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ORIGINAL ARTICLE

Effectiveness of a family support coaching program on diabetes mellitus self-management to improve health outcomes among Thai patients with uncontrolled type 2 diabetes: a quasi-experimental study

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ABSTRACT

Type 2 diabetes (T2D) is a public health challenge globally and in Thailand. Uncontrolled diabetes leads to acute and chronic complications. Diabetes mellitus self-management (DMSM) with social support from family members is considered an effective strategy to control diabetes. This study aims to evaluate the effectiveness of a family support coaching program on diabetes mellitus self-management (FS-DMSM) to improve health outcomes among Thai patients with uncontrolled T2D. A quasi-experimental study employing a pre- and posttest design with a nonequivalent control group was conducted at Bamrasnaradura Infectious Disease Institute (BIDI), Thailand. Sixty-four patients with T2D who met inclusion criteria were selected in experimental and comparison groups for a period of 3 months. The patients and their family members of the experimental group were recruited in the FS-DMSM program receiving 4 sessions of DMSM and family support education while the patients of the comparison group received routine treatment and care at BIDI. The results showed that after completing the intervention program, the experimental group significantly increased perceived diabetes family support, diabetes knowledge, diabetes self-efficacy and diabetes self-management within and between groups before and after intervention ($p<0.05$). Fasting plasma glucose and HbA1c also decreased significantly within and between groups before and after implementing ($p<0.05$). In conclusion, the FS-DMSM program could improve health outcomes of Thai patients with uncontrolled T2D. The FS-DMSM program should be merged with routine diabetes self-management education interventions to enhance DMSM practices.

Keywords: Family support, diabetes mellitus self-management, glycemic control, uncontrolled type 2 diabetes.

INTRODUCTION

Diabetes is a chronic, metabolic disease characterized by high blood glucose levels due to insufficient or infective use of insulin by the body. Type 2 diabetes (T2D) is the most common among adults [1]. Diabetes is projected be the 7th leading cause of death in 2030 [2]. The world diabetes prevalence was estimated to be 9.3% in 2019 and will rise to 10.2% by 2030 [3]. The global target is to halt the rise in diabetes by 2025 [4]. In Thailand, more than 4.2 million diabetes cases were reported in 2019. The prevalence of diabetes is approximately 8.3% in the Thai adult population aged 20 to 79 years old [5]. Diabetes accounts for approximately 4% of total deaths by total noncommunicable diseases (NCDs) [6] and an estimated 1.3 million Thai adults will live with diabetes at the end of 2035 [7].

Two thirds of patients with T2D live in urban areas [3]. Diabetes prevalence in the urban area was related to several risk factors including sedentary lifestyle, unhealthy diet and lack of time for regular exercise.[8-10] Diabetes mellitus self-management (DMSM) is necessary to delay disease progression and prevent complications. DMSM is defined as self-care- activities of patients with diabetes in six aspects, i.e., diet control, physical activity, blood glucose monitoring, medication adherence, prevention of complications, and regular follow-up [11]. The target of glycemic control (HbA1c <7%) is recommended among adult patients with T2D [12]. Poor glycemic control due to untreated or inadequate DMSM will induce serious acute and chronic complications [13]. Related findings showed that patients practicing DMSM properly maintained glycemic control [14] delayed the progression of the disease, prevented the risk of developing complications [15], reduced mortality, prevented hospital admissions, lowered cost of diabetes treatment [16-18] and improved their quality of life [19,20].

Factors influencing DMSM among patients with T2D comprised DM knowledge and DMSM knowledge [21], self-efficacy on DMSM [22], and social support from family members and healthcare providers [23]. Among these factors, social support from the family plays a vital role in supportive DMSM and helps patients to overcome diabetic complications [23-26]. Family members are considered a fundamental source of information and motivation for patients with T2D to successfully maintain diabetes control. Patients with T2D receiving full social support from their family members improved their DMSM control practices with positive health outcomes [27-29]. In DMSM, family members can provide social support to patients with T2D in terms of instrumental support (assist financially, prepare healthy meals, perform physical activity together, and accompany to visit the doctor), informational support (provide information related to DMSM practice), emotional support (encourage, praise and motivate the patient to follow DMSM), and appraisal support (setting glycemic control goals and evaluating).[30] Related findings of studies in Thailand have indicated that DMSM with family member involvement helped patients with T2D to control diabetes and delay diabetes complications [31, 32]

Bamrasnaradura Infectious Disease Institute (BIDI), located in the urban area of Nonthaburi Province, is a government 250-bed hospital serving as a general as well as

tertiary care hospital for significant infectious diseases. Because noncommunicable diseases (NCDs) have been dramatically increasingly rapidly in the last two decades in Thailand [6, 7], BIDI has expanded its services on NCDs including diabetes to efficiently mobilize healthcare resources. Patients with diabetes in urban areas of Nonthaburi and Bangkok can visit the BIDI for medical services at the Medicine Unit. However, diabetes self-management education and individual and group coaching on DMSM are not routinely conducted. The high volume of patients including patients with T2D creates a burden in providing services. In addition, insufficient family support on DMSM practices, especially when performing activities of daily living at home allow uncontrolled T2D problems to continue.

