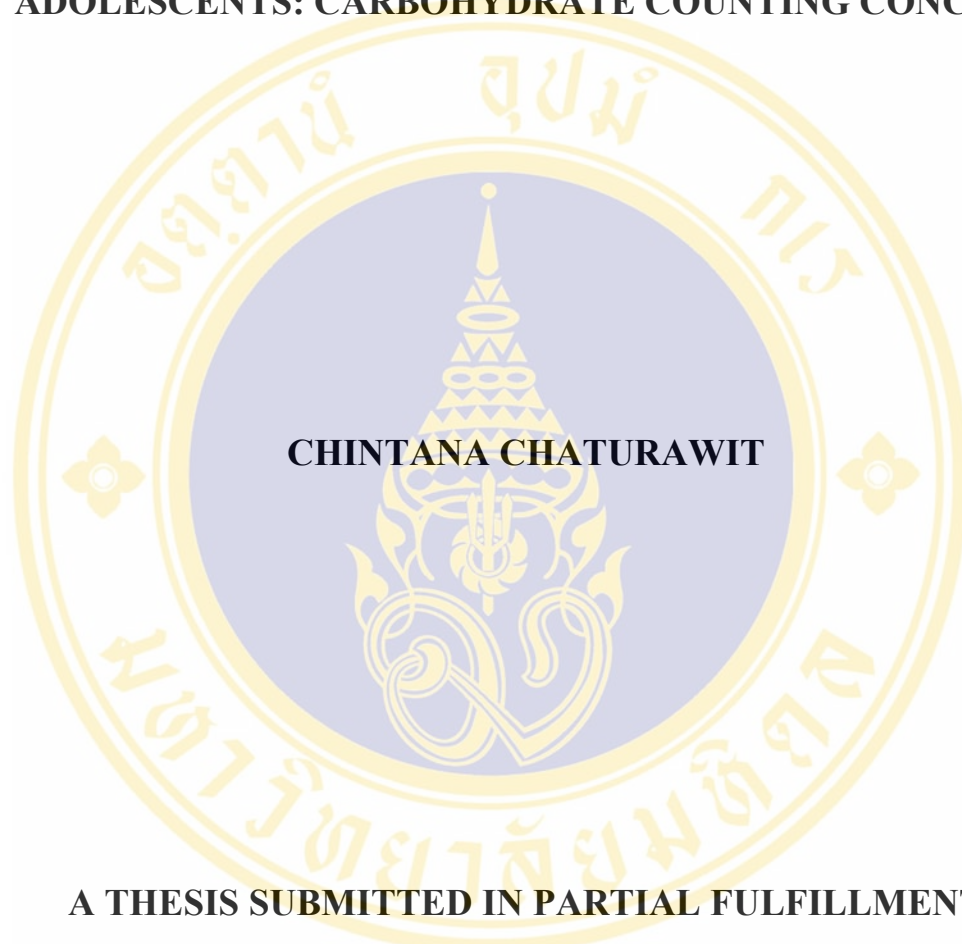


**DEVELOPMENT OF EDUCATIONAL TOOL MODEL FOR  
SELF-HELP MEAL PLANNING IN TYPE 1 DIABETIC  
ADOLESCENTS: CARBOHYDRATE COUNTING CONCEPT**



**A THESIS SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER OF SCIENCE  
(FOOD AND NUTRITION FOR DEVELOPMENT)  
FACULTY OF GRADUATE STUDIES  
MAHIDOL UNIVERSITY**

**2005**

**ISBN 974-04-6693-1**

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Thesis  
Entitled

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ADOLESCENTS: CARBOHYDRATE COUNTING CONCEPT**



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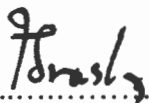
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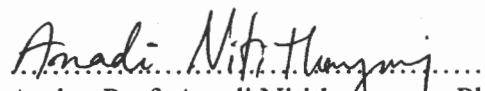
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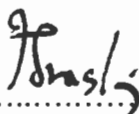
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## ACKNOWLEDGEMENT

I would like to express my deepest gratitude and sincere appreciation to my major-advisor, Dr. Sunard Taechangam for her great kindness, extensive support, very valuable suggestions, and devotion throughout my study.

Appreciations are also extended to my co-advisors, Dr. Chanida Pachotikarn for her very valuable suggestions, encouragement, constructive criticism, and extensive support, Assist. Prof. Vongsvat Kosulwat for her very valuable advice and guidance in this study and Prof. Pat Mahachoklertwattana for his very valuable suggestions as well as the facilitation of data collecting at Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital.

I wish to thank Assist. Prof. Nalinee Chongviriyaphan who was the external examiner of the thesis defense for her kindness and very valuable suggestions in this study, Assoc. Prof. Prapaisri Sirichakwal for her kindness in examining the content validity of the educational tool model and for providing suggestions for improvement, Mr. Tammawit Suwanapreuk who is expert in the field of illustration for his valuable suggestions for improvement. Thanks are also extended to other experts, photographers, illustrators and graphic designers for developing the educational tool model as well as Mr. Somchoke Khunsanong for his helpful guidance of this educational tool development project.

I am very grateful to Prof. Thep Himathongkam for obtaining the co-operation of the participants at Theptarin General Hospital, Mrs. Sallaya Kongsomboonvech for her helpful suggestions, Mrs. Chanika Surasingchaidej who never refused my requests and always gave me very valuable advice. In addition, I would like to thank to all staff members of the Educational Service and Research Center, Diabetes Center, Theptarin General Hospital for their contributions throughout the project as well as Miss Charinya Pramepreungvech and Pornthip Taechanivech who are ambulatory nurses for obtaining the co-operation of the participants at Ramathibodi Hospital.

Special thanks to all participants and their parents for the excellent co-operation and participation in this study and I also would like to special thanks my friends, Mr. Sukrit Chunlaphan, Pongsak Wangsuk, Miss Yuraida Hayeema, Thanwarin Tangsermwong, Nuttiga Songeaid, Niratchaporn Janejob, Utumporn Pinitchun, Sureeporn Savangchad and Nantinee Puengsakul. I deeply thank them for their kindness and sincere assistance. In addition, I would like to thank all friends for their encouragement and precious memories that we have shared, to name but a few.

My heartiest thanks are also extended to Kasatesart University and the Faculty of Graduate Studies, Mahidol University for giving the great chance and supporting the scholarship for study.

Finally, I greatly appreciate and have deepest gratitude for my family, especially my parents, and also Miss Soisuwan Sripommasa who is my best friend as well as Mr. Karuna Srichomchey who makes me feel like have an older brother. I have deep gratitude for their understanding, total care and love which inspired me to achieve this goal.

Chintana Chaturawit

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DEVELOPMENT OF EDUCATIONAL TOOL MODEL FOR SELF-HELP MEAL  
PLANNING IN TYPE 1 DIABETIC ADOLESCENTS: CARBOHYDRATE COUNTING  
CONCEPT

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ABSTRACT

Carbohydrate counting (CHO counting) is a meal planning approach for diabetes that focuses on carbohydrate as the primary nutrient affecting postprandial glycemic response. Appropriate educational tools for meal planning using this approach for type 1 diabetic adolescents, who are simultaneously in a physiopsychosocial changing period, is important to allow for variability of food choices and flexibility for their lifestyle as well as to prevent diabetic complications and also to increase quality of life. In this study, we developed and evaluated the effectiveness of the educational tool model for self-help meal planning for type 1 diabetic adolescents using CHO counting concept. The developed educational tool model comprised 2 tools: 1) the booklets of CHO counting as a colorful comic book composed of 2 books, the self-help guidelines for meal planning using CHO counting and food exchange lists for counting CHO and 2) a CHO counting game using photographic food cards. All tools were designed using a Cognitive Behavior Therapy and Edutainment approach to provide dietary knowledge for learning CHO counting.

The effectiveness of the developed educational tool model was assessed in a total of 20 type 1 diabetic adolescents (mean age of 15 years) to determine 1) the patient's knowledge and understanding of meal planning using CHO counting; 2) the accuracy in patient's perception and conceptualization in CHO counting and 3) the patient's satisfaction with the developed educational tool model. All evaluations were accomplished by arranging 2 sessions of a group meeting (once a week for 2 weeks) for class practice, homework exercises and using validated questionnaires. The patient's performances were determined before and at the end of the study. In general, the results revealed that most patients significantly improved their knowledge and understanding of meal planning using CHO counting ( $p < 0.05$ ) with high knowledge level (70% of participants) and moderate knowledge level (25% of participants) after using the developed educational tool model. A majority of the patients understood CHO counting concept at high level and they had high perception and conceptualization in this approach; in addition, they were also satisfied with the developed educational tool model. In conclusion, the developed educational tool model is acceptable as attractive learning tools for type 1 diabetic adolescents.

KEY WORDS: CHO COUNTING/ EDUCATIONAL TOOL MODEL/ TYPE 1 DIABETIC  
ADOLESCENTS/ MEAL PLANNING

182 P. ISBN 974-04-6693-1

การพัฒนาเครื่องมือสื่อการสอนต้นแบบเพื่อการวางแผนการบริโภคอาหารด้วยตนเองของผู้ป่วย  
 วัยรุ่นที่เป็นเบาหวานชนิดที่ 1: เทคนิคการนับหน่วยคาร์โบไฮเดรต  
 (DEVELOPMENT OF EDUCATIONAL TOOL MODEL FOR SELF-HELP MEAL  
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บทคัดย่อ

เทคนิคการนับหน่วยคาร์โบไฮเดรตเป็นหนึ่งในวิธีการวางแผนการบริโภคอาหารสำหรับผู้ป่วยเบาหวาน โดยมุ่งเน้นคาร์โบไฮเดรตซึ่งเป็นสารอาหารหลักสำคัญที่มีผลต่อระดับน้ำตาลในเลือดหลังอาหาร เครื่องมือสื่อการสอนที่เหมาะสมสำหรับใช้เป็นแนวทางในการวางแผนการบริโภคอาหาร โดยอาศัยเทคนิคนี้ นับเป็นสิ่งที่สำคัญต่อการวางแผนการบริโภคอาหารให้สอดคล้องกับพฤติกรรมดำเนินชีวิตของผู้ป่วยเพื่อควบคุมโรคเบาหวานได้ดีขึ้น โดยเฉพาะในผู้ป่วยวัยรุ่นซึ่งมักต้องการความยืดหยุ่นในการดูแลตัวเองสูงกว่าวัยอื่นๆ การศึกษานี้จึงมีวัตถุประสงค์เพื่อพัฒนา และทดสอบประสิทธิภาพของเครื่องมือสื่อการสอนต้นแบบที่ใช้ในการวางแผนการบริโภคอาหารด้วยตนเองในผู้ป่วยวัยรุ่นที่เป็นเบาหวานชนิดที่ 1 โดยอาศัยเทคนิคการนับหน่วยคาร์โบไฮเดรต ประกอบด้วย: 1) หนังสือภาพการ์ตูนประกอบสำหรับการนับหน่วยคาร์โบไฮเดรต ซึ่งได้แก่ 1.1) หนังสือคู่มือวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรตในระดับเบื้องต้น สำหรับเด็กวัยรุ่นที่เป็นเบาหวานชนิดที่ 1 และ 1.2) หนังสือคู่มือรายการอาหารแลกเปลี่ยนเพื่อการนับหน่วยคาร์โบไฮเดรต; 2) บัตรรูปภาพอาหารสำหรับเกมสัการับหน่วยคาร์โบไฮเดรต โดยนำหลักการสื่อสารและหลักการให้คำปรึกษา (หลักการให้ความรู้คู่ความบันเทิง และหลักการเรียนรู้เพื่อการปรับเปลี่ยนพฤติกรรม) มาใช้เป็นแนวทางในการพัฒนาเครื่องมือดังกล่าว

การทดสอบประสิทธิภาพของเครื่องมือได้ทำการศึกษาในวัยรุ่นที่เป็นเบาหวานชนิดที่ 1 จำนวน 20 ราย (อายุเฉลี่ย 15 ปี) โดย 1) ประเมินความรู้และความเข้าใจของผู้ป่วยในเรื่องการวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต ก่อนและหลังการทดลอง; 2) ประเมินความถูกต้องในการรับรู้และ มโนทัศน์ของการนับหน่วยคาร์โบไฮเดรตของผู้ป่วยจากการใช้เครื่องมือสื่อการสอนที่ได้พัฒนาขึ้น และ 3) ประเมินความพึงพอใจของผู้ป่วยในการใช้เครื่องมือสื่อการสอนที่ได้พัฒนาขึ้น โดยอาศัยการเข้ากลุ่ม สัปดาห์ละ 1 ครั้ง เป็นเวลา 2 สัปดาห์ เพื่อตอบแบบสอบถามหรือทำแบบฝึกหัดต่างๆ ทั้งในห้องเรียนและเป็นการบ้าน ก่อนและหลังการทดลอง ผลการศึกษาพบว่า ผู้ป่วยส่วนใหญ่มีความรู้และความเข้าใจในเทคนิคการนับหน่วยคาร์โบไฮเดรตเพิ่มขึ้นอย่างมีนัยสำคัญภายหลังการใช้เครื่องมือสื่อการสอน ( $P < 0.05$ ) โดย 70% ของผู้ป่วยได้คะแนนในระดับสูง และ 25% ได้คะแนนในระดับกลาง, มีการรับรู้และมโนทัศน์ในการนับหน่วยคาร์โบไฮเดรตด้วยคะแนนในระดับสูง ทางด้านความพึงพอใจในเครื่องมือสื่อการสอน ผู้ป่วยมีความพึงพอใจในระดับดีมาก สรุปได้ว่าเครื่องมือสื่อการสอนต้นแบบที่ได้พัฒนาขึ้นได้รับการยอมรับ และนับเป็นเครื่องมือสื่อการสอนที่ดึงดูดความสนใจในการเรียนรู้สำหรับผู้ป่วยวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

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## CHAPTER 1

### INTRODUCTION

#### Clinical Background

Type 1 diabetes is a non-communicable chronic disease which mostly found in children and adolescents. The incidence of type 1 diabetes in Thailand was reported to be as low as 0.2/100,000/year in last 20 years, whereas nowadays, the incidence especially in children and adolescents is increased as 1.65/100,000/year which was similar to the incidence of type 1 diabetes in other Asian countries (1, 2) Therefore, type 1 diabetes is now increasing in Thailand.

Type 1 diabetes is a serious chronic illness. It results from inflammatory destruction of the beta cells of the pancreas, leading to essential complete loss of the ability to synthesize and release insulin so the diabetics require insulin therapy by injection through their lives (3). Uncontrolled diabetes can lead to both acute and chronic complications including repeated infections, cardiovascular disease, kidney disease, loss of vision, and neuropathy. People with diabetes are at 2-4 fold increased risk of myocardial infarction and stroke (4). Diabetes is the most common cause of blindness with its onset in working age adults, and of non-traumatic amputations, and is the leading single cause of end-stage renal disease requiring dialysis and transplantation (3). On the other hand, it is also the leading cause of peripheral and autonomic neuropathy that makes the patients suffer from those symptoms (4).

However, the risk for developing such complications can be reduced as reported by several clinical trials. In the Diabetes Control and Complication Trial (DCCT) and the United Kingdom Prospective Diabetes Study (UKPDS) which patients were followed for an average of 10 years, epidemiological analysis of the data showed a continuous relationship between the risk of microvascular complications and glycemic control, such that for every percentage point decrease in HbA<sub>1c</sub> (e.g., 9 to 8%), there was a 35% reduction in the risk of microvascular complications, an 18% reduction in

combined fatal and nonfatal myocardial infarction and a 17% reduction in mortality (7,8). Furthermore, the improvement in glycemic control did not only decrease risk of complications or increase quality of life but also reduce an annual health care expense (9). To prevent diabetes complications and to live longer healthy life, glycemic control should be improved. In order to accomplish this goal, patients should be provided dietary knowledge and skills for changing lifestyle in order to improve quality of life.

### **Management of Type 1 Diabetes**

Treatment of type 1 diabetes requires insulin therapy combined with careful control of diet and physical activity. Medical Nutrition Therapy (MNT) has come into use recently which is integral to total diabetes care and management (5). The goal of MNT is to assist people with diabetes in making self-directed behavior changes that will improve their overall diabetes management and/or nutritional status. Diet and nutrition counseling plays a central role in the management of children and adolescents with type 1 diabetes.

Nutrition recommendations for children and adolescents with type 1 diabetes should focus on achieving blood glucose goals that maintain normal growth and development without excessive hypoglycemia. This can be accomplished through individualized food and meal planning, flexible insulin regimens and algorithms, self-blood glucose monitoring and education promoting decision-making based on outcomes (6).

### **Meal Planning: Carbohydrate Counting**

Carbohydrate counting is one of meal planning approaches used with clients who have diabetes that is interesting now. It is not a new concept. The concept of carbohydrate counting has been found since the 1920s, but it received renewed interest after to be used as 1 of 4 meal planning approaches in the DCCT. In this trial, carbohydrate counting was found to be an effective method for achieving treatment goals and increasing flexibility in meal planning (10).

Carbohydrate counting is a meal planning that focuses primarily on the amount of carbohydrate eaten. It is based on the assumption that carbohydrate is the macronutrient that has the most effect on postprandial blood glucose. On the other

hand, the major determinant of the glycemic response is the total amount of carbohydrate ingested rather than the source of carbohydrate (11). Therefore, it is the total amount of carbohydrate in a meal that primarily determines how much insulin is required, rather than the amount of protein or fat.

This approach can be used for individuals with type 1, type 2 and gestational diabetes. Three levels of carbohydrate counting have been identified based on increasing level of complexity. Level 1, or basic, introduces client to the concept of carbohydrate counting and encourages individuals to eat consistent amounts of carbohydrate at meal and snack (focuses on carbohydrate consistency). Level 2, or intermediate, focuses on identifying patterns in blood glucose levels as relate to food intake, diabetes medication and physical activity. The individual is taught to interpret records and take action based on blood glucose patterns. Level 3, or advanced, is designed to teach clients with type 1 diabetes who are using multiple daily injections or an insulin pump how to match short-acting insulin to carbohydrate using carbohydrate-to-insulin ratios. The individual determines how to adjust pre-meal insulin when eating more or less than usual by using this ratio. All three levels emphasize portion control and offer opportunities for using creative teaching such as “food lab” and use of a variety of carbohydrate resource tools and publications (12). Therefore, nutrition education/counseling about the way of individualized meal planning, especially in children and adolescents with type 1 diabetes is crucial for diabetes control and foundation of health.

### **Development of Nutrition Education Tool Model**

From the past, the research related to development of educational tools for diabetes meal planning found to be rare and carbohydrate counting is a new way of meal planning which has not received any interest from physician and dietitian in Thailand. Therefore, it is crucial for developing an educational tool model as well as for evaluating its effectiveness before applying in the clinical practice.

This approach 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.

In this study, the educational tool model was modified from educational booklets including “Carbohydrate counting (Getting started: level 1)”, “Carbohydrate counting (Moving on: level 2)”, and “Carbohydrate counting (Using carbohydrate/insulin ratios: level 3)” that be made by Daly A., et al. (13). However, some aspects especially the way of knowledge presentation and food items for carbohydrate counting which need to adapt to Thai-culture; besides, carbohydrate counting composes of 3 levels, have been identified based on increasing levels of complexity according to the above mention, while children and adolescents with diabetes have never known what and how carbohydrate counting is. Therefore, this study conducted only level 1 carbohydrate counting, or basic, to develop educational tool model for self-help meal planning for type 1 diabetic adolescents. We expect the patients will receive basic knowledge and understanding of carbohydrate counting and they can count carbohydrate correctly for diabetes control following MNT. Furthermore, this educational tool model can be modified to use with adults who have type 1, type 2, and gestational diabetes as well.

## **CHAPTER 2**

### **OBJECTIVES**

#### **General objective**

To develop educational tool model for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept

#### **Specific objectives**

1. To construct educational tool model for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept
2. To evaluate the effectiveness of educational tool model in type 1 diabetic adolescents by assessing:
  - 2.1 The patient's knowledge and understanding of meal planning using carbohydrate counting
  - 2.2 The accuracy in patient's perception and conceptualization in carbohydrate counting using the developed educational tool model
  - 2.3 The patient's satisfaction with educational tool model

#### **Scope of the study**

This study was to develop educational tool model for self-help meal planning in type 1 diabetic adolescents using level 1 carbohydrate counting which focused on patient's knowledge and understanding in carbohydrate counting concept so that patients can count carbohydrate correctly and can plan the menu for their own meal planning. This educational tool model was developed for type 1 diabetic adolescents. The evaluation of the effectiveness of educational tool model was performed in type 1 diabetic adolescents who were 12-19 years old and attended Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital.

## Expected benefits and applications

### Social:

- To offer the new way of meal planning approach that allows for variability of food choice, flexibility for lifestyle
- To increase quality of life

### Economic:

- To decrease health care expense

### Academic:

- Patients will receive basic knowledge which is important for further learning carbohydrate counting at higher levels (Level 2 and 3), in order to accomplish treatment plan following MNT
- Dietitian & health care teams can further apply this educational tool model to use with diabetic adolescents in Clinical Practice Setting.
- The developed educational tool model can also be modified to type 2 and gestational diabetes.

## Definition of terms

**Type 1 diabetic adolescents** referred to people who were diagnosed to be type 1 diabetes with 12-19 years old.

**Educational tool model** defined as the systematically developed model which comprised 2 tools:

**1. The booklets of carbohydrate counting** as a colorful comic book which was a set of 2 books. One was the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents and the another one was the book of food exchange lists for counting carbohydrate.

**2. The game of carbohydrate counting** as the photographic food card game.

Both of them had the backbone of dietary knowledge for learning carbohydrate counting. In addition, Cognitive behavior therapy and Edutainment approach were also conducted to them.

**Meal planning** is a way to plan the type or amount of foods eaten. When patients eat, how much they eat, and whether or not they have snacks should be based on their lifestyle, medications, and meal planning goals.

**Carbohydrate counting** was a meal planning approach that focused primarily on the amount of carbohydrate eaten to plan the amount of carbohydrate eaten, to number the carbohydrate unit or choice from carbohydrate food groups. The carbohydrate food groups included starch, fruit, milk, vegetable and other foods that contain carbohydrate. They were varied in weight for one carbohydrate unit or choice that supplies approximately 15 grams of carbohydrate.

**Anthropometric assessment as weight for height** defined as nutritional status which interpreted into 5 levels (Classified by Percentile System);

- Wasting : cut-off points as < P3
- Underweight: cut-off points as P3 - < P10
- Normal: cut-off points as P10- P90
- Overweight: cut-off points as > P90- P97
- Obesity: cut-off points as > P97

Data source: National Growth References for Children Under 20 Years of Age, 1999. Nutrition Division, Department of Health, Ministry of Public Health, Thailand.

## **CHAPTER 3**

### **LITERATURE REVIEW**

In this chapter, relevant information and study findings were reviewed. It was divided into 3 main parts as follows:

**Part 1** Care of children and adolescents with type 1 diabetes, particularly medical nutrition therapy focusing on dietary therapy as carbohydrate counting technique and the researches related to carbohydrate counting

**Part 2** Counseling and Edutainment Approach as the important aspects for developing of the educational tools

**Part 3** Measurement of the effectiveness of the educational tools, particularly the booklets as printed health materials and the researches related to measurement of the printed health materials

#### **Part 1 Care of children and adolescents with type 1 diabetes and the researches related to carbohydrate counting**

##### **1.1 Care of children and adolescents with type 1 diabetes**

###### **1.1.1 Diagnosis (14)**

The diagnosis of type 1 diabetes in children is usually straight-forward and requires little or no specialized test. Most children and adolescents with type 1 diabetes present with a several-week history of polyuria, polydipsia, polyphagia, and weight loss, with hyperglycemia, glycosuria, ketonemia, and ketonuria. Glycosuria alone, especially without ketonuria, may be caused by a low renal glucose threshold. Thus, an elevated blood glucose concentration must be documented to diagnose diabetes.

### Diagnostic Criteria (14)

The criteria for the diagnosis of diabetes are presented in Table 1. Three ways to diagnose diabetes are possible, and each must be confirmed on a subsequent day by one of the three methods given in Table 1.

**Table 1** Criteria for the diagnosis of diabetes (14)

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1. Symptoms of diabetes and a casual plasma glucose $\geq 200$ 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
2. Fasting plasma glucose $\geq 126$ mg/dl (7 mmol/l). Fasting is defined as no caloric intake for at least 8 h.
OR
3. 2-h plasma glucose $\geq 200$ mg/dl (11.1 mmol/l) during an oral glucose tolerance test. The test should be performed as described by the World Health Organization, using a glucose load of 75 g anhydrous glucose dissolved in water or 1.75 g/kg body weight if weight is $< 18$ kg.

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In the absence of unequivocal hyperglycemia, this criteria should be confirmed by repeat testing on a different day. The oral glucose tolerance test is not recommended for routine clinical use, but may be required in the evaluation of patients when diabetes is still suspected despite a normal fasting plasma glucose (15).

As the incidence of type 2 diabetes in children and adolescents increase, it becomes increasingly important to differentiate newly diagnosed type 1 from type 2 diabetes. In the slender prepubertal child, one can confidently assume a diagnosis of type 1 diabetes. However, in the overweight adolescent, differentiating type 1 from type 2 may be difficult; measurement of islet autoantibodies may be useful in such patients. In children with negative autoantibodies levels, the use of plasma C-peptide levels has been recommended, but the interpretation of such measurements is controversial. The differentiation between type 1 and type 2 diabetes has important implications for both therapeutic decisions and educational approaches. Regardless of

type of diabetes, the child who presents with severe fasting hyperglycemia, metabolic derangements, and ketonemia will require insulin therapy to reverse the metabolic abnormalities (14).

### **1.1.2 Initial Care**

Ideally, every child newly diagnosed with type 1 diabetes should be evaluated by a diabetes team (consisting of a pediatric endocrinologist, a nurse educator, a dietitian, and a mental health professional) qualified to provide up to date pediatric-specific education and support (14).

### **1.1.3 Diabetes Education**

Studies in children with type 1 diabetes have demonstrated that patient and family education, delivery of intensive diabetes care management, and close telephone contact with the diabetes team are associated with reduced hospitalizations, emergency room visits, and overall costs to the payer and patient (16, 17).

Education is best provided with sensitivity to the age and developmental stage of the child, with regard to both the educational approach and the content of the material delivered. Studies suggest that to be effective, educational interventions need to be on-going, with frequent telephone contact, and both in-person care and telephone availability have been demonstrated to improve HbA<sub>1c</sub> and to decrease hospitalization rates for acute diabetes complications (16-20).

### **1.1.4 Appropriate Self-management by Age**

Because of 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. The studies (21, 22) 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 2.

**Table 2** Major developmental issues and their effect on diabetes in children and adolescents (14)

Development stage (approximate ages)	Normal developmental tasks	Type 1 diabetes management priorities	Family issues in type 1 diabetes management
Infancy (0-12 months)	- Developing a trusting Relationship/ “bonding” With primary caregiver	- Preventing & treating hypoglycemia - Avoiding extreme fluctuations in blood glucose levels	- Coping with stress - Sharing the “burden of care” to avoid parent burnout
Toddler (13-36 Months)	- Developing a sense of mastery & autonomy	- Preventing & treating hypoglycemia - Avoiding extreme fluctuations in blood glucose levels due to irregular food intake	- Establishing a schedule - Managing the “picky eater” - Setting limits & coping with toddler’s lack of cooperation with regimen - Sharing the burden of care
Preschooler & early elementary School-age (3-7 years)	- Developing initiative in activities & confidence in self	- Preventing & treating hypoglycemia - Unpredictable appetite & activity - Positive reinforcement for cooperation with regimen -Trusting other caregivers with diabetes management	- Reassuring child that diabetes is no one’s fault - Educating other caregivers about diabetes management

**Table 2** Major developmental issues and their effect on diabetes in children and adolescents (14) (Cont.)

Development stage (approximate ages)	Normal developmental tasks	Type 1 diabetes management priorities	Family issues in type1 diabetes management
Older elementary School-age (8-11 years)	<ul style="list-style-type: none"> <li>- Developing skills in athletic, cognitive, artistic, social areas</li> <li>- Consolidating self-esteem with respect to the peer group</li> </ul>	<ul style="list-style-type: none"> <li>- Making diabetes regimen flexible to allow for participation in school/peer activities</li> <li>- Child learning short- and long-term benefits of optimal control</li> </ul>	<ul style="list-style-type: none"> <li>- Maintaining parental involvement in insulin &amp; blood glucose monitoring tasks while allowing for independent self-care for “special occasions”</li> <li>- Continue to educate school &amp; other caregivers</li> </ul>
Early adolescence (12-15 years)	<ul style="list-style-type: none"> <li>- Managing body changes</li> <li>- Developing a strong sense of self-identity</li> </ul>	<ul style="list-style-type: none"> <li>- Managing increased insulin requirements during puberty</li> <li>- Diabetes management &amp; blood glucose control become more difficult</li> <li>- Weight &amp; body-image concerns</li> </ul>	<ul style="list-style-type: none"> <li>- Renegotiating parents &amp; teen’s roles in diabetes management to be acceptable to both</li> <li>- Learning coping skills to enhance ability to self-manage</li> <li>- Preventing &amp; intervening with diabetes-related family conflict</li> <li>- Monitoring for signs of depression, eating disorders, risky behavior</li> </ul>

**Table 2** Major developmental issues and their effect on diabetes in children and adolescents (14) (Continued)

Development stage (approximate ages)	Normal developmental tasks	Type 1 diabetes management priorities	Family issues in type 1 diabetes management
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

**Adolescents**

Adolescence is a period of rapid biological change accompanied by increasing physical, cognitive, and emotional maturity. Adolescents are struggling to find their own identity separate from their families. Many of the diabetes-related tasks can interfere with the adolescent’s drive for independence and peer acceptance. Peer pressure may generate strong conflicts. In this age-group, there is a struggle for independence from parents and other adults that is often manifested as suboptimal adherence to the diabetes regimen.

Because adolescents have the fine motor control to competently perform most self-management activities, it is tempting for parents to turn over total diabetes management to the teenager. While adolescents can perform the tasks of diabetes management, they still need help with decision-making about insulin

adjustments. Adolescents whose parents maintain some guidance and supervision in the management of diabetes have better metabolic control (22, 23). Thus, continuing to involve parents appropriately, with shared management, is associated with improved control. The challenge is to find the degree of parental involvement that is comfortable for all involved, without risking deterioration in glycemic control from over- or under-involvement (24). Such involvement in diabetes management in this developmental stage can affect parent-adolescent relationships.

Parent-child conflict has been associated with poorer diabetes outcomes in several studies (25-27). During the later adolescent years, the parents and the diabetes care team need to assist the youth to transition to more independent self-management and to adult diabetes care providers.

### **1.1.5 Glycemic Control**

Current standards for diabetes management reflect the need to maintain glucose control as near to normal as safely possible. Even though 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. However, special consideration must be given to the unique risks of hypoglycemia in young children.

#### **Adolescents**

Investigators in the DCCT were able to control diabetes in this age-group only at a level ~ 1% higher than that achieved by adults. That teenagers included in the DCCT were able to achieve a mean HbA<sub>1</sub>C 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. However, several studies in the United States and Europe (20, 28, 29) have documented that mean HbA<sub>1</sub>C levels are generally >8.0% and with reduction comes a significant increase in the risk of severe hypoglycemia. Therefore, while an ideal target HbA<sub>1</sub>C identical to that for adults (<7%) could be recommended, It is recognized that this level of metabolic control is not achievable in most adolescents (28-29). Concerns regarding

the risks of hypoglycemia and of the potential of creating a feeling of failure in the patient and family leads to the general recommendation of HbA<sub>1</sub>C <7.5% in this group

**Table 3** Plasma blood glucose and HbA<sub>1</sub>C goals for type 1 diabetes by age group (14)

Values by age	Plasma blood glucose		HbA <sub>1</sub> C	Rationale
	Before meals	Bedtime/overnight		
Toddlers & preschool (<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 & relatively low risk of complications prior to puberty
Adolescents & Young adults (13-19 years)	90-130	90-150	<7.5%*	- Risk of hypoglycemia - 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 preprandial blood glucose values and HbA<sub>1</sub>C levels

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

### **1.1.6 Insulin Management of Diabetes**

Children with diabetes often require multiple daily injections of insulin, using combinations of rapid-, short-, intermediate-, or long acting insulin before meals and at bedtime to maintain optimal blood glucose control. If a large snack is consumed between meals, as often occurs in adolescents in the late afternoon, an extra injection of a rapid-acting insulin may be necessary.

