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Bachelor Thesis in Ecotrophology

Study on comprehension and practicability of a new meal-planning tool for patients with diabetes in Vietnam

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Abstract

Background: Due to the dramatic increase of diabetes mellitus in Vietnamese population for the past few years, a new dietary instrument for management of blood glucose based on the concept of GL has been developed, called “Glycemic Load counting and Meal planning”.

Objective: In the present study, three aspects of the newly developed method were assessed through the view of doctors and nutritionists, namely the comprehension, practicability and design and illustration.

Design: Sixteen participants, including doctors and nutritionists, were requested to read through the guide book “Glycemic Load couting and Meal planning” and then answer the questionnaires. The research was conducted within three weeks.

Result: Of sixteen participants, thirteen replies were returned (Response rate = 80%). In general, respondents were satisfied with the book with the average score of 3.85 (SD = 0.18) for comprehension, 3.50 (SD = 0.48) for practicability and 3.85 (SD = 0.34) for design and illustration. Between two occupations, there were significant differences in responses (Mann-Whitney’s U Test: W = 72, Z = -1.99, p = 0.04 and r = 0.47), particularly in the calculation of daily energy goal, the ability to build up diet based on the book and the choice of language.

Conclusion: Overall, the guide book “Glycemic Load Counting and Meal Planning” is well prepared and considered a useful dietary instrument. However, due to certain limitations in content and presentation, the concept is not yet suitable for widely application in population for the time being. From the angle of our experts in this field, several improvements and further researches should be made before this method can be published.

Table of Contents

List of Abbreviations

GI	Glycemic index
GL	Glycemic load
LGI – HF diet	Low glycemic index, high fiber diet
HGI – LF diet	High glycelic index, low fiber diet
Plasma FFA	Plasma free fatty acid
RR	Rate ratio
IAUC	Incremental area under the glucose response curve
AUC	Area under the glucose response curve
SD	Standard Derivation

List of Figures

List of Tables

1. Introduction

Worldwide, chronic diseases such as cardiovascular disease, stroke, cancer, chronic respiratory disease, and diabetes are by far the leading cause of mortality in the world; contribute to about 63% of all deaths[1]. Among them, diabetes mellitus poses an immeasurable threat not only to global health and health care structures but also a large economic burden on the individual and national healthcare system and economy[2,3].

In Vietnam the impact of diabetes has already shows some concerns. Experts estimate that there are at least 2 million people living with diabetes, though approximately 60% of these remain undiagnosed or unaware of their condition. Within twenty years diabetes' prevalence has dramatically grown, from about 1 - 2% in 1992 to almost 6% of the population in 2012; and is related to the death of more than 52,000 people in 2012[4]. Changing dietary and lifestyle habits to that of high fat and sugar rich foods, as well as less physical activities are some of the major contributors to this rapid and very alarming increase.

Considering the human and economic burden of diabetes, it would be important to emphasize nutritional therapy for diabetic patients. Among the many factors of this chronic disease, habitual diet is the major modifiable risk factor. It is simplest to identify, and the most cost-effective strategy for prevention and management of this disease. For that reason, a new meal-planning tool for diabetic patients, inspired by the concept of GL and North American[5] was developed last year at Nhan Dan Gia Dinh Hospital, in form of a guide book for patients. It is called "Glycemic Load Counting and Meal Planning" [6] and its primary goal for individuals with diabetes mellitus is to optimize their metabolic control through dietary choices that are attainable and sustainable within the

[1] WHO (2012) *World health statistics 2012.*
[2] IDF (2009) *The Economic Impact of Diabetes*
[3] IDF (2012) *IDF Diabetes Atlas. 5th Edition*
[4] WHO (2012) *Managing the burden of diabetes in Vietnam*
[5] American Diabetes Association and American Dietetic Association (2008) Choose your foods: Exchange list for diabetes.
[6] Ta TTM (2012) *Glycemic load counting and meal planning.*

Vietnamese culture, as well as offering customization for personal preferences and abilities of the patients themselves.

The knowledge which the method is built on, however, is rather new and not really popular within the Vietnamese population. Therefore it remains as a question, "Can this method can be adopted, understood, and applied by Vietnamese diabetic patients?". In the present study, I would like to assess two aspects: comprehension and practicability of this new method from the view of our doctors and nutritionists. Through that, an overall evaluation about this meal-planning tool can be obtain, and then the appropriateness of this book for public usage can be decide.

2. Theory

2.1 Effect of GI and GL on diabetes mellitus and other chronic diseases

Nutrition plays an essential role in controlling metabolic abnormalities, and is often described as the cornerstone of the clinical management of both type 1 and type 2 diabetes mellitus. For diabetic patients, it is crucial to achieve and maintain their blood glucose at safe level in order to prevent both acute (hyperglycemia, hypoglycemia) and long-term (rentonopathy, nephropathy, neuropathy and cardiovascular diseases) complications without negative effect on the quality of life[7]. Several attempts have been made to control the glycemic response to food, particularly to foods containing high carbohydrate. Among them, the concept of GI and GL are considered as useful instruments to manage the blood glucose concentration and reduce the risk of diabetes.

The clinical usefulness of GI and GL are clearly visible on diabetic patients, in whom the beneficial effects of low-GI, high fiber diets (LGI-HF) are observed in both short-term and long-term treatments. In their study, Giacco et al. [8] have shown that in patients with type 1 diabetes, an increased consumption of foods with low GI and high fiber content has a long-term positive effect on blood glucose. In fact, a LGI-HF diet produce a lower and more stable blood glucose level than a diet containing high GI and low-fiber foods (Figure 1) because dietary fiber, which is most found in legumes, vegetables, and fruits, as well as in whole-wheat cereals, reduce the absorption rate of glucose and fat from the small intestine, and thus lower postprandial glucose and insulin response. Along with the improvement in blood glucose control, LGI-HF diet also presents a sharp reduction in the rate of hypoglycemic event. Compared to the high-GI and low fiber diet (HGI-LF), this type of diet reduces the number of events significantly (0.73 ± 0.7 vs. 1.5 ± 1.2 events per patient) .

[7] Canadian Diabetes Assosication (2003) *Clinical practice guidelines for the prevention and manangement of diabetes in Canada*.
[8] Giacco R et al. (2000) *Long-term dietary treatment with increased amounts of fiber-rich low glycemic index natural foods improves blood glucose control and reduces the number of hypoglycemic events in type 1 diabetic patients.*

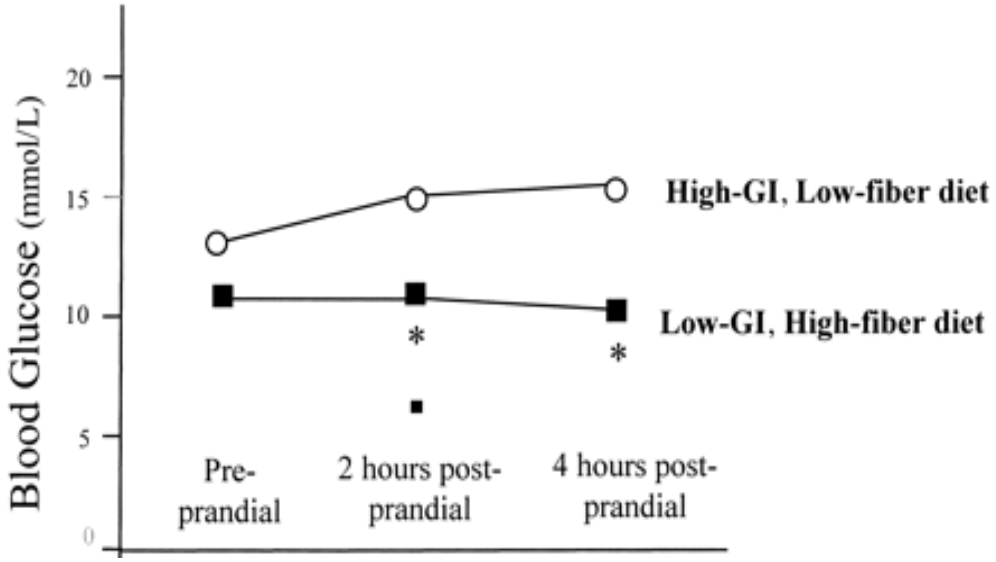

FIGURE 1: Postprandial blood glucose concentrations in patients with type 1 diabetes treated with a low glycemic index (GI), high-fiber diet or with a high-GI, low-fiber diet (a long-term, 24-wk, randomized controlled study; *n* = 63 patients).

