concept which comprised of the self-help guidelines for meal planning book, food exchange lists and carbohydrate counting photographic game cards. A majority of patients understood carbohydrate counting concept at high level and were also satisfied with these tools. Subsequently, Jampathed S. [33] developed the education tool for the advanced carbohydrate counting concept for providing overview knowledge about the pattern management for diabetes control including a diary for food intake, blood glucose level, insulin dose and exercise record. The results had been showed that these nutrition education tool and nutrition education program improved the subjects' knowledge and improved a bit of glycemic control in some subjects and majority of the subject was agreed positively with this developed education tool and the education class.

According to the above, development of educational tools model for meal planning using carbohydrate counting for diabetes care is interesting and challenging

to study in diabetic patients, especially in adolescents with type 1 diabetes as they are simultaneously in a physiopsychosocial changing period who need more flexibility in food choices and lifestyle.

Part 3: Concept on web-based instruction and learning

3.1 Defining web-based instruction (WBI) and learning

The term web-based learning means the internet is equipped with a supportive delivery medium in instructional designs as a synonymous with e-learning, internet-based training, advanced distributed learning, and web-based instruction, computer based or assisted learning, online learning [104]. Moreover, web-based instruction has the potential for improving the quality of education by supporting the dissemination of skills and knowledge in a holistic approach. The use of web-based learning activities, such as email or online discussion, synchronous or asynchronous communication encourages clients to learn actively [105].

Other definitions of web-based instruction had been determined by several researchers including, the hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web (www) to create a meaningful learning environment where learning is fostered and supported. Additionally, the WWW, with its increasing capacity for multimedia, multimode communication and information presentation, easy access to an ever-growing body of information and new way of data representation, has provided educators with exciting opportunities to enhance teaching and learning [108]. Moreover, WBI also means to present learners with body of knowledge as well as any learning-possible content through www so as to meet an individual's need, which will be beneficial in term of tutorial cost as well as broadening scope of learning [106].

The overall theme of above definition is that web-based instruction and learning, which is a new way of instruction and learning management, takes advantage of potentials of the Internet, which is regarded as a high instructional medium, to support instruction enabling meaningful learning connected to multi-network which can be accessible anywhere and anytime.

3.2 The element of web-based learning

The web-based learning can be an interactive such as linking, searching, and learning design that learner can contact with administrator and one can sent back information by using its activities, such as email or online discussion, synchronous or asynchronous communication that encourage learners to learn actively. Web-based learning was developed on many characteristics of internet for using as follows [107];

1. One-way presentation as a text
2. Pair presentation as text and graphic
3. Multimedia presentation consists of text, graphic, animation, sound, movie and video

Moreover, the web-based learning allows models such as cognitive-load and multimedia theory to be implemented as part of the learning design to enhance more individual learning, since the use of web-communication often encourages a high quality person-to-person communication. The communication is necessary to use internet as follows [107];

1. One way communication that watches from webpage
2. Two way communication like electronic mail or chat room
3. One to group communication that data was sent to other sources like discussion from one person to another people that is called the internet conference
4. Group to group communication presents a group process

3.3 Principle of web-based learning management

Web-based learning management needs to take learner into consideration. Mostly, the learners are motivated to feel interested with the online-lesson by create attractive learning environment such as utilizes graphic, visual image, or sound effective during introduction. Besides, learning via website allows learners to have more freedom to explore many sources of information by selecting desirable content for self-study. Therefore, informing learning objectives would assist learners to focus on relevance lesson and pay attention on the topic that they lack of understanding. As

a result, learner would be able to obtain knowledge and ability as specified in the objectives.

Furthermore, recalling previous knowledge that would help motivate the learner to understand the new knowledge quickly, which can done through the exercises or set up pre-test. This approach should provide feedback to communicate between learners and administer directly through online communication patterns.

3.4 Learning pattern on web-based education

Web-based communications can be grouped under two headings, stand-alone applications and Linkage Applications. Especially, these applications have received the greatest use in nutrition education to date [108]. Learning pattern on web-based educations is divided into 3 patterns as follows;

1. Stand-alone applications have been designed to provide information and training in nutrition education for the public, the paraprofessional, and the professional. These programs are run without connection to telephone, television, satellite, or other electronic transmissions and are available on floppy disks, CD-ROM disks, and laser disks with accompanying floppy disks.

2. Linkage Applications are presented as a web support course and web pedagogical resources that contain related information of the course become course activities. These resources will be in many forms for example contents, graphic image, animation, sound, and communication between the learner and websites. The use of linkage-applications by nutrition educators around the world through electronic mail, internet, and World Wide Web, is just emerging. Use is limited for on-line databases, electronic bulletin boards, fax machines and noncommercial television and teleconferencing [109].

3.5 Benefit of web-based learning

Advantages of web-based learning (WBL) include flexibility in participation, ease of accessing tutorials or updating content and documenting evaluations and assessments. Especially, the advantages in medical education include overcoming barriers of distance and time, economies of scale, and novel instructional

methods [110]. Additionally, technical advantages of WBL include universal accessibility, and have hyperlink functions that permit cross-referencing to other resources. These technical advances, specifically hyperlink and searching capabilities, fit the constructivist learning theory, where learners search out and create their own knowledge bases. There are also benefits in providing internet-based courses, including lower cost in electronic publication of course material and also faster for electronically revising and re-distributing course materials compared to printing material. Interestingly, the student's online behavior and registration are tracked automatically. Moreover, the learner evaluations with online interactive quizzes are automated as a primary advantages of e-learning which the individual can access their needed information [110,111].

However, as was evident with computer-assisted instruction, potential advantages may not translate into significant improvements in educational outcomes. With the widespread adoption of WBL, it is critical that medical educators have evidence regarding its performance as a learning medium [112]. Most important, the knowledge management system in internet based learning would not only augment the teaching abilities of the provider and foster the learning abilities of learners but also open new ways of integrating knowledge management concepts in the learning systems development process. This would definitely result in efficient use of time and other resources facilitating better reusability, sharing, pooling and collaboration in the learning process [113].

3.6 Limitations of web-based learning

Despite all the benefits of web based learning, however, not all clients are suited for the web-based education. There are several negative aspects that may be encountered, including lack of motivation can lead clients to drop out easily, and the social isolation as the client studies alone and faculty members not providing individualize instruction for specific learning needs.

Moreover, the cost and technical problems of computer may limit the number of clients that can afford the internet-based course. Besides, lack of clients' technical support to use the software tools may be one of limitations. Therefore, a poor technical support or tutorial help can lead to incorrect usage of software tools needed

to do assignments. Additionally, the use of technology for entertainment rather than education is also the important of limitations [113,114]

Part 4: Development of nutrition education tool

4.1 Diabetes self-management education (DSME)

Diabetes self-management education (DSME) is the ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care which is a critical element of care for all people with diabetes and is necessary in order to improve patient outcomes. These national standards are designed to define quality diabetes self-management education and to assist diabetes educators in a variety of settings to provide evidence-based education [115]. The primary purpose of diabetes education are to provide knowledge and skill training that help individuals identify barriers, and facilitate problem solving, and coping skills to achieve effective diabetes self-care behavior [116]. Moreover, Diabetes self-management education (DSME) is also defined as activities to assist the individual with diabetes to implement and sustain the ongoing behaviors needed to manage their illness. Interestingly, the behavior change is a unique outcome measurement, which should be evaluated at baseline and then at regular intervals after the education program. [119]. Additionally, the continuum of outcomes, including learning, behavioral, clinical change, and health status which should be assessed to demonstrate interrelationship between the diabetes self-management education and behavior change in the care of individual with diabetes such as changing in physical activity, food consuming, medication taking, monitoring of blood glucose and problem solving especially for blood glucose for reducing risks of diabetes complications [118]. (Figure 3)

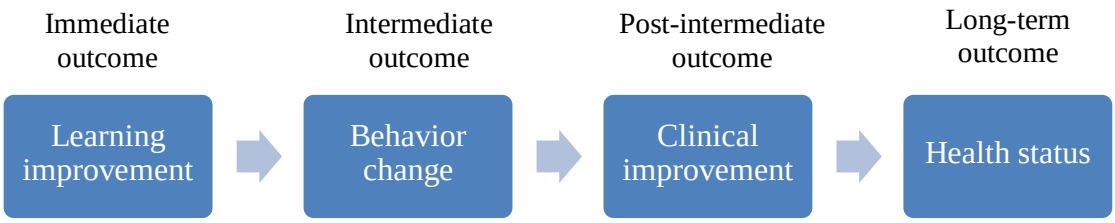

Figure 3 Health care outcome continuums

4.2Computerized Patient Diabetes Education (CPDE)

Computerized Patient Diabetes Education (CPDE) interventions is the application of technology to provide information on diabetes self-management as well as test the users' knowledge and provide feedback [117]. These interventions may lead to improved diabetes outcomes and appear not to be a substitute for, but a valuable supplement to human interaction. Many clinics have used computer-based instructions, with either direct system-patient interaction or an intermediate operator. The application of computers to diabetes management has expended to include assessment of knowledge and behavioral change. It also includes calculating dietary requirements, storage and analysis of diabetes management data and instruction and simulation in variety diabetes-related tasks for patients and providers [118,119].

Additionally, a web portal was developed to assist in diabetes education and self-management. Access to reliable information is an essential component of effective self-care in diabetes. Education was provided as a series of learning objects, aimed at patients with either Type 1 or Type 2 diabetes. The appropriate material was also provided via multimedia learning tools, such as tutorials and interactive quizzes. Throughout the development of the web portal, periodic assessment was carried out by an expert patient group who provided feedback to the health-care professionals involved with content development. There were also regular discussion forums with both patients and health-care staff. The web portal was designed to facilitate effective self-management, by providing ongoing support with regular feedback on progress.

The benefits of all computer-based patient education are; 1) Support just-in-time self-learning; 2) Consistent information that can be tailored to an individual patient’s personal characteristics. Moreover, computer-based learning programs can stimulate virtual environments, thereby allowing healthcare skills to be practiced in a simulated and safe setting. Computer systems and learning programs also can be adapted to meet the needs of people with disabilities [120]. Some studies suggest that integrated information or communication technology (ICT) was shown to improve knowledge, motivation and self-care behavior in patient with diabetes [121].

4.3 Web-based instruction in learning nutrition

In general, web-based instruction can be used to complement formal instruction of a basic nutrition course. These new forms of media allow educators to deliver flexible continuing education demanded by healthcare service providers and health professionals. Especially, the nutrition online represents an attempt to utilize the Internet to deliver a new kind of distance learning experience, one which offers both flexibility and a high degree of interaction among the clients and health instructors, while keeping costs down. Clients or patients' response toward the learning experience were gathered and instructional implications related to the use of this mode of learning were addressed. In learning nutrition and health knowledge, it allows users to search learning resources or databases to fulfill their learning curiosity and accomplish their learning tasks, aiming to encourage clients or patients to use the internet as a tool for learning nutrition content. Users interacted actively with related resources available on the web such as graphics, pictures, text, and video [108].

In addition, there are general production tools such as graphics packages, computer photo and clip art collections, and presentation software that are used by nutrition educators to enhance the production, adaptation, and dissemination of nutrition education materials. Moreover, nutrition educators are concerned about access to technologies that need training and practice lead to effectiveness in changing knowledge, attitudes and behaviors of the public [111].

4.3 Development of Web-Based Nutrition Lesson

Nutrition education tool is one component of nutrition education and diet counseling which developed in several types of mass media. The basic premise of Web-Based Nutrition Lesson that is printed reading materials combined with internet technology such as mailing lists, e-mail, real-time chat, assignments, and internet access via a special course menu that would allow learners to retain the benefits of the correspondence course while adding the interaction among the learners that is so valuable [122]. Moreover, the information from the internet can also saved on learner’s computers for further reference or selectively printed out.

In general, the major types of programs are designed both for professionals and clients include nutrient analysis, food service and recipe management, menu planning, clinical nutrition, drug-nutrient interaction, health-risk assessment and lifestyle prescription, food and nutrition education, and games [108]. These programs are for illustrative purposes as follows;

4.3.1 Nutrient analysis based on food intake records or recalls

A list of foods and beverages, along with the serving sizes, for one or more days is keyed into the computer program. The program calculates the nutrient intake of individuals or groups of individuals and compares it to a nutrient standard. Moreover, the effectiveness of these programs for computing nutrient intake for research and education purposes to be used more frequently in education and counseling settings, identifying nutrient excesses and deficiencies. Interestingly, this computerized nutrient analysis has significantly reduced both the time and effort of calculating intakes using calculators and food composition book.

However, the nutrient database is the most important feature. Especially, the database must be accurate, verified, and large enough to meet the intended task. In general, a nutrient adequacy is usually defined by the U.S. Recommended Dietary Allowances and some programs use other standards, including the Recommended Dietary Intake for Canadians, the U.S. Food and Drug Administration (FDA) labeling standards and Food Guide Pyramid servings.

Furthermore, the programs have now been used extensively for classroom assignments from elementary through to medical school students, and have been offered as a nutrition education service in shopping malls and health fairs, in science exhibits, and by public health, fitness trainers, food scientists and food service professionals [109,123].

4.3.2 Clinical nutrition

4.3.2.1 Assessment tools

Assessing nutritional status applications of patients such as charting medical records, teaching patients about diet and disease, and for computer-assisted education are widely available. Especially, the software for desktop computers and programs are useful for many formulas used in nutrition assessment, including basal metabolic energy needs, Body Mass Index (BMI), desirable body weight, diabetic food exchanges. These tools are useful in hospital and community research and service settings. This nutrition software for use on hand-held computers is becoming increasingly popular. However, these tools can be less cumbersome than manuals and allow for the use of more precise calculations nutrition care [109,124].

4.6.2.2 Patient education [111]

Most of programs provide dietary information and education to patients and usually available for individuals with diabetes, hypertension, heart disease, and complex medication regimens. These programs teach about causes of the disease, symptoms, complications, dietary management and menu planning. Multiple media are used in many modules from full-motion video to straight text. These programs and additional modules are being converted to CD-ROM to expand distribution possibilities.

Advantage of computer-mediated education are; 1) Delivering consistent and concise nutrition and health counseling even when a nutritionist is not available; 2) Engaging patients for a longer period of time because the program is interactive; 3) Creating more time for critical one-to-one counseling; 4) Crossing cultural and language barriers. Furthermore, an important advantage is its consistency to provide standard answers to predictable questions and it affords privacy in learning and assures equality of information to each user.

4.6.2.3 Computer-Assisted instruction (CAI) for health professionals

The nutrition programs available generally include content such as the relationship of diet to a disease, components of nutritional assessment, diet

history methods, and patient case studies. These programs vary from computer-text-on-screen to computer-based multimedia applications as follows;

Text-on-screen

A computer assisted instruction program that addresses both the prevention and management of disease including obesity, hypertension, diabetes, and lipid disorders. The program provides nutrition information and counseling strategies known to foster a positive physician and patient relationship. The user's knowledge is tested and compared to professional standards. Case studies are presented and the users answer multiple choice questions about case management [111].

This type of computer-assisted instruction (CAI) takes advantage of learning theories involving reinforcement of learning experiences, the advantages of self-paced learning, and repetition of difficult material.

Computer-based multimedia applications

This type of computer-assisted instruction is promoted as ways to increase learning and retention in a shortened learning time, provide realism, role modeling and simulations. Moreover, self assessment tools, included self-monitoring and self-recording give patient immediate feedback about their own diet and exercise pattern. The programs tests patients' ability with simulated cases and also contribute to the development of meta cognitive strategies that patients can internalize to use in all learning. As a final test, users complete a clinical challenge by reading a patient's chart, providing nutrition assessment and prescribing a management plan. Instructors can check the patients' performance. This systematic approach to teaching meta cognitive strategies that has some similarities to the stimulus control approach [111,125].

This program demonstrates the ability of computer mediated multimedia programs to: 1) Effectively model nutrition assessment and counseling behaviors; 2) Ensure consistency and equality of learning opportunities; and 3) Expose learners to be a master.

Application to distance learning [111]

Computer assisted-instruction (CAI) is a distance learning approach. Programs that provide performance feedback and coaching have demonstrated and improved learning in distance education and training situations. Moreover, the

computer based case studies teach the learner nutrition assessment practices, perform assessment tasks, and interpret results.

Although, the CAI cannot replace many clinical or nutrition education experiences, it also can help build and maintain cognitive and analytic skills in an interactive format. Some other advantages are; 1) Cases can be staged to challenge both the novice and the expert; and 2) Content can be indexed for easy access to any term, image, or sound.

4.6.3 Food and nutrition education instructional program and games

The most of food and nutrition instructional programs as interactive games via floppy disks or CD-ROMs have been designed for school-age children. As noted that the format of the lesson to the organization of the content was important to promote self-learning. Stories and character identification effectively aroused users' feelings and engaged them in lessons. Besides, sounds and animations incorporated into these programs helped users use their imagination. However, attention must be given to realism and accuracy of graphics to assure that the embedded nutrition concepts are attended and interpreted correctly. Problem solving assignments with an evaluation component were effective in helping users enjoy learning [126].

There are only a few nutrition education programs. One of the most popular and widely distributed CD-ROM programs is the "5-A-Day Adventures", is an education computer game as interactive program with music and video that was designed to increase the consumption of fruits a day. It includes activities about nutrients in fruits and vegetables, serving sizes, label reading, simple recipes and making salads. Interestingly, some people refer to these programs as "edutainment" that engage users' learning to promote healthy choices and a lifetime of fitness [127].

CHAPTER IV
MATERIALS AND METHODS

This study was designed to develop and evaluate the effectiveness of the educational tool model as the multimedia diabetes education website for self-help meal planning in type 1 diabetic children and adolescents focusing on their knowledge and understanding of diabetes and dietary management especially on the carbohydrate counting concept.

The study was conducted in a group of type 1 diabetic children and adolescents to determine; 1) Knowledge and understanding of meal planning using carbohydrate counting, 2) Accuracy in patient's perception and conceptualization in carbohydrate counting, 3) Current dietary assessment for evaluating nutrition status via the diabetes educational website 4) Attitude about diabetes and self-dietary management, and 5) Overall satisfaction with the developed educational tool model.

Ethical consideration

The study was approved by the Ethical Clearance Committee on Human Rights Related to Researches Involving Human Subjects, Faculty of Medicine, Ramathibohi Hospital, Mahidol University (Appendix A). The written informed consent was obtained from participants and their parents.

Study Protocol

The process of this study was consisted of 2 phases as follows:

- **Phase 1 :** Development of the multimedia diabetes educational website
- **Phase 2 :** Evaluation of the effectiveness of the multimedia diabetes educational website

Phase 1: Development of the multimedia diabetes education website

The purpose of this phase was to construct the multimedia website educational tool that was easily to learn and understand about a basic carbohydrate counting technique, in order to help patients planning their own menus for the whole day emphasizing on carbohydrate counting concept for appropriate diabetes eating practice. The flow chart of development of the multimedia website educational tool using basic carbohydrate counting concept was represented in Figure 4.

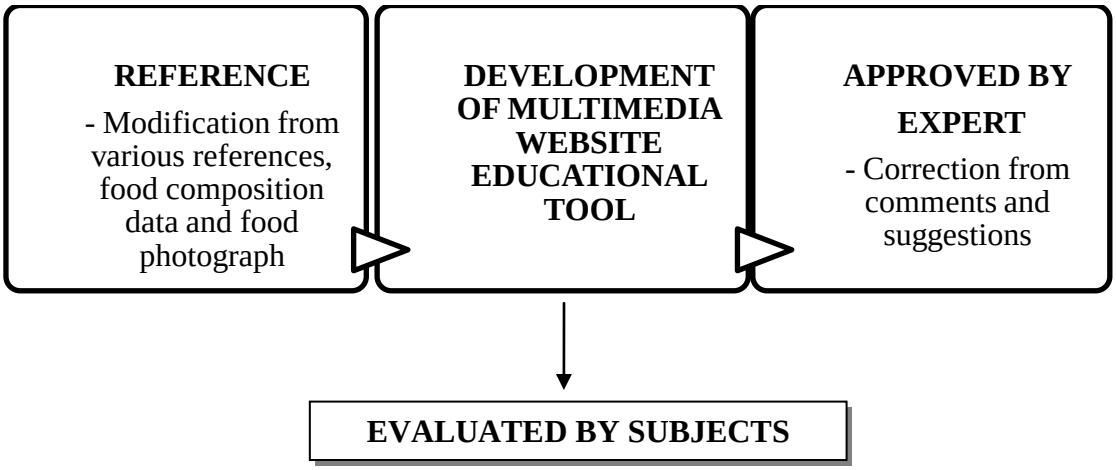

Figure 4 Flow chart representing phase 1: Development of the multimedia diabetes education website using basic carbohydrate counting concept

This phase consists of 5 steps as following:

Step 1 Research and preparation for development of diabetes educational website

The literatures related to diabetes knowledge and nutrition recommendation about basic carbohydrate counting were sought from various references to develop the diabetes educational website.

The contents of educational website were modified from reliable resources such as books, published documents, researches and websites related to carbohydrate counting concept [5, 89-92,128], especially the development of educational tool model for self-help meal planning in type 1 diabetes adolescents research.

Step 2 Selection of the appropriate format and media for the diabetes educational website development

The multimedia educational website was selected to use as the educational tool model which would be usually used by the wide society with its ease-of-use for the user to utilize. Furthermore, it provides the facility to provide online education and would also available 24 hours a day to get education and update user's data to improve their knowledge and understanding about diabetes and self-care management for further behavior modification.

The multimedia educational website was developed in the form of an interactive web base which mainly consists of general public contents, food intake and blood glucose level record, multiple-choice knowledge assessment with a self-score report for optimal descriptive feedback, interactive food card pictures and food list menu as a reference source for practicing carbohydrate counting and self-help meal planning from their individual targets. The appropriate format and media for development of diabetes educational website including the following: (Table 7-8)

2.1 System Specification

1. **Software**

Table 7 Software system specification for the educational diabetes development

Server & Development Software
Web server : Apache , PHP 5.x
Language Script : HTML, Java Script, PHP
Database My SQL 5.x or later
Macromedia Dreamweaver CS 3
Photoshop CS 3 or Later
Joomla 1.5.x

Table 7 Software system specification for the educational diabetes development (Cont.)

Client Software
Microsoft window XP/Vista/Window 7
Web Browser : • Internet Explorer 7.0 or Later • Firefox
Others : • Adobe Acrobat Reader, Adobe Flash 8 or Later

2. Hardware

Table 8 Hardware system specification for the educational diabetes development

Server Specification
Web Hosting Space : 1 GB or more
Monthly Bandwidth : 50 GB / Month
Memory : 1 GB

Client Hardware Specification
CPU : Pentium Dual Core
Memory : Minimum 512 MB/ 1G (Recommend)
Disk space : Minimum 3 GB

2.2 Register homepage in the specific URL

The multimedia educational website were registered a domain name and web domain though web hosting service. A name of website, KINPORDEE (means healthy eating) was decided to suit with the main aims contents for promoting and simple memorization when a visitor types in the URL of website, www.kinpordee.com, the noticeable home page is usually the first page they visit and see more menu.

Moreover, this multimedia educational website was created by JOOMLA [129], a content management system (CMS), which enables to build web site and powerful online applications. Contents can be simple text, photos, music, video and documents which could be an empowerment for user's self-learning.

2.3 Web design layout and defining theme

Most web design layout and website's logo were created as a remarkable pattern including a unique graphic cartoon as a mascot which normally has done in Photoshop program. (Figure 5-6) Furthermore, KINPORDEE theme music was created as a meaningful song lyric and tuneful melody for project's representative that would be used as a music background for the front-page loading.

Figure 5 Web designing layout and KINPORDEE theme logo

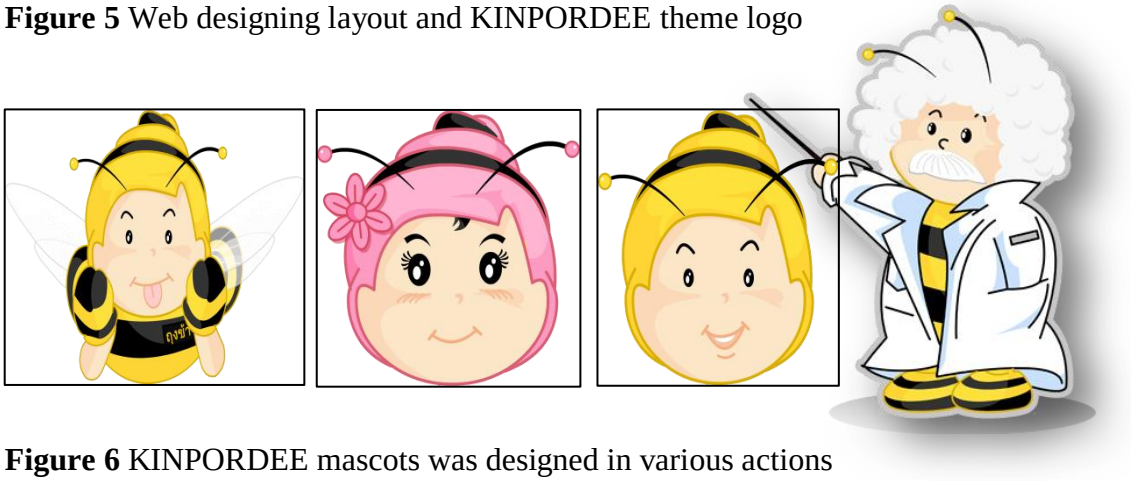

Figure 6 KINPORDEE mascots was designed in various actions

Moreover, an overall image and color selection which selected to use in the website were considered from the target user. The most graphic picture especially, food pictures were adjusted color and brightness from the Illustrator program which

enable to get more attention of the user. Wording and font selection which were considered from the easy and simple to read and understand to children and adolescents in target user.

Step 3 Determination the scope and outline of content

The diabetes educational website was developed in such a way that it was easy to understand for a general diabetic patient. The scope and contents were created for suitable with all users and covered all details extensively. Moreover, all ideas were discussed with advisors and web developer team for satisfying applicable requirements, in order to make it easier and more interactive for users to access the web content. There are 2 subordinate steps for developing the multimedia educational website as follows:

3.1 Main menu and sub contents selection

There were spending the time for creating main menu to be fit with a project's aims. A management in diabetes educational website context part as follows:

3.1.1 Collecting and categorizing data

The data were collected from many sources such as text books, journals, internet and CD-ROM. Consequently, the collected issues were developed as the content areas of the diabetes educational website into main 7 chapters as shown:

1. Information on diabetes care, particular on dietary therapy
2. Principle and benefits of meal planning using basic carbohydrate counting
3. Food groups which contain carbohydrate
4. Food items for carbohydrate counting
5. Methods of calculation and counting carbohydrate
6. Methods of increasing skill by weighing and measuring foods, estimating portions, figuring carbohydrate grams or choices using food labels and an appropriate reference for carbohydrate counting
7. Steps in self- help meal planning using carbohydrate counting

However, the multimedia educational website was divided into specific application requirements mainly, consist of general public contents, food intake and

blood glucose level record, multiple-choice knowledge assessment with a self-score report, interactive food card pictures and food list menu for a reference source for practicing carbohydrate counting and self-help meal planning from their individual targets.

3.1.2 Study the characteristics and food habits collecting the information of the target user

By using the validated questionnaires for:

1) Demographic data
2) Meal patterns and favorite foods
3) Food-frequency questionnaire
4) 24 hours dietary record

All data were collected using with the questionnaire part and was also used as the important baseline information to develop the multimedia educational website in the advance.

3.1.3 Optimal setting menu and content

The educational website's menus and contents were organized practically which contain contents suitable for young users and corresponds to the self-learning objectives. The created menus and contents were done under the scope of each topic reasonably. The main created menus and sub menus were composed of:-

- **E-PORDEE Public Library**
  - General information about diabetes and self-care management
  - General information about diabetes food
- **E-POR DEE Clinic**
  - **See a doctor**
    - E- Daily glucose level record
    - E- Self monitor blood glucose
  - **See a dietitian**
    - E-Daily intake record
    - E-Menu planning practice
    - E-Daily carbohydrate counting
    - Self-help meal planning guidelines
    - Carbohydrate counting technique

        - Food portion size estimation and nutrition label
    - **E-Nutrition assessment**
        - Evaluate nutrition status
        - Evaluate nutrition requirement
        - Self-nutrition assessment
- **E-POR DEE Fitness**
    - Benefits of exercise
    - Exercise with diabetes
- **E-POR DEE School**
    - E-Exercise practicing
    - E-Exercise record
- **E-POR DEE Supermarket**
    - Food exchange list for carbohydrate counting
    - Food Photo gallery
- **E-POR DEE Game**
    - Make a healthy meal planning
- **E-POR DEE Web board**
- **E-POR DEE Chat room**

KINPORDEE system feature shows in Figure 7. And this multimedia diabetes educational website consists of main 8 menus as shown in the Table 9.

KINPORDEE System Feature

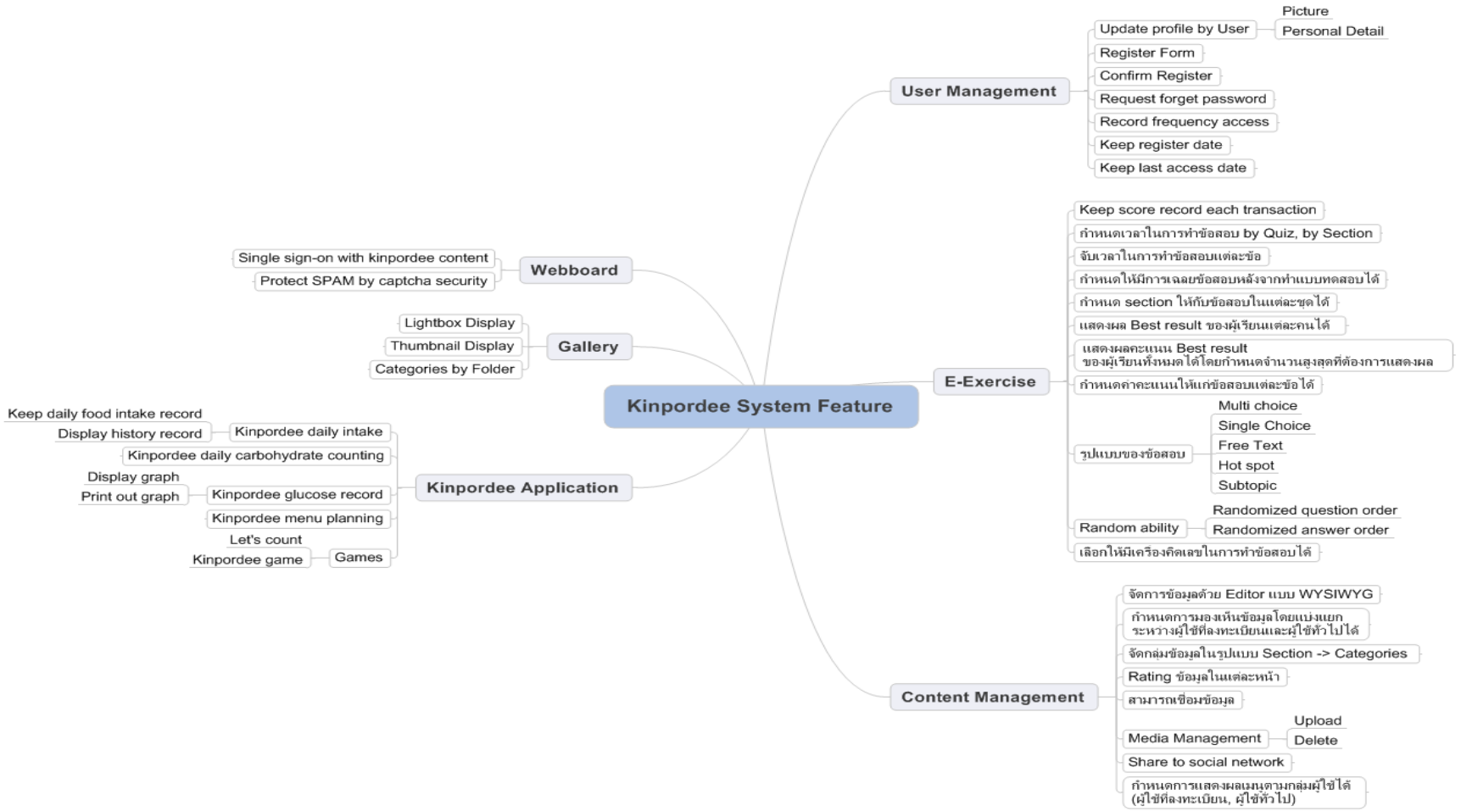

Figure 7 The multimedia educational website's system feature

Table 9 The scope and outline of the multimedia diabetes educational website

Menu	Objective	Menu content outline	Self-learning techniques
(1) E-PORDEE Public Library : Introduction and general diabetes information	1. To define diabetes differently 2. To acknowledge diabetes risks and its complications 3. To describe the importance of self-diabetes control 4. To describe the importance of dietary control	**1. General information about diabetes and self-care management** - Diabetes overview; definition - Type of diabetes - Cause of diabetes - Signs and symptoms of diabetes - Diabetes complications - Risks of poor diabetes control - Insulin working - Self-monitoring blood glucose (SMBG) - Behavior modification for improving diabetic control **2. General information about healthy eating for diabetes** - Food pyramid recommendation - Food guide for diabetes - Food label reading	- A context with the colorful cartoon pictures - A web link to the related application menus and article such as e-food photo gallery and e-food exchange list - Each e-exercise practicing for self-learning assessment using a multiple-choice knowledge test

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Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(2) E-POR DEE Clinic : An overall self-help guide lines for meal planning and self-control diabetes	1. To describe an appropriate calorie requirement and carbohydrate intake per day 2. To identify an individual standard body weight and set goal for management 3. To provide clinically useful information regarding the self-monitoring of blood glucose 4. To describe an appropriate dietary guidelines for diabetes 5. To define the aims and benefits of a healthy meal planning method such as the food exchange system and carbohydrate counting concept	**1. See a doctor** - Daily blood glucose level record - Self monitoring blood glucose **2. See a dietitian** - Daily dietary intake record - Daily carbohydrate unit counting and record - Principles and goals of meal planning - Principles and benefits of meal planning using a food exchange system - Principles and benefits of meal planning using a basic carbohydrate counting - Food groups which contain carbohydrate - Food items for carbohydrate counting	- A context with the colorful cartoon pictures - A web link to the related application menus and articles such as , e-nutrition assessment, e-daily intake record, e-glucose check, e-food photo gallery, e-daily carbohydrate counting and practicing, e-blood glucose check and record - Application programs for self-assessment and control diabetes - Each e-exercise practicing for self-learning assessment using a multiple-choice knowledge test

Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(2) E-POR DEE Clinic (Cont.) : An overall self-help guide lines for meal planning and self-control diabetes	6. To classify the food groups and amount of carbohydrate in the carbohydrate-containing food 7. To acknowledge the carbohydrate counting concept for self-help meal planning 8. To recognize the importance of estimating food portion size for meal planning 9. To emphasize using with the nutrition fact label for counting carbohydrate	- Carbohydrate counting concept - Steps for the self-help meal planning using carbohydrate counting - Portion size estimation - Reading nutrition fact label for counting carbohydrate **3. E-Nutrition assessment** - Nutrition assessment in term of Growth chart for Children, 5-18 years [130] - Daily energy requirement and carbohydrate unit target - Carbohydrate unit distribution for meal planning	- A context with the colorful cartoon pictures - A web link to the related application menus and articles such as , e-nutrition assessment, e-daily intake record, e-glucose check, e-food photo gallery, e-daily carbohydrate counting and practicing, e-blood glucose check and record - Application programs for self-assessment and control diabetes - Each e-exercise practicing for self-learning assessment using a multiple-choice knowledge test

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Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(3) E-POR DEE Fitness : A self-help guidelines for doing exercise with diabetes	1. To identify benefits of exercise with diabetes 2.To acknowledge an appropriate carbohydrate choice during exercise or unintended consequences 3. To identify cause of over or under blood glucose target and resolve those problems from the sample exercise situation 4. To improve skill for self-care during exercise	1. Benefits of exercise 2. Exercise and diabetes 3. Self-care skills to compile carbohydrate choices with type of exercise and blood glucose level	- A context with the colorful cartoon pictures - A web link to the related application menus and articles such as e-glucose check, e-food photo gallery and e-carbohydrate counting practice - Each e-exercise practicing for self-learning assessment using a multiple-choice knowledge test

Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(4) E-POR DEE School: A self-assessment exercise	1. To provide prospective users with understanding of general diabetes information and self-help meal planning 2. To evaluate and record the score of knowledge and understanding in each topic	**1.Exercise practicing:** The 14 topics were made up as follows: - Diabetes sounds familiar but it's an uncommon disease - Type of diabetes - Cause and symptoms of diabetes - Diabetes complications - Insulin working - Concerning Blood glucose and self-control - Diabetes and exercise - Diabetes care and practices - Healthy eating with diabetes - The 5 food groups and pyramid guidelines - Nutrition assessment and self-help meal planning	- Each e-exercise record for self-learning assessment using a multiple-choice and fill-in-the-blanks knowledge test - Encouraging user to demonstrate learning skills to compile meal planning from individual dietary goal

Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(4) E-POR DEE School (Cont.): A self-assessment exercise	1. To provide prospective users with understanding of general diabetes information and self-help meal planning 2. To evaluate and record the score of knowledge and understanding in each topic	- Using diabetic food exchange - Carbohydrate counting technique - Using nutrition labeling **2. Exercise record:** The 4 topics were made up as follows: - General of diabetic knowledge with self care management - Identifying a carbohydrate food and applying food reference list such as food exchange system and nutrition fact labeling - Estimating portion size and meal planning using basic carbohydrate counting - Estimating portion size in real food and meal planning using basic carbohydrate counting	

Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(5) E-POR DEE Supermarket: Food gathering data	1. To provide a food reference information for self-help meal planning 2. To practice and review the estimating food portion size for self-help meal planning using carbohydrate counting 3. To gather food pictures and data as a food categories for self-help meal planning using carbohydrate counting	1. Food exchange list for self-help meal planning using carbohydrate counting 2. Food reference pictures for self-help meal planning using carbohydrate counting	- Food pictures with actual portion size, encourage user to increase skills for self-estimated food - Interactive application program for self-learning and problem solving with meal planning
(6) E-POR DEE Game: Interactive educational game for meal planning	1. To improve health care professional practice about healthy meal planning 2. To improve knowledge and skills, and change attitudes and performance about healthy meal planning 3. To encourage users for self-learning with the interactive multimedia tool on line	**1. Make a healthy meal planning** - Select desirable food choice into a plate for making a healthy plate	- Moving food cartoon pictures with sound effect - Getting a score and challenging skill in each episode of game series

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Table 9 The scope and outline of the multimedia diabetes educational website (Cont.)

Menu	Objective	Menu content outline	Self-learning techniques
(7) E-POR DEE Web board: An online discussion site for managing user generated content	1. To motivate users participating in interesting forum, especially diabetes update forum. 2. To cultivate diabetes social bonds and interested groups for a topic and the discussions. 3. To announce news and club's information between the target and interested users.	1. E-Bulletin board 2. KINPORDEE CLUB's activity 3. Ask experts 4. FAQ 5. General sharing topics	- A day-to-day interesting forum may encourage users to have more interactions with the diabetes website's community.
(8) E-POR DEE Chat room: An on-line communication contexts communicating	1. To communicate directly with target users via text between in the same chat-room in real-time. 2. To share information and provide immediate feedback or responses to user's questions.	1. Chat room register and personal setting 2. KINPORDEE Chat room	- Sending text messages may promote community among groups of users who would be able to communicate informally, such as sharing experiments about self-care diabetes.

3.2 Designing of the content management system feature

The content management system feature was designed to organize and automate the website management and publication of data and content easily. The multimedia educational website system feature was composed of 6 parts mainly as follows:

3.2.1 User's management system

This component enables administrators to follow site members and give them the sense of being KINPORDEE member, by inviting them to visit the site if they don't login for more than 3 days or prescribed day during the study. Moreover, it has some kind of method to track and maintain user activities. Therefore, this user management system can control over who has access to which part of website applications. KINPORDEE user management system was included the following modules: (Figure 8)

- Login & Logout
- User Registration and update profile
- Account Activation
- Password Management

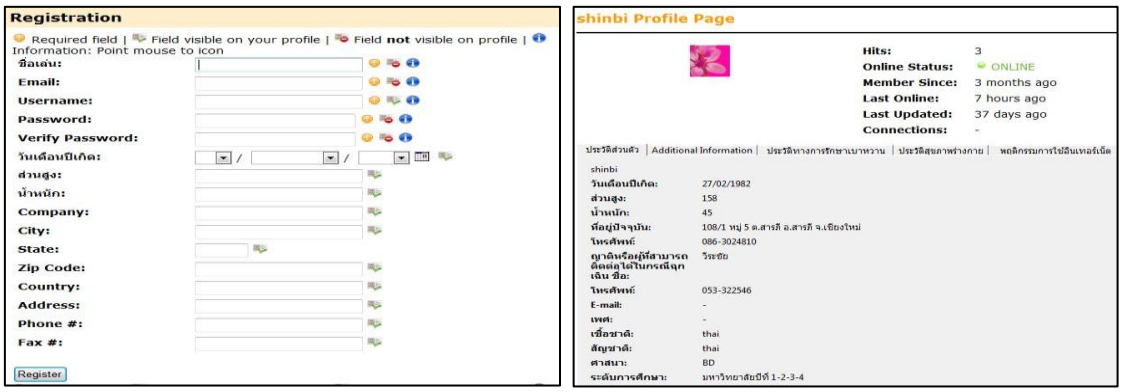


Figure 8 KINPORDEE user's management system

Moreover, for E-PORDEE resume, a part of user's management system also enable to collect and evaluate user's data, such as a score record and demographic data by using online questionnaires. However, the frequency of access the web page was recorded from GET CLICKY, [131] a clicky web analytics to monitor, analyze, and react to their visitor traffic in real time.

3.2.2 Content management system

This multimedia educational website was created by JOOMLA [129], a content management system (CMS), which enables to build web site and powerful online application to maintain a web presence with a high degree of efficiency and speed. Each content type can be simple text, photos, music, video and documents which could be an empowerment for user's self-learning. Moreover, it can control accessing to data, based on user roles. User roles define what information each user can view or edit by using the built-in "WYSIWYG" editor to create or update pages.

3.2.3 KINPORDEE applications

Useful applications were designed to encourage user's self-learning and practicing. Simple useful applications as follows:

- E-Daily intake record
- E-Daily carbohydrate counting
- E-Daily glucose level record
- E-Menu planning practice
- E-Games online

3.2.4 E-Exercise system

This system was designed to be a self-learning system for practicing and evaluating user's knowledge and understanding about diabetes self-management especially a meal planning. The system was included the score feedback function. (Figure 9)

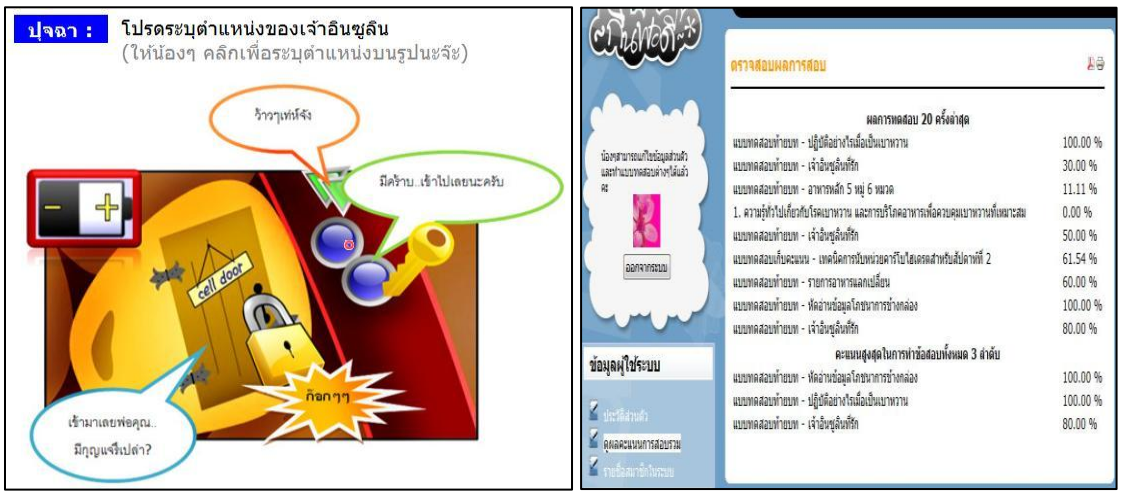


Figure 9 E-Exercise system and the score feedback page

3.2.5 Food references and photo gallery organized system

These systems were created to be the online sources for users. The various food sources were organized into different categories which can select and download. The users can learn and review carbohydrate units in different type of food. (Figure 10)

Figure 10 Food references and photo gallery organized system

3.2.6 Web board system

Discussion boards was created to enhance user's sharing their idea and updating information between members, this sites composed of textual content organized by html. The driving mechanism of a discussion board is the fact that users are registered and once registered can write posts. KINPORDEEE discussion board was made up of posts asking various types of question to which other users may provide answers to those questions. Major topics were stated as follows; (Figure 11)

- E-Bulletin board
- KINPORDEE CLUB's activity
- Ask experts
- FAQ
- General sharing topics

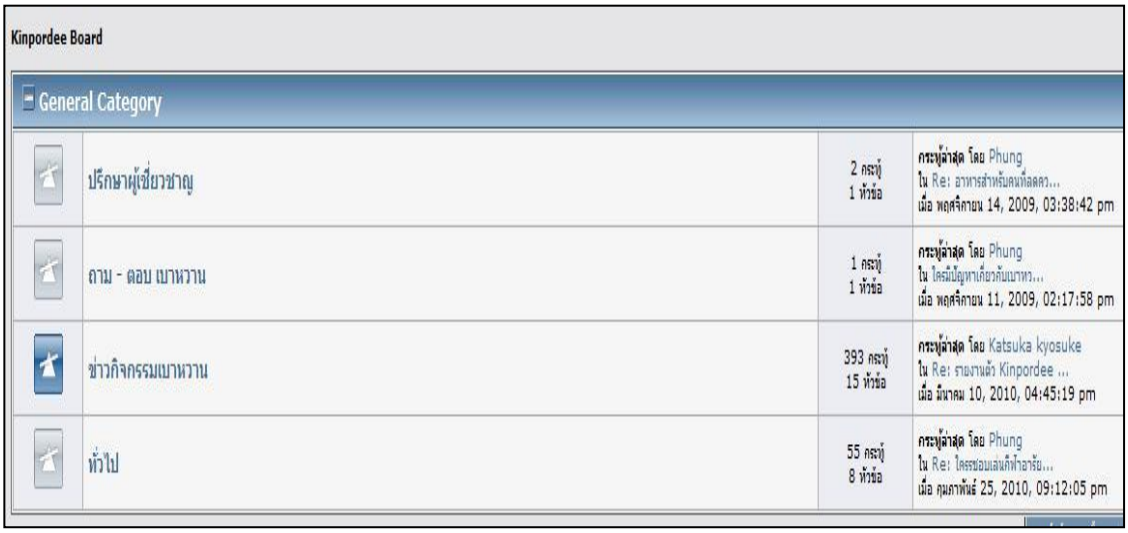


Figure 11 KINPORDEE Web board systems

3.2.7 Chat room system

Electronic chat was added to facilitate a communication, closely resembling actual, real-time conversations. Therefore, individual's log-into a system can communicate directly with other members logged into the same system. Within seconds of writing a comment online, everyone else logged-into the system can view and immediately respond to these initial remarks. (Figure 12)

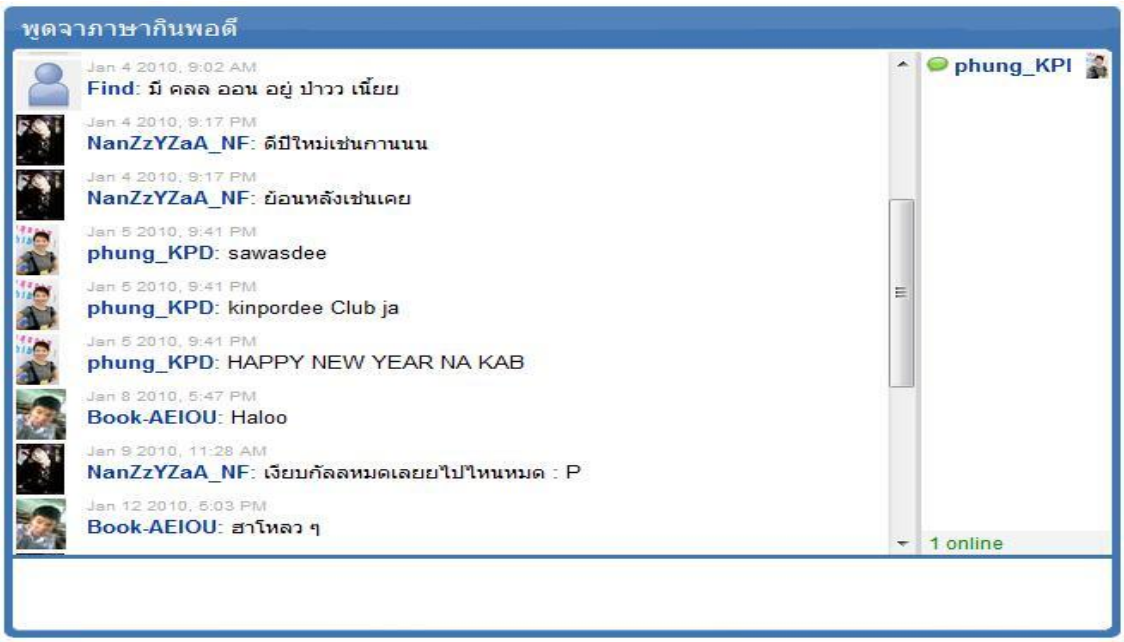


Figure 12 KINPORDEE Chat room system

STEP 4 Development of the multimedia diabetes educational website

The multimedia diabetes educational website was developed as a specific tool for a dietary self-care management in children and adolescents. The general contents were organized into 3 sections as follows:

4.1 The general public contents

These contents were modified primarily from the educational booklets of Chaturawit C. [30] and the guidelines of ADA on Diabetes care were also included [14, 22, 43, 44, 47]. The public contents were presented in 2 parts as follows:

4.1.1 The general information about diabetes and self-care management

To provide user's knowledge emphasized on diabetes self-care management. The following topics made up the multimedia diabetes educational website:

1. Definition, etiology and risk factors
2. Classification and symptoms of diabetes
3. Complication: Acute and long term complication
4. How is insulin working?
5. Treatment and prevention
6. Nutrition and exercise with diabetes
7. Self management in diabetes
8. Self-monitoring blood glucose (SMBG)
9. Nutrition and exercise with diabetes
10. Behavior modification for improving diabetic control

4.1.2 General information about healthy diabetes food to provide the general knowledge, emphasized on how to making a healthy diabetes food choice as following topics: [132]

1. The 5 food groups and food pyramid recommendation
2. Food guide for diabetes
3. Food label reading

4.2 The self-help guidelines for meal planning using carbohydrate counting

This section contained some modifications from the educational booklets of Chaturawit C. [32] and other sources included ADA and American Diabetes Association's publication and websites, [25, 26, 48, 49, 89-92] focus on a basic carbohydrate counting concept for choosing their appropriate meal**.** These contents were divided into 2 parts;

4.2.1 Nutrition assessment and self-help meal planning using a basic carbohydrate counting

To provide user's self-nutrition assessment in term of weight for height to assess their nutrition requirement and generate meal planning, emphasized on how to identify and select a food carbohydrate choice properly. Moreover, methods of increasing skill including weighed and measured foods, estimated portions, figured carbohydrate grams or choices using food labels were provided in the multimedia diabetes educational website as well.