Cross-sectional epidemiological studies have been unable to document improved control with increasing numbers of insulin injections per day, indicating that the number of injections alone is not sufficient to achieve optimal glycemic control (20). However, greater flexibility provided by multiple daily insulin injections (MDIs) per day, combined with carbohydrate counting and dose determined using an insulin-to-carbohydrate ratio, makes this an attractive therapeutic regimen for most middle school and high school students.

Although an MDI regimen with carbohydrate counting allows flexibility of eating times and amounts, the number of insulin injections required may be a barrier to good control; thus, many choose an insulin pump if it is an option financially and the patient and family are prepared for the training. Adjusting insulin based on the carbohydrate content of meals has been shown to improve glycemic control in adults (30). The principles of using carbohydrate counting and an insulin-to-carbohydrate ratio tailored to each individual is a principle that is applied to both insulin injection therapy and insulin pump therapy.

### **1.1.7 Blood Glucose Monitoring**

Blood glucose monitoring in general has been extensively reviewed by the American Diabetes Association (ADA) and is summarized in the ADA consensus statement “Self-Monitoring of Blood Glucose” (31). For children with type 1 diabetes, four or more tests per day are generally necessary.

SMBG is necessary for individuals to achieve optimal glycemic control; there is a good correlation between frequency of monitoring and glycemic control (32). Multiple blood glucose measurements should be done each day to determine patterns of hypoglycemia and hyperglycemia and to provide data for insulin dose adjustments.

### 1.1.8 Medical Nutrition Therapy

Medical Nutrition Therapy (MNT) plays a major role in the management of type 1 diabetes in children and adolescents, although it is often one of the most difficult aspects of treatment.

Nutrition recommendations for children and adolescents with type 1 diabetes should focus on achieving blood glucose goals that maintain normal growth and development without excessive hypoglycemia. This can be accomplished through individualized food and meal planning, flexible insulin regimens and algorithms, self-blood glucose monitoring and education-promoting decision-making based on outcomes (33).

Careful consideration of a child's appetite must be used when determining energy requirements. The ideal method for estimating a child's or adolescent's energy needs is a food/nutrition history of a typical daily intake, providing that growth and development are within normal limits. An evaluation of weight gain and growth begins at diagnosis by recording height and weight on pediatric growth charts. Adequacy of energy intake can be evaluated by following weight gain and growth patterns on a regular basis

Withholding food or having a child eat consistently without an appetite for food in an effort to control blood glucose should be discouraged. Macronutrient composition of the nutrition prescription should be individualized according to blood glucose and plasma lipid goals and requirements for growth and development.

Individualized food/meal plans and intensive insulin regimens can provide flexibility for children and adolescents with diabetes to accommodate irregular meal times and schedules, varying appetite, and vary activity levels.

In the Diabetes Control and Complications Trial, healthy food choices, exchange systems, carbohydrate counting and total available glucose were used (10). They were expressive discriminated. Healthy food choices were simplified structured tool but did not have flexibility of food choices. People who used exchange systems needed to focus on every macronutrients; carbohydrate, protein, and fat. Carbohydrate counting had only focus on one nutrient as carbohydrate and had flexibility of food choices. Total availability blood glucose had also focused on one nutrient; however, was tangled to calculate amount of glucose. Thus carbohydrate counting was found to

be an effective method for achieving treatment goals and increasing flexibility in meal planning.

There is some evidence that total carbohydrate content of meals and snacks is most important in determining the postprandial glucose response and, thus, in determining the premeal insulin dosage (34). The Dose Adjustment for Normal Eating (DAFNE) study group documented a decrease in HbA<sub>1c</sub> and an increase in patient satisfaction in adults after initiating diabetes management using carbohydrate counting for meal and snack carbohydrate content and insulin-to-carbohydrate ratio to determine the insulin dose (30).

### **1.1.8.1 Carbohydrate counting:**

#### **1.1.8.1.1 A brief history of Carbohydrate counting:**

Carbohydrate counting is a meal planning approach used with clients who have diabetes that focuses on carbohydrate as primary nutrient affecting postprandial glycemic response. It is not a new concept. Soon after the discovery of insulin in 1921, references appeared in the literature (35-37) that indicate that Carbohydrate counting was used in meal planning for persons with diabetes in the United States and in Europe. Joslin et al (35-36) reported tests in which they administered similar amounts of different carbohydrate-containing foods to compare dextrose to starches. No statistical differences were found in glycosuria or blood glucose using the various test meals. The “total glucose” value of carbohydrate, protein, and fat was figured to be 100%, 58%, and 10%, respectively (35-37). Foods were grouped according to their carbohydrate content; fruits and vegetables each included several categories based on percentage carbohydrate. Calculations of positive and negative carbohydrate balance were made according to the difference between total carbohydrate intake and glycosuria during a test period. If the dietary carbohydrate exceeded the amount of glucose in the urine, the subject was thought to be in positive carbohydrate balance. Ultimately, the total glucose value of the diet was used to determine the necessary dose of insulin (36).

Dietetics curriculums, however, have not focused on the meal planning approach per se. Rather, dietetics and other health care curriculums have taught the exchange system as the standard meal-planning tool for persons with diabetes. This has resulted in the exchange system being perceived as “the diabetic diet” or “the American Diabetes Association diet.” The first exchange lists were published in 1950 to provide a structured system based on grouping foods with similar distributions of carbohydrate, protein, and fat so that foods within a group could be exchanged (38). The 1976, 1986, and 1995 revisions of the exchange lists have shown increasing emphasis on carbohydrates. The 1995 lists state that starch, fruit, and milk choices are interchangeable and add another group, other carbohydrates, which includes some sugar-containing foods not mentioned in previous exchange lists (39). For years, consistency of carbohydrate has been a central concept in meal planning for persons with diabetes, including the exchange system for meal planning.

However, although the concept of carbohydrate counting has been found since the 1920s, but it received renewed interest after conducted to use as 1 of 4 meal planning approaches (Healthy food choices, Exchange systems, CHO counting, Total available glucose) in the DCCT. In the trial, Carbohydrate counting was found to be effective in meeting outcomes goal and allow flexibility in food choice. Recent practice pattern surveys have shown an increasing interest in use of carbohydrate counting for medical nutrition therapy for persons with diabetes (12).

#### **1.1.8.1.2 Definition of Carbohydrate counting (12, 40)**

Carbohydrate counting is a meal planning approach that focuses primarily on the amount of carbohydrate eaten. It is based on the assumption that carbohydrate has been the main nutrient affecting postprandial blood glucose levels due to period of glucose converting. Carbohydrate is converted to glucose within 1-2 hours after eating that has been faster than protein, which is within 2-4 hours, and fat, 4-6 hours.

#### **1.1.8.1.3 Levels of Carbohydrate counting (11-12, 41-43)**

Three levels of carbohydrate counting have been developed. The American Dietetic Association and American Diabetes Association have jointly published client education booklets for each level (Daly, Barry, Gillespie, Kulkaarni, & Richardson, 1995)

Level 1 (Basic): Introduces the concept of carbohydrate counting and emphasizes consistent amounts of carbohydrate at meals and snacks.

Level 2 (Intermediate): Focuses on relationships between food, medication, activity, and blood glucose level and introduces the concept of how to make adjustments based on blood glucose pattern (pattern management)

Level 3 (Advanced): teaches patients who use multiple daily injections of insulin or insulin pumps how to match short-acting insulin to carbohydrate using carbohydrate-to-insulin ratio. The individual determine how to adjust premeal insulin when eating more or less than usual by using this ratio.

#### **1.1.8.1.4 Using Carbohydrate Counting (11-13, 41-43)**

To start carbohydrate counting, people with all type of diabetes were possible candidates. Initially the clients learn why consistent carbohydrate intake is important in relation to blood glucose levels. Next, they also learn which foods contain carbohydrate, the concept of carbohydrate choices, how to start counting grams of carbohydrate, use of the nutrition fact panel on food labels, and how to use food lists to count carbohydrate. Carbohydrate values are identified according to food groups (Table 4). Next, the clients are encouraged to keep food records. Finally, practicing exercises are necessary for an idea of the client's usual carbohydrate intake. During target range and keep records of food intake, blood glucose levels, and physical activity. Follow-up contacted via telephone or fax in person to help determine whether carbohydrate target range is working or if it need to be renegotiated are employed. These activities are completed the client's progression through carbohydrate counting level 1.

Diabetes patients who have mastered level 1 and 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 at level 2 (pattern management). Pattern management can be approached as a three step process. In step 1, the client and dietitian study the records and look for blood glucose levels outside the client's target range. Possible explanations for blood glucose levels outside the target range are discussed with the client. In step 2, the client and dietitian find and interpret blood glucose patterns, noting the frequency and circumstances related to these patterns. They discuss reasons for these patterns and look for solutions to problems. In step 3, the client and dietitian decide, based on what they have learned in step 1 and 2, which items of the diabetes management regimen need adjustment. They list possible strategies to try, which may include changing diabetes medication dose or timing, changing amount or timing of carbohydrate intake, increasing, decreasing, or changing timing of physical activity.

Level 3 is designed primarily for type 1 diabetes patients who are receiving intensive insulin therapy, multiple daily injections of insulin or continuous, subcutaneous insulin infusion by insulin pump. Use of carbohydrate to insulin ratios allowed the client to match the amount of short- or rapid-acting insulin given before meals, and sometimes snacks, to the amount of carbohydrate to be consumed. The clients must have mastered carbohydrate counting level 1 and 2.

However, all three levels emphasize portion control. Recommended tools for portion control include measuring cups, spoons, and a food scale that weighs in grams and ounces. A critical step in teaching carbohydrate counting is to convince the client of the value of developing accurate portion-control skills. A useful teaching method designed of this purpose is a food lab. In the food lab, clients practice weighing and measuring actual foods and figuring carbohydrate content in an individual or group setting. This method can help to overcome client resistance to developing these skills.

Blood glucose results are an important measure of success at all levels of carbohydrate counting. Clients 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 premeal and postmeal levels (44-46).

**Table 4** Carbohydrate values according to food groups

Food group	Grams of Carbohydrate	Carbohydrate choice
1 starch/bread	15	1
1 fruit	15	1
1 milk	12	1
1 vegetable	5	1/3
1 meat/protein	0	0
1 fat	0	0

#### 1.1.8.1.5 Warning of Carbohydrate counting usage (42, 47)

There are some considerations of carbohydrate counting as follows:

1) **Weight Management:** One of the advantages of carbohydrate counting is flexibility of lifestyle. However, there is a risk of weight gain or unhealthy eating if clients focus only on carbohydrate and ignore the amounts of meat and meat substitutes and fat they eat. There are several reasons why patients might gain weight:

- As clients become skilled at carbohydrate counting and their glucose control improves, they no longer lose calories as glucose in their urine.
- Fats have more calories. For example, 1 teaspoon of butter or margarine is 45 calories, about the same as 2 cups of raw vegetables.
- The flexibility of carbohydrate counting may lead clients to treat themselves to high-calorie desserts or pastries, or larger portions of their favorite foods, than they were eating previously.
- Meeting their glucose targets may mean they have more episodes of hypoglycemia. If they are using high-calorie foods or too much carbohydrate to treat hypoglycemia, they are adding extra calories.

When clients and their dietitians check how much carbohydrate they are eating, also set up guidelines for meat and meat substitutes and fat intake. If they are not eating enough carbohydrate, it may be because they are eating too much protein and fat and these kinds of foods are satisfying their appetite.

2) Healthy Foods: As their carbohydrate counting skills advance and they enjoy the freedom of more food choices, remember to consider good nutrition. Be sure to aim for 5 servings per day of vegetables and fruits, 3 serving of whole grains, and 2-4 servings of low-fat milk or dairy foods. They should check with their dietitians about their calcium needs.

3) Hypoglycemia: It is an important that clients should know how to prevent low blood glucose episodes and which foods and glucose products to use to treat them. The general rule when treating a low glucose level is to first use 15 grams of carbohydrate, for example, glucose tablets or juice. After about 15 minutes, check glucose level and take additional 15 grams of carbohydrate if glucose is still low. Check again after 60 minutes. Treatment of hypoglycemia can lead to weight gain or an inability to lose weight, if that is their goal. This can occur particularly if they have frequent hypoglycemia (several times per week) and they use high-calorie foods or too much carbohydrate (such as candy bars or ice cream) to treat those episodes.

#### **1.1.9 Exercise (14, 40)**

Exercise generally increase the utilization of glucose, which is provided initially from the breakdown of muscle glycogen and subsequently, from hepatic glycogenolysis and gluconeogenesis. These effects are mediated through norepinephrine, epinephrine, growth hormone, cortisol, and glucagons along with the suppression of insulin secretion. Exercise offers many health-promoting benefits for people with and without diabetes, and intervention strategies that promote life-long physical activity should be encouraged.

With the increased prevalence of overweight and obesity in children and adolescents, children and adolescents with type 1 diabetes may also be overweight or obese. For these children, exercise is particularly encouraged as an important component of a weight management strategy. Studies in pediatric populations have shown that discouraging sedentary activities, especially time spent in front of the TV or computer monitor, is an effective method to increase physical activity and encourage weight loss in inactive children.

## 1.2 Researches related to Carbohydrate counting

During the past decade, several surveys of dietitians who provide medical nutrition therapy for persons with diabetes have been conducted to determine current practice patterns as well as assess the needs of dietitians (62-64). These surveys identified the need for a variety of meal planning approaches to be used in addition to the most widely used method, the exchange system. Thus, in 1993, The American Dietetic Association and the American Diabetes Association Steering Committee recommended the development and publication of 5 new nutrition resources for diabetes meal planning (64). Carbohydrate counting was 1 of the 5 approaches described in these resources.

In October 1996, the Diabetes Care and Education dietetic practice group offered a skill development workshop on Carbohydrate counting at the 79<sup>th</sup> Annual Meeting and Exhibition of The American Dietetic Association. The session which was limited because of the requirements of a hands-on interactive workshop that included a food lab, was sold out. The dietetic practice group conducted a pre-workshop survey of practice patterns of the workshop participants. A profile of the 200 workshop attendees indicated that 95% were registered dietitians and 16% were certified diabetes educators. By specially, the participants include generalists (64%), diabetes nutritionists (18%), and other (18%). Practice settings included hospital inpatient (31%), private practice (19%), hospital outpatient (14%), clinic (10%), and other (26%). The participants used a variety of meal planning approaches: exchange system (92%), general guidelines (75%), menu systems (45%), and carbohydrate counting (44%). Of those using carbohydrate counting, 24% were using basic or level 1; 13% were using intermediate or level 2; and 10% were using advanced or level 3. Response regarding the use of results from monitoring blood glucose levels to make food changes were follows: 23%, always; 44%, usually; 21%, occasionally; 12%, never. Sixty-three percent of respondents reported using the results of self-monitoring of blood glucose levels to make recommendations for medication adjustments, 67% used the results to make changes in diet, and 83% used these results for recommendations about physical activity. Approximately half of the respondents reported that they

usually or always as clients to weigh and measure foods and approximately has occasionally or never do.

A follow-up survey was conducted 6 months later; response rate was 64%. The follow-up survey showed an increase of 21% in the use of carbohydrate counting in general. Use of level 1 carbohydrate counting increased by 22%, level 2 increased 11%, and level 3 increased by 5%. These increases were statistically significant. The use of self-monitoring of blood glucose level did not change significantly in regard to making decision about changes in diet, recommending medication adjustments and physical activity, and asking clients to weigh and measure foods. The survey results suggested that dietetic professionals need to increase emphasis on the importance of teaching client's portion control skills and how to interpret the results of self-monitoring of blood glucose levels to adjust diabetes therapy. Mastery of these skills is a prerequisite to advancing to the more complex levels of counting carbohydrates and calculating carbohydrate-to-insulin ratios.

The 1994 American Diabetes Association nutrition recommendations report that scientific evidence does not support previous recommendations to avoid sugars, or simple carbohydrates, in favor of starches, or complex carbohydrates, because all carbohydrate, whether starch or sugar, is metabolized glucose in the body (65). Published research was reviewed intensively regarding use of sucrose in the diets of persons with type 1 and type 2 diabetes. The research showed no difference in glycemic response or insulin requirements between high-starch VS high-sucrose diets (66). Therefore, recommendations emphasize that priority should be given to the total amount of carbohydrate rather than the type (65).

Dietary behaviors associated with improved glycemic control in the Diabetes Control and Complications Trial (67) 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, that is, using carbohydrate-to-insulin ratios. These and other diet-related behaviors were related to lowering of the level of the glycosylated hemoglobin, HbA<sub>1C</sub>, which was associated with an overall reduction in the development of diabetes complications.

The study of Kalergis M., et al. (68) was designed to compare three intensive management strategies with respect to metabolic control (glycosylated hemoglobin,

preprandial blood glucose, lipid profile, body weight, hypoglycemic episodes) and psycho-social adaptation (quality of life, self-efficacy, stress and perceived complexity). Fifteen adults with type 1 diabetes were treated with three treatment strategies as follows: Simplified (SIMP) = meal plan based on food exchanges with no self-adjustment of insulin for food, exercise and stress. Qualitative (QUAL) = meal plan based on food exchanges with qualitative adjustment of insulin for food, exercise and stress. Quantitative (QUANT) = meal planning using CHO counting with quantitative adjustment of insulin for food, and qualitative adjustment of exercise and stress. All subjects followed each strategy for 3.5 month. Subjects kept detailed log sheets where they recorded preprandial blood glucose, insulin doses, food intake, activity and stress level at least four times/day. The psycho-social aspects were determined with validated questionnaires that were completed before and after each strategy. The researchers found that there were no statistical significant differences in metabolic control, quality of life and self-efficacy between the three strategies. (HbA1C: Baseline  $10.9 \pm 0.06$ , End of SIMP  $9.7 \pm 0.03$ , QUAL  $9.5 \pm 0.04$ , QUANT  $10.2 \pm 0.04$ ) Body weight and lipid profile did not change significantly. The frequency of severe hypoglycemic episodes for the entire study was 20 episodes/100 patient-years. Perceived complexity of treatment strategy increased ( $p < 0.0001$ ) from SIMP to QUANT (least to more flexible). Although the majority of subjects ( $n = 11$ ) were following a strategy similar to SIMP prior to entering the study, 12 subjects chose to continue with QUAL, three with QUANT and none with SIMP at the end of the study. These result indicated that a strategy that allows for flexibility of self-adjustments of insulin and is not very complex may be the strategy of choice for intensive management programs.

Bruttomesso D., et al. (69), studied the teaching and training program on CHO counting in type 1 diabetic patients. The objectives of this study were to plan and evaluate a simple educational program to improve dietary knowledge and teach how to count CHO. Forty-eight patients (age  $27 \pm 1$  yr, diabetes duration  $11 \pm 1$  yr, HbA<sub>1</sub>C 9%) attended 4 interactive meeting held at monthly intervals. The targets of course were: 1) to identify sources of CHO, fats and proteins; 2) to count CHO and to split them among meals; 3) to assume CHO-rich foods without changing daily calorie or CHO intake; 4) to modify the diet so as to correct hypoglycemic events. To evaluate

the effect of the course, patients 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 seven months later. After the course dietary knowledge improved significantly. The number of patients who weighed foods, estimated CHO food content and correctly distributed CHO among meal also increased. After the course patients reacted better when faced with hypoglycemia. The knowledge acquired persisted 7 months after the end of the course. Therefore they concluded that a simple teaching program can improve diet knowledge in type 1 diabetics and establish a sustained habit of counting CHO.

There was a study of an attempt to individualized diabetes medical nutrition therapy (70). In practice, however, many patients receive information on nutrition in group sessions. In order to address different needs of patients in such a setting, a class was developed in which patients are familiarized with two different meal planning approaches: The plate method and level 1 carbohydrate counting. To practice the Plate method, patients use plates and food models to build a balanced meal with appropriate portion sizes. The dietitian who teaches the class evaluated each meal. Patients enjoyed this activity since it allowed them to be actively involved using the carbohydrate counting approach, patients determined their healthy weight based on their height and age by using a weight table. Using a simple formula, which considered level of physical activity, patients calculate their individual caloric needs and received a meal plan with the corresponding caloric level. The dietitian explained how to use exchange lists and food labels as tools to determine carbohydrate choices or grams. Patients were asked to share with the class which foods they consumed with their previous meals. After the meals were recorded by the dietitian on the transparency, class participants were asked to look up the carbohydrate content in the exchange lists and on food labels. The number of grams were counted and compared to the carbohydrate allotments giving on the meal plans. According to the positive response on class evaluations, patients liked this class concept, and many patients scheduled appointments with the dietitian for more in depth nutrition therapy after class.

Jane U., et al. (71), studied the revision of the Food Guide Pyramid for Endurance Athletes based on Carbohydrate counting. Most of the information available for endurance athletes recommend the consumption of a predetermined gram amount of carbohydrate per kilogram of body weight usually in the range of 6-12 g/ kg body weight. Thus the total amount of carbohydrate recommended per day ranges from 300-1000 g as determined for individuals with body weights ranging from 50-90 kg training daily from 1 to more than 4 hours at intensities approximating 70%VO<sub>2</sub> max or greater. This data is based on research relating carbohydrate intake to maintenance of adequate glycogen stores to sustain competitive exercise for extended periods of time. The nutrition education of endurance athletes often includes the following: reference to the total amount of suggested carbohydrate; lists of foods with gram amounts of carbohydrate; and suggestions to follow the Food Guide Pyramid. However, the Food Guide Pyramid provides only approximately 300 g on carbohydrate if maximal servings are followed. This amount is inadequate for most endurance athletes. Currently there is not a simplified system to allow athletes to plan and consume diets with an adequate amount of carbohydrate. Thus, a simplified method to allow athletes to plan and consume diets with an adequate amount of carbohydrate will be presented. This method modifies the suggested number of servings of the Food Guide Pyramid while utilizing “Carbohydrate counting” principles. Several variations of the Food Guide Pyramid will be presented to accommodate diet requiring 400 g, 500 g, or 600 g of carbohydrate. “Carbohydrate counting” is utilized to simplify the choices at meals and snacks throughout the day with a minimum number from each group. Nutrition education would include determination of the appropriate amount of carbohydrate needed per day; determination of the total number of “carbohydrate choices”; serving sizes within each carbohydrate containing group; maintenance of the variety of the Food Guide Pyramid; reading labels. From this study indicated that carbohydrate counting not only be used widely in diabetic patients, but also in endurance athletes or others, particularly level 1 carbohydrate counting.

A discussion of carbohydrate counting is not complete without addressing the glycemic index (12). The glycemic index ranks foods on the basis of the glycemic effect of that food compared with a standard food, usually glucose or white bread (72-

73). Foods with high glycemic index, such as rice, produce a greater glycemic response than foods with a low glycemic index, such as legumes. One study comparing the use of diabetes exchange lists to the glycemic index concluded that the carbohydrate exchange lists more accurately predicted postprandial glycemic response to carbohydrate-containing foods, as part of a mixed meal, than did the glycemic index of foods (74). Through monitoring of blood glucose level and record keeping, clients become aware of their own variability of glycemic response to specific carbohydrate foods; in effect, they learn their own glycemic index (72). They may learn that even small portions of certain foods, such as pizza, produce a greater than expected glycemic response (75). If they wish to use these foods and maintain glycemic control, they can learn to adjust portion sizes, activity level, or diabetes medications.

Franz MJ. (76) studied to know is the source or the amount of carbohydrate more importance. There had been two approaches to examine the effects of carbohydrate on postprandial glycemia: 1) studied designed to determine the glycemic response of foods containing carbohydrate, regardless of the source, i.e., starch, sugar, or fiber (glycemic index [GI] of carbohydrates), and 2) studied comparing the glycemic response to equivalent amounts of starches or sugars. A number of food factors determine the glycemic response to carbohydrates: food form, digestibility, cooking, sugars, type of starch, presence of antinutrients, and second meal or lente effect. In people with diabetes, the severity of glucose intolerance and premeal glucose concentrations also influenced the glycemic response. The GI attempted to classify individual foods (50-g portions) by the extent to which they raise blood glucose levels compared with a standard (reference carbohydrate), initially glucose and in later studied bread. Acute glycemic responses differ, however, when meals containing low GI foods were compared to meals containing high GI foods long term (measured by fructosamine or HbA<sub>1C</sub>), the outcomes were mixed. If there was an effect from the GI of foods on glycemia, it was modest at best. In other studies, when sucrose was substituted for a variety of starches in meals or snacks and both acutely and for up to 6 weeks, the glycemic response was similar if the total amount of carbohydrate was similar. Therefore, the recommendation for persons with diabetes in regard to the glycemic effect of carbohydrates was that the total amount of carbohydrate in meals or snacks was more important than the source or type and was the first priority in the

planning of meals or snacks. This has led to the implementation of carbohydrate counting, in which foods were listed as carbohydrate choices based on the amount and not the source of the carbohydrate.

Hissa AS., et al. (77) studied to evaluate the degree of satisfaction of that approach in patients treated by intensive insulin therapy. Fifty type 1 diabetic patients submitted to carbohydrate counting for 6 months answered a questionnaire related to the lifestyle. The answers were favorable in: >80% to requirements related to the choice of the number of meals, to eat out, schedules of meals and social and daily activities, glycemic monitorization and interest in reading food labels; 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. The investigators concluded that according to the participant's opinion, carbohydrate counting was a very well accepted procedure, allowed a better lifestyle.

In Thailand, there is only one research that relates to carbohydrate counting. Wibunrattanasri N. (78) studied to develop and evaluate the self-help guidelines for meal planning using carbohydrate counting in type 2 diabetes care. The subjects (mean age of 55 years) received the guidelines with only one session of introduction. Then, 7 days after implementation, an evaluation of the appropriate guidelines was conducted by using interviewing method. The interview dealt with the satisfaction with the guidelines, understanding of the carbohydrate counting concept, and intention to use the carbohydrate counting record. Completion of counting carbohydrate was assessed through the carbohydrate counting record. In general, the researcher found that most of the subjects understood this approach at a medium level, which did not enable them to count carbohydrate intake correctly. However, this guideline was developed for adult with diabetes and found that its contents have not covered essential details for carbohydrate counting learning.

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 2 Counseling and Edutainment Approach

Counseling and Edutainment Approach as the important aspects for developing of the educational tools.

### 2.1 Cognitive Behavior Therapy (CBT) as Counseling approach (79-89)

#### 2.1.1 Definition of Cognitive Behavior Therapy (CBT):

Cognitive behavioral therapy is a form of psychotherapy that emphasizes the important role of thinking in how we feel and what we do. Cognitive-behavioral therapist teach that when our brains are healthy, it is our thinking that causes us to feel and act the way we do. Therefore, if we are experiencing unwanted feelings and behaviors, it is important to identify the thinking that is causing the feelings / behaviors and to learn how to replace this thinking with thoughts that lead to more desirable reactions.

There are several approaches to cognitive-behavioral therapy, including Rational Emotive Behavior Therapy, Rational Behavior Therapy, Rational Living Therapy, Cognitive Therapy, and Dialectic Behavior Therapy. **However, most cognitive-behavioral therapies have the following characteristics:**

1. CBT is based on the Cognitive Model of Emotional Response: Cognitive-behavioral therapy is based on the scientific fact that our thoughts cause our feelings and behaviors, not external things, like people, situations, and events. The benefit of this fact is that we can change the way we think to feel / act better even if the situation does not change.

2. CBT is Briefer and Time-Limited: Cognitive-behavioral therapy is considered among the "fastest" in terms of results obtained. The average number of sessions clients receive (across all types of problems) is only 16. Other forms of therapy, like psychoanalysis, can take years. What enables CBT to be briefer is its highly instructional nature and the fact that it makes use of homework assignments.

3. A sound therapeutic relationship is necessary for effective therapy, but not the focus: Some forms of therapy assume that the main reason people get better in therapy is because of the positive relationship between the therapist and client. Cognitive-behavioral therapists believe it is important to have a good, trusting relationship, but that is not enough. CBT therapists believe that the clients change when they learn to think differently; therefore, CBT therapists focus on teaching rational self-counseling skills.

4. CBT is a collaborative effort between the therapist and the client: Cognitive-behavioral therapists seek to learn what their clients want out of life (their goals) and then help their clients achieve those goals. The therapist's role is to listen, teach, and encourage, while the client's role is to express concerns, learn, and implement that learning.

5. CBT is based on stoic philosophy: Cognitive behavioral therapy does not tell people how they should feel. However, most people seeking therapy do not want to feel they way they do. CBT teaches the benefits of feeling, at worst, calm when confronted with undesirable situations. It also emphasizes the fact that we have our undesirable situations whether we are upset about them or not. If we are upset about our problems, we have two problems, the problem, and our upset about it. Most sane people want to have the fewest number of problems possible.

6. CBT uses the Socratic Method: Cognitive-behavioral therapists want to gain a very good understanding of their clients' concerns. That's why they often ask questions. They also encourage their clients to ask questions of themselves, like, "How do I really know that those people are laughing at me?" "Could they be laughing about something else?"

7. CBT is structured and directive: Cognitive-behavioral therapists have a specific agenda for each session. Specific techniques / concepts are taught during each session. CBT focuses on helping the client achieve the goals they have set. CBT is directive in that respect. However, CBT therapists do not tell their clients what to do rather, they teach their clients how to do.

8. CBT is based on an educational model: CBT is based on the scientifically supported assumption that most emotional and behavioral reactions are learned. Therefore, the goal of therapy is to help clients unlearn their unwanted reactions and to learn a new way of reacting. While CBT therapists do not present themselves as "know-it-alls", the assumption is that if clients knew what the therapist had to teach them, clients would not have the emotional / behavioral problems they are experiencing. Therefore, CBT has nothing to do with "just talking". People can "just talk" with anyone. The educational emphasis of CBT has an additional benefit, it leads to long term results. When people understand how and why they are doing well, they can continue doing what they are doing to make themselves well.

9. CBT theory and techniques rely on the Inductive Method: A central aspect of Rationale thinking is that it is based on fact, not simply our assumptions made. Often, we upset ourselves about things when, in fact, the situation isn't like we think it is. If we knew that, we would not waste our time upsetting ourselves. Therefore, the inductive method encourages us to look at our thoughts as being hypotheses that can be questioned and tested. If we find that our hypotheses are incorrect (because we have new information), then we can change our thinking to be in line with how the situation really is. There are over 25 very common mental mistakes that people make that cause them to not have the facts straight.

10. Homework is a central feature of CBT: If when you attempted to learn your multiplication tables you spent only one hour per week studying them, you might still be wondering what 5 X 5 equals. You very likely spent a great deal of time at home studying your multiplication tables, maybe with flashcards. The same is the case with psychotherapy. Goal achievement (if obtained) could take a very long time if all persons were only to think about the techniques and topics taught for one hour per week. That's why CBT therapists assign reading assignments and encourage their clients to practice the techniques learned.

### 2.1.2 Cognitive Behavioral Model of Diabetes

It has long been known that what people believe strongly influences their feelings and behaviors. The ancient Greek philosopher Epictetus stated, "People are not disturbed by the things that happen to them, but by the views they take of them." (80). More recently, the effects of people's cognitions and attitudes regarding their self-care behaviors have drawn increasing attention from clinicians and researchers. Cognitive models of health behavior have been introduced to help us appreciate the complexity of the health behavior change process and to better understand how behaviors are determined by attitudes and beliefs. From clinical practice, we know that educating patients and helping them acquire the necessary technical skills (e.g., injecting insulin, checking and interpreting blood glucose) is a prerequisite for self-care behavior but by no means guarantees success. Nor does informing patients about the benefits of intensive insulin therapy and raising their awareness about the potential risks of non-adherence automatically prompt a change in self-care behavior. The Health Belief Model (HBM) (81) proposes that, in addition to the level of knowledge, we need to take into account the beliefs people hold about their vulnerability to medical complications, the benefits and barriers they perceive, and their self-efficacy expectations, i.e., their confidence in being able to perform and maintain the self-care behaviors required to attain glycemic control. Related to this is the concept of "readiness to change" from the transtheoretical model that conceptualizes behavior change as a staged process and distinguishes between different motivational phases ranging from "pre-contemplation" to "action," when patients finally make the behavior change (82). Obviously, a person needs to have a certain readiness to change to gain any benefit from an educational intervention aimed at behavior change.

### **Transtheoretical Model:**

Prochaska et al. in a 1992 article in *American Psychologist* (83) describe the stages of change;

1) Pre-contemplation: a stage in which individuals are not considering changing in the near future (within the next 6 months). The client just does not see the problem.