Similar results have also been found in patients with type 2 diabetes, in whom this type of diet have consistently shown beneficial effects not only on management of blood glucose, but also on lipid metabolism, including plasma FFAs, total and LDL cholesterol, and PAI $_{-1}$ levels, as well as the insulin sensitivity (Table 1 and Table 2). [9]

[9] Rizkalla S et al. (2004) *Improved plasma glucose control, whole-body glucose utilization, and lipid profile on a low glycemic index in type 2 diabetic men*

	HGI diet			LGI diet	
		Baseline*	4 weeks*	Baseline*	4 weeks*
Glycemia (mmol/l)					
Fasting (0 min)	9.4 ± 0.5	9.8 ± 0.6	10.1 ± 0.8†	9.19 ± 0.7‡§‖**	
Morning peak (60–0 min)	4.2 ± 0.3†	3.7 ± 0.3†	2.8 ± 0.3‡	3.3 ± 0.5‡‖	
AUC (mmol · l^{-1} · 8 h^{-1})	527 ± 57†	520 ± 61†	358 ± 90‡	274 ± 32‡‖	
Insulinemia (pmol/l)					
Fasting (0 min)	113 ± 11	125 ± 16	111 ± 19	123 ± 22	
Morning peak (60–0 min)	142 ± 15	171 ± 19	126 ± 25	149 ± 27	
AUC/10^2 (pmol · l^{-1} · 8 h^{-1})	845 ± 10†	754 ± 27	646 ± 36‡	618 ± 65‖	
HbA_{1c} (%)	7.45 ± 0.35	7.57 ± 0.35†	7.56 ± 0.36†	7.17 ± 0.39‡§‖**	

TABLE 1: Plasma glucose, insulin and HbA_{1c} values during the metabolic day profile before (baseline) and after 4 weeks of HGI or LGI diets.

	HGI diet			LGI diet	
		Baseline*	4 weeks*	Baseline*	4 weeks*
Total cholesterol (mmol/l)	4.79 ± 0.24	4.90 ± 0.20	5.33 ± 0.43†	4.46 ± 0.29‡§‖**	
LDL cholesterol (mmol/l)	2.89 ± 0.26	3.03 ± 0.21	3.46 ± 0.44†	2.63 ± 0.26‡§‖**	
HDL cholesterol (mmol/l)	1.22 ± 0.13	1.28 ± 0.13	1.32 ± 0.11†	1.29 ± 0.11	
Triacylglycerols (mmol/l)	1.51 ± 0.0.26	1.32 ± 0.19	1.24 ± 0.20	1.21 ± 0.19	
FFA (mmol/l)	1.30 ± 0.25	1.47 ± 0.26†	1.21 ± 0.19	1.02 ± 0.18‡§‖**	
Apolipoprotein B (g/l)	1.04 ± 0.06	1.05 ± 0.06	1.07 ± 0.07†	1.01 ± 0.06††‡§**	
Total fat mass (kg)	24.9 ± 2.4	25.5 ± 2.6	26.3 ± 3.1	25.5 ± 2.7	
Lean mass (kg)	65.3 ± 0.9	63.8 ± 0.9	63.7 ± 1.1	63.9 ± 0.9	
PAI-1 activity	23.4 ± 5.2	24.6 ± 5.3	25.6 ± 3.8†	15.8 ± 1.8‡§‖**	

TABLE 2: Fasting plasma lipid and lipoprotein concentration, total fat and lean body mass measured by DEXA, and plasma PAI_{-1} at baseline and after 4 weeks of HGI or LGI diets.

In addition to a role in the treatment of diabetes, low GI and GL diets have recently been recommended for the prevention of other chronic diseases, including cancer, gallbladder, and heart diseases. The best evidence is presented in a meta-analysis of 37 prospective observational studies[10], whereas a significant association between overall GI and GL dietary with the risk of chronic diseases has been revealed. The study indicates that a carbohydrate-rich diet, independently of the fiber intake, can have detrimental effects on glycemic control, which plays a major role in the development of coronary disease and other complication. Overall, the rate ratios (RR) of the highest with the lowest quartile for developing chronic disease because of increasing GI or GL is about (GI RR = 1.14; GL RR = 1.09), but more emphasized for type 2 diabetes (GI RR = 1.40; GL RR = 1.27), cardiovascular disease (GI RR = 1.25) and gallbladder disease (GI RR = 1.26; GL RR = 1.41) (Table 3).

Chronic disease	GI rate ratio	P	GL rate ration	P
Type 2 diabetes	1.4 (1.23,1.59)	<0.0001	1.27 (1.12, 1.45)	<0.0001
Heart disease	1.25 (1.00, 1.56)	0.050	1.57 (0.87, 2.84)	0.140
Stroke	1.02b(0.86, 1.21)	0.805	1.28 (0.83, 1.98)	0.270
Breast cancer	1.09 (1.02, 1.16)	0.015	0.99 (0.92, 1.06)	0.797
Colorectal cancer	1.11 (0.99, 1.24)	0.059	1.11 (0.88, 1.40)	0.385
Pancreatic cancer	0.98 (0.78, 1.25)	0.896	0.96 (0.75, 1.23)	0.733
Endometrial cancer	1.13 (0.80, 1.60)	0.489	1.72 (0.75, 3.95)	0.204
Gastric cancer	0.77 (0.46, 1.29)	0.320	0.76 (0.46, 1.25)	0.282
Gallbladder disease	1.26 (1.13, 1.40)	<0.0001	1.41 (1.25, 1.60)	<0.0001
Eye disease	1.10 (0.91, 1.31)	0.323	0.96 (0.82, 1.12)	0.590
All diseases	1.14 (1.09, 1.19)	<0.0001	1.09 (1.04, 1.15)	<0.0001

TABLE 3: Rate ratios (and 95% CIs) for the comparison of the highest with the lowest quartile for developing chronic disease because of increasing glycemic index or glycemic load in 37 prospective

[10] Brand-Miller JC et al. (2008) *Glycemic index, glycemic load, and chronic disease risk – a meta-analysis of observational studies.*

cohort studies meeting a priori exclusion criteria (correlation between food-frequency questionnaire and weighted food records/24-h dietary recall > 0.5 in representative group).

As result, low GI and GL diets are independently associated with a recession of these diseases. These findings also indicate that the protection offered by low GI and GL diets is similar or higher than those seen for whole grains or fiber on the risk of type 2 diabetes and coronary heart disease, namely 20 – 30% reduction in risk of diabetes[11] and 20 – 40% reduction in risk of heart disease[12].

According to these studies, evidences of the chronic utility of low GI and GL diet were provided and the capacity of this type of diets in improvement of glucose- and lipid metabolism was clearly demonstrated. Furthermore, in type 2 diabetes, the beneficial effects of this type of diet on other diabetes related diseases such as cardiovascular risks, cancer, etc. are clearly visible. Therefore, for the time being, the concept of GI and GL has proven to be an appropriate nutritional concept for the maintenances of health and widely recognized as a reliable, physiologically based classification of foods according to their postprandial glycemic response.

2.2 The role of glycemic index in food choice

Definition of glycemic index (GI)

In the early 1980s, the first glycemic index (GI) concept was published by Jenkins et al[13] as a ranking system for carbohydrates based on their immediate effect on blood glucose level. Originally, GI was designed for diabetic patients as a guide to food selection, which gives advice to select foods with a low GI[14], due to their relatively low glycemic response following ingestion compared with high GI foods. Gram per gram, foods with low GI produced a lower peak in postprandial blood glucose and smaller overall blood sugar impact during the first two hours after eating than do foods with carbohydrate. Therefore, GI is used to estimate a person's blood glucose raising

[11] Venn BJ et al. (2004) *Cereal grains, legumes and diabetes.*
[12] Clifton P (2007) *Glycemic load and cardiovascular risk.*
[13] Jenkins DJ et al. (1981). *Glycemic index of foods: a physiological basis for carbohydrate exchange.*
[14] Jenkins DJ et al. (1983). *The glycemic index of foods tested in diabetic patients: a new basis for carbohydrate exchange favouring the use of legumes.*

potential of each gram of available carbohydrate (total carbohydrate minus fiber) in a particular food following its consumption.