Related studies have focused on patients and supports from healthcare providers and families in DMSM programs in communities, hospitals and diabetes clinics in rural areas in Thailand. However, a lack of sufficient information exists regarding the roles of family members providing support in DMSM in urban settings [31, 32]. Family members are key individuals in daily living activities of patients with T2D because they stay together in the same family. Therefore, family support was a focal point in DMSM for glycemic control of patients with T2D [33]. This study aimed to identify the effectiveness of a FS-DMSM on diabetes self-management. The social support theory in health of House [34] was applied to develop a FS-DMSM to strengthen family members to support patients on DMSM to delay progression of the disease and its complications. This intervention program emphasized capacity building and coaching strategy using participatory learning experiences between patients and their family members including small group discussions, brainstorming, role plays, case studies, demonstrations and practices. In addition, home visits, workplace visits, social networking using the Line application to share information and follow up on regular DMSM were also included in this study. Findings from this study could be applied to routine services to strengthen social support from family members to enhance DMSM practices among glycemic uncontrolled patients with T2D in urban areas of Thailand in the future.

MATERIALS AND METHODS

Design

A quasi-experimental study, employing a pre- and post-test design with a nonequivalent control group, was conducted. Data were collected three times at the initial period as a pretest, while posttests were conducted when the intervention was finished at the 4th week and at the 12th week of follow-up. Glycemic control (FPG, HbA1c) were collected twice from the BIDI laboratory records as pretest at baseline and posttest at 12th week follow-up.

Study setting, inclusion & exclusion criteria, sampling technique and sample size

Study setting: The Medicine Unit of BIDI, located in Nonthaburi Province was selected as the study site.

Inclusion and exclusion criteria: patients with Uncontrolled T2D and their family members serving as the main caregivers and willing to participate in the study were recruited as the subjects The inclusion criteria among patients with uncontrolled T2D included: 1) receiving a diagnosis of T2DM less than 5 years with HbA1c level 7 to 8% or higher. The reason to select those with duration of illness less

than 5 years because the longer the duration, the more complications were found including retinopathy, chronic kidney disease and heart disease, 2) aged 35 to 65 years old for which diabetes prevalence was usually found at higher levels than those of other age groups, 3) taking medication and 4) able to communicate in Thai, both verbally and in writing. Exclusion criteria included: 1) patients with T2D receiving insulin injection, having severe diabetic complications and underlying diseases and 2) those who could not fully comply with the intervention. The inclusion criteria of a family caregiver comprised; 1) living together with patients with T2D for at least one year and 2) able to communicate in Thai, both verbally and in writing.

Sampling technique: patients with T2D meeting the inclusion criteria were selected using the patient registration by queue of each day they visited. The selected subjects were randomly allocated to an experimental or a comparison group.

Sample size calculation: The sample size was calculated based on a comparison of two sample means [35]. Effect sizes (d) were calculated to determine the practical significance of these differences at a significant level ($p<.05$). In all, 25 participants for each group were needed based on a related study among Thai adults with T2D [31]. However, an effect size of Cohen equal to 0.50, indicated 1/2 of a standard deviation increased the outcome [36]. The calculated sample size for each group was equal to 32 of patients-caregiver dyads to achieve an effective size of 0.50 when α level was set at 0.05 and the power of test (1-β) was set at 0.80.

The FS-DMSM on DMSM

Aims and scope of the intervention program: A FS-DMSM was developed based on the social support theory of House [34]. The program aimed to improve family support on DMSM practices of patients with diabetes to improve their glycemic control and health outcomes.

Focal point of the program: The focal point of the program was the main caregiver in the family who supported the patient on daily living activities as well as DMSM practices. Participatory learning was conducted using the local language throughout the 12-week process by involving patients-caregiver dyads. This activity consisted of four sessions covering all aspects of DMSM, for which each session consumed from 60 to 90 minutes.

Description of the intervention program: The training program was conducted from July to September 2019. Five trainers including a researcher, two health counselors and two nurse educators facilitated the training. Participatory learning experiences through reflection and sharing, small group discussions, brainstorming, case studies, role plays and group and individual coaching were used for skill building of the caretakers to provide social support to the patients. This interactive learning process enabled the intervention group to earn sufficient knowledge and develop skills in dealing with the patients on their DMSM practices. The intervention program comprised four main sessions for which each session was conducted once weekly. Duration of each session was from 60 to 90 minutes.

