Preliminary Study of Effects of Diet Control Program using Food Exchange on Knowledge, Food Consumption Behaviors, and Glycemic Control among Persons with Type 2 Diabetes

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Abstract

OBJECTIVE: This quasi-experimental research aimed to examine the effects of a diet control program using food exchange on knowledge, food consumption behaviors, glycemic control and nutrient intake among persons with type 2 diabetes in sub-district health promoting hospitals.

MATERIALS AND METHODS: The sample of 44 persons with type 2 diabetes were divided by purposive sampling into two groups, experimental (n=22) and comparison (n=22). The experimental group participated in a 12-week diet control program using food exchange based on the Health Belief Model concept. The program consisted of one education session for two hours using a video, a food exchange pamphlet, a plate model to enhance subjects' understanding, meal planning, and three home visit follow-ups. Data were collected via four instruments: a demographic data questionnaire, health information records, a food consumption behavior of persons with diabetes questionnaire, a knowledge test and 24 hours food record. The data was analyzed through descriptive statistics, Wilcoxson Signed Rank test and Mann-Whitney U test.

RESULTS: After receiving the program, the experimental group had a significantly higher food consumption behavior score when compared to before the program (p=0.005) and scored significantly higher than the comparison group (p <0.001). Hemoglobin A1c (HbA1c) levels of the experimental group showed a significant reduction in more than the control group (p=0.002) whereas in knowledge score and in fasting blood sugar (FBS) there was no significant difference.

CONCLUSION: It is recommended that nurses can use this program to effectively modify type 2 diabetic patients' health behavior in diet control leading to glycemic control.

Keywords: diet control program, food consumption behavior, glycemic control

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Diabetes mellitus is a major global public health problem. The prevalence of type 2 diabetes mellitus in adult population worldwide has been rising from 4.7% in 1980 to 8.5% in 2014.[1] In Thailand; the prevalence of diabetes has also increased over time. Data from the fourth national health examination survey indicated that the prevalence of diabetes in people aged 15 and over was 2.3% in 1991 to 4.6% in 1997, to 6.8% in 2004 and to 6.9 % in 2009. The diabetes prevalence was higher in urban areas compared to rural areas.[2]

Diabetes can cause several health complications leading to the loss of function in many important organs such as cardiovascular, cerebro-vascular, kidney, eyes and nervous system.[3,4] These complications can be prevented by maintaining optimal blood glucose levels.[4] This can be achieved by lifestyle modification and adoption of appropriate health behaviors including diet control, physical activity and/or blood glucose monitoring. Studies showed that lifestyle interventions targeted at weight loss, diabetes nutrition, and physical activity recommendations have been shown to improve glycemic control.[5-7]

Dietary management is considered as a main aspect in controlling blood sugar level. It is widely accepted that healthy nutrition is the basis for the treatment of type 2 diabetes. It contributes positively to the

maintenance of blood sugar within the normal range and minimizes the complications of the disease.[7] However, an important problem of most diabetic patients is their inability to control their blood sugar level due to a lack of knowledge on diet control appropriate for consumption habits or contexts of the community, so they are unable to control their calorie intake from food consumption or choose the type of food appropriate for their disease.[8]

The concept of food exchange is known as the principle of food management that that can be interchangeable or replaceable as appropriate to the needs or contexts of individuals.[9,10] This concept can enable patients choosing a variety of wholesome foods in accordance with nutrition principles suitable for their lifestyles and level of activity.[9] Studies of a food exchange program both in Thailand[11,12] and other countries[13,14] showed positive outcomes. In order to enhance the capacity of patients to manage their dietary management using food exchange, education based on behavioral impact is important. A health belief model[15] is recommended for educational programs to increase impact of the programs. This model suggests that a person needs to have perceived susceptibility, perceived severity, and perceived threats of possible complications that influence them to avoid such threats.

According to data of Samut Prakarn province from the Bureau of Policy and Strategy, the Ministry of Public Health[16] indicates that the hospitalization rate for diabetes has increased from 665.72 per 100,000 in 2011, to 689.46 per 10,000 in 2012 and to 733.41 per 100,000 in 2013. This may indicate that the incidence of poor glycemic control has also increased. Bangpla district is the district in Samut Prakarn province with several suburban areas. A pilot study conducted by the researcher showed there was approximately a rate of 10% of poor glycemic control patients of all patients who attended a health promoting hospital. Therefore, this study aimed to examine the effects of a diet control program using food exchange whilst applying a Health Belief Model[15] on knowledge, food consumption behaviors, glycemic control and nutrient intake of persons with type 2 diabetes mellitus in a suburban setting.