In the Report on Carbohydrates in Human Nutrition in 1998, FAO/WHO defined GI as "*the incremental area under the blood glucose response curve of a 50g carbohydrate portion of a test food expressed as a percent of the response to the same amount of carbohydrate from a standard food taken by the same subject*"[15]. It means GI is determined by giving test subjects reference foods (either white bread or glucose), which contain 50 g of available carbohydrate in a portion of food. Then, their blood samples over 2 hours are collected and analyzed to obtain blood glucose concentrations, and the incremental area under the glucose response curve (IAUC) is calculated for each test and reference food. Hence, GI is defined as the ratio of IAUC of test food and reference food.

Since then, it has become the standard and validated method: use glucose, included a glycemic index value of 100 by definition as reference to determine which GIs for all other foods. With this method, hundreds of foods have been tested for GI with the purpose of ranking foods within and between food categories, and they are commonly understood as followed:

- Low GI food: GI < 55. For example: Orange (South Africa) with GI = 33
- Medium GI food: 56 < GI < 69. For example: Banana (Canada) with GI = 66
- High GI food: GI > 70. For example: Watermelon (Australia) with GI = 80[16].

Low GI foods are recommended for diabetic patients or for those who try to lose or maintain optimum weight as these foods will release glucose more slowly and steadily, which leads to more stable blood glucose reading after meals. However, it is also important to note that some foods generally considered to be unhealthy can have a low GI as well, for instance, chocolate cake (GI = 38), ice cream (GI = 37), or pure fructose (GI = 19)[17]. Furthermore, consumption of low GI foods before prolonged strenuous

[15] FAO (1998). *Carbohydrate in human nutrition.*
[16] J. Brand Miller et al. (2008); *International tables of glycemic index and glycemic load values: 2008*

exercise were found to increase endurance time and provided higher concentration of plasma fuels toward the end of exercise[17].

On the contrary, high GI foods would cause more rapid rises in blood sugar and lead to faster replenishment of muscle glycogen, and thus more suited for people who need energy recovery after exercises, in extreme labor condition or for someone experiencing hypoglycemia[18].

Practical application of the glycemic index

For the present, the concept of GI would seem like a proper mean of identifying the most carbohydrate containing foods and has been acknowledged as a useful tool to guide food choices. Many modern diets rely on this concept and achieved particular success, including the popular South Beach Diet[19] and the Nutrisystem Diet[20]. Moreover, the GI is also useful to rank foods in development of food exchange list, for instance, a list of categories of low GI food like vegetables, legumes, etc., or classification of food in an exchange list for an ethnic group or a country. Specific local foods should also be included in such list where information is available (e.g. specific rice varieties or vegetables in South East Asia).

Limitations of glycemic index

Although GI has been widely advocated as a means of identifying foods that might protect against disease or be useful in disease management, there are some limitations with exercising food choices based on GI.

First of all, for detailed application of the GI, a value of the GI for every food in the diet or meal needs to have been assigned. However, the values of many foods are still missing, especially for local or specific species of food, because the estimation of GI value required human subjects, and is both relatively expensive and time consuming.

[17] Thomas DE et al. (1991); *Carbohydrates feeding before exercise: effect of glycemic index*
[18] Burke LM et al. (1993) *Muscle glycogen storage after prolonged exercise: effect of the glycemic index of carbohydrates feedings.*
[19] Agatston A et al. (2003) *The South Beach Diet: The Delicious, Doctor-Designed, Foolproof plan for fast and healthy weitght loss.*
[20] Nutrisystem (2013) *Diabtes plan.*

Furthermore, the accuracy of the calculation depends upon the accuracy of the GI values ascribed to foods, which may vary from place to place due to local factors such as variety, cooking, processing, etc. Foods particularly prone to such variation include rice, potatoes and bananas.

On the other hand, in most societies, single foods are rarely eaten alone but rather incorporated into meals as dishes, particularly cereal such as rice, bread or pasta etc. But several studies[21,22] has claimed that aggregating the GIs of individual of components is impossible to predict the GI of the whole meal, due to the effect of the fat and protein content of the meal. Henry et al.[22] pointed out in his study that the blood glucose effect of the whole meal raise to varying levels, based on the type of carbohydrate foods and the topping/filling foods (Figure 2).

By coingestion of both fat and protein, the impact on blood glucose level is reduced significantly. It has been suggested that fat lowers the postprandial glucose response by increasing the osmolality of the stomach and thus delaying the rate of gastric emptying[23]. On the other hand, the addition of protein to a carbohydrate food increases the amount of insulin secreted, and therefore lead to reduction of the blood glucose effect[24]. However, there might be other mechanisms that are involved in this complex process[25]. Bornet et al. [26] also assumed that protein may create a protective network around the carbohydrate molecule and prevent the influence of glycolytic enzymes.

[21] Flint A et al. (2004) *The use of glycemic index tables to predict glycemic index of composite breakfast meals.*
[22] Henry CJ et al. (2006) The addition of toppings/fillings on the glycemic response to commonly consumed carbohydrate foods.
[23] Ebbeling CB, Ludwig DS (2001) **)**. *Treating obesity in youth: should dietary glycaemic load be a consideration?*
[24] Gulliford MC et al. (1989) *Differential effect of protein and fat ingestion on blood glucose responses to high-and low-glycemic-index carbohydrates in noninsulin- dependent diabetic subjects*.
[25] Normand S *et al*. (2001*) Influence of dietary fat on postprandial glucose metabolism (exogenous and endogenous) using intrinsically ^{13}C-enriched durum wheat.*
[26] Bornet FR *et al*. (1987) *Insulinemic and glycemic indexes of six starch-rich foods taken alone and in a mixed meal by type 2 diabetics.*

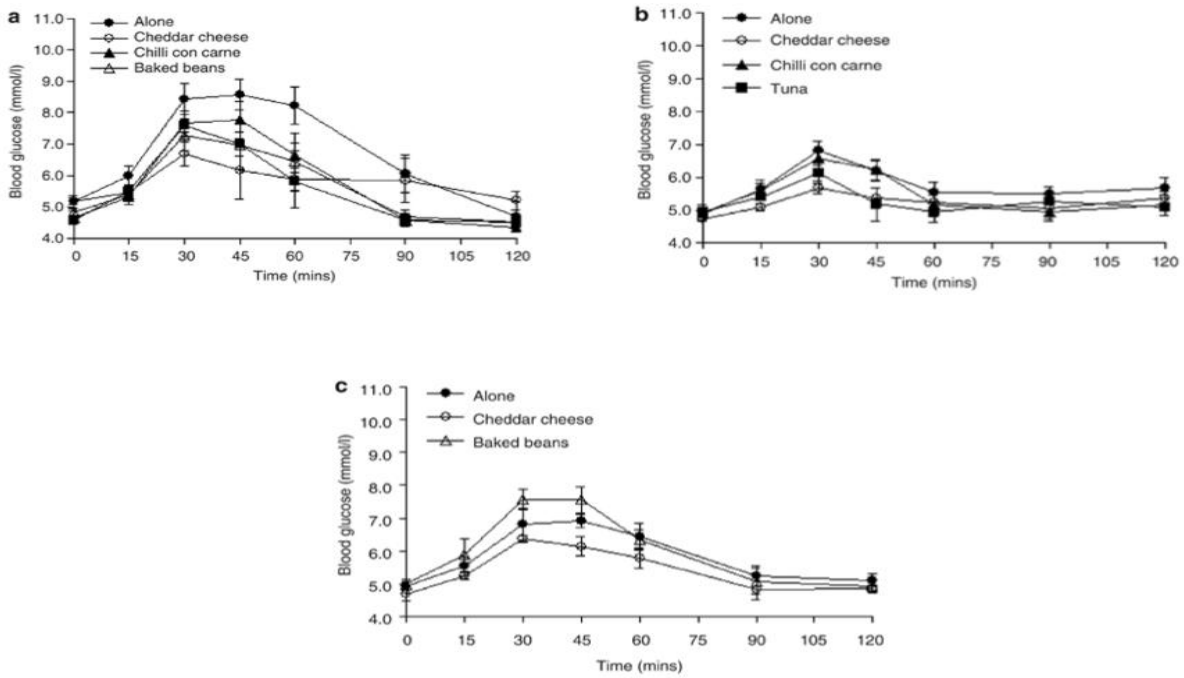

FIGURE 2: Glycemic response curves for the potato-based meal (a), pasta-based meal (b) and toast based meal (c). Values are the mean for 10 subjects with their s.e. represented by vertical bars.