2) Contemplation: a stage in which individuals are considering changing in the near future. The client has become aware of the problem, but is not sure she or he wants to change.

3) Preparation: a stage in which individuals intend to take action within a month and have attempted to take action in the last 6 months, without success. Some small steps toward change may have taken place.

4) Action: a stage in which individuals actually change their behavior. A considerable amount of commitment is required to make real changes.

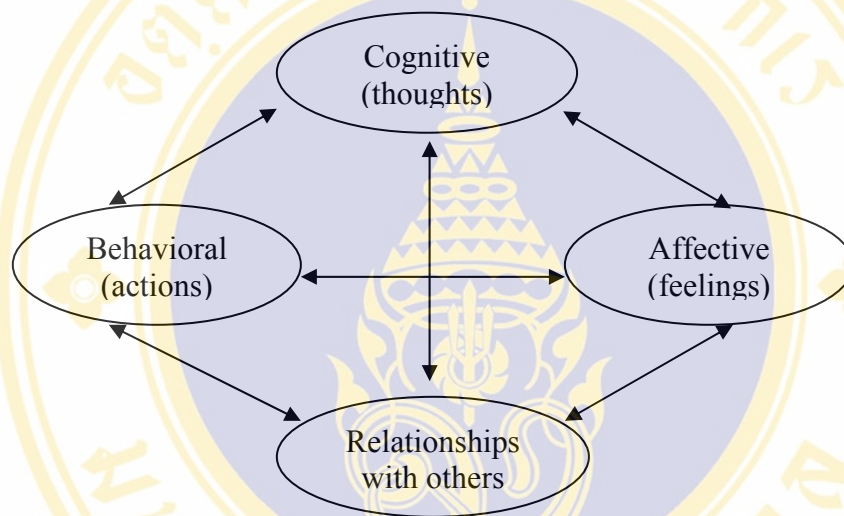
5) Maintenance: a stage in which individuals work to maintain the behavior change and prevent relapse.

6) Habituation: a stage in which new habits have been formed. For some people, this stage can last for a lifetime.

Non-adherence, then, may occur for several reasons, which are not mutually exclusive (84) ; Patients do not know what to do, Patients do not have the skills to carry out the self-care activities, Patients do not think they are able to carry out self-care activities, Patients do not think carrying out self-care activities will make a difference, Patients perceive the costs as greater than the benefits, Patients do not receive adequate reinforcement (pay-off) for meeting short-term goals, and Patients experience a lack of social support.

When cognitive attitudinal barriers, rather than lack of knowledge or skill, are the main obstacles to self-management, a cognitive behavioral intervention is required. Such an approach may be particularly beneficial for patients who, on the basis of experiencing multiple failures in attempting to manage their diabetes, have little or no belief anymore in their ability to cope adequately with the demands of the

treatment regimen, i.e., those who have developed strong negative beliefs regarding their diabetes self-efficacy. Such negative thoughts (e.g., "My diabetes is beyond my control.") result in negative feelings (e.g., sadness, anger) and maladaptive health behaviors (e.g., skipping injections, overeating, not checking blood glucose), thereby reinforcing this negative cycle. The basic premise of the cognitive behavioral model is that there is a constant interplay among the cognitions or beliefs that patients hold about their diabetes, their feelings, their behaviors, and other people (Figure 1).



**Figure 1** The Cognitive Behavior Model

Challenging patients' dysfunctional beliefs with more realistic, self-helping cognitions will enable them to feel less overwhelmed by the treatment regimen as well as by other stressors in life and will consequently help them cope more effectively with the demands imposed on them. This approach originates from Albert Ellis's Rational Emotive Therapy (RET) and Aaron T. Beck's Cognitive Behavior Therapy (CBT), two similar therapeutic approaches that have been successfully applied to a wide variety of emotional and behavioral problems, including depression and anxiety disorders (85-86).

Literature on RET and CBT in diabetes is still surprisingly limited. Zettler and associates (87) successfully used a cognitive-behavioral group program to help type 1 diabetic patients cope more effectively with their fears of long-

term complications. Recently, a study by Lustman and associates (88) demonstrated significant favorable effects of CBT both on psychological well-being and on glycemic control in depressed type 2 diabetic patients.

RET and CBT are based on the observation that people's emotional problems are founded in a system of dysfunctional or distorted beliefs about themselves and the world surrounding them. These core beliefs generate automatic negative thoughts that are easily triggered and often contain some cognitive distortion, such as exaggeration (magnifying), overgeneralization, making un-validated assumptions, all-or-nothing thinking, or personalization.

According to Ellis, core beliefs fall into three categories: 1) being demanding toward self (e.g., "I must adhere to my diabetes regimen in all circumstances, otherwise I am not a good patient."), 2) being demanding toward others (e.g., "My doctor must always listen to me, or else he is a bad doctor."), and 3) being demanding toward the world (e.g., "My life must always be enjoyable, or else it is not worth living."). Holding these irrational beliefs can easily cause feelings of frustration and result in dysfunctional behaviors, leading to poor diabetes control. This negative experience, in turn, reinforces a person's already existing negative attitude toward diabetes.

From this perspective, it may be extremely helpful for patients with poorly controlled diabetes to learn to explore their automatic thoughts, discover how these thoughts affect their mood and behavior, and challenge these beliefs with more constructive, self-helping cognitions. This will result in reduced negative feelings and more adaptive coping. Negative thoughts, however, are not per se always distorted, and it is important to keep that distinction in mind. There is much that is negative and unpleasant about diabetes, and negative thoughts should therefore be acknowledged as perfectly normal and realistic.

Such thoughts become dysfunctional when, for example, un-validated assumptions are made (e.g., "I'll lose my eyesight no matter what I do."), or when exaggeration takes place (e.g., "I can never do anything pleasant due to my diabetes."). Patients can benefit from looking critically at negative thoughts that are

overwhelming and paralyzing and replacing them with more positive cognitions. A good example is given by Albert Ellis, the founder of RET and a diabetes patient himself, who experienced quite a few problems in adjusting to the demands of the diabetes treatment regimen." So it is a pain! If I don't keep up with this annoying regimen, I'll soon create much greater pain and not even be around long enough to be able to cope with it. It's really rough to persist at this regimen. But it'll be much rougher if I don't!" (89).

According to the overall above, particularly CBT is based on an educational model (79); so, CBT was a considerable aspect for developing of educational tool model in this study.

## **2.2 Edutainment Approach (90-94)**

### **2.2.1 Definition of an edutainment:**

Edutainment is any communication initiative that sets out to educate and entertain at the same time. It can be defined as the art of integrating social messages into popular and high quality communication formats, based on a through research process. Edutainment is based on a non-negotiable process of research and development.

### **2.2.2 A brief history of edutainment:**

It was Aristotle's belief that the lessons we enjoy most are the ones that we learn best. But edutainment's origins go back further than the Greek philosopher, the method has, in fact, existed for as long as people have been telling stories as a way of teaching succeeding generations about the world we live in. In recent years, the massive growth of the entertainment industry, and advances in communications infrastructure and technology, have greatly boosted the potential of this approach to contribute to health and social development.

The 1980s, it was only in the 1980s that more and more people began to develop a true appreciation of the advantages of using popular media to promote health. Two significant groups in this regard were the Johns Hopkins University and Population Communication International (PCI), both of which saw in edutainment a

potentially effective vehicle for promoting child spacing in families in the developing world. The key contribution of these two groups to edutainment was their development of a scientific approach to integrating a social message into a popular communication format. This approach acknowledged the importance of research involving the target audience and other role-players. And also stressed the importance of pre-testing draft materials with the target audience.

The Johns Hopkins University **“Steps to Behavior Change”**: The Johns Hopkins University developed a program planning and implementation methodology, called the “P Process” and coined the term “Enter-educate”. They also developed a theoretical framework for individual behavior change, termed “Steps to Behavior Change”. Although developed with family planning in mind, it can be usefully adapted to other forms of health and development communication. It consists of five major steps:

Step 1: Knowledge (The person obtains knowledge which will allow her or him to make an informed decision around certain behavior.)

Step 2: Approval (The person approves of the suggested behavior change.)

Step 3: Intention (She or he intends adopting the new behavior.)

Step 4: Practice (She or he practices the new behavior.)

Step 5: Advocacy (She or he advocates the adoption of the new behavior to others.)

Not all individuals go through each step of the process in the same order, at the same rate, or at the same time. This model emphasizes that behavior change and thus communication intended to influence behavior change is a process. It recognizes that the behavior change is the goal and not the first step, and that people usually move through several intermediate steps before changing their behavior. It also suggests that people at different stages constitute distinct audiences. Thus they need to be communicated to through different approaches and, sometimes, with different messages.

Edutainment becomes an established field of study: By 1989, edutainment as a field of study had become sufficiently formalized for the first international conference on edutainment to be held at the Annenberg School of Communications at

the University of Southern California. In 1997, the second international conference on the topic was held at the University of Ohio.

**2.2.3 Process of an edutainment project-creation:** It consists of five phases.

**The five phases of an edutainment project are:**

Phase 1: Research and Planning (Topic research involving target audience and other stakeholders)

Phase 2: Development

- Messages design
- Integration of message into chosen form of entertainment
- Pre-testing with target audience and other role-players
- Modification as a result of pre-testing

Phase 3: Production

Phase 4: Implementation and promotion

Phase 5: Evaluation

**Phase 1: Research and Planning**

1.1 Choosing the topic: three guidelines should be followed

a) The topics should be relevant to a significant number of people in the community.

b) The topics should be able to attract funds from potential donors.

c) There needs to be a will within our organization to tackle the topics.

1.2 Identify the target audience:

The target audience consists of the people we are trying to reach with our communication intervention. It is helpful to divide the target audience into the primary target audiences and the secondary target audiences.

If we want our message to reach your primary target audience effectively, we will almost always need to reach other groups that can influence their attitude and practices. This groups of people are the secondary target

audiences. In this case, “secondary” does not mean “less important”. Some of this group can have a direct impact on the primary audience.

### 1.3 Decide on the scale of the edutainment project:

If the topic is relevant only to people in a small area, edutainment will be small-scale. On the other hand, if the topic is relevant to people over a large geographical area, we will want to implement a large-scale edutainment project.

### 1.4 Starting to budget and schedule:

- Estimate time frame, and how much money we will require for each phase in our edutainment project.

- Writing a complete project proposal, as we should have all the information we need about our target audience, and the media and formats to be used.

### 1.5 Building a supportive environment through partnerships:

- Guidelines for creating and maintaining successful partnerships:

- a) Bringing on board the best people available is a good basis for effective partnerships.

- b) Partnerships need to be constructed in such a way as to ensure that all partners feel that their needs are being met and they have as much to gain from the partnership as the management team.

- c) The fact that partners come from diverse backgrounds is both a strength and a weakness, will so often be in conflict, need to be managed throughout the entire process of creating the edutainment.

- d) A good way of maintaining healthy and effective partnerships is to ensure that all the partners understand the edutainment’s objectives and are pursuing a common vision. This can best be achieved by bringing all the major partners into the process as early as possible.

- e) Do not be afraid of withdrawing from relationships that are really not working out. For instance, a writer may be able to write excellent scripts, but may refuse to listen to any input from the topic experts. In a case like this it is better to get out of the partnership. Creating edutainment is an interactive process,

and the final product can be severely compromised by soured relationships between its co-creators.

#### 1.6 Researching the topic and the target audience:

It is vital in creating successful edutainment, and it is, to some extent, what differentiated edutainment from entertainment. However, because this kind of research takes time, it is often neglected in favor of getting the product finished. This can be dangerous, because the final edutainment product can give the wrong message to the target audience and can make the project lose credibility and support. The best way to find out this information is to run focus groups. This is usually a relatively cheap and very effective method.

#### 1.7 Choosing the edutainment media and formats:

1.7.1 Explore the edutainment opportunities of the different media available to the target audience:

1.7.1.1 Television: is probably one of the most effective media for edutainment. This is partly because ownership of television sets has increased dramatically in developing countries in recent years, and where people have access to more than one mass medium, it has been shown that they tend to choose television over the other media.

- Advantages are; a) It combines both sound and images, b) People do not need to be literate to understand television programs, and c) It allows the edutainer plenty of opportunities to contextualize educational messages within entertaining formats.

- Disadvantages are; a) Production costs tend to be high, and can increase overall edutainment budget, b) It is not a good medium for carrying detailed messages, since television transmits a message at a moment in time and the viewer cannot go back for clarification, and c) Television is usually less well accessed by poor people and those living in rural areas.

1.7.1.2 Radio: is ideal for edutainment, as it has the potential to transport the listener into places and situations that would be difficult with any other medium.

- Advantages are; a) It is popular with many people, b) Most developing countries have a reasonably well-developed radio network which

is accessible to communities that few other mass media reach, including people who are not literate, c) It also gives edutainers greater scope than television to generate a script in one language and adapt it culturally and linguistically for different audiences, and d) Radio production cost is relatively low.

- Disadvantages are; a) The listener cannot go back for clarification, b) It is usually difficult to have more than a few characters in a radio drama, so radio edutainment tends to carry fewer messages than television edutainment, and c) Batteries are expensive and can be a barrier for people accessing the radio.

1.7.1.3 Videos and audiocassettes: They have the same advantages as television and radio. In addition, they can be used to facilitate discussion, since they can be rewound and played again for points of clarification. However, they need relatively expensive equipment in order to be played, and they wear out with time.

1.7.1.4 Film: It is a popular form of entertainment in many countries. It can be stopped and started, or played over again if necessary, and this makes it a useful tool for facilitating group discussion. People do not need a formal education to understand a film. However, film can be expensive to produce, and need expensive equipment to be shown. It may be difficult to decide which languages to use in a film.

1.7.1.5 Print media: It means newspaper, magazines, pamphlets, comic strips, comic books, short story books, booklets and posters.

Advantages are: a) Printed materials can be read at the reader's own pace, and can be used in many different ways, for example, they can be read alone or in a group, with or without facilitator. They can also be kept for reference, b) Print media can often include more detailed information than broadcast media or performed drama, and can be used alone or in support of the other forms of edutainment, and c) Printed materials also carry authority, as the printed word tends to be viewed as credible.

In order for edutainment to be successful using print media, the material must be accessible to the target audience in terms of language,

layout and graphics, and if applicable, purchase price. (One of the potential disadvantages of printed materials is that they can be relatively expensive.) The edutainment messages must also be integrated into formats that are popular, such as comics, magazines, photo novellas, newspaper, etc.

1.7.1.6 The Internet: It is popular in many circles, as it combines audio, visual and print in one medium, and it transmits information very rapidly to and from people all over the world. Information from the Internet can also be saved on people's computers for further reference or selectively printed out. The most obvious disadvantage of the Internet is the expensive equipment required for accessing it. Few people in developing countries have access to the Internet or will have in the near future. Also, many people who do have access to the Internet are uncertain of how to use this new technology.

1.7.1.7 Live performances (plays, dance, puppet, shows, etc.): They are popular, well accepted forms of entertainment in most communities. They are effective for edutainment because facilitators or actors can engage the audience in debate around the issues raised, immediately after the performance. Live performances can respond to vary localized situations, using actors who are familiar with the issues. Live performances do not require the audience to have a formal education. They can be cost effective. One disadvantage of live performances to bear in mind is that they can only access relatively small groups of people.

1.7.2 Choose the most appropriate medium/media for the message: It will depend, to some extent, on the scale of the project.

- Guidelines for selecting a medium/media for small-scale edutainment:

a) Select a medium that allows you to respond to local issues.

b) Select a medium that allows you direct contact with your target audience, so that you can respond directly to the issues that edutainment raises, and can change your edutainment immediately if necessary, based on audience feedback. This will also enable you to capitalize on the program immediately, for example, by giving away posters, brochures and stickers based on your edutainment.

c) Select a medium that allows you to use influential local entertainers who may already have some insight into the issues. (However, never rely on these insights alone, as you may find messages being conveyed which are not appropriate.)

- Guidelines for selecting a medium/media for large-scale initiative: In order to promote topics such as health and development on a mass scale, need to select a medium (or media) that:

- a) can reach very large groups of people
- b) can reach all strata of society
- c) are believed to be credible sources of information
- d) have high visibility, which will be good for attracting funding
- e) can create credible role models
- f) can influence people's knowledge, attitudes, perceptions & practices.

The media that fulfill these criteria are generally the mass media, including radio, television, the mainstream print media, and in some cases, the Internet.

- Choosing an approach: single-medium or multimedia;

a) Using one medium only: - whether radio, music, theatre or any other medium, is relatively simple to manage. The disadvantage of this approach, however, is that your product must stand alone, and it therefore loses the potential reinforcement that other media can bring to it.

b) Using a multimedia approach: -Using media in combination is always more powerful than using a single medium. While this approach requires fairly complex project management and co-ordination, the benefits

are worth the effort: the synchronization of media can immediately reinforce your messages and can also reach different kinds of audiences at the same time. Just as advertisers use radio, television and print to increase the impact of their advertisement, having more than one source of information adds credibility to your edutainment message.

1.7.3 Explore the edutainment opportunities of a range of formats: It is not enough to just choose a medium (or media) for the edutainment. We also need to think about the kinds of formats within our chosen media that will be most successful in carrying the messages:

1.7.3.1 The story format (dramas, comedies, folktales, soap operas and performances by storytellers): Stories can portray real life in all its complexity, by confronting the characters with several issues and challenges all at the same time, and by showing the different ways in which different people react to situations and resolve difficult problems.

1.7.3.2 The game show format: This approach can stimulate the audience to think and thus to learn, it can challenge false ideas, it can be fun, and it can provide incentives for people to learn more about the topics. It is possible to combine a drama and a game show by presenting a short drama followed by questions or a quiz relating to the message.

1.7.3.3 The music and dance format: Popular singers can be asked to compose and record a song with a message, and also dance to the music if that is appropriate in the cultures. It is important to make sure that the performers are appropriate for the message. This approach can be used in a variety of media. The broadcast media (television and radio) will obviously reach a wider audience than live performances.

1.7.3.4 The talk-show format: Particularly on radio, are a useful forum for debate, and they offer you opportunity to respond directly to the issues that the target audience raises. These may be integrated with music or drama.

1.7.3.5 The puppet-show format: Puppet shows are very popular in parts of the developing world, and have been successfully used for edutainment. This approach can be cost effective, since only a few people are needed to put on a show that has multiple characters. Also, puppet shows can be taken to the target audience by having performances on the streets. Another advantage of puppets is that they are often able to deal with taboo subjects, such as sexual issues, in ways that real actors could not. In order for puppet shows to be successful, they need to be created and produced by skilled people. If you are going to use a puppet show, you also need to bear in mind that not everyone will identify with the puppets, and that live puppet shows only reach small numbers of people.

1.7.3.6 The comic format: Comics can be an effective format for print medium edutainment, as the combination of words and images is especially helpful for people with low literacy levels. However, if you are planning to use comics, do some research amongst your target audience: comics may not be well accepted if people do not come from a culture that is used to reading comics, and adults may think that comics are for children.

1.7.3.7 The photo novella format: Photo novellas (photo stories) are often more appealing than comics because of the use of photographs. People relate to the characters and environments more closely because the photographs depict situations in a more lifelike manner. The photo novella also offers the possibility of using well-known, popular characters. The major disadvantage of photo novellas is that they are relatively expensive to produce.

1.7.3.8 The poster format: Posters are useful for getting across broad messages, and can reach more people per unit than other print media. If you decide to use posters, do not clutter them with detail, or nobody will read them

1.7.4 Choose the most appropriate formats for the medium/media: The tables below show popular media and formats frequently used.

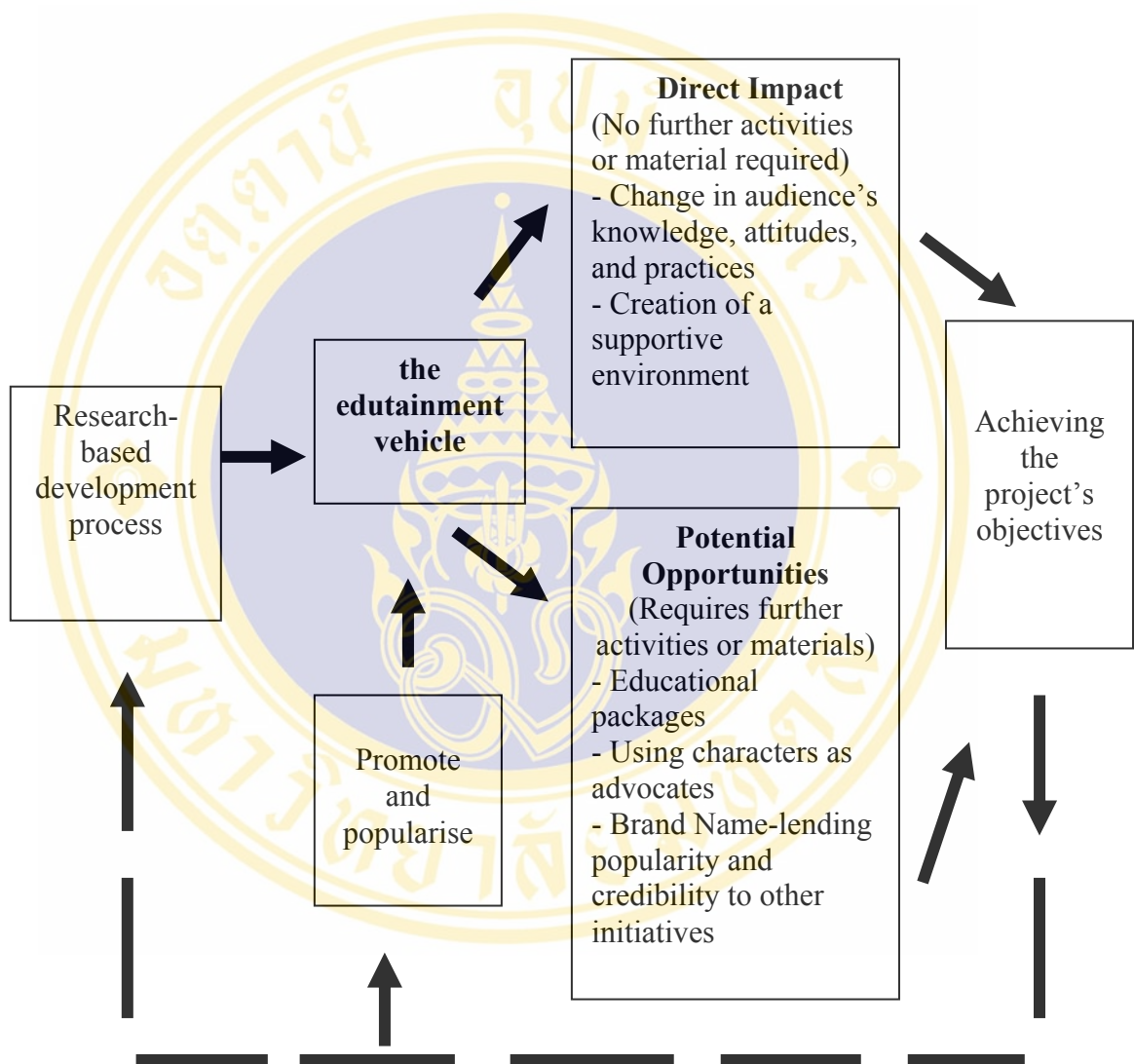
**Table 5** Popular media and formats frequently used for large-scale edutainment, at regional and national level (90)

Medium	Format
Television and Radio	Drama/comedies Soap operas New programs Sport Music Game shows
Radio	Talk shows (Phone-ins)
Well-written, well illustrated Newspaper and magazine articles	Print media Comic strips Photo novellas
The Internet	Informative, up-to-date web sites Chat-lines

**Table 6** Popular media and formats frequently used for small-scale, community level edutainment (90)

Medium	Format
Living Performances (including puppet shows and street theatre)	Drama/comedy by the local theatre group Dance Performances by local storytellers Game shows/quizzes
Community Radio	Talk shows Drama/comedy Music (folk songs, pop or rap music performed by local musicians) Poetry (composed and performed by the community poet)
Print Media	Local/community newspaper (illustrated articles) Comics Photo novellas Posters
Video Tape	Documentaries Drama/comedy
Audiocassettes	Music (folk songs, pop or rap music performed by local musicians) Talks Drama/comedy

1.8 Developing a total communication strategy: The diagram below illustrates how a well-planned broader communication strategy can enable you to take advantage of the range of opportunities that edutainment presents (90).



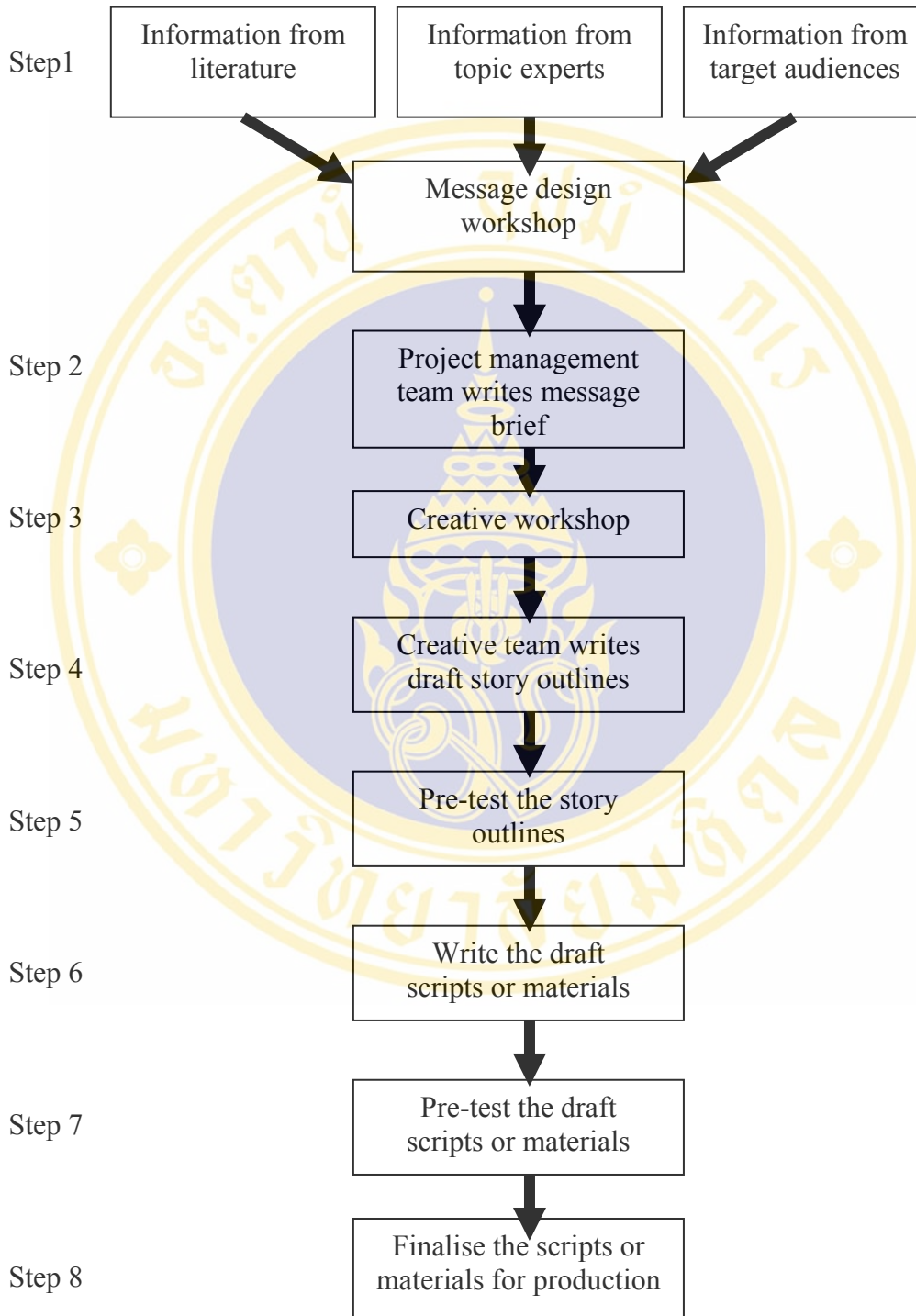
**Figure 2** The cycle continuous if using an ongoing vehicle

1.9 Raising funds for development, production, implementation and evaluation:

- Approaching donor organizations and governments
- Approaching the media
- Approaching commercial donors

**Phase 2: Development**

2.1 Developing the messages and the story line:

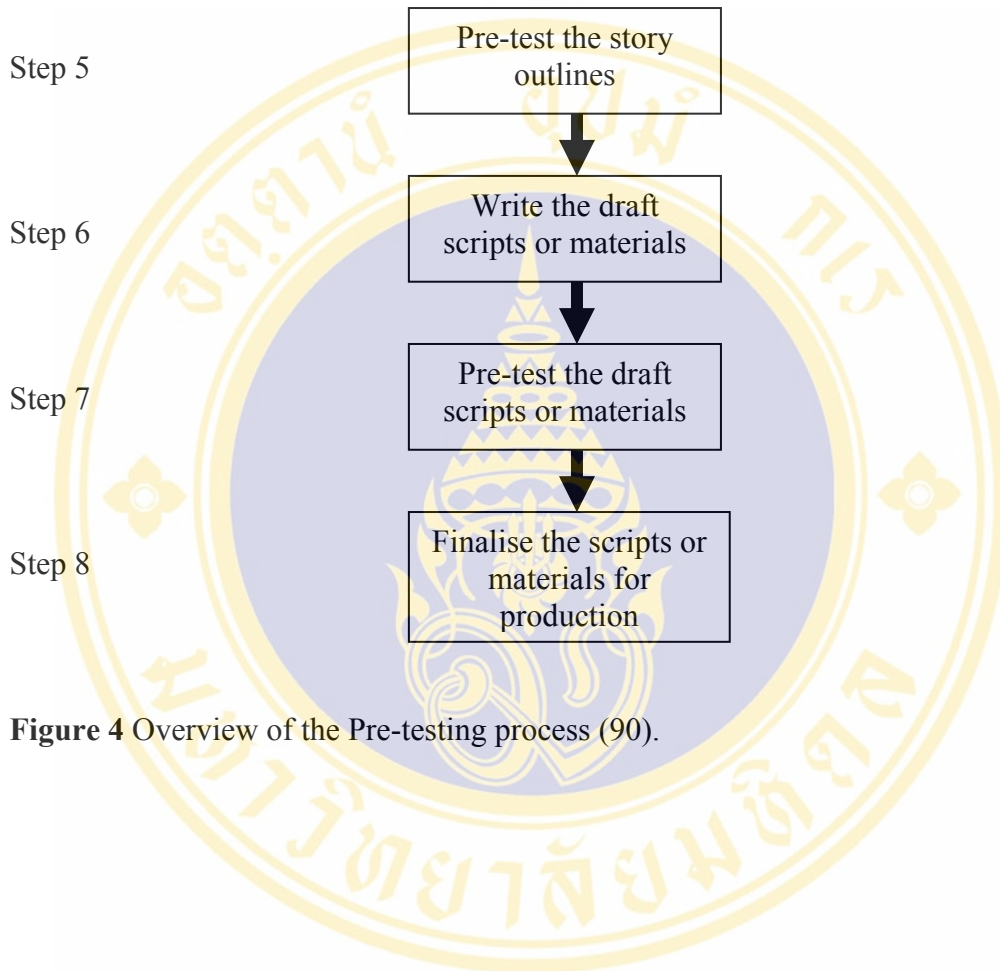


**Figure 3** Overview of the edutainment development process (90).

**Table 7** Summary of the Edutainment Development Process (90)

Step	Activity	Who is involved
1. Message design workshop	This involves discussing the information that you have gathered from the target audience, the topic experts and the literature, and designing messages.	- Project management team - Creative team - Topic experts - Researcher
2. Project management team	This is done after the message design workshop. It involves deciding how much detail goes with each message, deciding which media should carry which messages, and writing the final message brief for the creative team.	- Project management team
3. Creative workshop	This involves generating ideas about how to integrate the messages into the story.	- Project management team - Creative team - Mandated topic experts
4. Creative team writes draft story outlines	As a result of the creative workshop, the creative team drafts the story outlines	- Creative team

2.2 Pre-testing the edutainment: The step involved in the pre-testing process follow on from the steps involved in designing the message, and are as follows:



**Figure 4** Overview of the Pre-testing process (90).

**Table 8** Summary of the Pre-testing process (90)

Step	Activity	Who is involved
5. Pre-test the story outlines	Focus group sessions are held with people from the target audiences to discuss the story outlines. The story outlines are also discussed by the project management team and the topic experts	- Researcher - Project management team - Selected members of the target audience - Mandated topic expert
6. Write the draft scripts or materials	The project management team shares the feedback from the pre-testing with the creative team. The creative team writes the first draft, based on the original story outlines, and incorporating any changes that are necessary in the light of the feed back.	- Project management team - Creative team
7. Pre-test the scripts or materials	Go through the same procedure as in Step 5.	As in Step 5.
8. Finalise the scripts or materials for production	Implement final changes to the materials.	- Project management team - Creative team

### 2.3 Developing and pre-test an educational package:

Educational- packages are an optional supplement to the edutainment vehicle. They are the best way to reinforce the messages, and extend the impact, of the edutainment vehicle.

