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Original Article

Metabolic outcome for diabetes shared care program outpatients in a veterans hospital of southern Taiwan

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Abstract

Background: To evaluate the metabolic outcomes of the Diabetes Shared Care Program (DSCP) for Type 2 diabetes after completion of 1 year and 3 years of intervention.
Methods: Total 162 Type 2 diabetes (average age 67.14 years with 62.35% men and 37.65% women) in 2004 were referred to the diabetes educator for DSCP. Parameters related to diabetes among these patients were inquired, and biochemical data were compared before and after the DSCP by using SPSS 12.0 software.
Results: These patients had 3.1% emergency utilization rate and 1.9% hospitalization utilization rate; significant improvement in diastolic blood pressure (DBP), body weight after one year; and significant improvement in systolic blood pressure, DBP, body weight, total cholesterol, high-density lipoproteins cholesterol (HDL-C) and low-density lipoproteins cholesterol (LDL-C) levels after three years. But only 4.84% and 8.87% met all the A1C, blood pressure, and LDL-C target values after the 1- and 3-year interventions, respectively.
Conclusion: The A1C, blood pressure, and LDL-C achievement rate of DSCP in our hospital is low. DSCP is suggestive to patients with lower duration of diabetes, high baseline A1C, systolic blood pressure, DBP, LDL-C, and low baseline high-density lipoproteins cholesterol levels. Furthermore public health efforts are needed to control risk factors for vascular disease among diabetes.

Keywords: Diabetes mellitus; Diabetes mellitus educator; Diabetes shared care program

1. Introduction

Diabetes is a metabolic disease that is diagnosed on the basis of sustained hyperglycemia. People with Type 2 diabetes are at elevated risk for a number of serious health problems,

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including cardiovascular disease, premature death, blindness, kidney failure, amputations, fractures, frailty, depression, and cognitive decline.[1] Diabetes and its associated complications are known to place a tremendous burden on society and on the cost of health care.[2,3] Glycemic control is an important predictor of many chronic complications of diabetes and its improvement has been found to lead to cost savings.[4–6] The findings of the Diabetes Control and Complications Trial and the U.K. Prospective Diabetes Study support the idea that rigorous glycemic control not only improves a patient's overall health but also can prevent further complications.[7,8] The education of diabetic individuals on how to manage their own situation has been considered important since the 1930s.[9] The American Diabetes Association (ADA) recommends the assessment of self-management skills and the encouragement of continuous education on diabetes. However, in this regard, 50–80% of patients with diabetes have been found to have deficits in knowledge and skill.[10] Recently, Caliskan et al.[11] reported that only about 30% of people are aware that they suffer from diabetes, several studies have found that education about the self-management of diabetes played a crucial role in improving the metabolic outcome of diabetic patients,[12–14] though there were also some conflicting results.[15–17] A number of factors, including intervention characteristics, factors unique to the patient, and the care system structure, might explain the heterogeneity of the previous studies.[18]

Diabetes has become one of the major chronic diseases in Taiwan. Long-term control of diabetes largely depends on comprehensive education program and regular screening of diabetes-related complications to achieve optimal control goals. Our study aims to evaluate the metabolic outcomes of Diabetes Shared Care Program (DSCP) for southern Taiwan Type 2 diabetic patients after completion of 1 year and 3 years of intervention.