The first week was used to explore the caregiver-patient's problems on diabetic control and diabetic self-management practices, to establish diabetic goal setting and to enhance family members' knowledge on DM causes and complications, symptoms of hypoglycemia and

hyperglycemia and how to manage to maintain optimum ranges of blood sugar and HbA1C. At the end of the session, all patients and caretakers were invited to join a Line group. The Line group aimed to disseminate information to promote DMSM and monitor family members to support patients.

The second week was used to enhance a sense of responsibility among the family members to support patients and to raise their awareness on the importance of DMSM practices. Group-based coaching using case studies, demonstrations, role plays and practices were used to motivate family members to provide four types of social support to patients with T2D. This included instrumental support by accompanying to visit the doctor or preparing meals for patients. Emotional support was provided by encouraging, listening and empathizing patient's suffering. Informational support was provided to remind about medication and follow-up schedule as well as to recognize the importance of regular self-management practices. Appraisal support concerned decision making and evaluation results of proper or poor self-management on glycemic control.

The third week emphasized collaborative learning between patient and the caregiver to build-up skills in five aspects of DMSM including diet control, physical activity, medication adherence, blood glucose monitoring and management of hypo and hyperglycemia and its complications. The activities focused on preparing a simple menu for glycemic control and performing daily physical activity. Individual coaching was also included to enhance personal skills on blood glucose testing and manage hyperglycemic and hypoglycemic symptoms.

The fourth session emphasized the last aspect of DMSM on follow-up of the patient-caregiver activities at home and workplace to maintain DMSM practices. Line group and Line call was used to maintain connection and follow-up to strengthen family support in DMSM in all aspects.

At the end of the first session, the researchers provided a diabetes self-management booklet for self-study and self-report their activities in terms of dietary intake, regular medication, regular exercise and regular blood glucose monitoring. Details of family support in the DMSM program are shown in Table 1.

Table 1 Family support coaching program on diabetes mellitus self-management

Session/Time	Training method	Training materials
Session 1: Diabetes overview (60 minutes)	**Strategy:** Patients and family members focused **Objective:** To improve DM knowledge **Activity:** Lecture, presentation, QA, brain storming, group discussion. **Content:** T2D risks, causes, glycemic control range, FPG, HbA1c, complications, conclusion.	- Questionnaires - Handouts - Booklet - Video clip showed the symptoms of type 2 diabetes
	Strategy: Patient focused	Questionnaires

Session/Time	Training method	Training materials
Session 2: Diabetes self-management (90 minutes)	**Objective:** To improve DMSM knowledge and skills on DMSM practice. **Activity**: Lecture, presentation, brainstorm, role play, small group discussion, case study, demonstration. **Content:** DMSM components Diet control: healthy foods, glycemic index level of foods, diabetes plate, meal plan Physical activity: type, duration, exercise plan, and schedule Medication adherence: diabetes medication, side effects, dosage, reminder methods. Blood sugar monitoring: importance, self-blood monitoring at home, how to use a testing device to check blood sugar. Prevention of complications: acute and chronic complications, foot care, body check-up, patient-healthcare provider communication. Regular follow up: reminder, document preparation, questions to ask healthcare providers at hospital. Conclusion: QA, goal setting for DSM	Handouts Booklet Video clips show DSM practice Food models Physical activity and exercise pictures Blood sugar testing device Video clips and pictures showed diabetes foot care steps.
Session 3: Family support in DMSM (60 minutes)	**Strategy:** Family members focused. **Objective:** To increase family support on DMSM practice. **Activity:** Lecture, presentation, brainstorm, role play, small group discussion, case study, demonstration, voluntary **Content:** Social support from family Instrumental support: accompany the patient to see the doctor, financial assistance, food and equipment shopping, healthy meal preparation, meal and exercise together. Emotional support: empathy and listening to patient's suffering, cheering, encourage the patients to adhere to DMSM practice.	Questionnaires Handouts Booklet Video clip showed how family could support patients in DMSM practice. Family support on DMSM pictures

Session/Time	Training method	Training materials
	Informational support on treatment, self-care, and diabetes prevention information, meal plan and exercise schedule, remind to adhere to self-care plan, and follow up as schedule. Appraisal support: decision making, evaluation, and compare glycemic control results and how to improve DMSM practice.	
Session 4: Follow up (60 minutes)	**Strategy:** Patients and family focused. **Objective:** To strengthen and maintain DMSM practice and family support. **Activity:** Home visits and workplace visits hospital follow-up appointments, social network Line group, Line call. Continue DM and DSM knowledge provided Sharing problems and difficulties and find solutions on DMSM practice and support. DMSM activities sharing	Questionnaires Online video clips about DMSM, care, and DM prevention. Pictures Line group

Description among the comparison groups: Among the comparison groups who were attending the same clinic but on different days from the experimental group, routine services based on standard guidelines of the hospital were provided as usual by doctors and nurses. The guidelines comprised regular check-ups and medication monthly with routine health education each visit. At the end of the 12th week of follow-up for posttest, a booklet and one session on DMSE with a demonstration of food menus, proper exercise and blood glucose testing were provided to the comparison group.