Materials and Methods

Population and sample

This quasi-experimental study with a pretest-posttest two group design was conducted for this study. The population of the study was persons with type 2 diabetes at the Bangpla community who attended treatment and received care at the Bangpla Mu 6 Sub-district health promoting hospital and the Bangpla Mu 14 Sub-district health promoting hospital, Samutprakarn Province between February and October 2014.

The study sample were recruited purposively with the following inclusion criteria:
1. Diagnosed as type 2 diabetes.

2. Aged ≥ 30years old.
3. FBS ≥ 126 mg/dl at least once during last 3 hospital visits.
4. No language barrier or known mental disability.
5. No severe medical problems which hindered their participation in the study.

The 2 sub-district health promoting hospitals in Bangpla district, Sumut Prakarn province were randomly selected as experimental and for comparison purposes. The Bangpla Mu 14 sub-district health promoting hospital was selected as an experimental setting and the Bangpla Mu 6 sub-district health promoting hospital was the controlled setting.

The sample size was calculated by power analysis 17. Power of test = 0.80, p-value = 0.05 and effect size calculated from previous studies was 11 = 1.27 (large effect size), 42 samples were calculated (21 samples for each group). In this study, a total of 44 diabetic patients (experimental group = 22 and comparison group = 22) attended the program.

The intervention

Participants in the comparison group received routine care practiced at their health promoting hospital, which may have also included a summary of basic dietary principles by nurses. Participants in the intervention group, in addition to receiving the usual care, received comprehensive education on the main topics of diabetes; explanation of diabetes, symptoms and management, diet and the role of food exchange in controlling diabetes. The participants in the intervention group were also provided home visit and/or telephone follow up (3 times). The program was conducted by researchers and nurses. Comprehensive education was conducted at the sub-district health promoting hospital. The participants leaned about diabetes, and the food exchange concept by video animation developed by Fuangfung et al.[11] A demonstration and discussion was given on food exchange using a food plate model, a pamphlet on food exchange of the Potential Development of Thai People Project[18] and a manual on ready-to-eat dishes developed by Peasua et al.[19] After the educational program, patients received three home visits and/or telephone follow ups to give individualized advice based on the food record to modify and plan for dietary intake at breakfast, lunch, and dinner between the researcher, patients and family members focusing on behavior assessment, goal-setting, and problem-solving.

Data collection

This study was approved by the Institutional Review Board (IRB), Faculty of Medicine Ramathibodi Hospital, Mahidol University (2554/514). The patients received written and verbal explanations about the program before giving informed consent. The researcher and assistant researchers collected data and blood tests; FBS and HbA1c before starting the intervention and after the intervention was complete.

Data were collected using data forms and questionnaires for the following information:

1. Personal information and glycemic control (FBS and HbA1c)
2. Knowledge on diabetes and food exchange questions adopted from Supranee Feungfung consisted of 30 questions: diabetes knowledge (5 items), diabetes complication (10 items), and food consumption behavior (15 items). The questions were designed as a true-false test. Content validity index (CVI) of 0.81 and Kuder Richardson (KR-20) of 0.80 demonstrated acceptable instrument validity and reliability.
3. Food consumption behavior questions adopted from Supranee Feungfung[11] consisted of 15 questions. The questions were designed with 5 Likert scales (0 points for never/none to 4 points for always). Cronbach's demonstrated reliability of 0.62.
4. The 24 hours recall food record. The food record was used during each home visit for dietary planning and the energy intake and nutrients were calculated using INMUCAL-Nutrients V3.[20]