The following topics made up the multimedia diabetes educational website:

1. Nutrition assessment in term of Growth chart for Children, 5-18 years [132]
2. Principles and goals/benefits of meal planning
3. Principles and benefits of meal planning using a food exchange system
4. Principles and benefits of meal planning using a basic carbohydrate counting
5. Carbohydrate containing food groups
6. Calculation steps for the self-help meal planning using carbohydrate counting
7. Portion size estimation
8. Reading nutrition fact label for counting carbohydrate

4.2.2 The database site of food exchange lists and food photo gallery for counting carbohydrate

This food exchange lists database was focused on food groups which contain carbohydrate, in order to provide dietary information to users regarding to

carbohydrate values in variety of foods items for carbohydrate counting. Food items and carbohydrate values were taken from: [133,134,135,136,137,138,139]

a) Thai Food Exchange Lists, *Thai Dietetic Association*

b) Thai Food Composition Tables, *Institute of Nutrition, Mahidol University*

c) Nutritional values of Thai foods, *Nutrition Division, Department of Health, Ministry of Public Health*

e) Research related to nutritional values of Thai foods

f) Brochures or websites of Fast Food Guide

g) Food labeling of food products

All food items were categorized into 12 food groups; starch, fruit, milk, vegetable, fast-foods, one-plate/set-plate dish, snack, drink, Thai dessert, other dessert/miscellaneous, ready-to-eat food and condiment. Most food items were featured in amount that equaled one carbohydrate choice (15 grams). However, the non-starchy vegetable was defined an amounts that equal 1/3 carbohydrate choice (5 grams). And some food items were defined the carbohydrate choice as its usual serving size such as one-plate/set-plate dish, snacks, drink, Thai dessert and fast food.

Moreover, the actual food portion size of the selected food photo gallery was identified legibly i.e., a half of one serving, one serving, and two or three serving which were designated to be representative of each portion commonly consumed.

4.3 Diabetes educational website instruction manual

HELLO-KINPORDEE instruction manual was conducted as a website usage guideline which consists of accessing system and selecting specific topics in main menu through the various knowledge sources and the self-help guidelines menu for meal planning such as e-daily intake record, e-daily carbohydrate counting, e-glucose check and record, e-food photo gallery and e-food exchange list. Moreover, e-exercise practicing and record were also recommended as the self-learning system. Moreover, this manual was recommended to subjects to download through the website. (Appendix B)

STEP 5 Approval of the multimedia diabetes educational website

Most contents and applications were approved and commented by the dietetics and IT experts. Afterward, a test and website revision was conducted by 10 example users. Furthermore, the evaluation of satisfaction of the multimedia diabetes educational website was done by diabetic children and adolescents after finishing online- nutrition education program.

Phase 2: Evaluation of the effectiveness of the diabetes educational website

The aims of this phase;

1) To assess the subject's knowledge and understanding of meal planning by using carbohydrate counting: accomplished by using Pre and Post-test questionnaire and the weekly exercise scores
2) To assess the accuracy in subject's perception and conceptualization in carbohydrate counting skill using the multimedia diabetes educational website accomplished by evaluating subject's ability in estimating foods and count carbohydrate via class practice
3) To assess the subject's attitude about diabetes self-management
4) To assess the subject's satisfaction with the multimedia diabetes educational website: accomplished by using validated questionnaire
5) To study the subject's current dietary assessment via the multimedia diabetes educational website

This phase was proceeded as follows;

1. Instruments for data collection

1.1 Instruments used to collect the baseline characteristics of the subjects

Validated online questionnaires were used to obtain the baseline characteristics of the subjects (Appendix C) which were divided in 4 parts; 1) Personal data such as medical history, internet usage pattern and exercise pattern 2) Food eating pattern and food preference 3) Food frequency questionnaire 4) Food record form

1.2 Instruments for collecting nutritional status of the subjects

Anthropometry, biochemistry and dietary intake were assessed at baseline and at the end of the study to evaluating the effectiveness of diabetes educational website for meal planning using basic carbohydrate counting.

1.2.1 Anthropometric measurement

- Weigh measuring scale was used to measure the body weight
- Height measuring scale was used to measure the body height
- Measuring tape was used to measure mid arm circumferences (MAC)
- Skin fold caliper was used to measure triceps skin fold (TSF)
- Weight for height was calculated using INMU-Nutristat program [140] as Z-scores of the nutritional center for Health Statistics reference according to sex for determining of the nutritional status**.**

The interpretation of weight for height [132]:

> +3 SD	obesity
> + 2 SD to + 3 SD	beginning of obesity
> +1.5 SD to +2 SD	overweight
-1.5 SD to +1.5 SD	normal
< -1.5 SD to -2 SD	slightly underweight
< -2 SD	underweight

1.2.2 Biochemical assessment

The level of glycemic control was determined as follows [28]:

≤ 8%	good
> 8% and ≤ 10%	fair
> 10% and ≤ 12%	poor
> 12%	very poor

1.2.3 Dietary assessment

- Energy and nutrient requirement

Individual energy requirement calculated from Holliday-Segar method as follows [141] :

First 10 kg	x	100 Kcal/day
Second 10 kg	x	50 Kcal/day

> 20 kg x 20 Kcal/day

In case of nutrition status of subjects was in ranged of overweight and obesity. The energy requirement were subtracts out 500 kcal from energy requirement for weight reduction. The distribution of carbohydrate: protein: fat is determined at 50: 20: 30 % of energy requirement per day.

- Energy and nutrient intake assessment

The subjects were assigned to record their daily intake through E-daily food intake to access individual energy, carbohydrate, protein, fat intake at least 3 day per week. However, the determination of energy and nutrients intake was based on individual requirement as similar to the individual carbohydrate choice target per day.

1.3 Test Instruments used for evaluating the subject's knowledge and understanding of diabetes self-care and meal planning using carbohydrate counting concept

1.3.1 KAP Pre-test and post test questionnaires

The pre-test and post-test questionnaires were developed to measure knowledge (K), attitude (A) and practices (P) of subjects on their knowledge about diabetes self-care and meal planning using carbohydrate counting concept. Specially, KAP questionnaire had already verified by 3 experts for the content validity by evaluating Index of concordance value (IOC) [142]. The questionnaires were divided into 3 parts separately as multiple choice questions which consisted of totally 30 questions. The KAP questionnaires performed with each subject before and after self-learning with the educational website (Appendix D).

The scoring system was:

Right answer	:	1 point
Wrong answer	:	0 point
Total point	:	30 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

1.3.2 Weekly carbohydrate counting exercises

The carbohydrate counting exercises were used to practice a basic carbohydrate counting for self-help meal planning for 4 weeks. (Appendix E). Each assignment was multiple choice questions which consisted of totally 15 questions related to the main topics were designed as follows:

The first week: Self-nutrition assessment

The second week: Diabetes and carbohydrate

The third week: Carbohydrate counting for food mixed dishes

The fourth week: Carbohydrate counting for eating out and meal planning

The scoring system for each exercise was:

Right answer	:	1 point
Wrong answer	:	0 point
Total point	:	15 points

The scores were converted to percentage and were classified into 3 levels as follows:

Low level of knowledge	:	< 50% correct
Medium level of knowledge	:	50 – 75% correct
High level of knowledge	:	> 75% correct

1.3.3 Test instruments used for evaluating the accuracy in subject's perception and conceptualization in meal planning using carbohydrate counting skill

1.3.1.1 Weekly diabetes self-care dietary management knowledge exercises

These weekly exercises were used to assess the accuracy of carbohydrate counting focus on the food estimating for self-help meal planning for 4 weeks. (Appendix F). However, the food exchange list and food photo gallery (E-PORDEE Supermarket) were used to be an exercise's wizard. Each assignment was multiple choice and open ended questions which consisted of totally 15 questions (1 point in each question with total score of 15 points) related to the main topics were designed as follows:

The first week: General diabetes self care management knowledge

The second week: Identifying a carbohydrate food and applying food reference list such as food exchange system and nutrition fact labeling for carbohydrate counting

The third week: Estimating portion size and meal planning using basic carbohydrate counting

The fourth week (Class activity): Estimating portion size of actual food sample (mixed dishes) and meal planning using basic carbohydrate counting

The scoring system for each exercise was:

Right answer	:	1 point
Wrong answer	:	0 point
Total point	:	15 points

The scores were converted to percentage and were classified into 3 levels as follows:

Low level of knowledge	:	< 50% correct
Medium level of knowledge	:	50 – 75% correct
High level of knowledge	:	> 75% correct

However, the final class activity was held at Center for Health Empowerment, Ramathibodi Hospital. Several class activities were conducted for evaluating subject's perception and conceptualization in meal planning using carbohydrate counting skill. Firstly, each subject was assigned to access KINPORDEE website for self-nutrition assessment. The details included appropriate carbohydrate goal (servings), calories intake and quantity of carbohydrate food consumed per day. Each subject was assigned to complete the individual meal distribution to set their proper amount of carbohydrate choices consumed in each meal per day. Then, they were divided into three groups to plan two sample meals and presented to the class.

Secondly, a sample fruit market, with variety of carbohydrate food items from 5 groups was designed to evaluate subject's food estimation skills. Subjects were asked to estimate food portion sizes and calculate carbohydrate choices in each serving. Five food groups composed of;

- Starch
- Vegetable
- Fruit

- One-plate dishes
- Other carbohydrate food items, i.e. beverage, milk, snack and dessert

Specially, the total score of the accuracy in counting carbohydrates and meal planning was accumulated from all class activities which were 40 points (10 point in each question with total score of 40 points)

The scoring system for each exercise was:

Right answer	:	1 point
Wrong answer	:	0 point
Total point	:	15 points

The scores were converted to percentage and were classified into 3 levels as follows:

Low level of knowledge	:	< 50% correct
Medium level of knowledge	:	50 – 75% correct
High level of knowledge	:	> 75% correct

1.3.1.2 Weekly food intake record

At least weekly 3-day foods records were used to count and record the unit of carbohydrate consumed. Each subject was assigned to use E-PORDEE daily food intake record to monitor diet compliance and assess the individual carbohydrate consumption. The collected data included meal time, food items and ingredients, portion sizes, and amount of carbohydrate in gram and carbohydrate choice. In addition, the usual carbohydrate consumption corresponded to the individual carbohydrate goal was also evaluated and classified into 3 categories comparing to the appropriate goals as follows; (Total score equals 10 points)

The scoring method was as following by minus 1 point (-1) every 1 carb choice of Under/Over the goal with actual carbohydrate intake.

Achieved carbohydrate goal	0 carb choice	get -0	get 10 points
Under/Over carbohydrate goal	1 carb choice	get -1	get 9 points
Under/Over carbohydrate goal	2 carb choice	get -2	get 8 points
Under/Over carbohydrate goal	3 carb choice	get -3	get 7 points
Under/Over carbohydrate goal	4 carb choice	get -4	get 6 points

Under/Over carbohydrate goal	5 carb choice	get -5	get 5 points
Under/Over carbohydrate goal	6 carb choice	get -6	get 4 points
Under/Over carbohydrate goal	7 carb choice	get -7	get 3 points
Under/Over carbohydrate goal	8 carb choice	get -8	get 2 points
Under/Over carbohydrate goal	9 carb choice	get -9	get 1 points
Under/Over carbohydrate goal	≥10 carb choice	get -10	get 0 points

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

Low carbohydrate goal compliance : < 50%
Medium carbohydrate goal compliance : 50 – 75%
High carbohydrate goal compliance : > 75%

Furthermore, the subject's dietary intake record compliance was also considered as the responsibility for performing in 3 days food intake record per week and the scoring was determined as follows: (Total score equals 10 points)

Record 3 days : 10 points
Record 2 days : 7 points
Record 1 day : 3 points
Not record : 0 point

However, the total score of subject's dietary intake record compliance in four periods were totally 40 points. The scores were classified into 3 levels as follows:

Low dietary intake record compliance level : < 50%
Medium dietary intake record compliance level : 50 – 75%
High dietary intake record compliance level : > 75%

1.4 Test Instruments used for evaluating the subject's attitude for diabetes and dietary management

The attitude pre-test and post-test questionnaires were developed to measure subject's attitude for diabetes and dietary management. Specially, this questionnaire had already verified by expert for the content validity. The questionnaire was divided into 2 parts separately as a positive and negative attitude which consisted of totally 20 questions. Each subject performed the attitude test before and after self-

learning with the educational website (Appendix G). The closed-end questions of rating scale with 5 levels of measurement were ranged as follows:

Extremely disagreed	:	1 point
Very disagreed	:	2 points
Somewhat satisfied	:	3 points
Very agreed4 points	:	4 points
Extremely agreed	:	5 points

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

Low attitude level	:	< 50% score
Medium attitude level	:	50 – 75% score
High attitude level	:	> 75% score

1.5 Instrument used for evaluating the subject's satisfaction with the multimedia diabetes educational website

The questionnaire was used to assess the subject's satisfaction with the developed educational website (Appendix H). The satisfaction level was considered in term of the useful contents aspect, format and design aspect and also the website motivation aspect. However, the content aspect referred to the agreement and usefulness of the content with the objectives, languages or wording, and appropriateness to the target users. The format and design aspect referred to size, font, color, graphic design and configuration of an overall website. The website usage convenience referred to the access and self-practicing with the developed educational website to encourage the subject's self-learning. And the website motivation aspect referred to the challenging and interesting while using the developed educational website. The closed-end questions of rating scale with 5 levels of measurement were used. Each subject's comments were also collected.

The rating scale questionnaire was designed as follows:

1 point	: Extremely dissatisfied
2 points	: Very dissatisfied
3 points	: Somewhat satisfied

4 points : Very satisfied

5 points : Extremely satisfied

2. Study protocol

2.1 Subject selection and sample size calculation

Thirty-four subjects were invited to participate in this study. They were all children and adolescents who attended Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital and interested in using the multimedia diabetes educational website.

Inclusion criteria:

1) Type 1 diabetes
2) Age 12- 19 years old, both male and female
3) Ability to learn and assess the value of numerals
4) Ability to use the basic computer and internet knowledge
5) Willingness to participate in this study

Exclusion criteria:

1) Type 2 diabetes
2) Unwillingness to continue in this study

Sample size calculation

Sample size estimation was based on the sample size calculation for a single proportion, as follows: [143]

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

Whereas,

Z_α = 5% Type I Error (1.96)

Z_β = 95% Confidential (- 1.28)

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

π_0 = Baseline knowledge score 0.16 (From the previous study)

Therefore, n was calculated to be 30. With ±10% dropout rate, total sample size was estimated to be 33 subjects.

2.2 Study design

The subjects who met the inclusion criteria were informed about the study's objectives and procedure and also informed their right and signed the inform consent for an agreement to take part in the study. For some subjects who were less than 15 years old, their parents signed the consent form for them. The study was taken 4 periods for 6 weeks (7-10 days per each period). The researcher made an appointment to see all subjects twice during weekend day to perform KINPORDEE class orientation prior at period 1 and at the end of period 4. Furthermore, each subject should take an online self-learning at least 2-3 hours a week at home or school.

The flow chart of the study process is represented in Figure 13

Figure 13 Flow chart of the multimedia diabetes educational website model

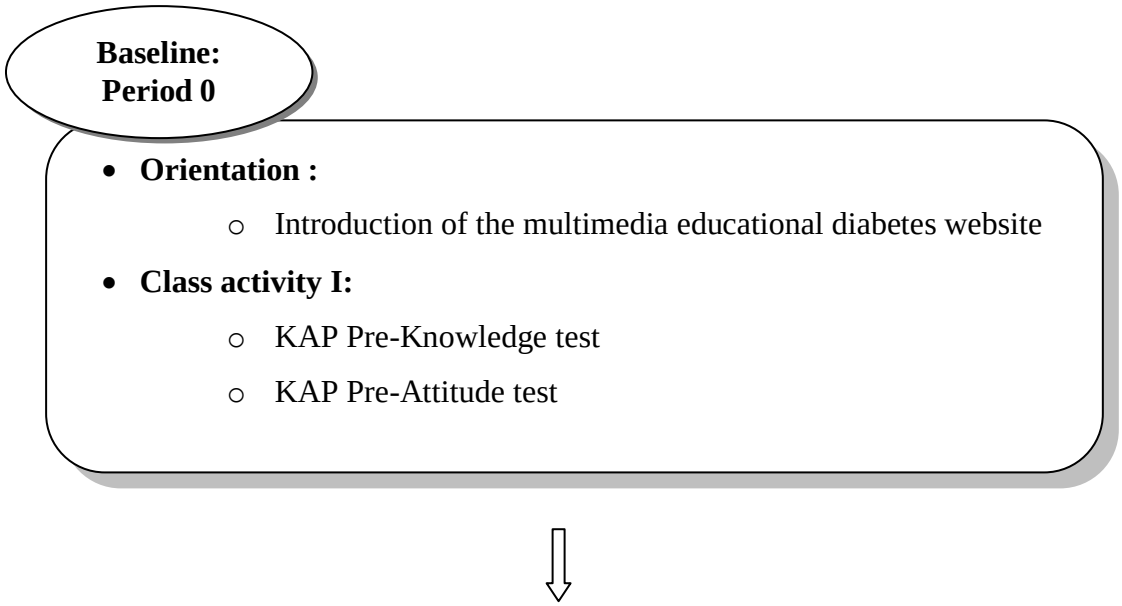


Figure 13 Flow chart of the multimedia diabetes educational website model (Cont.)

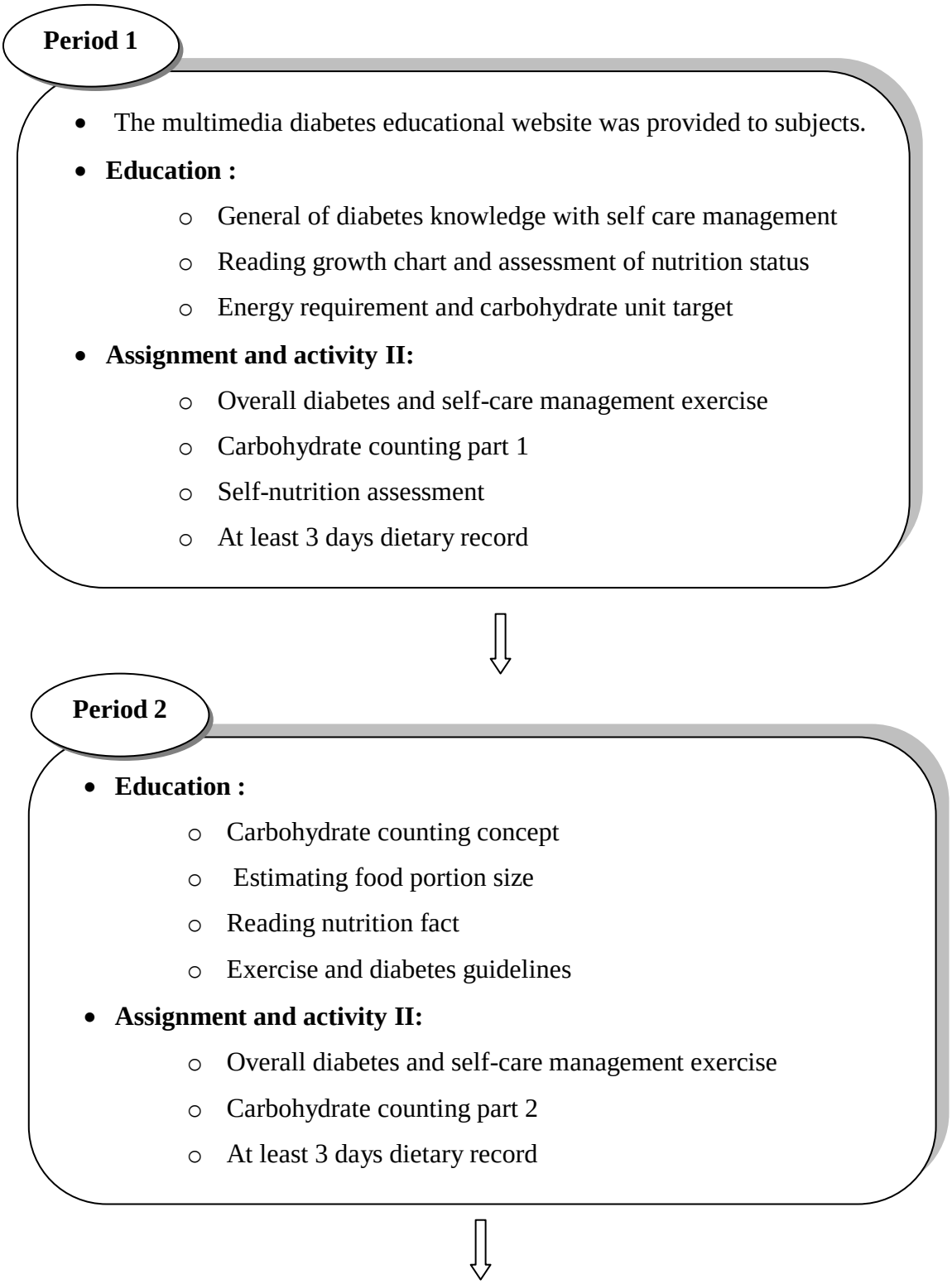
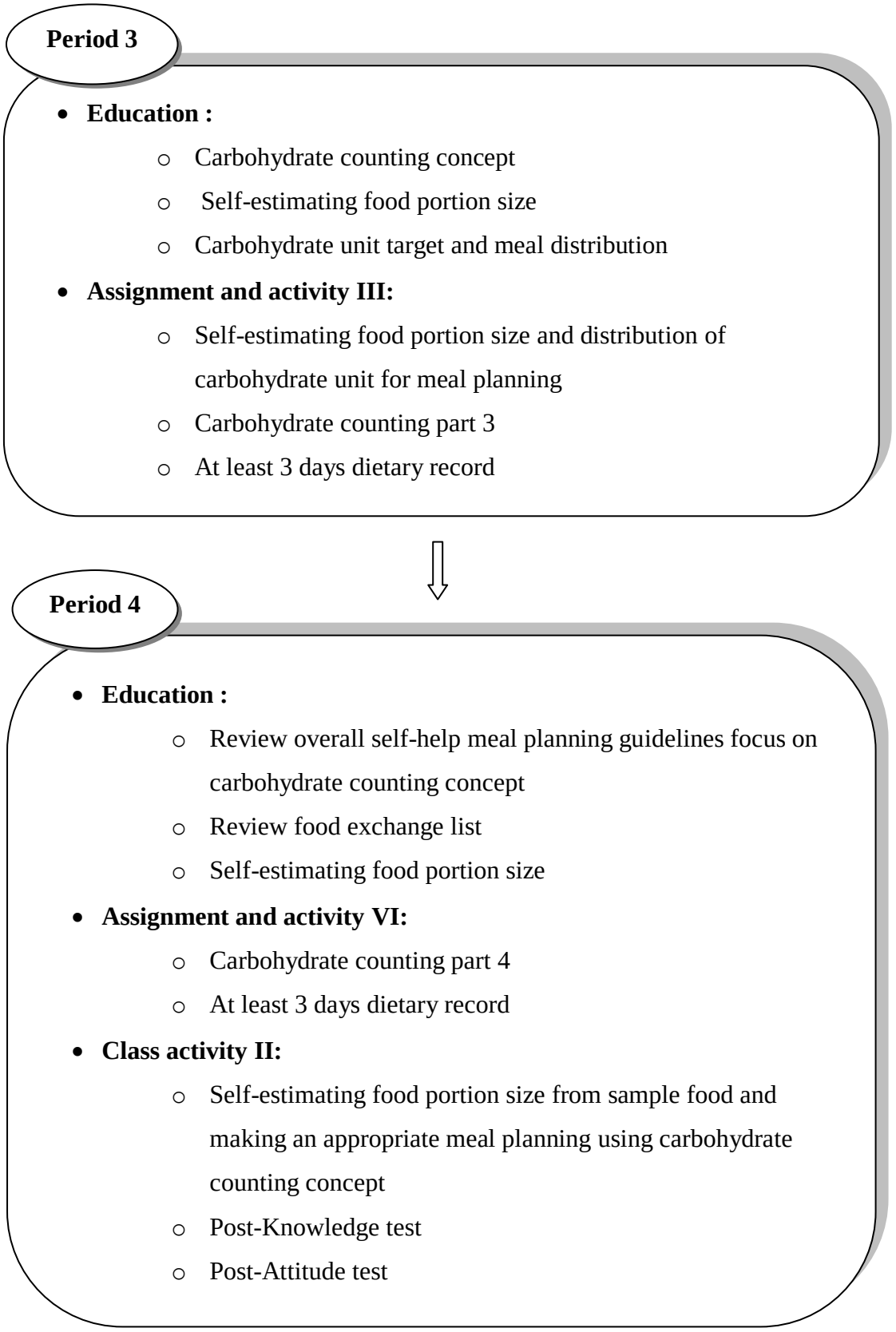


Figure 13 Flow chart of the multimedia diabetes educational website model (Cont.)



The study progress details were shown as follows;

<u>PERIOD 0</u> : MULTIMEDIA DIABETES EDUCATIONAL WEBSITE INTRODUCTION

(1) KINPORDEE orientation was conducted by researcher and support team for introducing KINPORDEE website, the multimedia diabetes educational website instruction related to the study's objectives.

(2) The subject's demographic data, medical treatment history, exercise frequency pattern, computer experience and internet usage pattern were collected as a baseline data. Anthropometry and dietary intake were also assessed to evaluate subject's nutrition status at baseline as follows;

- Weight (Wt), Height (Ht)
- Triceps skin fold thickness (TSF), Biceps skin fold thickness (BSF) and Mid arm circumference (MAC)
- Food frequency questionnaire, favorite food questionnaire and 24 hours dietary recall

Beside, some biochemical data were also determined as follows;

- HbA_1C level
- Fasting blood glucose level

(3) The subject's knowledge and understanding of meal planning using carbohydrate counting concept prior to self-learning of the multimedia diabetes educational website was assessed by using KAP Pre-test questionnaire.

(4) The subject's attitude towards diabetes and self-care was also assessed by using Pre-attitude test questionnaire.

(5) Food models were demonstrated to identify portions. Besides, food estimating skills were presented by using measuring equipments for estimating food portion sizes focus on a carbohydrate food.

(6) The multimedia diabetes educational website usage was introduced as following details;

6.1 Self-accessing through the web-based system

6.2 Online self-learning and self-practicing record to complete evaluation forms such as e-daily intake record and e-glucose check and record. In addition, e-nutrition assessment and e-self-glucose monitoring were recommended for all subjects.

6.3 Others online tools option such as e-food photo gallery, e-food exchange list and e-bulletin board. And technique to adding, editing and uploading data into the system such as e-resume and e-daily intake record were explained to each subjects.

(7) Subjects were assigned to complete a registration and begin with the introductory lesson as a self-study at home or school.

PERIOD 1: GENERAL DIABETES AND SELF-CARE MANAGEMENT KNOWLEDGE

(1) Each subject was assigned for online self-learning focusing on some specific menus as shown below;

1.1 E-POR DEE Public Library

- Reviewed the general diabetes knowledge such as definition, etiology, and risk factors, complications, treatment, prevention and a relationship between food intake, amount of insulin, physical activity and blood glucose level
- Reviewed the general diabetes diet knowledge such as a food group, nutrition labeling and diabetes diet
- Each subject was encouraged to practice each e- practicing exercise available on the diabetes educational website and a feedback score was determined through e-PORDEE report.
- **1.2 E-POR DEE Clinic**
- Each subject was assigned to assess their own nutrition status and energy requirement to achieve the appropriate meal planning recommendation to set the carbohydrate unit target for a meal distribution.
- Reviewed a basic self-help meal planning that consists of the main contents as shown below;

I. Food exchange system

II. Carbohydrate containing foods

III. Carbohydrate counting concept

- Each subject was encouraged to practice each e- practicing exercise available on the diabetes educational website and the feedback score was determined through e-PORDEE report.

(2) Each subject was assigned to complete both e-exercise records episode.1 for assessing their knowledge and understanding about general diabetes with self care management at the beginning of the week and the basic carbohydrate counting the end of the week, respectively. The score report was evaluated through e-PORDEE report.

(3) Each subject was assigned to complete their e-daily food intake record for e-daily carbohydrate intake was assessed for at least 3 days a week.

PERIOD 2: CARBOHYDRATE COUNTING CONCEPT

(1) Each subject was assigned for online self-learning focusing on the specific menus as follows;

1.1 E-POR DEE Clinic

- Reviewed meal planning method focusing on carbohydrate counting concept that consists of the main contexts as belowing;

I. Carbohydrate counting technique

II. Estimating food portion size

III. Reading nutrition fact label

- Each subject was recommended to monitor their blood glucose control and record by using e-glucose check and record

- Each subject was also encouraged to practice each e-practice exercises available on the educational website and a feedback score was assessed through e-PORDEE report.

1.2 E-POR DEE Supermarket

- Each subject was encouraged to review the food exchange knowledge and actual food portion size via e-food photo gallery and e-food exchange list.

1.3 E-POR DEE Fitness

- Reviewed the exercise and diabetes guidelines
- Each subject was encouraged to practice e-practice exercise available on educational website and received a feedback score through e-PORDEE report.

(2) Each subjects was assigned to complete both practical e-learning record episode.2 for assessing the their knowledge and understanding about the food portion size estimating for meal planning and the carbohydrate counting technique at the beginning of the week and the end of week, respectively. The score feedback report was determined through e-PORDEE report.

(3) Each subject was assigned to complete their e-daily food intake record for e-daily carbohydrate intake was assessed for at least 3 days a week.

<u>PERIOD 3</u>: ESTMATING A COMPLEX FOOD PORTION SIZE FOR MEAL PLANNING USING CARBOHYDRATE COUNTING

(1) Each subject was assigned for online self-learning focus on the specific menus as shown;

1.1 E-POR DEE Clinic

- Each subject was recommended to review the overall self-help meal planning guidelines focus on carbohydrate counting concept.
- Each subject was recommended to evaluate their nutrition status and carbohydrate unit target for self-help meal planning.
- Each subject was recommended to monitor their blood glucose control and also compare with their daily intake and exercise by using e-glucose check and record.

1.2 E-POR DEE Supermarket

- Each subject was encouraged to review the food exchange knowledge and actual food portion size via e-food photo gallery and e-food exchange list.

1.3 E-POR DEE Web board

- Each subject was encouraged for joining a web board system to discuss and make a social networking community between members.

(2) Each subject was assigned to complete both practical e-learning record episode.3 for assessing their knowledge and understanding about the self-estimating complex food portion size for meal planning and carbohydrate counting technique within the first and the end of week, respectively. The feedback score report was received through e-PORDEE report.

(3) Each subject was assigned to complete their e-daily food intake record for e-daily carbohydrate intake was assessed for at least 3 days a week.

<u>PERIOD 4</u>: VISUAL ESTMATING FOOD PORTION SIZE FOR MEAL PLANNING USING CARBOHYDRATE COUNTING

(1) Each subject was assigned for online self-learning focus on the specific menus as shown;

1.1 E-POR DEE Clinic

- Each subject was recommended to reviewed the overall self-help meal planning guidelines focus on carbohydrate counting concept
- Each subject was recommended to monitor their blood glucose control and also compare with their daily intake and exercise by using e-glucose check and record

1.2 E-POR DEE Supermarket

- Each subject was encouraged to review the food exchange knowledge and actual food portion size via e-food photo gallery and e-food exchange list

1.3 E-POR DEE Web board

- Each subject was encouraged for joining a web board system to discuss and make a social networking community between members.

(2) Each subject was assigned to complete practical e-learning record episode.4 for assessing their knowledge and understanding about the carbohydrate counting technique for mixed dishes at the beginning of week. The score report was received through e-PORDEE report.

(3) Each subject was assigned to complete their e-daily intake record and evaluated e-daily carbohydrate intake at least 3 days a week.

(4) All subject were scheduled to attend the final class meeting for evaluating their knowledge and understanding about the self-help meal planning using carbohydrate counting focus on the specific activities as following;

4.1 Evaluate the subject's nutrition status as follows;

- Weight (Wt), Height (Ht)
- Tricep skinfold thickness (TSF), Bicep skinfold thickness (BSF) and Mid arm circumference (MAC)

4.2 Each subject was assigned to complete the class assignment to assess the accuracy in perception and conceptualization about the estimation of portion size and carbohydrate counting skill with the provided test food items. In addition, subjects were also assigned to set their own meal plan according to their carbohydrate target using the available food items provided.

4.3 The subject's knowledge and understanding of meal planning using carbohydrate counting concept after used the multimedia diabetes educational website was assessed by using KAP Post-test questionnaire.

4.4 Subject's attitude towards diabetes and self-care was assessed by using Post-attitude test questionnaire.

4.5 Subject's satisfaction was assessed for the overall multimedia educational website by interviewing and completing questionnaires.

3. Data Analysis

- All data were analyzed by using the Statistical Package for the Social Sciences/Personal computer (SPSS/PC) for window 13.0 and a difference of $p < 0.05$ was considered to be a significant.

- The personal information was determined by descriptive statistics, such as percentage, mean, and standard deviation.

- The level of subject's understanding and accuracy in carbohydrate counting were determined as percentage, mean, and standard deviation.

- The Chi-square test was used for comparing frequencies or proportions of the gender, age, educational level, nutrition status and duration of diabetes with knowledge scores and compliance level.

- Paired t-test was used to compare the score of the subject's knowledge and understanding for carbohydrate counting between Pre-test and Post-test.

- The anthropometric and dietary intake were evaluated by using repeated measure ANOVA (Post hoc Bonferroni)

- The subject's satisfaction with the multimedia diabetes educational website was determined as percentage, mean, median, and standard deviation.

CHAPTER V
RESULTS

This study is conducted to develop a multimedia diabetes educational website for gathering diabetes knowledge and self-help meal planning based on the basic carbohydrate counting concept. Moreover, this developed website was determined the effectiveness of online self-learning in type 1 diabetic children and adolescents. Therefore, the results of this study are presented according to the sequence of the study as phase 1 and phase 2.

5.1 Phase 1: Development of the diabetes educational website

KINPORDEE website was tested on an overview, operation and understanding of online self-learning by 10 example users and after that the experts in related field of study had provided some comments. KINPORDEE website final version was constructed to provide general diabetes knowledge and healthy diet emphasizing on carbohydrate counting concept. It mainly consisted of 3 menus including the following;

5.1.1 Public library

- **General information about diabetes and self-care management**, public contents providing general diabetes knowledge emphasized on diabetes self-care management. The specific topics were consisted of topics such as diabetes definition and risk factors, diabetes complication, signs and symptoms, behavior modification for improving diabetic control, self-monitoring blood glucose and exercise with diabetes. (Figure 14)

- **General information about healthy diet for diabetes**, public contents providing the dietary guidelines for diabetes, emphasized on how to making a healthy diabetes food choice. The specific topics were consisted of topics such as 5 food groups and food pyramid recommendation, food guide for diabetes and food label reading. (Figure 15)

However, e- practicing exercises for each topic were available on the diabetes educational website for online self-learning. (Figure 16)

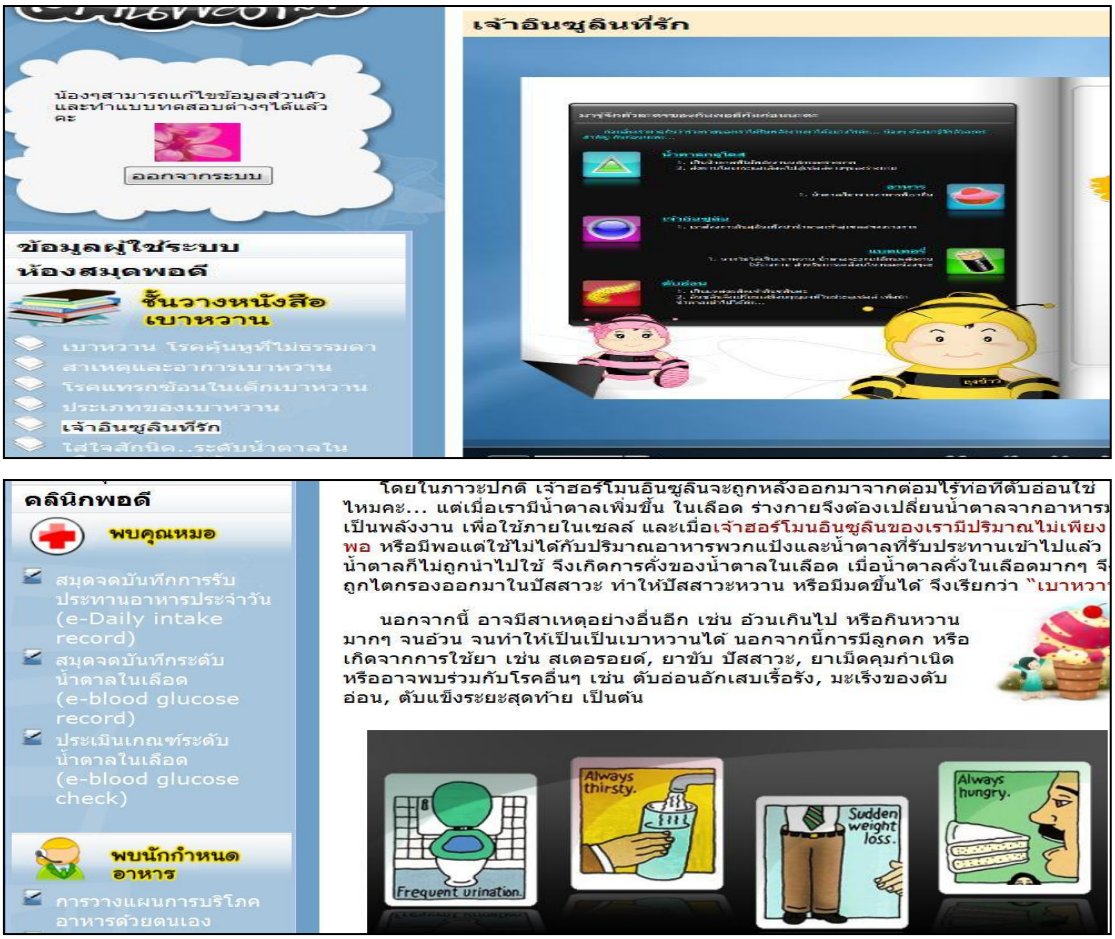


Figure 14 KINPORDEE website; Public library - General information about diabetes and self-care management

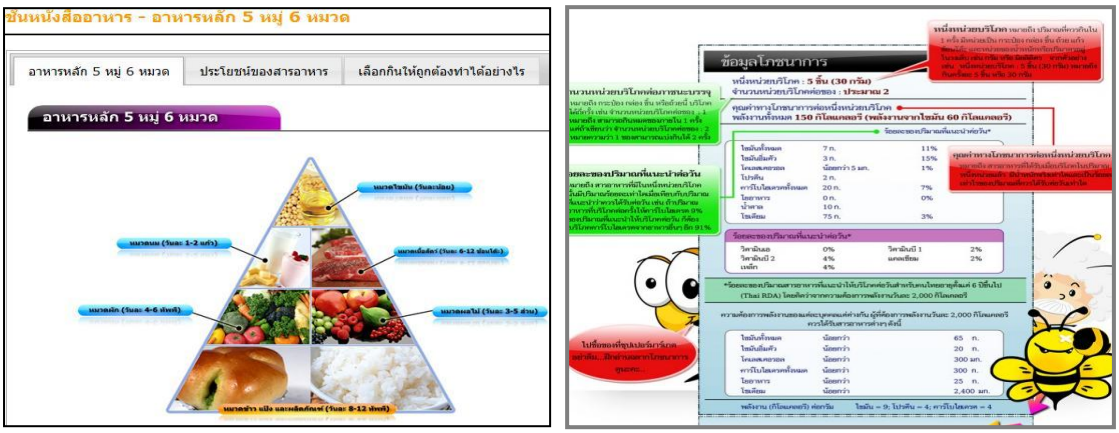


Figure 15 KINPORDEE website; Public library-General information about healthy diet for diabetes

Figure 15 (Cont.) KINPORDEE website; Public library-General information about healthy diet for diabetes

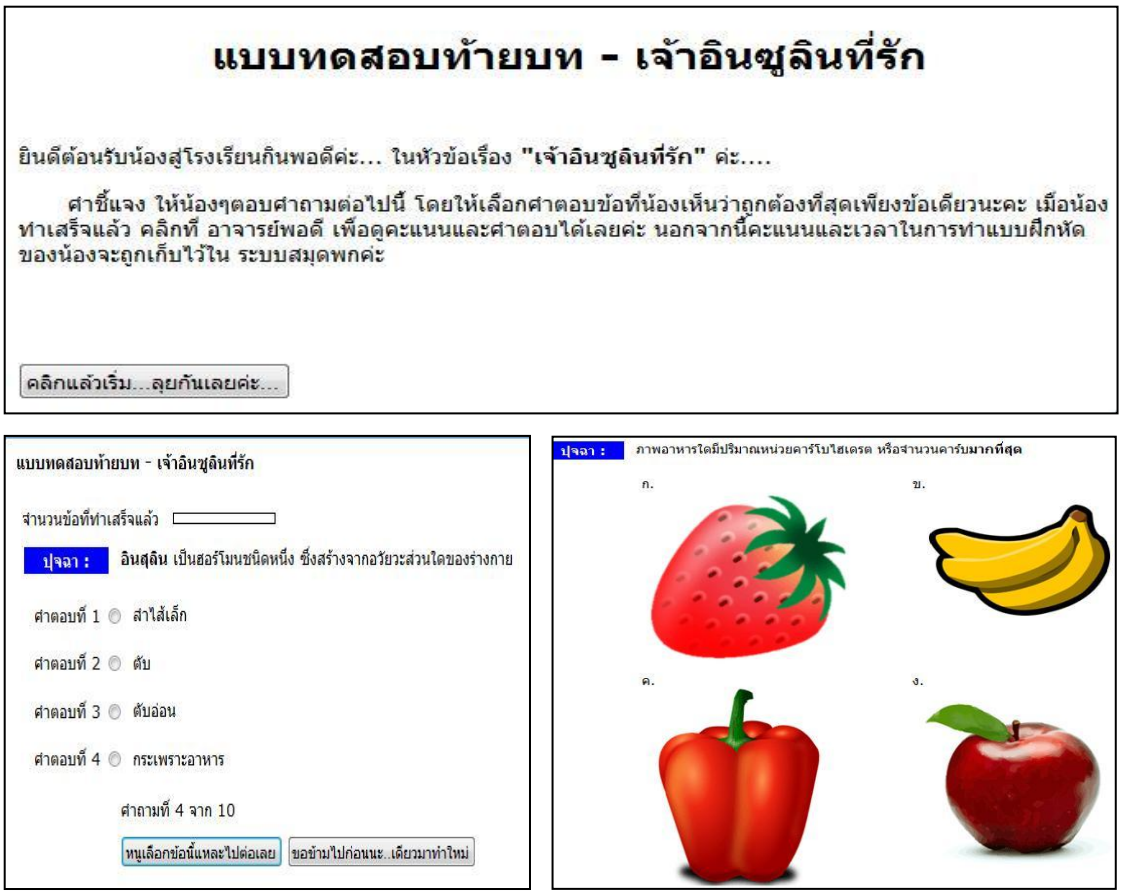


Figure 16 KINPORDEE website; e- practicing exercises for each topic

5.1.2 The self-help guidelines for meal planning using carbohydrate counting

- Nutrition assessment and self-help meal planning using a basic carbohydrate counting, provided subject's self-nutrition assessment and meal planning. These specific menus were composed of easy-steps for self help meal planning using carbohydrate counting, emphasized on how to identify and select a carbohydrate food choice properly. Moreover, steps in calculating and counting carbohydrate were included. (Figure 17-20.)

However, e- practicing exercises for each topic were also available on the diabetes educational website for these online self-learning contents.

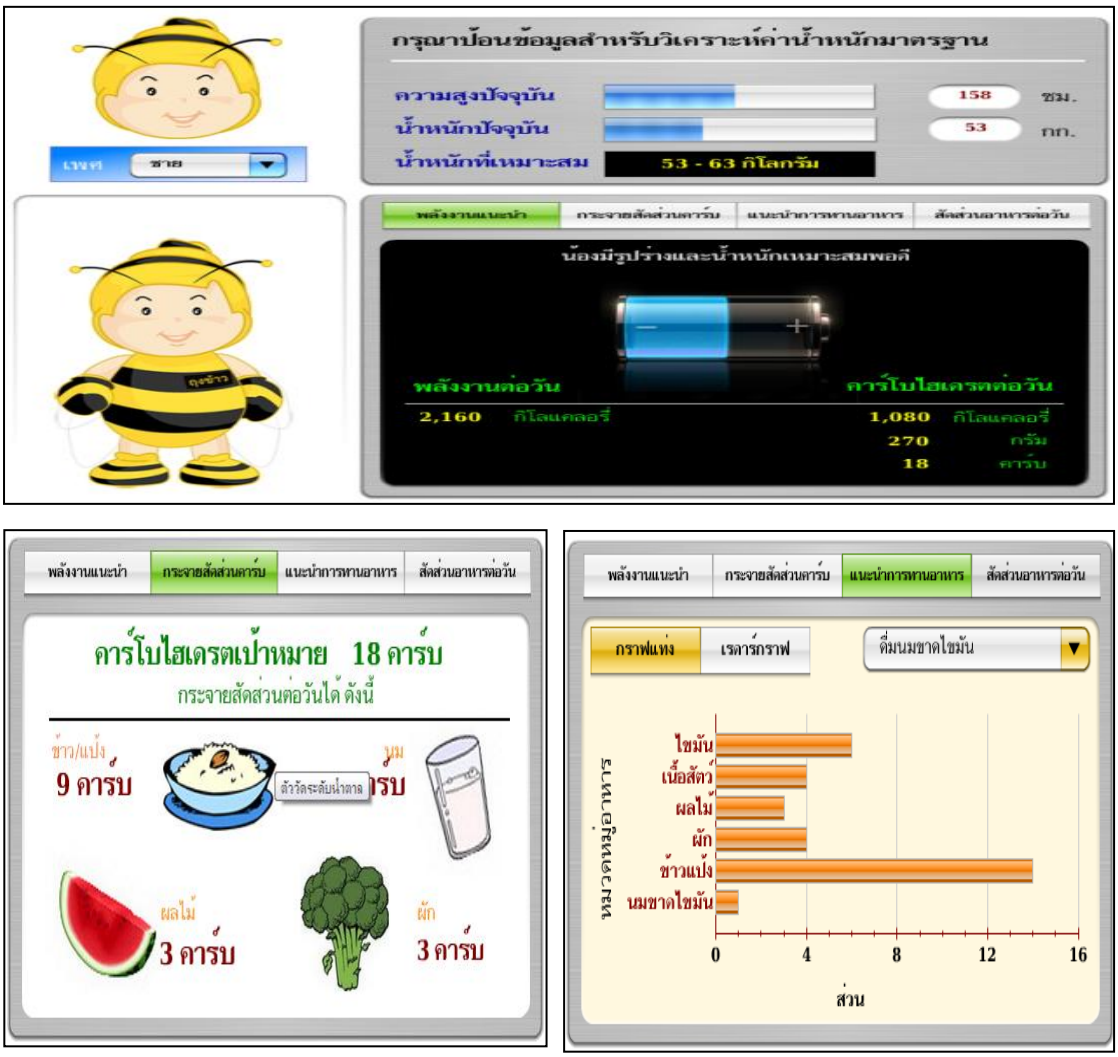


Figure 17 KINPORDEE website; Self-nutrition assessment and meal planning distribution

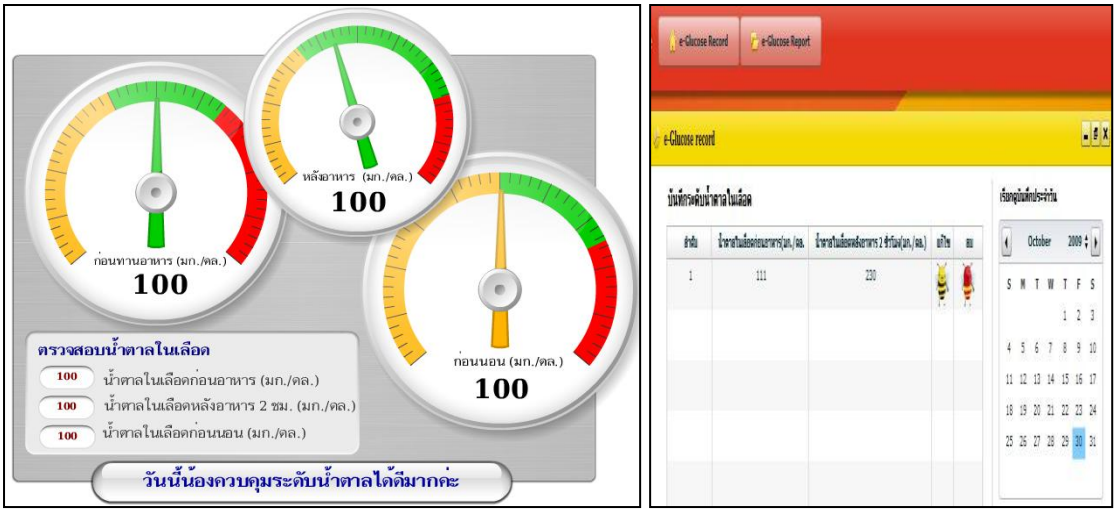


Figure 18 KINPORDEE website; Blood glucose monitor and daily blood glucose level record

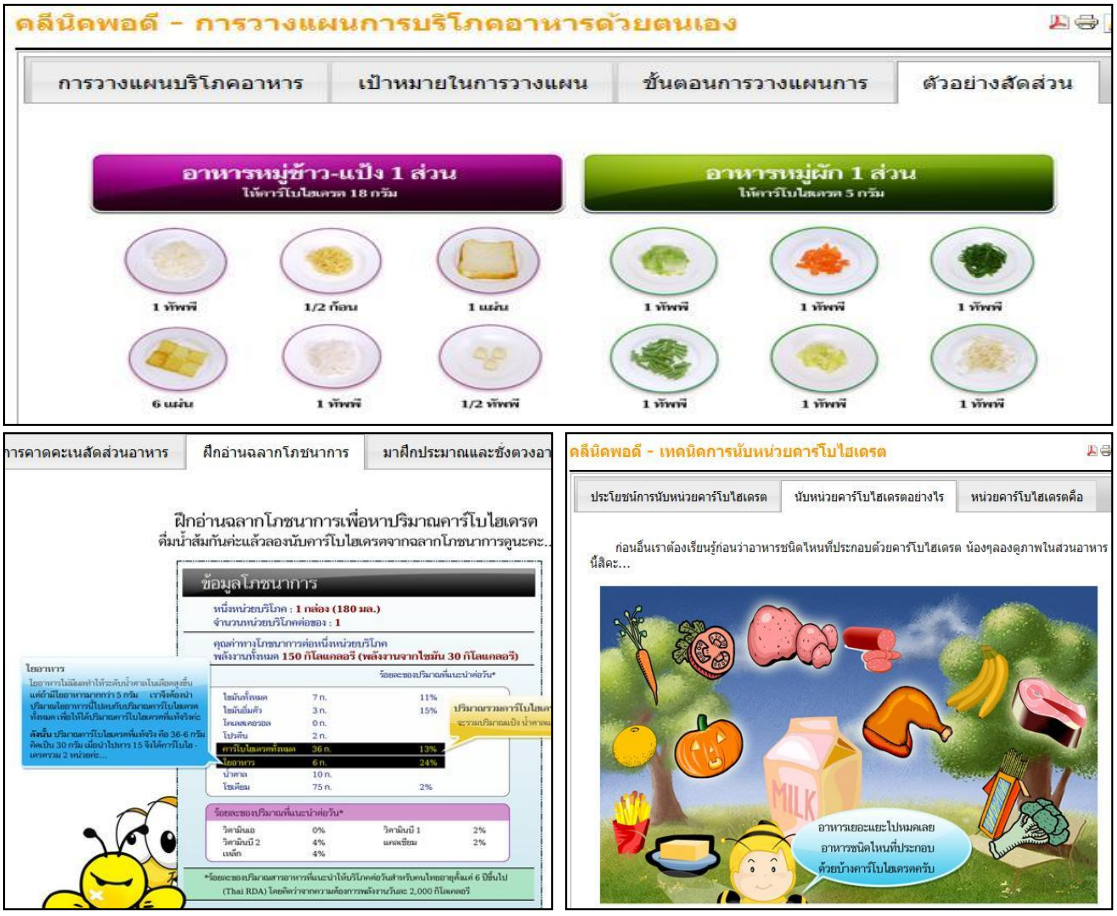


Figure 19 KINPORDEE website; Self-help guideline for meal planning using carbohydrate counting

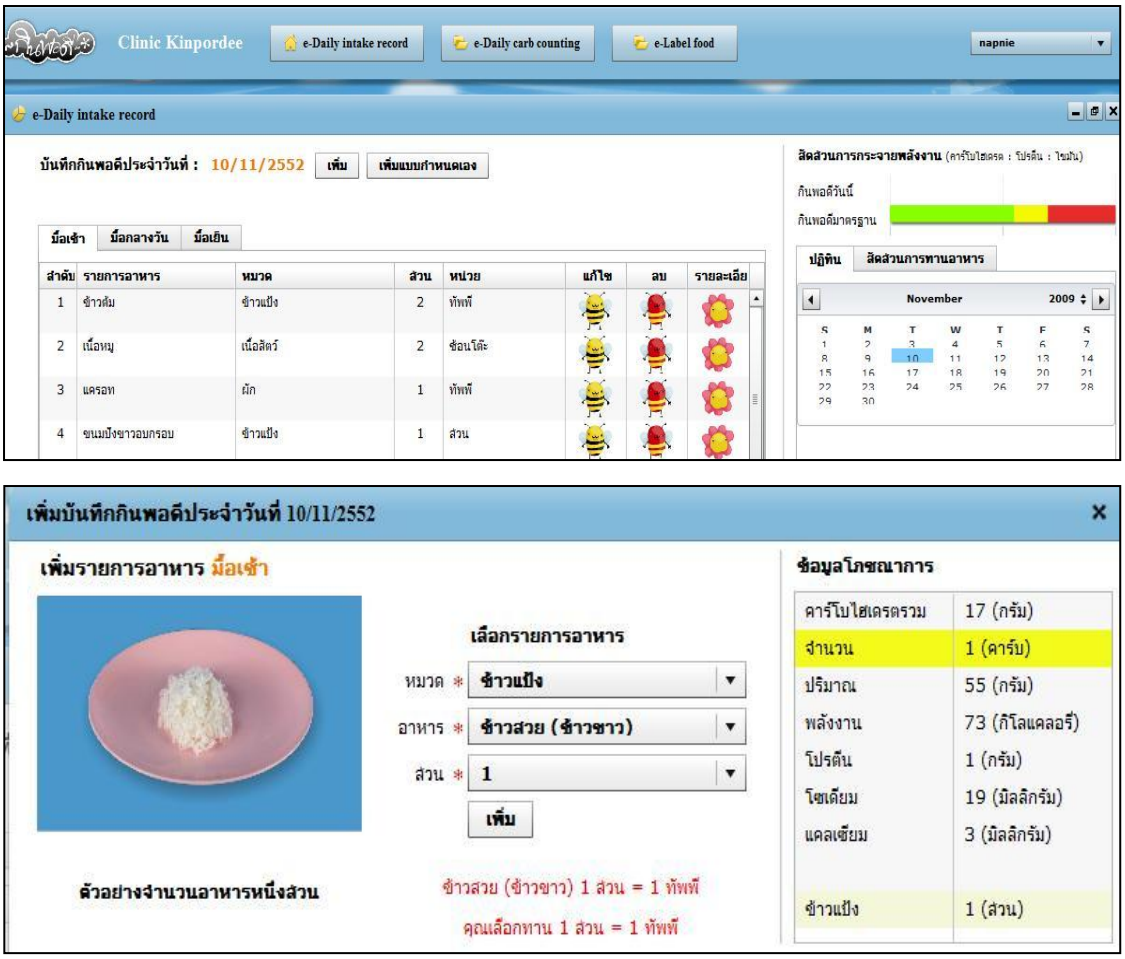


Figure 20 KINPORDEE website; E-daily intake record

5.1.3 The database site of food exchange lists and food photo gallery for counting carbohydrate

These food exchange lists database and food photo galleries (Figure 21, 22) were focused on food groups which contain carbohydrate, in order to provide dietary information to users regarding to the amount of carbohydrate in variety of food items for carbohydrate counting. Many references were used to identify each food nutrient values.