Data collection process

Preparation phase

A one day meeting was conducted between researchers and the two research assistants to explain the intervention processes and to train them to collect data by assisting in each activity of the intervention process and how to coach the patients and their family members to increase their skills. The research team implemented a one-month program with a total of four sessions at the OPD clinic of the BIDI and at their home or workplace. Two nurses from the BIDI joined both groups and provided individual counseling for patients with T2D and their family members to solve DMSM problems.

Data collection phase

Patients and their family members scheduled appointments and informed on training schedules at the initial phase of recruitment. Before starting the training program, the patients who agreed to participate in the program were asked to answer the questionnaire consisting of DMSM behaviors, perceived family support on DMSM, diabetes knowledge and DMSM self-efficacy at baseline. This questionnaire was conducted among patients in both experimental and comparison groups at the first and third month after the program ended. Laboratory

reports of FPG and HbA1c were collected at the hospital between the experimental and comparison groups at a baseline and at the third month. The patient's information was obtained from OPD records and patient's profile. Home visits, workplace visits and Line calls were made for patients and their caregiver every week from the beginning to the 12th week at the program end to monitor family support on DMSM.

Instrument to collect data

A structured questionnaire was used to collect data from both the experimental and control groups. The questionnaire was developed by the researchers based on literature review, modified from existing standard tools and validated by three experts in the NCD field. Data was obtained through face-to-face interviews about 45 to 60 minutes each respondent in both the experimental and comparison groups before conducting the intervention and considered as baseline data for all respondents. Thirty-four subjects from Phra Phutthabat General Hospital were involved in a pilot test to examine the reliability of the questionnaire. Socio-demographic questionnaires were used to collect data from patients and family members. DFBC-II, DKT, DSE and DSMQ-R Thai versions were used to collect data among patients. The questionnaires were separately conducted between the patient and the main caregiver.

Patient questionnaire: The six parts of the questionnaire are described below.

1) Socio-demographic and health related data comprised 7 questions on age, sex, education level, marital status and family history of diabetes, duration of diabetes, family caretakers.

2) Diabetes Family Behavior Checklist II (DFBC-II) Thai version: The DFBC-II was used to measure social support that patients with diabetes received from their family members for diabetes self-management. Cronbach's alpha coefficient ranged from 0.67 to 0.80 for supportive items. The DFBC-II Thai version presented an internal consistency of 0.72. In this study, 9 supportive items of the DFBC-II were used with permission from the developers to collect information on family support on diabetes in terms of diet, exercise, medication adherence and glucose testing. The response for each item ranged from 1 to 5 (1 = never, 2 = twice monthly, 3 = once weekly, 4 = several times weekly and 5 = at least once daily). The total score ranged from 9 to 45 and a higher score reflected a higher level of perceived family support [37, 38] DFBC-II was collected at three times: pretest at baseline, posttest at 1st month and 3rd month.

3) The diabetes knowledge test (DKT) Thai version: The DKT was developed by the Michigan Diabetes Research Training Center. These 23 items represent a test of general knowledge of diabetes. The first 14 items were used to examine diabetes knowledge of the participants who were not insulin dependent. Each question has four answer choices and the one correct answer received a score of 1 while the incorrect one received a score of 0. The total score ranged from 0 to 14 and a higher score indicated a higher level of diabetes knowledge. This questionnaire was modified and translated to Thai to be more appropriate for Thai patients. The Cronbach's alpha of the DKT in related studies was higher than 0.70.[39, 40] DKT was collected at three times: pretest at baseline, posttest at 1st month and 3rd month.

4) Self-Efficacy for Diabetes questionnaire (DSE) Thai version: Diabetes self-efficacy is defined as the belief of people in their own ability to complete tasks and achieve the goals in DSM practice. In this study, DSE was used to measure self-efficacy. Participants needed to respond to 8 items of a 10-point rating scale, ranging from 1 (not at all confident) to 10 (totally confident). The total score ranged from 8 to 80 and a higher score indicated higher self-efficacy. The internal consistency reliability was 0.83.[41,42] DSE was collected at three times: pretest at baseline, posttest at 1st month and 3rd month.

5)Diabetes Self-Management Questionnaire-Revised (DSMQ-R) Thai version: The DSMQ-R is a 5-point rating questionnaire with 20 items for noninsulin patients, including 9 positive and 11 negative items developed by Andreas Schmitt to assess self-care activities associated with glycemic control among adults with diabetes. All items described self-care activities related to the patient's diabetes over the last eight weeks. Participants rated the positive items using a 4-point Likert scale, including 3 (applies to me very much); 2 (applies to me to a considerable degree); 1 (applies to me to some degree); and 0 (does not apply to me). When '...is not required as a part of my treatment' is stated in the item, this item was not scored. The total of 20 items was computed before summing to the scale score and a higher total score indicated more effective self-management. The DSMQ-R Thai version reliability test using Cronbach's alpha coefficient exhibited a value of 0.78 [43,44]. DSMQ-R was collected at three times: pretest at baseline, posttest at 1st month and 3rd month.