2. Methods

2.1. Population

Our study included 162 diabetic patients who were enrolled in a DSCP from January 2004 to December 2004 and who subsequently completed a 1-year and 3-year follow-up program (124 diabetic patients finally) in the department of endocrinology and metabolism at Yongkang Veterans Hospital, Tainan, Taiwan. The study was approved by the appropriate ethical committees related to the institution in which it was performed. Subjects were not enrolled until they were informed of what was involved in the study and program and gave their written consent. Those who met the following criteria were included in the study if: (1) they had been diagnosed with Type 2 diabetes (ICD-9 number 250.0–250.93) and their conditions had been stabilized for more than a year following regular 3-month visits to the outpatient endocrinology departmentand (2) they had received basic information about diabetes and its care during every such visit. A patient was excluded from our study if: (1) the patient had one or more severe life-threatening illnesses in addition to diabetes or (2) if he or she had ever participated in the same kind of education program on diabetes during the 1 year leading up to the study. At the beginning of our study, we collected baseline data, shown in the third column of Table 1. Among 162 patients, there were 69.28% with hypertension, 48.14% with dyslipidemia, 33.33% with retinopathy, 27.16% with obesity, 21.60% with nephropathy, 16.05% with coronary artery disease (CAD), 16.05% with neuropathy, and 3.09% with cerebral vascular accident. There were 38 patients that withdrew from the 3-year follow-up program (124 diabetic patients finally). There was no evidence to show that the withdrawal patients were associated with more significant socio-demographic characteristics than were with the non-withdrawal patients (Table 1). Only the high-density lipoproteins cholesterol (HDL-C) level after 1-year intervention of withdrawal patients was significantly higher than that of the other patients for clinical parameters of the study group.

Table 1
Characteristics of the patients at baseline (total 162 patients)

Variable		Total (n = 162)	Withdrawal from 3-year DSCP		p[a]
			Yes (n = 38)	No (n = 124)	
Sex	Female	61 (37.7%)	17 (44.7%)	44 (35.5%)	0.303
	Male	101 (62.3%)	21 (55.3%)	80 (64.5%)	
Age	≤50 yr	17 (10.5%)	6 (15.8%)	11 (8.9%)	0.355
	51–60 yr	29 (17.9%)	4 (10.5%)	25 (20.2%)	
	61–70 yr	33 (20.4%)	9 (23.7%)	24 (19.4%)	
	71–80 yr	72 (44.4%)	15 (39.5%)	57 (46.0%)	
	>80 yr	11 (6.8%)	4 (10.5%)	7 (5.7%)	
Duration of diabetes	<1 yr	22 (13.6%)	2 (5.3%)	20 (16.1%)	0.480
	1–5 yr	50 (30.9%)	10 (26.3%)	40 (32.3%)	
	6–10 yr	36 (22.2%)	10 (26.3%)	26 (21.0%)	
	11–15 yr	32 (19.8%)	9 (23.7%)	23 (18.5%)	
	16–20 yr	13 (8.0%)	4 (10.5%)	9 (7.3%)	
	>20 yr	9 (5.6%)	3 (7.9%)	6 (4.8%)	
SMBG	No	143 (88.3%)	33 (86.8%)	110 (88.7%)	0.754
	Yes	19 (11.7%)	5 (13.2%)	14 (11.3%)	
Family history	No	86 (53.1%)	15 (39.5%)	71 (57.3%)	0.092
	Yes	49 (30.2%)	13 (34.2%)	36 (29.0%)	
	Unknown	27 (16.7%)	10 (26.3%)	17 (13.7%)	
Smoking	No	133 (82.1%)	34 (89.5%)	99 (79.8%)	0.175
	Yes	29 (17.9%)	4 (10.5%)	25 (20.2%)	
Drinking	No	134 (82.7%)	32 (84.2%)	102 (82.3%)	0.781
	Yes	28 (17.3%)	6 (15.8%)	22 (17.7%)	
Exercise	No	45 (27.8%)	12 (31.6%)	33 (26.6%)	0.550
	Yes	117 (72.2%)	26 (68.4%)	91 (73.4%)	
BMI	<24	60 (37.0%)	16 (42.1%)	44 (35.5%)	0.332
	24–27	58 (35.8%)	13 (34.2%)	45 (36.3%)	
	27–30	26 (16.0%)	3 (7.9%)	23 (18.5%)	
	≥30	18 (11.1%)	6 (15.8%)	12 (9.7%)	
Total		162 (100%)	38 (100%)	124 (100%)	

[a] Use Chi-square test.

BMI = body mass index; DSCP = Diabetes Shared Care Program; SMBG = self-monitoring of blood glucose.

2.2. Diabetes Shared Care Program

The program required physicians, diabetes specialist nurses, and dietitians to work together to provide integrated patient care. The physicians prescribed their medications based on clinical practice recommendations made by the ADA. All classes of antidiabetic, antihypertensive, and antidyslipidemic drugs were added based on individualized care plans, comorbidities, and other patient factors.