The food exchange lists application menu was composed of 11 different food groups with 1114 food items;

Food group	**Number of food items**
1) Starch	191 items
2) Fruit	66 items

3)	Milk	63 items
4)	Vegetable	35 items
5)	Fast-foods	140 items
6)	One-plate/set-plate dish	131 items
7)	Snack	234 items
8)	Drink and beverage	88 items
9)	Thai dessert	84 items
10)	Other dessert/miscellaneous	50 items
11)	Ready-to-eat food and condiment.	32 Items

Figure 21 KINPORDEE website; food exchange lists database

Figure 22 KINPORDEE website; food photo gallery for counting carbohydrate

5.2 Phase 2: Evaluation the effectiveness of the diabetes educational website

5.2.1 Baseline data of the study subjects

Study subjects

Initially 41 type 1 diabetic children and adolescents, who attended Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital, were recruited for the study. Seven subjects (17.1%) dropped out at week 1 and 2, respectively. The most common reason for dropout had given by dropped subject was a lack of time (9.8%), whereas one subject (2.4%) could not be contacted and two remaining subjects (4.9%) were taking on the university entrance examination. However, no significant information was sustained from them. Therefore, only the data from remaining 34 subjects were used to evaluate the results. The personal characteristics of the study subjects as follows; (Table 10-12)

Table 10 Baseline demographic characteristics of the subjects

Characteristics	n	%
Age (Years)		
12-15	20	58.8
16-19	14	41.2
Mean = 14.32; SD = 2.34; Min = 12; Max = 19		
Gender		
Male	12	35.5
Female	22	64.7
Religion		
Buddhism	32	94.1
Islam	1	2.9
Sikh	1	2.9
Education level		
Primary school	12	35.3
Secondary school	9	26.5
High school	11	32.4
Bachelor degree	2	5.9

Table 10 Baseline demographic characteristics of the subjects (Cont.)

Characteristics	n	%
Family history of diabetes		
Yes	16	47.1
No	18	52.9
Parent status		
Living together	27	79.4
Divorce	6	17.6
Others	1	2.9
Subjects living with		
Father and mother	26	76.5
Father or mother	7	24.6
Relatives	8	3.1
Parent's occupation		
Subject's father		
Government's employee	7	20.6
Private company's employee	9	26.5
Owner business	15	44.1
Freelance employee	2	5.9
Others	1	2.9
Subject's mother		
Housewife	11	32.4
Government's employee	3	8.8
Private company's employee	8	23.5
Owner business	9	26.5
Freelance employee	2	5.9
Others	1	2.9

Table 10 Baseline demographic characteristics of the subjects (Cont.)

Characteristics	n	%
Parent's education		
Subject's father		
Primary school (P1-P4)	1	2.9
Primary school (P5-P6)	1	2.9
Secondary school (M1-M3)	1	2.9
Secondary school (M4-M6)	3	8.8
Diploma/Certificate	11	32.4
Bachelor degree and higher	16	47.1
Unknown*	1	2.9
Subject's mother		
Primary school (P1-P4)	5	14.7
Primary school (P5-P6)	2	5.9
Secondary school (M1-M3)	4	11.8
Secondary school (M4-M6)	2	5.9
Diploma/Certificate	7	20.6
Bachelor degree and higher	13	38.2
Unknown*	1	2.9
Average family income per month		
< 10,000 Baht	5	14.7
10,000 – 19,999 Baht	6	17.6
20,000 – 29,999 Baht	7	20.6
30,000 – 39,999 Baht	5	14.7
40,000 – 49,999 Baht	4	11.8
> 50,000 Baht	7	20.6

**Unknown because father and mother died*

Demographic characteristics

Majority of the subjects were female with 22 females and 12 males. The age range was 12-19 years and 58.8% of the subjects aged between 12-15 years old.

The mean age of the subjects was 14.32 ± 2.34 years. Most of the subjects (94%) were Buddhism and 2.9% were Islam and Sikh. About 35.5% and 32.2% were in primary and high education level, respectively. The Over half (52.9%) didn't have diabetes family history. Most of them (76.5%) live together with their parents, whereas 24.6% live with either father and mother and other 3.1% live with their relative. Moreover, 44.1% of most fathers have their own business, whereas 32.4% of mothers were housewife, Parent's education background are mostly bachelor degree about 47.1%, 38.2% of fathers and mothers, respectively.. However, 20.6% of families have average income at 20,000 – 29,999 baht/month and more than 50,000 baht/month.

Table 11 Diabetes history and practice of the subjects

Diabetes history and practice	n	%
Diabetes duration (years)		
< 1 years	2	5.9
1-5 years	16	47.1
6-10 years	7	20.6
> 10 year	9	26.5
Mean = 5.76; SD = 4.18; Min = 1; Max = 13		
Insulin injection		
Syringe	19	55.9
Pen	11	32.4
Syringe and pen	1	2.9
Insulin pump	3	8.8
Using glucometer for monitoring blood glucose		
Yes	34	100
Ability of self monitoring blood glucose		
Yes	33	97.1
No	1	2.9

Table 11 Diabetes history and practice of the subjects (Cont.)

Diabetes history and practice	n	%
Frequency of blood glucose monitoring (times/day)		
0 times/day	0	0
1-2 times/day	9	26.5
3-4 times/day	25	73.5
Mean = 3.35; SD = 1.01 ; Min = 2 ; Max = 6		
Frequency of hypoglycemic episodes*		
Seldom	6	17.6
1-2 times/week	26	76.5
3-4 times/week	1	2.9
> 4 times/week	1	2.9
* *Lowest blood glucose (mg/dl): Mean = 54.71; SD = 8.87; Min = 40; Max = 70*		
Time of blood glucose monitoring		
Before breakfast	22	84.6
After breakfast	0	0
Before lunch	11	42.3
After lunch	0	0
Before dinner	23	88.5
After dinner	3	11.5
Bedtime	13	50
Before exercise	1	3.8
After exercise	1	3.8
When hyperglycemia	4	15.4
When hypoglycemia	9	34.6
Others, 3 a.m.	3	11.5

Table 11 Diabetes history and practice of the subjects (Cont.)

Diabetes history and practice	n	%
Fasting blood glucose (mg/dl)		
< 130 mg/dl	23	67.7
130-150 mg/dl	6	17.6
> 150 mg/dl	5	14.7
Mean = 123.56; SD = 24.20; Min = 86; Max = 186		
Glycosylated hemoglobin (HbA1C)		
< 8 %	7	20.6
8-10 %	17	50.5
>10-12 %	9	26.5
>12 %	1	2.9
Mean = 9.28; SD = 1.53; Min = 6.4; Max = 12.6		
Do you control diet for blood glucose control		
Yes	25	73.5
No	9	26.5
Physical activity		
Not exercise	9	26.5
1-2 times/week	14	41.2
3-5 times/week	9	26.5
> 5 times/week	2	5.9
Mean = 2.77; SD = 1.18; Min = 0; Max = 5		

Diabetes history and practice

Nearly half of them were diagnosed diabetes for 1-5 years. Mean diabetes duration of the subject is 5.76±4.18 years. All subjects had glucometer for monitoring their blood glucose with an average 3.35±1.01 times per day. More than 80% of subjects did self monitoring blood glucose before breakfast and dinner. Most subjects had controlled their diet for diabetes control which derived suggestion mainly from the doctors, nurses, and dietitians. Besides, 76.5% had hypoglycemic episodes 1-2 times/week and 41.2% did some physical activity at least 1-2 times/week. For glycemic control, an average glycosylated hemoglobin (HbA_1C) was 9.28 ± 1.53%.

About half (50.5%) of subjects were grouped according to the average HbA_1C levels, 8- 10% in the fair level, whereas 67.7% has an average fasting blood glucose level less than 130 mg/dl. The diabetes history and practice was shown in Table 11.

Table 12 Subjects' opinions on diet and carbohydrate counting

Subjects' opinions	n	%
Have you known about carbohydrate counting		
Yes	18	52.9
No	15	44.1
Not sure	1	2.9
Have you learned carbohydrate counting within 1 year		
Yes	18	52.9
No	16	47.1
Not sure	0	0
What do the subjects think about the objective of carbohydrate counting?		
Meal planning	22	64.7
Diet control	21	61.8
Blood glucose control	23	67.6
What is the subject's expectation from carbohydrate counting learning?		
Appropriate dietary intake	26	76.5
Various food choice	3	8.8
Appropriate weight	10	29.4
Normal blood glucose	29	88.3
Be healthy	28	82.4

Subjects' opinions on diet and carbohydrate counting

About 52.9% of subjects had known and learned about carbohydrate counting within 1 year, whereas other 47.1% have never learned this knowledge before. The main subject's opinion about the objective of carbohydrate counting is blood glucose control (67.6%). The subjects' expectations of carbohydrate counting

learning are controlling normal blood glucose (88.3%) and be healthy (82.4%) as shown in Table 12.

Table 13 Baseline anthropometric data of the subjects

Anthropometric data	Total (n=34)	Male (n=12)	Female (n=22)	Normal criteria*
Weight (kg)	52.57 ± 13.94	54.79 ± 20.16 [a]	51.97 ± 9.36 [b]	F 29.4 – 57.8 M 28.1 – 67.4
Height (cm)	157 ± 9.29	156.82 ± 13.85 [a]	157.43 ± 6.10 [b]	F 138.8 – 164.2 M 135.1 -177.6
Weight for age Z-scores **	1.04 ± 1.50	1.05 ± 2.06	1.03 ± 1.15	-1.5 to +1.5
Height for age Z-scores **	0.33 ± 1.07	-0.31 ± 1.13	0.68 ± 0.88	-1.5 to +1.5
Weight for height Z-scores **	0.88 ± 1.67	1.44 ± 2.15	0.57 ± 1.30	-1.5 to +1.5
Mid arm circumference (cm)	25.63 ± 4.44	24.01 ± 8.21	25.34 ± 3.63	N/A
Biceps skinfold thickness (mm)	12.71 ± 6.34	9.80 ± 5.47	14.30 ± 6.31	N/A
Triceps skinfold thickness (mm)	21.05 ± 9.54	16.05 ± 9.46	22.78 ± 9.45	N/A

Data are presented as mean ± SD

[a,b] Superscripts defined as significantly difference at p-value <0.05 by using Independent –Sample T-test method

*Reference of Department of Health, Ministry of Public Health [130]

** Calculated using INMU-Nutristat program [140] as Z-scores of the nutritional center for Health Statistics reference according to sex for determining of the nutritional status**.**

Subjects' nutritional Status

Anthropometric data

Mean anthropometric data and Z-scores of weight for age, height for age and weight for height of the subjects both male and female are shown in Table 13. Mean Z-scores of weight for age, height for age and weight for heights of all subjects both male and female are in normal range. However, there were a significantly difference between male and female for weight and height.

However, the distribution of baseline weight for height Z-scores level show that most 24 subjects (70.6%) were in a normal growth range, whereas only one subject (2.9%) was overweight, 6 subjects (17.6%) were begin obese and 3 subjects (8.8%) were obese. Frequency distributions of baseline Z-scores weight for height are shown in Table 14.

Table 14 Frequency distribution of baseline weight for height Z-scores

Weight for height Z-scores	**Total (n=34) n (%)**	**Male (n=12) n (%)**	**Female (n=22) n (%)**	**Normal criteria***
> 3.0	3 (8.8)	3 (25.0)	0 (0)	Obesity
> 2.0 to 3.0	6 (17.6)	1 (8.3)	5 (22.7)	Begin obese
> 1.5 to 2.0	1 (2.9)	0 (0)	1 (4.5)	Overweight
-1.5 to 1.5	24 (70.6)	8 (66.7)	16 (72.7)	Normal
< -1.5 to -2.0	0	0	0	Slightly underweight
< -2.0	0	0	0	Underweight

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

***** Reference of Department of Health, Ministry of Public Health [130]

Subject's food consumption patterns

Moreover, subjects' food consumption patterns (Table 15) were evidenced by meal patterns and favorite foods questionnaire, food-frequency questionnaire, and 24 hours dietary record before assessing KINPORDEE website. About 32.4% of subjects normally both 3 and 4 meals/day, others had 3 meals/day (26.5%) and 6 meals/day (8.8%), respectively. Over half of parents or relative (58.2%) prepared food for them and 29.4%, 11.8% were food shop and caregiver prepared meal for them. About half was eating outside 3-4 times per month. More than half of them (61.8%) stated there was a difference of dietary intake between school days and weekend which trended to eat more during the holidays. Their food patterns were mainly rice, bread, fried food recipes with lean meat and vegetable oil. Interestingly, more than half (58.8%) of subjects consumed 2 ladles of rice exchanges per meal by mean of 2.31±0.70 exchanges per day.

Most subjects often consumed green-leaf vegetables, low sweeten fruits and always drank some milks everyday (94.1%), especially low fat milk by mean of 2.21 ± 0.81 exchanges per day. However, they sometimes had some soft drink, salty snack and bakery. And most of them seldom had Thai dessert; some sweeten snack and fast foods.

Table 15 Subject's food consumption patterns

Food consumption patterns	n	%
Number of meals/day		
3	9	26.5
4	11	32.4
5	1**1**	32.4
6	**3**	8.8
Food preparation		
Parent/relative	20	58.8
Caregiver	4	11.8
Food shops	10	29.4

Table 15 Subject's food consumption patterns (Cont.)

Food consumption patterns	n	%
Frequency of outside eating		
1-2 times/month	3	8.8
3-4 times/month	17	50.0
>4 time/month	14	41.2
Difference of dietary intake between school days and weekend day		
Not difference	26	76.5
Difference	3	8.8
Average amount of rice consumption		
1.5 ladles/meal	4	11.8
2 ladles/meal	19	55.9
2.5 ladles/meal	1	2.9
3 ladles/meal	9	26.5
≥ 4 ladles/meal	1	2.9
Mean = 2.31; SD = 0.70; Min = 1.5; Max = 5		
Frequency of having vegetable consumption		
Everyday	20	58.8
Sometimes	14	41.2
Frequency of having fruit consumption		
Everyday	23	4
Sometimes	11	19
Frequency of snack consumption		
Never	7	20.6
Everyday	10	29.4
Sometimes	17	50
Frequency having dessert consumption		
Never	19	55.9
Sometimes	15	44

Table 15 Subject's food consumption patterns (Cont.)

Food consumption patterns	n	%
Frequency having bakery consumption		
Never	9	18.1
Sometimes	25	78.1
Frequency having soft drink consumption		
Never	14	41.2
Everyday	4	11.8
Sometimes	16	47.1
Frequency having fast food consumption		
Never	5	14.7
Sometimes	29	85.3
Frequency having milk consumption*		
Everyday	32	94.1
Sometimes	2	5.9
* *Daily milk consumption (exchange/day): Mean = 2.21 ; SD = 0.81; Min = 1; Max = 4*		

Dietary intake requirement

Mean dietary intake requirements of subjects, age 12-15 years and 16-19 years were presented in Table 16-17. Their mean dietary intake requirements were 2114.14 ± 266.5 and 2265.71 ± 333.13 kcal/day, respectively. The mean carbohydrate choices requirements were 17.85 ± 2.60 and 18.06 ± 2.57 carb choices/day, respectively. The mean protein intake requirements were 108.08 ± 14.52 and 110.22 ± 15.41, respectively. The mean protein intake requirements were 108.08 ± 14.52 and 110.22 ± 15.41 gram/day, respectively. And the mean fat intake requirements were 72.18 ± 9.66 and 75.77 ± 11.04 gram/day, respectively.

Baseline dietary intake

The baseline dietary intakes of the subjects, age 12-15 years and 16-19 years were presented in Table 16-17. Their mean energy intakes at baseline were 1634.45 ± 310.5 and 1869.21 ± 441.17 kcal/day, respectively. Whereas, the mean

carbohydrate choices at baseline were 13.55 ± 2.72 and 15.79 ± 2.59 carb choices/day, respectively. The mean protein intake requirements were 80.35 ± 25.02 and 78.50 ± 21.64 gram/day, respectively. And the mean fat intake requirements were 57.94 ± 16.22 and 69.75 ± 30.43gram/day, respectively. The caloric distribution percentage (carbohydrate: protein: fat) of both age groups were 50.72: 19.56: 32.27 and 50.84: 16.88: 32.91, respectively which only fat was inappropriate intake.

Changes of subject's dietary intake at different time points

Comparison of the mean dietary intake requirement and mean dietary intake at different time-points of two different age groups are presented in Table 16-17. All subjects' dietary intakes, amount of protein, fat and carbohydrate at different time points were significantly difference overall in their mean dietary requirement (p<0.05). For the subjects who were 12-15 years. There were a significantly different in energy intake of baseline and final period. For daily energy intake, there was no significant difference among baseline, period 1 and period 3 similar to daily amount of fat intake. In the other hands, there was no significant difference among carbohydrate choices intake during a study period and also significantly different with their mean carbohydrate target (p<0.05). Daily protein intake and protein caloric distribution were significant difference from baseline to the final period (p<0.05).

For the subjects who were 16-19 years. There were no significantly different in energy intake at different time points. And there was no significant difference among carbohydrate choices intake during a study period and their mean carbohydrate target (p<0.05). Daily protein and fat intake were no significant difference from baseline to the final period (p<0.05). Besides, there were no significant difference overall in different time points.

Regarding to all study subjects, most subjects (88.2%) had under dietary intake compared with their individual dietary requirements. And only 4 subjects (11.8%) had over dietary intake, especially 3 obesity subjects and only one subject who were grouped of age in 16-19 year and 12-15 years, respectively.

Table 16 Comparison of mean energy requirement and mean dietary intake at different time-points of 20 subjects (Age 12-15 years)

Dietary intake	Week 0	Week 1	Week 2	Week 3	Week 4	Dietary requirement*
Energy (kcal/day)	1634.45 ± 310.5[a]	1567.37 ±247.7[a]	1859.43 ± 447.98[b]	1587.63 ± 270.54[a]	1741.45 ± 252.98[ab]	2114.14 ± 266.5[c]
Carbohydrate (g/day)	205.74 ± 40.84[a]	200.99 ± 31.82[a]	237.74 ± 65.79[b]	199.29 ± 37.25[ab]	218.22 ± 30.48[ab]	264.27 ± 28.35[c]
(carb unit)	13.55 ± 2.72[a]	14.10 ± 2.40[a]	14.10 ± 3.18[a]	13.75 ± 2.31[a]	14.65 ± 1.98[a]	17.85 ± 2.60[c]
(% kcal)	50.72± 7.6	51.60 ± 5.67	51.0 ± 4.73	51.28 ± 4.85	50.27 ± 3.60	50.00
Protein (g/day)	80.35 ± 25.02[b]	73.88 ± 14.20[ab]	78.28 ± 17.71[ab]	67.31 ± 16.04[a]	74.49 ± 11.38[ab]	108.08 ± 14.52[c]
(% kcal)	19.56 ± 4.11[b]	18.92 ± 2.55[ab]	17.10 ± 2.93[a]	17.37 ± 3.38[a]	17.18 ± 1.87[a]	20.00
Fat (g/day)	57.94 ± 16.22[a]	52.01 ± 19.26[a]	73.19 ± 23.75[b]	50.89 ± 15.07[a]	60.41 ± 10.87[a]	72.18 ± 9.66[b]
(% kcal)	32.27 ± 8.89[ab]	29.45 ± 6.77[b]	35.66 ± 9.29[a]	29.08 ± 4.97[a]	31.27 ± 3.95[ab]	30.00

Data are presented as mean ± SD

[a,b,c] The different superscript defined as significantly difference, $p<0.05$ by using repeated measure ANOVA (Post hoc Bonferroni)

* Calculated from Holliday and Segar method [141]

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Table 17 Comparison of mean energy requirement and mean dietary intake at different time-points of 14 subjects (Age 16-19 years)

Dietary intake	Week 0	Week 1	Week 2	Week 3	Week 4	Dietary requirement*
Energy (kcal/day)	1869.21 ± 441.17[a]	1704.54 ± 299.72[a]	1867.54 ± 386.18[a]	1828.90 ± 294.55[a]	1834.78 ± 264.24[a]	2265.71 ± 333.13[b]
Carbohydrate (g/day)	238.93 ± 64.91[a]	223.70 ± 45.68[a]	246.71 ± 44.44[ab]	253.83 ± 72.09[ab]	236.60 ± 30.76[a]	282.86 ± 42.03[b]
(carb unit)	15.79 ± 2.59	15.64 ± 3.69	15.71 ± 1.86	15.85 ±2.38	15.85 ± 2.03	18.06 ± 2.57
(% kcal)	50.84± 7.77[b]	52.48 ± 5.78	53.32 ± 6.04	55.24 ± 13.56	48.94 ± 8.70	50.00
Protein (g/day)	78.50 ± 21.64[a]	72.99 ± 9.76[a]	74.70 ± 21.36[a]	79.84 ± 13.68[a]	77.15 ± 12.04[a]	110.22 ± 15.41[b]
(% kcal)	16.88 ± 2.60	17.35 ± 2.10	15.98 ± 3.25	17.36 ± 1.87	16.14 ± 3.48	20.00
Fat (g/day)	69.75 ± 30.43[ab]	58.83 ± 15.98[a]	64.11 ± 18.52[ab]	59.65 ± 12.23[a]	65.43 ± 8.33[ab]	75.77 ± 11.04[b]
(% kcal)	32.91 ± 8.74	31.01 ± 5.90	30.54 ± 4.26	29.06 ± 3.54	30.88 ± 6.66	30.00

Data are presented as mean ± SD

[a,b,c] The different superscript defined as significantly difference, $p<0.05$ by using repeated measure ANOVA (Post hoc Bonferroni)

* Calculated from Holliday and Segar method [141]

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Changes of subject's individual dietary intake comparing with the energy requirement at different time points

As shown in Table 18, the energy requirement range of overall subjects was 1760 – 2642 Kcal/day. At baseline, the energy intake of most subjects (85%) were lower than their energy requirement, whereas 12% and 3% of subjects consumed energy intake higher than their energy requirement and achieved their energy requirement, respectively. During the first period, most subjects (91%) consumed energy intake lower than their energy requirement, while there were 76% of subjects who still consumed energy intake lower than their energy requirement at the second period until the final period. However, there was no subject achieved their energy requirement and 24% of subjects consumed energy intake higher than their energy requirement at second period. While the number of subjects achieved their energy requirement increased to 12% at third period and decreased to 9% at the final period. Moreover, there were 12% and 17% of subjects who consumed energy intake higher than their energy requirement at the third period and the final period.

Table 18 Frequency of the individual energy intake of 34 subjects compared to their individual energy requirement at different time-points

Time point	Energy requirement range (Kcal/day)	Under-energy requirement n (%)	Achieved energy requirement n (%)	Over- energy requirement n (%)
Baseline	1760 - 2642	29 (85)	1 (3)	4 (12)
Period 1		31 (91)	1 (3)	2 (6)
Period 2		26 (76)	0 (0)	8 (24)
Period 3		26 (76)	4 (12)	4 (12)
Period 4		26 (76)	3 (9)	5 (17)

Changes of subject's anthropometric data at baseline and final period

As shown in Table 19, there was no significant difference in the mean anthropometric data from baseline and the end of the study. However, regarding to the

weight for height Z-scores level at final period show that most 24 subjects (70.6%) were in a normal growth range, whereas two subject (5.9%) was overweight, 5 subjects (14.7%) were begin obese and 3 subjects (8.8%) were obese as shown in Table 20.

Table 19 Mean anthropometric data of 34 subjects at baseline and final period

Anthropometric	**Baseline (n=34)**	**Final period (n=34)**
Weight (kg)	52.57 ± 13.94	52.63 ± 13.99
Height (cm)	157 ± 9.29	157.08 ± 9.25
Weight for height Z-scores	25.63 ± 4.44	25.71 ± 4.49
Mid arm circumference (cm)	12.71 ± 6.34	13.02 ± 7.09
Triceps skinfold thickness (mm)	21.05 ± 9.54	21.70 ± 10.22

Data are presented as mean ± SD

Table 20 Mean weight for height Z-scores at baseline and final period of 34 subjects

Weight for height Z-scores	**Baseline (n=34)**	**Final period (n=34)**	**Normal criteria***
> 3.0	3 (8.8)	3 (8.8)	Obesity
> 2.0 to 3.0	6 (17.6)	5 (14.7)	Begin obese
> 1.5 to 2.0	1 (2.9)	2 (5.9)	Overweight
-1.5 to 1.5	24 (70.6)	24 (70.6)	Normal
< -1.5 to -2.0	0	0	Slightly underweight
< -2.0	0	0	Underweight

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

***** Reference of Department of Health, Ministry of Public Health [130]

Changes of subject's mean HbA1C level classified by glycemic control level at different time points

At baseline, about half of subjects were in the fair level of glycemic control, mean HbA1C level was 9.01 ± 0.59%. There were a significantly different among the glycemic control level in baseline (p<0.05). Interestingly, there was no significant different among the glycemic control level in the final week. Group of good glycemic control (26.5%) had lower tendency of HbA1C, by mean of 7.02 ± 0.79% and the group of poor glycemic control (17.6%) had lower tendency of HbA1C, by mean of 10.63 ± 0.44%. However, about 17.6% of fair glycemic control group had lower tendency of HbA1C, by mean of 10.63 ± 0.44% compared with 26.5%, mean 11.00 ± 0.61% from baseline. Nevertheless, HbA1C level was increased to 14.40 ± 1.56%, about 11.8% of very poor glycemic control group increased by comparing with baseline (Table 19). Nevertheless, there are no significantly difference between baseline and the end of the study as show Table 21.

Table 21 Comparisons of the subject's mean HbA1C level between baseline and at the end of the study

Glycemic control level	HbA1C (%)
Baseline (%)	9.28 ± 1.53
At the end of the study (%)	9.46 ± 2.33
Change from baseline (%)	+0.18 (P > 0.05)*

Data are presented as mean ± SD

* Superscript defined as no significantly difference (p-value >0.05) by using Student's *t* tests

Table 22 Comparison of the subject's mean HbA1C level classified by glycemic control level comparing between baseline and at the end of the study

Glycemic control level	Baseline*		End of study	
	n (%)	HbA1C (%)	n (%)	HbA1C (%)
≤ 8 %	7(20.6)	7.29 ± 0.63	9 (26.5)	7.02 ± 0.79
> 8% and ≤ 10%	17(50.5)	9.01 ± 0.59	15 (44.1)	9.15 ± 0.61
> 10% and ≤ 12%	9 (26.5)	11.00 ± 0.61	6 (17.6)	10.63 ± 0.44
> 12%	1 (2.9)	12.60 ± 0.00	4 (11.8)	14.40 ± 1.56

Data are presented as mean ± SD

* Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

5.2.2 Subject's knowledge and understanding of diabetes and meal planning using carbohydrate counting concept

The assessment of the subject's knowledge and understanding diabetes self-care and meal planning using carbohydrate counting concept were evaluated by using validated KAP Pre-test and post test questionnaires and weekly carbohydrate counting exercises including a final class practicing. The level of knowledge and understanding scores were divided into 3 levels; low (< 50% correct), medium (50 – 75% correct), high (> 75% correct).

5.2.2.1 Knowledge and understanding of diabetes and meal planning using carbohydrate counting before and after using KINPORDEE website (Pre-test VS Post-test): KAP (Table 23, 24)

The results of this study show that before assessing KINPORDEE website, most subjects (52.9%) had moderate knowledge level. The mean KAP Pre-test score was 20.65 ± 4.34. Whereas, 35.3% and 11.8% of the subject had high and low knowledge level, respectively. However, after using KINPORDEE website, subject's knowledge and understanding scores were improved. There was no subject with low knowledge level. And most subjects (76.5%) had high knowledge level and other

subjects (23.5%) had moderate knowledge level. The mean KAP Post-test score was 25.06 ± 2.98. Furthermore, comparison of both pre and post knowledge score was found that there were significant difference between the knowledge and understanding score before and after using KINPORDEE website.

Table 23 Number and percentage of subject's knowledge and understanding level about diabetes and meal planning using carbohydrate counting before and after using KINPORDEE website (Pre-test VS Post-test): **KAP**

	Diabetes knowledge and meal planning using carbohydrate counting level		
	Low n (%)	**Medium n (%)**	**High n (%)**
Pre-test	4(11.8)	18 (52.9)	12 (35.3)
Post-test	0 (0)	8 (23.5)	26 (76.5)

Table 24 Comparison the score of subject's knowledge and understanding of diabetes and meal planning using carbohydrate counting between KAP Pre-test and Post-test

Knowledge score*	**Pre-test**	**Post-test**
Mean± SD	20.65 ± 4.34	25.06 ± 2.98[a]
Median	21.00 ± 4.31	25.00± 2.98[a]
Minimum	11	18
Maximum	27	29

Data are presented as mean ± SD, * Total knowledge score equal to 30.

[a] Superscript defined as significantly difference from pre-test at p-value <0.01 by using pair's student t-test

Comparison of KAP Pre and Post test levels of the study participants

The results indicate that before assessing KINPORDEE website, about 44.1% subjects had high knowledge (K) level and other subjects (38.2 and 17.6%) had medium and low knowledge level, respectively. Whereas, more than half of subjects

(64.7%) had high knowledge level and other 35.5% subjects had medium knowledge level after study period and no subjects had low knowledge level.

For subject's attitude (A) level, 38.2% of the subjects had both medium and high attitude level and 23.5% had low attitude level for Pre-test, however surprisingly most subjects (91.2%) had high attitude level and only 8.8% subjects had medium attitude level for Post-test.

And subject's practicing (P) level, about half of subjects (50.5%) had medium practicing level and others (26.5% and 23.5%) had medium and low practicing level, respectively for Pre-test. Whereas, about 76.5% subjects had high practicing level and another 23.5% subjects had medium practicing level for Post-test. Number and percentage of subject's comparing KAP scores are presented in Table 25.

Table 25 Number and percentage of subject's knowledge and understanding comparing KAP score about diabetes and meal planning using carbohydrate counting before and after using KINPORDEE website (Pre-test VS Post-test)

Level	**Diabetes knowledge and meal planning using carbohydrate counting score**	
	Pre-test n (%)	**Post-test n (%)**
Knowledge (K)		
Low	6 (17.6)	0 (0)
Medium	13 (38.2)	12 (35.5)
High	15 (44.1)	22 (64.7)
Attitude (A)		
Low	8 (23.5)	0 (0)
Medium	13 (38.2)	3 (8.8)
High	13 (38.2)	31 (91.2)
Practice (P)		
Low	8 (23.5)	0 (0)
Medium	17 (50.5)	8 (23.5)
High	9 (26.5)	26 (76.5)

Comparisons of knowledge level before and after using KINPORDEE website classified by age, sex, education level, diabetes duration and diabetes diet education experience within 1 year

As shown in Table 26, the overall subjects' knowledge level classified by age, sex, education level, diabetes duration and diabetes diet education experience within 1 year before assessing KINPORDEE website show that there was statistically significant for age and education level. Interestingly, about 71.4% of diabetes adolescent (16-19 years) had high knowledge level and no one had low knowledge level, whereas only 10% of diabetes children (12-15 years) had high knowledge level and other 70%, 20% had medium and low knowledge level, respectively. Additionally, the most subjects who study in high school and higher level (76.9%) had high knowledge level and also no one had any low knowledge level. In other words, there were only 22.2% secondary school subjects and no one from primary school had high knowledge level.

After self-learning with KINPORDEE website, (Table 27) no statistically significant differences were found among the subject's categories. Interestingly, there was no low knowledge level for each category. In the other hands, the most subjects (76.5%) had high knowledge level and only 23.5% subjects had medium knowledge level.

Table 26 Comparison of subject's Pre-test knowledge level classified by age, sex, education level, duration of diabetes and diabetes diet education experience within 1 year

	Pre-test knowledge level			Total	p-value
	Low n (%)	Medium n (%)	High n (%)		
Gender					
Male	2 (16.7)	5 (41.7)	5 (41.7)	12 (35.3)	0.595
Female	2 (9.1)	13 (59.1)	7 (31.8)	22 (64.7)	
Age					
12-15 years	4 (20.0)	14 (70.0)	2 (10.0)	20 (58.8)	0.001[a]
16-19 years	0 (0)	4 (28.6)	10 (71.4)	14 (41.2)	
Education level					
Primary school	2 (16.7)	10 (83.3)	0 (0)	12 (35.3)	0.001[a]
Secondary school	2 (22.2)	5 (55.6)	2 (22.2)	9 (26.5)	
High school and higher	0 (0)	3 (23.1)	10 (76.9)	13 (38.2)	
Diabetes duration					
1-5 years	1 (5.9)	11 (64.7)	5 (29.4)	17 (50.0)	0.372
6-10 years	2 (25.0)	4 (50.0)	2 (25.0)	8 (23.5)	
> 10 year	1 (11.1)	3 (33.3)	5 (55.6)	9 (52.9)	
Diabetes diet education experience in 1 year					
Yes	1 (6.3)	5 (31.3)	10 (62.5)	16 (47.1)	0.007
No	3 (16.7)	13 (72.2)	2 (11.1)	18 (52.9)	
Pre-test knowledge level					
Total	4 (11.8)	18 (52.9)	12 (35.3)	34 (100.0)	

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

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

Table 27 Comparison of subject's Post-test knowledge level classified by age, sex, education level, duration of diabetes and diabetes diet education experience within 1 year

	Post-test knowledge level			**Total**	**p-value**
	Low n (%)	**Medium n (%)**	**High n (%)**		
Gender					
Male	0 (0)	4 (33.3)	8 (66.7)	12 (35.3)	0.320
Female	0 (0)	4 (18.2)	18 (81.8)	22 (64.7)	
Age					
12-15 years	0 (0)	7 (35.0)	13 (65.0)	20 (58.8)	0.059
16-19 years	0 (0)	1 (7.1)	13 (92.9)	14 (41.2)	
Education level					
Primary school	0 (0)	4 (33.3)	8 (66.7)	12 (35.3)	0.231
Secondary school	0 (0)	3 (33.3)	6 (66.7)	9 (26.5)	
High school and higher	0 (0)	1 (7.7)	12 (92.3)	13 (38.2)	
Diabetes duration					
1-5 years	0 (0)	3 (17.6)	14 (82.4)	17 (50.0)	0.548
6-10 years	0 (0)	3 (37.5)	5 (62.5)	8 (23.5)	
> 10 year	0 (0)	2 (22.2)	7 (77.8)	9 (26.5)	
Diabetes diet education experience in 1 year					
Yes	0 (0)	3 (18.8)	13 (81.3)	16 (47.1)	0.536
No	0 (0)	5 (27.8)	13 (72.2)	18 (52.9)	
Post-test knowledge level					
Total	0 (0)	8 (23.5)	26 (76.5)	34 (100.0)	

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

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

Comparison of subject's Pre and Post test knowledge of diabetes meal planning using carbohydrate counting score

As shown in Table 28, by comparing the score of knowledge between Pre and Post test across specific categories of subject's education level, diabetes duration and diabetes diet education experience within 1 year, the results were found that the subject increased their knowledge score significantly. For sub-categories of the education level, there was statistical significance especially for primary ($p<0.01$) and secondary school ($p<0.05$), but no statistically significant pattern was found in high school and higher level. Additionally, there was only statistically significant for the subjects who had 1-5 years diabetes duration ($p<0.05$), whereas there were no significant difference for others diabetes duration. Furthermore, significant difference was also found in both subjects who had learned about diabetes diet ($p<0.02$) and who had never learned within 1 year ($p<0.01$).

Table 28 Comparison of subject's Pre and Post diabetes knowledge score based on the education level, diabetes duration and diabetes diet education experience

	KAP diabetes knowledge score *		**p-value**
Education level			
Primary school (n=12)	Pre- knowledge test	18.25± 3.19	0.000 [a]
	Post-knowledge test	23.83± 3.04	
Secondary school (n=9)	Pre- knowledge test	19.11± 4.43	0.003 [a]
	Post-knowledge test	23.89± 2.85	
High school and higher (n=13)	Pre- knowledge test	23.92± 3.20	0.545
	Post-knowledge test	27.00± 2.00	

Data are presented as mean ± SD, * Total score was 30

[a] Superscript defined as significantly difference at p-value <0.05 by using pair's student t-test

Table 28 Comparison of subject's Pre and Post diabetes knowledge score based on the education level, diabetes duration and diabetes diet education experience (Cont.)

	KAP diabetes knowledge score *		p-value
Diabetes duration			
1-5 years (n=17)	Pre- knowledge test	20.47± 3.50	0.020 [a]
	Post-knowledge test	25.00± 2.82	
6-10 years (n=8)	Pre- knowledge test	19.38± 4.47	0.070
	Post-knowledge test	24.38± 3.07	
> 10 year (n=9)	Pre- knowledge test	22.11± 5.62	0.129
	Post-knowledge test	25.78± 3.38	
Diabetes diet education experience in 1 year			
Yes (n=16)	Pre- knowledge test	22.56± 4.18	0.017 [a]
	Post-knowledge test	26.12± 2.39	
No (n=18)	Pre- knowledge test	18.94± 3.83	0.000 [a]
	Post-knowledge test	24.11± 3.20	

Data are presented as mean ± SD, * Total score = 30

[a] Superscript defined as significantly difference at p-value <0.05 by using pair's student t-test

5.2.2.2 Carbohydrate counting knowledge from weekly E-exercise assignments

The results as shown in Table 29, the mean percentage scores of self-care diabetes knowledge were 65.14 ± 15.10, 62.24 ± 17.26, 67.94 ± 16.84 and 59.50 ± 16.38 in period 1, 2, 3 and final period, accordingly. However, according to the level of self-learning knowledge scores were also divided into 3 levels; low (< 50% correct), medium (50 – 75% correct), high (> 75% correct). The results are presented that the most subjects (58.8%, 47.1, and 52.9%) had moderate knowledge level about self-care diabetes knowledge in period 1, 2, 3 and 4, accordingly. There was in the overall knowledge level for each weekly exercise.

Table 29 Frequency and mean scores percentage of subject's knowledge and understanding of diabetes knowledge and carbohydrate counting concept assessed by the score of E-exercise record (n=34)

Exercise assignment	Score			p-value
	Low n (%)	Medium n (%)	High n (%)	
Period 1				
General diabetes knowledge and self-management	7 (20.6)	20 (58.8)	7 (20.6)	0.000 [a]
Mean scores (%)	65.14 ± 15.10			
Period 2				
Identifying carbohydrate food and applying food reference list for carbohydrate counting	9 (26.5)	16 (47.1)	9 (26.5)	0.000 [a]
Mean scores (%)	62.24 ± 17.26			
Period 3				
Estimating portion size and meal planning	4 (11.8)	18 (52.9)	12 (35.3)	0.000 [a]
Mean scores (%)	67.94 ± 16.84			
Period 4				
Carbohydrate counting for eating out and meal planning	9 (26.5)	19 (55.9)	6 (17.6)	0.000 [a]
Mean scores (%)	59.50 ± 16.38			

Data are presented as mean ± SD**,** * Class Practice with 3 class activities

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

5.2.3 The accuracy in subject's perception and conceptualization in meal planning using carbohydrate counting skill

5.2.3.1 Carbohydrate counting knowledge from weekly E-exercise assignments and a final class practice

The results as shown in Table 30, the mean percentage scores of self-help meal planning focus on carbohydrate counting knowledge were 59.00 ± 15.28, 60.59 ± 15.37, 64.26 ± 16.84 and 83.76 ± 17.91in period 1, 2, 3 and final class practicing, accordingly. According to the self-learning knowledge scores were divided into 3 levels; low (< 50% correct), medium (50 – 75% correct), high (> 75% correct), so results are presented that the most subjects (58.8%, 47.1, and 52.9%) had moderate knowledge level about self-care diabetes knowledge in period 1, 2 and 3, accordingly, whereas about 76.5% had high knowledge level in the final class practicing. For the weekly self-help meal planning focus on carbohydrate counting scores, almost subjects were (52.9%, 55.9% and 55.9%) had medium knowledge level in period 1, 2 and 3, respectively. Interestingly, the most subjects (76.5%) had high knowledge level in the final class practicing and other 14.7%, 8.8% subjects had medium and low knowledge level, respectively. There was a statistically significance in the overall knowledge level for each weekly exercise.

Table 30 Frequency and mean scores percentage of the accuracy scores in subject's perception and conceptualization in meal planning using carbohydrate counting skill assessed by the score of weekly E-exercise record and a final class practice

Exercise assignment	Score level			p-value
	Low n (%)	Medium n (%)	High n (%)	
Period 1				
Self-nutrition assessment	10 (29.4)	18 (52.9)	6 (17.6)	0.000 [a]
Mean scores (%)	59.00 ± 15.28			

Data are presented as mean ± SD**,** * Class Practice with 3 class activities

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

Table 30 Frequency and mean scores percentage of the accuracy scores in subject's perception and conceptualization in meal planning using carbohydrate counting skill assessed by the score of weekly E-exercise record and a final class practice (Cont.)

Exercise assignment	Score level			p-value
	Low n (%)	Medium n (%)	High n (%)	
Period 2				
Diabetes and Carbohydrate counting	10 (29.4)	19 (55.9)	5 (14.7)	0.000 [a]
Mean scores (%)	60.59 ± 15.37			
Period 3				
Carbohydrate counting for food mixed dishes	7 (20.6)	19 (55.9)	8 (23.5)	0.000 [a]
Mean scores (%)	64.26 ± 16.84			
Period 4				
Class practice	3 (8.8)	5 (14.7)	26 (76.5)	0.000 [a]
Mean scores (%)	83.76 ± 17.91 [*]			

Data are presented as mean ± SD**,** [*] Class Practice with 3 class activities

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

The accuracy about a self-help meal planning focus on carbohydrate counting in class practice

As results from three class activities, the mean percentage scores of accuracy in meal planning using carbohydrate counting skill were 91.76 ± 14.24, 90.59 ± 16.13 and 76.03 ± 24.08, respectively. According to the level of self-learning knowledge scores which were also divided into 3 levels; low (< 50% correct), medium (50 – 75% correct), high (> 75% correct). The results are presented that most subjects (79.4%) had high accuracy level on self-nutrition assessment and meal distribution using KINPOREE website. Moreover, most of subjects (76.5%) had high accuracy level for planning proper two sample meals. For last activities, most of subjects (67.6%) had high accuracy level on estimating various food portion sizes and counting carbohydrate in a serving, whereas the other 20.6% and 11.8% subject were in the range of medium and low accuracy level, respectively. Nevertheless, there was a

statistically significance in the overall accuracy level for each activity. The frequency and percentage of the accuracy scores in subject's perception and conceptualization in meal planning using carbohydrate counting skill according in the class practice are shown in Table 31.

Table 31 Frequency and mean scores percentage of the accuracy scores in subject's perception and conceptualization in meal planning using carbohydrate counting skill assessed by the score of a final class practice

Class practice activities	Score level			p-value
	Low n (%)	Medium n (%)	High n (%)	
Activities 1				
Self-nutrition assessment and meal distribution	0 (0)	7 (20.6)	27 (79.4)	0.000 [a]
Mean scores (%)	91.76 ± 14.24			
Activities 2				
Set proper two samples meal planning	0 (0)	8 (23.5)	26 (76.5)	0.000 [a]
Mean scores (%)	90.59 ± 16.13			
Activities 3				
Estimating various food portion sizes for calculating carbohydrate choices in a serving	7 (20.6)	4 (11.8)	23 (67.6)	0.000 [a]
Mean scores (%)	76.03 ± 24.08			

Data are presented as mean ± SD

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

Activities for evaluating carbohydrate counting skill including estimating various food portions sizes to figure carbohydrate choices

The sample fruit market, with variety of carbohydrate food items from 5 groups was designed to evaluate subject's food estimation skills. Each subject group was assigned to estimate and calculate carbohydrate choices from selected food items and the results were recorded in their answer sheet.

Interestingly, the specific results of these activities in terms of subject's accuracy level in estimating portion sizes and figuring carbohydrate choice were shown in Table 32. For starchy group, (white rice, sticky rice, bread and rice noodle), about 58.8% of subjects had high accuracy level and 38.3%, 2.9% of subjects had medium and low accuracy level, respectively.

For fruit group, (apple, orange, banana, papaya and pineapple), most subjects (61.8%) had medium accuracy level and the remaining subjects (38.2%) had high accuracy level, whereas no low accuracy level had been found.

For one plate dish and other carbohydrate food group, (rice with fried pork and holy basil leaves, rice noodles soup with pork ball, donut and sandwich), about half of subjects (52.9%) had medium accuracy level and the remaining subjects (29.5%, 17.7%) had high and low accuracy level, respectively.

Moreover, for figuring carbohydrate choice of carbohydrate products (milk, yoghurt, orange juice and snack) from reading nutrition labels, most subjects (82.4%) had high accuracy level and only remaining subjects (11.8% and 8.8%) had low and high accuracy level, respectively.

Table 32 Number and percentage of subject's accuracy level in estimating and figuring carbohydrate choices in various foods portion sizes

Food items	Score level*			Score
	Low n (%)	Medium n (%)	High n (%)	
Starch	2 (2.9)	13 (38.2)	20 (58.8)	2.56 ± 0.56
Vegetable	8 (23.5)	8 (23.5)	18 (52.9)	2.06 ± 1.23
Fruit	0 (0)	21 (61.8)	13 (38.2)	2.38 ± 0.49
One- plate dish and other carbohydrate foods	6 (17.6)	18 (52.4)	27 (29.4)	2.00 ± 0.92
Carbohydrate products with nutrition label	4 (11.8)	2 (5.9)	28 (82.4)	2.68 ± 0.77

Data are presented as mean ± SD, *Score level; 3 scores = High, 2 scores = Medium, <1 score = Low

The accuracy in subject's perception and conceptualization in actual meal planning and carbohydrate counting by assessing weekly food intake record

The overall results as shown in Table 33. The mean carbohydrate goal for 34 subjects was 18.06 ± 2.57 carbs choices. However, subjects' actual carbohydrate choices at different time points were significantly lower than their mean carbohydrate goal. (p<0.05).There was no significantly difference of subjects' actual carbohydrate intake at the different time points. At baseline, the result showed that most subjects (88.2%) had under carbohydrate goal intake and other 11.8% subjects had over carbohydrate goal intake, whereas no one had achieved carbohydrate goal intake. However, percentage of subjects who had achieved carbohydrate goal intake was increased at period 1, 2, and 3 but decreased in the final week. Interestingly, the number of subjects who had over carbohydrate goal intake was still the same percentage (11.8%) from baseline to period 3 but had higher percentage (20.6%) in the final period. However, compared to baseline, most of subjects in final week (79.4%) had under carbohydrate goal intake and other 17.6% subjects had over carbohydrate goal intake, whereas only 2.9% had the achieved carbohydrate intake. Nevertheless, there was a statistically significance in the carbohydrate correspondence from baseline to week 3 (p<0.05).