6) Glycemic control outcomes measurements: Glycemic control (FPG mg/dl, HbA1c%) results were collected twice from the laboratory records of the BIDI as pretest at baseline and as posttest at 3rd month follow-up of the intervention period.

Main caregiver questionnaire: The four questions on socio-demographic data included age, sex, education level and relationship with patients.

Statistical analysis

Descriptive statistics were used to describe the demographic characteristics of participants and study variables in terms of frequency distribution, percentage, mean, range and standard deviation (SD). Independent t-test and repeated measure ANOVA were applied to examine the changes in perceived family support, diabetes knowledge, diabetes self-efficacy and diabetes self-management at baseline, the 1st month and 3rd month after the intervention. Paired-sample t-test was performed to compare the score of plasma glucose and HbA1c within the group before and after the intervention.

FPG and HbA1C levels showed nonnormal distribution so the Mann-Whitney U test was used to compare the rank of mean FPG and HbA1c score between the experimental and control groups. Level of statistical significant was set at $p < 0.05$.

Ethics considerations

This study was approved by Ethics Review Committee for Human Research, Faculty of Public Health, Mahidol University (COA. No. MUPH 2017-2020) and the Central Research Ethics Committee (CREC), Bamrasnaradura Hospital (IRB BIDI R023h/59). Inform consent was provided by each patient-caregiver dyad willing to participate in this study. The

information of the participants was kept confidential.

RESULTS

Characteristics of the participants

The 64 patients were divided in two groups. Overall, the participants in the experimental and comparison groups did not significantly differ in demographic characteristics. More than one half of the participants in both groups were male and in their 50s. The majority graduated from high school or obtained higher education levels. Most participants were married and had a family history of diabetes. Regarding the duration of diabetes, approximately one half of participants in the experimental group had been living with diabetes for more than two years while nearly 41% in the comparison group reported having the illness less than one year. The main support source came from the spouse in both groups (Table 2).

Table 2 Demographic characteristics of the patients between the two groups

Characteristics	Experimental group n = 32 (%)	Comparison group n = 32 (%)	*p*-value
Age (year)			
Mean ± SD	51.7 ± 8.5	49.5 ± 7.1	.281[a]
(Min-Max)	(35.0 - 65.0)	(35.0 - 64.0)	
< 40 years	5 (15.6)	4 (12.5)	
40 – 49 years	5 (15.6)	8 (25.0)	
50 – 59 years	16 (50.0)	18 (56.3)	
≥ 60 years	6 (18.8)	2 (6.2)	
Sex			.614[b]
Male	19 (59.4)	17 (53.1)	
Female	13 (40.6)	15 (46.9)	
Education			.837[c]
Primary school	6 (18.8)	8 (25.0)	
Secondary school	6 (18.8)	4 (12.5)	
High school	10 (31.2)	9 (28.1)	
University and higher	9 (28.1)	8 (25.0)	
Other	1 (3.1)	3 (9.4)	
Marital status			.507[c]
Single	3 (9.4)	6 (18.8)	
Married	26 (81.2)	22 (68.7)	
Widowed/divorced/ Separated	3 (9.4)	4 (12.5)	
Duration of diabetes (month)			
Mean ± SD	32.2 ± 23.3	23.8 ± 22.0	.141[a]
(Min-Max)	(2 – 60)	(1 – 60)	
< 1 year	8 (25.0)	13 (40.6)	
1 - 2 years	7 (21.9)	8 (25.0)	
>2 years	17 (53.1)	11 (34.4)	
Family history of diabetes			.784[b]

Characteristics	Experimental group n = 32 (%)	Comparison group n = 32 (%)	*p*-value
Yes	23 (71.9)	22 (68.7)	
No	9 (28.1)	10 (31.3)	
Family caregivers			.200[b]
Wife	15 (46.8)	9 (28.1)	
Husband	8 (25.0)	11 (34.4)	
Children	6 (18.8)	4 (12.5)	
Sibling/Parents/ Relatives	3 (9.4)	8 (25.0)	

Note: *a: obtained from independent t-test; b: obtained from Chi-square; c: obtained from Fisher's exact test; SD = Standard Deviation.*

Effectiveness of the program on study outcomes

The findings showed no significant differences in perceived diabetes family support, diabetes knowledge, diabetes self-efficacy, diabetes self-management, fasting plasma glucose and HbA1c between the two groups at baseline (Table 3).