Furthermore to regular medical treatment, all participants were introduced to self-care, nutrition, and other health issues by certified diabetes specialist nurses and dietitians at the beginning of the program. An individual 1-hour education class using an interactive approach aiming to resolve the problems of self-care, reinforce diabetic knowledge, and share experiences was provided in the first week. The class was delivered in Mandarin or other Chinese dialects. At the beginning of the class, patients were asked to discuss their understanding of diabetes. The class covered the main topics of diabetes mellitus, causes, natural course and complications of diabetes, mechanism of oral antidiabetes agents and insulin, subcutaneous insulin injection technique, foot care, symptoms of hypoglycemia and hyperglycemia, sick day management of diabetes mellitus and targets for diabetic control, and so forth. Individualized nutrition plans were prescribed, based on recommendations made by the ADA, and those patients who were overweight or obese were asked to reduce weight. Furthermore, patients were encouraged to monitor their blood glucose at home if possible. Patients' status was routinely monitored by taking the fasting blood sugar (FPG), A1C and other biophysical measurements, including systolic blood pressure (SBP), diastolic blood pressure (DBP), and body weight (BW). Based on these measurements physicians, nurses, and dietitians would reinforce the aims of the education program every 3 months. After the 1-year and 3-year programs, serum total cholesterol, triglyceride (TG), HDL-C, low-density lipoproteins cholesterol (LDL-C), glutamic pyruvic transaminase (GPT), and creatinine (Cr) levels were also assessed.

2.3. Statistical analysis

A computer system was used to integrate patients' baseline data and subsequent data. All the data for this study were obtained from this system. All private information was removed during the analysis. Changes in SBP, DBP, BW, FPG, A1C, cholesterol, HDL-C, LDL-C, TG, GPT, and Cr levels after the 1-year and 3-year programs were analyzed by Wilcoxon sign rank test. To identify patients who might be more responsive to the program, we compared the improvement in A1C values after the 1-year intervention. We also analyzed the effectiveness between the subgroups of different A1C baseline before and after 1-year intervention (total 162 patients). Improvement in each one of these was analyzed using the Wilcoxon sign rank test. Multiple linear regressions by stepwise method were also conducted to analyze the chief metabolic outcome, ABC (A indicates A1C; B, blood pressure (BP); C, LDL-C) after 1-year DSCP. Statistical analyses were performed by using SPSS 12.0 version statistics software. A p value <0.05 (two tailed) was considered statistically significant.

3. Results

3.1. DSCP has positive effects on SBP, DBP, BW, cholesterol, LDL-C and HDL-C levels

The effects of DSCP on each clinical parameter can be seen in Table 2, which illustrates mean difference and p value of statistical test after 3-year intervention. The numerical data with mean difference (denoted by d) and p value (denoted by p) before and after 3-year intervention (total 124 patients) were: SBP (135.38 ± 17.67 mmHg *vs.* 130.65 ± 12.65 mmHg, d = 4.73, $p = 0.006$); DBP (76.96 ± 10.32 mmHg *vs.* 73.26 ± 6.69 mmHg, d = 3.70, $p < 0.001$); BW (66.01 ± 10.00 kg *vs.* 65.28 ± 9.87 kg, d = 0.73, $p = 0.027$); FPG (169.86 ± 58.98 mg/dL *vs.* 161.21 ± 56.49 mg/dL, d = 8.65, $p = 0.166$); A1C (8.24 ± 1.74% *vs.* 8.18 ± 1.80%, d = 0.05, $p = 0.567$); total serum cholesterol (190.34 ± 37.97 mg/dL *vs.* 182.73 ± 37.61 mg/dL, d = 7.61, $p = 0.009$); HDL-C (44.38 ± 13.37 mg/dL *vs.* 47.55 ± 12.68 mg/dL, d = −3.17, $p < 0.001$); LDL-C (116.40 ± 29.72 mg/dL *vs.* 108.23 ± 34.05 mg/dL, d = 8.18, $p = 0.001$); TG (145.32 ± 84.48 mg/dL *vs.* 143.39 ± 96.45 mg/dL, d = 1.94, $p = 0.234$); GPT (42.51 ± 35.39 U/L *vs.* 42.61 ± 40.14 U/L, d = −0.10, $p = 0.058$); and Cr (0.97 ± 0.36 mg/dL *vs.* 1.17 ± 0.61 mg/dL, d = −0.20, $p < 0.001$).