Data analysis

Data entry and analysis were performed using Statistical Program for the Social Sciences (SPSS) version 18.0 software. Descriptive statistics were analyzed for frequency, percentage, mean and standard deviation. Chi-square test and independent t-test was used for comparing the characteristics of patients between the experimental and comparison group. Mann-Whitney U test and Wilcoxon signed rank test were used to compare personal data, knowledge score, food consumption behavior score, FBS and HbA1c before and after between the experimental and comparison groups.
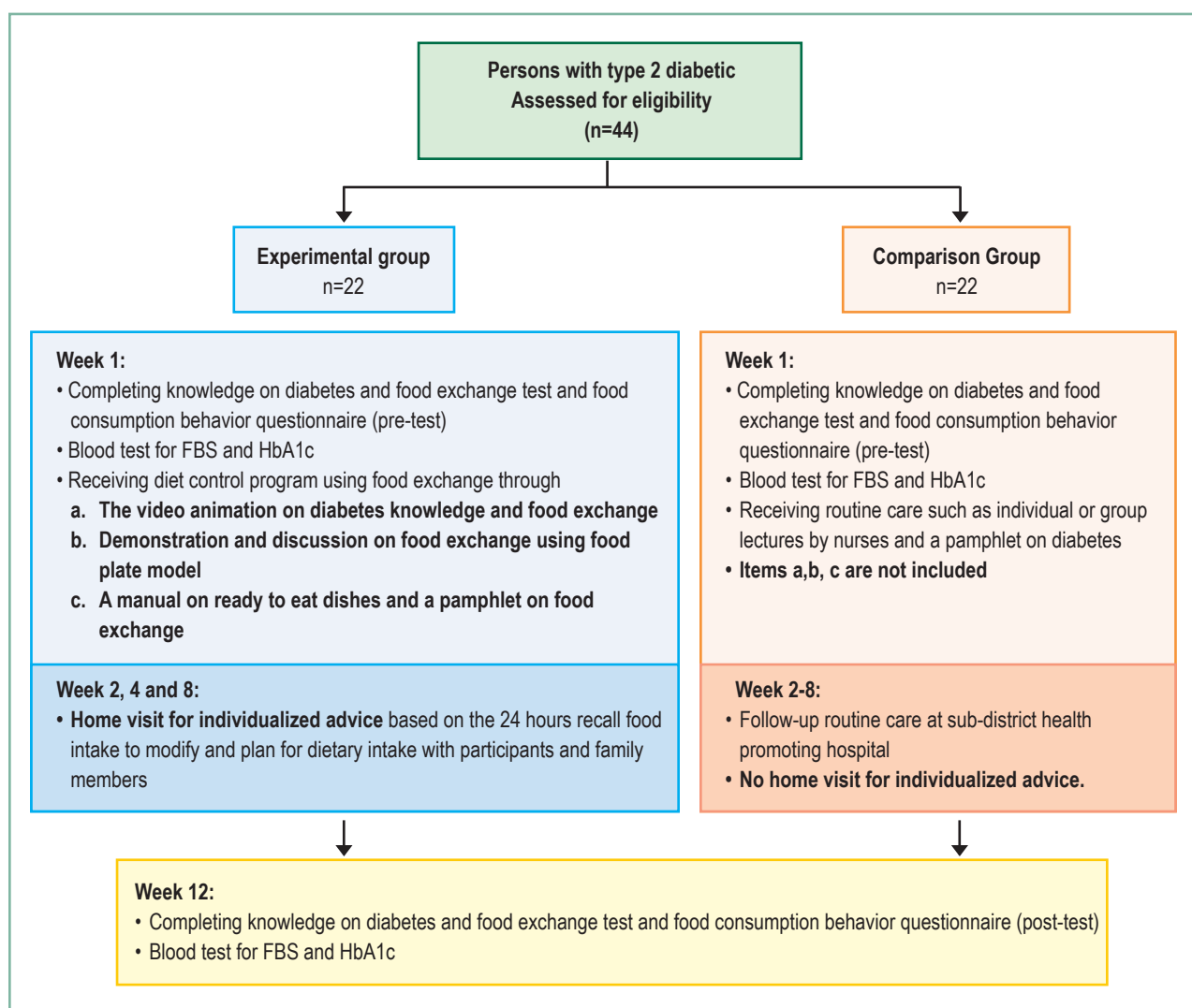

Figure1: Study diagram

Results

Of a total of 44 type 2 diabetic patients, 70.46% were female and 29.54% were male with an average age of 63.6±9.9 years old (ranging from 43-85 years old). Sixty-eight percent of patients were married and most of them (97.73%) had primary school and lower education with an average monthly income of THB 7,733.33. There was no difference in background characteristics between the experimental and comparison groups (Table 1).