Table 3 Comparison of the studies variables between the two groups over time

Outcomes	Experimental group (mean ± SD)	Comparison group (mean ± SD)	Effect size	p-value
Perceived diabetes family support (DFBC-II)				
Baseline	24.0 ± 9.9	21.0 ± 9.8		.23[a]
1st month	31.0 ± 9.2	21.1 ± 10.1		<.001[a]
3rd month	28.5 ± 8.9	21.6 ± 10.1	0.68	.005[a]
Diabetes knowledge (DKT)				
Baseline	9.8 ± 2.0	9.1 ± 2.3		.19[a]
1st month	12.4 ± 2.5	9.1 ± 2.3		<.001[a]
3rd month	13.3 ± 1.0	10.3 ± 2.1	1.42	<.001[a]
Diabetes self-efficacy (DSE)				
Baseline	47.7 ± 16.3	46.3 ± 13.0		.69 [a]
1st month	59.1 ± 16.1	45.1 ± 12.7		<.001[a]
3rd month	58.8 ± 15.5	45.3 ± 14.6	0.93	.001[a]
Diabetes self-management (DSMQ-R)	5.9 ± 1.3	6.1 ± 1.0		.40 [a]
Baseline				
1st month	7.3 ± 1.1	5.8 ± 1.0		<.001[a]
3rd month	7.5 ± 1.2	5.8 ± 1.1	1.54	<.001[a]
Glycemic control				
Fasting plasma glucose				
Baseline	157.6 ± 28.3	166.8 ± 55.2		.41 [b]
3rd month	135.3 ± 35.3	163.1 ± 55.4	-0.50	.017 [b]
p-value	<.001[c]	.623 [c]		

Outcomes	Experimental group (mean ± SD)	Comparison group (mean ± SD)	Effect size	p-value
HbA1c				
Baseline	8.4 ± 2.0	8.8 ± 1.7		.40 [b]
3rd month	7.3 ± 1.2	8.4 ± 1.5	-0.73	.002 [b]
p-value	<.001[c]	.114[c]		

Note: *a: obtained from independent t-test; b: obtained from Mann-Whitney U test; c: obtained from paired-sample t-test; p-value <.01; Cohen classified effect sizes as small (d = 0.2), medium (d = 0.5), and large (d ≥ 0.8).*

The patients with T2D in the experimental group showed significantly increased perceived diabetes family support (p<.001), diabetes knowledge (p<.001), diabetes self-efficacy (p<.001), diabetes self-management (p<.001) at the 1st and the 3rd months (Table 3). Specifically, the experimental group had higher perceived diabetes family support scores, diabetes knowledge, diabetes self-efficacy and diabetes self-management than the comparison group both at the 1st and the 3rd month after the intervention (Table 3, Figure 1). The results indicated a significant difference in the outcomes over time between the experimental and comparison groups. A significant difference was found in perceived diabetes family support (F= 8.202, p = .006), diabetes knowledge (F = 32.170, p <.001), diabetes self-efficacy (F = 8.233, p =.006) and diabetes self-management (F=18.543, p <.001) between the experimental and the comparison groups (Table 4). A significant difference was observed according to intervention stages. Perceived diabetes family support, (F=17.479, p<.001), diabetes knowledge (F=38.507, p <.001), diabetes self-efficacy (F = 9.820, p <.001), diabetes self-management (F = 13.919, p <.001) and interaction was observed between groups and intervention stages. Differences in perceived diabetes family support (F=16.298, p<.001), diabetes knowledge (F=13.761, p<.001), diabetes self-efficacy (F=14.192, p<.001) and diabetes self-management; (F=31.149, p<.001), were also found (Table 4).

Table 4 Repeated measures ANOVA of studied variables

Source of variation	*SS*	*df*	*MS*	*F*	*p value*
Perceived diabetes family support (DFBC-II)[a]					
Between subjects					
Group	2113.380	1	2113.380	8.202	.006
Error 1	15974.365	62	257.651		
Within subjects					
Time	419.010	1.264[b]	331.511	17.479	<.001
Time x group	390.698	1.264[b]	309.110	16.298	<.001
Error 2	1486.292	78.364[b]	18.966		
Diabetes knowledge (DKT)[a]					
Between subjects					
Group	268.380	1	268.380	32.170	<.001

Source of variation	*SS*	*df*	*MS*	*F*	*p value*
Error 1	517.240	62	8.343		
Within subjects					
Time	183.323	2	91.661	38.507	<.001
Time x group	65.510	2	32.755	13.761	<.001
Error 2	295.167	124	2.380		
Diabetes self-efficacy (DSE)[a]					
Between subjects					
Group	4456.380	1	4456.380	8.233	.006
Error 1	33558.865	62	541.272		
Within subjects					
Time	1117.260	1.656[c]	674.803	9.820	<.001
Time x group	1614.698	1.656[c]	975.246	14.192	<.001
Error 2	7054.042	102.652[c]	68.718		
Diabetes self-management (DSMQ-R)[a]					
Between subjects					
Group	47.102	1	47.102	18.543	<.001
Error 1	157.492	62	2.540		
Within subjects					
Time	16.450	1.182[b]	13.916	13.919	<.001
Time x group	36.814	1.182[b]	31.144	31.149	<.001
Error 2	73.276	73.289[b]	1.000		

***Note**: a: satisfied the assumption of homogeneity; b: Greenhouse-Geisser epsilon to adjust the degrees of freedom; c: Huynh-Feldt epsilon to adjust the degrees of freedom.*

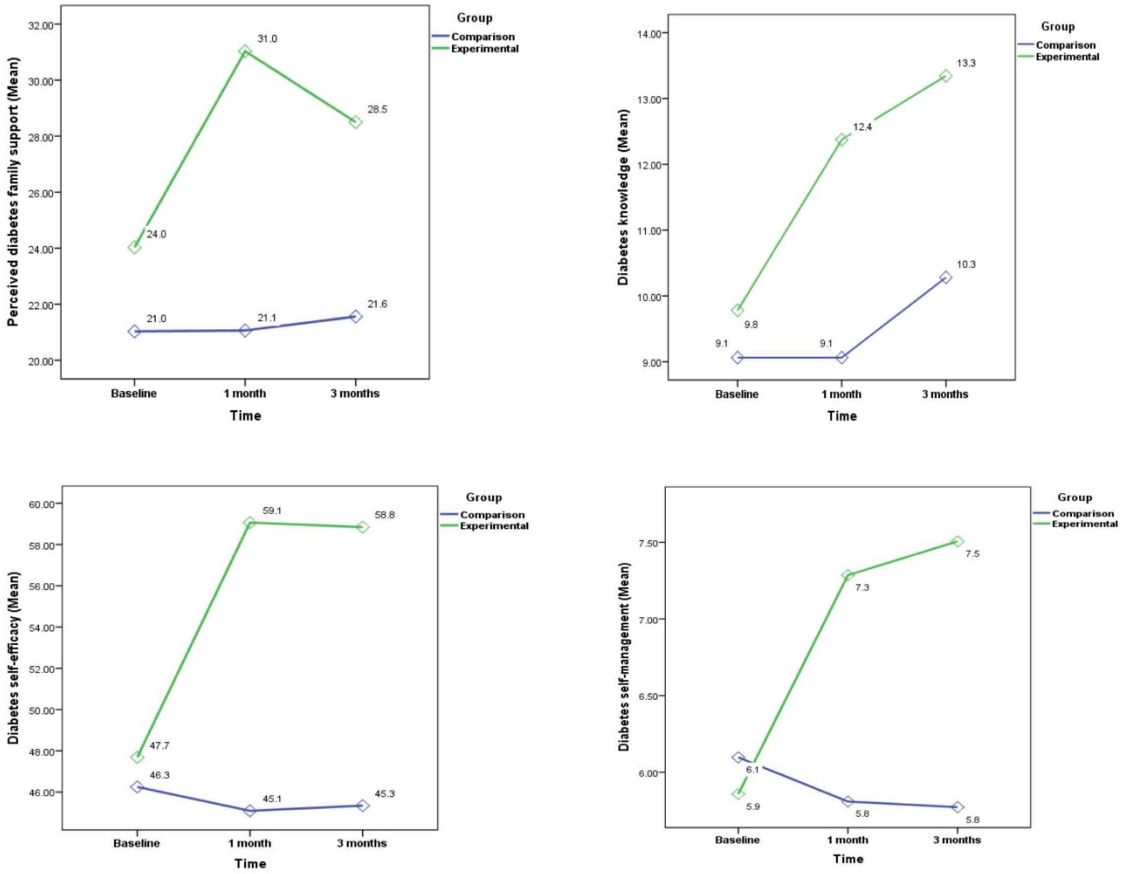

Figure 1 Mean differences of outcomes across time from FS-DMSM Program on perceived diabetes family support, diabetes knowledge, diabetes self-efficacy and diabetes self-management between the experimental and comparison groups

As presented in Table 3, the results showed a significantly reduced FPG level in the experimental group after the intervention ended (p <.001) while no significant change was observed in the comparison group (p = .623). In addition, the finding indicated that the experimental group had lower levels of FGD than the comparison group (p =.017). Regarding HbA1c, the level of the experimental group significantly reduced at the 3rd month after the intervention (p <.001) but did not different in the comparison group (p = .114). The experimental group had lower HbA1c levels than the comparison group at the 3rd month (p =.002).

The effect size was used to examine the magnitude of the program effect. The effect size was medium for perceived diabetes family support (d = 0.68), plasma glucose (d = 0.50) and HbA1c (d = 0.73) More importantly, the effect size was large for diabetes knowledge (d = 1.42), diabetes self-efficacy (d = 0.93) and diabetes self-management (d = 1.54) (Table 3)

DISCUSSION

Effectiveness of the program on study outcomes

The FS-DMSM on diabetes self-management indicated significant improvement of glycemic control, perceived diabetes family support, diabetes

knowledge, diabetes self-efficacy and DMSM over three months.

Sedentary lifestyles and poor diet control are common in the urban lifestyle contributing to poor DMSM [8-10] requiring more concern and involvement from family members. DMSM and family support played an important role in preventing and controlling diabetes [23-26]. The present study demonstrated that the program could improve the perceived diabetes family support of the experimental group compared with that of the comparison group. Family members who participated in the program learned and facilitated how to provide four types of social support including instrumental support, emotional support, informational support and appraisal support in DMSM practice. The findings were consistent with those of related studies [27-29].

Diabetes knowledge related factors influenced diabetes self-management [45, 46]. Family members also were more confident to provide support after they gained sufficient diabetes knowledge. The findings of the study indicated that they improved knowledge continuously after the training and program follow-up time.

The participatory learning method is appropriate to this FS-DMSM program because local language was used along with simple teaching methods including brainstorming, experience sharing, and demonstrations with individual and group coaching on DMSM practices. All activities helped to increase skills and confidence levels of patients with T2D to perform DMSM by themselves at home with sufficient support from their family members. In addition, social network Line group with messages, information, clips and DMSM activities shared online could motivate and help patients to maintain DMSM practices [56]. The findings were similar to related studies [45-47]. When patients with T2D and their family members gained diabetes knowledge, the patients will be confident to perform DMSM properly and their family members will enhance and provide support on DMSM sufficiently.

Diabetes self-efficacy is defined as the belief of patients in their ability to succeed in specific situations or accomplishing tasks to control diabetes. In this study, patients of the experimental group gained family support and diabetes knowledge so they were confident to perform DMSM practice daily properly. The findings revealed that their self-efficacy significantly increased after the training similar to the findings of related studies [32, 48].

DMSM helped improve glycemic control outcomes (FPG and HbA1c) leading to reduced risks of complications and improved their quality of life. [14-20] This study program facilitated the patients and their family to better understand and more fully realize the vital role of diabetes self-management. They were enabled to practice DMSM properly in daily living activities. The patient learned how to set goals and how to achieve them to control diabetes and prevent its complications. The experimental group significantly improved their diabetes self-management. The findings were consistent with studies conducted by Thojampa S [31] and Wichit N [32].

Glycemic control refers to blood glucose control level in a patient with diabetes including FGD, HbA1c. FGD measures glucose level after at least 8 hours of fasting. Hemoglobin A1C (HbA1c) test measures the amount of blood glucose attached to hemoglobin that provides information about the patient's average levels of blood glucose over the past three months [49]. In this study, FPG and HbA1c levels were decreased significantly among patients with T2D in the experimental group while no significant difference were

found in the comparison group after the intervention. It could be explained that the patients gained knowledge, self-efficacy, perceived diabetes family support and realized the benefits of DMSM. Patients were trained and facilitated how to set goals and perform and maintain their DMSM practice to control diabetes. They practiced diet control, made healthy food choices, and prepared proper diabetes meals. They also were trained how to plan and schedule their physical activity and exercise, and medication taking. In addition, patients were trained and practiced how to use blood glucose self-monitoring devices, and take care of themselves at home. Their family members were also facilitated regarding how to provide social support on DMSM. At the follow-up period after training, the patients and family members were motivated and encouraged to practice DMSM and provide family support. They also had opportunities to discuss and share their experiences and activities concerning how to achieve the goals they set. The findings of the study on glycemic control outcomes were similar to the findings of related studies [27, 31-33, 50-55].

Strength and limitations of the study

The strength of this study was a quasi-experimental design that could evaluate the effectiveness of the intervention on study outcomes in the hospital setting. In addition, social support theory and participatory learning method were applied to develop and implement the intervention program. The program could be applied in routine services of the BIDI by individual and group coaching for patients with T2D and their family members to help them to effectively practice and provide support on DMSM to control diabetes and prevent its compilations.

However, the duration of program was three months; therefore, outcomes of the program may not reflect the change in long term health outcomes of patients. The program was conducted on an OPD basis in a hospital, and noncontrolled variables may have influenced the outcomes so generalizing the findings to other settings may be limited.

RECOMMENDATIONS

Randomized control trials should be conducted in the future to ensure the effectiveness of FS-DMSM interventions. In addition, a larger sample size and longer time of follow-up should be used to observe the long-term impacts of the program on health outcomes of patients with T2D. In clinical practice, healthcare providers should involve family members to provide support and care for patients and participate in FS-DMSM program. The program can be modified and applied to other chronic metabolic diseases.

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