Additionally, the concept of GI should not be used in isolation, but should be interpreted in relation to other food characteristics, such as energy content, amount of other macro- and micro nutrients and dietary fiber. Otherwise, we can easily end up over-consuming fat and calories, because foods that generally considered being unhealthy can have a low GI, for instance, chocolate cake (GI = 38), ice cream (GI = 37)[17], but they may be energy dense and contain substantial amounts of sugars or undesirable fatty acids that contribute to reduce glycemic effect but not necessarily to good health outcomes.

Finally, the GI concept can in principle be used to categorize foods containing carbohydrates and is meaningful when comparing foods within group, for example breads, fruits, and different types of whole grains group. However, both the quality and quantity of carbohydrate of a food influence the glycemic response. By definition, the GI compares equal quantities of carbohydrate and provides only a measure of carbohydrate quality but not quantity. Because of this reason, GI seems to be

inconvenient and hard for people with diabetes to utilize, and this leads to the Glycemic Load (GL) discussion below.

2.3 The role of glycemic load in food choice

Definition of Glycemic Load (GL)

In 1997, the concept of Glycemic Load (GL) was first introduced by Dr. Willett and associates at the Harvard School of Public Health to represents the combination of quality as well as the quantity of carbohydrate in a portion of food[27,28]. It is a mathematical product of GI and takes into account how much carbohydrate a serving of food contains, as well as how great each gram of carbohydrate in the food will affect the blood glucose level. Approximately, one unit of GL can have the same effect of consuming one gram glucose, and the higher the GL, the greater the expected elevation in blood glucose.

Generally, when food is consumed within a typical serving size, GL can be define indirectly by multiplying the amount of carbohydrate contained in a specified serving size of the food by the GI value of that food (with the use of glucose as the reference food), which was then divided by 100[29].

GL = (Grams of available carbohydrate in the food x GI of the food) / 100

By using the above method, the GL values of many foods were determined and are usually classified as followed, when food is consumed over a range of usual intakes.

- GL of 10 or less is considered low. For example: Watermelon (Australia) with GL = 5, for one typical serving of 120g.
- GL between 11 and 19 is considered medium. For example: Banana (Canada) with GL = 16, for one typical serving size of 120g.

[27] Salmeron J et al. (1997) *Dietary fiber, glycemic load, and risk of NIDDM in men*.
[28] Salmeron J et al. (1997) *Dietary fiber, glycemic load, and risk of NIDDM in women*.
[29] Venn BJ et al. (2006) *The glycemic load estimated from the glycemic index does not differ greatly from that measured using a standard curve in healthy volunteers.*

- GL greater than 20 is considered high. For example: Raisins (Canada) with GL = 28, for one typical serving size of 60g.[16]

The relationship between GI and GL is not straightforward. A high GI food can have a low GL if eaten in small quantities, e.g. Watermelon (GI = 80); a high GI food has the same GL as a serving size of high fat ice cream (GI = 37), a low GI food. Conversely, a low GI food can have a high GL, when a bigger portion is consumed, e.g. GI value of mashed potato (GI = 71) may be contrasted with macaroni, a lower GI food (GI = 34). By same serving size of 150g, mashed potato (GL = 14) has a lower GL than macaroni (GL =18). According to *International tables of glycemic index and glycemic load values*[16], most of foods that have low GLs also have a low GL for a normal serving size, while foods with intermediate or high GLs can have a range from very low to very high, dependent upon the amount consumed.

Practicability of glycemic load compare to glycemic index.

In contrast to GI, GL is directly proportional to the amount of particular food eaten. At first, this statement seems counterintuitive. Brand-Miller et al. [30] have shown in their study that GL is not directly proportional to the amount of the particular food eaten. In fact, the rate of increase in AUC even declines, as the amount of food increased. For example, eating six servings of bread results in an approximately threefold increase in AUC. However daily usage refers to realistic proportion size of foods, and there are no great differences between the estimate using GI and the direct GL-measurement, as long as food is consumed in a typical portion size[29] (Figure 3)

[30] Brand-Miller JC et al. (2003c). *Physiological validation of the concept of glycemic load in lean young adults.*

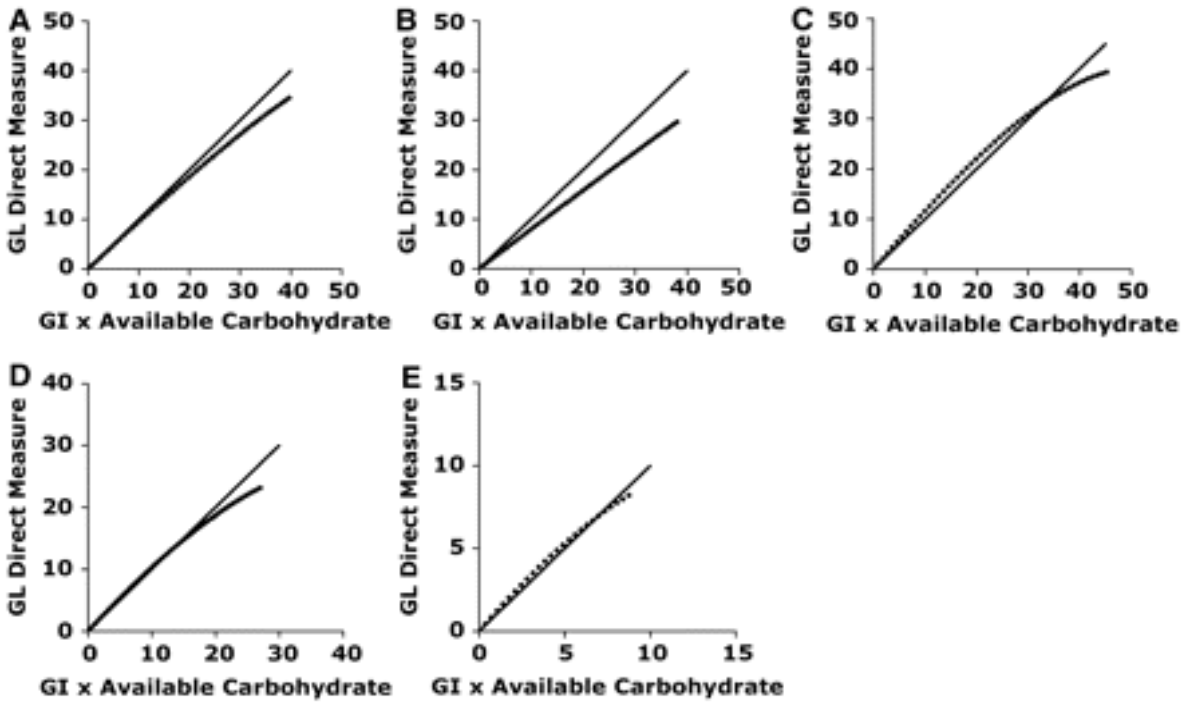

FIGURE 3: Comparison of mean GL (dashed line, *n* = 20) obtained using the direct measure and calculated from GI x available carbohydrate in increments of 1g up to 50g for white bread (A), fruit bread (B), potato (C), granola bar (D), and up to 25g for chickpeas (E). The solid straight line is the line of equivalence.

For this reason, it is appropriate to accept that GL is linearly related to the amount of the food eaten, and hence GL can be applied not only for one serving of a food, but also for daily serving of a food, and even for an entire day's meals. The GL of an entire day's meal can be calculated by summing the GL for all foods containing carbohydrate consumed in the diet, which should be a total of 80g per day or less for people with diabetes.

Additionally, the GL concept allows people with diabetes to compare the likely glycemic effect of realistic portion size of different foods. Through that, it is easier for patients not only to make the right kind of food choices, but also to decide the proper amount of food throughout the day in order to keep their blood glucose at a certain level.

Limitations of the glycemic load

There are a few limitations to GL's use that should be taken into consideration, namely the scarcity of GL value and the individual difference in serving size. First, GL is the mathematical product of GI and the amount of food consumptions. As we have seen in the above discussion, the GI values of many foods are still unavailable or unreliable due to variety in species, in the way to prepare food and in the measurement. Consequently, the GL value of these foods can also not be estimated.