Table 33 Comparison of the average carbohydrate goal and the actual carbohydrate intake from E-PORDEE daily intake record with number and percentage of 34 subjects at different time-points

Time point	Mean actual CHO intake* (unit/day)	Actual CHO Intake range (unit/day)	Under-goal n (%)	Achieved goal n (%)	Over-goal n (%)
Baseline	14.47 ± 3.55[ab]	10-25	30 (88.2)	0 (0)	4 (11.8)
Period 1	14.68 ± 3.06[a]	9-23	27 (79.4)	3 (8.8)	4 (11.8)
Period 2	14.76 ± 2.80[b]	9-25	26 (76.5)	4 (11.8)	4 (11.8)
Period 3	14.62 ±2.06[ab]	12-20	25 (73.5)	5 (14.7)	4 (11.8)
Period 4	15.15 ± 2.07[ab]	12-20	26 (76.5)	1 (2.9)	7 (20.6)
Mean CHO Goal	18.06 ± 2.57[c]	15-25			

* Data are presented as mean ± SD

[a,b,c] The different superscript were defined as significantly difference, $p<0.05$ by using repeated measure ANOVA (Post hoc Bonferroni)

Regarding to the accuracy in subject's perception and conceptualization in the actual carbohydrate intake and the individual carbohydrate goal as shown in Table 34, at baseline most subjects (70.6%) had low carbohydrate goal compliance level and remaining subjects (20.6%, 8.8%) had median and high carbohydrate goal compliance level, respectively. Surprisingly, most subjects (38.2%) had median carbohydrate goal compliance level at the final period. Whereas, 32.4% and 29.4% of subjects had low and high median carbohydrate goal compliance level, respectively. However, there was no significantly difference in an average carbohydrate goal compliance scores between the baseline and final period.

Table 34 Number and percentage of accuracy in subject's perception and conceptualization in carbohydrate counting in term of deviation from actual carbohydrate intake and individual carbohydrate goal achievement

Time	Mean Score (%)	Carbohydrate goal intake compliance level		
		Low n (%)	Medium n (%)	High n (%)
Baseline	40.29± 41.41	24 (70.6)	7 (20.6)	3 (8.8)
Final period	62.06± 26.03	11 (32.4)	13 (38.2)	10 (29.4)

Data are presented as mean ± SD

Comparison of individual carbohydrate goal intake compliance across categories of age, sex, nutritional status, duration of diabetes, diabetes diet education experience, dietary intake record and website compliance level

The overall results of subject's carbohydrate goal intake compliance level classified by age, sex, nutritional status, duration of diabetes, diabetes diet education experience, dietary intake record and website compliance level during self-learning with KINPORDEE website show that there was statistically significant in the carbohydrate goal intake compliance level for the subject's nutritional status and the diabetes diet education experience within 1 year. Interestingly, 17.6% of overweight or obesity subjects had high carbohydrate goal intake compliance level, whereas about 11.4% and 26.5% of normal weight subjects had high and low carbohydrate goal intake compliance level, accordingly. Nevertheless, most of subjects who had learned carbohydrate counting within 1 year (23.5%) had high carbohydrate goal intake compliance level and only 5.9% of subjects who had never learned carbohydrate counting before had high carbohydrate goal intake compliance level. While most of them (23.5%) had both low and medium carbohydrate goal intake compliance level, accordingly. However, there was no statistically significant among the others categories as shown in Table 35.

Table 35 Comparison of subject's carbohydrate goal intake compliance level classified by age, sex, nutritional status, duration of diabetes, diabetes diet education experience, dietary intake record and website compliance level

	Carbohydrate goal intake compliance level			**Total**	**p-value**
	Low n (%)	**Median n (%)**	**High n (%)**		
Gender					
Male	4 (11.8)	6 (17.6)	1 (2.9)	12 (35.3)	0.174
Female	7 (20.6)	7 (20.6)	9 (26.5)	22 (64.7)	
Age					
12-15 years	6 (17.6)	9 (26.5)	6 (17.6)	21 (61.8)	0.755
16-19 years	5 (14.7)	4 (11.8)	4 (11.8)	13 (38.2)	
Nutritional status					
Overweight or obesity	2 (5.9)	2 (5.9)	6 (17.6)	10 (29.4)	0.041*
Normal weight	9 (26.5)	11 (32.4)	4 (11.4)	24 (70.6)	
Diabetes duration					
1-5 years	9 (26.5)	5 (14.7)	3 (8.8)	17 (50.0)	0.098
6-10 years	0 (0)	4 (11.8)	4 (11.8)	8 (23.5)	
> 10 year	2 (5.9)	4 (11.8)	3 (8.8)	9 (52.9)	
Diabetes diet education experience in 1 year					
Yes	3 (8.8)	5 (14.7)	8 (23.5)	16 (47.1)	0.039*
No	8 (23.5)	8 (23.5)	2 (5.9)	18 (52.9)	
Website compliance level					
Low	3 (8.8)	0 (0)	0 (0)	3 (8.3)	0.442
Median	19 (55.9)	5 (14.7)	3 (8.8)	27 (79.4)	
High	2 (5.9)	2 (5.9)	0 (0)	4 (11.8)	

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

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

Table 35 Comparison of subject's carbohydrate goal intake compliance level classified by age, sex, nutritional status, duration of diabetes, diabetes diet education experience, dietary intake record and website compliance level (Cont.)

	Carbohydrate goal intake compliance level			**Total**	**p-value**
	Low n (%)	**Median n (%)**	**High n (%)**		
Dietary intake record compliance					
Median	9 (26.5)	10 (29.4)	7 (20.6)	26 (76.5)	0.815
High	2 (5.9)	3 (8.8)	1 (2.9)	8 (23.5)	
Overall carbohydrate goal compliance level					
Total	11 (32.4)	13 (38.2)	10 (29.4)	34 (100)	

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

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

The subject's dietary intake record compliance considering as the responsibility in 3 days food intake record per week using E-PORDEE daily intake record

As shown in Table 36, most subjects (44.1%, 55.9% and 50%) had low dietary intake record compliance level, especially from period 1, 2 and 3, accordingly. The mean record amounts were 1.75 ± 0.75, 1.59 ± 0.74 and 1.71 ± 0.76 times per period at period 1, 2 and 3, respectively. However, mean score of total average dietary intake record compliance score was 2.00 ± 0.86 times per week, the approximate 35.3% subjects had both medium and high dietary intake record compliance level and about 29.4% subjects had low dietary intake record compliance.

Table 36 Number and percentage of 34 subjects' dietary intake record compliance, considered as the responsibility for 3 days food intake record per week using E-daily intake record

Week	Record amount (times/week)	Dietary intake record compliance level		
		Low diet compliance n (%)	Medium diet compliance n (%)	High diet compliance n (%)
Period 1	1.75 ± 0.75	15 (44.1)	13 (38.2)	6 (17.6)
Period 2	1.59 ± 0.74	19 (55.9)	10 (29.4)	5 (14.7)
Period 3	1.71 ± 0.76	17 (50.0)	10 (29.4)	7 (20.6)
Period 4	2.27 ± 0.17	0 (0)	1 (2.9)	33 (97.1)
Total average	**2.00 ± 0.86**	**0 (0)**	**26 (76.5)**	**8 (23.5)**

Relationship between the groups of HbA1C improvement across categories of diabetes duration, glycemic control, diet compliance level, website compliance level and diabetes diet education experience within 1 year

As shown in Table 37, HbA1C improvement was divided into 3 groups according to the different characteristics among the group of HbA1C improvement ≥ 1% (n=4), the group of HbA1C improvement < 1% (n=12) and no HbA1C improvement group (n=18).

There were 23.5% of subjects in group of HbA1C improvement ≥ 1% had diabetes duration in 1-5 years, while there were no subjects with more than 6 years diabetes duration who had ≥ 1% HbA1C improvement. However, most of all subjects (50%, 52.9% and 55.6%) who had diabetes for 1-5 years, 6-10 years and more than 10 years, respectively, had no HbA1C improvement during study period.

Moreover, there were 3 subjects (10.7%) who had previously good glycemic control (HbA1C > 8%) were classified into the group of HbA1C reduction ≥ 1% and other 10 and 15 subjects (35.7% and 53.6%) were in the group of < 1% HbA1C improvement and no HbA1C improvement, respectively. Whereas, there was only one subject who had previously good glycemic control (HbA1C < 8%) was

classified into the group of HbA1C reduction ≥ 1%, but other 2, and 3 subjects were in the group of < 1% HbA1C improvement and no HbA1C improvement, respectively.

Interestingly, only 4 subjects (15.4%) who had good glycemic control and medium diet compliance level were in group of HbA1C reduction ≥ 1%. And most subjects (61.5%) who had median diet compliance were in no HbA1C improvement group. In the other hands, there were no HbA1C improvement ≥ 1% group with high diet compliance, but most subjects (75%) who had high level of diet compliance were in group of HbA1C reduction < 1%. However, the diet compliance level as a number of intake record was significantly difference among the group of HbA1C improvement ($p<0.05$).

For the subject who had diabetes diet education experience in 1 year, the results had been found that there was no HbA1C reduction ≥ 1% group, whereas most subjects (53.5%) had no HbA1C improvement during study period. In the contrast, there were subjects (22.2%) who had never learned about diabetes diet, were grouped in HbA1C improvement ≥ 1%, however about half were no in HbA1C improvement group.

Table 37 Relationship between the groups of HbA1C improvement across categories of diabetes duration, glycemic control, diet record compliance level, website compliance level and diabetes diet education experience within 1 year

	Group of HbA1C Improvement			Total	p-value
	≥ 1%	< 1%	≤ 0%		
Diabetes duration					
1-5 years	4 (23.5)	4 (23.5)	9 (52.9)	17 (50.0)	0.249
6-10 years	0 (0)	4 (50.0)	4 (50.0)	8 (23.5)	
> 10 year	0 (0)	4 (44.4)	5 (55.6)	9 (26.5)	
Glycemic control					
Good (HbA1C < 8%)	1 (16.7)	2 (33.3)	3 (50.0)	6 (17.6)	0.919
Poor (HbA1C ≥ 8%)	3 (10.7)	10 (35.7)	15 (53.6)	28 (82.4)	
Diet record compliance level					
Medium	4 (15.4)	6 (23.1)	16 (61.5)	26 (76.5)	0.024[a]
High	0 (0)	6 (75.0)	2 (25.0)	8 (23.5)	
Website compliance level					
Low	1 (33.3)	2 (66.7)	0 (0)	3 (35.3)	0.309
Medium	3 (11.1)	8 (29.6)	16 (59.3)	27 (26.5)	
High	0 (0)	2 (50.0)	2 (50.0)	4 (38.2)	
Diabetes diet education experience in 1 year					
Yes	0 (0)	7 (43.8)	9 (56.3)	16 (50.0)	0.121
No	4 (22.2)	5 (27.8)	9 (50.0)	18 (23.5)	
Overall HbA1C Improvement					
Total	4 (11.8)	12 (35.5)	18 (52.9)	34 (100.0)	

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

[a] Superscript defined as significantly difference at p-value <0.05 by using Chi Square method

5.2.4 Subject's diabetes self-management attitude

The assessment of the subject's diabetes self-management attitude was evaluated by using validated Pre and Post attitude test questionnaires. The level of attitude scores were divided in 3 levels; low (< 50% scores), medium (50 – 75% scores), high (> 75% scores).

5.2.4.1 Attitude score before and after using KINPORDEE website

As shown in Table (38-39), the results of this study show that before assessing KINPORDEE website, most subjects (58.8%) had moderate attitude level and other 41.2% subjects had high attitude level. There was no subject with low attitude level. Most subjects (64.7%) had high attitude level and only 35.3% had median attitude level. The mean Pre-attitude test score was 74.71± 7.14. However, after using KINPORDEE website, subject's attitude scores were improved significantly. The mean Post-attitude test score was 79.41 ± 7.72. Additionally, there was significant difference between the median attitude score before and after using KINPORDEE website.

Table 38 Frequency and percentage of subject's diabetes self-management attitude score

	Diabetes self-management attitude score		
	Low n (%)	**Medium n (%)**	**High n (%)**
Pre-test	0 (0)	20 (58.8)	14 (41.2)
Post-test	0 (0)	12 (35.3)	22 (64.7)

Table 39 Comparison of subject's diabetes self-management attitude test score before and after using KINPORDEE website

Knowledge score	**Pre-Attitude test**	**Post-Attitude test**
Mean± SD	74.71± 7.14	79.41 ± 7.72[a]
Median	75.00± 7.13	81.00 ± 7.72[a]
Min/Max	58/90	63/96

Data are presented as mean ± SD, Total score = 100

[a] Superscript defined as significantly difference from pre-test at p-value <0.01 by using pair's student t-test

Comparison of subject's Pre and Post attitude of diabetes management score across categories of education level, diabetes duration and diabetes diet education experience within 1 year

By comparing the attitude score between Pre and Post attitude test across specific categories of subject's education level, diabetes duration and diabetes diet education experience within 1 year, the results were found that the subject increased their knowledge score significantly. For sub-categories of the education level, there was statistically significance especially for secondary school ($p<0.02$) and high school and higher level ($p<0.01$), but no statistically significant pattern was found in primary school. Besides, a significant difference of attitude score was also found in both subjects who had learned about diabetes diet ($p<0.01$) and who had never learned within 1 year ($p<0.02$). However, there was no significant difference among the diabetes duration sub-categories. (Table 40)

Table 40 Comparison of subject's pre and post diabetes self-management attitude test score based on the education level, diabetes duration and diabetes diet education experience within 1 year

	Diabetes self-management attitude score		**p-value**
Education level			
Primary school (n=12)	Pre- attitude test	75.17± 4.61	0.091
	Post-attitude test	79.67± 9.44	
Secondary school (n=9)	Pre- attitude test	72.00± 10.49	0.011[a]
	Post-attitude test	78.00± 7.73	
High school and higher (n=13)	Pre- attitude test	76.15± 6.27	0.000[a]
	Post-attitude test	80.15± 6.34	
Diabetes duration			
1-5 years (n=17)	Pre- attitude test	76.06± 5.77	0.055
	Post-attitude test	79.65± 8.58	
6-10 years (n=8)	Pre- attitude test	70.25± 8.45	0.050
	Post-attitude test	77.75± 5.47	
> 10 year (n=9)	Pre- attitude test	76.11± 7.42	0.050
	Post-attitude test	80.44± 8.26	
Diabetes diet education experience in 1 year			
Yes (n=16)	Pre- attitude test	75.81± 7.70	0.000[a]
	Post-attitude test	80.43± 6.77	
No (n=18)	Pre- attitude test	73.72± 6.67	0.017[a]
	Post-attitude test	78.50± 8.56	

Data are presented as mean ± SD

[a] Superscript defined as significantly difference at p-value <0.05 by using Paired-Samples T test

5.2.5 Subject's satisfaction with KINPOEDEE website

The subject's satisfaction was considered from the website content aspect, website format, easy to use and enhance online self-learning and website motivation aspect by using the closed ended questions, rating scale with 4 levels of measurement.

As shown in Table 41- 45, the number and percentage of subject's opinion responding to KINPORDEE website for firstly web content aspect, the mean opinion level was 4.09 ± 0.82 as a rating scale by more than half of subjects from a very satisfied to an extremely satisfied for this aspect. Most subjects (64.7%) had concluded that KINPORDEE website was very easy to learn and understand language and it had an appropriate content arrangement. For the website format aspect, the mean opinion level was 4.40 ± 0.71. Moreover, easy to use and enhance online self-learning web content aspect, the mean opinion level was 4.09 ± 0.82 as a rating scale by more than half of subjects from a very satisfied to an extremely satisfied for this aspect. For the website format aspect, the mean opinion level was 4.40 ± 0.71. More than half of subjects had very satisfied with a website's attractive illustration that improves knowledge and easy to read font and size. Besides, the menus and applications had also a good arrangement. However, very few subjects assessed them as somewhat satisfied and very dissatisfied for food pictures present as the actual food portion sizes. For enhance online self-learning and website motivation aspect, the mean opinion's level were 4.01 ± 0.84 and, 4.29± 0.76 respectively. Most subjects were satisfied with overall assessment for according aspects. They were satisfied with the application menus which are easy to use and follow the objectives and could also enhance online self-learning. Moreover, most subjects (73.5%) had mentioned that the website's name (www.kinpordee.com) was very easy to remember and they were challenged in self-learning by e-exercise and other applications. However, some subjects had commented about the accessibility to use website that was too slowly and have some pop up error because of the old version of the internet explorer program.

Table 41 Number and percentage of subject and mean scores of subjects' satisfaction of KINPORDEE website

Assessment aspects	*Opinion level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
1. Website Content: 1.1 Corresponding to the objectives 1.1.1Learn about a general knowledge of diabetes and self care management	0 (0)	1 (2.9)	3 (8.8)	16 (47.1)	14 (41.2)	4.26 ± 0.75
1.1.2 Realize about the objectives of self-help meal planning for diabetes control	0 (0)	2 (5.9)	5 (14.7)	16 (47.1)	11 (32.4)	4.05 ± 0.85
1.1.3 Realize about carbohydrate role and diabetes control	0 (0)	2 (5.9)	6 (17.6)	15 (44.1)	11 (32.4)	4.03 ± 0.87
1.1.4 Realize about the importance of self-nutrition assessment	0 (0)	1 (2.9)	4 (11.8)	18 (52.9)	11 (32.4)	4.15 ± 0.74
1.1.5 Understand the role of nutrients which affect blood glucose	0 (0)	1 (2.9)	5 (14.7)	16 (47.1)	12 (35.3)	4.26 ± 0.83
1.1.6 Learn food groups which contain carbohydrate	0 (0)	1 (2.9)	5 (14.7)	12 (35.3)	16 (47.1)	4.23 ± 0.74

Data are presented as mean ± SD, *Opinion level; 5 = Extremely satisfied, 4 = Very satisfied, 3 = Somewhat satisfied, 2 = Very dissatisfied, 1 = Extremely dissatisfied

Table 41 Number and percentage of subject and mean scores of subjects' satisfaction of KINPORDEE website (Cont.)

Assessment aspects	*Opinion level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
1.1.7 Realize about an appropriate energy and carbohydrate requirement per day	0 (0)	0 (0)	6 (17.6)	14 (41.2)	14 (41.2)	3.82 ± 1.09
1.1.8 Self-appropriate meal plan by using carbohydrate counting technique	0 (0)	6 (17.6)	5 (14.7)	12 (35.5)	11 (32.4)	3.82 ± 1.09
1.1.9 Understand the principle of food exchange in food containing carbohydrate	0 (0)	6 (17.6)	5 (14.7)	13 (38.2)	10 (29.4)	3.79 ± 1.07
1.1.10 Understand the management of a normal blood sugar control	0 (0)	0 (0)	8 (23.5)	15 (44.1)	11 (32.4)	4.09 ± 0.75
1.2 Content presentation, precise and attractive to follow	1 (2.9)	1 (2.9)	6 (17.6)	17 (50)	9 (26.5)	3.94 ± 0.92
1.3 Appropriate content arrangement and overall length	0 (0)	1 (2.9)	2 (5.9)	22 (64.7)	9 (26.5)	4.15 ± 0.66

Data are presented as mean ± SD, *Opinion level; 5 = Extremely satisfied, 4 = Very satisfied, 3 = Somewhat satisfied, 2 = Very dissatisfied, 1 = Extremely dissatisfied

Table 41 Number and percentage of subject and mean scores of subjects' satisfaction of KINPORDEE website (Cont.)

Assessment aspects	*Opinion level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
1.4 Easy to learn and understand language	0 (0)	1 (2.9)	3 (8.8)	22 (64.7)	9 (23.5)	4.09 ± 0.67
1.5 Appropriate knowledge consequences	0 (0)	0 (0)	4 (11.8)	19 (55.9)	11 (32.4)	4.20 ± 0.64
Total content aspect						**4.09 ± 0.82**
2. Website format: 2.1 Attractive illustration	0 (0)	1 (2.9)	3 (8.8)	9 (26.5)	21 (61.8)	4.47 ± 0.79
2.2 Illustration that improves knowledge and understanding	0 (0)	0 (0)	1 (2.9)	14 (41.2)	19 (55.9)	4.53 ± 0.56
2.3 Menu and application arrangement, Easy to read font and size	0 (0)	0 (0)	3 (8.8)	16 (47.1)	15 (44.1)	4.35 ± 0.64
2.4 Food pictures present as the actual food portion sizes	0 (0)	1 (2.9)	4 (11.8)	15 (44.1)	14 (41.2)	4.20 ± 0.88
2.5 Clearly font size and color	0 (0)	0 (0)	2 (5.9)	15 (44.1)	17 (50)	4.44 ± 0.61
Total website format aspect						**4.40 ± 0.71**

Data are presented as mean ± SD, *Opinion level; 5 = Extremely satisfied, 4 = Very satisfied, 3 = Somewhat satisfied, 2 = Very dissatisfied, 1 = Extremely dissatisfied

Table 41 Number and percentage of subject and mean scores of subjects' satisfaction of KINPORDEE website (Cont.)

Assessment aspects	*Opinion level					Scores
	1 **n** **(%)**	**2** **n** **(%)**	**3** **n** **(%)**	**4** **n** **(%)**	**5** **n** **(%)**	
3. Ability to use and enhance online self-learning 3.1 Accessibility to use website	1 (2.9)	4 (11.8)	7 (20.6)	11 (29.4)	12 (35.3)	3.82 ± 1.14
3.2 Application menus are easy to use and follow the objectives	0 (0)	0 (0)	5 (14.7)	20 (58.8)	9 (26.5)	4.12 ± 0.64
3.3 Enhance overall online self-learning	0 (0)	0 (0)	7 (20.6)	17 (50)	20 (29.5)	4.09 ± 0.71
3.4 Interactive E-exercise and game stimulate online-self learning	0 (0)	0 (0)	6 (27.6)	17 (50)	11 (32.4)	4.15 ± 0.70
3.5 E-daily intake record is easy to use and comfortable to self-help meal planning	0 (0)	2 (5.9)	10 (29.4)	13 (38.2)	9 (26.5)	3.85 ± 0.89
Total enhance self-learning aspect						**4.01 ± 0.84**

Data are presented as mean ± SD, *Opinion level; 5 = Extremely satisfied, 4 = Very satisfied, 3 = Somewhat satisfied, 2 = Very dissatisfied, 1 = Extremely dissatisfied

Table 41 Number and percentage of subject and mean scores of subjects' satisfaction of KINPORDEE website (Cont.)

Assessment aspects	*Opinion level					Scores
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	
4. Website motivation for online self-learning						
4.1 www.kinpordee.com is easy to remember	0 (0)	1 (2.9)	1 (2.9)	7 (20.6)	25 (73.5)	4.64 ± 0.69
4.2 Interesting menus and simple to use	0 (0)	0 (0)	4 (11.8)	15 (44.1)	15 (44.1)	4.32 ± 0.68
4.3 Managing and self-learning control by users	0 (0)	1 (2.9)	8 (23.5)	14 (41.2)	11 (32.4)	4.03 ± 0.83
4.4 Challenging in online self-learning	0 (0)	0 (0)	6 (17.6)	16 (47.1)	12 (35.8)	4.18 ± 0.72
Total website motivation aspect						**4.29± 0.76**

Data are presented as mean ± SD, *Opinion level; 5 = Extremely satisfied, 4 = Very satisfied, 3 = Somewhat satisfied, 2 = Very dissatisfied, 1 = Extremely dissatisfied

Most subjects were satisfied with the KINPORDEE website. They intend to use this website and are also interested to participate with the extra class activities. Most subjects commented that the diabetes knowledge and useful applications in KINPORDEE website could improve and confirm their knowledge of diabetes self-management. Especially, this website was also a very good self-diabetes management guideline for their families and care takers.

Almost subjects stated that a color theme and website mascots are very attractive and colorful. The layout of the front page and some mouse over effect of the link "tabs" were designed creatively. Some subjects recommended that this website should have some flash and needs some movement in the site. Some subjects had recommended that there should be more stimulation and encouragement to other users

to use web board. However, few subjects commented that website information was too long and consumed too much time. They stated that the website accessibility was too slow because of their web browser and internet speed limitation. However, they didn't face any problems about online-self learning because almost subjects have some basic computer experience, especially the internet usage.

Comparison of subject's website compliance with an average time on site at different time points

The result was shown in Table 42, the level of website compliance was divided in 3 levels; low (< 1hour/week), medium (1-2 hours/week), high (>3 hours/week). The subjects' was divided into 3 levels; low compliance Most subjects (76.5%, 55.9%, 61.8% and 76.5%) had a medium website compliance level at period 1, 2, 3 and final period, respectively. There was no significantly difference between each period. However, the mean total average time on site was about 1.98± 1.19 hours/week which 79.4% of subjects had medium compliance level and others 11.8% and 8.8% had high and low website compliance level, respectively.

Table 42 Number and percentage of 34 subjects' website compliance and average time on site comparing at different time-points

Week	Average time on site (hours/week)	Website compliance level		
		Low compliance n (%)	Medium compliance n (%)	High compliance n (%)
Period 1	1.92 ± 1.24	4 (11.8)	26 (76.5)	4 (11.8)
Period 2	2.02 ± 1.17	8 (23.5)	19 (55.9)	7 (20.6)
Period 3	2.04 ± 1.20	6 (17.6)	21 (61.8)	7 (20.6)
Period 4	1.86 ± 1.26	5 (14.7)	26 (76.5)	3 (8.8)
Total average	**1.98± 1.19**	**3 (8.8)**	**27 (79.4)**	**4 (11.8)**

* Data are presented as mean ± SD, No significantly difference between each week, $p>0.05$ by using repeated measure ANOVA (Post hoc Bonferroni)

CHAPTER VI
DISCUSSION

The developed nutrition education tool using advanced carbohydrate Internet-based instruction for continuing nutrition education has been associated with favorable outcomes. Many studies have been shown to increase patient's nutrition knowledge and improve metabolic control [34,144,145]. The purposes of this study were to develop and evaluate the effectiveness of a multimedia diabetes educational website for self-help meal planning in type 1 diabetic adolescents by using basic carbohydrate counting concept. The subject's satisfaction of developed website, knowledge and attitude outcomes of subjects were also determined. This chapter discussed the results according to the sequence of the study in chapter 5.

6.1 Development of the multimedia diabetes educational website

Internet-based courses pose several challenges for self-care diabetes management. Especially, type 1 diabetic patients, the main challenge is to overcome learning and practicing basic carbohydrate counting concept for meal planning. KINPORDEE website, multimedia diabetes educational website was developed according to this purpose. The main menus were consists of general information about diabetes self-care management and self-help guidelines for meal planning using basic carbohydrate counting with many applications such as e-food photo gallery, e-food exchange list, e-exercise, e-daily intake record and e-glucose level monitor and record.

As a reason, type 1 diabetic children and adolescents have not appreciated traditional learning methods since they rarely contain the elements of fun and interactivity [146]. The basic premise of online nutrition education was that print materials combined with internet technology, especially WWW, with its increasing capacity for multimedia, easy access to an ever-growing body of information and new way of data representation, has provided educators and patients with exciting opportunities to enhance teaching and learning. In Thailand, this kind of educational tool via multimedia web-based system are quite limited, Nasanee A. [147] had

developed a diabetes website which provided overview diabetes and self-care information along with the frequently questions and answers from experts and online-questionnaires for website evaluation. However, this website almost provided only general diabetes information but not focuses on the nutrition management knowledge in deeply detail especially; the basic carbohydrate counting that is the most useful technique for self-help meal planning in the diabetic patients. Wibunrattanasri N. [102] developed self-help guidelines for meal planning using carbohydrate counting for adults with type 2 diabetes in the form of two small booklets with black and white illustration. However, there were many suggestions to apply color in both fonts and illustrations. Similarly, Chaturawit C. [30] had developed the colorful education tool booklets for meal planning using basic carbohydrate counting for type 1 diabetics adolescent. Subsequently, the education tool for the advanced carbohydrate counting concept was developed by Jampathed S. [31] which consisted of two colorful booklets for providing self-meal planning knowledge and pattern management for diabetes control including a diary for food intake, blood glucose level, insulin dose and exercise record. According to several previous studies, the results had been shown that these nutrition education tools and interventions improved the subjects' knowledge and majority of the subject was agreed positively with these developed education tools and the class educations activities [30,31]. Moreover, the result had shown a bit improvement of glycemic control in some subjects [31]. Additionally, Besuwan W. [148] discussed that nutrition printed material was also less complicated than intensive education, which might cause confusion to the patients with too much information and poor compliance overtime. Therefore, the print media was selected as an ideal medium for the tool as it was relatively cheaper, easily duplicated and could serve as a reliable source of information when needed by the users.

In the other hands, a very noticeable difference between the educational tools developed by previous studies and this current KINPORDEE website was a completely gathering the developed print media and adapting to a specific website applications for online self-learning. Therefore, it could be used as a reference self-help guideline by diabetes educators and patients. Similar to some part of KINPORDEE website development, Amanda C. et. al, [128] had developed the educational nutrition website which may be used by individuals with diabetes who are

learning carbohydrate counting skills. Moreover, the health care team can use to estimate patient's daily calorie need by entering individual's age, sex, and activity level and printing an individualized meal-planning worksheet for logging food choices with a registered dietitian. Although this worksheet does not specifically provide any details about which foods contain carbohydrates, it does emphasize balance and portion control. However, E-food photo gallery of KINPORDEE website was similar to the food gallery of MyPyramid website [128], which helps individuals gain a better understanding of portion sizes and features, especially to learn more effective in carbohydrate counting. Moreover, similar to E-daily intake record of KINPORDEE website, MyPyramid tracker tool is set up to track food choices by day. As both results, they can provide some benefits for patients to learn more about their food choices throughout the day and can also recommended daily calorie level, number of daily servings from each food group, and discretionary calories.

According to the American Diabetes Association's recommendation, KINPORDEE website can be used as a tool for diabetes nutrition education, ADA suggested that diabetes education is best provided with sensitivity with age and development of the child along with regard to the educational approach and content of the material delivered [39]. The contents of KINPORDEE website were consisted of general information about diabetes and self-help guideline to counting carbohydrate covered most of the recommendation and intervention for diabetes given by ADA and the basic carbohydrate counting guideline in diabetes clinical practice of Gillespie SJ, et al [18, 22-24, 87-90] All contents were discussed as a guide for type 1 diabetes patients to understand more about self-care diabetes management and encourage patients to choose their meal properly based on the carbohydrate counting concept. Besides, self-nutrition assessment application was designed to calculate subject's energy requirement based on their weight and height for further step in meal planning using carbohydrate counting. As modifying from Jampathed S. [31], E-glucose monitoring and record was developed to fulfill further step in the pattern management for the better glycemic control.

Despite all the benefits of web based learning, there are several negative aspects that may be encountered, including social isolation as the subject study alone, faculty members not providing individualized instruction for specific learning needs,

technical problems, and the use of technology for entertainment rather than education [110]. Therefore, KINPORDEE website created a web board and chat room for providing opportunities for communicating with researcher or health care team that should also be incorporated in the web-learning environment in order to offer subjects with accurate dietetics concepts and nutrition suggestion. Additionally, the relationship among the subject was also encouraged during a study period through these community systems.

However, there is no international consensus on the most appropriate tool for diabetes education, if the education tools are appropriate to the age of diabetics and can adapt to the needs of patients and family, it could be concluded that educational tool is advantage [149].

6.2 Effectiveness of the developed educational tool

The effectiveness of KINPORDEE website, an interactive multimedia website, in changing cognition, attitude, self-efficacy and food behavior in the area of the meal planning using basic carbohydrate counting was investigated. The study tested the hypothesis that subjects who completed a specific web-application, as an enhancement to the traditional self-help guideline of patients with type 1 diabetes, would evidence significant improvement in each factor compared to the baseline.

KINPORDEE website along with instruments designed to measure change in cognition, attitude and self-efficacy were developed and tested with 34 type 1 diabetic adolescents. This sample group participated with specific assignments and class practice for six periods. Self-learning through specific contents and exercise assignments during study period were recorded as knowledge score, daily carbohydrate choice intake, and online timing. Each practical activity score of the final class practice was also recorded. However, contents and activities in this study were covered the self-care diabetes and dietary management focusing on carbohydrate counting, but not including psychosocial issues to encourage behavior change during the study period that may cause no significant difference change in glycemic response.

The study findings were grouped into 5 categories for ease of discussion as follows;

6.2.1 Subject characteristics

Demographic characteristics of the subjects

This study considered gender, age, education level, region, and family status of 34 recruited adolescents with type 1 diabetes. Their age ranged from 12 to 19 years old, with mean age of 14.32 ± 2.34 years. The majority of the subjects were female (64.7%). The proportion of early adolescence (12-15 years) and lately adolescence (16-19 years) subjects in this study was 58.8% and 41.2%, respectively which was in accordance with the analyses of cumulative incidence rates study suggest that incidence is not increasing among young adults indicating rather a shift to a younger age at onset. However, the causes of these changes with time are unknown but the rapidity of the changes and the almost universally increasing trends in younger age groups are unlikely to be due to changes in the genetic background of the disease [1]. As the results of this study showed that the majority of participants were still young and studied in the primary school which may suggest that the prevalence of type 1 diabetes in Thailand is likely to be found in the early adolescence who need an intensive education for diabetes self-management closely [10].

The family factors, particularly dynamic and communication factors such as parental over-involvement and adolescent–parent concordance on responsibility for diabetes care appear to be important determinants of metabolic outcomes in adolescents with diabetes. Regarding to the family structure in this study, about 79.4% of the subjects' parents lived together and most of subjects (76.5%) lived with both father and mother. In term of the parent's education, majority of their parent had high education level. The result in this study, subjects who lives with both parents and they had high education level with being employed, had trend to be a good HbA1c control. As agree with the study of Cameron, T. et al, [150] has shown that both family structure (parents living together and father being employed) and family dynamics and communication on diabetes care are robust determinants of HbA1c in the adolescent years. Similar to the study of Graue M., et al. [151] revealed that 79.1% of the adolescents who lived with two parents and their parents who had moderate to high education level, had the tendency of better metabolic control. However, adolescents from divorced, separated and single-parent families in particular, appear to be most at

risk of poor metabolic outcome. Unfortunately, it is these aspects of family structure that are the most intractable and least amenable to intervention by health professionals.

For diabetes management, even though most adolescents can perform the tasks of self diabetes management, they still need some help from their parents for decision making about insulin adjustments. The study of Cameron FJ., et al. [150] confirmed that family factors, particularly dynamic and communication factors such as parental over-involvement and adolescent-parent concordance on responsibility for diabetes care appear to be important determinants of metabolic outcomes in adolescents with diabetes. Agree with this study, it was found that subjects who lived with two parents had the tendency of HbA1C reduction more than subjects who lived with single parent and relatives.

The economic impact of diabetes is considerable. Its costs affect health services, national productivity as well as individuals and families. In this study, regarding family monthly income, the both largest group (20.6%) had income a range from 20,000 to 29,999 baht and more than 50,000 baht per month similarly. Comparing the financial status of the subject's family with a reference data reported by Statistical Office 2007 [152], it was found that most of subject's parents income was higher than the average family income of 35,007 baht per month in Bangkok Metropolitan. In the other hands, about 14.7% of the subject's family income was less than 10,000 baht per month which lower than the average family income of 18,660 baht per month. The result of the study indicated that parent's income and occupation didn't not have an influence on their self-diabetes control. As agree with Geyer S. [153] revealed that education, income, and occupation class cannot be interchangeably as indicators of social inequalities in health. Although sometimes correlated, but they measure different phenomena and tap into different causal mechanisms. Correspond to the study of Isares C. **[**154] showed that blood glucose control was no significantly related with all socio-demographic factors and health status didn't show significantly relationship with blood glucose levels.

Besides, food habits were discussed. Most subjects had normally both 3 and 4 meals per day, and few of them had 6 meals per day, depended on their insulin injections. Their food patterns were mainly rice, bread, fried food recipes with lean meat and vegetable oil. Most subjects had often consumed green-leaf vegetables, some

milk especially low fat milk, but seldom consumed desserts and sweeten snacks. And most of them usually had at least 2 ladles of rice per meal. As the result, stated that most of type 1 diabetic adolescents in this study were always aware of kinds and amount of food intake. In the other hands, this awareness neither met concept of adequacy along with balance diet nor the nutrition recommendations particularly recommended carbohydrate goal [48].

Diabetes history and practice of the subjects

In this study, mostly 16 subjects (47.1%) had 1-5 years of diabetes duration; mean duration of diabetes was 5.76±4.18 years. Regarding self- monitoring of blood glucose, each subject had glucometer. About 25 subjects (73.5%) usually checked their blood glucose about 3-4 times per day, especially before dinner (88.5%) and before breakfast (84.6%), respectively. The evidence by the study of Renard, E. [155] found 1% significant change lower HbA1C in type 1 diabetes who performed self-monitoring blood glucose more than or equal to 3 times daily. Additionally, the previous study [44,156] noted that, the relationship between daily patient monitored blood glucose and HbA1c is very important and clearly defined to enable patients and health care providers to set appropriate daily preprandial glucose testing goals to achieve HbA1c levels representing low risks for adverse outcomes. Most subjects in this study (67.7%) had fasting blood glucose less than 130 mg/dl, with the mean of 123.56 ± 24.20 mg/dl preprandial blood glucose levels that correspond to the recommended of American Diabetes Association study (ADA) [44], patients with diabetes attempt to achieve average preprandial blood glucose levels of 90–130 mg/dl.

However, about half of the subjects had the mean baseline HbA1C 9.28 ± 1.53% that were higher than the American Diabetes Association recommendation and were grouped in the fair level. At the end of the study the mean HbA1C increased to 9.46 ± 2.33%. Similar to several studies have noted that the mean HbA1C level of the similar adolescent subjects by Jampathed S. [31] was 9.8±1.9% at the end of the study and consistency with the average HbA1C of 9.3±2.5% in Thailand Diabetes registry project study of Likitmaskul S.,et al [157] Additionally, Santiprabhob J., et al. [158] studied the etiology and glycemic control of Thai youth with type 1 diabetes and stated that the mean HbA1C was 8.9±2.1%. However, the DCCT study [16] reported that

HbA1C levels were decreased to only 8.1 ± 0.1% in adolescents who were under intensive management. The results indicated that it was very difficult in achieving targeted glycemic control in young patient. These studies showed that type 1 diabetic adolescents had fair glycemic control generally.

All over the study period, a final HbA1C in a good control subjects decreased to 3.6%, but surprisingly the final HbA1C increased 14.3% in subjects with very poor control when compared to baseline. There were a significantly different increase among the glycemic control level in baseline and in the final week ($p<0.05$) among very poor control subjects. Correspond to KICK-OFF study [102] which conducted 5 days training of carbohydrate counting and insulin dose adjustment training course for children and adolescents with type 1 diabetes aged 11-16 years. There were also no changes in HbA1C and BMI throughout the six month period. In contrast to Tatjana M. et. al, [159] that evaluated the possible influence of a structured teaching program for intensive group education of diabetic patients in one year after a 4-day structured teaching program, the result demonstrated that educational program improved overall well being and metabolic control significantly. In the other hands, the previous study of Santiprabhob J., et al [28], found that the mean HbA1C levels at pre-camp and post-camp were significantly decreased from 10.0 ± 3.1% to 9.0 ± 2.6%, respectively. As agree with this current study, HbA1C had a trend to decrease especially subjects who had good control (<8%) and poor control (> 10% and ≤ 12%). There were 20.6% subjects from baseline and 26.5% of subjects in the final week with the mean of HbA1C at baseline (7.29 ± 0.63%) and surprisingly at the end (7.02 ± 0.79%) that were ranged in the good control from the American Diabetes Association's recommendation (ADA). Moreover, there were 11.8% of subjects had HbA1C improvement more than 1%. These reductions of HbA1C every 1 % delayed the onset and slowed the progression of diabetic retinopathy, nephropathy and neuropathy in patients with type 1 diabetes [17].

When compared HbA1C according to glycemic control level in this study, it was found that about half of subject who had fair glycemic control (HbA1C 8-10%) had a trend to increase at final week. Interestingly, only one very poor control subjects (2.9%) who had HbA1C more than 12%, had a dramatic trend increase to 14.4% subjects with the mean HbA1C 14.4 ± 1.6% at the end with significantly difference

between baseline and final week. However, there was dramatically a reduction of HbA1C in 26.5% poor control group, mean baseline HbA1C (11.00 ± 0.61%) that decreased to 3.5% at final week. And 17.6% of poor control subjects had mean HbA1C (10.6 ± 0.4%) at final week. As agreement with Claresa S. et al [160], found that diabetes educational interventions do not result in a decline in HbA1c among all patients.

Children and adolescents are growing; their ability to participate in self-management of diabetes varies with changing motor development, cognitive abilities, and emotional maturation. In caring for the age-specific group, health care providers need to understand the different standards of care. However, the sociocultural factors from subject's peer pressure and family interaction had influence to the result of this study. As corresponds to Leonard J. [161] found that children and adolescents with type 1 diabetes often encountered conflict between maintaining their regimen and social acceptance. There was significantly more peer acceptable in a group of age 11–14 and 15–17 years than in the 8–10 group. And adolescents who deviate from strict adherence because of peer influence may be in the process of learning. However, if the deviations from strict adherence managed properly, it can help adolescents develop the ability to self-managed diabetes that go beyond medical outcomes (e.g., HbA1c, glycemic control, microvascular complications) which has been emphasized under different social situations.

Regarding to subjects' opinion about diet control, it was found that 73.5% of subjects did diet management to control blood glucose whereas 26.5% did not control their diet; the reason was given as family eating habit, peer pressure and lack of food choices. However, most subjects (76.5%) had hypoglycemic episodes about 1-2 times/week, mean lowest blood glucose was 55.88±10.69% mg/dl that may relate to their daily intake during a day.

When considering the subjects' opinions on diet and carbohydrate counting. There are not significantly differences between both groups of subjects who either learned (52.9%) or never learned (47.1%) about carbohydrate counting within 1 year. However, Swift PGF. [162], stated that health care educators engaged in education who are perceived by young people as being ‘‘motivating’’ may encourage greater adherence to therapy. This high level of motivation and enthusiasm in

educational intervention is likely to improve biomedical outcomes by itself. In contrast, those people who do not receive education or do not continue to have educational contacts are more likely to suffer diabetes related complications.

The baseline nutrition status of the subjects

The nutrition status of the subjects were assessed by weight for age, height for age and weight for height of the subjects, it was found that the most of them were within normal nutrition status (70.6%), which indicated that they had an appropriate weight and height with a normal growth. However, there were 6 subjects; only one male and 5 female begin obese (17.6%), whereas only one male subject were obese (8.8%). In addition, most of them also had poor diabetic control. Additionally, overweight subject was only one female (2.9%). The study found that almost three obesity subjects (8.8%) were more likely to consume excess caloric intake from snack and sweeten-drink during school. Others overweight and begin obese had tendency to consume high fat intake while sometimes carbohydrate intake was limited within the recommendation. Moreover, the result agreed with the study of Viboolyanont S. [162], suggested that adolescents with type 1 diabetes begin to neglect dietary management which they had well controlled in childhood because of peer pressure, they prefer fast foods and junk foods like other adolescents and trend to consume more calories and high fat intake as corresponding to the number of overweight and obese patients. Support to this study, Daly A. [163] stated that weight gain in type 1 diabetic can generally occurred following a numerous reasons including excess caloric intake after improving glycemic control, decreased caloric expenditure, and sedentary life styles. However, weight gain can be avoided through education and careful attention to therapy regimen. When compared the nutrition status of subjects in this study at the beginning and the end of the study defined by weight for height, it was found that there were no significant difference.

Dietary intake at requirement and different time points of the subjects

There was a significantly difference between subjects' mean dietary intake at baseline and requirements in both different age groups (Early and Late adolescents: age 12-15 years and 16-19 years). At baseline, the mean dietary intake of all subjects, were 1634.45 ± 310.5 and 1869.21 ± 441.17 kcal/day, respectively. And the mean dietary intake requirements of both age groups were 2114.14 ± 266.5 and 2265.71 ± 333.13 kcal/day, respectively. Moreover, the caloric distribution percentage (carbohydrate: protein: fat) of both age groups were 50.72: 19.56: 32.27 and 50.84: 16.88: 32.9, respectively which were ranged in the recommendation, but only fat distribution was inappropriate intake. In this study high fat intakes in childhood and adolescents have been linked to develop of 2.9% overweight, 8.8 % obesity and trend to be more subjects (17.6%) with a begin obese from the current study. As agree with Jampathed S. [31], the mean percentage fat intake at baseline was 33.87 ± 4.88 with 7.7% begin obese and 11.5 % obesity, especially some subjects (15.4%) who had trend to overweight in the end of the study. As correspond to previous study [164] showed that moderate fat intakes increased with age, as would be expected given increasing energy requirements. Similar to Chaturawit J. [30], this study found that some subjects usually consume commercial snacks and empty caloric drink during school time, whereas mostly consumed less carbohydrate intake but high fat intake such as fried food recipes after school and some meals. These results agree with Johns C, et al [165], found that the average of nutrient intakes among the adolescents type 1 diabetes subjects fell within the recommendation ranges but the high range of calories and fat was alarming. However, adolescents need sufficient nutritious foods to grow and develop normally, weight gain and increasing body size are normal components of this process growth [164].

Interestingly, there was a totally significant difference in the mean carbohydrate choices between baseline and requirements of early adolescent group with the mean of 13.55 ± 2.72 and 17.85 ± 2.60 carb choices/day. Similar to the late adolescent group with the mean of 15.79 ± 2.59 and 18.06 ± 2.57 carb choices/day, respectively. Moreover, there was also a totally significant difference in the mean protein and fat intake between baseline and requirements of early adolescent group and late adolescent group. As correspond to Gillespie SJ., et al [18] stated that once

carbohydrate counting was introduced for meal planning, patient might be lack of attention to protein and fat intake and usually emphasized on carbohydrate intake only. They might consume larger meat portion and this might be a reason of weight gain.

On the basis of at least 3-day nutritional intake at different time points were reported that the mean daily dietary intake in two difference age groups were significantly difference overall in their mean dietary requirement and no significantly difference at different periods. In different age groups, there was no significant difference among carbohydrate choices intake during a study period and also significantly different with their mean carbohydrate target ($p<0.05$). Daily protein intake and protein caloric distribution were significant difference from baseline to the final period ($p<0.05$). As agreement with Mayer-Davis EJ, et al study [166] that assessed dietary intake among a large cohort of youth with type 1 or type 2 diabetes, aged 10 to 22 years. The result showed that overall, dietary intake substantially failed to meet current nutrition recommendations and there is a critical need for improvement in dietary intake in youth with diabetes. Nevertheless, the overall results may be due to the under-reporting of intake through the helpful web based application, especially under estimating of food intake. Schoeller DA. [1678] had been suggested that up to one-third of the subjects under-report their energy intake by up to 25% The recommendation is that breads, cereals, rice, and noodles form the basis of a healthy diet, with 4–9 portions for those aged 9–13 years and 4–11 portions for those aged 14–18 years. As the study report, more than 70% subjects had rice only 2 ladles a meal and about half of subjects didn't have a snack times. And some subjects had under-report of fat intake for fried food recipes. Although, fats are important for growth and development, especially they are the most concentrated form of all the energy sources [164]. Interestingly, most of subjects in this current study usually had 2-3 portions of milk a day that lead to increase carbohydrate choices including the carbohydrate from main meal such as rice and bread. However, some of subjects stated that they usually aware amount of carbohydrate intake during a day due to the monitoring of blood glucose level result. However, these results could be only a trend for evaluating an overall intake pattern. Therefore, the individual physical activity and clinical treatment such as an insulin dosage adjustment with meal time might cause to the overall presented results.

This nutrition education provides the knowledge of carbohydrate counting concepts and meal planning. Especially, evaluating portions size and practicing in daily food intake skill for achieving blood glucose goals and improved normal growth and development. However, according to the study result, it was found that the subject couldn't reach daily intake requirement. Corresponded to Courtney L. et, al. [168], found that neither nutrition knowledge nor attitude correlated with dietary intake. Moreover, the knowledge was less than 1% predictive of dietary intake. These conflicting results have been reported for athletes regarding relationships between nutrition knowledge and dietary intake and thus concluded that runners with greater nutrition knowledge make better food choices. In contrast to previous study [160] that provided the intensive education of diabetic patients in 4-days and follow up to one year, the result indicated that patients' energy intake score had significantly improved one year after education. However, this current study had only six weeks to follow up subjects' intake. Therefore, this current study should take a long period to follow up and evaluate results to achieve an individual energy intake requirement in the advance.

6.2.2 Subject's knowledge and understanding of diabetes of meal planning using carbohydrate counting concept during the Pre-Test and Post-Test: KAP

The results of this study have evaluated the learning effects by determining of the KAP Pre-test and the Post-test before and after using the developed educational diabetes website. It was found that most subjects (52.9%) had moderate knowledge level; the mean pre-test and post-test score from total 30 scores were 20.65 ± 4.34 and 25.06 ± 2.98, respectively. The pair-comparison indicated a significant difference between these two tests ($p<0.01$) about the learning effects of this educational diabetes website. The result from Post-test showed that most subjects (76.5%) improved their knowledge and understanding with high knowledge level. The majority of the subjects learned very well about definition, sign & symptom of diabetes, their self-responsibility and its complication. The practical knowledge of diet control and diabetes self-care also learned very well. Interestingly, the most subjects (91.2%) got good level about the knowledge of diabetes attitude. This result is indeed better to have a positive attitude towards diabetes. Similarly, the findings by

Patchareeporn P. [169] showed that high diabetes knowledge improved a positive attitude towards diabetes through having received diabetes knowledge information with statistical significance ($p<0.01$). Therefore, this study result indicated that this developed educational diabetes website was able to increase subject's knowledge and understanding of diabetes self-care and meal planning using carbohydrate counting. This is support by the study of Chaturawit C. and Jampathed S. [30,31] which developed educational tools for self-help meal planning. Most subjects had "moderate" level in Pre-test knowledge of carbohydrate counting and mostly had "high" level for the Post-test after using the developed educational tools. And there were significant different between the score of the subject's knowledge ($p<0.05$) when compared the score of subject's knowledge at Pre-test and Post-test.

Regarding the related factors involved the subject's knowledge toward diabetes and dietary knowledge for self-care management. The subject's Pre test knowledge level, did not differ significantly compared to sex, diabetes duration and diabetes diet education experience within 1 year. Whereas, there were no those related factors involved their knowledge level at the end of the study.

Improved self-efficacy scores were reported for type 1 diabetes subjects following the use of KINPORDEE website. Especially, the mean knowledge level had significantly improved in subjects who studied in primary and secondary school and who had 1-5 years diabetes duration. The knowledge improvement was also observed in subjects either ever learn or never learn about diabetes diet education experience in 1 year following the completion of diabetes educational website. In contrast with Laigden D. [29], found the subjects whose education level was up to the high school or less. They didn't have the significant increase in knowledge for the Pre-test and Post-test of diabetes, carbohydrate counting score.