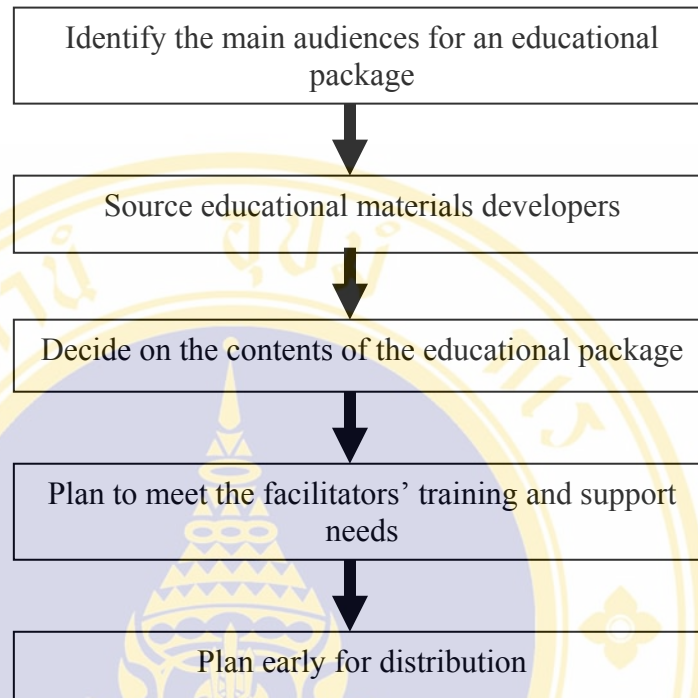
Different educational packages can be produced for the different groupings within your target audiences. Educational packages build on the credibility and popularity of the edutainment, so they are likely to be more popular and credible than the equivalent educational materials that are not based on edutainment.

The starting point for developing an educational package is the final scripts or materials that have been developed for the edutainment vehicle. It is only once these have been finalized that we can start developing the educational package. We need to know what the final edutainment vehicle is going to contain so that we can plan the best way of using it as the starting point for the educational materials. We will also need the final message brief in order to give guidelines to the educational materials writer on the information that the educational package should be cover. We may need to add more detail to the message brief for the educational materials writers, if we want the educational package to deal with certain topics in more detail than the edutainment did.

#### 2.3.1 Developing an educational package:

As with edutainment, the accompanying educational material will only achieving its maximum impact if it is as good as, or better than, any other educational packages that the audience is exposed to. For this reason, we should use the best people and resources available.

The development process for a typical edutainment educational package is as follows:



**Figure 5** Overview of the development process of typical edutainment educational package (90).

### 2.3.2 Pre-testing an educational package:

2.3.2.1 Pre-testing of pilot material: We can test the material with members of our target audience in the same way as we tested the edutainment materials, using focus group technique. We will also need to receive feedback from the consultants working with us. The purpose of pre-testing the pilot materials is usually to test the concept, for example, whether a comic is going to be appealing, rather than to test actual content of the pilot materials.

If the pre-testing indicates that there are problems with the concept (e.g. people do not like the idea of a comic), we and material developers will have to go back the drawing board and think of some alternative ideas. These ideas will also need to be pre-tested.

2.3.2.2 Development of the first draft of the complete educational package: Once we are sure that our basic concept is acceptable

to the target audience and our other partners in the project, we can develop the draft of the complete educational package.

2.3.2.3 Pre-testing the first draft: We need to test the first draft with our target audience and with topic and education consultants. Make sure that every sector of our target audience is involved in the pre-testing.

2.3.2.4 Revision as a result of pre-testing: Pre-testing of the first draft may lead us to change aspects of the content and style of the educational materials. The process of pre-testing and revision continues until we are satisfied with our materials.

2.3.2.5 Production of the final draft: The final draft can then be produced. The project management team's role in the production process is that of quality assurance.

### **Phase 3: Production**

To ensure the quality of production, it is essential that the project management team maintain control during production of both the edutainment vehicle and the educational package, to ensure that the messages are not distorted or lost during the production process.

### **Phase 4: Implementation and promotion**

Promoting, popularizing and getting the most out of the edutainment during implementation. There are three steps to successful promotion of the edutainment vehicle;

4.1 Initial marketing and pre-publicity: This is the period just before the edutainment starts, when we use all the means at our disposal to build an audience.

4.2 Consolidating the direct impact: Continuing to promote our edutainment once it begins.

4.3 Capitalizing on the edutainment's potential opportunities: It involves capitalizing on the edutainment's popularity and credibility, by using its brand name to launch other initiatives.

### **Phase 5: Evaluation**

This last step can seem daunting, but it helps us to find out the extent to which our edutainment product is socially useful and has integrity.

**Common Evaluation Methodologies:** There are two main methodologies for carrying out evaluation: qualitative and quantitative. We can also use a combination of these methodologies. They will be described below:

5.1 Quantitative methods: are based on the collection and interpretation of statistics. Among those often used by edutainment projects are:

5.1.1 Audience ratings: They are used to gauge how many people we reached and the demographics of our audience. Audience ratings are relatively easy to obtain. However, we will need to assess their strengths and limitations in our particular circumstances.

5.1.2 Competition: A good way of gathering information about the people we are reaching is through games and competitions. If we include some demographic questions on the entry forms, people will be motivated to send us the information in the hope of winning the prize.

5.1.3 Telephone responses: If the edutainment is radio-based, the number of phone calls made to the radio station can give us some idea as to whether or not our product is having an impact. If there is an existing help-line, which is used by members of our target audience to get information on topics covered in our edutainment, the number of calls made about specific topics over a period of time can be counted. An increase these types of calls during the edutainment can then usually be considered as evidence of success. However, the usefulness of phone call information depends on what proportion of target audience has access to a phone.

5.1.4 Use of a service related to the topic: If the edutainment message encourage the use of particular service, an increase in people using the service can be viewed as a measure of success.. This is especially convincing if people gave edutainment as a reason for their visit.

5.1.5 Surveys: They can be used to measure changes in knowledge, attitudes and, sometimes, behavior. They give the most useful information if they are carried out both before and after an edutainment intervention, although it can also be helpful to have just one survey after the program, using a control group.

Effective surveying depends on the researchers being very clear on what we need to find out, the researchers communicating appropriately with our audience, and the researchers selecting the right sample of people to answer their questions. If we hire an organization to conduct a survey, we need to communicate clearly about our needs and objectives.

5.2 Qualitative methods: are primarily based on the target audience's own perception of the value of the edutainment, rather than measurement by statistics. They are particularly useful when members of the target audience themselves make the connection between their own attitudinal or behavior shifts, or new knowledge gained, and our edutainment materials. Typical qualitative methods include as follow:

5.2.1 In-depth interviews

5.2.2 Observation of the edutainment's target audience actually viewing/listening to/ engaging with the edutainment materials

5.2.3 Focus-group discussions

5.2.4 Participatory appraisal in rural communities

5.2.5 Organizational analysis or process evaluation

There may also be other ways of carrying out qualitative evaluation, depending on our context. For instance, if listeners to our radio edutainment send us letters, we can analyze what they say, or, if we have a question-and-answer session after a live performance, we can record the audience's questions and comments and analyze them afterwards.

5.3 Using a combination of Quantitative and Qualitative methods: For complex projects, it is often best to use a variety of methods that complement one another, such as surveys, audience ratings, focus groups and in-depth interviews to get more complete evaluation.

### **Part 3 Measurement of the educational tools, particularly the booklets as printed health materials and the researches related to measurement of the printed health materials**

Measurement of the educational tools was the means for developing, monitoring, and evaluating the educational tools. For the booklets, these could range from formative to summative measures. Formative measures are generally used to solve the appropriated reasons for formative a media intervention such as market segmentation, target audience selection, and description. Summative measures are usually involved in assessing the outcome or evaluation of the intervention for example, changes in attitudes, knowledge and behaviors. Adequate strategy development research, pre-testing and pilot testing of campaign materials did not only increase the chances that the campaign is successful, but also assist in assessment if the campaign do not meet its objectives (95). Hence formative measures should be operated in this study that aimed to develop and evaluate the educational tool model as booklet and photographic food card game. This model was a kind of printed health material that could be a useful way of reaching the community with health messages.

#### **3.1 Evaluated components of printed materials**

Evaluation of printed materials aims to make sure the quality of the material is high, the printing is clear, the paper is durable and pleasant to handle, and the illustrations and design are appropriate and attractive (90). Finally, their quality is mostly determined by content, format, readability, comprehensibility, layout, illustration, and pilot testing (96).

##### **3.1.1 Content**

The content of health printed materials should be accurate and up-to-date to ensure that patients get the right messages (96). Getting the right message is a necessary condition for success. Determining the right message begin with a clear understanding of the campaign's objectives. The campaign's objectives contain information, motivation or persuasion, advocacy related objectives, and public announcement (95).

### 3.1.2 Format

The format of written materials has also been shown to be important with content being organized so that patients learn what they need to know and are not overloaded with less important materials. The characteristics of good writing are brevity, positive, clarity, personal and conversational style. Conversational narrative style consisting of short paragraphs, can stimulate and motivate the reader to read the entire messages (95, 97).

### 3.1.3 Readability and comprehensibility

Most studies evaluating the usefulness of patient education materials failed to address the association between readability and comprehensibility variables, and recall and compliance (96). Readability and comprehensibility of target audiences are possibly crucial variables, which imply target audience's background and lifestyle, for getting the message right (97). Getting the message right means consistency of a language, style and tone with the message objectives and the target audience's background and lifestyle (95).

### 3.1.4 Layout

Layout could influence the feel of a printed document. It includes adequate spacing, line length, and space between lines. The use of shorter sentences, which decrease the number of words, make sentence easier to understand and increase the likelihood of further reading. Short paragraphs that express only one idea are also advisable since this enables the reader to concentrate on one message or point at the time. Moreover style and size of font are also for optimal reading ease. The use of a summary section to emphasize important points is suggested. The important points in the material should be underlined or highlighted with boldface type and capital letters (95-97).

### 3.1.5 Illustrations

Illustrations could be important in aiding poor readers to comprehend health materials. They are also useful for emphasizing main messages, as well as decoration, motivation and organization to information and entertainment. To ensure

that the pictures illustrate the intended message: they should be simple, clearly drawn, and demonstrate one concept (95-96).

### 3.1.6 Pilot testing

It is important to get feedback from members of the target audience before the material is in general use. Patients could be asked to provide feedback on their overall assessment of the material as well as specifics such as content, format, layout, color, and illustrations. It would also be important to ascertain whether a sample of readers understood the material, particularly by asking questions concerning actual knowledge acquired (96, 97).

## 3.2 Researches related to measurement of the printed health materials

Hunt P. (98), studied to pre-test draft versions of the “Changing what you eat” resources for primary care. The resources composed the patient booklets and the professional’s guide. The aims of the field testing were: 1) to find out views of patients and professionals about the format and content of the patient booklet, 2) to assess the perceived usefulness of the patient booklet, by patients and professionals, for helping with behavior change, and 3) to find out views of professionals about the suitability of the professional’s guide as a tool for use in the primary health care setting. Thirty-two nurses, from six part of England, were asked to use the booklets with eight consecutive patients who were at risk of coronary heart disease or overweight/obese. They had received more training and practice in the use of the booklets than the other nurses and many had already used them with patients. Of 121 patients, 70 (58%) returned the questionnaires. The majority of nurses’ and the patients’ general views on the size, color, amount of writing, the illustrations and the overall length of the patient booklet were significant approved. All nurse mentioned the booklet’s suitability for patients. Overall the response to both the patient booklet and the guide for professionals was positive. The training for health professionals had essential received.

The study of Besuwan W. (99), evaluated the efficacy of modified method for self-control of diet and body weight in diabetic patients. Thirty-three diabetic patients, whose age being 30 to 70 years, were randomly divided into four groups. Nine patients in group I received a modified dietary brochure only. Eight patients in group II received the brochure with the verbal explanation according to the brochure. Eight patients in group III received only the verbal explanation. And in group IV, eight patients received the standard teaching with food models according to the food exchange system. The results displayed that fasting plasma glucose levels did not change throughout study period, but HbA<sub>1c</sub> levels significantly improved all groups at 24-week follow up. In group IV, HbA<sub>1c</sub> levels significantly decreased at eight-week follow-up, and body weight significantly reduced at 16-week follow-up. Lipid profiles of all groups do not change throughout study period. This study suggested that providing brochure with explanation improved glycemic control.

Anderson et al. (100), studied the tool for evaluating printed nutrition materials. The objectives of this study were to develop an instrument for evaluation of readability, stereotyping, instructional aids, format, and content of printed nutrition education materials and to determine the usefulness of this tool by applying it to prenatal nutrition materials currently used with pregnant adolescents. A questionnaire was mailed in New York State to 40 professionals known to the authors to be responsible for the nutrition component in programs for pregnant teenagers. The questionnaire also sought to elicit the perceptions of professionals with regard both to the reading abilities of their client pregnant teenagers and to the reading difficulty of the materials in use. Of the 40 surveys sent out, 14 were completed and returned with a total of 82 materials. From this sample, 20 materials were chosen to be evaluated in this study. A tool for evaluating printed nutrition materials on the basis of readability, stereotyping, use of instructional aids, format, and content was developed. Very few materials were judged superior, and most materials were either unacceptable or only adequate in terms of readability, stereotyping, format, and content, even though professionals maintained that content and readability were the most important factors they used in selecting materials. The use of an evaluation instrument in the selection of materials would assist the educators in considering special client needs while choosing teaching aids in a systematic, standardized manner.

Meagher D. et al. (101) studied to test the effectiveness of a 10 minute videotape and complementary print program guide on the knowledge and attitudes of junior high school students about blood pressure (BP). A randomized two group pre-test, post-test and delayed post-test design was used. The experimental group received an educational session on BP, designed for this study, which consisted of a 40-minute session, comprised of a 10-minute video presentation and discussion by the teacher on BP (guided by the program guide). The educational session was effective in improving student knowledge of BP at one week post-test; however, this positive effect did not persist at the three month post-test. Student interest in, or knowledge of, their own BP was not obviously affected by the session. The findings were interpreted in light of Social Learning Theory (SLT) and the PRECEDE Model of Health Education (PMHE). In testing the effect of one component of an educational program, i.e., the videotape and teacher lesson the environmental determinants of behavior change could not be addressed in this study. The educational session was able, however, to achieve the desired knowledge change. The 10-minute videotape and complementary print program guide was shown to be a viable educational tool and can therefore be utilized as a resource in a broader multi-faceted program of cardiovascular (CV) health promotion.

Health professionals delivered the printed materials, which had been widespread used mostly at out-patient section, to clients. Types of materials, which were generally used, were leaflets (102), brochures (99), complementary print program guide for certain tool (101) and booklets (78, 98, 103-104). The persons received the materials with professional's language by counseling (98-99, 102-104) or advising (104). According to the study of Besuwan W. (99), it showed that providing brochure with explanation was more effective than only providing either brochure or explanation. Scientific evidences (98, 103-104) showed that pre-testing draft versions was useful consequence to interpret message right for target groups. To get message right statistically affected to adopted appropriated self-care behaviors. Moreover the evaluation instrument could also facilitate identification of combinations of materials and/or supplemental oral and visual presentations and assure that all important topics are covered (100). These perspicacious persisting in these researches brought much help in attempting to develop and evaluate printed media as the educational tool model

included the booklets and photographic food card game for type 1 diabetic adolescents. This model should be used for diabetes care to get usefulness in treatment plan following MNT.



## CHAPTER 4

### MATERIALS AND METHODS

This study was designed to develop and evaluate the effectiveness of the educational tool model for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept. A trial study was later conducted in a group of type 1 diabetic adolescents to determine; 1) the patient's knowledge and understanding of meal planning using carbohydrate counting, 2) the accuracy in patient's perception and conceptualization in carbohydrate counting using the developed educational tool model, and 3) the patient's satisfaction with the developed educational tool model.

#### **Phase 1: Development of the educational tool model**

This phase was designed to construct educational tool model that easily to learn and understand in carbohydrate counting technique, in order to help patients planning their own menus for meal planning using carbohydrate counting correctly.

#### **The issues that were developed as content areas of educational tool model:**

1. Information on diabetes care, particular on dietary therapy
2. Principle and goals/benefits of meal planning using level 1 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

**Steps in this phase:**

**Step 1 Choose appropriate format and media for development of educational tool model:** depended on Edutainment and Counseling approach which was CBT was chosen for this study. The aim was to build patient's learning for behavior modification.

**Set of educational tool model comprised 2 tools:**

**1) The booklets of carbohydrate counting** as a colorful comic book which was a set of 2 books. One was the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents, to give patients knowledge emphasized on carbohydrate counting concept, in addition, it contained also a part of general information about diabetes to prepare patients for learning in carbohydrate counting. The another one was the book of food exchange lists for counting carbohydrate, in order to provide dietary information to patients regarding to carbohydrate values in variety of foods or food items for carbohydrate counting.

**2) The game of carbohydrate counting** as the photographic food card game, depended on Edutainment approach. Because of the booklet was rather one-way communication; so, interactive session as game would help patients to learn more effectively.

**Step 2 Study the characteristics and food habits of the target group:**

By using the validated questionnaires for: (see appendix A)

- 1) Demographic data
- 2) Meal patterns and favorite foods
- 3) Food-frequency questionnaire
- 4) 4-day food record

All data from this step were important as the baseline information to develop the educational tool model.

### **Step 3 Construct the educational tool model**

#### **3.1 Construct the booklets of carbohydrate counting**

3.1.1 The contents of diabetes management were reviewed in details including therapeutic options particularly dietary therapy as carbohydrate counting technique which was a new approach for Thais.

3.1.2 These booklets were modified from the educational booklets of Daly A., et al. (13, 41-42) including “Carbohydrate counting (Getting started: level 1)”, “Carbohydrate counting (Moving on: level 2)” and “Carbohydrate counting (Using carbohydrate/insulin ratios: level 3)”

#### **3.1.3 Contents in the booklets**

The booklets were designed for type 1 diabetic adolescents, who have taken insulin and were willing to learn how to manage food intake for controlling glycemic levels. Managing food intake or meal planning approach in this study focused only carbohydrate counting concept in level 1.

3.1.3.1 The self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents: the contents of this book were divided into 2 parts;

In the first part was general information about diabetes. It composed of nutrition assessment in term of weight for height, diabetes overview, diabetes care, risks for poor control, and dietary therapy for improving diabetic control which were based on Thai Food Based Dietary Guidelines, Nutritional flag, and Thai food exchange lists.

In the second part, focused on level 1 carbohydrate counting or the basic level. It composed of principles and goals/benefits of meal planning using level 1 carbohydrate counting, methods of calculation and counting carbohydrate, the easy steps in self- help meal planning using carbohydrate counting. Moreover, methods of increasing skill including weighed and measured foods, estimated portions, figured carbohydrate grams or choices using food labels and an appropriate reference for carbohydrate counting were provided in this book as well.

3.1.3.2 The book of food exchange lists for counting carbohydrate: the contents of this book focused on food groups which contain carbohydrate. Food items and carbohydrate values were taken from: 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, d) Research related to nutritional values of Thai foods, e) Brochures or websites of Fast Food Guide, f) Food labeling of several food products, g) Food habits of target group, which were collected in step 2 of this phase as mentioned above.

They were then categorized into 12 food groups; starch, fruit, milk, vegetable, fast-foods, one-plate dishes, set-plate dishes, salads, snacks, local dessert, other dessert/miscellaneous, and, ready-to-eat foods and condiments. The books additionally included free-foods, very low energy density foods and some foods that should be avoided.

3.1.4 The messages of the booklets were drafted to translate all of contents for type 1 diabetic adolescents management into practice.

#### 3.1.5 Appearances of the booklets:

The booklets were very well illustrated by illustrator. They were also designed to promote the willingness of reading for adolescents.

3.1.5.1 The self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents: Size of this booklet was 13 cm in width and 20 cm in length. Fifty-two pages were composed of covers, preface, contents, references, and appendix. The font type was colorful PSL-Passanun size 18 bold for heading, size 16 bold for emphasis and colorful PSL-text size 16 normal for detail. Space between each line was single spacing. The function of illustrations was to decorate and to easily read. To inform the message simple language was used for clear understanding and to motivate or persuade to practice according to the guidelines.

3.1.5.2 The book of food exchange lists for counting carbohydrate: Size of this booklet was 10 cm in width and 14 cm in length. Thirty-six pages were composed of covers, preface, list of contents, contents, and references. The font type was colorful PSL-text size 18 bold for heading, size 14 bold for emphasis and size 14 normal for detail. Space between each line was single spacing. The

function of illustrations was to decorate and to easily find out carbohydrate values of each food items or food groups for counting carbohydrate.

3.1.6 Content validity of draft of both booklets were proved in order to getting the right message. Four experts in the field of nutrition and dietetics and one expert in the field of illustration or illustrator, whose names were listed in appendix I, reviewed the completed content and wording, as well as the illustrations. All experts suggested the content should be adjusted and tailored to individual target group. In addition, sequence of contents and few words were advised to change in order to encourage health promotion behaviors. Moreover, the wording was positive, brevity, and clarity to support the reading ease and interest. Then the content was developed to correct the information for diabetes care especially meal planning using level 1 carbohydrate counting concept.

3.1.7 The righteousness of the message as well as the consistency of language and illustration of the two improved booklets were justified by five type 1 diabetic adolescents, whose characteristics were similar to participants. This step aimed to confirm the understandability, creditability, and relevance of the message before the actual booklets were produced. Five type 1 diabetic adolescents read the whole booklets from the first page to the end. The consistency of the illustration with message was agreed. All of the patients agreed positively with the booklets and had a few comments on some parts.

## **3.2 Construct the photographic food card as the game of carbohydrate counting**

3.2.1 Collection of food frequency, food preference data and food habits of subjects which were collected in step 2 of this phase as mentioned above.

3.2.2 Selection of appropriate food items for making the food photograph. The food items selected to be included in the photograph series were considered under the following criteria; must be common foods in the Thai diet, available in markets, and, available in data base of nutritional values particularly carbohydrate, protein, and fat . All food items were categorized into 10 food groups; starch, fruit, vegetable, fast-food, one-plate dishes & snacks, local desserts, other desserts/miscellaneous, milk and ready-to-eat foods, meat, and fat.

3.2.3 Identification of portion sizes of the selected food items. Food items and portion sizes of them were taken, i.e., a half of one serving, one serving, and two or three serving which were judged to be representative of the range of portions commonly and actually consumed, based on Thai food exchange lists.

3.2.4 Preparation of photographs. For each food, color photographs of a variety of their portion sizes were made by a professional photographer under highly controlled conditions of light and presentation of dishes. All dried foods items except some ready-to-eat foods were photographed on a white 6 in. diameter serving plate. For porridge rice was photographed in a pink 3.5 in. diameter serving bowl and placed on a pink 8 in. diameter serving plate. The portions of liquid local desserts were photographed in a white 3 in. diameter serving bowl. Most of one-plate dishes were photographed in a pink 8 in. diameter serving plate, except noodle soup which was photographed in a pink 6.5 in. diameter serving bowl. All beverages were photographed in a clear 2.5 in. diameter serving glass.

All photographs were printed in the landscape orientation in color and in one size (approximately 10.5 cm. x 15 cm.). The photographs, all of portion sizes for all of food items were of reduced size (3.5 cm. x 5 cm.) after placing on a photographic paper size 2P (120 gram).

3.2.5 All food photographs were developed to be photographic food card. Each food photograph was addressed their name and portion size by sticking a label on their surface. Then it was put into a proper size of clear thick plastic bag and was categorized into 10 groups by 10 color papers, in order to convenient for storing, packaging and using. List of photographic food cards shown in appendix H.

3.2.6 Photographic food cards were checked for the righteousness of the messages and format by five experts. Then all photographic food cards were adjusted according to recommendations.

3.2.7 Five type 1 diabetic adolescents, whose characteristics were similar to participants, justified the format and presentation of the improved card game. This step aimed to confirm the understandability, creditability, and relevance of the format and presentation before the actual photographic food cards were produced. In addition, to check their perception and satisfaction, these five type 1 diabetic adolescents were asked to set their meal plan by using the photographic food cards for

counting carbohydrate. The consistency of the format and presentation were agreed. All of the patients agreed positively with the photographic food card game and had a few comments on some aspects.

## **Phase 2: Evaluation of the effectiveness of the educational tool model**

The purposes of this phase:

- 1) To assess the patient's knowledge and understanding of meal planning using carbohydrate counting: accomplished by using Pre-test and Post-test questionnaire, the score of game playing and exercises
- 2) To assess the accuracy in patient's perception and conceptualization in carbohydrate counting using the developed educational tool model: accomplished by testing patient's ability in estimating foods and count carbohydrate via game playing, food demonstration, food model, food labeling and individualized 4-day food record
- 3) To assess the patient's satisfaction with the developed educational tool model: accomplished by using validated questionnaire and final interviewing

### **2.1 Subject selection:**

This phase was studied in 20 patients who attended Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital.

#### **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) Willingness to participate in this study

#### **Exclusion criteria:**

- 1) Participants who have ever known and learned carbohydrate counting
- 2) Participants as inpatients during the time of process

## 2.2 Instruments for data collection

Validated questionnaires were used for collecting data. The questionnaires were both closed ended and opened ended questions, and the contents of them were divided into 5 parts as follows;

### 2.2.1 Knowledge and understanding of meal planning using carbohydrate counting

This part concerned about knowledge and understanding on goal and concept of meal planning using carbohydrate counting. Pre-test and Post-test were conducted in each subject to assess knowledge and understanding of meal planning. The test comprised 2 parts (see appendix B).

2.2.1.1 The 1<sup>st</sup> part was the multiple choices questionnaire which was composed of 15 questions.

2.2.1.2 The 2<sup>nd</sup> part was True or False questionnaire which was composed of 10 questions.

Both parts were assembled to evaluate the scores for assessing the patient's knowledge and understanding of meal planning using carbohydrate counting.

The scoring method was:

Right answer score	1 point
Wrong answer score	0 point
Total score	25 points

The scores were classified into 3 levels as follows:

Scoring  $\leq 13$  points or  $\leq 50\%$  identified as low knowledge level

Scoring 14-19 points or 51-75% identified as moderate knowledge level

Scoring 20-25 points or  $>75\%$  identified as high knowledge level

### **2.2.2 Exercise for increasing skill by weighing and measuring foods, estimating portions, figuring carbohydrate grams or carbohydrate choices**

This questionnaire was used in the class practice. Food items used were divided into 3 groups based on their characteristics (see appendix C), in order to practice for increasing skill of patients in estimating portion sizes of various food. Subjects were asked to estimate food weight, measure portions which they should learn how much carbohydrate is in a serving. This questionnaire composed of 3 parts according to three food groups. All parts had the same details which included food items, estimated portion and grams carbohydrate, actual portion and actual grams of carbohydrate. Three food groups composed of;

2.2.2.1 Starch, vegetable, and fruit (Total score was 10 points)

2.2.2.2 Beverage, milk, and dessert (Total score was 7 points)

2.2.2.3 One-plate dishes (Total score was 3 points)

Total score was accumulated from all 3 parts which was 20 points.

The scores were classified into 3 levels as following:

Scoring  $\leq 10$  points or  $\leq 50\%$  identified as low knowledge level

Scoring 11-15 points or 51-75% identified as moderate knowledge level

Scoring 16-20 points or  $> 75\%$  identified as high knowledge level

### **2.2.3 Exercise for practicing in counting carbohydrate**

The questionnaires were used for assigned homework. It comprised 3 parts; (see appendix D).

2.2.3.1 The 1<sup>st</sup> part was opened ended question which was composed of 15 questions (1 point in each question with total score of 15 points). This part was designed to learn portion sizes, aimed to improve skill for counting carbohydrate by learning portion sizes in various foods using the book of food exchange lists for counting carbohydrate.

2.2.3.2 The 2<sup>nd</sup> part was opened ended question which was composed of 4 questions with total score of 5 points. This part was aimed to improve skill for counting carbohydrates which focused on understanding nutrition label information.

2.2.3.3 The 3<sup>rd</sup> part was 4-day food record to count and record unit of carbohydrate consumed. It was used to monitor patient's diet compliance and to assess patient's carbohydrate consumption. The details included meal time, food item and ingredients, portion sizes, and amount of carbohydrate in gram and unit or choice of carbohydrate. In addition, carbohydrate consumption corresponded to carbohydrate goal was also evaluated. The scoring method of this part was considered under the following criteria;

1) Responsibility in 4-day food record

(Total score was 10 points)

Record 4 days completely	10 points
Record 3 days	8 points
Record 2 days	5 points
Record 1 day	3 points
Not record	0 point

2) Usual carbohydrate intake corresponded to carbohydrate goal (Total score was 10 points).

3) Accuracy in counting carbohydrates (Total score was 10 points).

The scoring method for 2) and 3) was as following by minus 1 point (-1) every 5 grams of Under/Over the goal or incorrect counting.

Under/Over the goal or incorrect counting	0-4 grams	get -0	get 10 points
Under/Over the goal or incorrect counting	5-9 grams	get -1	get 9 points
Under/over the goal or incorrect counting	10-14 grams	get -2	get 8 points
Under/over the goal or incorrect counting	15-19 grams	get -3	get 7 points
Under/over the goal or incorrect counting	20-24 grams	get -4	get 6 points
Under/over the goal or incorrect counting	25-29 grams	get -5	get 5 points
Under/over the goal or incorrect counting	30-34 grams	get -6	get 4 points
Under/over the goal or incorrect counting	35-39 grams	get -7	get 3 points
Under/over the goal or incorrect counting	40-44 grams	get -8	get 2 points
Under/over the goal or incorrect counting	45-49 grams	get -9	get 1 point
Under/over the goal or incorrect counting	≥50 grams	get -10	get 0 point

However, eventually the total score of exercise for practicing in carbohydrate counting was 50 points (10 points from the 1<sup>st</sup> part, 5 points from the 2<sup>nd</sup> part, and 30 points from the 3<sup>rd</sup> part).

The scores were classified into 3 levels as follows:

Scoring  $\leq 25$  points or  $\leq 50\%$  identified as low knowledge level

Scoring 26-38 points or 51-75% identified as moderate knowledge level

Scoring 39-50 points or  $>75\%$  identified as high knowledge level

#### **2.2.4 Accuracy in perception and conceptualization in carbohydrate counting using the developed educational tool model**

The questionnaires were used in the class practice as interactive session, to assess the accuracy in patient's perception and conceptualization in carbohydrate counting using photographic food card game. The questionnaires (see appendix E) composed of 2 parts as follows;

2.2.4.1 The 1<sup>st</sup> part was opened ended questions, designed to record patient's meal plans set by themselves using photographic food cards for counting carbohydrate. The details included meal time, carbohydrate goal (grams), food items and ingredients, portion sizes, and quantity of carbohydrate (grams, and units or choices). The scoring method of this part was considered under the following criteria;

1) Amount of carbohydrate derived from the patient's meal planning corresponded to carbohydrate goal (Total score of 10 points).

2) Accuracy in counting carbohydrates (Total score of 10 points).

Therefore, the total score was 20 points for this 1<sup>st</sup> part.

2.2.4.2 The 2<sup>nd</sup> part was also opened ended questions, designed to record the result of the amount of carbohydrate counted from the test which patients consumed in the class. Patients had to count carbohydrate by using photographic food card, to recall portions they took. The lists of test meal, see appendix F. The details included food items and ingredients, portion sizes, and quantity of carbohydrate (grams, and units or choices). The scoring method of this part was only considered the accuracy in counting carbohydrate (Total score of 10 points).