On the other hand, GL should be used cautiously because serving size of food is not similar in all situations. Due to differences in culture and ethnic between countries, the portion sizes vary markedly from country to country, in particular foods that belong to typical daily menu, for instance, rice is usually consumed as a main component in most of countries in Asia, while in Europe it is just occasionally eaten and usually consumed in small amount, and the same situation goes for white bread, pasta, etc. Furthermore, even between people in the same country, the serving size is not the same due to the difference in gender, age, height, weight, and activity level, as well as body condition of individual. Therefore, all these factors must be considered when it comes to the calculation of GL.

2.4 The method "Glycemic load counting and meal planning".

Objectivity

With the purpose of helping diabetic patients in Vietnam to manage their blood glucose and achieve better quality of life through practicing a healthy diet, a new method called "Glycemic load counting and meal planning"[6] was developed by utilizing the concept of GL and the Food Exchange System, as well as other nutritional indicators. Through this, patients will gain a new perspective about meal-planning and they will be able to create their own daily menu based on nutritional needs that fit their life styles and activity levels.

Concept

The basic principle of this dietary instrument is building a daily menu that fulfill the requirements of diabetic patients on energy, protein, fat, dietary fiber and micronutrient, while maintaining the amount of GL for an entire day by 80g or less. Cornerstone of this method is the concept of GL. Because of reasons that previously mentioned, GL present the glycemic response of realistic portion size of different foods, and can be determined for a daily menu by summing the GL of all components. Accordingly, a low GL diet could easily be achieved by choosing serving of foods with low GL such as legume, dairy or vegetable, and limit foods with high GL like sugar-added products.

It is important to note that attaining an optimum healthy diet for diabetic patients requires concerns not only on glycemic impact of foods eaten, but also on other nutritional indicators. Benefits of reduction in carbohydrate intake would be expected only in a context of no overload in calories, no increase in total or saturated fat intake, as well as meeting the requirements of individual patients on fibers (10 to 13g per 1000kcal) [31] and micronutrients[32]. In this concept, the calculation of calories needs were based on height, gender and activity level of patients by their ideal body weights, and the ratio between the nutrients is presented as followed (Figure 4).

[31] Marlett JA et al. (2002) *Position of the American Dietetic Association: health implications of dietary fiber.*
[32] Mooradian AD (1994) *Selected vitamins and minerals in diabetes.*

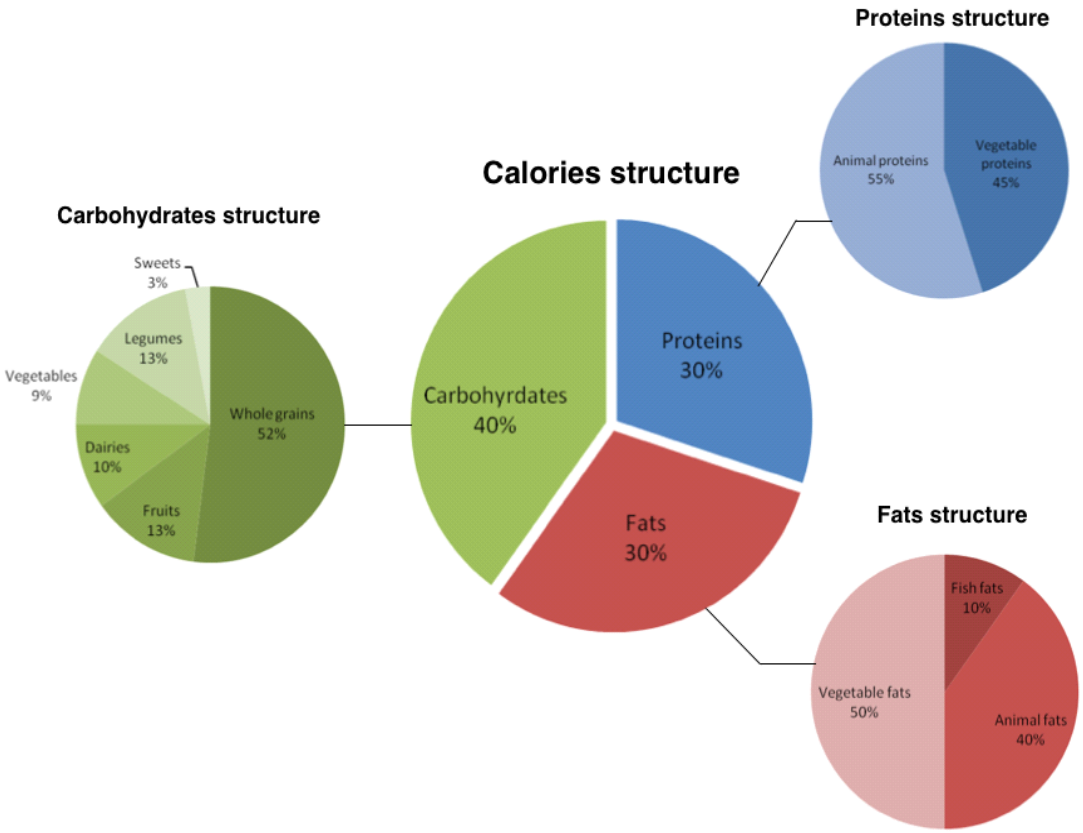

FIGURE 4: The structures of calories, proteins, fats and carbohydrates in the dietary instrument "Glycemic Load counting and Meal planning".

On the other hand, in order to simplify the meal planning, while controlling the GL limit of the diet, an Exchange List of Meal Planning for Vietnamese was created. Over 60 years ago, the American Dietetic Association, together with the American Diabetes Association and the US Public Health Services created the first edition of the Exchange List of Meal Planning[33]. Ever since, this meal-planning tool has proven to be useful, both to assess nutrient intake and to personalized meal plans for diabetic patients. However, the method was modified to adapt dietary choices of people in Vietnam, due to the difference in culture, preferences and capacities of the patients.

[33] Caso EK (1950) *Calculation of diabetic diets.*

Inspired by North America[5] , the Vietnamese exchange system was also divided into food groups: whole grains, vegetables, fruits, meat and substitutes, dairies, fat and finally sugar-added food. However, according to the Food Composition for East Asia[34], lentils, beans, and nuts, as well as fish and shellfish are widely consumed in the population; two more specific food groups were included in this version of the exchange system. Similar to other models, all groups contain nutritive values for one serving, including energy, carbohydrate, proteins, lipids, energy and micronutrient content. The amount of carbohydrate, however, was replaced with GL, enable user to know the exact GL of one serving of a food, and thus simplify the food choice. Additionally, due to a considerable intake of seasoning in cooking in Vietnam another food group for it was also added to this system to make it easier to use, which totaled ten food groups. Based on the daily calorie goal and distribution of nutrients in the diet, the servings in the ten food groups are allocated as in Table 4:

Foods (servings/day)										
Calorie goal	**Whole grains**	**Beans and Nuts**	**Vegetables**	**Fruits**	**Meat and Egg**	**Fish**	**Dairies**	**Sweets**	**Fats**	**Seasoning**
900	2	3	2	0.5	1	1	1	0.1	1	4
1000	2	3	2	0.5	1	1	1	0.1	1	4
1100	2	4	2	0.5	1	1	1	0.1	1	4
1200	2	4	3	1	1	2	1	0.1	2	3
1300	3	4	3	1	2	2	1	0.1	2	3
1400	3	5	3	1	2	2	1	0.1	2	3
1500	3	5	3	1	2	2	1	0.2	2	3
1600	3	5	4	1	2	2	1	0.2	2	3
1700	3	5	4	1	2	2	1	0.2	3	3
1800	3	6	4	1	2	2	2	0.2	3	3
1900	4	6	4	1	2	2	2	0.2	3	3
2000	4	6	4	1	2	3	2	0.2	3	2
2100	4	7	5	1	2	3	2	0.2	3	2
2200	4	7	5	1	3	3	2	0.2	3	2
2300	4	7	5	1	3	3	2	0.2	4	2
2400	5	8	5	1	3	3	2	0.2	4	2
2500	5	8	6	1	3	3	2	0.3	4	2
2600	5	8	6	1	3	3	2	0.3	4	2
2700	5	9	6	1	3	4	2	0.3	4	1
2800	5	9	6	1	3	4	2	0.3	5	1

[34] Leung WW et a.l. (1972) *Food composition table for use in East Asia.* Part 1.