Mean and standard deviation (SD) score of the experimental group on knowledge before attending the intervention was 22.86±5.89 and it was 23.68±4.19 after the intervention. The Wilcoxon Signed Rank test showed no statistically significant difference (*p*=0.242). For food consumption behavior, mean and SD score of the experimental group before attending the intervention was 38.50±5.64 and it was 39.72±5.59 after the intervention, so that the Wilcoxon Signed Rank test showed

statistically significant difference (*p*=0.005). The finding also showed the mean fasting blood glucose and HbA1c of the experimental group at before attending the intervention was 161.41±53.25 mg/dl and 8.84±2.39 mg% respectively and it reduced to 154.0±54.68 mg/dl and 8.15±1.82 mg% after the intervention but with no statistically significant difference (*p*=0.758 and 0.184 respectively).

When comparing the mean difference score before and after attending the intervention between the experimental and comparison groups, the results found that the experimental group had a significantly higher food consumption behavior score than the comparison group (*p*<0.001). HbA1c levels of the experimental group showed a significant reduction in more than the control group (*p*=0.002) whereas knowledge score and blood sugar (FBS) showed no statistically significant difference (Table 2). Average FBS and HbA1c of the experimental group was reduced and in the comparison group it increased (Figure 2).

Table 1: Patients' characteristics (n=44).

Characteristics	Total	Experimental group	Comparison group	*p*
n	44	22	22	
Gender				
Male	13 (29.54%)	7 (31.82%)	6 (27.27%)	0.741[a]
Female	31 (70.46%)	15 (68.18%)	16 (72.73%)	
Age (Yeas) (Mean (SD))	63.60 (9.90)	63.05 (10.78)	64.14 (9.23)	0.724[b]
Marital status				
Married	30 (68.18%)	18 (81.82%)	12 (54.55%)	0.104[a]
Single/Divorced	14 (31.82%)	4 (18.18%)	10 (45.45%)	
Education				
No education/Primary school	43 (97.73%)	22 (100%)	21 (95.45%)	-
High school	1 (2.27%)	0	1 (4.55%)	
Income (monthly) (Mean (SD))	7733.33 (9106.80)	7,555.56 (11235.30)	7885.71 (7086.91)	0.915[b]

a = Chi-square test

b = independent t-test

Table 2: Comparison of mean and mean difference of knowledge scores, food consumption behavior score and glycemic control between experiment and control groups (n=44).

Variables	Possible range	Experimental Group Mean(SD) Before	After	*p*	Comparison Group Mean(SD) Before	After	*p*	Mean difference* Experiment	Comparison	*p*
Total knowledge scores	0-30	22.86 (5.89)	23.68(4.19)	0.242[a]	20.41 (2.17)	19.81 (1.44)	0.230[a]	0.82 (5.45)	-0.69 (2.11)	0.051[b]
Diabetes knowledge	0-5	4.18 (0.39)	4.23 (1.54)	0.493[a]	3.86 (0.71)	3.41 (0.73)	0.290[a]	0.05 (1.49)	-0.46 (0.91)	0.448[b]
Diabetes complication	0-10	7.54 (2.21)	7.59 (1.05)	0.419[a]	7.09 (0.81)	6.45 (0.73)	0.147[a]	0.04 (2.45)	-0.64 (1.00)	0.235[b]
Food exchange	0-15	11.14 (4.60)	11.86 (3.30)	0.265[a]	9.45 (1.57)	9.95 (1.21)	0.147[a]	0.72 (4.62)	0.50 (1.59)	0.719[b]
Food consumption behavior score	0-60	38.50 (5.64)	39.72 (5.59)	0.005[a]	33.95 (4.86)	33.54 (4.89)	0.015[a]	1.23 (1.74)	-0.41 (1.09)	<0.001[b]
Glycemic control										
Fasting blood sugar (mg/dl)	-	161.41 (53.25)	154.0 (54.68)	0.758[a]	118.72 (17.28)	121.18 (17.78)	0.770[a]	-10.95 (63.08)	2.54 (18.77)	0.832[b]
HbA1c (mg%)	-	8.84 (2.39)	8.15 (1.82)	0.184[a]	6.88 (1.23)	7.46 (1.16)	0.001[a]	-0.70 (1.77)	0.58 (0.59)	0.002[b]