Subject's knowledge of carbohydrate counting from weekly E-exercise assignments

There were four assignments to evaluate subject's knowledge and understanding of diabetes and dietary self-care. Most subjects had a median level of knowledge score. For the first assignment, the data showed that most subjects could make correct choices about general diabetes knowledge and self-management in a

medium level with the mean of 65.14 ± 15.10%. However, in the second assignment, subjects were not only capable of identifying carbohydrate food, but also be able to apply food reference list for carbohydrate counting. Most subjects improved in making judgment on their food choice with the mean of 62.24 ± 17.26%. The third assignment, about half of subjects not only have the ability for estimating portion size, but also is able to make better food choice for meal planning with the mean of 67.94 ± 16.84% in the moderate knowledge level. However, only few subjects had low knowledge level in estimating portion size and meal planning. Additionally, in the last assignment, most of subjects also had moderate knowledge level in carbohydrate counting for eating out and meal planning. The mean assignment score for the last assignment was 59.50 ± 16.38%. Only 6 subjects were able to make better food choice when eating out. Most subjects still could not improve in making judgment on their food choices. Most subjects were unable to improve their learning to high level in all assignments. As agree with the study of a practical diabetes class education, Bunnag A, et al. [32], found that patients still lack of the basic nutrition knowledge and most of patients could not adjust the appropriate dietary and energy for their own meal plan for achieving the optimal blood glucose level. The class education should provide more frequent to the children and adolescent with type 1 diabetes. In contrast with Jampathed S. [31], more than half of subjects had high mean scores of knowledge about the carbohydrate counting concept from homework assignment each week. However, this study suggested that the class practice with a diet counseling using carbohydrate counting to improve the glycemic control had an effectiveness to improve their knowledge level during study.

6.2.3 The accuracy in subject's perception and conceptualization in meal planning using carbohydrate counting skill

Accuracy in carbohydrate counting knowledge from weekly E-exercise assignments

From a practical perspective, the findings from this project suggest that most diabetes adolescents had medium knowledge level for meal planning using carbohydrate counting skill. By evaluating their perception and conceptualization in

meal planning, there were four assignments included final class practice. Most subjects had slightly improved their knowledge score during the study period. For the first assignment, the data showed that about half of subjects could make accurate choices about the self-nutrition status in a median level. However 10 subjects were in low knowledge level and unable to make accurate choices for their nutrition status. The mean of this assignment score among subjects was 59.00 ± 15.28%. In the second assignment, over half of subjects had a median knowledge level about diabetes and carbohydrate counting and similar to the first assignment, 10 subjects were grouped in low knowledge level. Additionally, the third assignment, not only subjects were capable of identifying carbohydrate food for food mixed dishes, they were also able to counting carbohydrate for eating out. Most subjects had medium knowledge level and 8 subjects improved to high knowledge level, while less subjects with low knowledge level were dropped to 7 subjects. The mean assignment score for the third assignment was 64.26 ± 16.84%. The results of this study indicated that cognitive performance could be improved with effective educational intervention. However, one of major problems with internet-based learning is the isolation that subjects feel from their instructors and ineffective methods for dialog. This kind of communication helps to some extent but lacks the visual cues and facial expressions that convey messages of understanding, or lack of comprehension, of questions and responses between the student and instructor. [170]

The current study suggested that subjects should be empowered to enhance their learning process in a synchronous environment with the health care educator or face-to-face contact through this developed educational diabetes website. They may have a better understanding in the specific details. A weak point of this study was the fact that it was a non-randomized, uncontrolled study, thus this study was not able to demonstrate the net effect of this diabetes educational website.

Accuracy in carbohydrate counting knowledge for class practice

The assessment of accuracy in subject's perception and conceptualization in carbohydrate counting had achieved by evaluating subject's ability in estimation of sample foods and counting carbohydrate for the class practice. The results of this study indicated that cognitive performance could be improved effective educational

intervention with class activities and a good support from health care team. Significantly a larger positive gain in cognition of subjects was evident at all class activities. The subjects performed very well on cognitive items addressing the self-nutrition assessment and meal distribution for setting proper meal plans through KINPORDEE application, with the mean 91.76 ± 14.24% and 90.59 ± 16.13%, respectively. Besides, the subjects also well performed for self-estimating of various food portion sizes and calculating carbohydrate choices with the mean 76.03 ± 24.08%. However, the observation of these activities revealed that instructor should guide subjects to apply self-estimating of food portion sizes skill for carbohydrate counting for correct responses with regard to their self-dietary management.

Activities for estimating various food portions sizes to figure carbohydrate choices indicate that most subjects successfully achieved their learning goal in a medium level. More than half of subjects had high accuracy level for the self-estimating portion size and counting carbohydrate of starch and vegetable food items. The mean test score for estimating of both food groups was 2.56 ± 0.56 and 2.06 ± 1.23, respectively on a 1-3 scale. However, there were only 2.9% subjects who had low accuracy level for estimating starchy food items, whereas 23.5% subjects were similar in low and median accuracy level. However, some subjects were unable to estimate portion size and evaluate carbohydrate choice in selected vegetable items. Surprisingly, most of subjects (82.4%) had high accuracy level for counting carbohydrate of carbohydrate products nutrition label, the highest mean test score was 2.68 ± 0.77. Most subjects were able to evaluate carbohydrate choice in given products with nutrition label and also count carbohydrate included other food groups to design dietary plan on a nutritional basis. Moreover, most subjects (61.8%) had medium accuracy level for counting carbohydrate in fruit items and the remaining subjects had high accuracy level. However, there were no subjects with low accuracy level for this food group. The mean test score for estimating of this fruit items was 2.38 ± 0.49. For one plate dish and others carbohydrate food items, most subjects (52.9%) had medium accuracy level with the mean test score of 2.00 ± 0.92.

These results showed that the developed educational diabetes website could be the online self-learning tool to improve the subject's accuracy in describe the food containing carbohydrate and identify carbohydrate choice. In agreement with the

above mentioned results, subjects should have to learn and encourage for more online self-study. However, provision dietary class activity by the health care team, addition to the educational tool was also the most important together with the educational tool.

Subject's perception and conceptualization in actual meal planning and carbohydrate counting by assessing weekly food intake record

The accuracy in subject's perception and conceptualization in actual meal planning and carbohydrate counting were individually assessed at least 3-day food intake records in each week to evaluate the subject's diet compliance in corresponding to carbohydrate goal**.** The findings in this pilot study indicated that most adolescents with type 1 diabetes did not consume appropriate carbohydrate intake and either over- or under carbohydrate goal intake for their regular meal pattern. The result indicated that subject's actual carbohydrate choices at different time points were significantly lower than in their mean carbohydrate goal ($p<0.05$). At baseline, most subjects (88.2%) had under carbohydrate goal intake and remaining subjects had over carbohydrate goal intake, whereas no one had an achieved carbohydrate intake. The mean carbohydrate goal was 18.06 ± 2.57 carbs choices. However, the majority of subjects had under carbohydrate intake in each week. And the number of some subjects who had achieved carbohydrate intake slightly increased from week 1 to 3, but finally decreased at the end of the study. The only 4 subjects who had over carbohydrate intake were still the same percentage as baseline but increased to 7 subjects in the final week. Nevertheless, there was no statistically significance in the carbohydrate correspondence from baseline and the end of the study. These results indicated that most subjects still consumed carbohydrate intake less than their carbohydrate.

Similar to Laigden D. [31] study, presented that the overall carbohydrate goal of mostly type 2 diabetes subjects still remained at a low accuracy level in all study period and indicating that these subjects still consumed more than their carbohydrate target. Correspond to Franziska K. et al. [47] that assessed carbohydrate counting accuracy in type 1 diabetic patients, reported that and only included nine adult patients. There were a correlation data between patient and nutritional software–assisted evaluation of carbohydrate content of meals and found 85.2% of participants'

carbohydrate evaluation was within 15% of the computer-assisted carbohydrate assessment.

In agreement with the Chaturawit J. [32], the subjects had a moderate skill in the diet compliance in corresponding to carbohydrate goal. Most type 1 diabetes subjects (95%) had usual carbohydrate intake less than carbohydrate goal. Only one of them (5%) had usual carbohydrate intake higher than carbohydrate goal. However, the 4 day intake records of subjects were taken from only one week that did not predict the accuracy of carbohydrate counting from week to week.

In this study, subjects worked through the website unsupervised and at their own place. E-PORDEE daily intake record allows subjects to submit their daily food record and assess their own nutrition status according to their daily food intake at least 3 day weekly. (Figure 14) Most subjects reported average record 2.00 ± 0.86 times per week. Most subjects tended to spend more time during a final week due to the phone and e-mail encouragement once a week. Most subjects (76.5%) were grouped in the medium level of diet compliance. Subjects could review the previous intake record corresponding to the previous study [127] presented that the subjects can retrieve the information previously stored when requested to review. However, subjects need more encouragement to promote daily intake record through the web-system. It is useful to have web reminders or specific links to get through that web application directly.

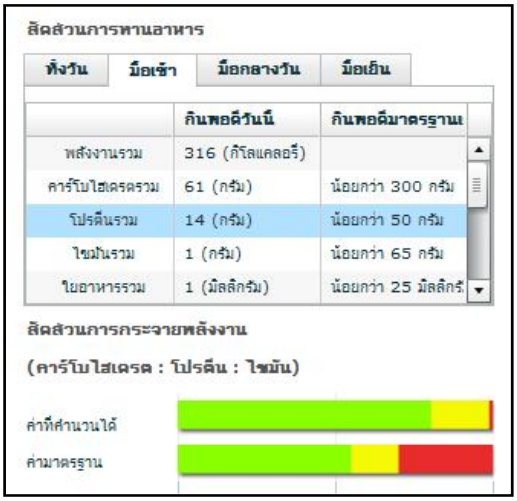

Figure 23 A feedback screen that follows the daily food record activity. Once subjects selected food items, KINPORDEE website provided feedback about the nutrient evaluation.

When comparing a corresponding of carbohydrate intake with HbA1C during the study period, there were no correlation between subject's carbohydrate goal

and diabetes nutritional website–assisted evaluation of carbohydrate content of meals. The previous study of Franziska K. et al. [47] indicated that the correlation between type 1 diabetes adolescents with accurate (within 10 grams) carbohydrate assessment had the lowest HbA1C values, and this was statistically significant for the dinner meals. In the other hands, adolescents who overestimated the carbohydrate grams at dinner time had the highest HbA1C values. However, the study result showed that 12 and 18 subjects were in the group of HbA1C improvement < 1% and no HbA1C improvement group, respectively. Only 4 subjects had good glycemic control and medium diet compliance level with HbA1C reduction ≥ 1%. However, most subjects (61.5%) who had median diet compliance with no HbA1C improvement. In the other hands, there were no subjects with HbA1C improvement ≥ 1% who had high diet compliance, but most subjects (75%) who had high level of diet compliance have a little change in HbA1C reduction < 1%. Moreover, the result stated that only subjects who had 1 to 5 diabetes duration had the HbA1C improvement ≥ 1%. In addition, subjects who had never learned about diabetes diet also had ≥ 1% HbA1C improvement.

As agreement with the results, the previous study of Franziska K. et al. [47] was cross-sectional study and only observed at a one-time measurement of carbohydrate counting accuracy and HbA1C improvement, both of which can change over time due to multiple factors. Better understanding of these relationships is needed to improve clinical care of youths with type 1 diabetes. Moreover, Uitewaal, et al [171] had studied in Turkish with type 2 diabetes to assess the effect of ethnic-specific diabetes education on glycaemic control. Compared with the control group, mean HbA1c in the intervention group decreased by 0.3%. A significant decrease in HbA1c was observed only in women with HbA1c >7% at baseline. Serum lipid concentrations, blood pressure and body mass index remained unchanged in the intervention group. The results indicated that the educational approach has no clear effect on glycaemic control or cardiovascular risk factors.

6.2.4 Subject's diabetes self-management attitude

Attitude improvement was measured in adolescent with type 1 diabetes following nutrition education. Improvement was also reported for attitudes toward

diabetes self-care management following the online education and class activities to promote dietary knowledge and diabetes community through KINPORDEE website. It was noticed that over half of the subjects (58.8%) had median attitude level before using diabetes educational website. The mean pre-attitude score for all subjects was 74.71± 7.14%. At the end of the study, most subjects (64.7%) had high attitude level, whereas the mean post-attitude score increased to 79.41 ± 7.72%. This current study shows that most subjects had a high attitude level toward diabetes self-care management, even there were no significant change between pre and post attitude test. Correspond to the previous study of Franziska K. et al. [45] which was noticed significant improvement in overall well-being significantly. This improvement was due to reduction in depression, anxiety. Moreover, energy intake and well-being increased significantly at the end of the study.

Regarding the related factors involve the subject's attitude toward diabetes self-care management. Both subjects' attitude tests, which did not differ significantly by sex and diabetes duration. The mean attitude level had a significantly difference in the education level, especially subjects who studied in the secondary school and high school or higher level. Moreover, the diabetes diet education experience in 1 year was also the one factor involved the significantly attitude difference among diabetes subjects.

Additionally, attitude along with knowledge and self-efficacy plays a part in behavior change. Several studies have reported positive attitude change following education. Finally, positive attitude change was measured in adolescent with diabetes following web based nutrition education [170,172] However, this current study was noted a similar change occurred in subjects with all categories of diabetes duration indicating that other factors rather than the intervention probably were responsible for attitude change.

However, it is interesting to note that some negative attitude were improved at the end of the study such as "feel unconfident when parents or doctor asked about the blood glucose level", and "meal planning to meet dietary goal when eating outside is hard and difficult". However, most subjects may have decided that in spite of the negative attitude offered, they could "learn better." This was similar to the study of Anun and Peter [173], that evaluated the effectiveness of a computer

based learning (CBL) program in diabetes management which reported that overall results of user's attitudes on CBL program were in a positive range.

KINPORDEE administration was designed to record the subject's average time on site with an expectation that subjects would spend at least 3 hours per week. However, it was reported that most subjects spent average 1.98± 1.19 hours per week. And most of subjects were grouped in a moderate website compliance level. The most frequent applications were daily intake record, exercise record and public library, respectively. Interestingly, there were 6 subjects who reported spending more time working through KINPORDEE website, had a greater improvement in cognitive and attitude scores. A noticeable difference is seen in time on task and post test scores for completing self-online learning programs. Moreover, all of these subjects had also the greater improvement in glycemic control after the study period. Agreement with the above results, the study of Lina Lee, [174] reported that most students spent 45 minutes or less per module. It indicated that time on task positively correlated with cognitive change scores and also have a difference in time on task and post test scores for each of these programs.

6.2.5 Subject's overall satisfaction with the multimedia diabetes educational website

Related to the overall subject's satisfaction with the developed diabetes educational website for dietary self-care, especially carbohydrate counting, the five point scales were used to determine the subject's level of satisfaction with the developed diabetes educational website. The satisfied responses were assessed on many aspects such as website content, website format, ability to use and enhance self-learning and website motivation. All aspects were focused on self-learning about meal planning using basic carbohydrate counting concept and motivated to completed exercises and daily food intake record. The satisfaction level was indicated between "Extremely satisfied" to "Extremely dissatisfied". Most subjects were satisfied with this developed diabetes educational website. Most subjects (64.7%) had concluded that KINPORDEE website was very easy to learn and understand language. Moreover, it had the appropriate content arrangement that was suitable with their age. Especially,

the color theme and web mascots are very attractive and colorful. Moreover, subjects were mostly satisfied in all aspects ranging from very satisfied to extremely satisfy.

However, there was a comment on the daily food intake record that the font size should be bigger and some subjects did not like to re-password before getting through this application. Some subjects stated that the food pictures demonstrating showing the amount of specific food sources per serving could be easily related to their food intake selection as the actual food portion sizes. They stated that it was very helpful for learning with pictures and was much easier than just showing the number of grams per serving. Most subjects anticipated more pictures and did not agree to read textual information as the only visual information. Some subjects recommended that this website should have more flash applications to be more attractive. However, a few subjects had problem about the speed of presenting content and pictorial information was also a main concern among subjects. Some felt impatient toward the waiting time of loading up food images because of their web browser and internet speed limitation. However, few subjects complained that the content of discussion was “so long” and consumed too much time. Some subjects were too timid to voice their opinions on the web board. Some subjects would prefer reading the information in the discussion board to expressing themselves even though they could choose to remain anonymous.

For subject’s learning responses, some subjects commented that the online assignments encouraged them to apply what they learned in the instruction to practice in their daily life, especially self-help meal planning. These task-oriented assignments encouraged them to go through the diabetes knowledge in greater detail, because they had to gather sufficient knowledge to answer the problem tasks given. Moreover, they stated that E-food photo gallery and E-food exchange list were the best diabetes food resource to improve their knowledge for making a proper meal plan. Most subjects stated that the knowledge and useful applications in KINPORDEE website could improve and confirm their knowledge of diabetes self-management. However, some subjects and their parents had recommended that this website needed to promote and encourage others members to join web board which was the best way for sharing experiences among diabetes community. As correspond to Chaturawit C.[30] and Jampathed S.[31], most subjects were satisfied with the overall in “very good” level in

both developed booklets and a face-to-face class activities about meal planning using basic and advance carbohydrate counting, respectively.

Additionally, some subjects preferred having personal feedback from the developed diabetes educational website such as automatic score report, and bulletin board. In the other hands, some subjects preferred having personal feedback through a chat system, e-mail and phone. Most diabetes parents were interested in KINPORDEE class activities. They stated that this kind of useful activities should be organized every 2-3 months to remind their children about diabetes and dietary self-care. Bunnag A, et al [32] had also agreed with the above mention tools and educational program. Several subjects posted that nutrition education class was very useful and hoped to join with the other type 1 diabetes adolescents for the next set up. Some subjects commented that the nutrition education class make them learn healthier eating with a proper carbohydrate portion. Moreover, subjects also learned very well about the causes of hypoglycemia and hyperglycemia. These data show that nutrition tool and nutrition education appropriate to the age of subjects and their needs. Some studies have shown no significant differences between classroom and distance education and high overall levels of satisfaction from subjects [175].

For the study's suggestion, to accomplish overall better outcome through online self-learning with KINPORDEE website, the subjects should often access through the site and its applications. They should be encouraged to take more time on self-learning together with completion of practical exercises. Moreover, the subject's diabetes knowledge needs to extend to more resources available in the internet. More effort should be made to encourage the use of resources and online interaction for better result in online-self learning. For a better online self-efficiency, the previous study of Chi-Yuan C. et al. [131] had suggested that e-services should be listed together on the front of the homepage and highlighted. It is suggested that learners can use the instrument developed in this study to select the best system for self-study, without being dispirited to further save time and to improve knowledge and skills needed for self-learning.

CHAPTER VII
CONCLUSION

This study involved the development of the multimedia diabetes educational website for self-help meal planning in type 1 diabetic children and adolescents using basic level of carbohydrate counting concept and evaluating the effectiveness of the developed diabetes educational website in term of knowledge and attitude improvement, accuracy in perception and conceptualization of basic carbohydrate counting, and the subject's satisfaction with the developed diabetes educational website.

KINPORDEE website, the multimedia diabetes educational website was developed according to the main purpose. KINPORDEE website which included the overview of general information about diabetes self-care management, self-help guidelines for meal planning using basic carbohydrate counting with many applications such as e-food photo gallery, e-food exchange list, e-exercise, e-daily intake record and e-glucose level monitor and record. KINPORDEE website included many interactive activities that provided the subjects with opportunities to learn whether they had accurately learned the information presented and to practice skills in applying that information. For encouraging a specific diabetes community, there were two useful menus such as e-web board and e-chat room that is one option to contact with the health care team and other members.

The effectiveness of this diabetes educational website was assessed with 34 type 1 diabetes adolescences within 6 weeks to improve carbohydrate counting knowledge and skills. Most of them (70.6%) had a normal nutritional status with 2.9% overweight, 17.6% begin obese and 8.8 % obesity. Interestingly, about half of subjects had learned about diabetes and dietary self-care, especially the basic carbohydrate counting within 1 year and another half had never learned before. The nutrition education was applied to these subjects in term of interactive learning which included learning with exercise practices, exercise assignments, and joining the class activities.

The results show that the subject's knowledge and attitude for diabetes and dietary self-care management were improved at the end of the study. The majority of subjects had a better understanding about general information about diabetes and self-care management (diabetes cause and definition, signs and symptoms of diabetes and its complications and insulin action). They also had good practice knowledge about self-monitoring blood glucose (SMBG) and behavior modification for improving diabetic control. However, this knowledge improvement was not significantly difference in the subjects who were in the high school or higher, and subjects who had more than 6 years diabetes duration. Regarding to the attitude knowledge for diabetes self-care management, the majority of subjects improved their attitude knowledge at the end of the study. The results of this study indicated that cognitive performance could be improved with effective educational intervention. Interestingly, the significantly increase in carbohydrate counting score was affected by the final class practice because some subjects had reviewed the important topic before the class that was the results by both website and phone reminder. Class activities contributed to improve nutrition knowledge for diabetic subjects. They stated a positive response and preferred a further class practice.

The subject's daily intake record was used to determine the subject's compliance with an appropriate meal to achieve the nutrition requirement, especially the carbohydrate goal. The result indicated that most subjects could not achieve their carbohydrate goal and the energy requirement at the end of the study, especially in a normal weight subjects. The related factors might be an awareness of hypoglycemia according to their experience report and underreport/estimate of their intake through this web application. As a result of this study's findings, suggest that further research should explore factors other than nutrition knowledge and attitude that influence dietary intake among diabetic subjects, since knowledge and attitude were not found here to be primary factors impacting dietary intake. However, the effectiveness of this diabetes educational website was evaluated on glycemic control that mostly found in 11.8% of subjects who had 1-5 years diabetes duration with more than 1% HbA1C improvement. And they also had the moderate level of diet and website compliance.

Majority of subject indicated their satisfaction level ranking from "very satisfied" to "extremely satisfied" in all aspects according to the developed diabetes

educational website. Overall satisfied results indicated that this diabetes educational website provided the subjects many opportunities to attain performance accomplishment and thereby succeeded in improving self-efficacy. Moreover, some subjects and their family were interested in the distance learning and the extra class activities. As a practical suggestion, although this diabetes educational website was developed to provide basic knowledge and understanding of carbohydrate counting for self-help meal planning, however the family and health care professionals should maintain some guidance and supervision in the management of diabetes for children and adolescents. In addition, in order to provide appropriate interventions with effective diabetes educational website, the extra group meeting or telephone contact as available are still needed to be ongoing and finally reach the objectives.

In conclusion, KINPORDEE website fulfills its intention to improve knowledge and the attitude. However, this website can be effective when used appropriately in the diabetes self-management education process. It had a positive effect on self-efficacy and self-motivation to improve a bit of glycemic control in some subjects. Even the intervention was not taken a role in this study, only educational website could not significantly improve glycemic control and achieve carbohydrate goal of most subjects, but at least it could encourage them to concern on their healthy eating with the good attitude that might effect to decrease HbA1C in some subjects. Moreover, many factors affect glycemic control of the subjects. The study showed that not only online self-learning would be improve glycemic control in some subjects but also diabetes duration and subject's compliance on carbohydrate counting were significantly related to the reduction of HbA1C.

Recommendations for the further study

1. A follow-up evaluation would be conducted for the long-term effect of educational website including with a larger sample size; collect data on subject's postprandial glucose level, and their daily glucose variability; and include consideration of other important factors to glucose control, such as physical activity and dietary factors other than carbohydrate intake.
2. The advance carbohydrate counting should be conducted for the further study in order to get usefulness in carbohydrate counting approach,

especially in type 1 diabetes patients who seek matching insulin dose with the amount of carbohydrate consumption for a better glycemic control.

3. The comparative study of the different groups, either distance learning or class learning group in order to compare the result for improving the diabetes self-management education process.
4. This diabetes educational website for self-help meal planning using basic level of carbohydrate counting may be applied to study in adults who have type 1, type 2, and gestational diabetes, in order to widely provide the effective educational material to Thai diabetic patients.

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APPENDIX

APPENDIX A

Documentary proof of ethical clearance committee on human rights related to researches involving human subjects

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
ถนนพระราม 6 กทม. 10400
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Documentary Proof of Ethical Clearance Committee on Human Rights Related to Researches Involving Human Subjects Faculty of Medicine, Ramathibodi Hospital, Mahidol University

No MURA2007/342

Title of Project	The Effectiveness of Diet Counseling Using Carbohydrate Counting on Blood Glucose Control in Type I Diabetic Adolescents
Protocol Number	ID 08 – 50 – 15
Principal Investigator	Dr.Sunard Taechangam
Official Address	Division of Human Instrition Institute of Intrition Mahidol University

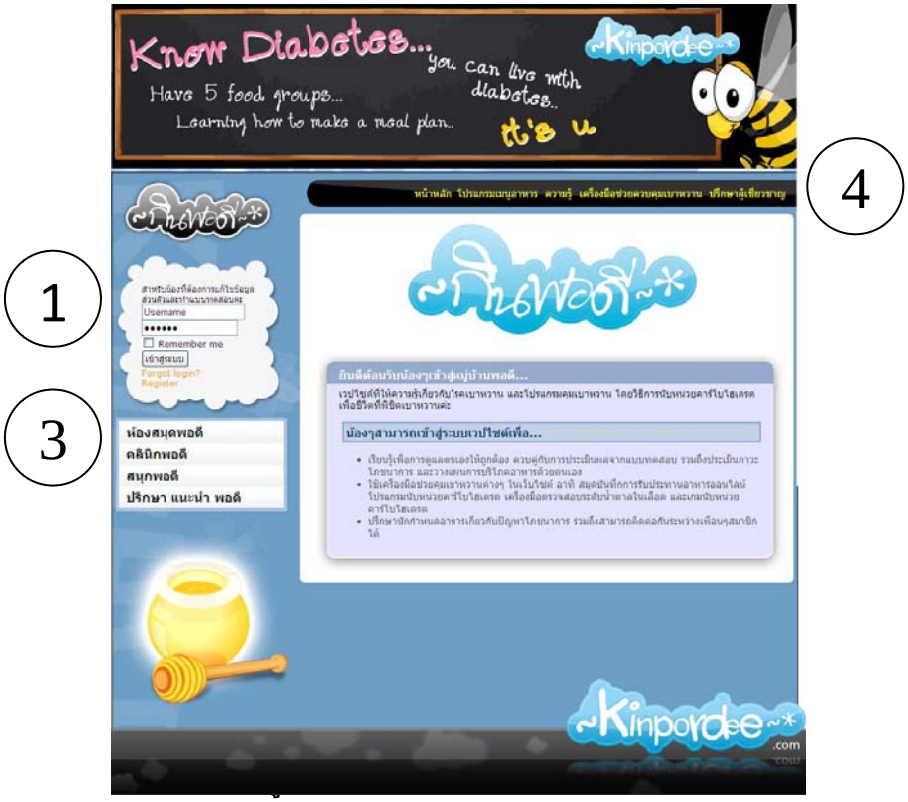
The aforementioned project has been reviewed and approved by Committee on Human Rights Related to Researches Involving Human Subjects, based on the Declaration of Helsinki.

Signature of Secretary Committee on Human Rights Related to Researches Involving Human Subjects	..... Assoc. Prof. Duangrurdee Wattanasirichaigoon, M.D.
Signature of Chairman Committee on Human Rights Related to Researches Involving Human Subjects	..... Prof. Boonsong Ongphiphadhanakul, M.D.
Date of Approval	November 22, 2007

APPENDIX B

คู่มือการใช้งานระบบ KINPORDEE

1. หน้าจอเว็บหลัก พิมพ์ www.kinpordee.com จะปรากฏหน้าจอเว็บไซต์ดัง รูปที่ 1



จากรูป 1 อธิบายได้ดังนี้ เมื่อเข้าสู่ระบบ หน้าจอแรกจะเป็นหน้าจอหลักในการทำงาน ซึ่งแบ่งออกเป็น 4 ส่วน ดังนี้

หมายเลข 1 ส่วนของการล็อกอินเพื่อเข้าใช้งานระบบ โดยกรอกชื่อผู้ใช้งาน และรหัสผ่าน

หมายเลข 2 ส่วนของเมนูหลักของเว็บไซต์ประกอบไปด้วย ห้องสมุดพอดี คลินิคพอดี สนุกพอดี ปรึกษาแนะนำพอดี

หมายเลข 3 ส่วนของเมนูลัดที่เข้าสู่ระบบ หน้าหลัก โปรแกรมเมนูอาหาร ความรู้ เครื่องมือควบคุมเบาหวาน ปรึกษาผู้เชี่ยวชาญ

หมายเลข 4 ส่วนของข้อความแสดงการต้อนรับการเข้าสู่เว็บไซต์กินพอดี

การสมัครสมาชิก

1. การสมัครสมาชิด กดปุ่ม Register จะปรากฏหน้าจอดังรูป ที่ 1

รูปที่ 1 หน้าจอการกรอกรายละเอียดการสมัครสมาชิก

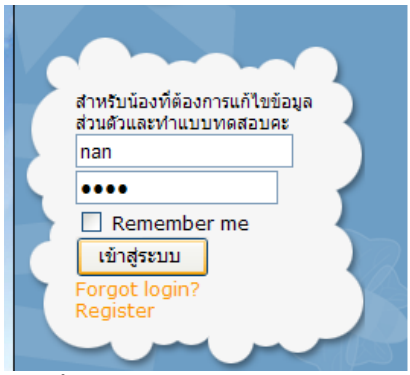
ผู้ใช้งานทำการกรอกรายละเอียดทั้งหมดดังที่ปรากฏในหน้าจอ เมื่อกรอกรายละเอียดเสร็จทำการกดปุ่ม Register

2. เมื่อกดปุ่ม Register เรียบร้อยแล้ว จะปรากฏหน้าจอ ยืนยันการสมัครสมาชิก

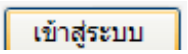
3. ผู้ใช้งานเปิดเข้าเมลที่ใช้ทำการสมัครสมาชิกเพื่อทำการยืนยันอีกครั้ง

การล็อกอินเข้าสู่ระบบ

1. ทำการกรอกข้อมูล ชื่อผู้ใช้งาน และ รหัสผ่าน ดังรูปที่ 1

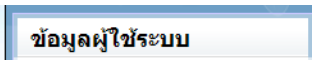


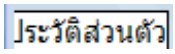
รูปที่ 1 หน้าจอการล็อกอินเข้าสู่ระบบ

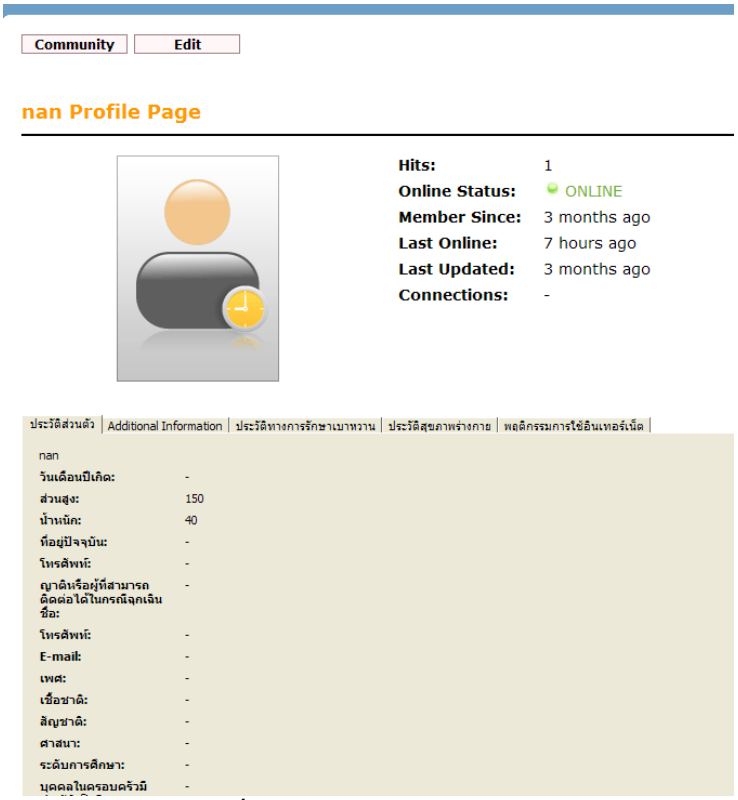
2. จากนั้น กดปุ่ม 

จาปรากฏหน้าหลักของการใช้งานดังรูปที่ 2

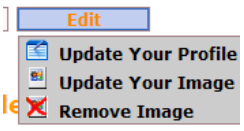
รูปที่ 2 หน้าจอหลักหลังจากล็อกอินเข้าสู่ระบบ

3. เมนู  ประกอบด้วย เมนูย่อยหลักๆ 3 เมนูย่อยดังนี้คือ ประวัติส่วนตัว ดูผลคะแนนการสอบรวม

กดปุ่ม  จะปรากฏหน้าจอดังรูปที่ 3



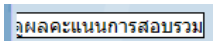
รูปที่ 3 รายละเอียดประวัติส่วนตัว

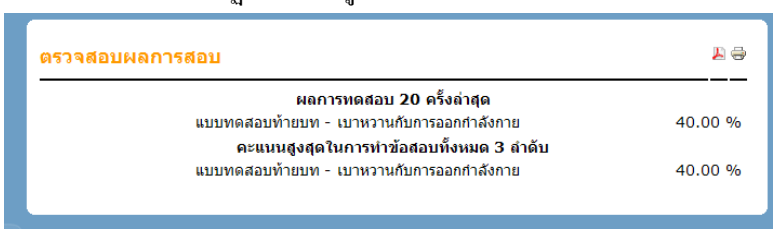
ประกอบไปด้วย แถบรายละเอียดข้อมูล 5 แถบด้วยกันคือ **ประวัติส่วนตัว Addition Information ประวัติทางการรักษาเบาหวาน ประวัติสุขภาพร่างกาย พฤติกรรมการใช้อินเตอร์เน็ต** โดยผู้ใช้งานสามารถแก้ไขข้อมูลส่วนตัวได้ด้วยการกดปุ่ม  ซึ่งการแก้ไขมี 3 รายการด้วยกันคือ

Update Your Profile คือ แก้ไขข้อมูลประวัติส่วนตัว

Update Your Image คือ การเปลี่ยนรูปภาพตามที่ต้องการ

Remove Image คือ การลบภาพที่ต้องการ

เมนู  จะปรากฏหน้าจอดังรูปที่ 4

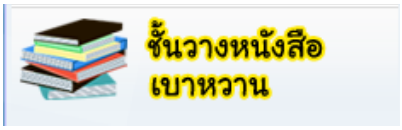


รูปที่ 4 หน้าจอ แสดงผลสรุปคะแนนการทำแบบทดสอบ

เมนู ายชื่อสมาชิกในระบบ จะปรากฏหน้าจอดังรูปที่ 5

รูปที่ 5 หน้าจอ แสดงผลรายชื่อสมาชิก

4. เมนู **ห้องสมดพอดี** ประกอบไปด้วยเมนูย่อยดังต่อไปนี้คือ

4.1 

คือ ส่วนของการแสดงเนื้อหาที่เกี่ยวข้องกับข้อมูลเบาหวาน ดังนี้

4.1.1

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 6

รูปที่ 6 เนื้อหา เบาหวาน โรคคุ้นหูที่ไม่ธรรมดา

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

4.1.2 เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 7

รูปที่ 7 เนื้อหา สาเหตุและอาการของเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

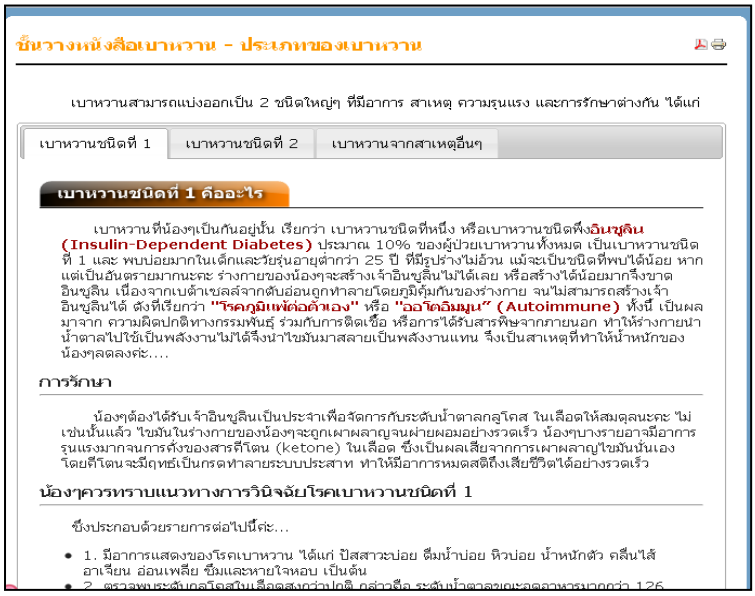
4.1.3 เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 8

รูปที่ 8 เนื้อหา โรคแทรกซ้อนในเด็กเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

4.1.4

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 9

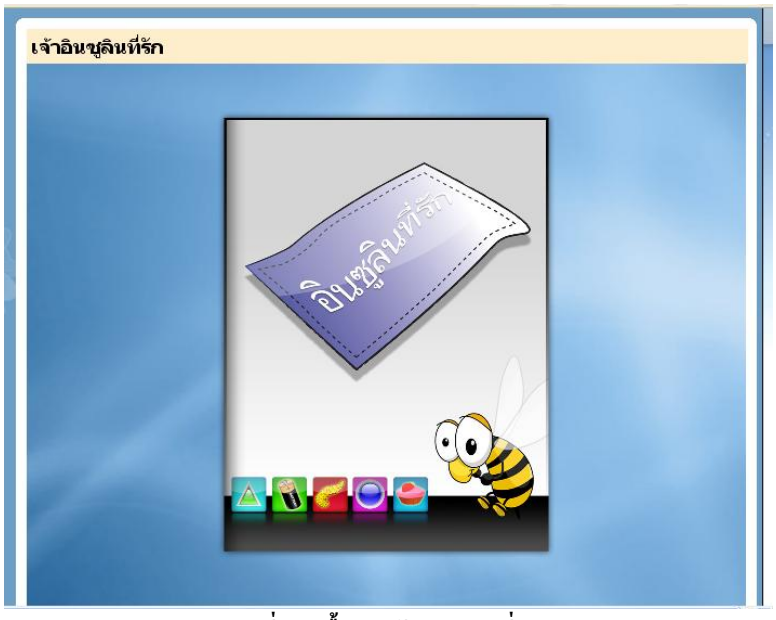


รูปที่ 9 เนื้อหา ประเภทของเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

4.1.5

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 10



รูปที่ 10 เนื้อหา เจ้าอินซูลินที่รัก

โดยผู้ใช้งานสามารถคลิกที่หนังสือ รูปที่ 10 เพื่อเข้าไปอ่านเนื้อหาได้

4.1.6

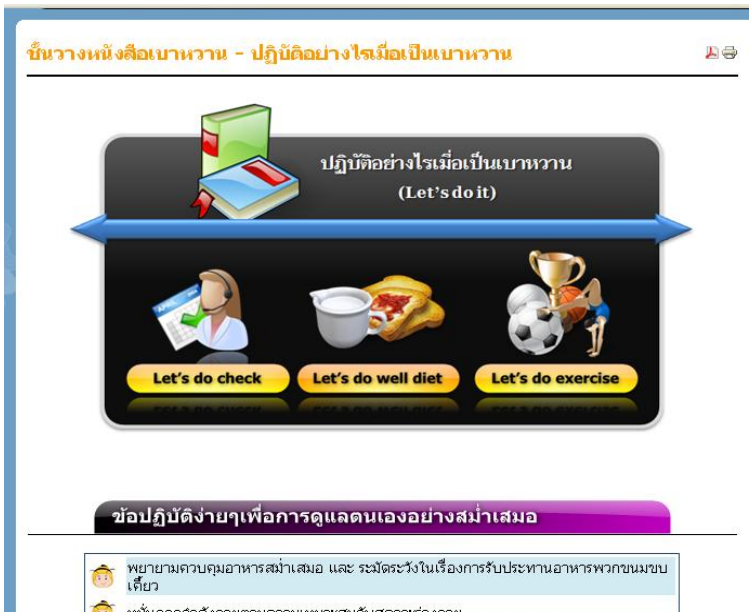
เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 11

รูปที่ 11 เนื้อหา ระดับน้ำตาลในเลือกควบคุมได้

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

4.1.7

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 12



รูปที่ 12 เนื้อหา ปฏิบัติอย่างไรเมื่อเป็นเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ
ตามลำดับ

4.2

คือ ส่วนของการแสดงเนื้อหาที่เกี่ยวข้องกับการ กินพอดี ดังนี้

4.2.1

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 13

รูปที่ 13 เนื้อหา อาหาร 5 หมู่ 6 หลัก

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ
ตามลำดับ

4.2.2

เมื่อกดปุ่ม แล้วจะปรากฏเนื้อหาดังรูปที่ 14

รูปที่ 14 เนื้อหา ทานอย่างไรเมื่อเป็นเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ ถ้าต้องการตรวจสอบเกณฑ์น้ำหนักและประเมินภาวะโภชนาการของผู้ใช้งานให้กดปุ่ม

จะปรากฏหน้าจอ ดังรูปที่ 15

รูปที่ 15 ตรวจสอบเกณฑ์น้ำหนักและประเมินภาวะโภชนาการด้วยตนเอง

4.2.3 เมนู

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่

รูปที่ 16 เนื้อหา รู้ไว้ ใช้ใช้ เรื่องอาหารเบาหวาน

ผู้ใช้งานสามารถบันทึกข้อมูล ในรูปแบบ ไฟล์ Acrobat Reader หรือ ปริ้นเอกสารได้ โดนกดปุ่ม หรือ ตามลำดับ

CLINIC PORDEE

คู่มือการใช้ระบบในส่วนของคลินิคพอดี

1. กดปุ่ม เมนู คลินิกพอดี จะปรากฏเมนูย่อยดังนี้

รูป 1 แสดงเมนูทั้งหมดที่อยู่ในส่วนของคลินิคพอดี

จากรูป 1 อธิบายได้ดังนี้ เมื่อกดปุ่มคลีนิคพอดี จะปรากฏเมนูย่อย ซึ่งแบ่งออกเป็น 3 หมวดย่อย ดังนี้

หมายเลข 1 หมวดพบคุณหมอ ประกอบไปด้วยเมนู

หมายเลข 1.1

เมื่อกดเมนูนี้จะปรากฏหน้าจอดังรูป ที่ 2

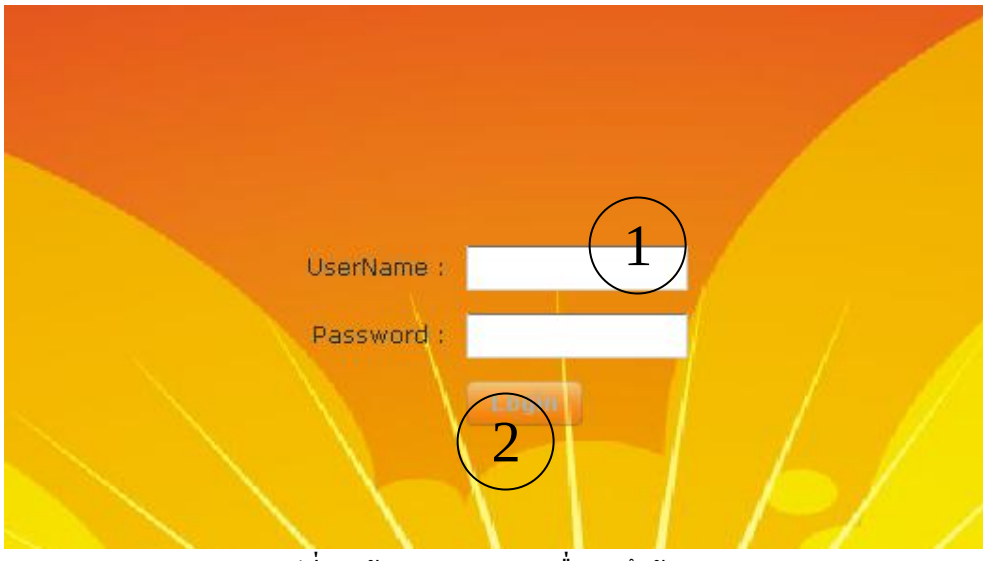
รูปที่ 2 หน้าจอบันทึกน้ำตาลพอดี

จากรูป 2 อธิบายได้ดังนี้ ส่วนประกอบของหน้าจอนี้ประกอบไปด้วย 3 ส่วนคือ

หมายเลข 1 ส่วนของวิธีการใช้งานระบบการบันทึกน้ำตาลพอดี

หมายเลข 2 ส่วนของการพิมพ์เนื้อหาหรือการแปลงไฟล์ให้อยู่ในรูปแบบของ pdf ไฟล์

หมายเลข 3 ส่วนของการล็อกอินเข้าสู่ระบบ เมื่อกดที่รูปภาพในหมายเลขที่ 3 นั้นจะปรากฏหน้าจอดังรูปที่ 3 คือ

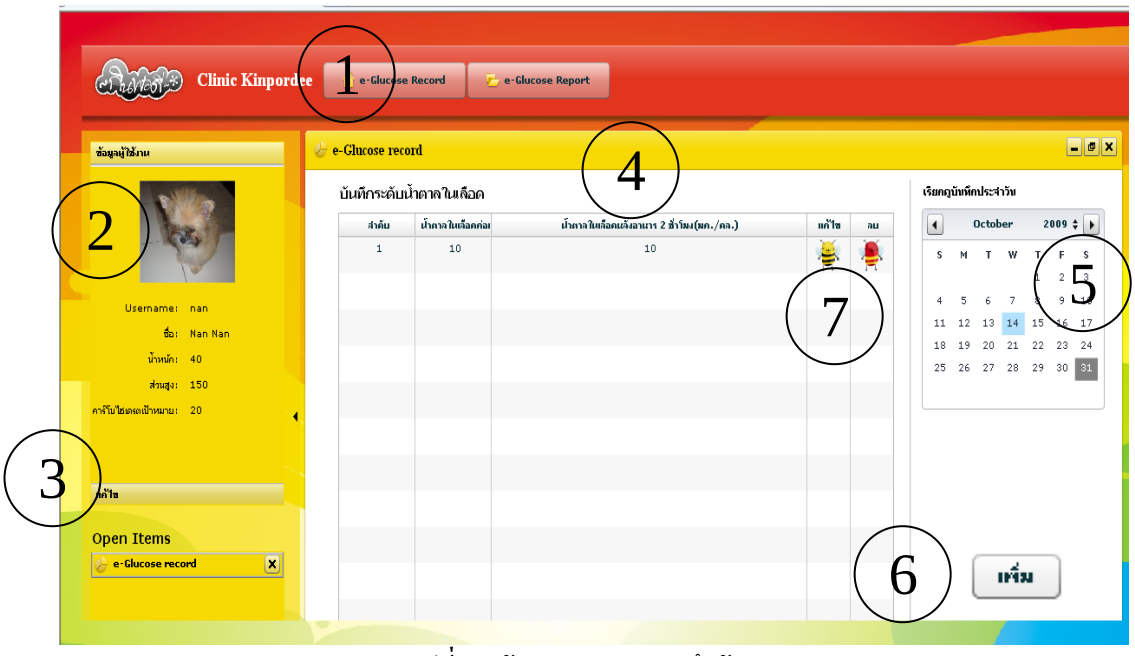


รูปที่ 3 หน้าจอการล็อกกอินเพื่อบันทึกข้อมูล

จากรูป 3 อธิบายได้ดังนี้

หมายเลข 1 ให้กรอกชื่อใช้งานของผู้ใช้งาน และ รหัสผ่านเข้าสู่ระบบ

หมายเลข 2 กดปุ่ม login เพื่อเข้าสู่ระบบ เมื่อกดปุ่มนี้แล้วจะปรากฏหน้าจอดังรูปที่ 4



รูปที่ 4 หน้าหลักของการบันทึกข้อมูล

จากรูป 4 อธิบายได้ดังนี้

หมายเลข 1 ปุ่มในการบันทึกข้อมูลคือ

และปุ่มที่จะแสดงผลการรายงานที่บันทึกคือ

หมายเลข 2 แสดงข้อมูลและรูปภาพของผู้ใช้งาน ซึ่งจะให้มีการกำหนดคาร์โบไฮเดรตเป้าหมายที่ต้องการ โดยทำการกดปุ่มแก้ไขในหมายเลขที่ 3

หมายเลข 3 กดปุ่ม แก้ไข เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 5 โดยทำการบันทึก น้ำหนัก ส่วนสูง และ คาร์โบไฮเดรตเป้าหมาย จากนั้นทำการกดปุ่ม

รูปที่ 5 หน้าจอการแก้ไขข้อมูล

หมายเลข 4 หน้าจอการแสดงผลการบันทึกข้อมูล

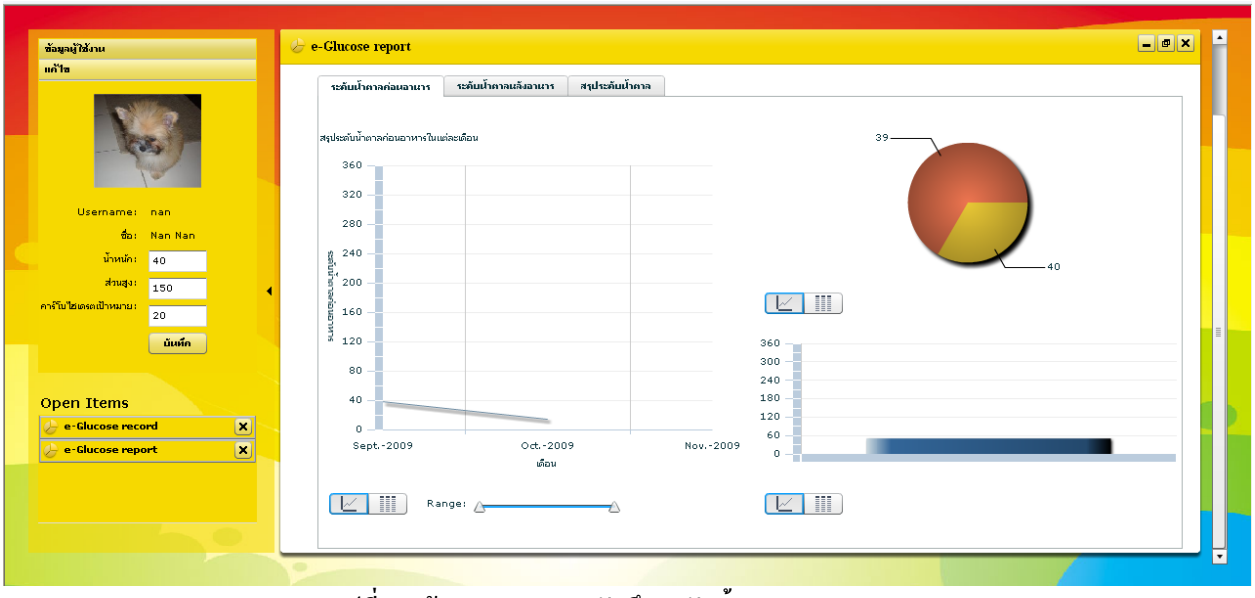
หมายเลข 5 ปฏิทินเพื่อให้ทำการเลือกว่าต้องการบันทึกข้อมูลของวันที่ไหน ให้ เลือกวันที่ในปฏิทินก่อน ทำการกดปุ่มเพิ่มข้อมูลใน หมายเลขที่ 6

หมายเลข 6 เมื่อกดปุ่ม

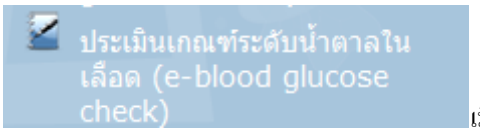
จะปรากฏหน้าจอดังรูปที่ 6 โดยทำการบันทึก ปริมาณน้ำตาลก่อนอาหาร และน้ำตาลหลังอาหาร จากนั้นกดปุ่ม

รูปที่ 6 หน้าจอการบันทึกระดับน้ำตาล

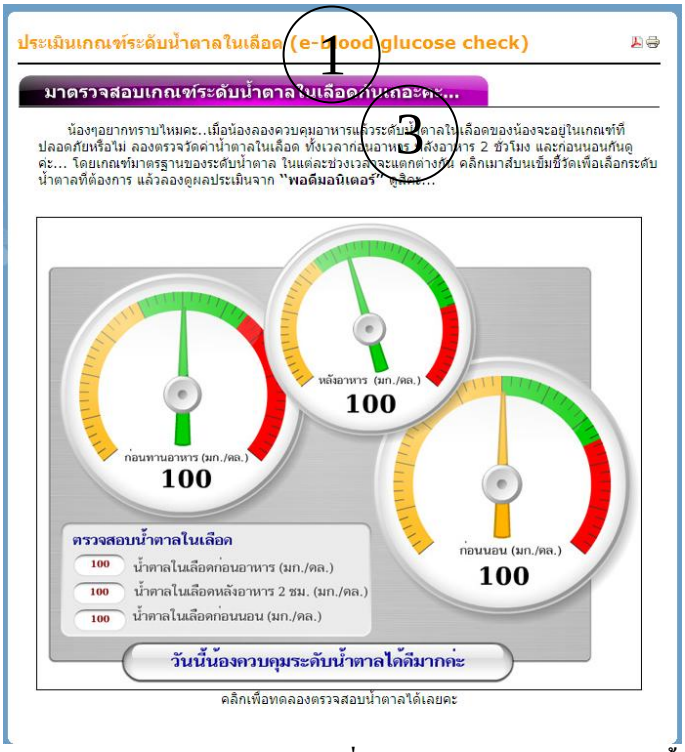
หมายเลข 7 ปุ่มแก้ไขข้อมูลที่ทำการบันทึกไปแล้วหากต้องการแก้ไขให้กดปุ่ม แล้วทำการแก้ไขตามที่ต้องการแล้วกดปุ่ม หากต้องการลบข้อมูลให้กดปุ่ม หากต้องการดูรายงานสรุปผลตามที่ได้บันทึกข้อมูลไปแล้วนั้น ให้กดปุ่ม จะปรากฏหน้าจอดังรูปที่ 7



รูปที่ 7 หน้าจอรายงานการบันทึกระดับน้ำตาล

หมายเลข 1.2 

เมื่อกดเมนูนี้จะปรากฏหน้าจอดังรูป ที่ 8



รูปที่ 8 หน้าจอประเมินเกณฑ์ระดับน้ำตาลในเลือด

จากรูป 8 อธิบายได้ดังนี้

หมายเลข 1 อธิบายวิธีการตรวจสอบเกณฑ์ระดับน้ำตาลในเลือด

หมายเลข 2 สามารถพิมพ์คำอธิบายในรูปแบบของรายงานนามสกุล pdf หรือต่อกับเครื่องปริ้นเตอร์ได้

หมายเลข 3 ทำการกดภาพนี้เพื่อทำการทดสอบเกณฑ์ปริมาณน้ำตาลได้ โดยเมื่อกดภาพนี้แล้วจะปรากฏหน้าจอดังรูปที 9

รูปที่ 9 หน้าจอทดลองประเมิณเกณฑ์ระดับน้ำตาลในเลือด

จากรูป 9 อธิบายได้ดังนี้

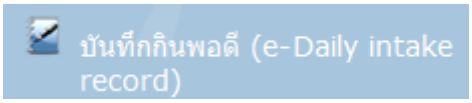
หมายเลข 1 ผู้ใช้งานทำการเลือกเข็มไปยังตำแหน่งที่ต้องการได้ ซึ่งจะเป็นข้อมูลก่อนทานอาหาร

หมายเลข 2 ผู้ใช้งานทำการเลือกเข็มไปยังตำแหน่งที่ต้องการได้ ซึ่งจะเป็นข้อมูลหลังทานอาหาร

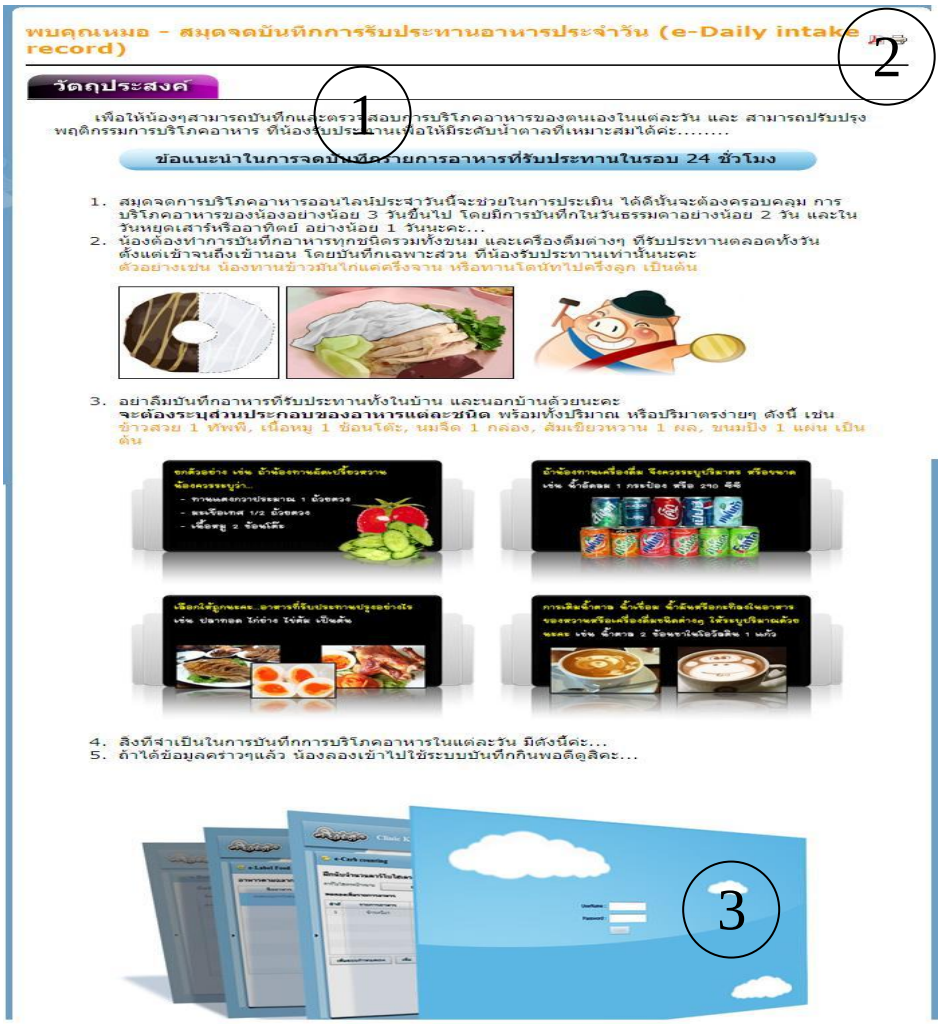
หมายเลข 3 ผู้ใช้งานทำการเลือกเข็มไปยังตำแหน่งที่ต้องการได้ ซึ่งจะเป็นข้อมูลก่อนนอน

หมายเลข 4 รายละเอียดตรวจสอบระดับน้ำตาลในเลือดข้อมูลที่ได้ทำการลากในหมายเลข 1 2 และ 3 ตามลำดับจะปรากฏในหมายเลข 4 นี้

หมายเลข 5 นั้นเป็นข้อความสรุปผลว่าผู้ใช้งานควบคุมระดับน้ำตาลได้ดีขนาดไหน

หมายเลข 2.1 

เมื่อกดเมนูนี้จะปรากฏหน้าจอดังรูป ที่ 10



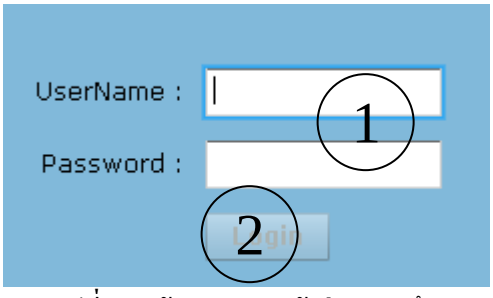
รูปที่ 10 หน้าจอหลักของการบันทึกกินพอดี

จากรูป 10 อธิบายได้ดังนี้

หมายเลข 1 อธิบายวิธีการเขียนสมุดจดบันทึกรับประทานอาหาร

หมายเลข 2 สามารถพิมพ์คำอธิบายในรูปแบบของรายงานนามสกุล pdf หรือต่อกับเครื่องปริ้นเตอร์ได้

หมายเลข 3 ทำการกดภาพนี้เพื่อทำการบันทึกรับประทานอาหารประจำวันได้ โดยเมื่อกดภาพนี้แล้วจะปรากฏหน้าจอดังรูปที่11



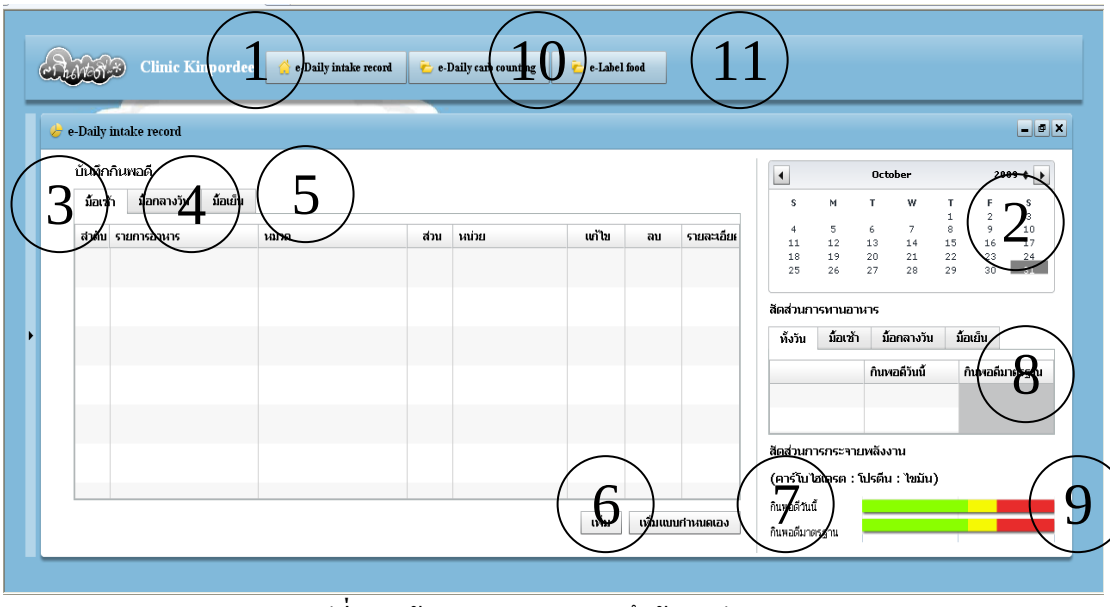
รูปที่ 11 หน้าจอล็อกอินเข้าสู่การบันทึก

จากรูปที่ 11 อธิบายได้ดังนี้

หมายเลข 1 ให้กรอกชื่อผู้ใช้งานและรหัสผ่าน

หมายเลข 2 ให้กดปุ่ม

เพื่อเข้าสู่ระบบ โดยเมื่อกดปุ่มแล้วจะปรากฏหน้าจอดังรูปที่ 12



รูปที่ 12 หน้าจอหลักของการบันทึกข้อมูลประจำวัน

จากรูปที่ 12 อธิบายได้ดังนี้

หมายเลข 1 ปุ่ม

เมื่อกดปุ่มนี้ จะปรากฏหน้าจอ การบันทึกข้อมูลการกินอาหารประจำวัน

หมายเลข 2 ปฏิทินเพื่อทำการบันทึกข้อมูลในแต่ละวัน โดย เลือกวันที่ที่ต้องการทำการบันทึก จากนั้นทำการกดปุ่ม

ในหมายเลข6

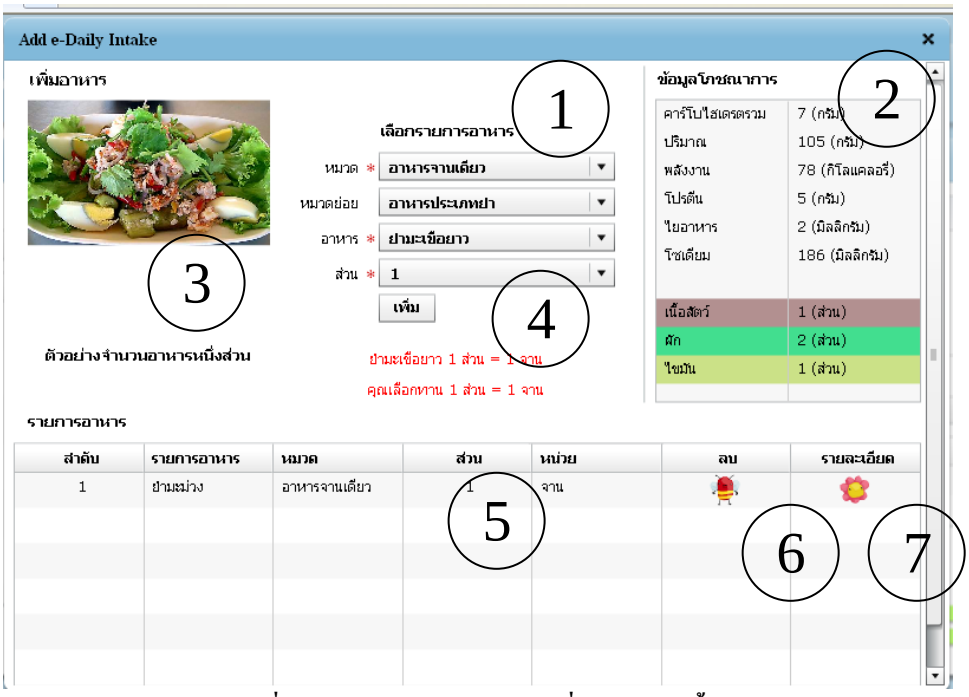
หมายเลข 3 แสดงข้อมูลที่ได้ทำการบันทึกในมื้อเช้า

หมายเลข 4 แสดงข้อมูลที่ได้ทำการบันทึกในมื้อกลางวัน

หมายเลข 5 แสดงข้อมูลที่ได้ทำการบันทึกในมื้อเย็น

หมายเลข 6 เลือกแถบข้อมูลที่ต้องการเพิ่มตามมื้อเช่นต้องการเพิ่มข้อมูลมื้อเช้าให้กดปุ่มหมายเลข 3 ก่อน กดปุ่ม

จะปรากฏหน้าจอในการบันทึกข้อมูลดังรูปที่ 13



รูปที่ 13 หน้าจอการบันทึกอาหารที่กินในแต่ละมื้อ

จากรูปที่ 13 อธิบายได้ดังนี้

หมายเลข 1 เลือกรายการอาหารที่ต้องการ มีหัวข้อดังนี้ หมวดอาหาร หมวดย่อยของอาหาร ชื่ออาหาร และ สัดส่วนที่ใช้ในการรับประทาน

หมายเลข 2 แสดงข้อมูลโภชนาการตามรายการอาหารที่ทำการเลือก

หมายเลข 3 แสดงรูปภาพรายการอาหารที่ทำการเลือก

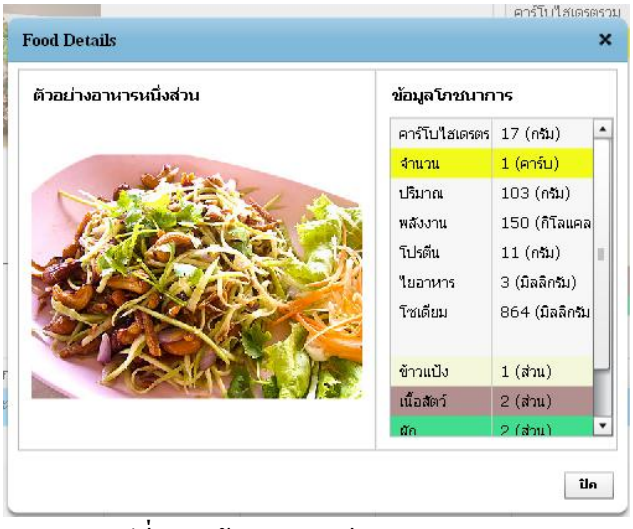
หมายเลข 4 กดปุ่ม

เพื่อเพิ่มรายการอาหารที่ได้ทำการเลือกไว้

หมายเลข 5 แสดงรายการอาหารจากที่ได้ทำการเพิ่มในหมายเลข 4 ไว้

หมายเลข 6 เมื่อต้องการลบข้อมูลที่ไม่ต้องการออก ทำการกดปุ่ม

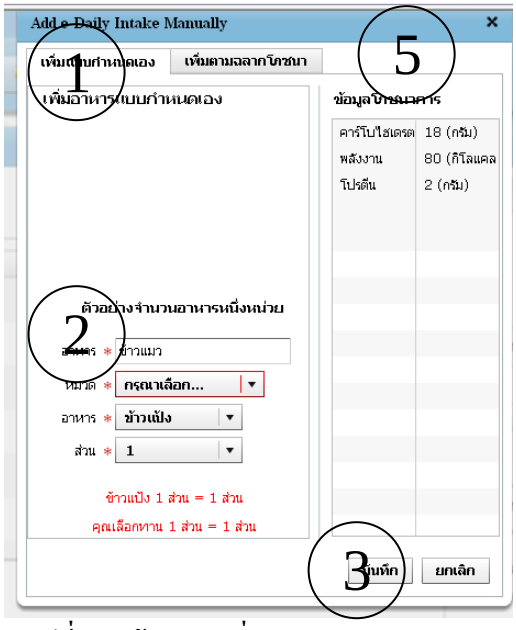
หมายเลข 7 เมื่อต้องการดูรายละเอียดของข้อมูลที่ได้ทำการเพิ่มลงไปนั้นให้กดปุ่ม จะปรากฏหน้าจอดังรูปที่ 14



รูปที่ 14 หน้าจอรายละเอียดรายการอาหาร

หมายเลข 7 เมนู

เมื่อไม่มีรายการอาหารที่ต้องการในหมายเลข 6 ผู้ใช้งานสามารถเพิ่มรายการเมนูอาหารได้เอง โดยกดปุ่มนี้ จะปรากฏหน้าจอดังรูปที่ 15



รูปที่ 15 หน้าจอการเพิ่มอาหารแบบกำหนดเอง

จากรูปที่ 15 อธิบายได้ดังนี้

หมายเลข 1 แถบ

เพื่อทำการเพิ่มอาหารตามต้องการด้วยตนเอง

หมายเลข 2 กรอกชื่ออาหารที่ต้องการ เลือก หมวด ชนิดอาหาร และ สัดส่วนที่ต้องการ

หมายเลข 3 กดปุ่ม

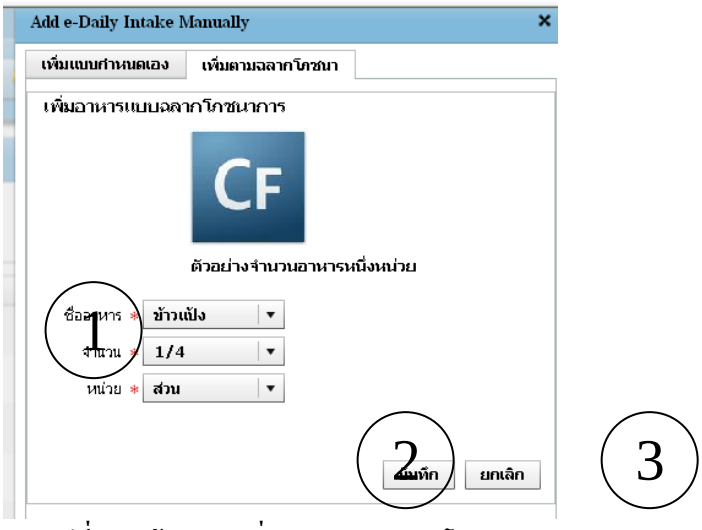
เพื่อทำการบันทึกข้อมูลลงในระบบ

หมายเลข 4 กดปุ่ม

เพื่อทำการยกเลิกรายการที่ไม่ต้องการ

หมายเลข 5 ปุ่มแถบ

เมื่อกดปุ่มนี้จะรากฏหน้าจอดังรูปที่ 16



รูปที่ 16 หน้าจอการเพิ่มอาหารตามฉลากโภชนา

จากรูปที่ 16 อธิบายได้ดังนี้

หมายเลข 1 กรอกชื่ออาหารที่ต้องการ สัดส่วนที่ต้องการ และหน่วย

หมายเลข 2 กดปุ่ม

เพื่อทำการบันทึกข้อมูลลงในระบบ

หมายเลข 3 กดปุ่ม

เพื่อทำการยกเลิกรายการที่ไม่ต้องการ

หมายเลข 8 สัดส่วนการทานอาหาร

หมายเลข 9 สัดส่วนการกระจายพลังงาน

หมายเลข 10 เมนู

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 17

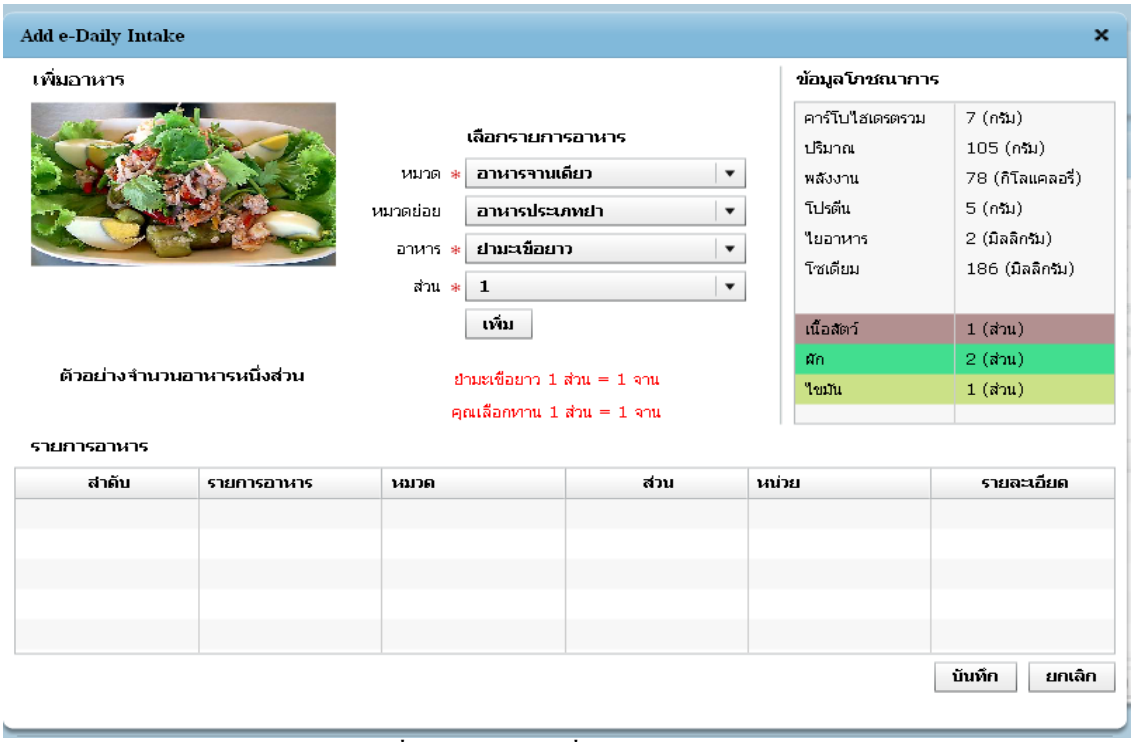
รูปที่ 17 หน้าจอ E daily Counting

จากรูปที่ 17 อธิบายได้ดังนี้

หมายเลข 1 แสดงรายละเอียดข้อมูลรายการอาหารทั้งมื้อเช้า กลางวันและ เย็น

หมายเลข 2 ส่วนของการแสดงข้อมูลอาหารที่ต้องการเพิ่มข้อมูล

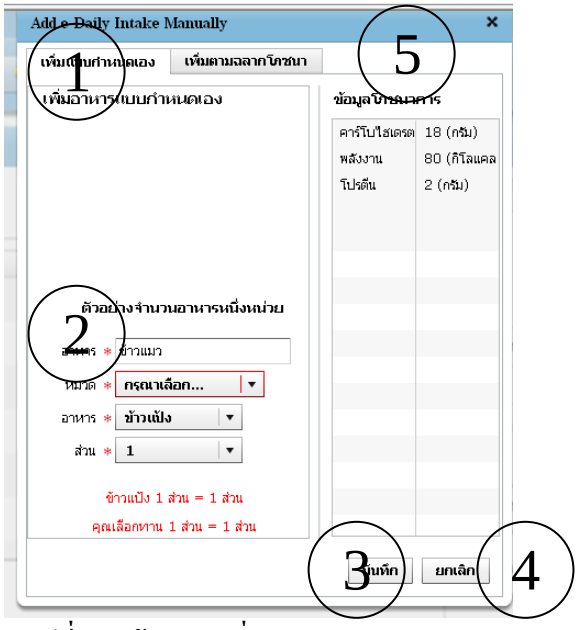
หมายเลข 3 ปุ่ม เมื่อกดปุ่มนี้จะปรากฏหน้าจอ ดังรูปที่ 18



รูปที่ 17 หน้าจอการเพิ่ม E-daily Intake

จากรูปที่ 17 อธิบายรายละเอียดตามรูปที่ 12

หมายเลข 4 ปุ่ม เพิ่มแบบกำหนดเอง เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 18



รูปที่ 18 หน้าจอการเพิ่มอาหารแบบกำหนดเอง

จากรูปที่ 18 อธิบายได้ดังนี้

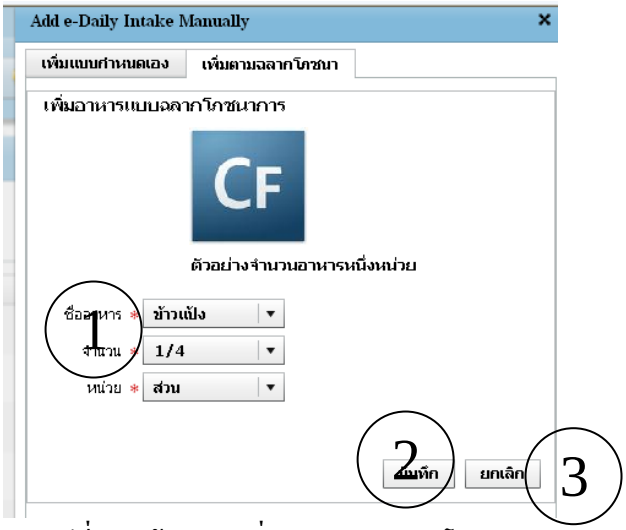
หมายเลข 1 แถบ เพิ่มแบบกำหนดเอง เพื่อทำการเพิ่มอาหารตามต้องการด้วยตนเอง

หมายเลข 2 กรอกชื่ออาหารที่ต้องการ เลือก หมวด ชนิดอาหาร และ สัดส่วนที่ต้องการ

หมายเลข 3 กดปุ่ม บันทึก เพื่อทำการบันทึกข้อมูลลงในระบบ

หมายเลข 4 กดปุ่ม ยกเลิก เพื่อทำการยกเลิกรายการที่ไม่ต้องการ

หมายเลข 5 ปุ่มแถบ เพิ่มตามฉลากโภชนา เมื่อกดปุ่มนี้จะรากฏหน้าจอดังรูปที่ 19



รูปที่ 19 หน้าจอการเพิ่มอาหารตามฉลากโภชนา

จากรูปที่ 19 อธิบายได้ดังนี้

หมายเลข 1 กรอกชื่ออาหารที่ต้องการ สัดส่วนที่ต้องการ และหน่วย

หมายเลข 2 กดปุ่ม

เพื่อทำการบันทึกข้อมูลลงในระบบ

หมายเลข 3 กดปุ่ม

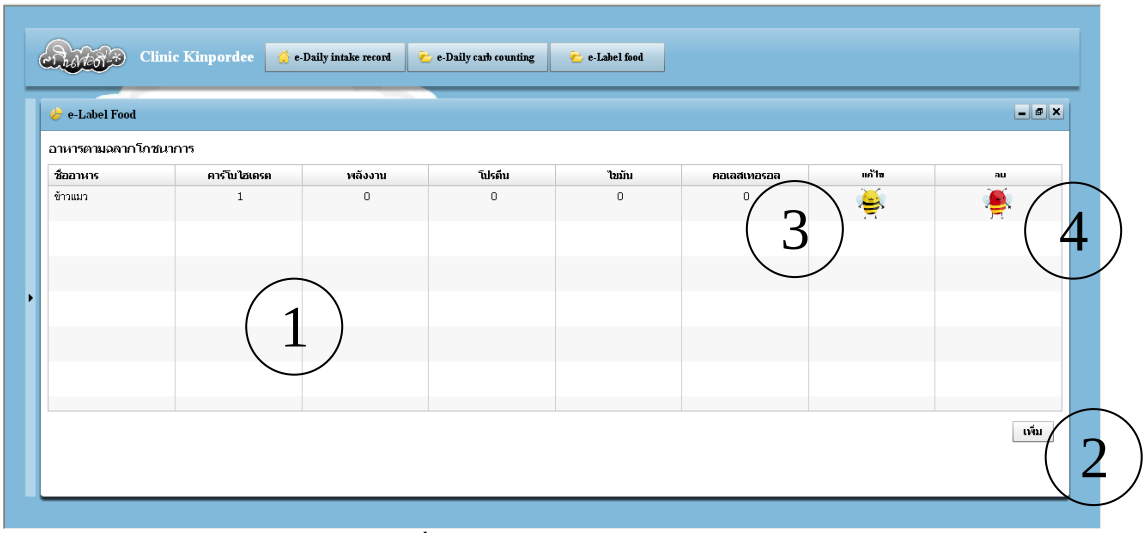
เพื่อทำการยกเลิกรายการที่ไม่ต้องการ

หมายเลข 5

เมื่อกดปุ่มนี้จะยังไม่มีอะไรเกิดขึ้น

หมายเลข 10 เมนู

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 20



รูปที่ 20 หน้าจอแสดงข้อมูล e-label

จากรูปที่ 20 อธิบายได้ดังนี้

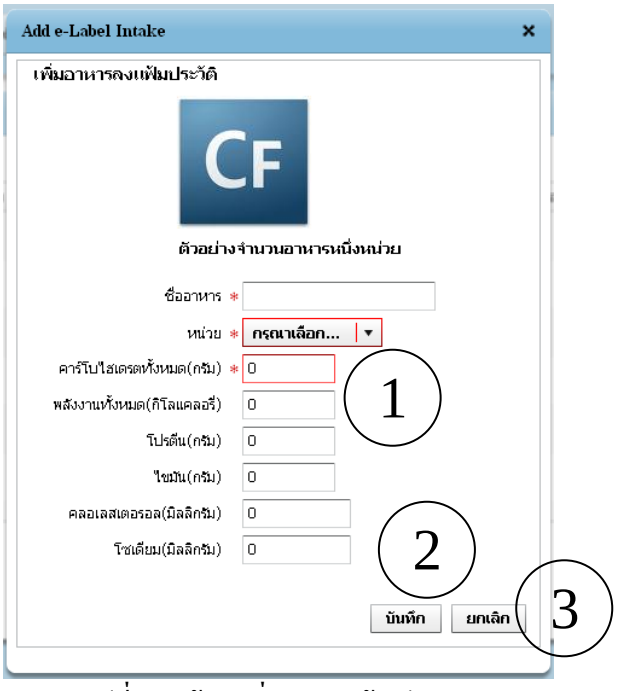
หมายเลข 1 ส่วนของการแสดงผลข้อมูลอาหารตามโภชนาการ

หมายเลข 2 ปุ่ม

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 21

หมายเลข 3 ปุ่มการแก้ไขข้อมูล เมื่อต้องการแก้ไขข้อมูลให้กดปุ่มนี้

หมายเลข 4 ปุ่มการลบข้อมูล



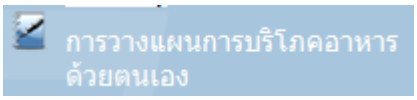
รูปที่ 21 หน้าจอเพิ่มอาหารแฟ้มประวัติ

จากรูปที่ 21 อธิบายดังนี้

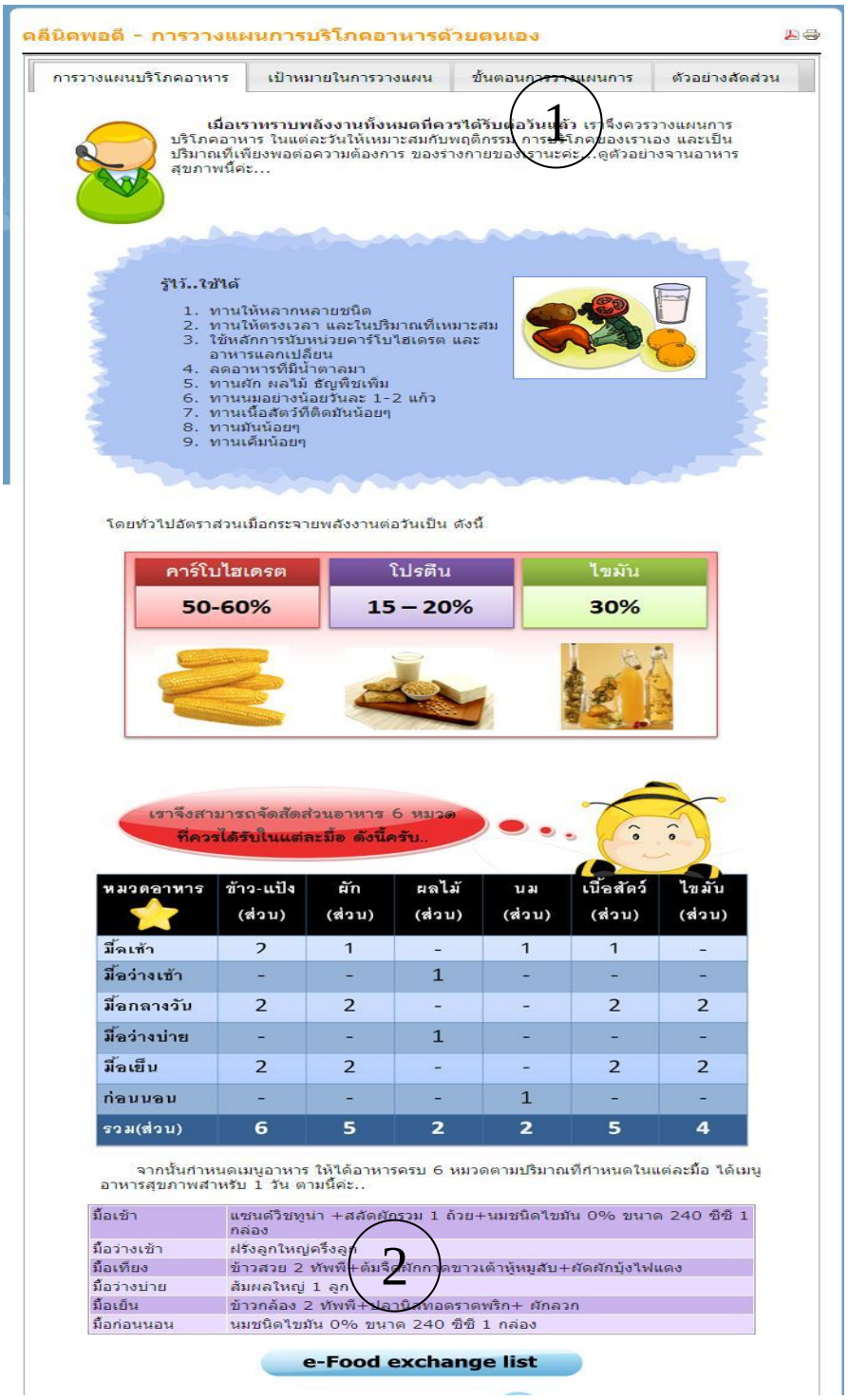
หมายเลข 1 ส่วนของการเพิ่มข้อมูลอาหารในหนึ่งหน่วย

หมายเลข 2 ปุ่มบันทึกข้อมูล

หมายเลข 3 ปุ่มยกเลิก เมื่อไม่ต้องการข้อมูลนั้นแล้ว

หมายเลข 2.2 ปุ่ม 

เมื่อปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 22



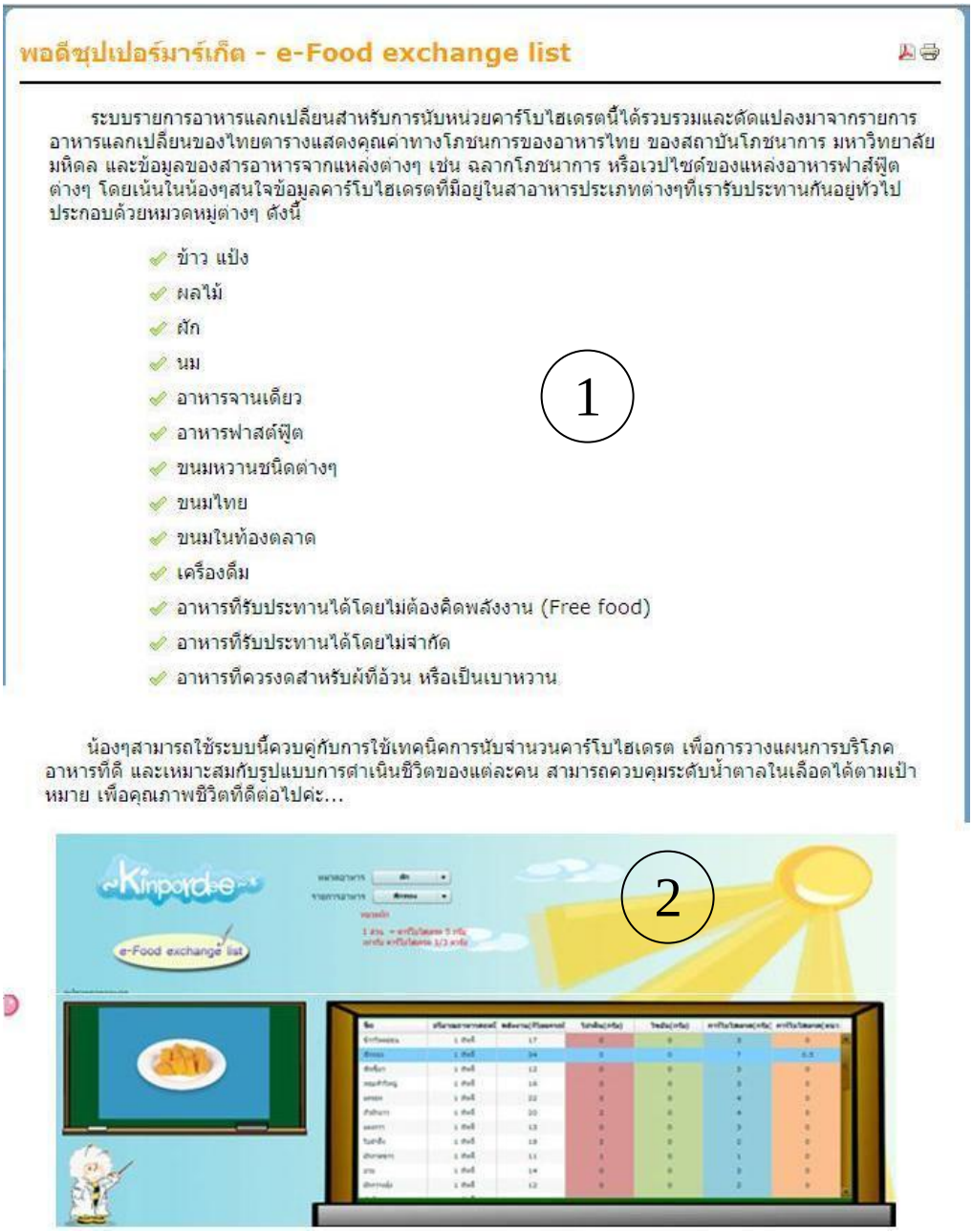
รูป 22 หน้าจอหลักการวางแผนบริโภคอาหารด้วยตนเอง

จากรูปที่ 22 อธิบายดังนี้

หมายเลข 1 ส่วนแสดงข้อมูลเนื้อหาการวางอผนบริโภคอาหารด้วยตนเอง

หมายเลข 2 ปุ่ม

เมื่อกดปุ่มนี้จะปรากกฏหน้าจอดังรูป 23

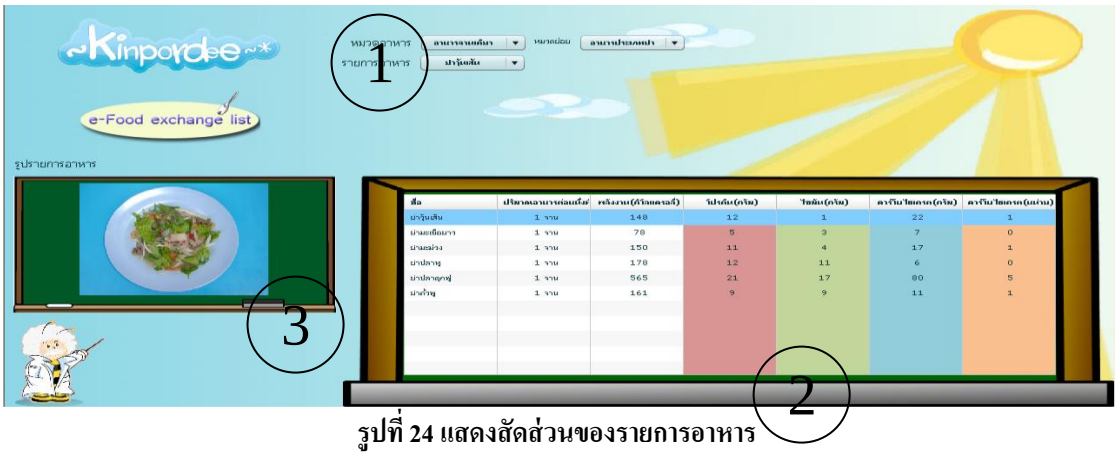


รูปที่ 23 หน้าจอ พอดีซุปเปอร์มาร์เก็ต

จากรูปที่ 23 สามารถอธิบายได้ดังนี้

หมายเลข 1 ส่วนของการแสดงข้อมูลแนะนำในส่วนของพอดีซุปเปอร์มาร์เก็ต

หมายเลข 2 เมื่อกดภาพนี้จะปรากฏหน้าจอดังรูปที่ 24



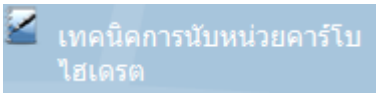
รูปที่ 24 แสดงสัดส่วนของรายการอาหาร

จากรูปที่ 24 สามารถอธิบายได้ดังนี้

หมายเลข 1 ส่วนของการเลือกข้อมูลที่ต้องการทราบโดยทำการเลือก หมวดอาหารที่ต้องการ จากนั้นเลือก หมวดย่อย และ รายการอาหาร

หมายเลข 2 ส่วนของการแสดงข้อมูลอาหาร หากต้องการดูรายละเอียดขอมูลรายการอื่นให้นำเมาส์คลิกที่ชื่อรายการอาหารในแต่ละบรรทัดนั้น

หมายเลข 3 ส่วนของภาพที่แสดงตามรายการอาหารที่ได้ทำการเลือกนั้น

หมายเลข 2.3 ปุ่ม 

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 25

หมายเลข 3 หมวด

จะมีหมวดย่อยดังนี้คือ

หมายเลข 3.1 ปุ่ม

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 26

รูปที่ 26 เนื้อหาการประเมินน้ำหนักตัวที่เหมาะสม

จากรูปที่ 26 สามารถอธิบายได้ดังนี้

หมายเลข 1 หน้าปกหนังสือการประเมินน้ำหนักตัวที่เหมาะสม

หมายเลข 2 ส่วนของการคลิกปุ่ม เพื่อดูเนื้อหาข้างใน โดยกดที่ปุ่ม ดังนี้คือ

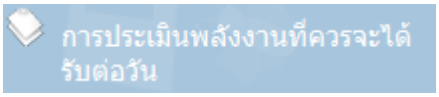
เปิดหนังสือ

เปิดไปยังหน้าถัดไป

ไปหน้าสุดท้าย

ย้อนกลับ

ไปยังหน้าแรก

หมายเลข 3.2 ปุ่ม 

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 27

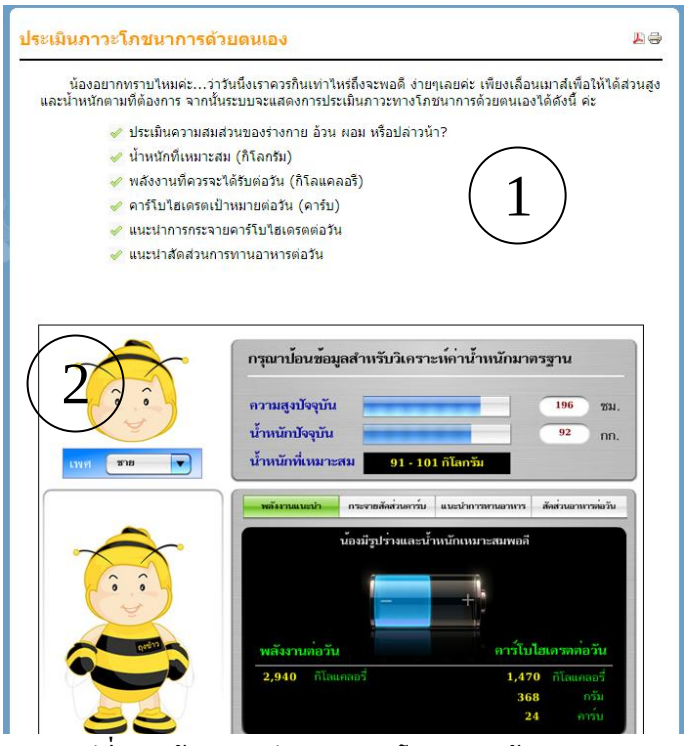
รูปที่ 27 เนื้อหาการประเมิณพลังงานที่ควรจะได้รับในแต่ละวัน

จากรูปที่ 27 สามารถอธิบายได้ดังนี้

หมายเลข 1 ส่วนของการอธิบายวิธีการคำนวณพลังงานของร่างกาย

หมายเลขที่ 3.3 ปุ่ม

เมื่อกดปุ่มนี้จะปรากฏหน้าจอดังรูปที่ 28

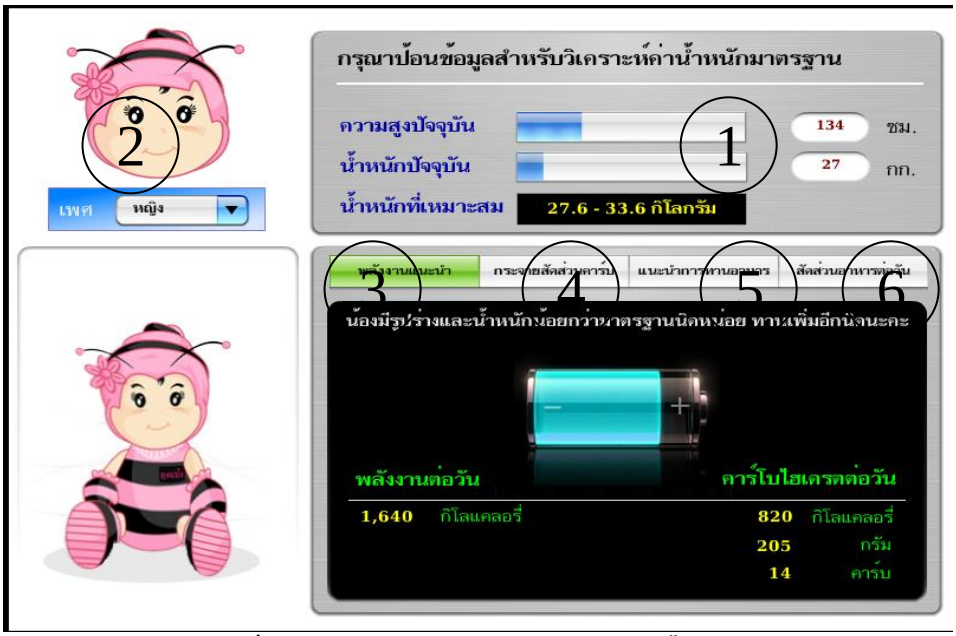


รูปที่ 28 หน้าจอการประเมินภาวะโภชนาการด้วยตนเอง

จากรูปที่ 28 สามารถอธิบายได้ดังนี้

หมายเลข 1 ส่วนของการอธิบายประเมินภาวะโภชนาการด้วยตนเอง

หมายเลข 2 กดที่ภาพจะปรากฏหน้าจอดังรูปที่ 29



รูปที่ 29 ส่วนของการป้อนข้อมูลการวิเคราะห์น้ำหนัก

จากรูปที่ 29 สามารถอธิบายได้ว่า

หมายเลข 1 ส่วนของการป้อนข้อมูลความสูงและน้ำหนัก โดยทำการลากเมาส์ค้างในช่องแต่ละช่อง

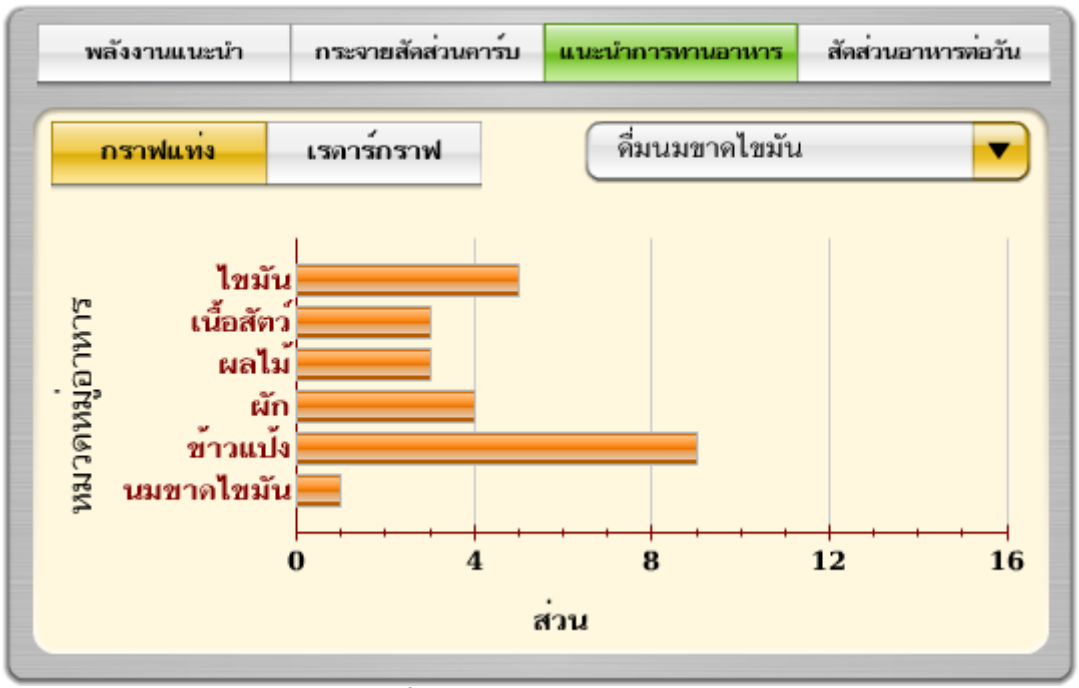
หมายเลข 2 ส่วนของการเลือกเพศ ว่า หญิง หรือ ชาย

หมายเลข 3 ส่วนของการแสดงผลพลังงานแนะนำ

หมายเลข 4 ส่วนของการแสดงผลกระจายสัดส่วนคาร์บ ดังรูปที่ 30

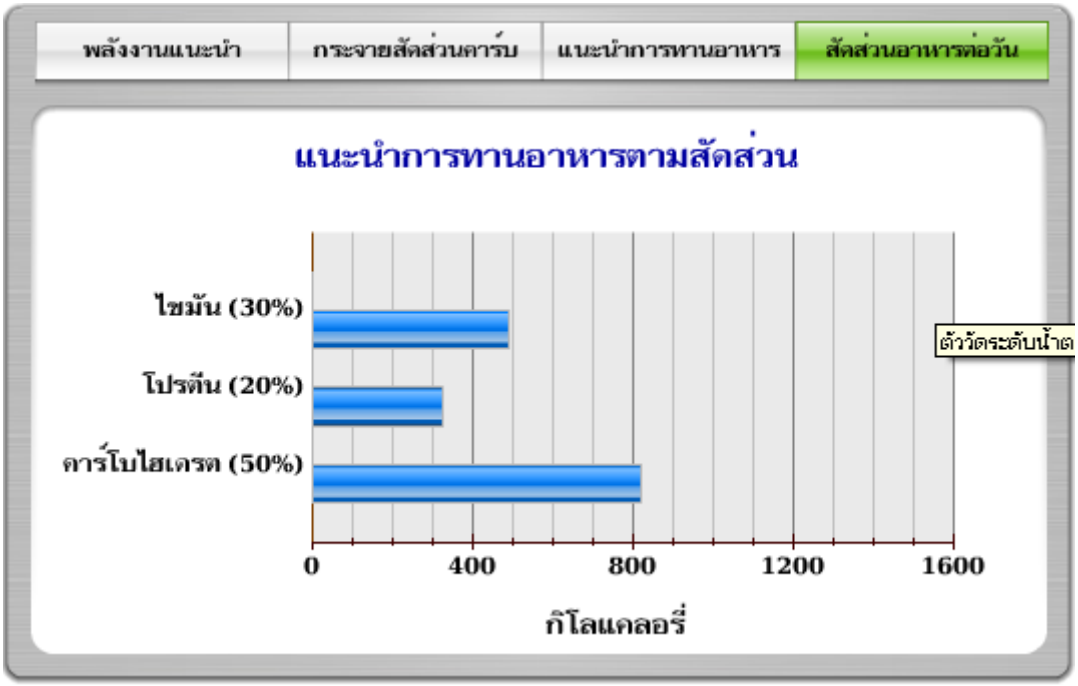
รูปที่ 30 แสดงผลกระจายสัดส่วนคาร์บ

หมายเลข 5 ส่วนของการแสดงผลการแนะนำอาหาร ดังรูปที่ 31



รูปที่ 31 แสดงผลการแนะนำอาหาร

หมายเลข 6 ส่วนของการแสดงผลสัดส่วนอาหารต่อวัน ดังรูปที่ 32



รูปที่ 31 แสดงผลสัดส่วนอาหารต่อวัน

APPENDIX C

แบบสอบถามเกี่ยวกับข้อมูลทั่วไป ประวัติการรักษา และการใช้ยา
สำหรับเด็กวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

คำชี้แจง : ให้ขีดเครื่องหมาย √ ลงใน ( ) หน้าข้อความตามที่ตรงกับความเป็นจริงหรือเติมคำลงในช่องว่าง _____ ให้สมบูรณ์

ชื่อ _____นามสกุล_____ชื่อเล่น _____

เลขที่เวชระเบียน _____ ที่อยู่ปัจจุบัน _____

_____

ญาติหรือผู้ที่สามารถติดต่อได้ _____โทรศัพท์ _____

(1) วัน/เดือน/ปีเกิด _____อายุปัจจุบัน _____ ปี _____ เดือน

(2) เพศ ( ) ชาย ( ) หญิง

(3) เชื้อชาติ _____ ศาสนา _____

(4) ส่วนสูง _____ เซนติเมตร

(5) น้ำหนัก _____ กิโลกรัม

(6) ระดับการศึกษา

1. ( ) ไม่ได้เรียน 2. ( ) ประถมศึกษาปีที่ _____
3. ( ) มัธยมศึกษาปีที่ _____ 4. ( ) อาชีวศึกษาหรืออนุปริญญาปีที่ __
5. ( ) มหาวิทยาลัยปีที่ _____ 6. ( ) อื่นๆ ระบุ _____

(7) ประวัติครอบครัว : บุคคลในครอบครัวเป็นเบาหวานหรือไม่

1. ( ) ไม่มี
2. ( ) มี คือ _____

(8) สถานภาพครอบครัวของพ่อและแม่

1. ( ) อยู่ด้วยกัน 2. ( ) แยกกันอยู่
3. ( ) หย่าร้าง 4. ( ) อื่นๆ ระบุ _____

(9) ปัจจุบันพักอาศัยอยู่กับใคร

1. ( ) บิดาและมารดา 2. ( ) บิดาหรือมารดา ระบุ_____
3. ( ) ญาติ เกี่ยวข้องเป็น ___ 4. ( ) อื่นๆ _____

(10) บิดา มารดา มีอาชีพหลักคือ (ตอบทั้งอาชีพของบิดาและมารดา คนละ 1 อาชีพ)

บิดา	อาชีพ	มารดา
( )	1. พ่อบ้าน/แม่บ้าน	( )
( )	2. รับราชการ	( )
( )	3. พนักงานรัฐวิสาหกิจ	( )
( )	4. ลูกจ้างบริษัทเอกชน	( )
( )	5. ธุรกิจส่วนตัว	( )
( )	6. รับจ้าง	( )
( )	7. อื่นๆ คือ	( )

(11) การศึกษาของบิดา มารดา (ตอบทั้งการศึกษาของบิดา มารดา เพียง 1 คำตอบเท่านั้น)

บิดา	ระดับการศึกษา	มารดา
( )	1. ป. 1 – ป.4	( )
( )	2. ป. 5 – ป.6	( )
( )	3. ม.1 – ม.3	( )
( )	4. ม.4 – ม.6	( )
( )	5. อนุปริญญา	( )
( )	6.ปริญญาตรีขึ้นไป	( )
( )	7. อื่นๆ คือ	( )

(12) มีพี่น้องทั้งหมด _____ คน (รวมตัวเอง) เป็นลูกคนที่ _____ ของครอบครัว

(13) ครอบครัวมีรายได้เฉลี่ยต่อเดือน ประมาณ

1. ต่ำกว่า 10,000 บาท
2. สูงกว่า 10,000 บาท แต่ไม่เกิน 20,000 บาท
3. สูงกว่า 20,000 บาท แต่ไม่เกิน 30,000 บาท
4. สูงกว่า 30,000 บาท แต่ไม่เกิน 40,000 บาท
5. สูงกว่า 40,000 บาท แต่ไม่เกิน 50,000 บาท
6. 50,000 บาทขึ้นไป

(14) ได้รับการวินิจฉัยว่าเป็นเบาหวาน เป็นระยะเวลา _____ ปี _____ เดือน

(15) การรักษา : จำนวนครั้งของการฉีดอินซูลิน _____ ครั้ง/วัน

มื้อ/เวลา.....	ชนิดของยาฉีดอินซูลิน	ขนาดของยาฉีดอินซูลิน (ยูนิต)
เช้า ..... น.		
เที่ยง ..... น.		
เย็น ..... น.		
ก่อนนอน ..... น.		

(16) ระดับน้ำตาลในเลือดก่อนอาหาร (FBG), มื้อเช้าวันนี้ คือ _____ มก./ดล.

ระดับน้ำตาลในเลือดหลังอาหาร (PBG), มื้อเย็นเมื่อวานนี้ คือ _____ มก./ดล.

ระดับน้ำตาลสะสมในเลือด (HbA1C), ค่าที่ได้ครั้งล่าสุด คือ _____ %

(17) ความถี่ของภาวะน้ำตาลในเลือดต่ำ _____ ครั้ง/สัปดาห์

ช่วงเวลาที่มักเกิดภาวะน้ำตาลในเลือดต่ำ _____

ระดับน้ำตาลในเลือดต่ำ มีค่าประมาณอยู่ในช่วง _____ มก./ดล.

แก้ไขปัญหาระดับน้ำตาลในเลือดต่ำ โดย _____

(18) ปัจจุบันควบคุมอาหารเพื่อการรักษาโรคเบาหวานหรือไม่

1. ( ) ไม่ควบคุม เพราะ _____
2. ( ) ควบคุม ได้รับคำแนะนำจาก _____

(19) โดยปกติ ออกกำลังกายหรือไม่

1. ( ) ไม่ออกกำลังกาย
2. ( ) ออกกำลังกาย, ชนิดของการออกกำลังกาย _____

ความถี่ _____ ครั้ง/สัปดาห์

ระยะเวลาโดยเฉลี่ย ครั้งละประมาณ _____ นาที

(20) คุณเคยรู้จักเทคนิคการนับหน่วยคาร์โบไฮเดรต (Carbohydrate counting) หรือไม่

1. ( ) รู้จัก จากใครและที่ใด _____
2. ( ) ไม่รู้จัก
3. ( ) ไม่แน่ใจ

(21) คุณเคยเรียนรู้เทคนิคการนับหน่วยคาร์โบไฮเดรตหรือไม่

1. ( ) เคยเรียนรู้ จากใครและที่ใด _____
2. ( ) ไม่เคย
3. ( ) ไม่แน่ใจ

(22) คุณคิดว่า การเรียนรู้เทคนิคการนับหน่วยคาร์โบไฮเดรต เป็นการเรียนรู้เกี่ยวกับอะไรบ้าง (ตอบได้มากกว่า 1 ข้อ)

1. ( ) การวางแผนการกินอาหาร
2. ( ) การควบคุมปริมาณอาหาร
3. ( ) การรักษาระดับน้ำตาลในเลือด

(23) คุณหวังว่า การเรียนรู้เทคนิคการนับหน่วยคาร์โบไฮเดรต จะทำให้เกิดผลอะไรต่อตัวคุณ (ตอบได้มากกว่า 1 ข้อ)

1. ( ) รับประทานอาหารได้ถูกต้องเหมาะสมมากขึ้น
2. ( ) รับประทานอาหารได้หลากหลายมากขึ้น
3. ( ) ทำให้ควบคุมน้ำหนักอยู่ในเกณฑ์ที่เหมาะสม
4. ( ) ระดับน้ำตาลในเลือดอยู่ในเกณฑ์ปกติ
5. ( ) สุขภาพร่างกายแข็งแรงมากขึ้น

แบบสอบถามพฤติกรรมการบริโภคอาหาร

คำชี้แจง : ให้ขีดเครื่องหมาย √ ลงใน ( ) หน้าข้อความตามที่ตรงกับความเป็นจริงหรือเติมคำลงในช่องว่าง _____ ให้สมบูรณ์

1. รูปแบบการบริโภคอาหาร:

1) รับประทานอาหาร วันละ _____ มื้อ ได้แก่

( ) มื้อเช้า ( ) มื้อว่างเช้า ( ) มื้อเที่ยง ( ) มื้อว่างบ่าย

( ) มื้อเย็น ( ) มื้อก่อนนอน( ) อื่นๆ ระบุ _____

2) รับประทานข้าว มื้อละ _____ ทัพพี และ/หรือ ขนมปัง _____ แผ่น

3) รับประทานกับข้าว; เนื้อสัตว์ เฉลี่ย _____ ช้อนโต๊ะต่อมื้อ

ไข่ เฉลี่ย _____ ฟอง/วัน หรือ _____ ฟอง/สัปดาห์

ประเภทอาหารที่ชอบ (เลือกตอบได้มากกว่า 1 ข้อ)

( ) ต้มจืด

( ) แกงกะทิ

( ) ของผัด, ทอด

( ) ปิ้ง, ย่าง

4) ผัก ( ) รับประทานได้ดี

( ) เลือกเป็นบางชนิด

( ) ไม่รับประทานเลย

5) ผลไม้ ( ) รับประทานได้ดี

( ) เลือกเป็นบางชนิด

( ) ไม่รับประทานเลย

6) ขนม

- ขนมขบเคี้ยว เช่น มันฝรั่ง, ข้าวเกรียบกุ้ง เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ, จำนวน _____ ถุง/วัน หรือ____ ถุง/สัปดาห์

( ) รับประทานนานๆครั้ง

- ขนมไทย ของหวาน

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ, จำนวน ____ ถ้วย/วัน หรือ___ถ้วย/สัปดาห์

( ) รับประทานนานๆครั้ง

- เบเกอรี่ต่างๆ เช่น บราวนี่, เค้ก, คุกกี้ เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ, จำนวน _____ ชิ้น/วัน หรือ___ชิ้น/สัปดาห์

( ) รับประทานนานๆครั้ง

7) อาหารและเครื่องดื่มที่มีน้ำตาล

- น้ำผลไม้

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ

จำนวน _กล่อง/วัน หรือ กล่อง/สัปดาห์

( ) รับประทานนานๆครั้ง

- น้ำอัดลม

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ

จำนวน _ ขวด/วัน หรือ ____ กระป๋อง/วัน หรือ _____ กระป๋อง/สัปดาห์

( ) รับประทานนานๆครั้ง

- น้ำหวาน เช่น Hale' s blue boy เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ

จำนวน _____ แก้ว/วัน หรือ _____ แก้ว/สัปดาห์

( ) รับประทานนานๆครั้ง

- ทอฟฟี่

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ จำนวน ____ เม็ด/วัน

( ) รับประทานนานๆครั้ง

8) นมและผลิตภัณฑ์นม

- นมบรรจุกล่องหรือขวด
  ( ) ไม่รับประทาน
  ( ) รับประทานเป็นประจำ
  ชนิด ( ) ขาดมันเนย ( ) พร่องมันเนย ( ) ไขมันเต็มส่วน
  จำนวน ____ กล่อง/วัน หรือ _____กล่อง/สัปดาห์
  ( ) รับประทานนานๆครั้ง
- นมเปรี้ยว/ยาคูลท์
  ( ) ไม่รับประทาน
  ( ) รับประทานเป็นประจำ, จำนวน_____ ขวด/วัน หรือ __ขวด/สัปดาห์
  ( ) รับประทานนานๆครั้ง
- โยเกิร์ต
  ( ) ไม่รับประทาน
  ( ) รับประทานเป็นประจำ
  จำนวน _____ ถ้วย/วัน หรือ _____ ถ้วย/สัปดาห์
  ( ) รับประทานนานๆครั้ง
- โอวัลติน หรือไมโล
  ( ) ไม่รับประทาน
  ( ) รับประทานเป็นประจำ
  จำนวน ____ กล่อง/วัน หรือ _____ กล่อง/สัปดาห์
  ( ) รับประทานนานๆครั้ง
- นมถั่วเหลือง เช่น ไวตามิลค์, แลคตาซอย, วี-ซอย เป็นต้น
  ( ) ไม่รับประทาน
  ( ) รับประทานเป็นประจำ
  จำนวน _____ กล่อง/วัน หรือ _____ กล่อง/สัปดาห์
  ( ) รับประทานนานๆครั้ง

- ไอศกรีม

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ

จำนวน ____ ถ้วย/วัน หรือ ___ ถ้วย/สัปดาห์

( ) รับประทานนานๆครั้ง

9) อาหารฟาสต์ฟูดส์ เช่น แมคโดนัลด์, เบอร์เกอร์คิง, เคเอฟซี, เซสเตอร์กริลล์, พิซซ่า, แดรี่ควีน เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเฉลี่ยเดือนละ _____ ครั้ง

10) ผู้ประกอบอาหารให้รับประทาน

( ) บิดา มารดา หรือญาติ

( ) ลูกจ้าง หรือพี่เลี้ยง

( ) ซื้ออาหารจากร้านอาหาร

( ) อื่นๆ ระบุ _____

11) ความถี่ของการรับประทานอาหารนอกบ้าน _____ ครั้ง/สัปดาห์

2. รายการอาหารที่ชื่นชอบและบริโภคเป็นประจำ

คำชี้แจง: ให้น้องๆบอกรายการอาหารต่างๆที่ชื่นชอบ และบริโภคเป็นประจำของน้องเพื่อเติมในช่องว่างให้สมบูรณ์ด้วยค่ะลุยกันเลยค่ะ...

ข้าว หรือผลิตภัณฑ์จากธัญพืชที่ชอบรับประทาน ได้แก่	
กับข้าวที่ชอบรับประทาน ได้แก่	
อาหารจานเดียวที่ชอบรับประทาน ได้แก่	
ผักที่ชอบรับประทาน ได้แก่	
ผลไม้ที่ชอบรับประทาน ได้แก่	
นม หรือโยเกิร์ตที่ชอบรับประทาน ได้แก่ (ระบุชนิด และยี่ห้อด้วยนะคะ...)	
ขนมไทย ของหวาน และเบเกอรี่ที่ชอบรับประทาน ได้แก่	
ขนมขบเคี้ยวที่ชอบรับประทาน ได้แก่ (ระบุชนิด และยี่ห้อด้วยนะคะ...)	
อาหารฟาสต์ฟู้ดที่ชอบรับประทาน ได้แก่	
เครื่องดื่มที่ชอบรับประทาน (โปรดระบุชนิดและยี่ห้อ)	

แบบสอบถามความถี่ในการบริโภคอาหาร

(Food Frequency Questionnaire)

คำชี้แจง: ให้น้องๆเลือก√ ที่แสดงถึงความถี่ หรือจำนวนครั้งในการรับประทานอาหารชนิดต่างๆที่น้องรับประทานกันอยู่บ่อยๆเริ่มกันได้เลยค่ะ...

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
ข้าว หรือผลิตภัณฑ์จากธัญพืช						
- ข้าวสวย						
- ข้าวกล้อง หรือข้าวซ้อมมือ						
- ข้าวเหนียว						
- ข้าวต้ม หรือโจ๊ก						
- ก๋วยเตี๋ยว มักกะโรนี วุ้นเส้น ขนมจีน บะหมี่กึ่งสำเร็จรูป						
- ถั่วเมล็ดแห้ง ลูกเดือย ข้าวโอ๊ต ซีเรียล						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
ขนมปังชนิดต่างๆ						
- ขนมปังปอนด์						
- ขนมปังโฮลวีท						
- ขนมปังกรอบ						
- เค้ก โดนัท คุกกี้ แยมโรล มัฟฟินเบเกอรี่ต่างๆ						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
ผักชนิดต่างๆ						
- ผักใบเขียว เช่น ผักบุ้ง ผักตำลึง ผักคะน้า						
- ผักที่มีแป้งสูง เช่น เผือก มัน แห้ว มันแกว ข้าวโพด ฟักทอง ถั่วลันเตา						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
นม หรือผลิตภัณฑ์						
- นมขาดมันเนย						
- นมพร่องมันเนย						
- นมไขมันเต็มส่วน						
- โยเกิร์ตเต็มส่วน						
- โยเกิร์ตพร่องไขมัน						
- นมเปรี้ยว หรือยาคูลย์						
- ไมโล หรือโอวัลติน						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
ผลไม้						
- ผลไม้ที่มีรสหวานน้อย เช่น ชมพู่ ฝรั่ง มะม่วงดิบ						
- ผลไม้ที่มีรสหวานมาก เช่น แตงโม ลำไย ลิ้นจี่ ทุเรียน						
- ผลไม้อบแห้ง เช่น ลูกพรุน ลูกเกด ลูกพลับ						
- ผลไม้ลอยแก้ว หรือผลไม้กระป๋อง						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
อาหาร หรือเครื่องดื่มที่มีน้ำตาล						
- น้ำผลไม้						
- น้ำผัก						
- ชา กาแฟ						
- ช็อกโกแลต หรือโกโก้						
- ลูกกวาด หรือทอฟฟี่						
- น้ำอัดลม						
- น้ำหวาน เช่น เฮลส์บลูบอย						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
ขนม						
- ขนมขบเคี้ยวรสหวาน เช่น ปาร์ตี้ ขนมอบกรอบเคลือบช็อคโกแลต						
- ขนมขบเคี้ยวรสเค็ม เช่น มันฝรั่งทอดกรอบ ข้าวเกรียบกุ้ง						
- ขนมทอดน้ำมัน เช่น กล้วยทอด ปาท่องโก๋						
- ขนมใส่กะทิ เช่น ข้าวมันบัวลอย						
- ของหวานที่ทำจากไข่แดง เช่น ทองหยิบ ทองหยอด						
- ขนมใส่น้ำเชื่อม เช่น กล้วยเชื่อม ฟักทองเชื่อม						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร					
	ทุกวัน	สัปดาห์ละ		เดือนละ		ไม่รับประทาน
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
อาหารฟาสต์ฟู้ด						
- ไก่ทอด เฟรนซ์ฟราย นัดเก๊ต						
- แฮมเบอร์เกอร์ แซนด์วิช						
- ขนมทอดน้ำมัน เช่น กล้วยทอด ปาท่องโก๋						
- บาร์บีคิว						
- พิซซ่า						
- สลัด น้ำสลัด						
- ไอศกรีม						

3. บันทึกรายการอาหารที่บริโภคโดยปกติใน 1 วัน

คำชี้แจง : จงกรอกข้อมูลเวลาและรายการอาหารที่รับประทานโดยปกติใน 1 วันลงในช่องว่าง

มื้อเช้า

โดยปกติรับประทานเวลา	อาหารเช้าที่รับประทานอยู่บ่อยๆ	อาหารที่รับประทานบ้างเป็นบางครั้ง

ไม่รับประทานอาหารเช้า

มื้อกลางวัน

โดยปกติรับประทานเวลา	อาหารกลางวันที่รับประทานอยู่บ่อยๆ	อาหารที่รับประทานบ้างเป็นบางครั้ง

ไม่รับประทานอาหารกลางวัน

มื้อเย็น

โดยปกติรับประทานเวลา

อาหารเช้าที่รับประทานอยู่บ่อยๆ

อาหารที่รับประทานบ้างเป็นบางครั้ง

ไม่รับประทานอาหารเย็น

มื้อว่างเย็น หรือมื้อก่อนนอน

โดยปกติรับประทานเวลา

อาหารเช้าที่รับประทานอยู่บ่อยๆ

อาหารที่รับประทานบ้างเป็นบางครั้ง

ไม่รับประทานอาหารว่างเย็น หรือมื้อก่อนนอน

แบบบันทึกการบริโภคอาหาร

(Food Record)

ชื่อ _____ นามสกุล _____ ชื่อเล่น _____

รายการอาหารวันที่ _____

ข้อแนะนำในการบันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง :

1. แบบบันทึกการบริโภคอาหาร 7 วัน จะต้องครอบคลุมการบริโภคทั้งในวันธรรมดาและวันหยุดสุดสัปดาห์ ดังนั้นจึงขอความร่วมมือให้บันทึกการบริโภคอาหารในวันธรรมดาเป็นเวลา 5 วัน และในวันหยุดเสาร์-อาทิตย์ เป็นเวลา 2 วัน
2. บันทึกอาหารทุกชนิดรวมทั้งขนมและเครื่องดื่มที่รับประทานตลอดวัน ตั้งแต่ตื่นนอน จนเข้านอน (บันทึกเฉพาะปริมาณที่รับประทานเท่านั้น)
3. บันทึกอาหารที่รับประทานทั้งที่บ้านและนอกบ้าน
4. ข้อความต่อไปนี้เป็นสิ่งจำเป็นในการบันทึก
    - ระบุส่วนประกอบของอาหารแต่ละชนิด พร้อมทั้งปริมาณหรือปริมาตร อาหารที่เป็นของแข็งให้ระบุเป็นช้อนตวงหรือทัพพี ส่วนอาหารที่เป็นของเหลวให้ระบุปริมาตรเป็นซีซี หรือระบุตามที่ตวง-วัดที่ใช้อยู่ที่บ้าน ถ้าไม่สามารถประมาณปริมาณได้ให้พยายามบันทึกในรูปขนาดแทน เช่น 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
    - ควรระบุว่าอาหารที่รับประทานปรุงอย่างไร เช่น ปลาทูทอด ไก่ย่าง ไข่ต้ม เป็นต้น
    - การเติมน้ำตาล น้ำเชื่อมหรือกะทิลงในเครื่องดื่ม อาหารของหวานชนิดต่างๆ ให้ระบุปริมาณด้วย เช่น น้ำตาล 2 ช้อนชา ในกาแฟ 1 ถ้วย

แบบบันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง

ประจำวัน _____ ที่ _____ เดือน _____ พ.ศ. _____

ชื่อ _____ นามสกุล _____ ชื่อเล่น _____

มื้ออาหาร เวลา (น.)	สถานที่	รายการอาหาร	ส่วนประกอบของอาหาร	ปริมาณ หรือ ปริมาตร ของอาหาร

APPENDIX D

แบบประเมินความรู้และความเข้าใจก่อนและหลังการเรียนรู้
เรื่องการวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต
(KAP: Pre-test, Post-test)

ชื่อ _____ **ชื่อเล่น** _____**เลขที่**_____

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่น้องเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

<u>ตอนที่ 1</u> การประเมินผลความรู้ความเข้าใจเกี่ยวกับโรคเบาหวาน และการกินอาหารเพื่อควบคุม เบาหวานที่เหมาะสม

1. เบาหวานประเภทที่ 1ที่พบบ่อยในเด็ก เกิดจากสาเหตุใด
   - ก. ตับอ่อนถูกทำลายโดยน้ำตาล
   - ข. ตับอ่อนไม่สามารถสร้างล้มเหลวสร้างอินซูลินไม่ได้
   - ค. การติดเชื้อบางชนิดทำให้กระเพาะถูกทำลาย
   - ง. ความอ้วนทำให้ร่างกายไม่สามารถควบคุมอินซูลินได้ดี

2. ข้อใดเป็นอาการบ่งชี้ของภาวะระดับน้ำตาลในเลือดต่ำ
   - ก. ผื่นขึ้นตามลำตัว
   - ข. ท้องเสีย มีไข้ อาเจียน
   - ค. ใจสั่น เหงื่อ ออกมาก อ่อนเพลีย
   - ง. ไม่อยากอาหาร น้ำหนักตัวลด

3. หลักการสำคัญของเทคนิคการนับหน่วยคาร์โบไฮเดรต คือข้อใด
   - ก. คาร์โบไฮเดรตให้รสหวานมากกว่าสารอาหารชนิดอื่น
   - ข. คาร์โบไฮเดรตสามารถทำให้ระดับน้ำตาลในเลือดสูงได้มากกว่าสารอาหารชนิดอื่นๆ
   - ค. ปริมาณคาร์โบไฮเดรตมีความสำคัญต่อระดับน้ำตาลในเลือดมากกว่าประเภทของคาร์โบไฮเดรต
   - ง. ถูกทั้งข้อ ข และ ค

4. ข้อใดต่อไปนี้เป็นข้อความที่**ถูกต้อง**

ก. เกลือแร่ และวิตามินให้พลังงานแก่ร่างกาย

ข. ไขมัน 1 กรัม ให้พลังงาน 4 กิโลแคลอรี

ค. คาร์โบไฮเดรต 1 กรัม ให้พลังงาน 4 กิโลแคลอรี

ง. โปรตีน 1 กรัม ให้พลังงาน 7 กิโลแคลอรี

5. สารอาหารชนิดใดที่ช่วยในการลดการดูดซึมไขมันและน้ำตาลในเลือด และยังช่วยให้ระบบขับถ่ายดีขึ้น

ก. วิตามินซี

ข. โปรตีน

ค. ใยอาหาร

ง. แคลเซียม

6. หมวดอาหารในข้อใด ที่ให้คาร์โบไฮเดรต

ก. ข้าว-แป้ง, นม, ผัก, ผลไม้

ข. ข้าว-แป้ง, ไขมัน, นม, ผลไม้

ค. ข้าว-แป้ง, เนื้อสัตว์, ผัก, ไขมัน

ง. ข้าว-แป้ง, เนื้อสัตว์, ผัก, ผลไม้

7. หนึ่งหน่วยคาร์โบไฮเดรต หมายถึง คาร์โบไฮเดรตจำนวนกี่กรัม

ก. 10 กรัม

ข. 15 กรัม

ค. 20 กรัม

ง. 25 กรัม

8. อาหารหมวดนม 1 ส่วนแลกเปลี่ยนให้คาร์โบไฮเดรตกี่กรัม

ก. 18 กรัม

ข. 15 กรัม

ค. 12 กรัม

ง. 5 กรัม

9. เครื่องดื่มชนิดใดที่ต้องนับหน่วยคาร์โบไฮเดรต

ก. น้ำโซดา

ข. น้ำอัดลมไดเอท

ค. ชามะนาวใส่น้ำตาลเทียม

ง. น้ำแดงเฮลซ์บลูบอย

10. ข้อใดต่อไปนี้เป็นข้อที่**ไม่ถูกต้อง**

ก. มังคุด 4 ผล มีคาร์โบไฮเดรต เท่ากับ ส้มเขียวหวาน 1 ผลกลาง

ข. ข้าวกล้อง 1 ทัพพี มีคาร์โบไฮเดรต เท่ากับ ขนมปังโฮลวีท 1 แผ่น

ค. กล้วยน้ำว้า 1 ผล มีคาร์โบไฮเดรต เท่ากับขนมจีน 1 จับใหญ่

ง. โยเกิร์ต 1 ถ้วยตวง มีคาร์โบไฮเดรตเท่ากับผักคะน้าสุกแค่ 1 ทัพพี

11. ข้อใดต่อไปนี้ เป็นแหล่งอาหารที่ประกอบด้วยคาร์โบไฮเดรต

ก. ข้าวสวย เนยแข็ง เม็ดบัวต้ม

ข. กุ้งแม่น้ำ ฟักทอง มันฝรั่งต้ม

ค. ข้าวเม่า หมูสามชั้น มันเทศต้ม

ง. ข้าวกล้อง ขนมปังโฮลวีท ข้าวโพดต้ม

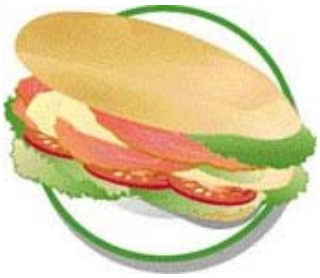
12. อาหารชนิดใดมีปริมาณหน่วยคาร์โบไฮเดรต หรือจำนวนคาร์บ**น้อยที่สุด**

ก.

พิซซ่าต้มยำกุ้ง

ข.

เนื้อปลาลวกจิ้มน้ำพริก

ค.  แซนด์วิชแฮม

ง. คุ๊กกี้ข้าวโอ๊ต

<u>ตอนที่ 2</u> การประเมินผลด้านทัศนคติต่อการควบคุมเบาหวานและการวางแผนการกินอาหารด้วยตนเอง

13. เบาหวานคือ การเสียสมดุลย์ของการเผาผลาญอาหารทำให้น้ำตาลในเลือดสูงขึ้น จึงต้องปรับสิ่งใดต่อไปนี้ให้สมดุลย์

ก. การควบคุมอาหาร การออกกำลังกาย และการนอนหลับ

ข. การควบคุมอาหาร การทำสมาธิ และการฉีดอินซูลิน

ค. การควบคุมอาหาร การออกกำลังกาย และการดูแลความสะอาดของร่างกาย

ง. การควบคุมอาหาร การออกกำลังกาย และการฉีดอินซูลิน

14. ข้อใดคือผลกระทบที่ได้รับ หากเราไม่มีการควบคุมเบาหวานที่ดี

ก. สามารถปรับปริมาณอินซูลินได้ตามความต้องการ

ข. ระดับน้ำตาลในเลือดสูงเกิน หรือต่ำเกินเกณฑ์เป้าหมาย

ค. ความต้องการพลังงานของร่างกายเปลี่ยนแปลงไป ทำให้อยากอาหารน้อยลง

ง. ถูกทุกข้อ

15. เป้าหมายในการวางแผนการบริโภคอาหาร คือข้อใด

ก. ป้องกันและชะลอภาวะแทรกซ้อนของโรคเบาหวาน

ข. ช่วยควบคุมระดับน้ำตาลในเลือดให้ใกล้เคียงค่าปกติมากที่สุด

ค. เพื่อให้ได้รับพลังงานและสารอาหารครบถ้วน สามารถเจริญเติบโตได้ตามวัย

ง. ถูกทุกข้อ

16. ข้อใดเป็นความคิดที่**ถูกต้อง**เกี่ยวกับการวางแผนการบริโภคอาหารเพื่อการควบคุมเบาหวานที่ดี

ก. การนับหน่วยคาร์โบไฮเดรตเป็นวิธีการจำกัดชนิดของอาหาร

ข. รายการอาหารแลกเปลี่ยนช่วยให้การประกอบอาหารรวดเร็วขึ้น

ค. การฝึกวางแผนการกินอาหารด้วยตนเองช่วยให้ควบคุมเบาหวานได้ดีที่สุด

ง. การวางแผนการบริโภคอาหารไม่ได้มีส่วนช่วยลดภาวะแทรกซ้อนของเบาหวาน

17. ข้อใด**เป็น**ประโยชน์โดยตรงของเทคนิคการนับหน่วยคาร์โบไฮเดรต

ก. ช่วยให้สามารถวางแผนการบริโภคอาหารที่เหมาะสมเพื่อควบคุมระดับน้ำตาลในเลือดได้ดี

ข. ช่วยให้สามารถปรับปริมาณอินซูลินได้อย่างเหมาะสม สอดคล้องกับแผนการกินอาหารที่กำหนดไว้ ภายใต้การดูแลของทีมแพทย์ผู้ดูแลรักษา

ค. ช่วยลดเวลาในการประกอบอาหารในแต่ละมื้อได้

ง. ข้อ ก และ ข ถูก

18. ข้อใดกล่าวถูกต้องในการดูแลเบาหวานด้วยตนเอง

ก. หมั่นพยายามตรวจระดับน้ำตาลในเลือดด้วยตนเองอยู่เสมอ

ข. การกินอาหารไม่ตรงเวลาเป็นสาเหตุของระดับน้ำตาลในเลือดต่ำ

ค. การกินยาลดระดับน้ำตาลในเลือดเป็นการควบคุมเบาหวานที่ง่ายที่สุด

ง. ถ้าควบคุมอาหารได้ดี ไม่จำเป็นต้องควบคุมการออกกำลังกายและฉีดอินซูลิน

19. น้องๆเห็นด้วยหรือไม่กับคำกล่าวที่ว่า **“เบาหวานเป็นโรคเรื้อรังที่พบบ่อย ไม่สามารถรักษาให้หายขาดได้ แต่สามารถมีชีวิตอย่างเป็นปกติสุขได้”**

ก. ไม่เห็นด้วย เพราะเบาหวานมักมีภาวะแทรกซ้อนอยู่เสมอ แม้จะควบคุมดีเพียงใดก็ตาม

ข. ไม่เห็นด้วย เพราะเบาหวานเป็นโรคทางพันธุกรรมที่ไม่สามารถควบคุมได้เลย

ค. เห็นด้วย เพราะการกินยาและฉีดอินซูลินก็สามารถควบคุมเบาหวานได้อย่างดีไร้กังวล

ง. เห็นด้วย เพราะการเรียนรู้การวางแผนการกินที่ดีทำให้เรารู้จักกินพอดีและควบคุมเบาหวานได้อย่างดี

<u>ตอนที่ 3</u> การประเมินผลด้านการนำความรู้ที่ได้รับไปใช้อย่างถูกต้องในการควบคุมเบาหวานและการวางแผนการกินอาหารด้วยตนเอง

20. ผู้ใดสามารถดูแลตัวเองได้ดีที่สุดเมื่อระดับน้ำตาลในเลือดสูงขึ้นมาก

ก. น้องช้างลดปริมาณอินซูลินทันที

ข. น้องสิงโตลดปริมาณคาร์โบไฮเดรตในมื้ออาหารระหว่างวัน

ค. น้องแพนด้าเพิ่มปริมาณคาร์โบไฮเดรตในมื้ออาหารระหว่างวัน

ง. น้องเสือเพิ่มระยะเวลาหรือความหนักของการออกกำลังกาย

21. แหล่งข้อมูลอ้างอิงที่ให้ข้อมูลปริมาณคาร์โบไฮเดรต สามารถดูจากที่ใดได้บ้าง

ก. ฉลากโภชนาการ

ข. รายการอาหารแลกเปลี่ยน

ค. เอกสาร หรือ แผ่นพับแสดงคุณค่าทางโภชนาการของอาหาร

ง. ถูกทุกข้อ

22. อาหารเช้าประกอบด้วย (1) นมขาดมันเนย 1 แก้ว (240 ซีซี)
(2) ขนมปังโฮลวีท 2 แผ่น
(3) กล้วยน้ำว้า 1 ผลกลาง

จงคำนวณ หรือ นับหน่วยคาร์โบไฮเดรตที่ได้จากการรับประทานอาหารเช้ามื้อนี้

ก. 63 กรัม หรือ 4 คาร์บ

ข. 64 กรัม หรือ 4 คาร์บ

ค. 65 กรัม หรือ 4 คาร์บ

ง. 66 กรัม หรือ 4 คาร์บ

23. เราควรเพิ่มอาหารใดต่อไปนี้เมื่อมีระดับน้ำตาลในเลือดน้อยกว่า 70 มิลลิกรัมต่อเดซิลิตร

ก. ปลาทูทอด 1 ตัว

ข. ผัดผักบุ้ง 1 จาน

ค. น้ำตาล 2 ก้อน

ง. เนยสด 2 ก้อน

24. เด็กคนไหนปฏิบัติตัวได้ถูกต้องในการดูแลสุขภาพตัวเองด้านการกินอาหารอย่างถูกวิธี

ก. อาราเล่ชอบกินอาหารที่ประกอบด้วย เนย น้ำมันหมู เบคอน และกะทิ

ข. ชินจังเลือกกินเนื้อสัตว์ เช่น หมูไม่ติดมัน น่องไก่เลาะหนัง

ค. โดเรม่อนชอบกินอาหารประเภททอดที่ใช้น้ำมันปาล์ม

ง. โนบิตะชอบกินขนมปังเบเกอรี่ใช้มาการีนเป็นส่วนประกอบ

25. ผู้ใดวางแผนการกินอาหารได้เหมาะสมและเพียงพอต่อความต้องการของร่างกาย

ก. รุจชอบทานเนื้อสัตว์ วันละ 2 ช้อนโต๊ะ

ข. บี้ดื่มนมสดแทนข้าว วันละ 4-5 แก้วเป็นประจำ

ค. สิงโตมักทานข้าวสวย วันละ 6-11 ทัพพี

ง. นิชคุณมักทานผัก วันละ 1 ทัพพี ก็เพียงพอ

26. ผู้ใดมีการปฏิบัติเกี่ยวกับการกินอาหารอย่างเหมาะสม

ก. สิงโตชอบกินขนมขบเคี้ยวกรอบ

ข. แก้มมักเลือกซื้ออาหารที่มีสีสวยน่ารับประทาน

ค. บี้มักดื่มเครื่องดื่มชูกำลังเมื่อต้องการความสดชื่น

ง. รุจมักคำนึงถึงคุณค่าทางโภชนาการก่อนเลือกซื้ออาหาร

27. ผู้ใดมีการตอบสนองต่อปัญหาของการคุมเบาหวานในทางลบ

ก. คุณหญิงระย้าคิดว่าควรจะเลิกคุมเบาหวานดีกว่า คงแก้ปัญหานี้ไม่ได้แน่ ทำไปก็คุมไม่ได้หรอก

ข. คุณหนูยิ้มมองเห็นว่าอะไรคือปัญหาของตนเองในการคุมเบาหวาน แล้วตั้งใจที่จะจัดการกับปัญหานั้น

ค. กล้าพยายามสังเกตพฤติกรรมการกินของตนเอง เพื่อหาจุดบกพร่องในการวางแผนบริโภคอาหารเสมอ

ง. แก้วคิดว่าการวางแผนการกินอาหารเป็นขั้นตอนหนึ่งเพื่อการควบคุมเบาหวาน แม้จะดูยุ่งยาก แต่เดี๋ยวก็ผ่านมันไปได้

28. ผู้ใดมีความคิดที่เหมาะสมที่สุดในการดูแลตัวเองเพื่อควบคุมเบาหวาน

ก. แป้งร่ำมักตรวจระดับน้ำตาลในเลือดเมื่อรู้สึกอ่อนเพลีย และเวียนศีรษะ

ข. แป้งจี่มักออกกำลังกายอย่างสม่ำเสมอ โดยเริ่มออกกำลังกายแบบหนักก่อน แล้วจึงค่อยๆลดความแรงลง

ค. ถุงข้าวมักกินอาหารโดยคำนึงถึงแต่ปริมาณคาร์โบไฮเดรต แต่ไม่คำนึงถึงปริมาณโปรตีนและไขมัน

ง. ถุงแป้งมักฝึกชั่ง ตวง วัด หรือคาดคะเนปริมาณของอาหาร เพื่อช่วยให้นับหน่วยคาร์โบไฮเดรตง่ายขึ้น

29. ผู้ใดปฏิบัติตัว**ถูกต้อง**เมื่อเป็นเบาหวาน

ก. ผู้ใหญ่ลีคิดว่าไม่จำเป็นต้องควบคุมการกินอาหารประเภทขนม

ข. นางมาปล่อยตัวให้อ้วน โดยเน้นการกินอาหารประเภทแป้ง น้ำตาลและไขมัน

ค. ผู้ใหญ่แดงมักกินยาควบคุมน้ำตาลในเลือดเอง โดยไม่ต้องไปพบแพทย์สม่ำเสมอ

ง. เจ้าปี๊ดตรวจระดับน้ำตาลในเลือดเป็นประจำ โดยควบคุมผลเลือดให้อยู่ระหว่าง 70-110 มิลลิกรัมต่อเดซิลิตร

30. ข้อใดเป็นการปฏิบัติตัวที่ถูกต้องในการออกกำลังกายอย่างเหมาะสมของผู้เป็นเบาหวาน

ก. งดดื่มน้ำ เพื่อไม่ให้รู้สึกจุกเสียดเมื่อออกกำลังกาย

ข. งดกินอาหารพวกแป้ง ก่อนและหลังการออกกำลังกาย

ค. ไม่จำเป็นต้องตรวจระดับน้ำตาลในเลือดก่อน และหลังออกกำลังกาย

ง. หลีกเลี่ยงการออกกำลังกาย ถ้าระดับน้ำตาลในเลือดสูงกว่า 250-300 มก./ดล.

APPENDIX E

แบบประเมินความรู้ความเข้าใจผ่านระบบเวปไซต์

เรื่อง เทคนิคการนับหน่วยคาร์โบไฮเดรต สำหรับสัปดาห์ที่ 1

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

1. ข้อใดคือผลลัพท์แรกจากการประเมินโดยกราฟแสดงเกณฑ์อ้างอิงการเจริญเติบโตของเด็กอายุ 5-18 ปีขึ้นไป

จ. น้ำหนักที่เหมาะสมตามเกณฑ์

ฉ. พลังงานที่เหมาะสมตามเกณฑ์

ช. จำนวนคาร์โบไฮเดรตที่เหมาะสม

ซ. ความเสี่ยงของการเกิดเบาหวาน

2. น้องถุงแป้งหนัก 45 กิโลกรัม สูง 155 เซนติเมตร จะมี**น้ำหนักที่เหมาะสม**เป็นเท่าไหร่ จากกราฟแสดงเกณฑ์อ้างอิงการเจริญเติบโตของเด็กหญิงอายุ 5-18 ปีขึ้นไป

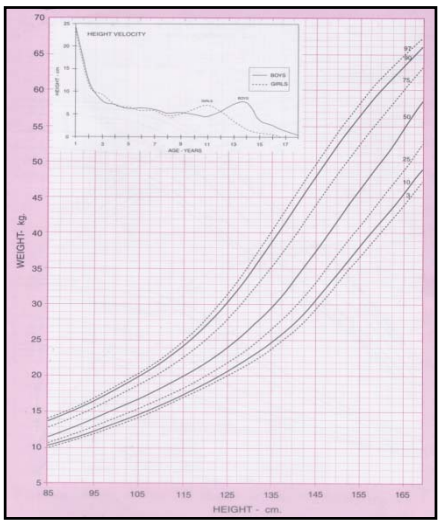
ก. 45 กิโลกรัม

ข. 55 กิโลกรัม

ค. 46 กิโลกรัม

ง. 56 กิโลกรัม

คลิกรูป



3. เด็กหญิงถุงแป้ง อายุ 15 ปี ส่วนสูง 156 ซม. น้ำหนัก 45 กิโลกรัม และมีภาวะโภชนาการอยู่ในเกณฑ์ผอม ควรจะได้รับปริมาณพลังงานที่เหมาะสมต่อวันเป็นเท่าไหร่ จากสูตรตัวอย่าง ดังนี้
(น้ำหนัก 10 กก. แรก x100) + (น้ำหนัก 10 กก. ต่อไป x 50) + (..... x 20)

จ. 1,500 กิโลแคลอรีต่อวัน

ฉ. 2,000 กิโลแคลอรีต่อวัน

ช. 2,500 กิโลแคลอรีต่อวัน

ซ. ไม่มีข้อใดถูก

4. เด็กหญิงถุงแป้ง จึงควรได้คาร์โบไฮเดรตที่เหมาะสม (กิโลแคลอรีต่อวัน) ในปริมาณเท่าไหร่

ก. 750 กิโลแคลอรีต่อวัน

ข. 1,000 กิโลแคลอรีต่อวัน

ค. 1,250 กิโลแคลอรีต่อวัน

ง. ไม่มีข้อใดถูก

5. เด็กหญิงถุงแป้ง จึงควรได้ปริมาณคาร์โบไฮเดรตเป้าหมาย (กรัมต่อวัน) ในปริมาณเท่าไหร่

ก. 190 กรัมต่อวัน

ข. 250 กรัมต่อวัน

ค. 313 กรัมต่อวัน

ง. ไม่มีข้อใดถูก

6. เด็กหญิงถุงแป้ง จึงกำหนดปริมาณคาร์โบไฮเดรตเป้าหมาย (หรือคาร์บต่อวัน) ในปริมาณเท่าไหร่

ก. 13 หน่วยคาร์โบไฮเดรตต่อวัน

ข. 17 หน่วยคาร์โบไฮเดรตต่อวัน

ค. 21 หน่วยคาร์โบไฮเดรตต่อวัน

ง. ไม่มีข้อใดถูก

7. หากเด็กหญิงถุงแป้ง แบ่งสัดส่วนการรับประทานอาหาร ดังนี้

- มื้อเช้า ปริมาณคาร์โบไฮเดรต 6 คาร์บ
- มื้อกลางวัน ปริมาณคาร์โบไฮเดรต 6 คาร์บ
- มื้อเย็น ปริมาณคาร์โบไฮเดรต 6 คาร์บ

ดังนั้น จะสามารถทานคาร์โบไฮเดรตก่อนนอนได้อีกหรือไม่และในปริมาณกี่คาร์บตามเป้าหมายที่กำหนด

ก. เพิ่มอีก 1 คาร์บ
ข. เพิ่มอีก 2 คาร์บ
ค. เพิ่มอีก 3 คาร์บ
ง. เพิ่มอีก 4 คาร์บ

8. เมื่อเด็กหญิงถุงแป้งทราบปริมาณหน่วยคาร์โบไฮเดรตเป้าหมายต่อวันแล้ว จึงควรกระจายให้ได้สัดส่วนในอาหารหมวดใดบ้าง

ก. ข้าวแป้ง ผัก ผลไม้ นม
ข. ข้าวแป้ง ผัก ผลไม้ ไขมัน
ค. ข้าวแป้ง เนื้อสัตว์ นม ไขมัน
ง. ข้าวแป้ง เนื้อสัตว์ ไขมัน ผลไม้

9. หากรับประทานอาหารโดยคำนึงถึงแต่ปริมาณคาร์โบไฮเดรต แต่ไม่คำนึงถึงปริมาณโปรตีนและไขมันจะทำให้น้ำหนักเกินและอ้วนได้ในที่สุด

ก. ถูก
ข. ผิด

10. อาหารคาร์โบไฮเดรตหมวดใดที่ให้พลังงาน**มากที่สุด**ในปริมาณที่เท่ากัน 1 คาร์บ

ก. ข้าว แป้ง
ข. นม
ค. ผลไม้
ง. ผัก

11. อาหารคาร์โบไฮเดรตหมวดใดที่ให้พลังงาน**น้อยที่สุด**ในปริมาณที่เท่ากัน 1 คาร์บ

ก. ข้าว แป้ง
ข. นม
ค. ผลไม้
ง. ผัก

12. เนื้อปลา 2 ช้อนโต๊ะ จะมีปริมาณคาร์โบไฮเดรตเป็นจำนวน 1 คาร์บ

ก. ถูก

ข. ผิด

13. เนื้อปลา 2 ช้อนโต๊ะ จะมีปริมาณคาร์โบไฮเดรตเป็นจำนวน 1 คาร์บ

ก. ถูก

ข. ผิด

14 ผักชนิดใดมีปริมาณคาร์โบไฮเดรตสูงสุด

ก. มะเขือเทศ

ข. ฟักทอง

ค. แตงกวา

ง. ผักบุ้ง

15. จากการ์ดอาหารต่อไปนี้ อาหารชนิดใดมีคาร์โบไฮเดรตเป็นองค์ประกอบ

ก. กุ้ง

ข. เนื้อไก่

ค. กล้วย

ง. น้ำมัน

แบบประเมินความรู้ความเข้าใจผ่านระบบเวปไซต์

เรื่อง เทคนิคการนับหน่วยคาร์โบไฮเดรต สำหรับสัปดาห์ที่ 2

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

1. ข้อใดเป็นวิธีการฝึกหาปริมาณคาร์โบไฮเดรตในอาหารที่รับประทานโดยทั่วไป

ก. ตรวจสอบข้อมูลอาหารผ่านเวปไซด์กินพอดี

ข. นำอาหารนั้นมาฝึก ชั่ง ตวง วัด ปริมาณด้วยตนเองที่บ้าน

ค. สอบถามปริมาณอาหารจากร้านอาหาร หรือดูฉลากโภชนาการ

ง. ถูกทุกข้อ

2. อาหารหมวดข้าวแป้ง 1 ส่วน มีพลังงาน 80 กิโลแคลอรี่ จะประกอบด้วยสารอาหารอะไรบ้าง และมีปริมาณเท่าไหร่

ก. คาร์โบไฮเดรต 5 กรัม โปรตีน 2 กรัม

ข. คาร์โบไฮเดรต 7 กรัม โปรตีน 2 กรัม

ค. คาร์โบไฮเดรต 12 กรัม โปรตีน 2 กรัม

ง. คาร์โบไฮเดรต 18 กรัม โปรตีน 2 กรัม

3. อาหารหมวดผลไม้ 1 ส่วน มีพลังงาน 60 กิโลแคลอรี่ จะประกอบด้วยสารอาหารอะไรบ้าง และมีปริมาณเท่าไหร่

ก. คาร์โบไฮเดรต 5 กรัม

ข. คาร์โบไฮเดรต 7 กรัม

ค. คาร์โบไฮเดรต 15 กรัม

ง. คาร์โบไฮเดรต 18 กรัม

4. หลักการสำคัญของเทคนิคการนับหน่วยคาร์โบไฮเดรต คือข้อใด

ก. คาร์โบไฮเดรตสามารถทำให้ระดับน้ำตาลในเลือดสูงได้มากกว่าสารอาหารชนิดอื่นๆ

ข. ปริมาณรวมของคาร์โบไฮเดรตมีความสำคัญต่อระดับน้ำตาลในเลือดมากกว่าประเภทของคาร์โบไฮเดรต

ค. คาร์โบไฮเดรตให้รสหวานมากกว่าสารอาหารชนิดอื่น

ง. ถูกทั้งข้อ ก และ ข

5. ข้อใดคือประโยชน์ของเทคนิคการนับหน่วยคาร์โบไฮเดรต

ก. ช่วยให้สามารถเลือกทานอาหารได้หลากหลายไม่จำเจ

ข. ช่วยให้สามารถทานอาหารหวานๆได้ไม่จำกัด

ค. ช่วยให้สามารถปรับปริมาณอินซูลินได้อย่างเหมาะสมกับแผนการบริโภคอาหาร

ง. ข้อ ก และ ค ถูก

6. ข้อใดคือความหมายของอาหารหมวดผักปริมาณ 1 คาร์บ หรือหน่วยคาร์โบไฮเดรต

ก. ผักบุ้ง 1 ทัพพี

ข. ผักตำลึง 1 ทัพพี

ค. ผักคะน้า 1 ทัพพี และผักคะน้า 1 ทัพพี

ง. ผักคะน้า 1 ทัพพี ผักบุ้ง 1 ทัพพี และผักตำลึง 1 ทัพพี

7. ข้อใด คือ การนับคาร์โบไฮเดรตปริมาณหนึ่งคาร์บได้อย่างถูกต้อง

ก. เงาะ 1 ผล ชมพู่ 1 ผล

ข. ไข่ 1 ฟอง บะหมี่สำเร็จรูป 1/3 ห่อ

ค. สาลี่ 1 ผล ส้มโอ 2 กลีบใหญ่

ง. ทุเรียน 1 ผล กล้วยตาก 1 ผล

8. ผู้ใดทานอาหารที่ประกอบด้วยคาร์โบไฮเดรตปริมาณรวม 2 คาร์บได้อย่างพอดี

ก. โดเรมอนดื่มน้ำเต้าหู้ 1 แก้ว (220 ซีซี) และกล้วยน้ำว้า 1 ผล

ข. ชินจังดื่มน้ำแอปเปิ้ล 1/2 ถ้วยตวง (120 ซีซี) และโจ๊ก 2 ถ้วยตวง

ค. อาราเล่ทานข้าวสวย 1 ทัพพี และมังคุด 1 ลูก

ง. โคนันทานขนมปังโฮลวีท 1 แผ่น และแฮม 1 แผ่น

9. อาหารในหมวดใดมีการคาดคะเนปริมาณได้อย่างถูกต้อง

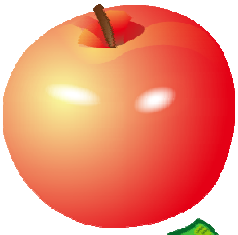
ก. ข้าว แป้ง 1 ส่วน คือ ข้าวเหนียว 1 ทัพพี

ข. ผลไม้ 1 ส่วน คือ มะละกอสุก ประมาณ 6-8 ชิ้นคำ

ค. ผัก 1 ส่วน คือ ฟักทองนึ่ง 2 ทัพพี

ง. นม 1 ส่วน คือ

10. ภาพอาหารใดมีปริมาณหน่วยคาร์โบไฮเดรต หรือจำนวนคาร์บ**มากที่สุด**

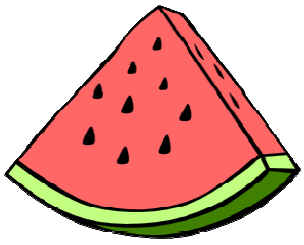
ก. 

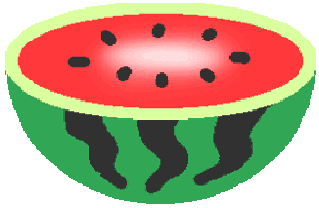
ข.

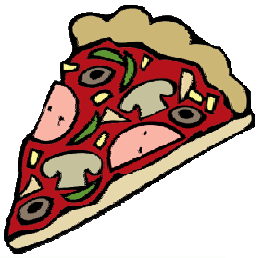
ค.

ง.

11. ภาพอาหารใดมีปริมาณหน่วยคาร์โบไฮเดรต หรือจำนวนคาร์บ**น้อยที่สุด**

ก. 

ข. 

ค. 

ง.

12. โปรตีน 1 ส่วน เท่ากับ เนื้อสัตว์ 1 ช้อนโต๊ะ หรือ เนื้อสัตว์ 15 กรัม

ก. ถูก

ข. ผิด

13. ไขมัน 1 ส่วน เท่ากับ น้ำมัน 1 ช้อนชา หรือ กะทิ 1 ช้อนโต๊ะ

ก. ถูก

ข. ผิด

14. ข้อใดคือการแลกเปลี่ยนอาหารหมวดข้าวแป้งกับอาหารหมวดผลไม้ได้**ถูกต้อง**

ก. ข้าวสวย 2 ทัพพี = ส้มเขียวหวาน 1 ผลใหญ่

ข. ข้าวต้ม 1 ทัพพี = ขนุน 4 ยวง

ค. ขนมปังปอนด์ 1 แผ่น = แตงโม 8 ชิ้นคำ

ง. ข้าวเหนียว 1/2 ทัพพี = มะม่วงดิบ 1 ลูก

15. ข้อใดคือการแลกเปลี่ยนอาหารหมวดนมกับอาหารหมวดอื่นๆได้**ถูกต้อง**

ก. นมจืดพร่องไขมัน 1 กล่อง = ลองกอง 6 ลูก + เนื้อสัตว์ไขมันต่ำ 2 ส่วน

ข. นมจืดไม่มีไขมัน 1 กล่อง = ชมพู่ 4 ลูก + เนื้อสัตว์ไขมันต่ำ 1 ส่วน + ไขมัน 2 ส่วน

ค. นมจืดไม่มีไขมัน 1 กล่อง = กล้วยหอม 1 ลูก + เนื้อสัตว์ไขมันต่ำ 1 ส่วน + ไขมัน 1 ส่วน

ง. นมจืดไขมันเต็มส่วน 1 กล่อง = ลิ้นจี่ 6 ลูก + เนื้อสัตว์ไขมันต่ำ 1 ส่วน + ไขมัน 1 ส่วน

แบบประเมินความรู้ความเข้าใจผ่านระบบเวปไซต์

เรื่อง เทคนิคการนับหน่วยคาร์โบไฮเดรต สำหรับสัปดาห์ที่ 3

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

1. อาหารใดที่ต้องนับหน่วยคาร์โบไฮเดรต จากเมนู **“ข้าวเหนียว+ส้มตำ+ไก่ย่าง+ลาบเป็ด**”

จ. ไก่ย่าง ลาบหมู

ฉ. ส้มตำ ลาบหมู

ช. ข้าวเหนียว ไก่ย่าง

ซ. ข้าวเหนียว ส้มตำ

2. อาหารใดที่ต้อง**ไม่ต้องนับ**หน่วยคาร์โบไฮเดรต จากเมนู **“ข้าวสวย+ผัดผักกะเฉด+ปลานิลทอด+บัวลอย”**

ก. ข้าวสวย

ข. บัวลอย

ค. ปลานิลทอด

ง. ผักกระเฉด

3. อาหารจานเดียวเมนูใด ที่ต้องนับหน่วยคาร์โบไฮเดรต

ก. ขนมจีนน้ำเงี้ยว

ข. สปาเกตตี้ไวท์ซอส

ค. ข้าวผัดกระเพราไข่ดาว

ง. ถูกทุกข้อ

4. อาหารว่างเมนูใด ที่ต้องนับหน่วยคาร์โบไฮเดรต

ก. เค้ก คุกกี้ ไอศครีม

ข. สาคูไส้หมู ขนมชั้น ทองม้วน

ค. ซาลาเปา ขนมจีบ ขนมไหว้พระจันทร์

ง. ถูกทุกข้อ

5. เครื่องดื่มชนิดใดที่**ไม่ต้อง**นับหน่วยคาร์โบไฮเดรต

ก. ชาเย็นโบราณ
ข. น้ำอัดลมไดเอท
ค. น้ำมะนาวโซดา
ง. น้ำแดงเฮลซ์บลูบอย

6. เด็กชายถุงข้าวรับประทานแฮมเบอร์เกอร์ขนาดจัมโบ้ มีปริมาณคาร์โบไฮเดรต 62 กรัม จะเท่ากับคาร์โบไฮเดรตกี่คาร์บ (หน่วยคาร์โบไฮเดรต)

ก. 2 คาร์บ
ข. 3 คาร์บ
ค. 4 คาร์บ
ง. 5 คาร์บ

7. เด็กหญิงถุงแป้งไปทานสุกี้กับเพื่อนๆ อาหารในข้อใด**ไม่ต้อง**นับหน่วยคาร์โบไฮเดรต

ก. บะหมี่ผัก
ข. วุ้นเส้น
ค. ผักบุ้ง
ง. ลูกชิ้นกุ้ง

8. ถุงแป้งและถุงข้าวสั่งอาหารที่ร้านพิซซ่าทานด้วยกัน อาหารในข้อใด**ไม่ต้อง**นับหน่วยคาร์โบไฮเดรต

ก. พิซซ่า
ข. ปีกไก่บาร์บีคิว
ค. ขนมปังกระเทียม
ง. น้ำอัดลมแบบเติมไม่อั้น

9. ถุงข้าวสั่งไปทานร้านอาหารตามสั่ง โดยสั่งข้าวราดกระเพราหมูไข่เจียว 1 จานและน้ำมะนาวไม่ใส่น้ำตาล 1 แก้ว มีส่วนประกอบ ดังนี้ ข้าวสวย 2 ทัพพี เนื้อหมู 4 ช้อนโต๊ะ ไข่เจียว 1 ฟอง ดังนั้นในมื้อนี้ถุงข้าวจะทานคาร์โบไฮเดรตประมาณกี่คาร์บ

ก. 1 คาร์บ
ข. 2 คาร์บ
ค. 3 คาร์บ
ง. 4 คาร์บ

10. อาหารประเภทยำชนิดใดมีจำนวนหน่วยคาร์โบไฮเดรต (คาร์บ) **มากที่สุด**

ก. ยำมะม่วง 1 จาน

ข. ยำถั่วพู 1 จาน

ค. ยำปลาทู 1 จาน

ง. ยำมาม่า 1 จาน

11. อาหารประเภทของว่างชนิดใดมีจำนวนหน่วยคาร์โบไฮเดรต (คาร์บ) **มากที่สุด**

ก. สาคูไส้หมู 1 จาน

ข. ทอดมันปลาและน้ำจิ้ม 1 จาน

ค. ปอเปี๊ยะทอดและน้ำจิ้ม 1 จาน

ง. ไส้กรอกอีสานทอด 1 ชิ้น

12. อาหารประเภทขนมไทยชนิดใดมีจำนวนหน่วยคาร์โบไฮเดรต (คาร์บ) **น้อยที่สุด**

ก. ขนมชั้น 1 ชิ้น

ข. บัวลอย 1 ชามแก้วเล็ก

ค. ทองหยอด 4 ชิ้น

ง. ขนมลูกชุบ 4 ลูก

13. ภาพอาหารใดมีปริมาณหน่วยคาร์โบไฮเดรต หรือจำนวนคาร์บ**มากที่สุด**

ก.

ข.

ค.

ง.

14. ภาพอาหารใดมีปริมาณหน่วยคาร์โบไฮเดรต หรือจำนวนคาร์บ**น้อยที่สุด**

ก.

ข.

ค.

ง.

15. ผู้ใดทานคาร์โบไฮเดรตในปริมาณ**มากที่สุด**

ก. รันม่าทานข้าวมันไก่ 1 จาน และเฟรนซ์ฟรายจัมโบ้ 1 ที่

ข. เคอิโงะทานยำวุ้นเส้น และน้ำส้มคั้น 1 แก้ว

ค. เคนอิจิทานบะหมี่ต้มยำ และชาไม่ใส่น้ำตาล

ง. มิซาเอะทานข้าวซอย1 ทัพพี และผัดผักบุ้ง 1 จาน

แบบประเมินความรู้ความเข้าใจผ่านระบบเวปไซต์

เรื่อง เทคนิคการนับหน่วยคาร์โบไฮเดรต สำหรับสัปดาห์ที่ 4

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

1. ถุงแป้งทานอาหารเช้ามื้อหนึ่งประกอบด้วย (1) นมพร่องมันเนย 1 แก้ว (240 ซีซี)
(2) ขนมปังโฮลวีท 2 แผ่น
(3) เนยเทียม 1 ก้อน
(3) กล้วยน้ำว้า 1 ผลกลาง

จงนับหน่วยคาร์โบไฮเดรตที่ได้จากการรับประทานอาหารในมื้อนี้

จ. 3 คาร์บ
ฉ. 4 คาร์บ
ช. 5 คาร์บ
ซ. 6 คาร์บ

2. ถุงข้าวอาหารกลางวันมื้อหนึ่งประกอบด้วย (1) ข้าวกล้อง 4 ทัพพี
(2) แกงเขียวหวานไก่ 1 ถ้วย
(3) แอปเปิ้ล 1 ผล
(3) โยเกิร์ต 1 ถ้วย

จงนับหน่วยคาร์โบไฮเดรตที่ได้จากการรับประทานอาหารในมื้อนี้

ก. 3 คาร์บ
ข. 5 คาร์บ
ค. 7 คาร์บ
ง. 9 คาร์บ

3. ข้อใดต่อไปนี้เป็นแหล่งอาหารคาร์โบไฮเดรตที่มีปริมาณ**ใยอาหารสูง**

ก. ข้าวสวย ขนมปังขาว เม็ดบัวต้ม
ข. ข้าวกล้อง ขนมปังโฮลวีท ข้าวโพดต้ม
ค. ข้าวเหนียว ขนมปังกรอบ มันฝรั่งต้ม
ง. ข้าวเม่า ขนมจีน มันเทศต้ม

4. อาหารฟาสซ์ฟู้ดในข้อใดต่อไปนี้ มีจำนวนหน่วยคาร์โบไฮเดรต หรือคาร์บ**มากที่สุด**

ก. ไอศครีมโคน
ข. พิซซ่าต้มยำกุ้งแบบแป้งบาง
ค. พิซซ่าต้มยำกุ้งแบบแป้งหนานุ่ม
ง. นัคเก็ตไก่ 6 ชิ้น

5. เมื่อปริมาณคาร์โบไฮเดรตเป้าหมายของถุงแป้งเท่ากับ **320 กรัมต่อวัน** ดังนั้นถุงแป้งจะทานได้กี่คาร์บต่อวัน

_____คาร์บ

6. เมื่อปริมาณคาร์โบไฮเดรตเป้าหมายของถุงข้าวเท่ากับ **350 กรัมต่อวัน** แต่ถุงข้าวทานได้เพียง 280 กรัม ดังนั้นถุงข้าวจะต้องทานเพิ่มอีกกี่คาร์บจึงจะได้ชื่อว่าเป็นคน **“กินพอดี”** ตัวจริง

_____คาร์บ

7. ผู้ใดเลือกทานอาหารมื้อเย็นได้เหมาะสม ตามเป้าหมายของตนเองที่กำหนดไว้ คือ **7 คาร์บ**

ก. เป็นต่อทานแฮมเบอร์เกอร์ 1 ชิ้น และน้ำอัดลมกลิ่นโคล่า 1 กระป๋อง
ข. พี่อู๊ดทานข้าวสวย 3 ทัพพี แกงส้มผักรวม 1 ถ้วย ชมพู่ 4 ผล และคุ๊กกี้ 2 ชิ้น
ค. พี่ยมข้าวสวย 3 ทัพพี แกงส้มผักรวม 1 ถ้วย ชมพู่ 4 ผล และซาลาเปาไส้หมู 1 ลูก
ง. พี่หมอนทานข้าวสวย 3 ทัพพี แกงจืดเต้าหู้หมูสับ 1 ถ้วย และนมพร่องมันเนย 1 กล่อง

8. ฮีโร่ตัวไหนสามารถวางแผนการรับประทานอาหารโดยแบ่งสัดส่วนจำนวนคาร์โบไฮเดรตได้อย่างเหมาะสม เมื่อมีจำนวนคาร์โบไฮเดรตเป้าหมาย เท่ากับ **18 คาร์บ**

ก. แบทแมนทานมื้อเช้า 4 คาร์บ มื้อว่างเช้า 2 คาร์บ มื้อเที่ยง 4 คาร์บ มื้อเย็น 4 คาร์บ
ข. ซูปเปอร์แมนทานมื้อเช้า 5 คาร์บ มื้อว่างเช้า 2 คาร์บ มื้อเที่ยง 3 คาร์บ มื้อเย็น 5 คาร์บ
ค. มดเอ็กซ์ทานมื้อเช้า 6 คาร์บ มื้อเที่ยง 5 คาร์บ มื้อเย็น 6 คาร์บ ก่อนนอน 1 คาร์บ
ง. สไปเดอร์แมนทานมื้อเช้า 6 คาร์บ มื้อเที่ยง 5 คาร์บ มื้อเย็น 5 คาร์บ ก่อนนอน 1 คาร์บ

9. อาหารชนิดใดสามารถรับประทานได้โดยไม่จำกัด

ก. เจลาตินชนิดไม่ใช่น้ำตาล
ข. น้ำอัดลมไดเอท
ค. ซุปใส
ง. ถูกทุกข้อ

10. จากการ์ดอาหารที่กำหนด ฮีโร่ตัวไหนเลือกอาหารมื้อเที่ยงอย่างเหมาะสม โดยทานคาร์โบไฮเดรตไม่เกิน 8 คาร์บ

ก. มดเอ็กซ์ทานทองหยิบ 4 ดอกและเต้าส่วน 2 ถ้วย

ข. ซูปเปอร์แมนทานข้าวหน้าเป็ด 1 จานและทองหยิบ 2 ดอก

ค. แบทแมนทานก๋วยเตี๋ยวเส้นเล็ก 2 ชาม และทองหยิบ 4 ดอก

ง. สไปเดอร์แมนทานก๋วยเตี๋ยวเส้นเล็ก 1 ชาม และข้าวหน้าเป็ด 1 จาน

11. จากภาพอาหารดังกล่าว อาหารชนิดใดมีปริมาณคาร์โบไฮเดรต**มากที่สุด**

ก.

ข.

ค.

ง.

12. อาหารจานเดียวชนิดใดมีปริมาณคาร์โบไฮเดรตมากที่สุด

ก. ข้าวหมกไก่

ข. กระเพาะปลา

ค. ขนมจีนน้ำยา

ง. ข้างยำปักษ์ใต้

12. อาหารสำเร็จรูปหรือเครื่องปรุงชนิดใดที่ต้องนับหน่วยคาร์โบไฮเดรต

ก. ซีอิ๊วขาว

ข. ซอสพริก

ค. น้ำมันหอย

ง. นมข้นหวาน

14. ถุงข้าวสั่งอาหารที่ร้านอาหารตามสั่ง มีรายการ ดังนี้

ข้าวราดกระเพราหมูไข่เจียว 1 จาน

(ข้าวสวย 2 ทัพพี เนื้อหมู 4 ช้อนโต๊ะ ไข่ 1 ฟอง น้ำมัน 3 ช้อนชา)

น้ำมะนาว 1 แก้ว **(น้ำตาล 3 ช้อนชา)**

ดังนั้นในมื้อนี้ถุงข้าวจะทานคาร์โบไฮเดรตประมาณกี่คาร์บ

จ. 1 คาร์บ

ฉ. 2 คาร์บ

ช. 3 คาร์บ

ซ. 4 คาร์บ

15. ถุงแป้งสั่งอาหารที่ร้านอาหารตามสั่ง มีรายการ ดังนี้

ผัดซีอิ๊วหมู 1 จาน

(ก๋วยเตี๋ยวเส้นใหญ่ 3 ทัพพี เนื้อหมู 4 ช้อนโต๊ะ ไข่ 1 ฟอง น้ำมัน 3 ช้อนชา)

น้ำมะนาว 1 แก้ว **(ไม่ใส่น้ำตาล)**

ดังนั้นในมื้อนี้ถุงข้าวจะทานคาร์โบไฮเดรตประมาณกี่คาร์บ

ก. 1 คาร์บ

ข. 2 คาร์บ

ค. 3 คาร์บ

ง. 4 คาร์บ

APPENDIX F

แบบประเมินความถูกต้องในการรับรู้และมโนทัศน์ผ่านระบบเวปไซต์

สัปดาห์ที่ 1 : แบบความรู้ทั่วไปเกี่ยวกับโรคเบาหวาน และการบริโภคอาหาร เพื่อการควบคุมเบาหวานที่เหมาะสม

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

1. เบาหวานประเภทที่ 1ที่พบบ่อยในเด็ก เกิดจากสาเหตุใด
   - จ. ตับอ่อนถูกทำลายโดยน้ำตาล
   - ฉ. ตับอ่อนล้มเหลวสร้างอินซูลินไม่ได้
   - ช. การติดเชื้อบางชนิดทำให้กระเพาะถูกทำลาย
   - ซ. ความอ้วน โดยร่างกายมีภาวะดื้อต่อเจ้าอินซูลิน

2. **ข้อใดไม่ได้เกี่ยวข้องกับเบาหวาน**
   - ฌ. เกิดโรคแทรกซ้อนในระยะท้ายของโรคที่ไต ตา หรือปลายประสาท
   - ญ. มีความผิดปกติในอินซูลิน โดยอินซูลินน้อยกว่าปกติ หรือเกิดภาวะดื้อต่ออินสุลิน
   - ฎ. เกิดไขมันในเลือดต่ำ ความดันโลหิตต่ำ นิ่วในถุงน้ำดี และความอ้วนน้ำตาลในเลือดสูงเกินปกติ
   - ฏ. เสี่ยงของการเกิดหลอดเลือดแดงตีบ ทำให้เกิดเป็นอัมพาต โรคหัวใจ หรือเส้นเลือดแดงส่วนปลายตีบ

3. ข้อใดเป็นอาการบ่งชี้ของภาวะระดับน้ำตาลในเลือดต่ำ
   - ก. ผื่นขึ้นตามลำตัว
   - ข. ท้องเสีย มีไข้ อาเจียน
   - ค. ใจสั่น เหงื่อ ออกมาก อ่อนเพลีย
   - ง. ไม่อยากอาหาร น้ำหนักตัวลด
4. ข้อใดเป็นอาการบ่งชี้ของระดับน้ำตาลในเลือดสูงร่วมกับภาวะมีกรดในเลือด (DKA)
   - ก. ซึมลงและไม่รู้สึกตัว (หรือโคม่า)
   - ข. หอบเหนื่อย ลมหายใจมีกลิ่นคล้ายผลไม้
   - ค. อาการคลื่นไส้ อาเจียน ปวดท้อง หายใจเร็วและแรง
   - ง. ถูกทุกข้อ

5. ผู้ใดปฏิบัติไม่ถูกต้องเมื่อเป็นเบาหวาน
    ก. คุณระย้าหมั่นดูแลทำความสะอาดมือและเท้าเป็นพิเศษ
    ข. คุณหนูยิ้มพยายามออกกำลังกายอย่างหนัก เพื่อความแข็งแรงของร่างกาย
    ค. อิ่มพกน้ำตาล หรือลูกกวาดติดตัวเสมอ และใช้ทันทีเมื่อสงสัยว่าทีอาการน้ำตาลต่ำ
    ง. จวนพยายามควบคุมอาหารสม่ำเสมอ และระมัดระวังการรับประทานอาหารพวกขนมขบเคี้ยว

6. ข้อใดคือลักษณะของอินซูลินที่ใช้ฉีด
    ก. อินซูลินแบบใส
    ข. อินซูลินแบบขุ่น
    ค. อินซูลินแบบแห้ง
    ง. ข้อ ก และ ข

7. หากเราทานอาหารมากเกินไป แต่ฉีดอินซูลินในปริมาณน้อยไป ส่งผลให้ระดับน้ำตาลในเลือดเป็นอย่างไร
    ก. ระดับน้ำตาลในเลือดปกติ
    ข. ระดับน้ำตาลในเลือดสูงขึ้น
    ค. ระดับน้ำตาลในเลือดต่ำลง
    ง. ถูกทุกข้อ

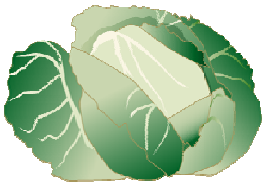
8. ผู้ใดสามารถดูแลตัวเองได้ดีเมื่อระดับน้ำตาลในเลือดสูงขึ้น
    ก. นิชคุณลดปริมาณอินซูลินในมื้ออาหารก่อนหน้า
    ข. เต้าหมิงซื่อปรับเวลาการฉีดอินซูลินให้เหมาะสมกับเวลามื้ออาหาร
    ค. ซันไช่เพิ่มปริมาณคาร์โบไฮเดรตในมื้ออาหารก่อนหน้า
    ง. เรนลดระยะเวลาหรือความหนักของการออกกำลังกาย

9. เราควรเพิ่มการรับประทานอาหารชนิดใดให้มากขึ้นเพื่อช่วยแก้ไขภาวะระดับน้ำตาลในเลือดสูงได้
    ก.

ข.

ค.

ง.



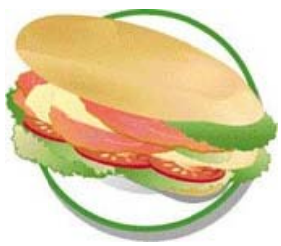
10. อาหารจานใดที่เด็กเบาหวานควรเลือกรับประทานมากที่สุด

ก.

ข.

ค.

ง.



11. เป้าหมายระดับน้ำตาลในเลือดก่อนอาหารของผู้เป็นเบาหวานคือ 100 – 130 มิลลิกรัมต่อเดซิลิตร

ก. ถูก

ข. ผิด

12.เป้าหมายระดับน้ำตาลในเลือดหลังอาหารของผู้เป็นเบาหวานมีค่าน้อยกว่า 200 มิลลิกรัมต่อเดซิลิตร

ข. ถูก

ค. ผิด

13. การทำกิจกรรมต่างๆ หรือใช้พลังงานน้อยเกินไปนั้นเป็นสาเหตุของระดับน้ำตาลในเลือดสูง

ก. ถูก

ข. ผิด

14. การรับประทานอาหารช้า หรือไม่ได้รับประทานอาหารมื้อนั้นๆเป็นสาเหตุของระดับน้ำตาลในเลือดต่ำได้

ก. ถูก

ข. ผิด

15. เราควรเลือกดื่มนมไขมันเต็มส่วน มากกว่าเลือกดื่มนมพร่องมันเนยหรือนมขาดไขมัน เพื่อช่วยควบคุมระดับน้ำตาลในเลือดให้เหมาะสม

ก. ถูก

ข. ผิด

แบบประเมินความถูกต้องในการรับรู้และมโนทัศน์ผ่านระบบเวปไซต์

สัปดาห์ที่ 2: เรื่อง ทักษะด้านการคาดคะเนปริมาณอาหารด้วยตนเองเพื่อฝึกการวางแผนการบริโภคอาหารให้เหมาะสม

ตอนที่ 1 คำชี้แจง: จงใช้ข้อมูลจากเมนูรายการอาหารแลกเปลี่ยนสำหรับการนับหน่วยคาร์โบไฮเดรต (e-food exchange list) และคลังภาพอาหาร (e-Food photo gallery) ในการฝึกค้นหาสัดส่วน หรือขนาดของอาหาร (Portion sizes) พร้อมทั้งฝึกคำนวณ หรือนับหน่วยคาร์โบไฮเดรตจากรายการอาหารต่อไปนี้ พร้อมเลือกคำตอบที่เหมาะสม

ตัวอย่าง: ข้าวต้ม 2 ทัพพี ⟹ **คาร์โบไฮเดรต 18 กรัม**

สตรอเบอร์รี่ 13 ผล ⟹ **คาร์โบไฮเดรต 1 คาร์บ**

(1) นมสดพร่องมันเนย _____ = คาร์โบไฮเดรต 12 กรัม

- 1/2 กล่อง
- 1/4 กล่อง
- 1 กล่อง
- 2 กล่อง

(2) กล้วยไข่ _____ = คาร์โบไฮเดรต 15 กรัม

- 1/2 ลูก
- 1 ลูก
- 2 ลูก
- 3 ลูก

(3) ลูกเกด _____ = คาร์โบไฮเดรต 1 คาร์บ

- 1 ช้อนโต๊ะ
- 2 ช้อนโต๊ะ
- 3 ช้อนโต๊ะ
- 4 ช้อนโต๊ะ

(4) น้ำแอปเปิ้ล _____ = คาร์โบไฮเดรต 30 กรัม

- 1/3 ถ้วยตวง
- 1/2 ถ้วยตวง
- 1 ถ้วยตวง
- 2 ถ้วยตวง

(5) ข้าวสวย _____ = คาร์โบไฮเดรต 2 คาร์บ

- 1/2 ทัพพี
- 1 ทัพพี
- 2 ทัพพี
- 3 ทัพพี

(6) ผักปุ้งสุก _____ = คาร์โบไฮเดรต 5 กรัม

- 1/2 ถ้วยตวง
- 1 ถ้วยตวง
- 2 ถ้วยตวง
- 3 ถ้วยตวง

(7) ทองหยอด _____ = คาร์โบไฮเดรต 24 คาร์บ

- 2 เม็ด
- 4 เม็ด
- 6 เม็ด
- 8 เม็ด

(8) ไอศกรีม _____ = คาร์โบไฮเดรต 2 คาร์บ

- 1/2 โคน
- 1 โคน
- 2 โคน
- 3 โคน

(9) ขนมจีบ _____ = คาร์โบไฮเดรต 1 คาร์บ

- 1 ชิ้น
- 2 ชิ้น
- 3 ชิ้น
- 4 ชิ้น

(10) ข้าวต้ม _____ = คาร์โบไฮเดรต 36 กรัม

- 1 ทัพพี
- 2 ทัพพี
- 4 ทัพพี
- 6 ทัพพี

(11) บะหมี่สำเร็จรูป 1 ห่อ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(12) ข้าวโพดอ่อน 1 ทัพพี = คาร์โบไฮเดรต _____ กรัม

- 5 กรัม
- 10 กรัม
- 15 กรัม
- 20 กรัม

(13) แอปเปิ้ล 2 ผลเล็ก = คาร์โบไฮเดรต _____ กรัม

- 5 กรัม
- 10 กรัม
- 15 กรัม
- 20 กรัม

(14) บร็อคโคลีลวก 1/2 ถ้วยตวง = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(15) นมเปรี้ยวพร้อมดื่ม 200 ซีซี = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(16) นมถั่วเหลือง 1 แก้ว (220 ซีซี) = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(17) ซาลาเปา 1 ลูก = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(18) มันฝรั่งแผ่นทอดกรอบ 12-18 ชิ้น = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(19) นมข้นหวาน 2 ช้อนโต๊ะ = คาร์โบไฮเดรต _____ คาร์บ

- 1/2 คาร์บ
- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ

(20) น้ำตาลทราย 1 ช้อนชา = คาร์โบไฮเดรต _____ กรัม

- 5 กรัม
- 10 กรัม
- 15 กรัม
- 20 กรัม

ตอนที่ 2

คำชี้แจง: จงตอบคำถามต่อไปนี้ โดยอาศัยข้อมูลโภชนาการของฉลากมันฝรั่งทอดกรอบที่แสดงไว้ข้างล่างนี้

ข้อมูลโภชนาการ	
หนึ่งหน่วยบริโภค : 1/2 ซอง (40 กรัม)	
จำนวนหน่วยบริโภคต่อซอง: 2	
คุณค่าทางโภชนาการต่อหนึ่งหน่วยบริโภค	
พลังงานทั้งหมด 240 กิโลแคลอรี (พลังงานจากไขมัน 90 กิโลแคลอรี)	
	ร้อยละของปริมาณที่แนะนำต่อวัน*
ไขมันทั้งหมด 14 ก.	15 %
ไขมันอิ่มตัว 4.5 ก.	22 %
โคเลสเตอรอล 0 มก.	0 %
โปรตีน 3 ก.	
คาร์โบไฮเดรตทั้งหมด 28 ก.	
ใยอาหาร น้อยกว่า 1 ก.	8 %
น้ำตาล 2 ก.	3 %
โซเดียม 430 มก.	14 %

ร้อยละของปริมาณที่แนะนำต่อวัน*			
วิตามินเ อ	0 %	**วิตามินบี 1**	น้อยกว่า 2 %
วิตามินบี 2	น้อยกว่า 2 %	**แคลเซียม**	2 %
เหล็ก	6 %		

ร้อยละของปริมาณสารอาหารที่แนะนำให้บริโภคต่อวันสำหรับคนไทยอายุตั้งแต่ 6 ปี ขึ้นไป (Thai RDI) โดยคิดจากความต้องการพลังงานวันละ 2,000 กิโลแคลอรี

จากข้อมูลโภชนาการบนฉลากมันฝรั่งทอดกรอบ 1 ซอง (น้ำหนักสุทธิ 80 กรัม)

(1) ถ้าเรารับประทานข้าวเกรียบกุ้ง 1/2 ซอง (40 กรัม)

ก. 5 กรัม หรือ 1 คาร์บ

ข. 14 กรัม หรือ 1 คาร์บ

ค. 28 กรัม หรือ 2 คาร์บ

ง. 36 กรัม หรือ 3 คาร์บ

(2) ถ้าเรารับประทานมันฝรั่งทอดกรอบ 1/4 ซอง (20 กรัม) จะได้รับคาร์โบไฮเดรตจำนวนกี่กรัม และกี่คาร์บ

ก. 5 กรัม หรือ 1 คาร์บ

ข. 14 กรัม หรือ 1 คาร์บ

ค. 28 กรัม หรือ 2 คาร์บ

ง. 36 กรัม หรือ 3 คาร์บ

(3) ถ้าเรารับประทานมันฝรั่งทอดกรอบ 1 ซอง (80 กรัม)

ก. 5 กรัม หรือ 1 คาร์บ

ข. 14 กรัม หรือ 1 คาร์บ

ค. 28 กรัม หรือ 2 คาร์บ

ง. 36 กรัม หรือ 3 คาร์บ

(4) ถ้าเรารับประทานมันฝรั่งทอดกรอบ 1 ซอง (80 กรัม) จะได้รับพลังงานทั้งหมดกี่กิโลแคลอรี

ก. 120 กิโลแคลอรี

ข. 240 กิโลแคลอรี

ค. 380 กิโลแคลอรี

ง. 480 กิโลแคลอรี

(5) จำนวนหน่วยบริโภคต่อซอง เท่ากับ 2 หมายความว่าอย่างไร

ก. ปริมาณ 1 ซอง สามารถกินหมดได้ 1 ครั้ง

ข. ปริมาณ 1 ซอง สามารถกินหมดได้ 2 ครั้ง

ค. ปริมาณ 2 ซอง สามารถกินหมดได้ 1 ครั้ง

ง. ปริมาณ 2 ซอง สามารถกินหมดได้ 2 ครั้ง

แบบประเมินความถูกต้องในการรับรู้และมโนทัศน์ผ่านระบบเวปไซต์

สัปดาห์ที่ 3: เรื่อง คาดคะเนปริมาณสัดส่วนอาหารที่ซับซ้อนขึ้น เพื่อการวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว โดยใช้วิธีกากบาท (X)

คำชี้แจง: จงใช้ข้อมูลจากรายการอาหารแลกเปลี่ยนสำหรับการนับหน่วยคาร์โบไฮเดรต (e-food exchange list) และคลังภาพอาหาร (e-Food photo gallery) สำหรับการนับหน่วยคาร์โบไฮเดรตในการฝึกค้นหาสัดส่วน หรือขนาดของอาหาร (Portion sizes) พร้อมทั้งฝึกคำนวณ หรือนับหน่วยคาร์โบไฮเดรตจากรายการอาหารต่อไปนี้ พร้อมเลือกคำตอบที่เหมาะสม

ตัวอย่าง: ขนมจีนซาวน้ำ 1 ที่เสิร์ฟ → คาร์โบไฮเดรต 59 กรัม

ข้าวโพดคลุก 1จานเล็ก → คาร์โบไฮเดรต 1 คาร์บ

(1) ก๋วยเตี๋ยวราดหน้าหมู 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(2) เย็นตาโฟเส้นใหญ่น้ำ 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(3) ข้าวเหนียวดำน้ำกะทิ 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(4) กล้วยบวชชี 1 ชามเล็ก = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(5) ข้าวเหนียวสังขยา 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(6) ข้าวหมกไก่ 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ
- 5 คาร์บ

(7) ยำวุ้นเส้น 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(8) บะหมี่ต้มยำ 1 ที่เสิร์ฟ = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(9) ลอดช่องน้ำกะทิ 1 ชามเล็ก = คาร์โบไฮเดรต _____ กรัม

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

(10) เค้กมีหน้า ขนาด 2x2 นิ้ว จำนวน 1 ชิ้น = คาร์โบไฮเดรต _____ คาร์บ

- 1 คาร์บ
- 2 คาร์บ
- 3 คาร์บ
- 4 คาร์บ

แบบประเมินความถูกต้องในการรับรู้และมโนทัศน์ต่อกิจกรรมกลุ่ม

สัปดาห์ที่ 4: เรื่อง ทักษะการคาดคะเนสัดส่วนและประเมินปริมาณอาหารจริงด้วยตนเอง เพื่อฝึกการวางแผนการบริโภคอาหารให้เหมาะสม

ข้อมูลส่วนตัวเพื่อการประเมิน (โดยใช้โปรแกรมประเมินภาวะโภชนาการด้วยตนเอง)

ส่วนสูง	..... **เซนติเมตร**
น้ำหนัก	..... กิโลกรัม
น้ำหนักที่เหมาะสม	..... กิโลกรัม
รูปร่างอยู่ในเกณฑ์	สมส่วน/อ้วนไป/ผอมไป

1. การวางแผนการบริโภคอาหาร

พลังงานและสารอาหารที่ควรได้รับต่อวัน

1. พลังงาน ……..….. กิโลแคลอรี
2. คาร์โบไฮเดรตเป้าหมาย ……..... กรัม หรือ ……..…….... หน่วยคาร์โบไฮเดรต

   แบ่งเป็น ข้าว-แป้ง ……... คาร์บ

   ผัก ……... คาร์บ

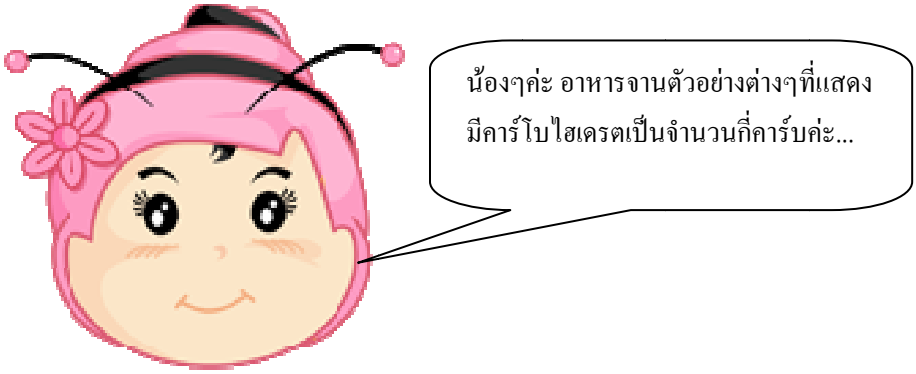
   ผลไม้ ……... คาร์บ

   นม ……... คาร์บ

2. กระจายปริมาณคาร์โบไฮเดรตในแต่ละมื้อ

	ข้าว-แป้ง	ผัก	ผลไม้	นม	รวมคาร์บ
เช้า					
ว่างเช้า					
เที่ยง					
ว่างบ่าย					
เย็น					
ก่อนนอน					
รวม					

3.การนับหน่วยคาร์โบไฮเดรตอาหารชุดทดลองที่รับประทานจริง (ตัวอาหารจริงใน 3 กล่องปริศนา)



APPENDIX G

แบบประเมินทัศนะคติที่มีต่อโรคเบาหวานและการดูแลตัวเองด้านการวางแผนการบริโภคอาหารของเด็กและวัยรุ่นเบาหวาน

(Pre-Post Attitude Test)

คำชี้แจง โปรดกาเครื่องหมาย ✓ ลงในช่องว่างของแต่ละข้อความ ให้ตรงกับระดับของความคิดเห็นของน้องๆ

ข้อที่	ทัศนคติ	ระดับความคิดเห็น				
		เห็นด้วยอย่างยิ่ง (5)	เห็นด้วย (4)	ไม่แน่ใจ (3)	ไม่เห็นด้วย (2)	ไม่เห็นด้วยอย่างยิ่ง (1)
1.	เบาหวานเป็นโรคไม่น่ากลัวหากรู้จักการดูแลตัวเองเรื่องอาหาร ยา และการออกกำลังกาย					
2.	หากไม่มีการควบคุมเบาหวานที่ดีจะมีผลให้ระดับน้ำตาลในเลือดสูงขึ้น และเกิดโรคแทรกซ้อนตามมา					
3.	การปรับเปลี่ยนพฤติกรรมการบริโภคอาหาร การปรับปริมาณอินซูลิน และการออกกำลังกาย สามารถควบคุมเบาหวานได้ดีกว่าการได้รับยาลดระดับน้ำตาลเพียงอย่างเดียว					
4.	การควบคุมปริมาณคาร์โบไฮเดรตในอาหาร ช่วยทำให้สามารถควบคุมเบาหวานได้เป็นอย่างดี					
5.	โดยปกติมักคำนึงถึงปริมาณคาร์โบไฮเดรตเป้าหมายในระหว่างการบริโภคอาหารระหว่างวัน					
6.	รู้สึกมั่นใจมากขึ้นเมื่อคำนึงถึงปริมาณคาร์โบไฮเดรตที่รับประทาน โดยเฉพาะการทานอาหารนอกบ้าน					
7.	การเรียนรู้การวางแผนการบริโภคอาหารเป็นสิ่งที่ไม่ยาก และควรเรียนรู้เป็นอย่างยิ่ง					
8.	การเรียนรู้หรือค้นคว้าข้อมูลจากอินเตอร์เน็ตเกี่ยวกับเบาหวานและการดูแลตัวเอง เป็นเรื่องที่น่าสนใจ ไม่ยากและนำไปใช้ได้					
9.	ความรู้ในการควบคุมเบาหวานด้วยตนเองสามารถนำไปประยุกต์ใช้ให้เกิดประโยชน์ต่อการป้องกันและควบคุมเบาหวานในระยะยาวได้					
10.	การแลกเปลี่ยนประสบการณ์ระหว่างกลุ่มชมรมพี่น้องเบาหวาน และผู้ปกครองมีส่วนช่วยให้การควบคุมเบาหวานดีขึ้นและมีทัศนคติต่อเบาหวานที่กว้างขึ้น					

ข้อที่	ทัศนคติ	ระดับความคิดเห็น				
		เห็นด้วยอย่างยิ่ง (1)	เห็นด้วย (2)	ไม่แน่ใจ (3)	ไม่เห็นด้วย (4)	ไม่เห็นด้วยอย่างยิ่ง (5)
1.	เมื่อเป็นเบาหวานแล้ว ก็มิได้วิตกกังวลใดๆ เนื่องจากใครๆก็เป็นกัน					
2.	การวัดระดับน้ำตาลในเลือดระหว่างวันเป็นเรื่องยุ่งยากและเสียเวลา					
3.	หากพบว่าระดับน้ำตาลในเลือดหลังอาหาร2 ชั่วโมงสูงมากผิดปกติ ก็ไม่ควรกังวลในการบริโภคอาหารในมื้อต่อไปมากนัก					
4.	การรับประทานยาลดระดับน้ำตาลในเลือดจะทำให้สะดวกและเป็นวิธีที่ง่ายที่สุดในการควบคุมเบาหวาน					
5.	รู้สึกไม่มั่นใจเมื่อผู้ปกครอง หรือแพทย์ทราบผลการวัดระดับน้ำตาลในเลือด หรือตรวจการสุขภาพของตนเอง					
6.	เกิดความรู้สึกลำบากใจ เมื่อต้องปรับเปลี่ยนรูปแบบการดำเนินชีวิต ซึ่งขัดกับความชอบ หรือสิ่งที่กระทำโดยปกติเคยชิน					
7.	การนับหน่วยคาร์โบไฮเดรตเป็นวิธีการวางแผนการบริโภคอาหารที่ค่อนข้างยาก และซับซ้อน					
8.	การวางแผนการบริโภคอาหารให้ตรงตามเป้าหมายเมื่อต้องทานอาหารนอกบ้านเป็นเรื่องลำบาก และยุ่งยาก					
9.	การเรียนรู้เรื่องเบาหวานและการดูแลตัวเองผ่านทางอินเตอร์เน็ตเป็นเรื่องเสียเวลา ไม่เหมือนกับการไปพบแพทย์					
10.	การบันทึกระดับน้ำตาลในเลือดและการบริโภคอาหารระหว่างวัน ไม่ได้มีส่วนช่วยให้ควบคุมเบาหวานได้ดีขึ้นเลย					

APPENDIX H

แบบประเมินความพึงพอใจของผู้ใช้ที่มีต่อเวปไซต์ให้ความรู้เรื่องเบาหวานและการดูแลตนเอง ในการวางแผนการบริโภคอาหารจากเทคนิคการนับหน่วยคาร์โบไฮเดรต

<u>คำชี้แจง</u> กรุณาเขียนเครื่องหมาย ✓ ลงในช่องที่ตรงกับความคิดเห็นของท่านสุด และเติมข้อความลงในช่องว่างที่เว้นไว้เพื่อประเมินความพึงพอใจในการใช้งานเวปไซต์ โดยที่ระดับค่าความคิดเห็น เป็นดังนี้

5 = ดีมาก 4 = ดี 3 = ปานกลาง 2 = พอใช้ 1= ควรปรับปรุง

รายละเอียดในการประเมิน	ระดับความคิดเห็น				
	5	4	3	2	1
<u>1. ด้านเนื้อหาและประโยชน์ที่ได้รับจากเวปไซต์</u>					
1.1 เนื้อหาตรงตามวัตถุประสงค์					
- ความรู้ทั่วไปเกี่ยวกับโรคเบาหวานและการดูแลตัวเอง	.....	.....	.....	.....	.....
- ตระหนักถึงวัตถุประสงค์ของการวางแผนมื้ออาหารเพื่อควบคุมเบาหวาน	.....	.....	.....	.....	.....
- เข้าใจบทบาทของคาร์โบไฮเดรตกับการควบคุมเบาหวาน	.....	.....	.....	.....	.....
- ตระหนักถึงความสำคัญของการประเมินภาวะโภชนาการด้วยตนเอง	.....	.....	.....	.....	.....
- เข้าใจการปฏิบัติตัวเพื่อควบคุมระดับน้ำตาลในเลือดด้วยตนเองให้อยู่ในเกณฑ์ปกติ	.....	.....	.....	.....	.....
- ตระหนักถึงแหล่งอาหารที่มีคาร์โบไฮเดรตเป็นองค์ประกอบ	.....	.....	.....	.....	.....
- ตรหนักถึงพลังงานและปริมาณคาร์โบไฮเดรตที่เหมาะสมต่อวัน	.....	.....	.....	.....	.....
- สามารถวางแผนการรับประทานอาหารที่เหมาะสมกับตนเองโดยอาศัยหลักการนับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....	.....
- เข้าใจหลักการเบื้องต้นในการแลกเปลี่ยนหรือทดแทนอาหาร (หมวดอาหารที่มีคาร์โบไฮเดรต: หมวดข้าวแป้ง หมวดผลไม้ หมวดนม หมวดผัก และหมวดคาร์โบไฮเดรตอื่นๆ)	.....	.....	.....	.....	.....
- ทราบแนวทางการปฏิบัติตัวเพื่อควบคุมระดับน้ำตาลและในเลือดให้อยู่ในเกณฑ์ปกติ	.....	.....	.....	.....	.....

รายละเอียดในการประเมิน	ระดับความคิดเห็น				
	5	4	3	2	1
1.2 การนำเสนอเนื้อหามีความกระชับและชวนให้ติดตาม	.....	.....	.....	.....	.....
1.3 ปริมาณของเนื้อหามีความยาวเหมาะสม	.....	.....	.....	.....	.....
1.4 เนื้อหาในบทเรียนง่ายต่อการเข้าใจ	.....	.....	.....	.....	.....
1.5 การลำดับเรื่องราวมีความเหมาะสม	.....	.....	.....	.....	.....
2. ด้านการออกแบบเวปไซด์และความสวยงาม					
2.1 ภาพประกอบในเนื้อหามีความสวยงามดึงดูดความสนใจ	.....	.....	.....	.....	.....
2.2 ภาพประกอบทำให้เข้าใจเนื้อหาได้ดีขึ้น	.....	.....	.....	.....	.....
2.3 การวางองค์ประกอบของภาพและเมนูต่างๆ	.....	.....	.....	.....	.....
2.4 รูปภาพสื่อถึงขนาดของอาหารตามขนาดอาหารจริง	.....	.....	.....	.....	.....
2.5 สี และขนาดของตัวอักษรมองเห็นได้ชัดเจน	.....	.....	.....	.....	.....
3. ด้านความสะดวกในการใช้งานและการมีส่วนร่วมต่อการเรียนรู้ผ่านเวปไซด์					
3.1 การเข้าถึงเวปไซด์ด้วยความรวดเร็ว	.....	.....	.....	.....	.....
3.2 เมนูประยุกต์ต่างๆใช้งานได้ง่ายตรงตามวัตถุประสงค์	.....	.....	.....	.....	.....
3.3 มีส่วนร่วมในการเรียนรู้และทำให้รู้สึกกระตือรือร้นในการเรียนมากขึ้น	.....	.....	.....	.....	.....
3.4 คำถามและเกมส์ช่วยกระตุ้นให้มีความเข้าใจเนื้อหามากขึ้น	.....	.....	.....	.....	.....
3.5 ระบบบันทึกอาหารใช้งานง่ายและสะดวกต่อการวางแผนการบริโภคอาหารด้วยตนเอง	.....	.....	.....	.....	.....
4. ด้านแรงจูงใจในการเรียนรู้ผ่านเว็บไซต์					
3.1 ชื่อเวปไซด์ www.kinpordee.com ที่จดจำง่าย	.....	.....	.....	.....	.....
3.2 เมนูต่างๆในเวปไซด์นี้น่าสนใจและใช้งานได้ง่าย	.....	.....	.....	.....	.....
3.3 การเรียนรู้ด้วยวิธีนี้สามารถควบคุมการเรียนด้วยตนเองได้ 3.4 การเรียนรู้ด้วยวิธีนี้ท้าทายความสามารถของตนเอง	.....	.....	.....	.....	.....

BIOGRAPHY

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