TABLE 4: Listing of servings in the ten food groups based on calorie goals.

For measurement of foods, serving size was converted into kitchen tools, e.g. different kind of spoons, bowls and glasses, etc. like in the American system. But to make it more familiar with Vietnamese patients, some food kinds such as beans, lentils and nuts, as well as vegetables were also converted in cut, piece and palm portion size. For example: one serving of Black eye peas is 31g with a GL of 2,1g, can be exchanged to 3 soup spoons or 2 palm size portions[6].

Practicability and application issues

Although the method might be able to use as a tool for patients to exercise healthy diet, questions have been raised regarding the appropriateness of utilizing this dietary instrument in the population. In Vietnam, nutritional therapy as treatment of diabetes has only gotten more attention in the past few years. It was often put aside due to the lack of nutritional trainings in health care professionals. As a result, the concept of GI and GL are not widely distributed in the population, and in fact, it is still limited to selected circles of doctors, nutritionists, and a limited number of patients. Furthermore, many Vietnamese prefer and consume quite a bit of foods that are rich in carbohydrates; e.g. rice, fruits, sweets, etc., while the amount of these foods in this instrument is strongly limited. Hence it remains a question, whether this method can be adopted and applied by the patients. For these reasons, the below study was conducted to testify the comprehension and the practicability of the method, firstly from the view of our experts in this field.

3. Study design and methods

3.1 Study design

Sixteen participants were invited to take part in this crossover study. They accepted the invitation after hearing explanations about the purpose of the research, this group includes doctors and nutritionists from five different hospitals and institutes in Ho Chi Minh City. Within the sample, experiences on the concept of GL and GI were diverse from no experience, theoretical experience, to practical experience. Additionally, the approval of using the guide book: “Glycemic Load Counting and Meal Planning” for the study was obtained from the author, Dr. Ta Thi Tuyet Mai from Nhan Dan Gia Dinh Hospital, Ho Chi Minh City.

The study was planned for three weeks and divided in to two stages. At the beginning of the research, each participant received an exemplar of the guide book, and was given two weeks to read through this book. After that, a survey, including questions about the comprehension, illustration and design, as well as practicability of the new meal-planning instrument was sent to each of them (see Appendix), and each subject was asked to answer the questions individually. Both the evaluations and the books were written in Vietnamese. Finally after one week, the surveys were collected and analyzed. The responses were coded as followed: 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = fully agree.

3.2 Statistical analysis

All statistical analysis was performed using R version 2.15.3, System for Window (The R Project for Statistical Computing, Vienna, Austria). The main factors regarded in the analysis were the agreement and satisfaction of doctors and nutritionists with the book. The differences in responses of the two groups were compared by a non-parametric Mann-Whitney U Test (also called Wilcoxon rank-sum test or Wilcoxon-Mann-Whitney test). Results were expressed as mean and standard deviation, W and Z- values for Mann-Whitney U Test, and considered significant when p values < 0.05.

3.3 Results

Of sixteen doctors and nutritionists, thirteen replies were sent back after three weeks. Three other did not return due to unknown reasons. The rate of response was about 80% and responses of the participants were presented in Table 4 and 5, respectively.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Fully agree	Response average	SD
Comprehension						**3.85**	**0.18**
1. Definition GI	0% (0)	0% (0)	8% (1)	**77% (10)**	15% (2)	4.08	0.49
2. Definition GL	0% (0)	8% (1)	31% (4)	**38% (5)**	23% (3)	3.77	0.93
3. Difference GI/GL	0% (0)	0% (0)	23% (3)	**54% (7)**	23% (3)	4.00	0.71
4. Calorie goal	0% (0)	0% (0)	31% (4)	**69% (9)**	0% (0)	3.69	0.48
5. Serving of food groups	0% (0)	0% (0)	38% (5)	**62% (8)**	0% (0)	3.62	0.51
6. Basic steps to build up diet	0% (0)	0% (0)	23% (3)	**62% (8)**	15% (2)	3.92	0.64
Practical ability						**3.50**	**0.48**
7. Ability to build up diet	0% (0)	8% (1)	31% (4)	**54% (7)**	8% (1)	3.62	0.78
8. Self-exercise of patients	0% (0)	23% (3)	**62% (8)**	15% (2)	0% (0)	2.92	0.64
9. Using as references	0% (0)	0% (0)	8% (1)	**77% (10)**	15% (2)	4.08	0.49
10. Recommendation for patients	0% (0)	0% (0)	**62% (8)**	38% (5)	0% (0)	3.38	0.51
Total Respondents							**13**

TABLE 5: Participant's level of agreement with statements about comprehension and practical ability of the guide book "Glycemic Load counting and Meal planning".

For the comprehension of the book, the average response was 3.85 (n = 13, SD = 0.18). Majority of the participants agreed or fully agreed with statements in four of six questions, inlcuding definition of GI (in total 92%), calculation of calorie goals (in total 69%), difference between GL and GI (in total 69%) as well as basic steps to build up

diet (in total 77%). With the remaining statements, only more than half of the participants responded “agree” or “fully agree”.

For the practical ability, the average response was slightly lower. Of four questions, a mean score of 3.5 (n =13, SD = 0.48) was resulted. In this section, participants only agreed with statement 7 about the ability to build up diet, and statement 10 about using the book as reference, with a percentage of 92% and 77%, respectively. The rest was denied or stayed “not sure” by more than half of the participants.

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	Response average	SD
Design and Illustration						**3.85**	**0.34**
11. Choice of language	0% (0)	0% (0)	**54% (7)**	46% (6)	0% (0)	3.46	0.52
12. Legibility of texts	0% (0)	8% (1)	15% (2)	**62% (8)**	15% (2)	3.85	0.80
13. Logical organization	0% (0)	0% (0)	31% (4)	**54% (7)**	15% (2)	3.85	0.69
14. User-friendliness of table	0% (0)	8% (1)	31% (4)	**46% (6)**	15% (2)	3.69	0.85
15. Illustration pictures	0% (0)	0% (0)	8% (1)	46% (6)	**46% (6)**	4.38	0.65
Total Respondents							**13**

TABLE 6: Satisfaction of participants in design and illustration of the guide book “Glycemic Load counting and Meal planning”.

For design and illustration of the book, the result was similar to the comprehension with a response average of 3.85 (n =13, SD = 0.34). Most of the participants were satisfied or very satisfied with the items, namely 77% for legibility, 69% for logical organization, 61% for tables and 92% for illustration pictures. Only in question 11, about half of the participants answered “neither dissatisfied nor satisfied” with the choice of language.

Of thirteen respondents, seven are doctors and six are nutritionists. The responses of doctors was, therefore, slightly different compared to the ones of nutritionists (Figure 5),

particularly in the responses about GL-concept, the ability of expert to create diet using the method, and the usage of words which was chosen in this book.

