

# The Efficacy of a Health Program and a Food Diary in Blood Sugar Control of Patients with Type 2 Diabetes

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## I. INTRODUCTION

Diabetes is one of the most significant chronic illness as it cannot be completely cured, and this can affect the economic development significantly. According to International Diabetes Federation (IDF), it is reported that there are 285 million patients with diabetes globally, and it is expected to soar to over 435 million by 2030<sup>1</sup>. Currently, around 4.8 million adults in Thailand suffer from diabetes, and complications tend to occur when their higher ages. This was mainly due to a sedentary lifestyle, obesity and an increase in age. From the total number of patients, there are only 35.6 percent or 2.6 million people who have been diagnosed and properly received a treatment, and there are only 0.9 million people whose symptoms are under control. Therefore, this results in the number of mortalities of over 200 people per day. It is predicted that the prevalence of diabetes will surge to 5.3 million people by 2040<sup>2</sup>. For those who do have a poor control of their blood sugar level, this can result them in many complications, including diabetic retinopathy, coronary artery disease, Chronic kidney diseases, cerebrovascular diseases, and neuropathy<sup>3</sup>. Also, it is very likely that they will get a diabetic foot wound that could result in amputation.

According to a report from NCD Clinic Plus of 2019 in the 4<sup>th</sup> Health region, the patients who had a good control of their blood sugar level made up only 27.64 percent of all patients, and this ranked 8<sup>th</sup> in the country (from 12 health regions). This average number is lower than that of overall nation, which is 28.32 percent<sup>4</sup>. Although diabetes cannot be completely cured, a patient is able to control their blood sugar level by correcting their habits, including controlling diet, exercising, managing stress, and taking medicine. Patients should be determined to take care of themselves. If they have poor self-management, this will lead to a poor control of diabetes. According to the previous studies<sup>5,6,7</sup>, it is found that with an efficacy of a health education program on diabetes and a practice on choosing diet, the blood sugar level of participants who participated in the program was lower than that before the program significantly ( $p < 0.05$ ). In addition, the use of a clinical record also helps. The record includes processes in how to direct oneself and a record with closed-ended questions, which associate with meals,

exercises, and medicine taking. The patients are asked to mark a check mark on the tasks that they performed every day. It is found that after the experiment, there is a significant difference between the blood sugar level in the study and control groups ( $p < 0.05$ ).

In the previous studies, most participants were poor control diabetic patients. Thus, the researcher is interested in study about the results of using a health program and a food diary in patients' blood sugar level in both good and poor control diabetic patients. The research aims that this project will be beneficial in helping control blood sugar level of patients with type 2 diabetes, especially in Primary care NCD Clinic Also, it will help to decrease complications of patients with diabetes under the care provision so that they could have a better quality of life.

### ➤ Objective

To assess the results of the efficacy of the health program and the food diary in reducing the fasting blood sugar level of patients with type 2 diabetes

## II. METHODOLOGY

### ➤ Samples

This is a quasi-experimental study, and the convenience sampling is applied to randomize the samples. The target samples are 40 patients with type 2 diabetes who received medical services at NCD Clinic, Promoting Health Hospital of Khao Wong Sub-district, Phra Phutthabat District, Saraburi Province. Inclusion criteria can be listed as following: 1) patients with type 2 diabetes who have received follow-ups at NCD Clinic, Promoting Health Hospital of Khao Wong sub-district, Phra Phutthabat District, Saraburi Province not less than 6 months 2) the patients have provided their consents in participating this study, and they do not correspond with any exclusion criteria. Exclusion criteria include 1) fragile patients, including bedridden patients 2) pregnant patients 3) illiterate patients.