* difference in scores between before and after attending the intervention

a = Wilcoxon Signed Rank test
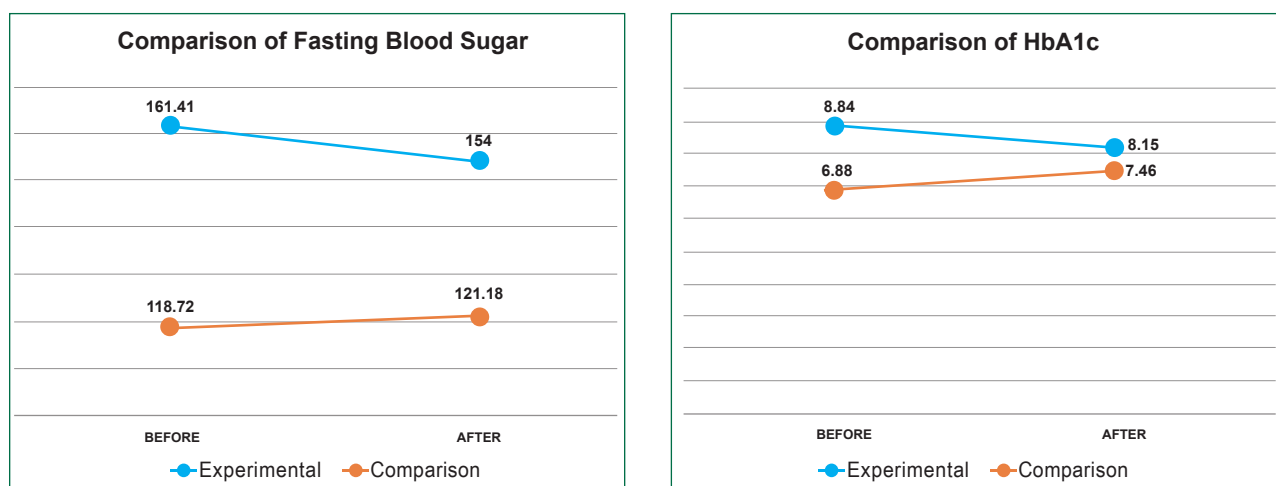
b = Mann-Whitney U test

Figure 2: Comparison of mean fasting blood sugar and HbA1c between experiment and control group

Discussion

The results of this study showed that the patients who joined the diet control program had an improvement in the food consumption behavior score. These results were similar to the results from several studies[11-13] in which food consumption behavior score in the intervention group increased significantly. The result is congruent with the Health Belief Model[15]. This was due to the patients in the experimental group perceived susceptibility from the education and that they also perceived benefits and especially perceived barriers from home visits or telephone follow ups. Then they can modify dietary intake, setting their goal and problem-solving by themselves. Moreover, home visits gave an opportunity to meet and discuss with patients' family members who may prepare food for the patients. This can help to reduce patients' barriers to suitable food consumption. The experimental group in this study also showed an improvement in glycemic control shown by a statistical significant reduction of HbA1c. The trend of nutrition intakes in the experimental group improved. Intakes of carbohydrate and sugar decreased. Reduction in fasting blood sugar and HbA1c might be mainly as a result of food consumption behavior change in the experimental group.

However, it is noteworthy that the knowledge score was not statistically different from before starting the program, but the knowledge score tended to go up. This may due to the fact that patients in the experimental group were mostly elderly (mean age=63.60 and SD=9.90) and their education was primary school level and lower which may impact the participants' learning. When comparing the mean difference knowledge score between the experimental group and the comparison group, it was found that the mean score of the experimental group was higher than that of the comparison group. This may have been because the participants in the experimental group received knowledge from the video animation which is easy to learn and remember.

Conclusion

In summary, in the experimental group, food consumption behavior significantly increased and HbA1c was also improved. Also, intakes of carbohydrate and sugar were more likely to decrease, while knowledge and FBS was not significantly decreased. This study indicates that diabetes education and individualized diet planning through a home visit is effective for dietary management.

Acknowledgements

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