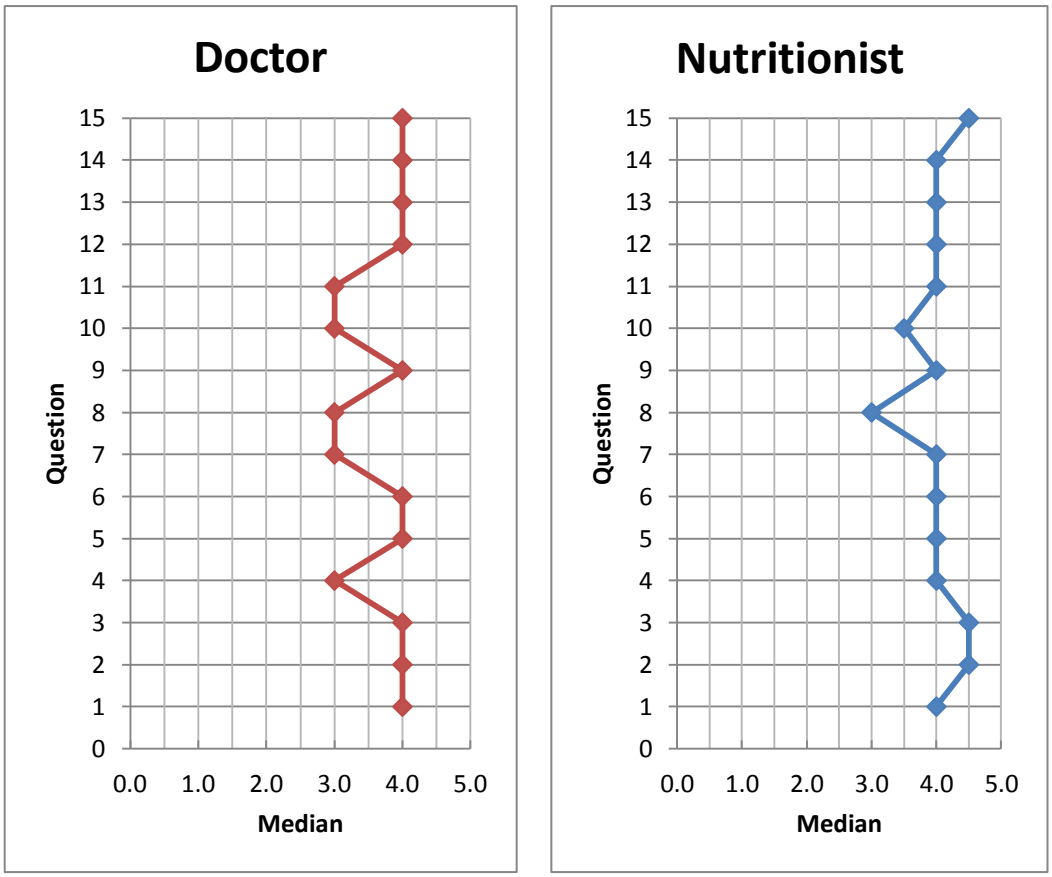

FIGURE 5: Median of 15 questions in the evaluation on guide book “Glycemic Load counting and Meal planning” between doctors and nutritionists.

Furthermore, in order to evaluate the statistical difference between both groups, a Mann-Whitney’s U Test based on medians of 15 questions was conducted. As the result, two groups differed significantly from each other with $W = 72$, $Z = -1.99$, $p = 0.04$ and $r = 0.47$.

4. Discussion

The guide book "Glycemic Load counting and Meal planning" are proposed as a dietary instrument for diabetic patients in Vietnam to control and manage their blood glucose level. Through the present study, the first evidences that support this concept have been provided, including three aspects: comprehension, practical ability, as well as design and illustration.

4.1 Comprehension

Clearly visible evidence is reflected in the insight of this book. According to table 4, majority of doctors and nutritionists showed positive respond toward the ability to understand the main contents of this book, particularly the concept of GI with more than 90% totally and GL with about 60% in total. While the responses on definition of GI were quite homogeny, the responses to GL were slightly different between two occupations, i.e. nutritionist gave a median score of 4.0 for this question, while the result of doctors was only 3.0. The reason for that might be because concept of GL is relatively new and not as widely distributed in the doctor groups as is GI, and that lead to difficulties in comprehension by a few participants. Conversely, nutritionists might have encountered this concept because of their job in greater or lesser degree; therefore they have a better understanding of the concept and gave higher median score.

Other aspects of the comprehension, including calculations of calories needed servings of each food groups and basic steps to build up diet were also relatively highly evaluated. The results were also no different between the two occupations. However, suggestions have been made regarding the calculation of energy needs. In their opinions, individual activity level should not be classified based on the distribution of time spent on the 5 main activities, but rather be categorized in occupation group such as: scientist, worker, cook, waiters, athlete etc. Through this classification, users can easily find out the typical activity level that is appropriate with their job, and consequently their daily calories goal can be estimated.

Furthermore, because of concerns about average height, the typical daily energy needs of Vietnamese are about 1100 kcal to 2200 kcal by women, and 1200 kcal to 2400 kcal by men. Sample menus, such as examples for these common calorie requirements are therefore strongly advised. Ideally, a guide book for each stage of energy needs from 1100 kcal to 2400 kcal should be developed.

Finally, from the view of doctors, an improvement in the content of sample menus should be made, i.e. diabetic patients should consume food containing carbohydrates such as rice, bread, etc. for breakfast due to treatment with insulin in the morning; otherwise the blood glucose can be sunken under the safe limit. Beside, breakfast should contain about 30% of total energy needs in one day[35]. In this case, the calorie content of breakfast was too low with less than 10%, compared to the instructions. Therefore, it is recommended to increase the quantity of carbohydrate rich foods in breakfast by reducing the amount of them in lunch. By doing this, GL of total diet remain constant, but higher quantity of carbohydrates for breakfast can be obtained.

4.2 Practicability

Another aspect that was considered in this study is the application of this guide book. According to the responses, results of this section were clearly separated into two different segments. For doctors and nutritionists, this book is a quite useful instrument and gets the support of majority of participants. By utilizing the guide book, they will be able to make the right choice of food and can decide the amount for each kind of foods, and thus they can create appropriate diet for people with diabetes or diabetes related disease. However, due to the lack of practical experience on planning diet the doctor group seems to be unsure about the ability to exercise the method themselves. Moreover, the book can also be applied at consultation with patients, in order to explain to them what kind of food and by which amount is allowable. And of course, it can naturally be used as reference for further researches that related to dietary instrument for diabetic patients.

[35] Ho Chi Minh City - Institute of Nutrition (2012) *Calorie requirement for an appropriate diet.*

Conversely, the application of the book in population was not well agreed within the whole group. In fact, about 80% of doctors and nutritionists answer “disagree” or “neither disagree nor agree” with the self-exercise of patients and more than 60% of the group did not recommend this book for patients. In their opinion, the knowledge in this book is considered as too explicit and complicated compared to the level of most of Vietnamese patients. They emphasized that such specific information could cause confusion and disinterest on first sight, and consequently lead to refusal.

On the other hand, the ratio of macronutrients also took concerns of several participants. Compared to the recommendations of Ho Chi Minh City - Institute of Nutrition about the distribution of macronutrient in diet for Vietnamese (Protein: Carbohydrate: Lipid = 12 – 14%: 60 – 65%: 18 – 25%) [35] and *“Management and Treatment of Diabetes”* (Protein: Carbohydrate: Lipid = 10%: 60-65% :25-30%)[36], the ratio in the present concept (Protein: Carbohydrate: Lipid = 30%: 40%: 30%) is slightly different. According to them, a typical daily menu of diabetic patients composed mainly from foods containing carbohydrate e.g. rice, vegetable, fruits, less foods that are rich in lipid and protein like meats, fish, milk, etc. The percentage of carbohydrate in this method was, however, decreased, while the amount of protein was almost doubled, consequently their typical diet must be changed, and that might lead to difficulty for patients to exercise.

In order for patients to use this dietary instrument themselves, only the most basic information should be provided, for instance, short explanations about GI and GL, how and where to find GL value, simpler calculation of daily energy needs, reduction of specific information like requirement of micronutrients, as well as a simple clarification for the macronutrient distribution. Finally, instructions for use from doctors and nutritionist at the beginning are strongly advocated.

4.3 Design and Illustration

Design and illustration of the book are other aspects that took regard in the present study. Overall, participants were satisfied with the presentation of this book, in particular

[36] Ta VB (2003). *Management and treatment of diabetes*

the illustrated pictures with more than 90% of the whole group. The main purpose of them i.e. support the understanding of the Food Exchange list was fulfilled. By using the pictures, the process to choose both kind and amount of food will be simplified.