### ➤ *Sampling Size Calculation*

Usa Tassanawin, Theeranuch Haniratsai, and Wanpen Pinyopassakul<sup>9</sup> studied about the results of providing a day camp to patients with type 2 diabetes on their awareness on taking care of themselves and their blood sugar levels. The hypothesis is that before the experiment, the average fasting blood sugar level is 172.86 mg/dL, and after 1-month experiment, the average fasting blood sugar level would be 144.23 mg/dL. Standard deviation (SD) is 29.65, and this is a two-sided experiment with type 1 error, significance at 5% and power at 80%. The sample size is calculated to be 34 participants, and 15 percent, or more 6 participants, are chosen just in case that data might be incomplete. Therefore, there will 40 participants (n=40) in this study, and it can be divided into 20 participants for the study group and another 20 participants for the control group.

### III. DATA COLLECTION

The data had been collected from July to December 2020. The participants in the study group had been provided with a health program, a food diary, an education, and a standard treatment. On the other hand, the participants in the control group had received a standard treatment solely, and a health program, a food diary, an education had not been included in their treatments. There was a follow-up three months after the experiment. The results were assessed by fasting plasma glucose test (FPG).

A health program refers to a program provided by a doctor, and the program includes information regarding diets, food exchange lists<sup>10</sup>, and diabetic diets. The aim of this program is to change and correct participant's eating habits, and the patients are also informed of how to record their diets in the food diary. A food diary for a patient with type 2 diabetes is measured 5.8 x 8.3 inches, and it consists of a record for a patient to note down a date, a meal (divided into breakfast, lunch and dinner), an amount of intake rice or carbohydrate (per a rice ladle), a type of food, snacks, fruits, and drinks (per glass/bottle). For a small information book, it informs a patient of three types of diet, including food that they should avoid, food that they could have in a large amount, and food that they can have in a limited amount, as well as food exchange lists for a diabetic patient. This food diary has met the quality media criteria, including proper contents, comprehensible language, pictures, and font size, as it has been adapted to fulfill the mentioned criteria before the usage. The authority figures are personnel working in Phra Phutthabat Hospital, including 2 nutritionists and 1 health educator.

A standard program refers to a medical service received by a patient, and this service includes medical prescription and standard follow-ups proceeded by NCD Clinic. A patient will be informed of diets and how to take care of themselves from doctors and nurses as well as information regarding their medicine intake from pharmacists.

### IV. DATA ANALYSIS

Independent factors include the health program and the food diary. Primary outcome is the average fasting plasma glucose (FPG). Secondary outcome is the average fasting plasma glucose before and after the study, the difference between the average fasting plasma glucose before and after the study, the percentage of a change in the average fasting plasma glucose before and after the study, and the percentage of participants whose the average fasting plasma glucose decline.

Data is analyzed by the statistical software and there is a usage of fundamental statistics, including frequency, percentage, mean, standard deviation, mean differences. There is an application of Chi-square test, Fisher's exact test, and Independent t-test.

### ➤ *Right to Protection and Research Ethics*

This study has been approved by the committee of research ethics regarding to human study of Boromarajonani College of Nursing, Phra Phutthabat. (The number of projects: 007/63, certified at September 2, 2020). The participants were informed of essential information, asked for their consents as they signed on the consent forms to confirm their participation.

### V. RESULTS

### ➤ *Demographic data*

The majority of samples are females, making up for 67.5 percent while males made up for 32.5%. The average age is 61.2±12.2 years old. The average height is 158.3±8.2 centimeters. The average weight is 66.2±17.1 kilograms. The average body mass index (BMI) is 26.5±6.6 kg/m<sup>2</sup>. The systolic blood pressure level is 137.3±14.0 mmHg, and the diastolic blood pressure level is 76.2±11.1 mmHg. The average heartbeat rate is 82.6±11.3 bpm. The average Fasting plasma glucose before the study is 165.2±33.3 mg/dL. Most of participants have been diagnosed to have diabetes less than 5 years. They seldom exercise and do not drink alcohol or smoke. Regarding participants' chronic disease, all of them have diabetes, whereas 90.0 percent of them have high-blood pressure, and 82.5 percent have dyslipidemia. 15.0 percent have chronic kidney disease, and another 15 percent have cerebrovascular disease. 2.5 percent of the participants have other chronic diseases. The average level of HbA1C is 7.6±1.4%, and most of patients' levels are at 6.0-6.9%. Regarding lipid profiles, most of patients' Cholesterol levels are lower than 200 mg/dL, while their Triglyceride levels are less than 150 mg/dL. LDL levels are higher than 100 mg/dL, and HDL levels are in range of 40-60 mg/dL. Most of patients take 2 types of antidiabetic medicine.

When comparing general and health data of participants in the study and control group, it is found that the systolic and diastolic blood pressure level of participants in the study group is higher than those in the control group (P=0.022 and P=0.016 respectively). Meanwhile, the general factors and other health data are quite similar (P>0.05).

Characteristics	Total (n=40)	Experimental group (n=20)	Control group (n=20)	P-value
<b>Sex</b>				
Male	13 (32.5)	7 (35.0)	6 (30.0)	0.736 <sup>c</sup>
Female	27 (67.5)	13 (65.0)	14 (70.0)	
Age ( $\bar{x}$ ), (mean $\pm$ SD)	61.2 $\pm$ 12.2	62.1 $\pm$ 9.7	60.4 $\pm$ 14.5	0.674 <sup>t</sup>
Height (cm), (mean $\pm$ SD)	158.3 $\pm$ 8.2	159.0 $\pm$ 8.3	157.5 $\pm$ 8.2	0.567 <sup>t</sup>
BW (kg), (mean $\pm$ SD)	66.2 $\pm$ 17.1	67.9 $\pm$ 19.7	64.5 $\pm$ 14.3	0.532 <sup>t</sup>
BMI (kg/m <sup>2</sup> ), (mean $\pm$ SD)	26.5 $\pm$ 6.6	26.8 $\pm$ 7.3	26.2 $\pm$ 6.0	0.786 <sup>t</sup>
Systolic (mmHg), (mean $\pm$ SD)	137.3 $\pm$ 14.0	142.3 $\pm$ 12.9	132.3 $\pm$ 13.5	0.022 <sup>*</sup>
Diastolic (mmHg), (mean $\pm$ SD)	76.2 $\pm$ 11.1	80.4 $\pm$ 10.4	72.1 $\pm$ 10.4	0.016 <sup>*</sup>
Heart Rate (bpm), (mean $\pm$ SD)	82.6 $\pm$ 11.3	82.25 $\pm$ 11.27	80.4 $\pm$ 10.4	0.869 <sup>t</sup>
<b>Status</b>				
Single	1 (2.5)	1 (5.0)	0 (0.0)	0.565 <sup>c</sup>
Married	32 (80.0)	16 (80.0)	16 (80.0)	
Separate	7 (17.5)	3 (15.0)	4 (20.0)	
<b>Education level</b>				
Below Primary	4 (10.0)	1 (5.0)	3 (15.0)	0.570 <sup>c</sup>
Primary degree	32 (80.0)	17 (85.0)	15 (75.0)	
Secondary degree	4 (10.0)	2 (10.0)	2 (10.0)	
<b>Occupation</b>				
None	13 (32.5)	6 (30.0)	7 (35.0)	0.692 <sup>c</sup>
Famer	5 (12.5)	2 (10.0)	3 (15.0)	
Employer	11 (27.5)	7 (35.0)	4 (20.0)	
Trade	7 (17.5)	4 (20.0)	3 (15.0)	
Other	4 (10.0)	1 (5.0)	3 (15.0)	
<b>Income (Baht)</b>				
<5,000	22 (55.0)	11 (55.0)	11 (55.0)	1.000 <sup>c</sup>
5,000-10,000	14 (35.0)	7 (35.0)	7 (35.0)	
> 10,000	4 (10.0)	2 (10.0)	2 (10.0)	
<b>FCBG Before (mg/dL), (mean<math>\pm</math>SD)</b>	165.2 $\pm$ 33.3	169.0 $\pm$ 39.0	161.3 $\pm$ 26.8	0.472 <sup>t</sup>
<b>Duration for diagnosis Diabetes (Year)</b>				
< 5	17 (42.5)	8 (40.0)	9 (45.0)	0.785 <sup>c</sup>
5-10	11 (27.5)	5 (25.0)	6 (30.0)	
> 10	12 (30.0)	7 (35.0)	5 (25.0)	
<b>Exercise</b>				
Never	9 (22.5)	4 (20.0)	5 (25.0)	0.780 <sup>c</sup>
sometime	19 (47.5)	9 (45.0)	10 (50.0)	
> 3 time/week	12 (30.0)	7 (35.0)	5 (25.0)	
<b>Alcohol</b>				
Yes	5 (12.5)	2 (10.0)	3 (15.0)	1.000 <sup>f</sup>
No	35 (87.5)	18 (90.0)	17 (85.0)	
<b>Smoking</b>				
Yes	5 (12.5)	1 (5.0)	4 (20.0)	0.342 <sup>f</sup>
No	35 (87.5)	19 (95.0)	16 (80.0)	
<b>Other disease ¶</b>				
Diabetes	40 (100.0)	20 (100.0)	20 (100.0)	-
Hypertension	36 (90.0)	19 (95.0)	17 (85.0)	0.605 <sup>f</sup>
Hyperlipidemia	33 (82.5)	18 (90.0)	15 (75.0)	0.407 <sup>f</sup>
Chronic Renal Disease	6 (15.0)	2 (10.0)	4 (20.0)	0.661 <sup>f</sup>
CVD	6 (15.0)	2 (10.0)	4 (20.0)	0.661 <sup>f</sup>
Others	1 (2.5)	0 (0.0)	1 (5.0)	1.000 <sup>f</sup>
<b>HbA1c (%), (mean<math>\pm</math>SD)</b>	7.6 $\pm$ 1.4	7.6 $\pm$ 1.4	7.6 $\pm$ 1.4	1.000 <sup>t</sup>
6.0-6.9	17 (42.5)	9 (45.0)	8 (40.0)	
7-8	10 (25.0)	4 (20.0)	6 (30.0)	
> 8	13 (32.5)	7 (35.0)	6 (30.0)	

Characteristics	Total (n=40)	Experimental group (n=20)	Control group (n=20)	P-value
<b>Cholesterol (mg/dL), (mean±SD)</b>	176.3±30.2	175.1±35.9	177.4±24.2	0.813 <sup>t</sup>
< 200	33 (82.5)	16 (80.0)	17 (85.0)	
200-239	6 (15.0)	3 (15.0)	3 (15.0)	
> 239	1 (2.5)	1 (5.0)	0 (0.0)	
<b>Triglyceride (mg/dL), (mean±SD)</b>	159.2±77.1	170.5±91.9	148.0±59.1	0.362 <sup>t</sup>
< 150	19 (47.5)	9 (45.0)	10 (50.0)	
150 - 200	12 (30.0)	5 (25.0)	7 (35.0)	
> 200	9 (22.5)	6 (30.0)	3 (15.0)	
<b>LDL (mg/dL), (mean±SD)</b>	95.7±25.8	94.2±27.1	97.1±24.9	0.727 <sup>t</sup>
< 70	8 (20.0)	4 (20.0)	4 (20.0)	
70-100	14 (35.0)	8 (40.0)	6 (30.0)	
> 100	18 (45.0)	8 (40.0)	10 (50.0)	
<b>HDL (mg/dL), (mean±SD)</b>	49.8±10.2	49.3±11.3	50.2±9.2	0.784 <sup>t</sup>
< 40	7 (17.5)	5 (25.0)	2 (10.0)	
40-60	28 (70.0)	13 (65.0)	15 (75.0)	
> 60	5 (12.5)	2 (10.0)	3 (15.0)	
<b>Drug use</b>				
1 type	12 (30.0)	4 (20.0)	8 (40.0)	0.096 <sup>c</sup>
2 type	20 (50.0)	9 (45.0)	11 (55.0)	
3 type	3 (7.5)	3 (15.0)	0 (0.0)	
Oral and inject	5 (12.5)	4 (20.0)	1 (5.0)	

Chi-square test (c), Fisher exact test (f), Independent t-test (t)

\* significant level at 0.05 ( $\alpha=0.05$ )

Table 1:- The general and health information

➤ *Clinical outcomes of intervention*

The average of Fasting plasma glucose after the experiment of the study group is at 158.5±37.2 mg/dL, while that of the control group is 169.5±33.0 mg/dL, which shows no significant difference (P=0.329). The difference of Fasting plasma glucose before and after the experiment of the study group is at -10.6±6.3 mg/dL, while that of the control group is 8.2±3.6 mg/dL, which shows significant difference (P=0.015). The percentage of the change in Fasting plasma glucose of the study group is at -5.4±3.7 percent, while that of the control group is 5.0±2.3 percent, which shows significant difference (P=0.024). Regarding the number of participants who have undergone a decrease in Fasting plasma glucose, it is found that there are 12 participants in the control group who have experienced that, making up for 60.0 percent, whereas there are only 5 participants in the control group, making up for 25.0 percent, which shows significant difference (P=0.025).

Outcome of treatment	Experimental group (n=20)	Control group (n=20)	t / $\chi^2$	P-value
Sugar Level at 3 months, Mean±SD	158.5±37.2	169.5±33.0	0.989	0.329
Mean difference Before and After, Mean±SE	-10.6±6.3	8.2±3.6	2.585	0.015*
The Percentage of Changing (%), mean±SE	-5.4±3.7	5.0 ±2.3	2.367	0.024*
The Changing, n (%)				
Increase	8 (40.0)	15 (75.0)	5.013	0.025*
Decrease	12 (60.0)	5 (25.0)		

Chi-square test (c), Fisher exact test (f), Independent t-test (t)

\* Significant level at 0.05 ( $\alpha=0.05$ )

Table 2:- The Level of Fasting Capillary Blood Glucose (FCBG) between the experimental and control group

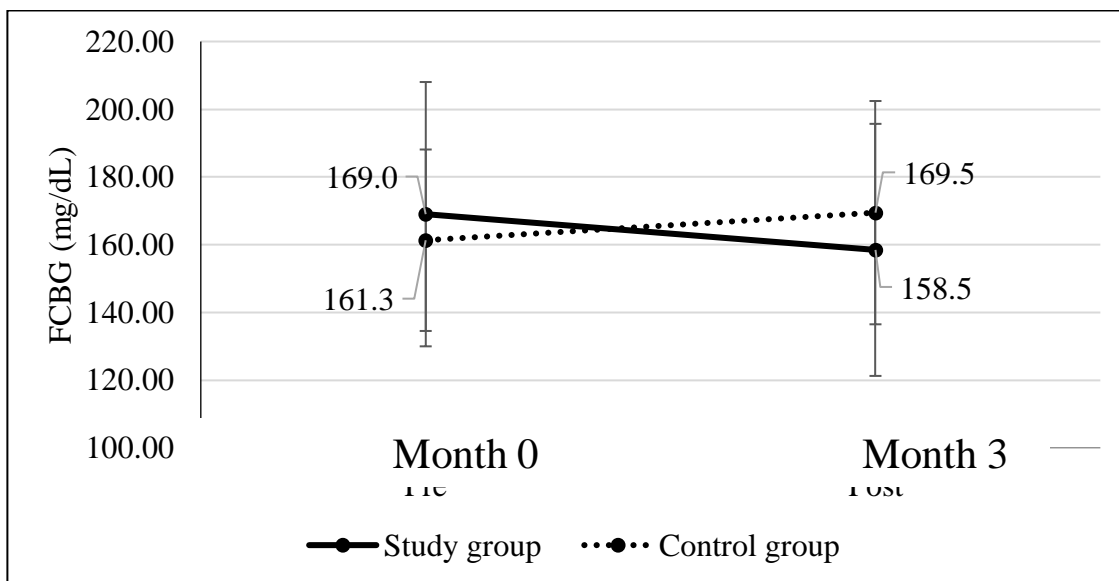


Fig 1:- The Level of Fasting Capillary Blood Glucose (FCBG) after 3 months between the experimental and control group

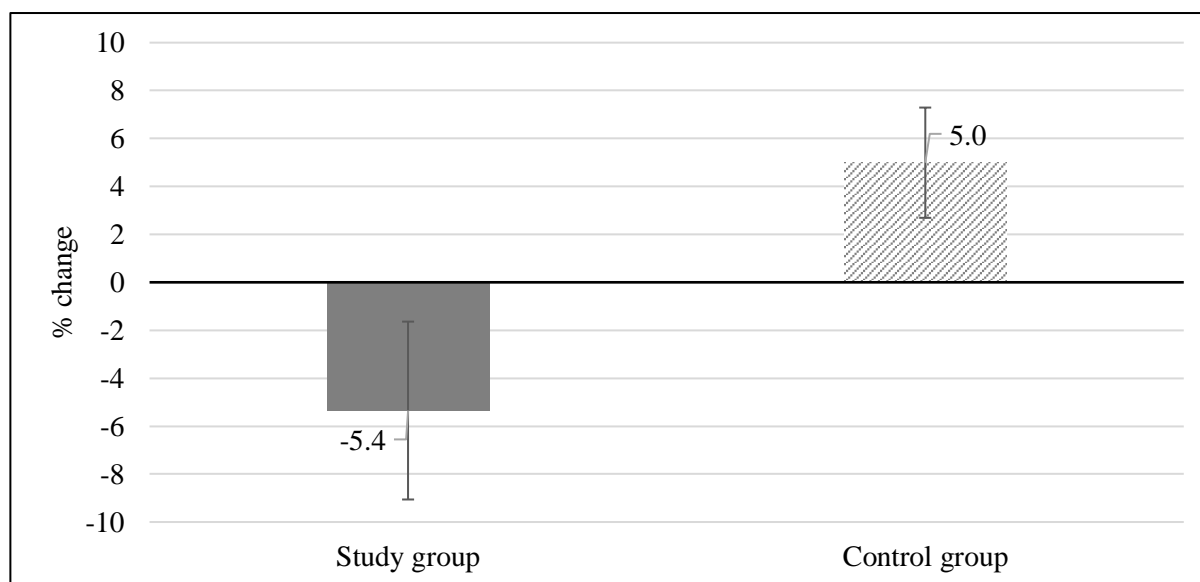


Fig 2:- ค่าร้อยละการเปลี่ยนแปลงของ FCBG (%) ของกลุ่มศึกษาและกลุ่มควบคุม

## VI. DISCUSSION

According to the findings assessed at NCD Clinic of Health Promoting Hospital in Khao Wong sub-district, Phra Phutthabat District, Saraburi Province, it is found that most of patients are females and patients' average age is 61.2±12.2 years old. The results correspond with HDC (Health Data Service Center) of Public Health Department of the year 2019<sup>4</sup>. The average body mass index (BMI) is 26.5±6.6 kg/m<sup>2</sup>, and this BMI is classified as obesity according to BMI criteria of Asian population<sup>11</sup>. Most of participants do not exercise regularly. Regarding their medical history, in addition to having diabetes, 90.0 and 82.5 percent of participant have high blood pressure and dyslipidemia, respectively. Participants' general data correspond with the risk factors of having diabetes, which include obese or overweight females, not exercising regularly despite an increase in age, and having high blood pressure or dyslipidemia.

When comparing general and health data of participants in the study and control group, it is found that the systolic and diastolic blood pressure level of participants in the study group is significantly higher than those in the control group (P=0.022 and P=0.016 respectively). As convenience sampling is applied in choosing samples, this might have caused selection bias. Since participants are able to deny participating in this study, the patients who cannot control blood pressure level well are less likely to deny participating in this study than those who can.

Three months after the experiment, the average Fasting plasma glucose of the study group decreased by 10.6±6.3 mg/dL, while that of the control group increased by 8.2±3.6 mg/dL, which shows significant difference (P=0.015). The average of Fasting plasma glucose after the experiment of the study group is at 158.5±37.2 mg/dL, while that of the control group is 169.5±33.0 mg/dL. The results correspond with Maryam Suemu's previous study<sup>7</sup>, which focused only

on the samples that do not have a good control of their blood sugar levels. It is found that FBS levels before and after the experiment is at  $182.3 \pm 43.9$  mg/dL vs  $163.9 \pm 50.8$  mg/dL. This indicates that the study of samples that do not have a good control of their blood sugar levels would show more evident change in blood sugar level than the use of samples that both have and do not have a good control of their blood sugar levels. In addition, regarding the number of participants who have undergone a decrease in Fasting plasma glucose, it is found that there are 12 participants (60.0%) in the control group who have experienced that, whereas there are only 5 participants (25.0%) in the control group, which shows significant difference ( $P=0.025$ ).

The results are consistent with the study hypothesis, and it can be concluded that the efficacy of a health program and a food diary can help patients to decrease their blood sugar level within 3 months. The positive change is caused by the fact that the study group has been informed of exchange food lists and diabetic food to change and correct patients' eating habits. Also, by recording their meals, the patients are enabled to aware of their choices of diets. The findings correspond with the previous studies<sup>5,6,7</sup> and the mindsets in improving health<sup>11</sup>. The objective in cure diabetes is to control the blood sugar level to be at the normal level, or as close as possible in order to avoid complications that may occur in the future.

The successful self-care must correspond with patient's daily routines, and this includes the changing in the habits of exercising, eating, and weight controlling. The patients should not smoke, and they should control their blood sugar levels to be at the normal levels. This also includes regular feet examination, eyes and kidney's functions<sup>14</sup>. However, since the length of the study, 3-month period, might be quite short, the study of other factors should be proceeded in a longer period. This could indicate the positive changes more evidently, and this could help patients to have a better control of diabetes and prevent the complications from occurring in the future.

The strength of the tools used in this study, the health program and the food diary, is that they are not complicated tools in helping diabetic patients control their blood sugar levels. They can be applied easily, and they are also appropriate for the usage at primary care unit and health promoting hospitals in local districts. This can be concluded by the fact that all 20 participants in the study recorded their meals in the diary and kept up to their appointments throughout three-month period. The limitation of this study is that it is a non-blinding study as it is unable to keep the division of sample groups into the study (those who have received a health program and a food diary) and the control groups confidential, and this might result in the bias found in the study. Moreover, the samples are randomized by the convenience sampling method, and this might result in the limited distribution of the sample groups. However, the general data of participants in this study is very similar, though the use of computer-generated randomization might help to decrease the amount of selection bias and accidental bias.

## VII. CONCLUSION

The efficacy of a health program and a food diary can help patients with type 2 diabetes to control their blood sugar levels, and this can be concluded from the fact that the Fasting plasma glucose before and after the experiment of the study group shows significant difference. Therefore, it is advisable that doctors should include the health program and the food diary in the alternative methods in helping diabetic patients reduce their blood sugar levels, especially those who receive medical service at primary care unit and promoting health hospitals in local districts.

## SUGGESTIONS

1. The efficacy of the health program and the food diary can help patients with type 2 diabetes to control their blood sugar levels, so it could be provided to patients at primary medical centers and promoting health hospitals in local districts. However, for the provision to patients at secondary or tertiary medical centers, it should improve to be more appropriate for patients with other chronic diseases such as chronic kidney disease.
2. There should be a follow-up provided to patients after the study in order to assess their average blood sugar levels during the last three years.
3. In this study, there is a limitation, which is the time length of study. Hence, it is advisable to use a longer period, and assess patient's blood sugar level in the long terms, such as 6, 9, and 12-month period.
4. It is advisable to apply randomized controlled trial (RCT) in the future study to prevent selection bias in choosing the samples and increase the validity of study results.

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