However, eventually the total score of accuracy in patient's perception and conceptualization in carbohydrate counting using photographic food card game was 30 points (20 points from the 1<sup>st</sup> part, and 10 points from the 2<sup>nd</sup> part)

The scores were classified into 3 levels as follows:

Scoring  $\leq 15$  points or  $\leq 50\%$  identified as low knowledge level

Scoring 16-23 points or 51-75% identified as moderate knowledge level

Scoring 24-30 points or  $>75\%$  identified as high knowledge level

### **2.2.5 Satisfaction with the developed educational tool model**

The questionnaire (see appendix G) was divided into 3 parts as follows;

2.2.5.1 Patient's satisfaction with the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents.

2.2.5.2 Patient's satisfaction with the book of food exchange lists for counting carbohydrate

2.2.5.3 Patient's satisfaction with photographic food card game

The satisfactions were considered from the content and format of each tool. The content aspect referred to correspond with objectives, languages or wording, overall length, concise, appropriate to target audience, health promoting. The format referred to size, font, amount of writing, color, and the illustrations. For the satisfaction of photographic food card, the quality of food photographs were also evaluated. With 4 levels of the closed ended questions were used to measuring, the comments of patients were collected as well.

Levels of measurement were;

Very good	4 scores
Good	3 scores
Fair	2 scores
Need improvement	1 score

### **2.3 Helpful carbohydrate counting teaching tools:**

- Measuring equipment to teach portion size and the importance of portion size control
- Calculator
- Foods and/or food models to demonstrate and to identify portions
- Food packages with nutrition facts of commonly purchased food items and convenience or ready-to-eat foods to demonstrate use of carbohydrate information

### **2.4 Validity and reliability of research instruments**

All the research instruments were validated by experts, then they were revised according to the recommendations, fulfilled with appropriate contents and language used for final approving before commencing the research work. Furthermore reliability was tested as understandability, credibility, and relevance of the message among type 1 diabetic adolescents, whose characteristics were similar to participants.

### **2.5 Assessment Procedure**

To evaluate the effectiveness of the developed educational tool model which studied in type 1 diabetic adolescents.

2.5.1 Type 1 diabetic adolescents who met inclusion criteria were informed the objectives and the study procedure. All participants signed the consent form to confirm their agreement. For patients who were less than 15 years old, their primary caregiver signed the consent form for them.

2.5.2 Twenty subjects of type 1 diabetic adolescent were recruited for the study. To facilitate for advising and learning, subjects were divided into 4 small groups (5 persons each group) Each group would be advised by the researcher about carbohydrate counting concept using the developed educational tool model. The subjects were scheduled for group meeting once a week for 2 weeks.

**At week 0:**

(1) The nutritional status of patients was assessed focused on anthropometric assessment included weight and height.

(2) Pre-test questionnaire was used to assess the patient's knowledge and understanding of meal planning using carbohydrate counting.

(3) Patients were provided a set of developed educational tool model included; the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents and the book of food exchange lists for counting carbohydrate. In addition, they were also provided the calculator, to help them in figuring carbohydrate.

(4) Main content of the booklets, method of usage, and usefulness of the booklets were introduced.

(5) Patients learned the concept of carbohydrate counting from the self-help guidelines for meal planning using carbohydrate counting and they also learned the amount of carbohydrate in each food groups and also in serving sizes from the two booklets, particularly the book of food exchange lists.

(6) Patients practiced in the class for increasing skill in estimating portion size, measuring foods, and counting carbohydrate in grams/choices in various foods.

(7) Patients were assigned homework to practice counting carbohydrate at home with set of measuring cups and spoons. The assignment had three parts, emphasizing portion sizes, food labeling and patient's diet compliance. All parts were clearly described by the investigator.

**At week 1:**

(1) Assigned homework was collected by the investigator.

(2) The accuracy in patient's perception and conceptualization in carbohydrate counting using the developed photographic food card game were assessed. At the 1<sup>st</sup> step, Patients were assigned to set their own meal plans appropriated to their carbohydrate goal, and then they used the photographic food cards to plan their menus and count carbohydrate for this meal.

(3) The test lunches or snacks were provided to each patient.

After finished the meal, patient had to count amount of carbohydrate consumed by using photographic food cards and the investigator checked the accuracy in patient's perception and conceptualization from the food left over and also their record.

(4) Post-test questionnaire was used to assess the patient's knowledge and understanding of meal planning after used the developed educational tool model.

(5) Patient's satisfactions with the developed educational tool model were assessed. Moreover, patients were interviewed in the term of intention to use this tool and interested to learn the higher carbohydrate counting levels.

### **2.6 Data Analysis:**

All data were analyzed by using the Statistical Package for the Social Sciences/Personal Computer (SPSS/PC<sup>+</sup>), for window Version 11.0:

1. The personal information was determined as percentage, mean, median, minimum-maximum, and standard deviation.
2. Paired t-test was used to compare the score of the patient's knowledge and understanding for carbohydrate counting between Pre-test and Post-test.
3. The level of accuracy in patient's perception and conceptualization in carbohydrate counting were determined as percentage, mean, median, minimum-maximum, and standard deviation.
4. The patient's satisfactions of the developed educational tools model were determined as percentage, mean, median, minimum-maximum, and standard deviation.

## CHAPTER 5

### RESULTS

This study, aimed to develop the educational tool model for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept and also to evaluate the effectiveness of the developed educational tool model. Therefore, the results of this study were presented according to the sequence of the study.

#### **5.1 The developed educational tool model**

This model was validated by five experts, then it was revised according to the recommendations for final approval before commencing the research work. The focused group session was held with five type 1 diabetic adolescents, whose characteristics were similar to participants studied, to test the understandability, creditability, and relevance of the message and also satisfactions with the educational tool model.

A set of educational tool model was produced and provided for 20 type 1 diabetic adolescents. It comprised 2 tools:

- 1) The booklets of carbohydrate counting as colorful comic books

- 1.1) The self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents, to provided knowledge to patients emphasizing on carbohydrate counting concept. It had also a part of general information about diabetes to prepare patients for learning carbohydrate counting.



**Figure 6:** The booklets as the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents

1.2) The book of food exchange lists for counting carbohydrate, to provide patients dietary information regarding to carbohydrate values in variety of food items for carbohydrate counting.



**Figure 7:** The book of food exchange lists for counting carbohydrate

2) The game of carbohydrate counting as photographic food card game, to help patients to learn more effective in carbohydrate counting. Food photographs which composed of 10 food groups were developed for photographic food cards. A list and number of foods used to make food photographs was as follows.

Food group	Number of food items
Starch	33 items
Fruit	48 items
Vegetable	22 items
Fast-food	20 items
One-plate dishes and snacks	20 items
Local dessert	21 items
Other dessert/miscellaneous	28 items
Meat	21 items
Fat	7 items
Milk & ready-to-eat foods	26 items

(For more information, see appendix H)



**Figure 8:** The example of the photographic food cards

## 5.2 The effectiveness of the educational tool model

### 5.2.1 Personal characteristics of the study subjects

The total of 20 type 1 diabetic adolescents, who attended Out-patient Pediatric Endocrine Clinic at Ramathibodi Hospital were recruited for this study.

**Table 9** The Patient's characteristics studied (n = 20)

Variables	n	%
<b>Gender</b>		
Male	5	25
Female	15	75
<b>Age in years</b>		
12-15	11	55
13-19	9	45
Mean = 15.0, SD = 2.35, Median = 15.0, Minimum = 12.0, Maximum = 19.0		
<b>Education level</b>		
Primary school	5	25
Secondary school	12	60
University	3	15
<b>Diabetes family history</b>		
Not have	8	40
Have	12	60
<b>Number of insulin injections/day (times)</b>		
2	14	70
3	6	30
<b>Frequency of hypoglycemic episodes</b>		
1-2 times/week	12	60
3-4 times/week	6	30
> 4 times/week	2	10
<b>Physical activity</b>		
Not exercise	5	25
Exercise 1-2 times/week	7	35
3-5 times/week	6	30
> 5 times/week	2	10

Majority of the subjects were female with 15 females and 5 males. Their average age was 15 years old. All subjects were Buddhism. Most subjects (60%) studied at secondary school. Nearly half had not diabetes family history. Half of them

were diagnosed diabetes for 6-10 years. Most subjects had controlled their diet for diabetes control which derived mainly from the doctors, nurses, and dietitians. Besides, most of them had injected insulin 2 times/day, had hypoglycemic episodes 1-2 times/week, and did some exercises for healthy (Table 9).

**Table 10** The baseline nutritional status of 20 diabetic adolescents

Variables	n	%
Anthropometric assessment: *Weight for Height		
Wasting	1	5
Underweight	1	5
Normal	13	65
Overweight	2	10
Obesity	3	15
Fasting blood glucose (mg/dl)		
< 130	15	75
130-150	1	5
> 150	4	20
Mean = 116.2, SD= 54.50 Median = 90.0, Minimum = 58.0, Maximum = 277.0		
Postprandial blood glucose (mg/dl)		
< 180	6	30
180-200	6	30
> 200	8	40
Mean = 181.6, SD = 66.63, Median = 199.0, Minimum = 50.0, Maximum = 269.0		
Glycosylated hemoglobin (HbA <sub>1c</sub> )		
< 7.5 %	7	35
7.5-8.5 %	4	20
> 8.5 %	9	45
Mean = 8.5, SD = 1.87, Median = 8.3, Minimum = 5.7, Maximum = 12.9		

\*Weight for Height: Classified by Percentile System, < P3 as Wasting, P3 - < P10 as Underweight, P10- P90 as Normal, > P90- P97 as Overweight, and > P97 as Obesity.

Data source: National Growth References for Children Under 20 Years of Age, 1999. Nutrition Division, Department of Health, Ministry of Public Health, Thailand.

**Table 10** The baseline nutritional status of 20 diabetic adolescents (Cont.)

Variables	n	%
Number of meals/day		
2	1	5
3	12	60
4	3	15
5	1	5
6	3	15
Food preparation		
Parent/relative	14	70
Caregiver	1	5
Food shops	5	25
Frequency of outside eating		
1-2 times/month	15	75
3-4 times/month	5	25
Difference of eating between school days and holidays		
No difference	11	55
Difference	9	45

Anthropometric assessment using Standard Curve of Weight for Height of Department of Health, Ministry of Public Health indicated that more than half (65%) were normal. Their average fasting blood glucose was 116 mg/dl, average postprandial blood glucose was 182 mg/dl, and average glycosylated hemoglobin (HbA<sub>1C</sub>) was 8.5%, which was primary poor glycemic control (Table 10).

Their food consumption patterns were evidenced by meal patterns and favorite foods questionnaire, food-frequency questionnaire, and 4-day food record before providing the educational tool model. Most subjects had 3 meals/day, few of them had 4-6 meals/day, their parents or relative prepared food for them, frequency of outside eating was 1-2 times/month. Difference of eating between school days and holidays, nearly half of them (45%) reported the difference and trended to eat more during the holidays. Their food patterns were mainly rice, fried food recipes with lean meat and vegetable oil.

Most subjects always consumed green-leaf vegetables, drank some milks especially low fat milk, but seldom ate fruits especially high sweetened fruits. Most subjects did not consume refined sugar, i.e., sweetened beverage, fruit juice, confectionery, snack with caramel, but they took snacks with high salt content and also fast foods quite often. However, most subjects did not take fermented foods, canned foods, herbs, and any food supplements.

## **5.2.2 Patient's knowledge and understanding of meal planning using carbohydrate counting**

The assessment of the patient's knowledge and understanding of meal planning using carbohydrate counting were performed by using Pre-test and Post-test questionnaire, the score of game playing and exercises (both in class and homework).

### **5.2.2.1 Patient's knowledge and understanding of meal planning using carbohydrate counting before and after using the developed educational tool model (Pre-test VS Post-test): (Table 11-12)**

Before using the developed educational tool model, it was found that most patients (65%) had moderate knowledge level. Twenty percentages (4 persons) of patients had high knowledge level, whereas 15% of patients had low knowledge level.

After using the developed educational tool model, patient's knowledge and understanding of meal planning were improved. Seventy percentages of patients had high knowledge level while twenty-five percentages of patients had moderate knowledge level, however, five percentages of patients still had low knowledge level

Comparison the score of patient's knowledge and understanding of meal planning using carbohydrate counting between Pre-test and Post-test. It was found that there were significant different between the score of patient's knowledge and understanding in carbohydrate counting before and after using the developed educational tool model. The score of patient's knowledge and understanding in carbohydrate counting before using the educational tool model were lower than the score of those after using the educational tool model. (Table 12)

**Table 11** Number and percentage of Patient's knowledge and understanding of meal planning using carbohydrate counting before and after used the developed educational tool model (Pre-test VS Post-test)

Knowledge level	Pre-test		Post-test	
	n	%	n	%
Low	3	15	1	5
Moderate	13	65	5	25
High	4	20	14	70
Total	20	100	20	100

**Table 12** Comparison the score of Patient's knowledge and understanding of meal planning using carbohydrate (Pre-test and Post-test)

Knowledge score	Pre-test	Post-test	Paired t-test p-value
Mean	16.0	22.0	< 0.05
SD	0.31	0.59	
Median	16.0	22.0	
Minimum	10.0	11.0	
Maximum	22.0	25.0	

#### 5.2.2.2 Exercise for increasing skill including weigh and measure foods, estimate portions, figure carbohydrate grams or choices for practicing in counting carbohydrate in class practice

The results of patient's knowledge and understanding of meal planning using carbohydrate counting were also assessed from the score of exercise in class practice.

Selected food items used were divided into 3 groups based on their characteristics, in order to practice for increasing patient's skill in estimating portion sizes of various foods. Subjects were assigned to estimate, to weigh or measure selected food item displayed, in addition, they also estimated the amount of carbohydrate in a serving portion.

The specific results of patient's knowledge and understanding of meal planning using carbohydrate counting in the class practice in terms of correct or incorrect answers according to three food groups, showed that food group 1; All patients (100%) got the correct answer in counting carbohydrate of apple, bread, and boiled kale. Fifty percentages of patients got the correct answer of pineapple and boiled rice noodles whereas 65-75% of patients got the correct answer of orange, rice, boiled mungbean, and boiled cabbage. (Table 13)

For food group 2; All patients (100%) got the correct answer of milk, orange juice, and sandwich and 40-45% of patients got the correct answer of Jam, Met khanun, Pa tong gho and cookies had the 50%, 45%, 40%, and 40% of correct answer, respectively. (Table 13)

For food group 3; Ninety five percentages of patients got the correct answer of Khao rat na kai phat bai kaprao kai dow (Rice with fried chicken and Holy Basil leaves with fried egg), 65% of patients got the correct answer of Khao niao mu ping (Glutinous rice with roasted pork) and only 40% of patients got the correct answer of Sen mi luk chin nam (Thin rice noodles soup with ball). (Table 13)

**Table 13** Number and percentage of correct and incorrect answers in each food item of 3 food groups

Food items	Correct		Incorrect	
	n	%	n	%
<u>Starch, vegetable and fruit</u>				
Rice	12	60	8	40
Bread	20	100	-	-
Boiled thin rice noodles	16	80	4	20
Boiled mungbean	11	55	9	45
Boiled kale	20	100	-	-
Boiled cabbage	12	60	8	40
Orange	15	75	5	25
Apple	20	100	-	-
Grape, green	7	35	13	65
Pineapple	16	80	4	20

**Table 13** Number and percentage of correct and incorrect answers in each food item of 3 food groups (Cont.)

Food items	Correct		Incorrect	
	n	%	n	%
<u>Milk, beverage and dessert</u>				
Milk	20	100	-	-
Orange juice	20	100	-	-
Pa tong gho	8	40	12	60
Cookies	8	40	12	60
Sandwich	20	100	-	-
Met khanun	9	45	11	55
Jam	10	50	10	50
<u>One- plate dish</u>				
Sen mi luk chin nam (Thin rice noodles soup with ball)	8	40	12	60
Khao rat na kai phat bai kaprao- kai dow (Rice with fried chicken and Holy Basil leaves with fried egg)	19	95	1	5
Khao niao mu ping (Glutinous rice with roasted pork)	13	65	7	35

Eventually, the results of the average score of this exercise, showed that most patients (55%) had moderate knowledge level, nearly one-third of patients (35%) had high knowledge level while 10% of patients were in low knowledge level. (Table 14)

**Table 14** Number and percentage of Patient's knowledge and understanding of meal planning using carbohydrate counting assessed by the score of exercise, class practice

Knowledge level	n	%
Low	2	10
Moderate	11	55
High	7	35
Total	20	100

### 5.2.2.3 Exercise for practicing in counting carbohydrate:

The results of patient's knowledge and understanding of meal planning using carbohydrate counting were also assessed from the score of exercise as assigned homework.

The assigned homework composed of 3 parts; the 1<sup>st</sup> part that focused on practice for learning portion sizes from carbohydrate resource book, the 2<sup>nd</sup> part that focused on understanding in nutrition label information, and the 3<sup>rd</sup> part that focused on doing 4-day food record in order to 1) assess these compliance or responsibility for recording, 2) evaluate the accuracy of counting carbohydrate, and 3) determine whether their carbohydrate consumption corresponded to carbohydrate goal or not. The result showed that more than half of patients (60%) had moderate knowledge level. One-fourth of patients (25%) had high knowledge level. While at least group was in low knowledge level. (Table 15)

**Table 15** Number and percentage of Patient's knowledge and understanding of meal planning using carbohydrate counting assessed by the score of exercise as homework

Knowledge level	n	%
Low	3	15
Moderate	12	60
High	5	25
Total	20	100

The specific results of the average score of the 3<sup>rd</sup> part exercise of 4-day food record which were evaluated in three different aspects as mentioned above, the results showed that the responsibility for recording had the highest average score (9.5 points), the accuracy in counting CHO had the moderate average score (6.9 points), and corresponding to CHO goal had the lowest average point (1.4 points) (Table 16). Most patients (95%) had usual carbohydrate intake less than carbohydrate goal. Only one of them (5%) had usual carbohydrate intake more than carbohydrate goal.

**Table 16** Comparison of the average point of 4-day food record (the 3<sup>rd</sup> part exercise) between three evaluated aspects

Evaluated aspects	Mean	SD	Median	Minimum	Maximum
Responsibility for recording	9.5	1.28	10.0	5.0	10.0
Corresponding to CHO goal	1.4	2.01	0.0	0.0	6.0
Accuracy in counting CHO	6.9	3.36	8.0	0.0	10.0

### 5.2.3 Accuracy in Patient's perception and conceptualization in carbohydrate counting using the developed educational tool model

The assessment of accuracy in patient's perception and conceptualization in carbohydrate counting using the developed educational tool model had accomplished by testing patient's ability in estimate foods and count carbohydrate via game playing, food demonstration, food model, food labeling and individualized 4-day food record. However, accuracy in patient's perception and conceptualization in carbohydrate counting using photographic food card game was the main assessment.

It composed of 2 parts; the 1<sup>st</sup> part, patients had to record their own meal planning using photographic food card for counting carbohydrate. The 2<sup>nd</sup> part, patients had to record the amount of carbohydrates consumed from the test meal which patients derived in the class.

The specific results of the 1<sup>st</sup> part assessment which were evaluated in two different aspects, showed that for corresponding to CHO goal; nearly half of patients (40%) had CHO intake corresponded to CHO goal, nearly one-third of patients (35%) had over-goal of CHO intake, one-fourth of patients (25%) had under-goal CHO intake in their meal plan (Table 18). For accuracy in counting carbohydrates, it was found that more than half of patients (55%) could count CHO correctly, nearly one-third of patients (30%) counted were under-actual CHO count, while at least group (15%) was patients who counted to be over-actual CHO count (Table 17).

**Table 17** Number and percentage of Accuracy in patient's perception and conceptualization in carbohydrate counting in term of deviation from CHO goal and actual CHO for the 1<sup>st</sup> part assessment

Deviations	n	%
<u>CHO goal</u>		
Under-goal	5	25
Actual	8	40
Over-goal	7	35
Total	20	100
<u>Actual CHO</u>		
Under-actual CHO	6	30
Actual	11	55
Over-actual CHO	3	15
Total	20	100

The 2<sup>nd</sup> part assessment was only considered the accuracy in counting carbohydrates, the results revealed that nearly half of patients (45%) counted CHO correctly, nearly one-third of patients (35%) were over-actual CHO count, while at least group of patients (20%) were under-actual CHO count (Table 18).

**Table 18** Number and percentage of Accuracy in patient's perception and conceptualization in carbohydrate counting in term of deviation from actual CHO for the 2<sup>nd</sup> part assessment

Deviations	n	%
Under-actual CHO	4	20
Actual	9	45
Over-actual CHO	7	35
Total	20	100

Eventually, the results of the accuracy in patient's perception and conceptualization in carbohydrate counting using the developed educational tool model, showed that most patients (80%) had high knowledge level, nearly one-fourth of patients (20%) had moderate knowledge level while no patient had low knowledge level. (Table 19)

**Table 19** Number and percentage of Accuracy in patient's perception and conceptualization in carbohydrate counting using the developed photographic food card game

Knowledge level	n	%
Low	-	-
Moderate	4	20
High	16	80
Total	20	100

### 5.3 Patient's satisfaction with the developed educational tool model

The patient's satisfaction was considered from the content aspect and also format of each tool. The content aspect referred to correspond to objectives, languages or wording, overall length, concise, appropriate to target audience, health promoting. The format referred to size, font, color, and the illustrations. Additionally, the quality of food photographs were also evaluated. The closed ended questions of rating scale with 4 levels of measurement were used and also the comments of patients were collected as well. The patients responded positively as shown in Table 20-22.

The self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents, most patients satisfied with overall assessment. Most criteria of the content and format aspect were assessed to be very good, few patients assessed them to be fair, and nobody assessed them to need improvement.

Although most criteria were assessed to be very good more than good, however, some criteria were assessed to be good more than very good which included learning the importance of practice in weighing or measuring foods for getting correct portion sizes, assessing and setting self- appropriate weight goal, Overall length appropriately, and also attractive cover (Table 20).

**Table 20** Satisfaction assessment of the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
<b>1.Content:</b>						
1.1 Corresponding to objectives						
- Learn the goal of meal planning	18 (90%)	2 (10%)	-	-	3.90	0.31
- Understand the role of nutrients which affect blood glucose	16 (80%)	4 (20%)	-	-	3.80	0.41
- Learn principle and rationale of CHO counting	17 (85%)	3 (15%)	-	-	3.85	0.37
- Understand the meaning and method of CHO counting	16 (80%)	4 (20%)	-	-	3.80	0.41
- Learn food groups which contain CHO	17 (85%)	3 (15%)	-	-	3.85	0.37
- Learn appropriate references of CHO value for counting CHO	12 (60%)	8 (40%)	-	-	3.60	0.50
- Learn the importance of practice in weighing or measuring foods for getting correct portion sizes	9 (45%)	11 (55%)	-	-	3.45	0.51
- Understand and enjoy using CHO counting	11 (55%)	9 (45%)	-	-	3.55	0.51
- Figure or count CHO correctly	15 (75%)	5 (25%)	-	-	3.75	0.44

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

**Table 20** Satisfaction assessment of the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents (Cont.)

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
- Assess and set self-appropriate weight goal	7 (35%)	13 (65%)	-	-	3.35	0.49
- Set self-appropriate meal plan	11 (55%)	9 (45%)	-	-	3.55	0.51
1.2 Language, easy to learn	18 (90%)	2 (10%)	-	-	3.90	0.31
1.3 Content presentation, precise and attract to follow	12 (60%)	8 (40%)	-	-	3.60	0.50
1.4 Overall length, appropriately	9 (45%)	11 (55%)	-	-	3.45	0.51
1.5 Appropriate knowledge to adolescents with 12-19 yrs.	15 (75%)	5 (25%)	-	-	3.75	0.44
1.6 Story sequences, appropriately	16 (80%)	4 (20%)	-	-	3.80	0.41
1.7 Health promoting	16 (80%)	3 (15%)	1 (5%)	-	3.75	0.55
Total, Content aspect:					3.85	0.37

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

**Table 20** Satisfaction assessment of the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents (Cont.)

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
<b>2. Format:</b>						
2.1 Appropriate size	19 (95%)	1 (5%)	-	-	3.95	0.22
2.2 Attractive cover	7 (35%)	13 (65%)	-	-	3.35	0.49
2.3 Page and illustration- arrangement	11 (55%)	9 (45%)	-	-	3.55	0.51
2.4 Attractive illustration	19 (95%)	1 (5%)	-	-	3.95	0.22
2.5 Illustration increase understanding	16 (80%)	4 (20%)	-	-	3.80	0.41
2.6 Font and its size, easy to read	18 (90%)	2 (10%)	-	-	3.90	0.31
2.7 Appropriate text- emphasis	16 (80%)	4 (20%)	-	-	3.80	0.41
Total, Format aspect:					4.00	0.00
Total					3.90	0.31

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

The book of food exchange lists for counting carbohydrate, most patients were satisfied with overall assessment for this tool. Most criteria in the content aspect were assessed to be very good and nobody assessed them to be fair or need improvement.

While most criteria in the format aspect were assessed to be good which included attractive cover, page and illustration arrangement, and font and its size, easy to read. Nobody assessed them to be fair or need improvement (Table 21).

**Table 21** Satisfaction assessment of the book of food exchange lists for counting CHO

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
<b>1. Content:</b>						
1.1 Corresponding to objectives						
- Learn food groups which contained CHO	18 (90%)	2 (10%)	-	-	3.90	0.31
- Learn nutritional value each food item, particularly CHO	18 (90%)	2 (10%)	-	-	3.90	0.31
1.2 Content covers most common foods adolescents consumed	11 (55%)	9 (45%)	-	-	3.55	0.51
1.3 Content presentation, food grouping, easy to learn	14 (70%)	6 (30%)	-	-	3.70	0.47
1.4 Learning promoting in CHO counting	17 (85%)	3 (15%)	-	-	3.85	0.37
Total, Content aspect:					3.95	0.22
<b>2. Format:</b>						
2.1 Appropriate size	17 (85%)	3 (15%)	-	-	3.85	0.37
2.2 Attractive cover	5 (25%)	15 (75%)	-	-	3.25	0.44
2.3 Page and illustration-arrangement	9 (45%)	11 (55%)	-	-	3.45	0.51
2.4 Font and its size, easy to read	8 (40%)	12 (60%)	-	-	3.40	0.50
2.5 Appropriate text-emphasis	18 (90%)	2 (10%)	-	-	3.90	0.31
Total, Format aspect:					3.95	0.22
Total					3.95	0.22

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

Photographic food card game, most patients were satisfied with overall assessment for this tool. Most criteria in the content were assessed to be very good, some patient assessed them to be good. Moreover, all criteria were assessed to be very good more than good, few patients assessed them to be fair, and nobody assessed them to need improvement.

While all criteria in the photograph aspect were assessed to be good more than very good, few patients assessed them to be fair, and nobody assessed them to need improvement. On the contrary, all criteria in the format aspect were assessed to be very good more than good, but few patients assessed them to be fair, and nobody assessed them to need improvement (Table 22).

**Table 22** Satisfaction assessment of photographic food card game

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
<b>1.Content:</b>						
1.1 Corresponding to objectives						
- Learn nutritional value for counting CHO	17 (85%)	3 (15%)	-	-	3.85	0.37
- Correct nutritional value, correspond to food-photographic card	17 (85%)	3 (15%)	-	-	3.85	0.37
1.2 Food items cover most common foods adolescents consumed	13 (65%)	6 (30%)	1 (5%)	-	3.85	0.37
1.3 Learning promoting in CHO counting	19 (95%)	1 (5%)	-	-	3.85	0.37
<b>Total, Content aspect:</b>					<b>3.90</b>	<b>0.31</b>

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

**Table 22** Satisfaction assessment of photographic food card game (Cont.)

Assessment aspects	*Opinion				Mean	SD
	4 n (%)	3 n (%)	2 n (%)	1 n (%)		
<b>2. Photograph:</b>						
2.1 Clear and bright	8 (40%)	11 (55%)	1 (5%)	-	3.35	0.59
2.2 Reflect on actual food portion sizes	8 (40%)	10 (50%)	2 (10%)	-	3.30	0.66
Total, Photograph aspect:					3.40	0.68
<b>3. Format:</b>						
3.1 Appropriate size	13 (65%)	6 (30%)	1 (5%)	-	3.60	0.60
3.2 Font and its size, easy to read	16 (80%)	3 (15%)	1 (5%)	-	3.75	0.55
3.3 Appropriate text- emphasis	18 (90%)	2 (10%)	-	-	3.90	0.31
3.4 endurance	18 (90%)	1 (5%)	1 (5%)	-	3.85	0.49
3.5 Attractive presentation	12 (60%)	8 (40%)	-	-	3.60	0.50
Total, Format aspect:					3.90	0.45
Total					3.90	0.45

\*Opinion ; 4 = Very good, 3 = Good, 2 = Fair, 1 = Need improvement

Most patients were satisfied with the developed educational tool model, however, there were some comments from interviewing about the difficulty in counting carbohydrate. Most patients said that mixed foods or combinations food such as fast food, cake, dessert, and one-plate dishes were difficult for them to assess, fruit and milk were easy food groups for counting carbohydrate, starches were still difficult

because they didn't know portion sizes correctly, vegetables were still difficult because they couldn't remember what kind of vegetables didn't need count carbohydrate.

Moreover, patients were also asked about the intention to use these tools of level 1 carbohydrate counting and their interest to learn the higher carbohydrate counting levels. All patients intended to use these tools continuously and were also interested to learn the higher carbohydrate counting levels. All patients wanted to be provided these educational tools, and also they wanted to attend the group meeting for further learning carbohydrate counting continuously. They said that they enjoyed estimating, weighing, measuring, and also counting carbohydrate in various foods in the class. And carbohydrate counting allowed for variability of food choices and flexibility for their lifestyle and would make them improve their self-care for diabetic control.

## CHAPTER 6

### DISCUSSION

The main objectives of the study were to develop and evaluate the effectiveness of the educational tool model for self-help meal planning in type 1 diabetic adolescents by using carbohydrate counting concept. This chapter discussed the results according to the sequence of the study as the same way in chapter 5.

#### 6.1 The developed educational tool model

Edutainment and Counseling approach which was Cognitive Behavior Therapy (CBT) as the important aspects for developing educational tool model. The educational emphasis of CBT has an additional benefit, it leads to long term results. When people understand how and why they are doing well, they can continue doing what they are doing to make themselves well (79). However, type 1 diabetic children and adolescents have not appreciated traditional learning methods since they rarely contain the elements of fun and interactivity (105). Besuwan W. discussed that nutrition printed material was also less complicated than intensive education, which might cause confusion to the clients from too much information and poor compliance overtime (99). In this study, not only the booklets as colorful comic books were developed for adolescents, but also the interactive tool as photographic food card game was also developed for them to learn more effective in carbohydrate counting.

#### 6.2 The effectiveness of the educational tool model

##### 6.2.1 Personal characteristics of the study subjects

Of this study, the subject characteristics focused on basic demographic for diabetes; gender, age, anthropometric data, fasting blood glucose (FBG), postprandial blood glucose (PBG), Glycosylated hemoglobin (HbA<sub>1C</sub>), education level, diabetes family history, dietary control, number of insulin injections/day, frequency of hypoglycemic episodes, physical activity, number of meals/day, food preparation,

frequency of outside eating, different of eating between working days and holidays. Their characteristics were relevant to type 1 diabetic population which found by Sangeam S. (106). Besides, demographic data, food habits were discussed. Most subjects had 3 meals/day and few of them had 4 -6 meals/day, depended on their insulin injections. Their food patterns were mainly rice, fried foods with lean meat and vegetable oil. Most subjects had always consumed green-leaf vegetables, some milk especially low fat milk, but seldom consumed fruits especially high sweetened fruit. Most subjects did not take refined sugar, i.e., sweetened beverage, fruit juice, confectionery, snack with caramel, but they often consumed snacks with high salt content and fast foods. The result indicated that most of Thai diabetic adolescents in this study were only aware of the type of food they consumed. Their awareness neither met concept of adequacy along with balance diet nor the nutrition recommendations particularly in carbohydrate counting concept (5). Moreover, the result agreed with Viboolyanont S. (107) who has 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 (5 of 20 persons) reported in our subjects. In addition, they also had poor diabetic control. However, most subjects did not consume any fermented foods, canned foods, herbs, and food supplements.

## **6.2.2 Patient's knowledge and understanding of meal planning using carbohydrate counting**

### **6.2.2.1 Patient's knowledge and understanding of meal planning using carbohydrate counting before and after using the developed educational tool model (Pre-test VS Post-test):**

Before using the developed educational tool model (Pre-test), most patients (65%) had moderate knowledge level, and after used, the result from Post-test showed that most patients improved their knowledge and understanding with high knowledge level.

When we compared the score of patient's knowledge and understanding of meal planning using carbohydrate counting between Pre-test and

Post-test, there were significant different between the score of patient's knowledge and understanding in carbohydrate counting before and after used the developed educational tool model.

The score of patient's knowledge and understanding in carbohydrate counting before used the developed educational tool model were lower than the score of those after used the developed educational tool model ( $p < 0.05$ ). This result indicated that this developed educational tool model was able to increase patient's knowledge and understanding of meal planning using carbohydrate counting.

#### **6.2.2.2 Exercise for increasing skill including weigh and measure foods, estimate portions, figure carbohydrate grams or choices for practicing in counting carbohydrate in class practice:**

A critical step in teaching carbohydrate counting is to convince the client of the value of developing accurate portion control skills (12). In this study, three food groups based on their characteristics were used to practice for increasing skill of patients in estimating portion sizes and counting carbohydrates in various foods. This result found that most patients (55%) had moderate knowledge level, nearly one-third of patients (35%) had high knowledge level while at least group (10%) was low knowledge level. This result showed that most patients had a moderate skill in practice for weighing and measuring foods, estimating portions, and figuring or counting carbohydrate grams or choices. The specific results related to correct or incorrect answer according to three food groups, showed that most patients correctly estimated as 75%, 70%, and 65% of food group 1 (Starch, vegetable, and fruit), food group 2 (Milk, beverage and dessert), and food group 3 (One-plate dishes), respectively.

Food group 1; All patients (100%) got the correct answer in counting carbohydrate of apple, bread, and boiled kale. Fifty percentages of patients got the correct answer of pineapple and boiled rice noodles whereas 65-75% of patients got the correct answer of orange, rice, boiled mungbean, and boiled cabbage.

Food group 2; All patients (100%) got the correct answer of milk, orange juice, and sandwich and 40-45% of patients got the correct answer of Jam, Met

khanun, Pa tong gho and cookies had the 50%, 45%, 40%, and 40% of correct answer, respectively.

Food group 3; Ninety five percentages of patients got the correct answer of Khao rat na kai phat bai kaprao kai dow (Rice with fried chicken and Holy Basil leaves with fried egg), 65% of patients got the correct answer of Khao niao mu ping (Glutinous rice with roasted pork) and only 40% of patients got the correct answer of Sen mi luk chin nam (Thin rice noodles soup with ball).

Our result was consistent with Weber J. et al. (108) which demonstrated that accuracy of estimation varied by type or appearance of the foods, the following observations suggested that visual aspects of the foods do have a significant impact.

#### **6.2.2.3 Exercise for practicing in counting carbohydrate:**

As assigned homework, more than half (60%) of patients had moderate knowledge level. One-fourth (25%) of patients had high knowledge level. While at least group (15%) was in low knowledge level. This result showed that most patients had a moderate skill on practice for finding information of portion sizes from carbohydrate resource book as the book of food exchange lists for carbohydrate counting and on understanding nutrition label information which was the basic of level 1 carbohydrate counting (12). The specific result of the average score of the 3<sup>rd</sup> part exercise which was 4-day food record and were evaluated in the three different aspects, showed that responsibility for recording had the highest average score (9.5 points or 95% of the score), accuracy in counting CHO had the moderate average score (6.9 points or 69% of the score), and corresponding to CHO goal had the lowest average score (1.4 points or 14% of the score).

This result showed that most patients complied with carbohydrate counting concept which patients were encouraged to keep food records and to identify portion sizes that they usually consume by weighing and measuring amounts (12). Unfortunately, up to now there is no information available on the carbohydrate intake for Thai diabetic adolescents. Only a mention of Bandini LG. et al. that overweight adolescents tend to understate their own energy intake which may reflect the fact that subjects have larger portion on average and are therefore likely to under-report the amount (109). However, most subjects in this study were normal, only one-fourth of

subjects (5 of 20 persons) tended to be obese (overweight & obese); so this might exactly indicated that most diabetic adolescents in our study had usual carbohydrate intake less than carbohydrate goal.

### **6.2.3 Accuracy in Patient's perception and conceptualization in carbohydrate counting using the developed educational tool model**

Photographic food card game was the main educational tool which used to assess the accuracy in patient's perception and conceptualization in carbohydrate counting.

Patients were assigned to set their own meal plans appropriated to their carbohydrate goals by using photographic food cards. In addition, they had to figure or count carbohydrates from meal which they derived in the class (counted carbohydrate in only actually portions intake by using photographic food cards to help them recalled portions they ate). This result found that most patients (80%) had high knowledge level, nearly one-fourth of patients (20%) had moderate knowledge level while group of low knowledge level was none. Our result indicated that most patients had high perception and conceptualization in carbohydrate counting which was consistent with the increasing of knowledge and understanding after used the developed educational tool model (Post-test).

The result of individualized meal plan using photographic food cards to help them in estimating and counting carbohydrates which were evaluated in the two different aspects, for corresponding to CHO goal; nearly half of patients (40%) had CHO intake corresponded to CHO goal, nearly one-third of patients (35%) had over-goal CHO intake, one-fourth of patients (25%) had under-goal CHO intake in their meal plan. This might have also a little effect from photographic food cards that they selected, portion size of foods in the cards were fixed and might be inadequate for patients to make good judgment of food portion for their meal plan. However, we attempted to develop two or three portion sizes of each food to cover these effects.

For accuracy in counting carbohydrates, more than half of patients (55%) counted CHO correctly (to meet Actual CHO), nearly one-third of patients (30%) were under-actual CHO count, while at least group of patients (15%) were over-actual CHO count. This result was independent from the result of CHO goal correspondence

because when patients selected photographic food cards for their meal plan, they can learn the correct portion shown in each card. Our result showed that most patients had high perception and conceptualization in carbohydrate counting.

The result of counting actual carbohydrates intake from Lunch or Snack by using photographic food cards to recall portion size they took, showed that nearly half of patients (45%) were count CHO correctly (met Actual CHO), nearly one-third of patients (35%) were over-actual CHO count, while at least group of patients (20%) were under-actual CHO count. The result showed that memory of patients might have also affected to this result.

#### **6.2.4 Patient's satisfaction with the developed educational tool model**

Type 1 diabetic children and adolescents have not appreciated traditional learning methods since they rarely contain the elements of fun and interactivity (105). In this study we developed educational tool model which depended on Cognitive behavior therapy and Edutainment approach (79-94). Set of developed educational tool model comprised; 1) The self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents, 2) The book of food exchange lists for counting carbohydrate, and 3) Photographic food card game. Most patients were satisfied with overall criteria for all tools. Most criteria for all tools were assessed to be very good in both content and format aspects, some patient assessed them to be good, few patients assessed them to be fair, and nobody assessed to need improvement.

Although most criteria were assessed to be very good more than good, on the contrary, some criteria were assessed to be good more than very good which included concern the important of practicing in weigh or measure foods for correct portion sizes, to assess and set self-appropriate weight goal, Overall length appropriately, and attractive cover. Particularly in the 2<sup>nd</sup> tool and the 3<sup>rd</sup> tool; For the 2<sup>nd</sup> tool, most criteria in the format aspect were assessed to be good more than very good which included attractive cover, page and illustration arrangement, and font and its size, easy to read. For the 3<sup>rd</sup> tool which was photographic food card game, all criteria in the photograph aspect included clear & bright and reflect on actual food portion sizes were assessed to be good more than very good, little patient assessed

them to be fair. While format aspect tended to be very good. Those criteria which were assessed to be fair and good more than very good should be regarded to improve quality of educational tool in order to provide the effective educational tools for diabetes care.

The study of Wibunrattanasri N. (78), which developed the self-help guidelines for meal planning using carbohydrate counting for adults with type 2 diabetes, the style of illustrations (simple black- and white line drawings) were simplified to view for those patients. Most patients were satisfied with that tool. However, some patients commented that color should be included in the guidelines, which agreed with the results of Ruud J., et al.(102). Format planned to please target readers got better and better the acceptability of printed materials, since design was one of crucial factor in determining whether resources were read or were disposed of by the potential reader. Therefore style of presentation and format could also have an effect of the functionally literate adolescent's ability and desired to read message. Our study, the style of illustrations was colorful line drawings which different from the study of Wibunrattanasri N. and the style trend to be popular among children and adolescents group. The content of educational tools aspect was also crucial factor. Silverstein J., et al. stated that education is best provided with sensitivity to the age and developmental stage of the child, with regard to both the educational approach and the content of the material delivered (14). In this study, most patients were satisfied with the contents of all developed educational tools. The contents of this tool might be to encourage patients in changing behavior. Most of our subjects were in preparation stage which in the middle stage of Transtheoretical model; individuals intended to take action, to learning in carbohydrate counting such as food record keeping, they had attempted to take action to keep food records and practice the exercise. If we further modify to use higher level of carbohydrate counting, they might be able to change to action, maintenance, or habituation stage, respectively if they were sure that carbohydrate counting approach help them success in diabetes control. However, it also depended on individualized characteristics or their lifestyle, their family and also environments (14).

Most patients were satisfied with the developed educational tool model, however, there was some comments about the difficulty in counting carbohydrate from

interviewing. Most patients said that mixed foods or combinations food such as fast food, cake, dessert, and one-plate dishes were difficult for them to assess, fruit and milk were easy food groups for counting carbohydrate, starches were still difficult because they didn't know portion sizes correctly, vegetables were still difficult because they couldn't remember what kind of vegetables didn't need count carbohydrate. The results showed that they were able to count carbohydrates correctly if they learn the correct portions. In addition, it showed that patients need to increase skill in weighing, measuring, and counting carbohydrates as well as using carbohydrate resource references. This result was also consistent with Weber J., et al. (108) which demonstrated that accuracy of estimation varied by type or appearance of the foods.

Moreover, patients were also asked about the intention to use these tools of level 1 carbohydrate counting and their interest to learn the higher carbohydrate counting levels. All patients intended to use these tools continuously and were also interested to learn the higher carbohydrate counting levels. All patients wanted to be provided these educational tools, and also they wanted to attend the group meeting for further learning carbohydrate counting continuously. They said that they enjoyed estimating, weighing, measuring, and also counting carbohydrate in various foods in the class. And carbohydrate counting allowed for variability of food choices and flexibility for their lifestyle and would make them improve their self-care for diabetic. Our result was consistent with the study of Hissa AS., et al. (77) which studied to evaluate the degree of satisfaction of carbohydrate counting approach in patients treated by intensive insulin therapy. It was concluded that carbohydrate counting was a very well accepted procedure and allowed a better lifestyle.

Our results indicated that the developed educational tool model was acceptable as attractive learning tools for type1 diabetic adolescent. One of the important factors of the effectiveness of our educational tool model was the combination of a set of booklets and the photographic food card game which was in the process of interactive learning, which depended on Cognitive behavior therapy and Edutainment approaches. This would lessen the effect of one-way communication of booklets.

## CHAPTER 7

### CONCLUSION

In this study, we have developed and evaluated the effectiveness of the educational tool model for self-help meal planning in type 1 diabetic adolescents using carbohydrate counting concept. A set of educational tool model comprised; the booklets of carbohydrate counting as a colorful comic book including the self-help guidelines for meal planning using carbohydrate counting for type 1 diabetic adolescents, the book of food exchange lists for counting carbohydrate, and the game of carbohydrate counting as photographic food card game. Our results were agreed positively with the developed educational tool model.

The evidence from this study demonstrated that patients could increase knowledge and understanding of meal planning using carbohydrate counting with the developed educational tool model. Majority of the patients understood carbohydrate counting concept at high level and they had high perception and conceptualization in this approach; besides, they were satisfied with the developed educational tool model and intended to use these tools continuously. Moreover, they were interested to learn the higher carbohydrate counting levels, in order to get usefulness in treatment plan following Medical Nutrition Therapy. With all reasons, our educational tool model is acceptable as attractive learning tools for type 1 diabetic adolescents. However, the success of the subjects in the study also depended on the practice via class practice and homework exercise as well.

As a **practical suggestion**, although the educational tool model was developed to provide basic knowledge and understanding of carbohydrate counting that focused on self-help meal planning using carbohydrate counting concept, 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 educational tools, group meeting or telephone contact as available are still needed to be ongoing.

### **Recommendations for the further study**

1. Development of photographic food card will be able to modify for patients who have mastered portion control skill training, it does not need to be addressed with correct portion size of foods, in order to increase their perception and conceptualized in the amount or portion of foods by food photographs.

2. For subjects of this study, carbohydrate counting at higher level can be applied to them, in order to get usefulness in carbohydrate counting approach. Development of educational tools for level 2 and level 3 carbohydrate counting may be needed.

3. Although subject's basic characteristics were not different from general type 1 diabetic adolescent population, classes of education and category of hospital were not varied. Therefore further study should include a comparative study using sample groups in the other category of hospital, such as private hospital with various class of education.

4. This educational tool model may be applied to study in adults who have type 1, type 2, and gestational diabetes, in order to deliver effective educational materials to diabetic patients, widely.

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## APPENDIX A

### แบบสอบถามเกี่ยวกับข้อมูลทั่วไป ประวัติการรักษา และการใช้ยา สำหรับเด็กวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

คำชี้แจง : ให้ขีดเครื่องหมาย ✓ ลงใน ( ) หน้าข้อความตามที่ตรงกับความเป็นจริง หรือเติมคำ  
ลงในช่องว่าง \_\_\_\_\_ ให้สมบูรณ์

ชื่อ \_\_\_\_\_ วันที่ \_\_\_\_\_  
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 \_\_\_\_\_



(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 10,000 บาท แต่ไม่เกิน 30,000 บาท
4. ( ) สูงกว่า 10,000 บาท แต่ไม่เกิน 40,000 บาท
5. ( ) สูงกว่า 10,000 บาท แต่ไม่เกิน 50,000 บาท
6. ( ) 50,000 บาทขึ้นไป

(14) ได้รับการวินิจฉัยว่าเป็นเบาหวานเมื่อ \_\_\_\_\_  
 ระยะเวลาที่เป็นเบาหวาน \_\_\_\_\_ ปี \_\_\_\_\_ เดือน

(15) การรักษา : จำนวนครั้งของการฉีดอินซูลิน \_\_\_\_\_ ครั้ง/วัน

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

(16) ระดับน้ำตาลในเลือดก่อนอาหาร (FBG), มือเช้าวันนี้ คือ \_\_\_\_\_ mg/dl

ระดับน้ำตาลในเลือดหลังอาหาร (PBG), มือเย็นเมื่อวานนี้ คือ \_\_\_\_\_ mg/dl

ระดับน้ำตาลสะสมในเลือด (HbA<sub>1c</sub>), ค่าที่ได้ครั้งล่าสุด คือ \_\_\_\_\_ %

(17) เกิดภาวะน้ำตาลในเลือดต่ำบ่อยแค่ไหน \_\_\_\_\_ ครั้ง/สัปดาห์

มักเกิดขึ้นในเวลาใด \_\_\_\_\_

ระดับน้ำตาลในเลือดต่ำ มีค่าประมาณอยู่ในช่วง \_\_\_\_\_mg/dl

แก้ไขปัญหามารูกระดับน้ำตาลในเลือดต่ำ โดย \_\_\_\_\_

(18) เคยลดน้ำหนักหรือไม่

1. ( ) ไม่เคย เพราะ \_\_\_\_\_

2. ( ) เคย โดยวิธี \_\_\_\_\_

ได้รับคำแนะนำจาก \_\_\_\_\_

(19) ปัจจุบันควบคุมอาหารเพื่อการรักษาโรคเบาหวานหรือไม่

1. ( ) ไม่ควบคุม เพราะ \_\_\_\_\_

2. ( ) ควบคุม ได้รับคำแนะนำจาก \_\_\_\_\_

(20) โดยปกติ ออกกำลังกายหรือไม่

1. ( ) ไม่ออกกำลังกาย

2. ( ) ออกกำลังกาย; ชนิดของการออกกำลังกาย \_\_\_\_\_

ความถี่ \_\_\_\_\_ ครั้ง/สัปดาห์

ระยะเวลาโดยเฉลี่ย ครั้งละประมาณ \_\_\_\_\_ นาที

**แบบสอบถามพฤติกรรมการบริโภคอาหาร**

**คำชี้แจง :** ให้ขีดเครื่องหมาย ✓ ลงใน ( ) หน้าข้อความที่ตรงกับความเป็นจริง หรือเติมคำลงในช่องว่าง \_\_\_\_\_ ให้สมบูรณ์

**1. รูปแบบการบริโภคอาหาร:**

- 1) รับประทานอาหาร วันละ \_\_\_\_\_ มื้อ ได้แก่
- ( ) มื้อเช้า ( ) มื้อว่างเช้า ( ) มื้อเที่ยง ( ) มื้อว่างบ่าย
- ( ) มื้อเย็น ( ) มื้อก่อนนอน ( ) อื่นๆ ระบุ \_\_\_\_\_
- 2) รับประทานอาหาร มื้อละ \_\_\_\_\_ ทักพี และ/หรือ ขนมปัง \_\_\_\_\_ แผ่น
- ถ้วยเดียว หรือผลิตภัณฑ์จากธัญพืชอื่นๆ (ระบุชนิดและปริมาณ \_\_\_\_\_)
- 3) กับข้าว; เนื้อสัตว์ โดยเฉลี่ย \_\_\_\_\_ ชิ้นต่อมื้อ
- ไม่รับประทานเนื้อ ( ) หมู ( ) ปลา ( ) ไก่ ( ) อื่นๆ \_\_\_\_\_
- ชอบรับประทานเนื้อ ( ) หมู ( ) ปลา ( ) ไก่ ( ) อื่นๆ \_\_\_\_\_
- ไข่ โดยเฉลี่ย \_\_\_\_\_ ฟอง/วัน หรือ \_\_\_\_\_ ฟอง/สัปดาห์
- ผัก ( ) รับประทานได้ดี
- ( ) เลือกเป็นบางชนิด เช่น (โปรดระบุ) \_\_\_\_\_
- ( ) ไม่รับประทานเลย
- ประเภทอาหารที่ชอบ ( ) ต้มจืด
- (เลือกตอบได้มากกว่า 1 ข้อ) ( ) แกงกะทิ
- ( ) ของผัด, ทอด
- ( ) อื่นๆ (ระบุ) \_\_\_\_\_

- 4) ผลไม้;
- ( ) ไม่รับประทาน
- ( ) รับประทาน จำนวนครั้งละ \_\_\_\_\_ ( ) ทุกมื้อ
- ( ) ทุกวัน
- ( ) ทุกสัปดาห์
- ผลไม้ที่รับประทานบ่อย ได้แก่ \_\_\_\_\_

## 5) ขนม;

- ขนมขบเคี้ยว เช่น มันฝรั่ง, ข้าวเกรียบกุ้ง เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_

จำนวน \_\_\_\_\_ ถูง/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

- ขนมไทย/ของหวาน

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_

จำนวน \_\_\_\_\_ ถ้วยหรือ \_\_\_\_\_ ชิ้น/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

- เบเกอรี่ต่างๆ เช่น บราวนี่, เค้ก, คุกกี้ เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_

จำนวน \_\_\_\_\_ ชิ้น/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

## 6) อาหารและเครื่องดื่มที่มีน้ำตาล;

- น้ำผลไม้

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_

จำนวน \_\_\_\_\_ แก้ว/วัน หรือ \_\_\_\_\_ กล่อง/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

- น้ำอัดลม

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_

จำนวน \_\_\_\_\_ ขวด/วัน หรือ \_\_\_\_\_ กระป๋อง/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

- น้ำหวาน เช่น Hale's blue boy เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_  
จำนวน \_\_\_\_\_ แก้ว/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

- ทอफी

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุชนิด \_\_\_\_\_  
จำนวน \_\_\_\_\_ เม็ด/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

7) นมและผลิตภัณฑ์นม;

- นมบรรจุกล่องหรือขวด

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ ระบุยี่ห้อ \_\_\_\_\_

ชนิด ( ) ขาดมันเนย ( ) พร่องมันเนย ( ) ไขมันเต็มส่วน

รส ( ) จืด ( ) หวาน ( ) ช็อกโกแลต ( ) สตรอเบอร์รี่

( ) รสอื่นๆ ระบุ \_\_\_\_\_

ขนาดกล่อง/ขวดละ \_\_\_\_\_ ซีซี

จำนวน \_\_\_\_\_ กล่อง/วัน หรือ \_\_\_\_\_ ขวด/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

ระบุยี่ห้อ \_\_\_\_\_ ชนิด \_\_\_\_\_ รส \_\_\_\_\_

- นมเปรี้ยว/ยาคูลท์

( ) ไม่รับประทาน

( ) รับประทานเป็นประจำ

ระบุยี่ห้อ \_\_\_\_\_ ชนิด \_\_\_\_\_ รส \_\_\_\_\_

ขนาดกล่อง/ขวดละ \_\_\_\_\_ ซีซี

จำนวน \_\_\_\_\_ กล่อง/วัน หรือ \_\_\_\_\_ ขวด/วัน สัปดาห์ละ \_\_\_\_\_ วัน

( ) รับประทานนานๆ ครั้ง

## - โยเกิร์ต

 ไม่รับประทาน รับประทานเป็นประจำ

ระบวยี่ห้อ \_\_\_\_\_ ชนิด \_\_\_\_\_ รส \_\_\_\_\_

จำนวน \_\_\_\_\_ ถ้วย/วัน สัปดาห์ละ \_\_\_\_\_ วัน

 รับประทานนานๆ ครั้ง

## - ไอวอลล์/ไมโล

 ไม่รับประทาน รับประทานเป็นประจำ

ระบวยี่ห้อ \_\_\_\_\_ ขนาดกล่อง/ขวดละ \_\_\_\_\_ ซีซี

จำนวน \_\_\_\_\_ กล่อง/วัน หรือ \_\_\_\_\_ ขวด/วัน สัปดาห์ละ \_\_\_\_\_ วัน

 รับประทานนานๆ ครั้ง

## - นมถั่วเหลือง เช่น ไวตามิลค์, แลคตาซอย, วี-ซอย เป็นต้น

 ไม่รับประทาน รับประทานเป็นประจำ

ระบวยี่ห้อ \_\_\_\_\_ ขนาดกล่อง/ขวดละ \_\_\_\_\_ ซีซี

จำนวน \_\_\_\_\_ กล่อง/วัน หรือ \_\_\_\_\_ ขวด/วัน สัปดาห์ละ \_\_\_\_\_ วัน

 รับประทานนานๆ ครั้ง

## - ไอศกรีม/เชอร์เบท

 ไม่รับประทาน รับประทานเป็นประจำ

ระบวยี่ห้อ \_\_\_\_\_ ชนิด \_\_\_\_\_ รส \_\_\_\_\_

จำนวน \_\_\_\_\_ ถ้วย/วัน หรือ \_\_\_\_\_ แท่ง/วัน สัปดาห์ละ \_\_\_\_\_ วัน

 รับประทานนานๆ ครั้ง

## - นม หรือผลิตภัณฑ์นมชนิดอื่นๆ (ระบุ) \_\_\_\_\_

 ไม่รับประทาน รับประทานเป็นประจำ จำนวน \_\_\_\_\_ /วัน สัปดาห์ละ \_\_\_\_\_ วัน รับประทานนานๆ ครั้ง

8) อาหารฟาสต์ฟู้ด เช่น แมคโดนัลด์, เบอร์เกอร์คิง, แคนดักกี้ (KFC), เซสเตอร์กริลล์, พิซซ่า, แครีควีน เป็นต้น

( ) ไม่รับประทาน

( ) รับประทานเฉลี่ยเดือนละ \_\_\_\_\_ ครั้ง

ระบุรายการอาหารและปริมาณที่รับประทานในแต่ละครั้ง ดังนี้คือ

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9) ผลิตภัณฑ์เสริมอาหาร/อาหารเสริม เช่น ชูไปกัสกัด, วิตามินต่างๆ เป็นต้น

( ) ไม่รับประทาน

( ) รับประทาน (โปรดระบุชนิด) \_\_\_\_\_

ความถี่ในการรับประทาน \_\_\_\_\_ วัน ต่อสัปดาห์

10) ผู้ประกอบอาหารให้รับประทาน

( ) บิดา มารดา หรือญาติ โปรดระบุ \_\_\_\_\_

( ) ลูกจ้าง หรือพี่เลี้ยง

( ) ซื้ออาหารจากร้านอาหาร

( ) อื่นๆ ระบุ \_\_\_\_\_

11) ความถี่ของการรับประทานอาหารนอกบ้าน \_\_\_\_\_ ครั้ง/สัปดาห์ หรือ \_\_\_\_\_ ครั้ง/เดือน

โปรดระบุสถานที่ \_\_\_\_\_

12) การรับประทานอาหารในวันหยุดสุดสัปดาห์ กับวันธรรมดา มีความแตกต่างกันหรือไม่

( ) ไม่แตกต่าง

( ) แตกต่าง คือ \_\_\_\_\_

\_\_\_\_\_

## 2. รายการอาหารที่ชื่นชอบ และบริโภคเป็นประจำ:

(1) ข้าว/ผลิตภัณฑ์จากธัญพืชที่ชื่นชอบรับประทาน ได้แก่

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(2) กับข้าวที่ชื่นชอบรับประทาน ได้แก่

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(3) อาหารจานเดียวที่ชื่นชอบรับประทาน (เช่น ข้าวหมูแดง, ก๋วยเตี๋ยวผัดซีอิ้ว) ได้แก่

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(4) ผักที่ชื่นชอบรับประทาน ได้แก่

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(5) ผลไม้ที่ชื่นชอบรับประทาน ได้แก่

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(6) นม/โยเกิร์ตที่ชื่นชอบรับประทาน (โปรดระบุชนิด และยี่ห้อ) ได้แก่

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(7) ขนมไทย/ของหวาน/เบเกอรี่ที่ชื่นชอบรับประทาน (เช่น กล้วยบัวดชี, เค้ก) ได้แก่

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(8) ขนมขบเคี้ยวที่ชื่นชอบรับประทาน (เช่น เลย์, ข้าวเกรียบกุ้ง...โปรดระบุยี่ห้อ) ได้แก่

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(9) อาหารฟาสต์ฟู้ดที่ฉันชอบรับประทาน (เช่น แคนตักกี้ (KFC), พิซซ่า, แมคโดนัลด์  
พร้อมระบุชนิดของอาหาร เช่น ไก่ทอด, แฮมเบอร์เกอร์, เฟรนช์ฟราย เป็นต้น) ได้แก่

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\_\_\_\_\_

(10) เครื่องดื่มที่ฉันชอบรับประทาน (เช่น น้ำผลไม้, น้ำอัดลม....โปรดระบุชนิดและยี่ห้อ)  
ได้แก่

\_\_\_\_\_  
\_\_\_\_\_

3. บันทึกรายการอาหารบริโภคโดยปกติใน 1 วัน:

คำชี้แจง : จงกรอกข้อมูลเวลา และรายการอาหารที่รับประทานโดยปกติใน 1 วัน  
ลงในช่องว่าง \_\_\_\_\_

มือเช้า

โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารเช้าที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_  
\_\_\_\_\_

อาหารเช้าที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_  
\_\_\_\_\_

( ) ฉันไม่รับประทานอาหารเช้า

( ) ฉันไม่รับประทานอาหารเช้า \_\_\_\_\_ วัน/สัปดาห์

มือว่างเช้า

โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารว่างเช้าที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_  
\_\_\_\_\_

อาหารว่างเช้าที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_  
\_\_\_\_\_

( ) ฉันไม่รับประทานอาหารว่างเช้า

มี<sup>๕</sup>อาหารกลางวัน โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารกลางวัน<sup>๕</sup>ที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_

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\_\_\_\_\_

อาหารกลางวัน<sup>๕</sup>ที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_

\_\_\_\_\_

มี<sup>๕</sup>อาหารว่างบ้าง โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารว่าง<sup>๕</sup>ที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

อาหารว่าง<sup>๕</sup>ที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_

\_\_\_\_\_

( ) ฉันไม่รับประทานอาหารว่าง

มี<sup>๕</sup>อาหารเย็น โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารเย็น<sup>๕</sup>ที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

อาหารเย็น<sup>๕</sup>ที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_

\_\_\_\_\_

มี<sup>๕</sup>อาหารว่างเย็น/ก่อนนอน โดยปกติฉันรับประทานเวลา \_\_\_\_\_ น.

อาหารว่างเย็น/ก่อนนอน<sup>๕</sup>ที่ฉันรับประทานอยู่บ่อยๆ ได้แก่ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

อาหารว่างเย็น/ก่อนนอน<sup>๕</sup>ที่ฉันรับประทานบ้างเป็นบางครั้ง ได้แก่ \_\_\_\_\_

\_\_\_\_\_

( ) ฉันไม่รับประทานอาหารว่างเย็น/ก่อนนอน

**แบบสอบถามความถี่ในการบริโภคอาหาร**  
(Food Frequency Questionnaire)

**คำชี้แจง:** ให้ขีดเครื่องหมาย ✓ ลงในช่องที่แสดงความถี่ หรือจำนวนครั้งของการรับประทาน  
อาหารชนิดต่างๆ ที่ตรงกับความเป็นจริงของตัวท่านมากที่สุด

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร ในระยะเวลา 1 เดือนที่ผ่านมา					หมายเหตุ	
	ทุกวัน	สัปดาห์ละ		เดือนละ			ไม่รับประทานเลย
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง		
<b>เมล็ด/ผลิตภัณฑ์จากธัญพืช</b>							
- ข้าวสวดย							
- ข้าวกล้อง / ข้าวซ้อมมือ							
- โจ๊ก ข้าวต้ม							
- ก๋วยเตี๋ยว มักกะโรนี บะหมี่กึ่งสำเร็จรูป วุ้นเส้น สปาเก็ตตี้ มักกะโรนี ขนมจีน							
- ข้าวเหนียว							
- ลูกเดือย ถั่วเมล็ดแห้ง ข้าวโอ๊ต ซีเรียล							
<b>ขนมปัง</b>							
- ขนมปังปอนด์							
- ขนมปังโฮลวีท							
- ขนมปังกรอบ							
- เค้ก โดนัท แยมโรล คุกกี้ มัฟฟิน เบเกอรี่ต่างๆ							
<b>ผัก</b>							
- ผักใบเขียว เช่น ผักตำลึง ผักบุ้ง ผักคะน้า							

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร ในระยะเวลา 1 เดือนที่ผ่านมา					หมายเหตุ
	ทุกวัน	สัปดาห์ละ		เดือนละ		
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
- ผักที่มีแป้งสูง เช่น ฟักทอง ข้าวโพด ถั่วลันเตา เผือก มัน แห้ว มันแกว						
<b>ผลไม้</b> - ผลไม้ที่มีรสหวานน้อย เช่น ชมพู่ ฝรั่ง (อื่นๆ โปรดระบุในหมายเหตุ)						
- ผลไม้ที่มีรสหวานมาก เช่น ทุเรียน ลิ้นจี่ ลำไย (อื่นๆ โปรดระบุในหมายเหตุ)						
- ผลไม้อบแห้ง เช่น ลูกพรุน ลูกเกด (อื่นๆ โปรดระบุในหมายเหตุ)						
- ผลไม้ลอยแก้ว หรือ ผลไม้กระป๋อง						
<b>นม/ผลิตภัณฑ์นม</b> (โปรดระบุยี่ห้อ และรสชาติ ของนมทุกชนิดที่ท่าน รับประทานลงในหมายเหตุ) - นมขาดมันเนย						
- นมพร้อมมันเนย						
- นมไขมันเต็มส่วน						
- โยเกิร์ตพร้อมไขมัน						
- โยเกิร์ตไขมันเต็มส่วน						
- นมเปรี้ยว/ยาคูลท์						
- ไมโล/โอวัลติน						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร ในระยะเวลา 1 เดือนที่ผ่านมา					หมายเหตุ	
	ทุกวัน	สัปดาห์ละ		เดือนละ			ไม่รับประทานเลย
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง		
- นมถั่วเหลือง							
<b>อาหารหรือเครื่องดื่มที่มีน้ำตาล</b>							
- น้ำผัก							
- น้ำผลไม้							
- ชา กาแฟ							
- ช็อกโกแลต โกโก้							
- ลูกกวาด/ทอฟฟี่							
- เครื่องดื่มที่มีแอลกอฮอล์ เช่น เหล้า เบียร์							
- เครื่องดื่มชูกำลัง เช่น ลิโพ กระทิงแดง เอ็ม100 เอ็ม150							
- น้ำอัดลม							
- น้ำหวาน เช่น Hale's blue boy							
- เครื่องดื่มสมุนไพร (โปรดระบุชนิดในหมายเหตุ)							
<b>ขนม</b> (โปรดระบุชื่อ หรือชนิด ลงในหมายเหตุ)							
- ขนมขบเคี้ยวรสเค็ม เช่น มันฝรั่งทอด ข้าวเกรียบกุ้ง							
- ขนมขบเคี้ยวที่มีรสหวาน เช่น ปาร์ตี้ ขนมอบกรอบ เคลือบช็อกโกแลต							

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร ในระยะเวลา 1 เดือนที่ผ่านมา					หมายเหตุ
	ทุกวัน	สัปดาห์ละ		เดือนละ		
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง	
- ขนมทอดน้ำมัน เช่น กล้วยทอด ปาท่องโก๋						
- ซาลาเปา สะเก๋ ขนมจีบ						
- ขนมใส่กะทิ เช่น บัวลอย ข้าวเหนียวมูล						
- ขนมหวานที่ทำจากไข่แดง เช่น ฝอยทอง ทองหยิบ ทองหยอด						
- ขนมใส่น้ำเชื่อม เช่น กล้วยเชื่อม พักทองเชื่อม						
<b>อาหารฟาสต์ฟู้ด</b>						
- บาร์บีคิว						
- นั้คเก็ต ไก่ทอด เฟรนช์ฟราย						
- แฮมเบอร์เกอร์ แซนดิวิช						
- พิซซ่าหน้าต่างๆ						
- สลัด น้ำสลัด						
- ไอศกรีม/เชอร์เบท (โปรดระบุชนิด และรสชาติ ลงในหมายเหตุ)						
<b>เนื้อสัตว์</b>						
- เนื้อสัตว์ไขมันต่ำ เช่น เนื้อปลา เนื้อไก่						
- เนื้อสัตว์ติดมัน เช่น คอหมู หมูสามชั้น เบคอน ไส้กรอก ไส้อ้ว ไส้กรอกอีสาน กุนเชียง						

ชนิดของอาหาร	จำนวนครั้งของการรับประทานอาหาร ในระยะเวลา 1 เดือนที่ผ่านมา					หมายเหตุ	
	ทุกวัน	สัปดาห์ละ		เดือนละ			ไม่รับประทานเลย
		4-6 ครั้ง	1-3 ครั้ง	2-3 ครั้ง	1 ครั้ง		
- เครื่องในสัตว์ เช่น ตับ หัวใจ ลำไส้ กึ้น							
- อาหารทะเล เช่น ปลาหมึก กุ้ง หอยนางรม ปู							
<b>ไขมัน</b> - เนยเหลว เนยแข็ง ครีม มายองเนส ชุป น้ำสลัด							
- แกงกะทิ เช่น มัสมัน แกงเขียวหวาน แกงคั่ว							
- ใช้น้ำมันจากสัตว์ เช่น น้ำมันหมู หรือใช้น้ำมันปาล์ม ในการประกอบอาหาร							
- ใช้น้ำมันพืช เช่น กุ้ง คิง อუნ ในการประกอบอาหาร (โปรดระบุชนิดของน้ำมัน เช่น น้ำมันรำข้าว หรือน้ำมัน ถั่วเหลือง ลงในหมายเหตุ)							
<b>อื่นๆ</b> - อาหารหมักดอง							
- อาหารบรรจุกระป๋อง หรือบรรจุซอง เช่น ปลา – กระป๋อง บะหมี่กึ่งสำเร็จรูป							
- พืช หรือยาสมุนไพร (โปรดระบุชนิดในหมายเหตุ)							
- ผลิตภัณฑ์/อาหารเสริม (โปรดระบุชนิดในหมายเหตุ)							

## แบบบันทึกการบริโภคอาหาร 4 วัน

(4-Day Food Record)

ชื่อ \_\_\_\_\_ นามสกุล \_\_\_\_\_ ชื่อเล่น \_\_\_\_\_

เลขที่เวชระเบียน \_\_\_\_\_ รายการอาหารวันที่ \_\_\_\_\_ ถึงวันที่ \_\_\_\_\_

## ข้อแนะนำในการบันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง :

1. แบบบันทึกการบริโภคอาหาร 4 วัน จะต้องครอบคลุมการบริโภคอาหารทั้งในวันธรรมดา และวันหยุดสุดสัปดาห์ ดังนั้นจึงขอความร่วมมือให้บันทึกการบริโภคอาหารในวันธรรมดาเป็นเวลา 3 วัน และในวันหยุดเสาร์-อาทิตย์ เป็นเวลา 1 วัน
2. บันทึกอาหารทุกชนิดรวมทั้งขนมและเครื่องดื่มที่รับประทานตลอดวัน ตั้งแต่ตื่นนอน จนเข้านอน (เฉพาะส่วนที่รับประทานเท่านั้น)
3. บันทึกอาหารที่รับประทานทั้งที่บ้านและนอกบ้าน
4. ข้อความต่อไปนี้เป็นสิ่งจำเป็นในการบันทึก
  - 4.1 ระบุส่วนประกอบของอาหารแต่ละชนิด พร้อมทั้งปริมาณหรือปริมาตร โดยของแข็งให้ระบุเป็นช้อนตวงหรือทัพพี ส่วนของเหลวให้ระบุปริมาตรเป็นช้อนชี่หรือ ระบุตามที่ตวง-วัดที่ใช้อยู่ ที่บ้าน ถ้าไม่สามารถประมาณปริมาณได้ให้พยายามบันทึกในรูปขนาดแทน เช่น ขนาดเล็ก กลาง ใหญ่ หรือขนาดกว้างยาวของอาหาร ยกตัวอย่างเช่น ผัดเปรี้ยวหวาน : ควรระบุรับประทานมากกว่าประมาณ 4 ช้อนโต๊ะ (หรือ 1 ทัพพี) มะเขือเทศ 2 ช้อนโต๊ะ เนื้อหมู 2 ช้อนโต๊ะ หรือระบุว่ารับประทานมากกว่าประมาณ 1/2 ลูกใหญ่ มะเขือเทศ 1 ลูกเล็ก เนื้อหมู 5 ชิ้น ขนาดชิ้นละ 1X2 ซม. เครื่องดื่ม : ควรระบุเป็นปริมาตร หรือขนาด เช่น โคล่า 1 ขวดกลาง หรือ 290 ซีซี เป็นต้น
  - 4.2 อาหารที่รับประทานปรุงอย่างไร เช่น ปลาทอด ไก่ย่าง ไข่ต้ม เป็นต้น
  - 4.3 การเติมน้ำตาล น้ำเชื่อมหรือกะทิลงในเครื่องดื่ม อาหารของหวานชนิดต่างๆ ให้ระบุปริมาณด้วย เช่น น้ำตาล 2 ช้อนชา ในกาแฟ 1 ถ้วย

• ตัวอย่างการบันทึก

บันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง  
 ประจำวัน ศุกร์ ที่ 11 เดือน มิถุนายน พ.ศ. 2547  
 ของ ชื่อ ด.ช. บังปอนด์ นามสกุล รักเรียน ชื่อเล่น น้องปัง

มื้ออาหาร เวลา (น.)	สถานที่	รายการอาหาร	ส่วนประกอบของ อาหาร	ปริมาณ หรือ ปริมาตรของ อาหาร
มือเช้า (06.30)	ที่บ้าน	ข้าวต้ม ไข่เค็ม กุนเชียงทอด นมสด (ตราเมจิ)	ข้าวต้ม (เฉพาะเนื้อข้าว) ไข่เค็ม กุนเชียง น้ำมันก๊าก (น้ำมันถั่วเหลือง) นมสดพร้อมมันเนย (รสจืด)	2 ทัพพี 1 ฟอง 2 ช้อนโต๊ะ 1 ช้อนโต๊ะ 240 ซีซี
มือว่างเช้า (10.00)	ที่โรงเรียน	บราวนี่	บราวนี่	1 ชิ้น (2x2 นิ้ว)
มือกลางวัน (12.00)	ที่โรงเรียน	ก๋วยเตี๋ยวลูกชิ้นเนื้อสด            ปอเปี๊ยะสด	ก๋วยเตี๋ยวเส้นใหญ่ ถั่วงอก เนื้อสุก ลูกชิ้นเนื้อวัว กระเทียมเจียว ปรุงรส น้ำตาลทราย น้ำปลา พริกป่น แป้งปอเปี๊ยะ กุนเชียง เต้าหู้ ถั่วงอก เนื้อปู น้ำราด (รสหวาน)	1 ทัพพี 2 ช้อนโต๊ะ 2 ช้อนโต๊ะ 6 ลูก 2 ช้อนชา  2 ช้อนชา 1 ช้อนชา ½ ช้อนชา 3 แผ่น 2 ช้อนชา 2 ช้อนโต๊ะ 2 ช้อนโต๊ะ 1 ช้อนโต๊ะ 1 ช้อนโต๊ะ

มื้ออาหาร เวลา (น.)	สถานที่	รายการอาหาร	ส่วนประกอบของ อาหาร	ปริมาณ หรือ ปริมาตรของ อาหาร
มื้อกลางวัน (12.00)	ที่โรงเรียน	กล้วยบวชชี	กล้วยน้ำว้า กะทิ น้ำตาล	4 ช้อน (1 ลูก) 4 ช้อนโต๊ะ 2 ช้อนชา
มื้อว่างบ่าย (15.00)	ที่โรงเรียน	สับปะรด	สับปะรด	1 ช้อน (2x3 นิ้ว)
มื้อเย็น (18.00)	ที่บ้าน	ข้าวสวย แกงเผ็ดไก่  ผัดคะน้าปลาเค็ม  ไข่เจียวหมูสับ  ส้มเขียวหวาน	ข้าวสวย เนื้อไก่ น้ำแกง (กะทิ) มะเขือเปราะ  คะน้า ปลาเค็ม น้ำมันก๊าก (น้ำมันถั่วเหลือง) ไข่ หมูสับ น้ำมันก๊าก (น้ำมันถั่วเหลือง) ส้มเขียวหวาน	2 ทัพพี 2 ช้อนโต๊ะ 2 ช้อนโต๊ะ 10 ช้อน (ผ่า 4 ส่วน/ลูก) 4 ช้อนโต๊ะ 2 ช้อนโต๊ะ 1 ช้อนโต๊ะ ½ ฟอง 1 ช้อนโต๊ะ 2 ช้อนโต๊ะ 2 ลูก (ขนาดกลาง)
มื้อว่างเย็น/ ก่อนนอน (22.00)	ที่บ้าน	นมสด (ตราเมจิ)	นมสดพว่องมันเนย (รสจืด)	240 ซีซี

บันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง

ประจำวัน \_\_\_\_\_ ที่ \_\_\_\_\_ เดือน \_\_\_\_\_ พ.ศ. \_\_\_\_\_

ของ ชื่อ \_\_\_\_\_ นามสกุล \_\_\_\_\_ ชื่อเล่น \_\_\_\_\_

มื้ออาหาร เวลา (น.)	สถานที่	รายการอาหาร	ส่วนประกอบของ อาหาร	ปริมาณ หรือ ปริมาตรของ อาหาร
				

## APPENDIX B

### แบบทดสอบความรู้ก่อน และหลังการทดลอง (Pre-test, Post-test)

: แบบประเมินความรู้และความเข้าใจเรื่องการวางแผนการบริโภคอาหารด้วยตนเอง  
โดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต

ชื่อ-สกุล.....

Subjects No. ....

#### ตอนที่ 1 :

คำชี้แจง โปรดตอบคำถามต่อไปนี้ โดยให้เลือกคำตอบข้อที่ท่านเห็นว่าถูกต้องที่สุดเพียงข้อเดียว  
โดยใช้วิธีกากบาท (X)

1. เป้าหมายในการวางแผนการบริโภคอาหาร คือข้อใด
  - ก. ช่วยควบคุมระดับน้ำตาลในเลือดให้ใกล้เคียงค่าปกติมากที่สุด
  - ข. ป้องกันและชะลอภาวะแทรกซ้อนของโรคเบาหวาน
  - ค. เพื่อให้ได้รับพลังงานและสารอาหารครบถ้วน สามารถเจริญเติบโตได้ตามวัย
  - ง. ถูกทุกข้อ
  
2. หลักการสำคัญของเทคนิคการนับหน่วยคาร์โบไฮเดรต คือข้อใด
  - ก. คาร์โบไฮเดรตสามารถทำให้ระดับน้ำตาลในเลือดสูงได้มากกว่าสารอาหารชนิดอื่นๆ
  - ข. ปริมาณรวมของคาร์โบไฮเดรตมีความสำคัญต่อระดับน้ำตาลในเลือดมากกว่าประเภทของคาร์โบไฮเดรต
  - ค. คาร์โบไฮเดรตให้รสหวานมากกว่าสารอาหารชนิดอื่น
  - ง. ถูกทั้งข้อ ก และ ข

3. เทคนิคการนับหน่วยคาร์โบไฮเดรตมีประโยชน์อย่างไร
- ก. ช่วยให้สามารถเลือกรับประทานอาหารได้หลากหลาย ไม่จำเจ
  - ข. ช่วยให้สามารถวางแผนการบริโภคอาหารได้สอดคล้องกับตนเองมากที่สุด
  - ค. สามารถปรับใช้ยาฉีดอินซูลินได้อย่างเหมาะสม สอดคล้องกับแผนการบริโภคอาหารที่ได้วางไว้ ภายใต้การดูแลของทีมแพทย์ผู้ดูแลรักษา
  - ง. ถูกทุกข้อ
4. ข้อใดต่อไปนี้เป็นไม่ถูกต้อง
- ก. โปรตีน 1 กรัม ให้พลังงาน 4 กิโลแคลอรี
  - ข. คาร์โบไฮเดรต 1 กรัม ให้พลังงาน 7 กิโลแคลอรี
  - ค. ไขมัน 1 กรัม ให้พลังงาน 9 กิโลแคลอรี
  - ง. เกลือแร่ และวิตามิน ไม่ให้พลังงาน
5. สารอาหารในข้อใด ที่มีผลต่อระดับน้ำตาลในเลือดมากที่สุด
- ก. โปรตีน
  - ข. ไขมัน
  - ค. คาร์โบไฮเดรต
  - ง. มีผลเท่ากันทุกข้อ
6. หมวดอาหารในข้อใด ที่ให้คาร์โบไฮเดรตทั้งหมด
- ก. ข้าว-แป้ง, นม, ผัก, ผลไม้
  - ข. ข้าว-แป้ง, เนื้อสัตว์, ผัก, ไขมัน
  - ค. ข้าว-แป้ง, ไขมัน, นม, ผลไม้
  - ง. ข้าว-แป้ง, เนื้อสัตว์, ผัก, ผลไม้

7. อาหารหมวดข้าว-แป้ง 1 ส่วนแลกเปลี่ยน ให้คาร์โบไฮเดรตกี่กรัม

- ก. 18 กรัม
- ข. 15 กรัม
- ค. 12 กรัม
- ง. 5 กรัม

8. อาหารหมวดนม 1 ส่วนแลกเปลี่ยน ให้คาร์โบไฮเดรตกี่กรัม

- ก. 18 กรัม
- ข. 15 กรัม
- ค. 12 กรัม
- ง. 5 กรัม

9. อาหารหมวดผลไม้ 1 ส่วนแลกเปลี่ยน ให้คาร์โบไฮเดรตกี่กรัม

- ก. 18 กรัม
- ข. 15 กรัม
- ค. 12 กรัม
- ง. 5 กรัม

10. อาหารหมวดผัก 1 ส่วนแลกเปลี่ยน ให้คาร์โบไฮเดรตกี่กรัม

- ก. 18 กรัม
- ข. 15 กรัม
- ค. 12 กรัม
- ง. 5 กรัม

11. หนึ่งหน่วยคาร์โบไฮเดรต หมายถึง คาร์โบไฮเดรตจำนวนกี่กรัม

- ก. 10 กรัม
- ข. 15 กรัม
- ค. 20 กรัม
- ง. 25 กรัม

12. แหล่งข้อมูลอ้างอิงที่ให้ข้อมูลปริมาณคาร์โบไฮเดรต สามารถดูจากที่ใดได้บ้าง
- ฉลากโภชนาการ
  - รายการอาหารแลกเปลี่ยน
  - เอกสาร หรือแผ่นพับแสดงคุณค่าทางโภชนาการของอาหารแต่ละรายการ ตามร้านอาหารต่างๆ
  - ถูกทุกข้อ
13. ข้อใดต่อไปนี้เป็นไม่ถูกต้อง
- มังคุด 4 ผล มีคาร์โบไฮเดรตเท่ากับ ลิ้นจี่ 6 ผล
  - ข้าว 1 ทัพพี มีคาร์โบไฮเดรตเท่ากับ ขนมปัง 1 แผ่น
  - ข้าวโพดต้ม 1/2 ฝัก มีคาร์โบไฮเดรตเท่ากับ ขนมจีน 1 จับใหญ่
  - โยเกิร์ต 1 ถ้วยตวง มีคาร์โบไฮเดรตเท่ากับ ฝักคะน้าสุก 1 ทัพพี
14. ผักในข้อใด ไม่จำเป็นต้องนำมานับหน่วยคาร์โบไฮเดรต
- ผักนึ่ง
  - แตงกวา
  - แครอท
  - ถูกทั้งข้อ ก และ ข
15. อาหารเข้ามือหนึ่งประกอบด้วย (1) นมพร่องมันเนย 1 แก้ว (240 ซีซี)  
(2) ขนมปังโฮลวีท 2 แผ่น  
(3) กล้วยน้ำว้า 1 ผลกลาง
- จงคำนวณ หรือนับหน่วยคาร์โบไฮเดรตที่ได้จากการรับประทานอาหารในมือนี้
- 63 กรัม หรือ 4 หน่วย
  - 64 กรัม หรือ 4 หน่วย
  - 65 กรัม หรือ 4 หน่วย
  - 66 กรัม หรือ 4 หน่วย

**ตอนที่ 2 :**

**คำชี้แจง** จงกาเครื่องหมาย ✓ หน้าข้อที่ท่านเห็นว่าถูกต้อง และกาเครื่องหมาย ✗ หน้าข้อที่ท่านเห็นว่าผิด

- .....1. การนับหน่วยคาร์โบไฮเดรตเป็นวิธีการจำกัดชนิดของอาหาร
- .....2. คาร์โบไฮเดรตเป็นสารอาหารเพียงชนิดเดียวที่เปลี่ยนเป็นน้ำตาลในเลือดได้
- .....3. ในหนึ่งวันแต่ละคนต้องการคาร์โบไฮเดรตปริมาณเท่ากัน
- .....4. เครื่องหนึ่งของพลังงานที่ควรจะได้รับ ควรมาจากคาร์โบไฮเดรต
- .....5. การฝึกชั่ง ตวงวัดปริมาณหรือขนาดของอาหาร จะช่วยให้นับหน่วยคาร์โบไฮเดรตได้ง่ายขึ้น
- .....6. นมพว่องมันเนย 1 ถ้วยตวง มีคาร์โบไฮเดรตเท่ากับ ผักสุก 1 ท็อปพี
- .....7. ผลไม้ทั้งสด อบแห้ง ดอง และน้ำผลไม้ไม่มีคาร์โบไฮเดรต
- .....8. ฝรั่ง ½ ผลกลาง มีคาร์โบไฮเดรตเท่ากับ น้ำส้มคั้น ½ ถ้วยตวง
- .....9. หนึ่งหน่วยคาร์โบไฮเดรต หมายถึงอาหารที่มีคาร์โบไฮเดรตจำนวน 15 กรัม
- .....10. การนับหน่วยคาร์โบไฮเดรตไม่จำเป็นต้องนับเครื่องดื่ม

## APPENDIX C

แบบฝึกหัด: การชั่ง ตวง วัดปริมาณ/ปริมาตร หรือขนาดของอาหารเพื่อการนับหน่วย  
คาร์โบไฮเดรต

คำชี้แจง:

ขั้นที่ 1 จงคาดคะเนปริมาณของอาหารโดยการประมาณด้วยสายตา พร้อมทั้งนับหน่วยคาร์โบไฮเดรตจากปริมาณอาหารที่ประมาณได้ จากนั้นกรอกข้อมูลที่ได้ลงในช่องว่างที่กำหนดไว้

ขั้นที่ 2 จงชั่ง ตวง วัด ปริมาณอาหารโดยใช้มาตรวัดต่างๆ เช่น ตาชั่งน้ำหนักอาหาร ถ้วยตวง ช้อนตวง ทัพพี เป็นต้น พร้อมทั้งนับหน่วยคาร์โบไฮเดรตจากปริมาณอาหารที่วัดได้จริง จากนั้นกรอกข้อมูลที่ได้ลงในช่องว่างที่กำหนดไว้

## แบบฝึกหัด

การชั่ง ตวง วัดปริมาณ / ปริมาตร หรือขนาดของอาหาร  
เพื่อการนับหน่วยคาร์โบไฮเดรต

รายการอาหาร/ ส่วนประกอบ	ผลจากการคาดคะเน		ผลจากการวัดจริง	
	ปริมาตร (ถ้วยตวง,ทัพพี, ช้อนโต๊ะ,ช้อนชา) /น้ำหนักอาหาร ( กรัม)	ปริมาณ คาร์โบไฮเดรต (กรัม)	ปริมาตร (ถ้วยตวง,ทัพพี, ช้อนโต๊ะ,ช้อนชา) /น้ำหนักอาหาร ( กรัม)	ปริมาณ คาร์โบไฮเดรต (กรัม)
<b>อาหารกลุ่มที่ 1 :</b>				
1) ข้าวสวย				
2) ขนมปัง				
3) เส้นหมี่ขาวลวก				
4) ถั่วเขียวต้มสุก				
5) ผักคะน้าสุก				
6) ผักกาดขาวสุก				
7) ส้มเขียวหวาน				
8) แอปเปิ้ล				
9) องุ่นเขียว				
10) สับปะรด				
<b>อาหารกลุ่มที่ 2 :</b>				
1) นมสด				
2) น้ำส้มคั้น				
3) ปาท่องโก๋				
4) คุกกี้				
5) แชนดิวิช				
6) เม็ดขนุน				
7) แยมผลไม้				

การชั่ง ตวง วัดปริมาณ / ปริมาตร หรือขนาดของอาหาร  
เพื่อการนับหน่วยคาร์โบไฮเดรต (ต่อ)

รายการอาหาร/ ส่วนประกอบ	ผลจากการคาดคะเน		ผลจากการวัดจริง	
	ปริมาตร (ถ้วยตวง,ทัพพี, ช้อนโต๊ะ,ช้อนชา) /น้ำหนักอาหาร ( กรัม)	ปริมาณ คาร์โบไฮเดรต (กรัม)	ปริมาตร (ถ้วยตวง,ทัพพี, ช้อนโต๊ะ,ช้อนชา) /น้ำหนักอาหาร ( กรัม)	ปริมาณ คาร์โบไฮเดรต (กรัม)
<b>อาหารกลุ่มที่ 3 :</b>				
1) เส้นหมี่ลูกชิ้นน้ำ - เส้นหมี่ขาว - ถั่วงอก - ผักนึ่ง - ลูกชิ้น - เนื้อหมู				
2) ข้าวราดกระเพราไก่ + ไข่ดาว - ข้าวสวย - ใบกระเพรา - เนื้อไก่ - ไข่				
3) ข้าวเหนียวหมูปิ้ง - ข้าวเหนียวนึ่ง - เนื้อหมูปิ้ง				

## APPENDIX D

## การบ้านสำหรับเทคนิคการนับหน่วยคาร์โบไฮเดรต

## ตอนที่ 1

**คำชี้แจง:** จงใช้ข้อมูลจากคู่มือรายการอาหารแลกเปลี่ยนสำหรับการนับหน่วยคาร์โบไฮเดรต ในการฝึกค้นหาสัดส่วน หรือขนาดของอาหาร (Portion sizes) พร้อมทั้งฝึกคำนวณ หรือนับหน่วยคาร์โบไฮเดรตจากรายการอาหารต่อไปนี้ พร้อมเติมคำตอบลงในช่องว่างที่กำหนดไว้

ตัวอย่าง :	ข้าวต้ม $\frac{3}{4}$ ถ้วยตวง	=	คาร์โบไฮเดรต	18	กรัม
	สตรอเบอร์รี่ 13 ผล (175 กรัม)	=	คาร์โบไฮเดรต	15	กรัม
(1) นมสดพร่องมันเนย	_____	=	คาร์โบไฮเดรต	12	กรัม
(2) ก๋วยเตี๋ยว	_____	=	คาร์โบไฮเดรต	15	กรัม
(3) ลูกเกด	_____	=	คาร์โบไฮเดรต	1	หน่วย
(4) น้ำองุ่น	_____	=	คาร์โบไฮเดรต	30	กรัม
(5) ข้าวสวย	_____	=	คาร์โบไฮเดรต	2	หน่วย
(6) มะละกอดิบ	_____	=	คาร์โบไฮเดรต	5	กรัม
(7) ทองหยิบ	_____	=	คาร์โบไฮเดรต	28	กรัม
(8) ไอศกรีม	_____	=	คาร์โบไฮเดรต	2	หน่วย
(9) ปาท่องโก๋	_____	=	คาร์โบไฮเดรต	18	กรัม
(10) น้ำตาลทราย	1 ช้อนชา	=	คาร์โบไฮเดรต	_____	กรัม
(11) น้คเก็ต (แมคโดนัลด์)	6 ชิ้น	=	คาร์โบไฮเดรต	_____	กรัม
(12) กระเพาะปลา	1 ที่เสิร์ฟ	=	คาร์โบไฮเดรต	_____	หน่วย
(13) ต้มยำกุ้ง	1 ที่เสิร์ฟ	=	คาร์โบไฮเดรต	_____	กรัม
(14) ยำถั่วพู	1 ที่เสิร์ฟ	=	คาร์โบไฮเดรต	_____	หน่วย
(15) ไข่กรอกอีสานทอด	1 ที่เสิร์ฟ	=	คาร์โบไฮเดรต	_____	กรัม

**ตอนที่ 2**

**คำชี้แจง:** จงตอบคำถามต่อไปนี้ โดยอาศัยข้อมูลโภชนาการของฉลากข้าวเกรียบกึ่งที่แสดงไว้ข้างล่างนี้

<b>ข้อมูลโภชนาการ</b>	
หนึ่งหน่วยบริโภค : 1/2 ซอง (40 กรัม)	
จำนวนหน่วยบริโภคต่อซอง : 2	
คุณค่าทางโภชนาการต่อหนึ่งหน่วยบริโภค	
พลังงานทั้งหมด 200 กิโลแคลอรี (พลังงานจากไขมัน 90 กิโลแคลอรี)	
ร้อยละของปริมาณที่แนะนำต่อวัน*	
ไขมันทั้งหมด 10 ก.	15 %
ไขมันอิ่มตัว 4.5 ก.	22 %
โคเลสเตอรอล 0 มก.	0 %
โปรตีน 3 ก.	
คาร์โบไฮเดรตทั้งหมด 25 ก.	8 %
ใยอาหาร น้อยกว่า 1 ก.	3 %
น้ำตาล 2 ก.	
โซเดียม 330 มก.	14 %
ร้อยละของปริมาณที่แนะนำต่อวัน*	
วิตามินเอ 0 %	วิตามินบี 1 น้อยกว่า 2 %
วิตามินบี 2 น้อยกว่า 2 %	แคลเซียม 2 %
เหล็ก 6 %	
*ร้อยละของปริมาณสารอาหารที่แนะนำให้บริโภคต่อวันสำหรับคนไทยอายุตั้งแต่ 6 ปีขึ้นไป(Thai RDI) โดยคิดจากความต้องการพลังงานวันละ 2,000 กิโลแคลอรี	

**คำถาม :** จากข้อมูลโภชนาการบนฉลากข้าวเกรียบกึ่ง 1 ซอง (น้ำหนักสุทธิ 80 กรัม)

- (1) ถ้าเรารับประทานข้าวเกรียบกึ่ง ¼ ซอง (20 กรัม)  
 จะได้รับคาร์โบไฮเดรตจำนวน .....กรัมหรือ.....หน่วย
- (2) ถ้าเรารับประทานข้าวเกรียบกึ่ง ½ ซอง (40 กรัม)  
 จะได้รับคาร์โบไฮเดรตจำนวน .....กรัม หรือ.....หน่วย
- (3) ถ้าเรารับประทานข้าวเกรียบกึ่ง 1 ซอง (80 กรัม)  
 จะได้รับคาร์โบไฮเดรตจำนวน .....กรัม หรือ.....หน่วย
- (4) จำนวนหน่วยบริโภคต่อซอง เท่ากับ 2 หมายความว่า.....  
 .....

## ตอนที่ 3

## บันทึกการบริโภคอาหารเพื่อการนับหน่วยคาร์โบไฮเดรต

**คำชี้แจง:** จงบันทึกการบริโภคอาหารเป็นเวลา 4 วัน พร้อมทั้งนับหน่วยคาร์โบไฮเดรตจากปริมาณอาหารที่ได้บันทึกไว้

**ตัวอย่าง:** บันทึกรายการอาหารที่รับประทานในรอบ 24 ชั่วโมง

ประจำวัน อังคาร วันที่ 14 เดือน มิถุนายน พ.ศ. 2548

ของ ชื่อ ด.ช. ปังปอนด์ นามสกุล รักเรียน ชื่อเล่น น้องปัง

คาร์โบไฮเดรตเป้าหมาย: เข้า 54 กรัม ว่างเข้า 20 กรัม เทียง 65 กรัม ว่างบ่าย \_ กรัม เย็น 75 กรัม ก่อนนอน \_ กรัม

มื้ออาหาร/เวลา (ระบุสถานที่)	รายการอาหาร	ส่วนประกอบ	ปริมาตร/ปริมาตร ของอาหาร	ปริมาณ คาร์โบไฮเดรตที่ เป็นกรัม (หน่วย)
มือเช้า	(1) ข้าวสวย	- ข้าวสวย	2 ทัพพี	36
07.30 น.	(2) แกงจืดเต้าหู้	- ผักกาดขาว	2 ทัพพี	0
ที่บ้าน		- เต้าหู้ขาว	1 หลอด	0
		- หมูสับ	3 ก้อน	0
	(3) ก๋วยเตี๋ยว	- ก๋วยเตี๋ยว	1 ผลกลาง	15
			<b>รวม:</b>	<b>51 กรัม (3 หน่วย)</b>
มือว่างเช้า	(1) วาฟเฟิล	- วาฟเฟิล (4X5 นิ้ว)	1 แผ่น	18
10.00 น.			<b>รวม:</b>	<b>18 กรัม (1 หน่วย)</b>
ที่โรงเรียน				
มือกลางวัน	(1) ก๋วยเตี๋ยวผัดซีอิ้ว	- ก๋วยเตี๋ยวเส้นใหญ่	2 ทัพพี	36
12.30 น.		- ผักคะน้าสุก	1 ทัพพี	5
ที่โรงเรียน		- น้ำตาล	1 ช้อนชา	5
	(2) เงาะ	- เงาะ	4 ผลใหญ่	15
			<b>รวม:</b>	<b>61 กรัม (4 หน่วย)</b>
มือเย็น	(1) ข้าวสวย	- ข้าวสวย	3 ทัพพี	54
18.00 น.	(2) ผัดผักรวมมิตร	- ผักคะน้า +	2 ทัพพี	10
		เห็ดฟาง + แครอท		
ที่บ้าน	(3) ปลาทุย่าง	- ปลาทุย่าง	1 ตัวกลาง	0
	(4) น้ำส้มคั้นสด	- น้ำส้มคั้นสด	1 ถต. (240 ซีซี)	30
			<b>รวม:</b>	<b>94 กรัม (4 หน่วย)</b>







**APPENDIX F**

รายการอาหารที่ใช้ในการประเมินการรับรู้ และมโนทัศน์ในการนับหน่วยคาร์โบไฮเดรต

**อาหารกลางวัน ชุดที่ 1**

1. ข้าวสวย
2. แกงจืดผักกาดขาว
3. ปลาทอด
4. ผัดเผ็ดถั้วฝักยาว
5. แตงโม

**อาหารกลางวัน ชุดที่ 2**

1. ข้าวสวย
2. แกงส้มผักรวมปลา
3. น่องไก่ทอด
4. ผัดผักรวมกุ้ง
5. ส้มเขียวหวาน

**อาหารว่าง**

1. แขนดวีชทูน่า
2. นมจืดพร่องมันเนย

## APPENDIX G

### แบบประเมินความพึงพอใจในการใช้เครื่องมือสื่อการสอน

**คำชี้แจง:** โปรดกรอกข้อความลงในช่องว่าง และเขียนเครื่องหมาย (X) ลงในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด

**ตอนที่ 1 :** หนังสือคู่มือวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วยคาร์โบไฮเดรตระดับเบื้องต้น สำหรับเด็กวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

**ตอนที่ 2 :** คู่มือรายการอาหารแลกเปลี่ยนเพื่อการนับหน่วยคาร์โบไฮเดรต

**ตอนที่ 3 :** บัตรรูปภาพอาหารสำหรับเกมส์การนับหน่วยคาร์โบไฮเดรต  
(Photographic Food Card Game)

## ตอนที่ 1

## แบบประเมินความพึงพอใจ

สำหรับหนังสือคู่มือวางแผนการบริโภคอาหารด้วยตนเองโดยใช้เทคนิคการนับหน่วย  
คาร์โบไฮเดรตระดับเบื้องต้น สำหรับเด็กวัยรุ่นที่เป็นเบาหวานชนิดที่ 1

รายละเอียดในการประเมิน	ดีมาก 4	ดี 3	พอใช้ 2	ควรปรับปรุง* 1
1. เนื้อหา				
1.1 เนื้อหาตรงตามวัตถุประสงค์				
- ทราบถึงเป้าหมายของการวางแผนการบริโภคอาหารเพื่อการควบคุมระดับน้ำตาล	.....	.....	.....	.....
- เข้าใจบทบาทของสารอาหารประเภทต่างๆ ที่มีผลต่อระดับน้ำตาลในเลือด โดยเฉพาะสารอาหารประเภทคาร์โบไฮเดรต	.....	.....	.....	.....
- ทราบถึงหลักการและความสำคัญของการใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....
- เข้าใจความหมายและวิธีการนับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....
- ทราบถึงหมวดหมู่ของสารอาหารที่มีคาร์โบไฮเดรตเป็นส่วนประกอบ	.....	.....	.....	.....
- ทราบถึงแหล่งข้อมูลอ้างอิงที่ให้ข้อมูลปริมาณคาร์โบไฮเดรต เช่น ฉลากโภชนาการ	.....	.....	.....	.....
- ตระหนักถึงความสำคัญของการฝึกชั่งตวง วัดปริมาณอาหาร และขนาดของอาหาร (portion size)	.....	.....	.....	.....
- เข้าใจและสนุกกับการใช้เทคนิคการนับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....

รายละเอียดในการประเมิน	ดีมาก 4	ดี 3	พอใช้ 2	ควรปรับปรุง* 1
- สามารถคำนวณ และนับหน่วยคาร์โบไฮเดรตได้อย่างถูกต้อง	.....	.....	.....	.....
- สามารถประเมินและกำหนดเป้าหมายของน้ำหนักตัวที่เหมาะสมกับตนเองได้	.....	.....	.....	.....
- สามารถวางแผนการบริโภคอาหารที่เหมาะสมกับตนเองโดยอาศัยหลักการของการนับหน่วยคาร์โบไฮเดรตได้	.....	.....	.....	.....
1.2 ภาษาอ่านแล้วเข้าใจง่าย	.....	.....	.....	.....
1.3 การนำเสนอเนื้อหา; กระชับ และชวนติดตาม	.....	.....	.....	.....
1.4 ปริมาณของเนื้อหาที่มีความยาวเหมาะสม	.....	.....	.....	.....
1.5 ความรู้ในเนื้อหาที่มีความเหมาะสมกับระดับกลุ่มเป้าหมาย (วัยรุ่นอายุระหว่าง 12-19 ปี)	.....	.....	.....	.....
1.6 การลำดับเรื่องราวมีความเหมาะสม	.....	.....	.....	.....
1.7 ส่งเสริมพฤติกรรมสุขภาพ (อาหาร การออกกำลังกาย และการดูแลตัวเองเพื่อการควบคุมโรคเบาหวาน)	.....	.....	.....	.....
<b>2. ด้านการจัดรูปเล่ม</b>				
2.1 ขนาดของหนังสือคู่มือมีความเหมาะสม	.....	.....	.....	.....
2.2 ปกมีความดึงดูดใจ	.....	.....	.....	.....
2.3 การจัดหน้าและภาพประกอบเหมาะสม	.....	.....	.....	.....
2.4 ภาพประกอบเนื้อหา ดึงดูดความสนใจ	.....	.....	.....	.....
2.5 ภาพประกอบช่วยให้เข้าใจเนื้อหาได้ดีขึ้น	.....	.....	.....	.....
2.6 ขนาดของตัวอักษรมองเห็นชัดเจน	.....	.....	.....	.....
2.7 การเน้นข้อความมีความเหมาะสม	.....	.....	.....	.....

หมายเหตุ \*ควรปรับปรุง ; กรุณาให้รายละเอียดในข้อเสนอแนะ



**ตอนที่ 2**  
**แบบประเมินความพึงพอใจ**  
**สำหรับหนังสือคู่มือรายการอาหารแลกเปลี่ยนเพื่อการนับหน่วยคาร์โบไฮเดรต**

รายละเอียดในการประเมิน	ดีมาก 4	ดี 3	พอใช้ 2	ควรปรับปรุง* 1
<b>1. เนื้อหา</b>				
1.1 เนื้อหาตรงตามวัตถุประสงค์ - ทราบถึงหมวดหมู่ของสารอาหารที่มีคาร์โบไฮเดรตเป็นส่วนประกอบ - ทราบถึงข้อมูลปริมาณสารอาหารในอาหารแต่ละรายการ โดยเฉพาะปริมาณคาร์โบไฮเดรต	.....	.....	.....	.....
1.2 เนื้อหาครอบคลุมรายการอาหารที่วัยรุ่นไทยส่วนใหญ่รับประทาน	.....	.....	.....	.....
1.3 การนำเสนอเนื้อหา; การจัดกลุ่มอาหารช่วยให้ง่ายต่อการเข้าใจ และมีความเหมาะสม	.....	.....	.....	.....
1.4 ส่งเสริมการเรียนรู้เทคนิคการนับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....
<b>2. ด้านการจัดรูปเล่ม</b>				
2.1 ขนาดของหนังสือมีความเหมาะสม สะดวกต่อการพกพา	.....	.....	.....	.....
2.2 ปกมีความดึงดูดใจ	.....	.....	.....	.....
2.3 การจัดหน้าและภาพประกอบเหมาะสม	.....	.....	.....	.....
2.4 ขนาดของตัวอักษรเหมาะสม	.....	.....	.....	.....
2.5 การเน้นข้อความมีความเหมาะสม	.....	.....	.....	.....

หมายเหตุ \*ควรปรับปรุง ; กรุณาให้รายละเอียดในข้อเสนอแนะ



**ตอนที่ 3**  
**แบบประเมินความพึงพอใจ**  
**สำหรับบัตรรูปภาพอาหารสำหรับเกมส์การนับหน่วยคาร์โบไฮเดรต**  
**(Photographic Food Card Game)**

รายละเอียดในการประเมิน	ดีมาก 4	ดี 3	พอใช้ 2	ควรปรับปรุง* 1
<b>1. ด้านเนื้อหา</b>				
1.1 เนื้อหาตรงตามวัตถุประสงค์				
- ให้ข้อมูลสารอาหารที่จำเป็นสำหรับการ นับหน่วยคาร์โบไฮเดรต	.....	.....	.....	.....
- ข้อมูลสารอาหารถูกต้อง สอดคล้องกับ รูปภาพ	.....	.....	.....	.....
1.2 หมวดหมู่อาหารครอบคลุมรายการอาหาร ที่วัยรุ่นไทยส่วนใหญ่รับประทาน	.....	.....	.....	.....
1.3 ส่งเสริมการเรียนรู้เทคนิคการนับหน่วย คาร์โบไฮเดรต	.....	.....	.....	.....
<b>2. ด้านรูปภาพ</b>				
2.1 รูปภาพคมชัด	.....	.....	.....	.....
2.2 รูปภาพสื่อถึงขนาดของอาหารตามขนาด อาหารจริง	.....	.....	.....	.....
<b>3. ด้านการจัดรูปแบบ</b>				
3.1 ขนาดของภาพมีความเหมาะสม	.....	.....	.....	.....
3.2 ขนาดของตัวอักษรมองเห็นชัดเจน	.....	.....	.....	.....
3.3 การเน้นข้อความมีความเหมาะสม	.....	.....	.....	.....
3.4 การทำรูปแบบบัตรมีความคงทนถาวร	.....	.....	.....	.....
3.5 รูปแบบการนำเสนอน่าสนใจ	.....	.....	.....	.....

**หมายเหตุ \*ควรปรับปรุง ; กรุณาให้รายละเอียดในข้อเสนอแนะ**



## APPENDIX H

## รายการบัตรรูปภาพอาหาร (Photographic Food Cards)

## 1. กลุ่มข้าวแป้ง 33 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต ในอาหาร (กรัม)
<b>เมล็ดธัญพืช/ผลิตภัณฑ์จากธัญพืช</b>		
1) ข้าวสวย 1 ทัพพี	55	18
2) ข้าวสวย 2 ทัพพี	110	36
3) ข้าวกล้อง 1 ทัพพี	55	18
4) ข้าวกล้อง 2 ทัพพี	110	36
5) ข้าวเหนียวหนึ่ง 1/2 ทัพพี	35	18
6) ข้าวต้ม (เฉพาะเนื้อข้าว) 2 ทัพพี	-	18
7) ข้าวต้ม (เฉพาะเนื้อข้าว) 4 ทัพพี	-	36
8) โจ๊กหมู 1 ถ้วยตวง	-	18
9) โจ๊กหมู 2 ถ้วยตวง	-	36
10) เส้นเล็กลวก 2/3 ถ้วยตวง (1 ทัพพี)	-	18
11) ก๋วยเตี๋ยวเส้นใหญ่ 1 ทัพพี	60	18
12) ก๋วยเตี๋ยวเส้นใหญ่ 1 ทัพพี	120	36
13) เส้นหมี่ขาวลวก 3/4 ถ้วยตวง	-	18
14) บะหมี่ลวก 3/4 ถ้วยตวง (1 ก้อน)	-	18
15) รุ้นเส้นสุก 2/3 ถ้วยตวง (1 ทัพพี)	-	18
16) มักกะโรนีสุก 2/3 ถ้วยตวง	-	18
17) มักกะโรนีสุก 1 1/3 ถ้วยตวง	-	36
18) ขนมจีน 1 จับใหญ่	90	18

## 1. กลุ่มข้าวแป้ง 33 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต ในอาหาร (กรัม)
<b>เมล็ดธัญพืช/ผลิตภัณฑ์จากธัญพืช(ต่อ)</b>		
19) บะหมี่สำเร็จแห้ง 1 ซอง	60	54
20) ขนมปังปอนด์ 1 แผ่น	25	18
21) ขนมปังโฮลวีท 1 แผ่น	25	18
22) แครกเกอร์กลม 4 แผ่น	40	36
23) ข้าวโพดขาวแกะเมล็ด 1/2 ถ้วยตวง	-	18
24) ข้าวโพดเหลืองแกะเมล็ด1/2 ถ้วยตวง	-	18
25) ข้าวโพดเหลือง 1/2 ฝัก	65	18
26) ข้าวโพดเหลือง 1 ฝัก	150	36
27) เมล็ดแป๊ะก๊วย 3 ซ้อนโต๊ะ	40	18
28) ถั่วแดงสุก 1/2 ถ้วยตวง	-	18
29) ถั่วเขียวสุก 1/2 ถ้วยตวง	-	18
30) มันเทศต้ม 1 หัวใหญ่	65	18
31) มันเทศต้ม 3 หัวเล็ก	65	18
32) เผือกต้ม 3 หัวเล็ก	65	18
33) เผือก-มันต้ม 6 หัวเล็ก	130	36

## 2. กลุ่มผลไม้ 48 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>ผลไม้สด</b>		
1) เงาะ 2 ผลใหญ่	40	8
2) เงาะ 4 ผลใหญ่	85	15
3) กล้วยไข่ 1 ผลกลาง	45	15
4) กล้วยน้ำว้า 1 ผลกลาง	45	15
5) กล้วยหอม 1 ผลใหญ่	100	30
6) ละมุด 1 ผล	80	15
7) ละมุด 2 ผล	160	30
8) น้อยหน่า 1/2 ผลใหญ่	70	15
9) น้อยหน่า 1 ผลใหญ่	140	30
10) ส้มเขียวหวาน 1 ผลใหญ่	120	15
11) ส้มเขียว 1 ผลกลาง	120	15
12) ส้มโอ 2 กลีบใหญ่	130	15
13) ขนุน 2 ยวงขนาดกลาง	60	15
14) ขนุน 4 ยวงขนาดกลาง	120	30
15) แก้วมังกร 10 ชิ้นคำ	115	15
16) มะม่วงสุก 1 ผลกลาง	160	30
17) มะม่วงดิบ 1 ผลใหญ่	200	30
18) ทูเรียน 1 เม็ดกลาง	40	15
19) ทูเรียน 1 เม็ดใหญ่	80	30
20) แคนตาลูป 1/4 ผล	200	15
21) แตงโม 10 ชิ้นคำ	285	15

## 2. กลุ่มผลไม้ 48 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>ผลไม้สด (ต่อ)</b>		
22) มะละกอสุก 5-8 ชิ้นคำ	115	15
23) สับปะรด 4 ชิ้นคำ	60	8
24) สับปะรด 8 ชิ้นคำ	125	15
25) สับปะรด 1 ชิ้นยาว	125	15
26) ฝรั่ง 1/2 ผลกลาง	120	15
27) แอปเปิ้ลเขียว 1 ผล	120	15
28) แอปเปิ้ลแดง 1 ผล	100	15
29) สาลี่หอม 1 ผล	135	15
30) สาลี่ 1 ผลใหญ่	240	30
31) ชมพู 2 ผลใหญ่	250	15
32) องุ่นเขียว 12 ผลกลาง	60	8
33) องุ่นเขียว 20 ผลกลาง	120	15
34) องุ่นแดงนอก (เล็ก) 16 ผล	100	15
35) สตรอเบอรี่ 6 ผล	90	8
36) ลิ้นจี่ 6 ผล	110	15
37) ลำไย 6-7 ผล	55	15
38) ลองกอง 7-8 ผล	90	15
39) มังคุด 4 ผล	80	15
<b>ผลไม้อบแห้งธรรมชาติ</b>		
40) ลูกพรุน 3 ผลกลาง	-	15
41) ลูกพรุน 6 ผลกลาง	-	30
42) ลูกพรุน 9 ผลกลาง	-	45
43) ลูกเกด 2 ชิ้นโต	-	15

## 2. กลุ่มผลไม้ 48 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>ผลไม้อบแห้งธรรมชาติ (ต่อ)</b>		
44) ลูกเกด 4 ชั้นนโต๊ะ	-	30
45) มะขามหวาน 4 ฝัก	40	30
<b>น้ำผลไม้</b>		
46) น้ำส้มคั้น 1/2 ถ้วยตวง	120 ซีซี	15
47) น้ำส้มคั้น 1 ถ้วยตวง	240 ซีซี	30
48) น้ำมะพร้าวอ่อน 1 ถ้วยตวง	240 ซีซี	45

## 3. กลุ่มผัก 22 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>ผักที่ให้พลังงานน้อย</b>		
1) ผักบุ้ง (สุก)	-	ไม่นับ
2) ผักกาดขาว (ดิบ)	-	ไม่นับ
3) ผักกาดขาว (สุก)	-	ไม่นับ
4) ผักกวางตุ้ง (สุก)	-	ไม่นับ
5) กะหล่ำปลี (สุก)	-	ไม่นับ
6) แตงกวา (ดิบ)	-	ไม่นับ
7) พริกเขียว (ดิบ)	-	ไม่นับ
8) ดอกกะหล่ำ (สุก)	-	ไม่นับ
9) บวบ (สุก)	-	ไม่นับ
10) มะเขือเทศ (ดิบ)	-	ไม่นับ

## 3. กลุ่มผัก 22 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>ผักที่ให้พลังงานมาก</b>		
11) ผักคะน้า (สุก) 1 ท็อปปี	-	5
12) บร็อกโคลี่ (สุก) 1 ท็อปปี	-	5
13) หน่อไม้ฝรั่ง (ดิบ) 1 ถ้วยตวง	-	5
14) แครอท (สุก) 1 ท็อปปี	-	5
15) หอมหัวใหญ่ 1 ท็อปปี	50	5
16) พริกทอง 1 ท็อปปี	45	5
17) ข้าวโพดอ่อน (สุก) 1 ท็อปปี	-	5
18) ถั่วฝักยาว (ดิบ) 1 ถ้วยตวง	-	5
19) ถั่วลันเตา (ดิบ) 1 ถ้วยตวง	-	5
20) มะละกอดิบ 1 ถ้วยตวง	-	5
21) มะเขือ (ดิบ) 2 ท็อปปี	60	5
22) มะระจีน (ดิบ) 2 ท็อปปี	100	5

## 4. กลุ่มอาหารประเภทพาสต์ฟู้ด 20 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>แมคโดนัลด์</b>		
1) เบอร์เกอร์หมู 1 ชิ้น	-	31
2) นั้คเก็ต 3 ชิ้น	-	7
3) นั้คเก็ต 6 ชิ้น	-	14
4) เฟรนช์ฟราย 1 ที่เสิร์ฟ (เล็ก)	-	27

## 4. กลุ่มอาหารประเภทฟาสต์ฟู้ด 20 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
<b>แคนดักกี้</b>		
5) ไก่แซบ(น้องเล็ก) 2 ชิ้น	-	18
6) ไก่แซบ(น้องเล็ก) 3 ชิ้น	-	27
7) ไก่ไม่มีกระดูก 2 ชิ้น	-	18
8) ไก่ไม่มีกระดูก 3 ชิ้น	-	27
9) ไก่แซบ 2 ชิ้น+ ไม่มีกระดูก 1 ชิ้น	-	27
10) ไก่แซบ 1 ชิ้น+ ไม่มีกระดูก 2 ชิ้น	-	27
11) ไก่นุ่ม (อกสันใน) 1 ชิ้น	-	18
12) ไก่แซบ 1+ ไก่นุ่ม 1 ชิ้น	-	27
13) ไก่ไม่มีกระดูก1+ไก่นุ่ม1+ ไก่แซบ1ชิ้น	-	36
14) สลัดโคลสลอ 1 ที่เสิร์ฟ (เล็ก)	-	18
15) มันทด 1 ที่เสิร์ฟ (เล็ก)	-	18
16) สลัดโคลสลอ1+ มันทด1 ที่เสิร์ฟ (เล็ก)	-	36
17) เบอร์เกอร์ไก่กรอบ 1 ชิ้น	-	36
<b>อื่นๆ</b>		
18) ขนมปังกระเทียม 2 ชิ้น (1/2 แผ่น)	-	9
19) ขนมปังกระเทียม 4ชิ้น (1 แผ่น)	-	18
20) พิซซ่า 1 ชิ้น	-	27

## 5. กลุ่มอาหารจานเดียว 20 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) ข้าวราดกะเพราไก่ + ไข่ดาว 1 ที่เสิร์ฟ	-	59
2) ข้าวน้ำพริกปลาทอด 1 ที่เสิร์ฟ	-	59
3) ข้าวผัดอเมริกัน 1 ที่เสิร์ฟ	-	54
4) ข้าวคอกกะปิ 1 ที่เสิร์ฟ	-	64
5) ข้าวหมกไก่ทอด 1 ที่เสิร์ฟ	-	59
6) ข้าวหน้าเป็ด 1 ที่เสิร์ฟ	-	64
7) ข้าวขาหมู 1 ที่เสิร์ฟ	-	64
8) ข้าวมันไก่ 1 ที่เสิร์ฟ	-	59
9) ข้าวหมูแดง 1 ที่เสิร์ฟ	-	59
10) ข้าวหมูกรอบ 1 ที่เสิร์ฟ	-	59
11) ก๋วยเตี๋ยวผัดซีอิ๊วหมู 1 ที่เสิร์ฟ	-	64
12) ก๋วยเตี๋ยวผัดไทยใส่ไข่ 1 ที่เสิร์ฟ	-	64
13) ขนมจีนน้ำยา 1 ที่เสิร์ฟ	-	51
14) ส้มตำไทย 1 ที่เสิร์ฟ	-	13
15) ก๋วยเตี๋ยวดำหน้าเส้นใหญ่ 1 ที่เสิร์ฟ	-	46
16) บะหมี่แห้ง, หมูแดง 1 ที่เสิร์ฟ	-	36
17) ก๋วยเตี๋ยวลี้นเล็ก, น้ำ 1 ที่เสิร์ฟ	-	36
18) เส้นเล็กเย็นตาโฟน้ำ 1 ที่เสิร์ฟ	-	36
19) สาคูใส่หมู 5 ลูก	80	21
20) ไข่กรอกอีต่าน 1 แท่ง	100	7

## 6. กลุ่มขนมไทย 21 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) ก๋วยเตี๋ยวเชื่อม 4 ช้อน (2 ผล)	120	53
2) ก๋วยเตี๋ยววุ้น 1 ที่เสิร์ฟ	100	31
3) ข้าวเหนียวถั่วดำ 1 ที่เสิร์ฟ	120	60
4) เต้าส่วน 1 ที่เสิร์ฟ	130	10
5) บัวลอยไข่หวาน 1 ที่เสิร์ฟ	130	41
6) ตะโก้แห้ง 1 กระทง	50	11
7) ตะโก้แห้ง 2 กระทง	100	21
8) ขนมลูกตาล 1 ช้อน	35	17
9) ขนมลูกตาล 2 ช้อน	70	34
10) ขนมลูกชุบ 4 ลูก	40	20
11) ขนมลูกชุบ 6 ลูก	60	30
12) ขนมถั่วแปบ 3 ตัว	100	44
13) สังขยาฟักทอง 1 ช้อน (1/8 ลูก)	80	45
14) ข้าวเม้าทอด 1 ช้อน	60	28
15) ก๋วยเตี๋ยวแขกทอด 3 ช้อน	70	32
16) มันทอด 3 ช้อน	90	43
17) ขนมชั้น 1 ช้อน	40	20
18) ทองหยอด 4 เม็ด	30	24
19) ทองหยิบ 2 ดอก	35	28
20) เม็ดขนุน 5 เม็ด	40	30
21) ขนมไหว้พระจันทร์ไส้ทุเรียน 1/2 ลูก	100	60

## 7. กลุ่มขนมหวานอื่นๆ 28 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) ซาลาเปา 1 ลูก	-	27
2) ขนมจีบ 3 ชิ้น	-	14
3) ขนมจีบ 4 ชิ้น	-	18
4) ปาท่องโก๋ 1 คู่	25	18
5) ปาท่องโก๋ 2 คู่	50	36
6) ปาท่องโก๋ 1 ชิ้นกลม	25	18
7) แยมโรล 1 ชิ้น	-	18
8) แยมโรล 2 ชิ้น	-	36
9) คุกกี้ 2 ชิ้น	15	18
10) คุกกี้ 4 ชิ้น	30	36
11) แซนดิวิช, แยม 1 ชิ้น	-	18
12) แซนดิวิช, แยม 2 ชิ้น	-	36
13) บัตเตอร์เค้ก 1 ชิ้น	-	18
14) บราวนี่ 1 ชิ้น (2x2 นิ้ว)	-	18
15) ขนมปังไส้ช็อคโกแลต 1 ชิ้น	-	36
16) ขนมปังไส้หมูหยอง 1 ชิ้น	-	36
17) ขนมปังไส้เผือก 1 ชิ้น	-	36
18) เค้กกล้วยหอม 1 ชิ้น	-	27
19) เค้กช็อกโกแลต 1 ชิ้น	-	36
20) โดนัทพอนเดอร์ริง 1 ชิ้น	-	36
21) โดนัทเคลือบน้ำตาล 1 ชิ้น	-	36
22) พายสับปะรด 1 ชิ้น	-	54
23) วาฟเฟิล 1 ชิ้น (4x5 นิ้ว)	-	18

## 7. กลุ่มขนมหวานอื่นๆ 28 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
24) ไอศกรีม 1/2 ถ้วยตวง	-	18
25) ไอศกรีม 1 ถ้วยตวง	-	36
26) ไอศกรีม 1 1/2 ถ้วยตวง	-	54
27) แยมผลไม้ 1 ช้อนโต๊ะ	-	15
28) น้ำตาลทราย 1 ช้อนโต๊ะ	-	15

## 8. กลุ่มเนื้อสัตว์ 21 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) น่องไก่ติดหนัง 1 ชิ้น	45	0
2) เนื้อไก่สุก 2 ช้อนโต๊ะ	30	0
3) เนื้อไก่ (ไม่ติดมัน) 1 ชิ้น	30	0
4) เนื้อหมูสุก 1 ชิ้น	30	0
5) หมูเนื้อแดงสุก 2 ช้อนโต๊ะ	30	0
6) หมูปอดติดมัน 6 ก้อน	30	0
7) ตับหมู 6-7 ชิ้น	30	0
8) ลูกชิ้นหมู 6 ลูก	-	0
9) หมูหยอง 1/2 ถ้วยตวง	15	5
10) ปลาหนึ่ง 1 ตัวขนาดกลาง	60	0
11) ปลานึ่ง 1 ชิ้น	30	0
12) ไช้ไก่ 1 ฟอง	-	0
13) ไช้ต้ม 1 ฟอง	-	0
14) ไช้ขาวต้ม 2 ฟอง	-	0

## 8. กลุ่มเนื้อสัตว์ 21 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
15) เต้าหู้เหลือง, แข็ง 1/2 แผ่น	65	0
16) เต้าหู้ขาว, อ่อน 3/4 หลอด	100	0
17) หอยลายสุก 15 ตัว	30	0
18) หอยแครงสุก 15 ตัว	30	0
19) กุ้ง 8 ตัว	30	0
20) ปลาหมึกสุก 2 ชิ้นโต๊ะ	30	0
21) ไส้กรอก 1 แท่ง	30	0

## 9. กลุ่มไขมัน 7 รายการ

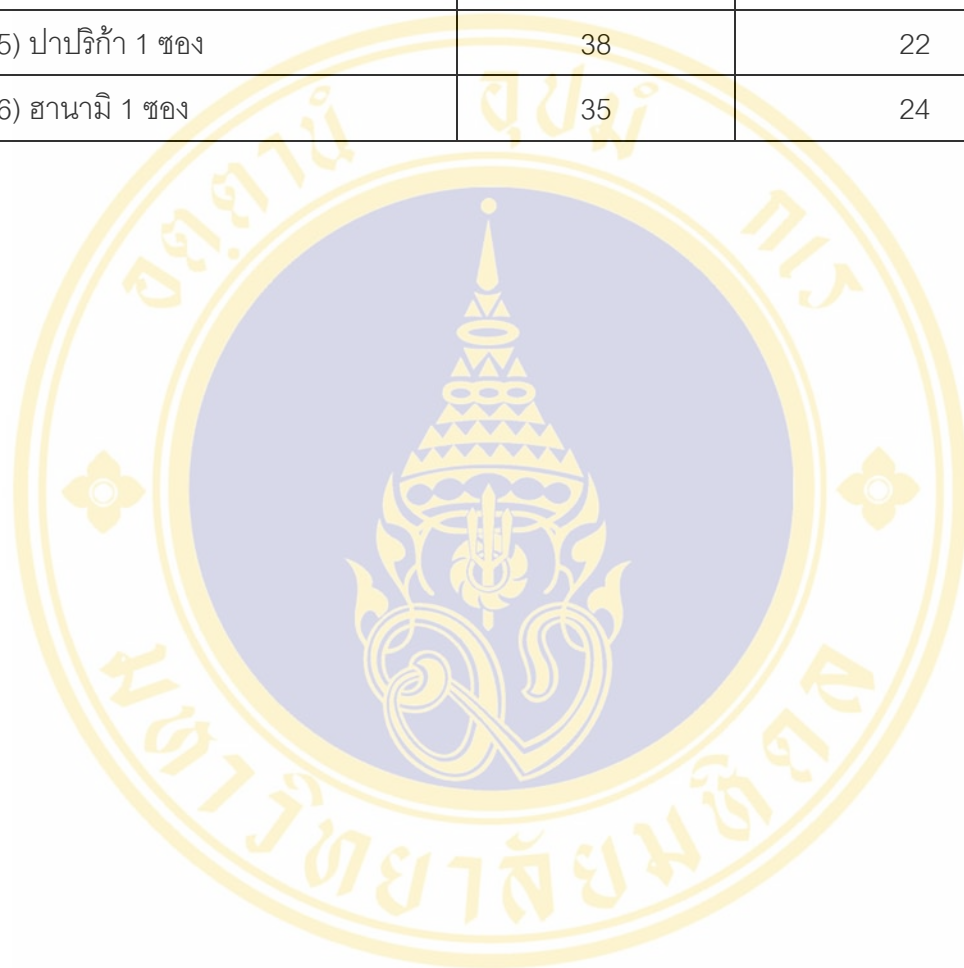
รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) น้ำมันพืช 1 ช้อนชา	-	0
2) มายองเนส 1 ช้อนชา	-	0
3) สลัดน้ำใส 1 ช้อนโต๊ะ	-	0
4) กะทิ 1 ช้อนโต๊ะ	-	0
5) เมล็ดดอกทานตะวัน 2 ช้อนโต๊ะ	-	0
6) เมล็ดพื้กทอง 2 ช้อนโต๊ะ	-	0
7) เมล็ดมะม่วงหิมพานต์ 10 เมล็ด	-	0

## 10. กลุ่มนม และอาหารสำเร็จรูป 26 รายการ

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
1) นมขาดมันเนย (เมจิ) 1 ขวด	220 ซีซี	12.4
2) นมพร่องมันเนย 1 แก้ว	240 ซีซี	12
3) นมพร่องมันเนย 1 ขวด	200 ซีซี	12
4) นมพร่องมันเนย Calcimex 1 กล่อง	220 ซีซี	21
5) นมพร่องมันเนย Foremost 1 กล่อง	250 ซีซี	13
6) นมไขมันต่ำ แคลเซียมสูง 1 ขวด	200 ซีซี	12
7) นมไขมันครบส่วน 1 กล่อง	200 ซีซี	13
8) นมถั่วเหลืองวี-ชอย 1 กล่อง	230 ซีซี	14
9) แลคตาชอย 1 กล่อง	300 ซีซี	32
10) โยวาลติน 1 กล่อง	200 ซีซี	30
11) โยเกิร์ต รสธรรมชาติ 1 ถ้วย	150	16
12) โยเกิร์ตผสมธัญญาหาร 1 ถ้วย	150	39
13) โยเกิร์ตผสมวุ้นมะพร้าว 1 ถ้วย	140	9
14) โยเกิร์ต รสสตอเบอร์รี่ 1 ถ้วย	150	26
15) นมเปรี้ยววอดซ์มิลล์ 1 ขวด	120 ซีซี	19
16) น้ำแอปเปิ้ล ตราทิปโก้ 1 กล่อง	200 ซีซี	26
17) น้ำองุ่นแดง ตราทิปโก้ 1 กล่อง	200 ซีซี	29
18) น้ำผักผลไม้รวมผสมปีทรุท 1 กล่อง	200 ซีซี	19
19) ชาเขียว รสมะนาว 1 กล่อง	250 ซีซี	43
20) Pepsi Max 1 กระป๋อง	325 ซีซี	0
21) Coca Cola Light 1 กระป๋อง	325 ซีซี	0
22) บ๊อคกี รสนม 1 กล่อง	27.5	19
23) ปลาสดวอร์ด ตราทาโร 1 ซอง	42	22

## 10. กลุ่มนม และอาหารสำเร็จรูป 26 รายการ (ต่อ)

รายการอาหาร	น้ำหนักอาหาร (กรัม)	ปริมาณคาร์โบไฮเดรต (กรัม)
24) คอนเน่ 1 ซอง	30	17
25) ปาปริก้า 1 ซอง	38	22
26) ฮานามิ 1 ซอง	35	24



## APPENDIX I

รายนามผู้เชี่ยวชาญในการตรวจสอบคุณภาพของเครื่องมือ

- 1) อ. ดร. สุนาฏ เตชางาม
- 2) อ. ดร. ชนิตา ปโชติการ
- 3) ผศ. ดร. วงสวาท โกศลวัฒน์
- 4) รศ. ดร. ประไพศรี ศิริจักรวาล
- 5) อ. ธรรมวิทย์ สุวรรณพฤษ



**BIOGRAPHY**

<b>NAME</b>	Miss Chintana Chaturawit
<b>DATE OF BIRTH</b>	22 June 1979
<b>PLACE OF BIRTH</b>	Pattani, Thailand
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