Other items, including the legibility of texts, logical organization, user-friendliness of the table also satisfied more than two third of the participants, and the results were even no different between the two occupations. But at several points improvements were necessary; otherwise it might cause confusion for users. For example, the location of number of serving in part 2 “Patient information” was inappropriate because at this point the definition of serving of food groups had not been provided yet, or the overlapping of information in Appendix 2 and 3, as well as in sample menus (in text form and in form of pictures). Therefore it is recommended to combine the tables and menus so as to avoid the repeat of information. Beside, the details of Food Exchange System are advised to reduce in order to simplify the usage of this book by patients. Only the most significant nutrient values such as energy, proteins, lipid, and GL should be included. Others are only relevant when patients are obligated to follow, for instance, sodium and potassium concentration for patients with kidney insufficiency, etc. Moreover, an illustration tool to represent servings in the ten food groups that should be taken into consideration is the *“Eatwell Plate”*[37]. The model is a pictorial summary of the main food groups and their recommended portions for a healthy diet, and it can naturally be adapted for the present dietary instrument, for instance, the servings in the ten foods group of calorie goal of 900kcal can be performed as followed:

[37] United Kingdom Deparment of Health (2012**)** *The eatwell plate is a policy tool that defines the Government’s recommendations on healthy diets*

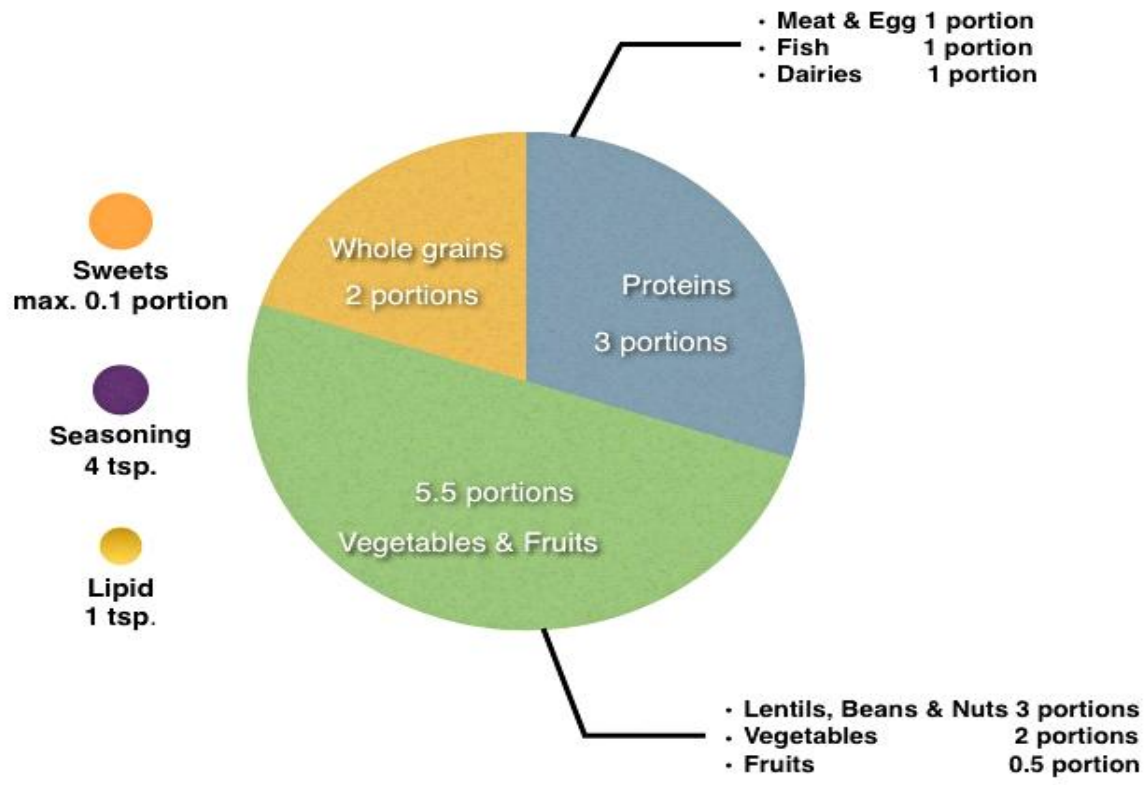

FIGURE 6: Servings in ten food groups of calorie goals 900 kcal, inspired by the “Eatwell Plate” model.

Of 4 items, the one that got the least sympathize of respondents was the choice of language. Only about half of participants response “satisfied” with the language, the rest were neither dissatisfied nor satisfied and the aspect was also criticized more by the doctor group than the group of nutritionists. Expert afraid that the application of complicated terms such as “available carbohydrate”, “serving of a food”, “daily serving”, “weight without skin per serving”, “GL per day”, etc. They required explanations for them as well. Several specific and local names for foods, which were not used overall in Vietnam, were also included in the table, and consequently it lead to difficulties by making food choice. It is, therefore, recommended to choose basic and most common words, short explanations are even necessary for specific terms.

Finally, there were critics according to the clarity of the book that should be noted, such as the lack of references in determination of GI and GL, in calculation of daily energy needs, and in distribution of carbohydrate and GL within the diet.

4.4 Limitations

Although the research has reached its aims, there were some unavoidable limitations that need to be acknowledged and addressed regarding the present study. The first limitation concerns the energy requirement of the sample menu. According to the guide book, a calories needs with 900 kcal is only suitable for woman with 135 cm height, while the average height of Vietnamese people is between 150 cm and 165 cm. For this reason, a 900 kcal diet is uncommon and cannot represent the whole population. However, in this study I did not make any attempt at presenting how effective the dietary instrument in population is, but rather provided a general assessment about the comprehension and practicability of the new concept from the view of doctors and nutritionist. Results of the research was therefore not much affected by the energy requirement, and using a guide book for 900 kcal for this study could be considered as acceptable.

The second limitation has to do with the result is the selection of participants. As previously mentioned, the sample was relatively small (n=16) and subjects were not randomly selected but rather individually invited. Participants could only be invited through acquaintance, and thus it might have an impact on the final result. I tried to maintain the objectivity of the study by selecting participants with different experience on GI and GL concept and from various hospitals; moreover the surveys were conducted anonymously and individually so that the response of one participant was not influenced by others. However, a possibility that the result was overestimated could always exist.

5. Conclusion

Overall, the guide book “Glycemic Load Counting and Meal Planning” is considered a useful dietary instrument. It brings a whole new perspective that differs greatly from the old concept for the treatment and management of diabetes by using nutrition therapy. However, due to certain limitations in content and presentation, the concept is not yet suitable for widely application in population for the time being. From the angle of our experts in this field, several improvements should be made before this method can be published.

Additionally, it should be acknowledged that the result of the present study based solely on the responses of thirteen doctors and nutritionists, and thus it can reflect only a dimension of the situation. In order to get a whole spectrum, a study on larger population with a mixture of participants, including patients should be performed.

Finally, the main purpose of this dietary instrument is helping people with diabetes to exercise healthy diet. Researches on the usefulness of this method on patients are, therefore, strongly advised. It would be best if a cohort study on population can be carried out, in which patients are followed prospectively and subsequent status evaluation with respect to health outcome are conducted to determine the beneficial effect of the guide book “Glycemic Load counting and Meal planning”.

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Appendix

Evaluation of the Guide book "Glycemic Load Counting & Meal Planning"

Study on the comprehension and practicability of the guide book from the view of doctors and nutritionists.

My profession is: _____

I´ve already gained experience in Glycemic Index: theoretical / practical / no experience

I´ve already gained experience in Glycemic Load: theoretical / practical / no experience

I´ve occupied myself with this guide book: intensely / marginal

Comprehension

Please tick one circle in each row to assess your level of agreement with the following statements.

	Strongly disagree	**Disagree**	**Neither disagree nor agree**	**Agree**	**Fully agree**
1. The definition of GI is clear.	O	O	O	O	O
2. The explanations of GL are easy to understand.	O	O	O	O	O
3. I can differentiate GI from GL.	O	O	O	O	O
4. With this book I´m able to determine the daily energy needs.	O	O	O	O	O
5. The explanations of number of servings in ten food groups are clear.	O	O	O	O	O
6. Each step of building daily menu is well clarified.	O	O	O	O	O

Practical Ability

Please tick one circle in each row to assess your level of agreement with the following statements.

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Fully agree
7. By using the book I´m able to plan meals for diabetic patients appropriately.	O	O	O	O	O
8. The book can be used solely by patients without further explanations.	O	O	O	O	O
9. I would recommend this book for reference.	O	O	O	O	O
10. I´ll recommend this guide book to my patients.	O	O	O	O	O

Design and Illustration

Please tick one circle in each row to assess your level of satisfaction with the following aspects of the text's design and illustration.

	Very dis-sastified	Dis-satistfied	Neither dis-satisfied nor satisfied	Satisfied	Very satisfied
11. Choice of language	O	O	O	O	O
12. Legibility of textes	O	O	O	O	O
13. Logical organization	O	O	O	O	O
14. User-friendliness of tables	O	O	O	O	O
15. Illustration pictures	O	O	O	O	O

My overall review and criticism: