The Effect of Diabetes Self-management Education Provided by Certified Diabetes Educator Compared to Usual Diabetes Education on Glycemic Level and Stage of Behavior Change in Adult with Types 2 Diabetes Mellitus

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ABSTRACT

Objective: To explore the effect of diabetes self-management education and support (DSMES) provided by Siriraj certified diabetes educators (CDE) compared to usual diabetes education (DE) on glycemic level and stage of behavior change in patients with type 2 diabetes mellitus (T2D).

Materials and Methods: Patients with T2D having A1C 8-12% were recruited between 2019-2020 to receive DSMES from CDE. Patients received the usual DE from healthcare professionals in 2016 were randomly selected from their medical records.

Results: 76 patients were enrolled in each group. Mean±SD age was 59.4±11.5 years. After receiving DSMES and DE, A1C decreased dramatically at 3 months in both groups without significant difference between the groups (9.4±1.1% to 8.0±1.2% vs. 9.5±1.1% to 8.1±1.5%, respectively). However, the DEMES group can further decrease A1C to 7.8±1.2% while A1C in the usual DE group increased to 8.5±1.6% at 12 months (p=0.028). In the DSMES group, most patients can move to the next stage of behavior change and reported a better QOL (89.4±11.6 vs. 92.6±12.2, p=0.018).

Conclusion: The receipt of DSMES from CDE significantly improved the level of A1C, the stage of behavior change, and QOL. Its benefit on the glycemic level can last at least one year.

Keyword: Diabetes self-management education; certified diabetes educator; glycemic level; stage of behavior change; quality of life (Siriraj Med J 2024; 76: 61-68)

INTRODUCTION

Type 2 diabetes mellitus (T2D) is a disorder of carbohydrate metabolism with two main pathophysiologies, including insulin resistance and relative insulin deficiency. The Western Pacific region has the highest number of people living with diabetes in 2021, which is 206 million, and could project to 260 million by 2045.[1] In the same direction, the prevalence of diabetes in Thailand has increased from 8.9% in 2014 to 9.5% in 2020,[2] and only 33.3% of people with type 2 diabetes can achieve optimal glycemia.[3]

Diabetes Self-Management Education and Support (DSMES) is the process of facilitating the knowledge, skills, and abilities necessary for diabetes self-care. It is

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an important element in diabetes care that helps people with diabetes make informed decisions, solve problems, develop personal goals and action plans, and cope with emotions and life stresses.It can facilitate behavior change, improve glycemic control, reduce diabetes complications, and improve quality of life.[4] The previous national Thai survey demonstrated the need for competent diabetes educators, adequate time to provide diabetes education, and a clearly defined role for diabetes educators.[5] The Siriraj Diabetes Center of Excellence has established the Certified Diabetes Educator Program, Faculty of Medicine Siriraj Hospital, in 2017, which is the first certified diabetes educator program in Thailand organized by the Faculty of Medicine. After graduating, Siriraj Certified Diabetes Educator (CDE), who works in our hospital, will rotate to work as CDE in DSMES clinic. The objectives of this study were to evaluate the effect of CDE-provided DSMES compared to the usual diabetes education (DE) provided by the health professional on the glycemic level, the behavior change, and the quality of life.

MATERIALS AND METHODS

Design and participants

This is a prospective cohort with a historical controlled cohort study at Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. The inclusion criteria were 1) adult patients with T2D aged 18-80 years 2) having A1C 8-12% 3) having been diagnosed with T2D for at least 6 months and 4) receiving DSMES from CDE or usual DE from the health care professional. The exclusion criteria were patients with terminal illness or unable to participate in the DSMES program. Patients in the usual DE group were randomly selected from the electronic medical record. They had to receive the usual DE from the healthcare professional in the Outpatient Division or Siriraj Diabetes Center during 2016 before establishing CDE. In the DSMES group, patients were recruited from the DSMES clinic at Siriraj Diabetes Center of Excellence during 2019-2020. They received DSMES by CDE at baseline, 3, 6, and 12 months. Demographic data, glycemic, and lipid levels were collected from both groups. Knowledge of diabetes and quality of life were evaluated at baseline, 6 and 12 months, while the stage of behavior change was evaluated every visit after receiving DSMES.

The protocol was approved by the Siriraj Institutional Review Board (SIRB) of the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, (COA no. Si 715/2019). Written informed consent was obtained from patients in the DSMES group.

Diabetes self-management education and support

DSMES was provided to patients at baseline, 3, 6, and 12 months. It took around 45-60 minutes per session. The DSMES session consisted of four components, including building relationships, assessment, implementation, and evaluation. CDE assessed the knowledge, understanding, attitude, mental, social, needs, and self-care management of patients by determining their problems, using open questions and the motivational interviewing principle. CDE applied deep listening principles and good communication skills using both verbal and nonverbal body language. The topics of DSMES in each session were individualized and depended on the assessment and the problems of the patients. The main topics of DSMES included diabetes pathophysiology, healthy eating and food exchange, acute and chronic diabetic complications, exercise, glucose monitoring, diabetes medication, insulin injection technique and self-care for special conditions. The educational materials used were the Siriraj DM interactive tool, food models, glucose monitoring, and insulin injection devices.

The CDE discussed with patients and their families about their problems and developed suitable solutions together. DSMES was delivered based on the motivation interviewing principle to build patients' confidence in their potential to take care of themselves. For behavior problems related to diabetes, the intention of the patients to change was taken into account by choosing appropriate change processes and counseling techniques that matched each stage, as well as providing psychological and social support. CDE encouraged patients to set SMART goals (specific, measurable, achievable, relevant, and time-based) and evaluated the results at the next visits. During the COVID-19 pandemic, some follow-up visits were made by telephone.

Usual diabetes education

Before the establishment of CDE, DE was provided by a healthcare professional primarily by a nurse or a dietitian. The DE session was mainly content-based teaching, including general knowledge of diabetes, healthy diet, and exercise. It was mainly one-way communication from the healthcare professional to ensure the completeness of the content. At that time, the goal setting and stage of behavior change theory were not applied. Ninety-five percent of the patients received DE only one session.

Laboratory measurement

Plasma glucose, cholesterol, triglycerides and high-density lipoprotein cholesterol (HDL-C) were measured on a Cobas® 8000 modular analyzer (Roche Diagnostics,

Basel, Switzerland). Plasma levels of low-density lipoprotein cholesterol (LDL-C) were calculated using the Friedewald formula. The A1C level was determined by a turbidimetric inhibition immunoassay (Integra 400 analyzer; Roche Diagnostics).

Diabetes knowledge, stage of change, and quality of life evaluation

Diabetes knowledge was assessed at baseline, 6 and 12 months using a diabetes knowledge assessment tool that consisted of 24 true-false questions. Patients can also choose unknown as an answer. Sixteen questions were part of an instrument to assess general knowledge of patients with diabetes,[6] and eight questions were from a pretest of our center's T2D camp. The questions covered general knowledge of diabetes, diet, exercise, sickness management, and foot care. The assessment tool was tested in 20 patients with T2D. The reliability of the tool calculated by Kuder-Richardson 20 (KR-20) was 0.754.

Quality of life was assessed at baseline, 6 and 12 months using WHOQOL – BREF – THAI.[7] WHOQOL – BREF, an abbreviated version of WHOQOL –100, consists of 26 questions in 4 domains, including physical, psychosocial, social, and environment. The score ranges from 26 to 130. Higher scores mean a better quality of life. Quality of life can be classified into 3 groups including 1) a poor quality of life (score 26 – 60), 2) a moderate quality of life (score 61-95) and 3) a good quality of life (score 96-130).

During the DSMES session, CDE and patients discussed unhealthy behaviors that patients would like to change. Stage of behavior change[8] including pre-contemplation, contemplation, preparation, action, maintenance, and relapse were evaluated for each behavior by CDE at baseline and at each visit.

Sample size calculation

Previous data from our hospital showed that the number of patients having A1C less than 7% at 12 months after receiving usual diabetes education was 25%. We expected that the number of patients having A1C less than 7% at 12 months after receiving DSMES by CDE would increase to 50%. Using these data, an alpha level of 0.05, an allowable error (d) of 0.02, and a 30% increase were required to compensate for the loss of follow-up, a sample size of 76 participants in each group was required.

Statistical analysis

The baseline characteristics were compared between the DSMES and the usual DE group. The medical results were compared between baseline and each visit within the group and between the groups. Knowledge of diabetes, stage of behavior change, and quality of life were compared between baseline and 6 to 12 months only in the DSMES group. Paired t-test and unpaired t-test were used for normal distribution data, and the Mann-Whitney test was used for nonnormal distribution data. Chi-square and Fisher's exact test were used for categorical data. Statistical analysis was performed using SPSS version 21 and Python version 3.7.

RESULTS

Baseline characteristics

Seventy-six patients with T2D were recruited in each group. The mean±SD age was 59.4±11.5 years; the median duration of diabetes (IQR) was 9.2 (3.7, 13.1) years. There were no differences in baseline characteristics between the groups, except for a higher diastolic blood pressure in the control group (Table 1). Around 40% of patients received insulin therapy.

Medical outcomes

Both groups demonstrated a significant improvement in fasting plasma glucose (Table 2) and A1C after receiving DSMES and the usual DE. However, only DSMES group can maintain glycemic control at 12 months. In the DSMES group, A1C decreased sharply from 9.4±1.1% to 8.0±1.2%, p< 0.001 at 3 months and further decreased to 7.8±1.2% at 12 months, p< 0.001 compare to baseline. In the usual DE group, A1C decreased significantly from 9.5±1.1% to 8.1±1.5%, p< 0.001 at 3 months, but increased slightly to 8.5±1.6%, p< 0.001 at 12 months (Fig 1). A1C was significantly lower in the DSMES group compared to the usual DE group at 12 months (7.8±1.2% vs. 8.5±1.6%, p=0.028).

Triglyceride and LDL-C did not change during the study period. HDL-C significantly increased in DSMES group at 3 months (Table 2).

Diabetes knowledge and quality of life evaluation

After receiving DSMES from the CDE team, the patient gained more knowledge and had a better quality of life. The diabetes knowledge score increased from 16.9±4.3 at baseline to 20.1±2.5 at 12 months (p < 0.001). When comparing between baseline and 6 to12 months, the QOL score improved statistically from 89.4±11.6 to 92.6±12.2, p=0.018, and the number of patients with good quality of life increased from 18 (27.7%) to 27 (41.5%), p=0.064.

TABLE 1. Baseline characteristics.

Baseline Characteristics	Total (n=152)	DSMES Group (n=76)	Usual DE Group (n=76)	p-value
Age (Year)	59.4±11.5	58.3±10.6	60.4±12.2	0.265
Gender, Female (%)	95 (62.5)	47 (61.8)	48 (63.2)	0.867
Education Level, n (%)	(n= 88)	(n =75)	(n = 13)	0.855
Elementary school or below	38 (43.2)	33 (44.0)	5 (38.5)	
Secondary school or equivalent	22 (25.0)	19 (25.3)	3 (23.1)	
Bachelor's degree or above	28 (31.8)	23 (30.7)	5 (38.5)	
Type of Insurance				
Civil servant medical benefit	87 (57.2)	42 (56.6)	44 (57.9)	0.628
Universal Health Coverage/ Social Health Insurance	50 (32.9)	27 (35.5)	23 (30.3)	
Self-payment/other	15 (9.9)	6 (7.9)	9 (11.8)	
Duration of diabetes (Year)	9.2 (3.7,13.1)	8.7 (3.2,13.1)	9.3 (5.0,13.5)	0.388
Comorbidity, n (%)				
Hypertension	125 (82.2)	61 (80.3)	64 (84.2)	0.524
Dyslipidemia	114 (75.0)	55 (72.4)	59 (77.6)	0.454
Coronary artery disease	20 (13.2)	7 (9.2)	13 (17.1)	0.150
Cerebrovascular disease	5 (3.3)	2 (2.6)	3 (3.9)	0.649
BMI (kg/m^2)	27.0±5.8	27.5±6.6	26.4±4.7	0.300
SBP (mmHg)	133.7±15.1	131.8 ± 13	135 ± 16.8	0.106
DBP (mmHg)	73.3±11.5	70.2 ± 12.1	76.5 ± 9.9	0.001*
Oral hypoglycemia agent, n (%)	(n=140)	(n=76)	(n=73)	0.365
1 medications	27 (19.3)	11 (14.9)	16 (24.2)	
2 medications	2 (37.9)	29 (39.2)	24 (36.4)	
≥ 3 medications	60 (42.9)	34 (45.9)	26 (39.4)	
Insulin injection, n (%)	66 (43.4)	28 (36.8)	38 (50.0)	0.102

Data were presented as mean±SD, and median (IQR), *$p < 0.05$ comparing between the DSMES and the usual DE group

TABLE 2. Comparison of the medical outcome between the DSMES and the usual DE group.

	DSMES group				Usual DE group			
	baseline	3-month	6-month	12-month	baseline	3-month	6-month	12-month
Fasting plasma glucose (mg/dL)	n = 75 182±56	n = 64 152±45*	n = 57 159±53*	n = 60 156±61*	n = 74 195±83	n = 72 151±55*	n = 71 163±61*	n = 76 166±66*
Triglyceride (mg/dL)	n = 47 131 (99,208)	n = 33 119 (92,213.5)	n = 27 119 (96,189)	n = 43 123 (84,159)	n = 48 150 (109,226)	n = 26 147 (98.5,194)	n = 31 146 (103,183)	n = 37 137 (96,195)
HDL-C (mg/dL)	n = 48 45.2±10.9	n = 31 51.9±14.5*	n = 26 50.0±11.2	n = 43 50.9±16.0	n = 44 44.5±13.1	n = 26 46.6±13.8	n = 27 49.4±17.6	n = 34 48.8±14.8
LDL-C (mg/dL)	n = 55 93.9±32.6	n = 34 89.2±39.8	n = 31 91.9±40.4	n = 47 92.8±37.9	n = 48 94.8±36.2	n = 28 98.0±29.7	n = 32 88.9±34.6	n = 39 86.9±36.5

Data were presented as mean±SD, and median (IQR) * $p < 0.05$ comparing with baseline value.

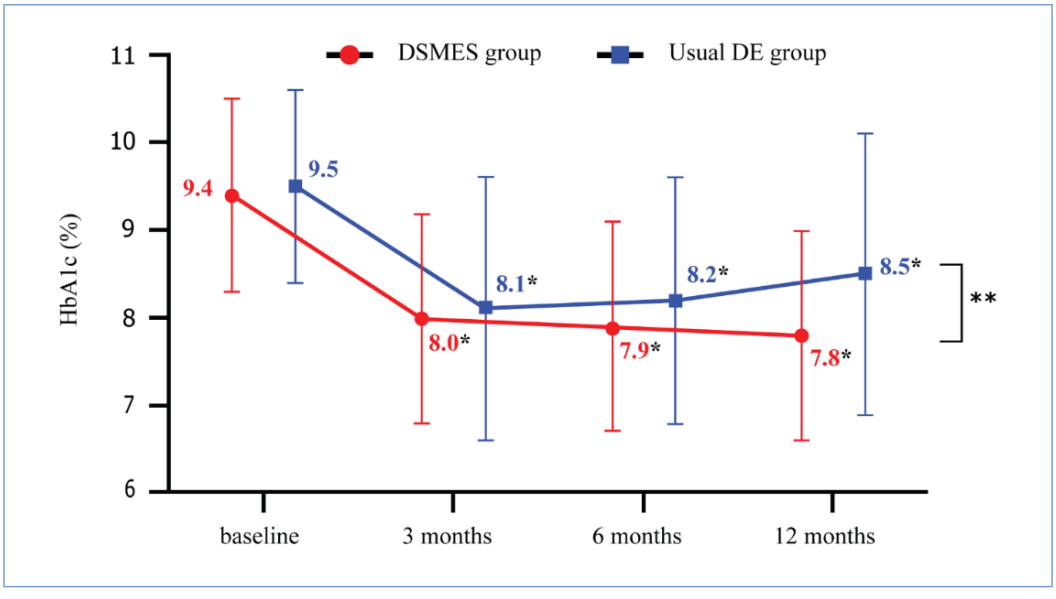

Fig 1. Hemoglobin A1c level during the study. The error bar represents the standard deviation. * $p < 0.05$ comparing with the baseline values. ** $p < 0.05$ comparing between the groups.

Behavior change

The most common behavioral problems that the patient aimed to change were unhealthy eating (53.7%), followed by inadequate exercise (21.1%), and improper medication use (13.7%). The majority of patients can move to the next stage of behavior change after receiving DSME from CDE. The number of patients in action and maintenance stage increased from 0.6% to 69.9%, $p< 0.001$ at 12 months (Fig 2).

The chronic diabetic complications screening rates

The rate of screening for diabetic complications was significantly higher in the DSMES group. When comparing between the DSMES and the usual DE group, the screening rate for diabetic retinopathy was 75 (98.7%) vs. 66 (86.8%), p=0.009; the screening rate for diabetic nephropathy was 70 (92.1%) vs. 55 (72.4%), p=0.002 and the screening rate for diabetic foot problems was 73 (96.1%) vs. 23 (30.3%), $p < 0.001$.

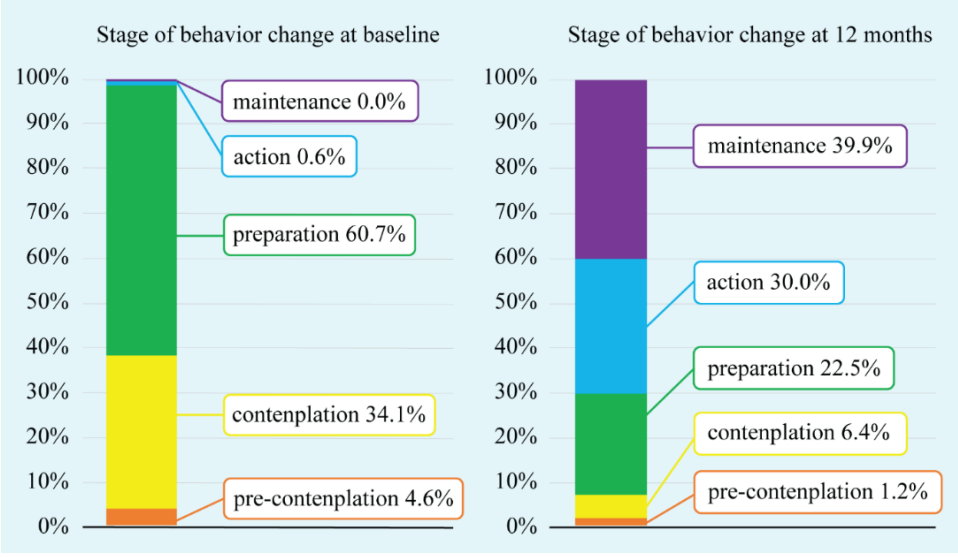

Fig 2. Stage of behavior change at baseline and 12 months in the DSMES group. * $p < 0.001$ comparing between baseline and 12 months

DISCUSSION

The effect of CDE-provided DSMES on the glycemic level in our study was consistent with previous studies in patients with T2D.[9,10] A large meta-analysis in 2016 showed that the overall mean±SD reduction in A1C for all patients randomized to DSME was 0.74±0.63%.[9] A systematic review from the countries of the Middle East showed mean±SD reduction of A1C after the DSME program was 1.15±0.55%.[10] Our study also showed a mean±SD of 1.6±1.5 % of the reduction in A1C after receiving DSME. Although a recent meta-analysis revealed that the DSME contact time > 10 hours exhibited a better rate of A1C reduction than the DSME contact time < 10 hours,[9] our study showed that even a total DSMES contact time of approximately 4 hours could demonstrate an advantage in A1C reduction. The shorter duration of DSMES with favorable medical and psychological outcomes is suitable for public hospitals with high workload in our country.

While there was a slight rebound in A1C level in usual DE group, the effect of DSMES on glycemic level was maintained for 12 months. The authors believe that this sustainability was caused by increasing the knowledge of diabetes, changing unhealthy behavior, and regular follow up throughout 12 months whereas usual DE had only one session at baseline. Although having only diabetes knowledge is not enough to change behavior, it is important to create awareness, which is the first step of behavior change.[11] The most common unhealthy behaviors that our patients would like to change were unhealthy eating, inadequate exercise, and taking medications irregularly. For eating habit, previous meta-analysis showed that delivery of medical nutritional therapy by dietitian reduced A1C by 0.43% in people with diabetes.[12] Bowen et al. also showed that proving DSMES by CDE using a modified plate method technique improved A1C by 0.83% in people with T2D.[13] Exercise not only improves glycemic control, but also increases cardiovascular fitness, reduces cardiovascular risk factors, contributes to weight loss, and improves well-being.[14] For medication, a study of newly diagnosed patients with diabetes in Singapore found that 35% of patients did not take their medications regularly, and poor adherent patients (proportion of days covered less than 40%) had an increase in A1C by 0.4% during the two years of follow-up.[15] Therefore, changing these unhealthy behaviors should contribute to a better glycemic level.

In the DSMES group, 4.6% of patients was in precontemplation stage, 34% of patients was in contemplation stage, and 60% was in preparation stage at baseline of our study. Interestingly, 70% of patients moved to the action and maintenance stage at 12 months. Using various kinds of techniques by CDE during DSME session might be one factor that result in this significant progression of behavior change. The first important step in our DSMES session was establishing the rapport by appropriate greeting, making an effort to know the patient as a person,[16] and paying attention to the patients. After collecting information and evaluating, CDE designed the content of the session and used the appropriate change process for each patient. If patients are in the pre-contemplation or contemplation stage, CDE will try to raise awareness, increase pros, and overcome cons (decision balance principle). If the patients are in the preparation stage, CDE will encourage the patients to set the SMART goal of behavior change and develop a realistic plan together.[8] Because changing behavior is a continuous process

that can move forward or backward, following up with the patient is a very important step. During follow up sessions, CDE re-evaluated stage of behavior change, worked together with patients to explore barriers and find solutions for behavior change, provided positive feedback and empowered patients to believe in their own ability.

Chronic diabetic complications cause significant comorbidities and disabilities such as coronary artery disease, end stage renal disease, blindness, and amputation.[17-19] Diabetic nephropathy, retinopathy, and foot problems should be screened at least annually for early detection and treatment.[20, 21] Our study showed that DSMES can improve the rate of screening for chronic diabetic complications. We hypothesized that the rate of complication screening increased because patients gained more knowledge and awareness about diabetic complications after receiving DSMES. Additionally, CDE are authorized to schedule appointments for complication screenings for patients according to our hospital pathway. Our finding was consistent with the systematic review from the United Kingdom, which indicated that the suggestion of a healthcare provider and their knowledge about the effects of non-attendance on vision were facilitators for retinal screening in patients with diabetes.[22]

Our study had some limitations. First, we used retrospective data from patients who received usual DE from a healthcare professional before the establishment of CDE as a comparator group because DSMES provided by CDE is our standard care in our hospital right now. Therefore, we did not have data on diabetes knowledge, stage of behavior change, and quality of life in the usual DE group. Second, there was a COIVD-19 pandemic during our study that resulted in a change in some follow-up visits from face-to-face to telephone consultation.

CONCLUSION

Our study found that CDE-provided DSMES can decrease A1C 3 months early and maintain its benefit until 12 months. It can also improve diabetes knowledge, stage of behavior change, quality of life, and the rate of chronic diabetic complication screening.

Practice implications

Proving DSMES by CDE using motivational interviewing, good communication skills and stage of change principle at visits 0 and 3, 6, and 12 months with estimated total contact time of 4 hours can help people with T2D to control their blood glucose and improve quality of life.

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Author contributions

K.W., N.T. and L.P. conceived and designed the study plan. K.W., N.T., W.K., S.U., V.L. and L.P acquired, analyzed, and interpreted the data. K.W., N.T., and L.P. drafted the article. All authors reviewed, edited, and approved the final version of the article.

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