The results demonstrated that DBP, BW, and HDL-C levels were significantly lower after 1-year DSCP intervention. Moreover, SBP, DBP, BW, total serum cholesterol, and LDL-C levels were significantly lower and HDL-C levels were significantly higher after 3-year DSCP intervention.

Table 2
Comparisons[a] of clinical parameters between before and after 3-year DSCP (total 124 patients)

Items	3-year DSCP difference[b] (p)
SBP (mmHg)	4.73 (0.006**)
DBP (mmHg)	3.70 (<0.001***)
BW (kg)	0.73 (0.027*)
FPG (mg/dL)	8.65 (0.166)
A1C (%)	0.05 (0.567)
Cholesterol (mg/dL)	7.61 (0.009*)
HDL-C (mg/dL)	−3.17 (<0.001***)
LDL-C (mg/dL)	8.18 (0.001**)
TG (mg/dL)	1.94 (0.234)
GPT (U/L)	−0.10 (0.058)
Cr (mg/dL)	−0.20 (<0.001***)

[a] Use Wilcoxon sign rank test.
[b] Difference is the mean difference of clinical parameter before minus after.
BW = body weight; Cr = creatinine; DBP = diastolic blood pressure; DSCP = Diabetes Shared Care Program; FPG = fasting blood sugar; GPT = glutamic pyruvic transaminase; HDL-C = high-density lipoproteins cholesterol; LDL-C = low-density lipoproteins cholesterol; SBP = systolic blood pressure; TG = triglyceride.
* A p value <0.05; ** $p < 0.01$; *** $p < 0.001$.

3.2. The effects of DSCP on clinical parameters between different A1C level patients

We further analyzed the effectiveness on clinical parameters between before and after 1-year DSCP (total 162 patients) for different A1C baseline groups. As shown in Table 3, the group with baseline A1C $\geq$ 9% demonstrated significant improvement ($p < 0.05$) on DBP, FPG, and A1C levels after 1-year DSCP intervention.

3.3. The effects of DSCP on A1C, BP, and LDL-C levels of diabetes patients

Among these patients, there were baseline 25.8% with A1C <7%, 41.9% with BP <130/80 mmHg, and 31.5% with LDL-C <100 mg/dL. We analyzed whether DSCP could increase patients' number/percentage to achieve the A1C, BP, and LDL-C target levels. As shown in Fig. 1, the percentages of A1C <7% increased from 25.8% to 30.6% and 32.3% after 1-year and 3-year intervention, respectively. The percentages of BP <130/80 mmHg increased from 41.9% to 57.3% and 58.1% after 1-year and 3-year intervention, respectively. Furthermore, the percentages of LDL-C <100 mg/dL increased from 31.5% to 33.1% and 42.7% after 1-year and 3-year intervention, respectively. Moreover, total ABC target achievement rates increased from 4.03% to 4.84% and 8.87% after 1-year and 3-year intervention, respectively.

We found that there were only five of 162 patients who ever visited the emergency room because of diabetic complication after 1-year intervention. Furthermore, there were only three of 162 patients who ever were hospitalized because of diabetic complication after 1-year intervention. The emergency and hospitalization utilization rates were 3.1% and 1.9%, respectively. To further determine the relationship between the chief metabolic outcome, ABC, after 1-year DSCP and baseline clinical parameters, multiple linear regression analysis was used (total 162 patients). Results (Table 4) revealed that the three factors which contributed most in improvement of A1C were higher A1C status, lower total cholesterol level, and lower DM duration at baseline; the factor which contributed most in improvement of SBP status was higher SBP at baseline; the two factors contributing most in improvement of DBP status were higher DBP and higher age at baseline; and the two factors contributing most in improvement of LDL-C status were higher LDL-C and lower HDL-C levels at baseline.

Table 3
Comparisons[a] of clinical parameters difference[b] among the subgroups of different A1C baseline after 1-year DSCP (total 162 patients)

Items	A1C < 7% (n = 39)	A1C 7–7.9% (n = 36)	A1C 8–8.9% (n = 33)	A1C ≥ 9% (n = 54)
SBP (mmHg)	4.92	2.83	0.64	−0.93
DBP (mmHg)	6.15**	3.11	0.30	5.04**
BW (kg)	0.57	0.71	1.32**	0.024
FPG (mg/dL)	−11.95**	1.50	−28.15**	58.65***
A1C (%)	−0.47***	−0.069	−0.21	1.39***
Cholesterol (mg/dL)	2.23	−0.39	−8.97	5.33
HDL-C (mg/dL)	2.28	1.64	2.15	2.63
LDL-C (mg/dL)	2.31	1.89	−5.73	2.39
TG (mg/dL)	−12.95	−33.50*	−11.97	11.59
GPT (U/L)	−3.44	0.08	4.03	5.89
Cr (mg/dL)	0.00	0.06*	0.009	−0.004

[a] Use Wilcoxon sign rank test.
[b] Difference is the mean difference of clinical parameter before 1-year DSCP minus after 1-year DSCP.
BW = body weight; Cr = creatinine; DBP = diastolic blood pressure; DSCP = Diabetes Shared Care Program; FPG = fasting blood sugar; GPT = glutamic pyruvic transaminase; HDL-C = high-density lipoproteins cholesterol; LDL-C = low-density lipoproteins cholesterol; SBP = systolic blood pressure; TG = triglyceride.
* A p-value <0.05; **$p < 0.01$; ***$p < 0.001$.

4. Discussion

Diabetes is a chronic and progressively deteriorative disease. In prospective epidemiologic studies, the incidence of many of these outcomes is directly associated with the degree of hyperglycemia, as measured by the plasma glucose or A1C level (the measurement of mean blood glucose level for 2–3 months). The U.K. Prospective Diabetes Study has revealed that each percentage point reduction in the A1C level is associated with a 37% reduction in microvascular complication, a 14% reduction in myocardial infarction, a 12% reduction in stroke, and a 16% reduction in heart failure.[19]

Few studies have been done regarding the effect of a self-management education program on A1C control in diabetic patients. In fact, those studies have inconsistent results. Gagliardino and Etchegoyen demonstrated an improvement in the A1C level after a 1-year teaching program (9.0 ± 2.0% *vs.* 7.8 ± 1.6%, $p < 0.001$).[20] However, Gabbay et al. found no difference in the A1C levels after a 1-year intervention (7.46 ± 1.4% *vs.* 7.45 ± 1.4%, $p > 0.05$).[21] Our results demonstrated that diabetes education insignificantly improves the FPG and A1C levels after 1-year intervention, and this improvement effect decreases after 3-year intervention. There may be two explanations for these differences. First, in previous studies, the average baseline A1C level was at least 9%,[14,20] whereas in our study, the baseline A1C level was 8.28 ± 1.75%. Second, as time went by, adherence to the program and motivation decreased. Other studies have reported similar findings.[18] Another study reported that the positive effect on glycemic control and behavior as a consequence of self-management training was more obvious in the short-term follow-up.[12] A Bulgarian study illustrated no difference in glycemic control between men and women.[14] The gender difference was not obvious in our study either.

Elevated SBP or DBP and left ventricular hypertrophy are clearly associated with an increased risk of CAD.[22] Better BP control can help to limit complications because of microvascular, macrovascular, and stroke in diabetic patients.[19] Studies have shown that a 2-mmHg reduction in DBP would result in a 17% decrease in the prevalence of hypertension, and a 6% reduction in the risk of coronary heart disease, and a 15% reduction in risk of stroke and transient ischemic attack.[23] In the PEDNID-LA study,[20] the inclusion criteria did not confine stable BP before entry. Furthermore, high baseline BP

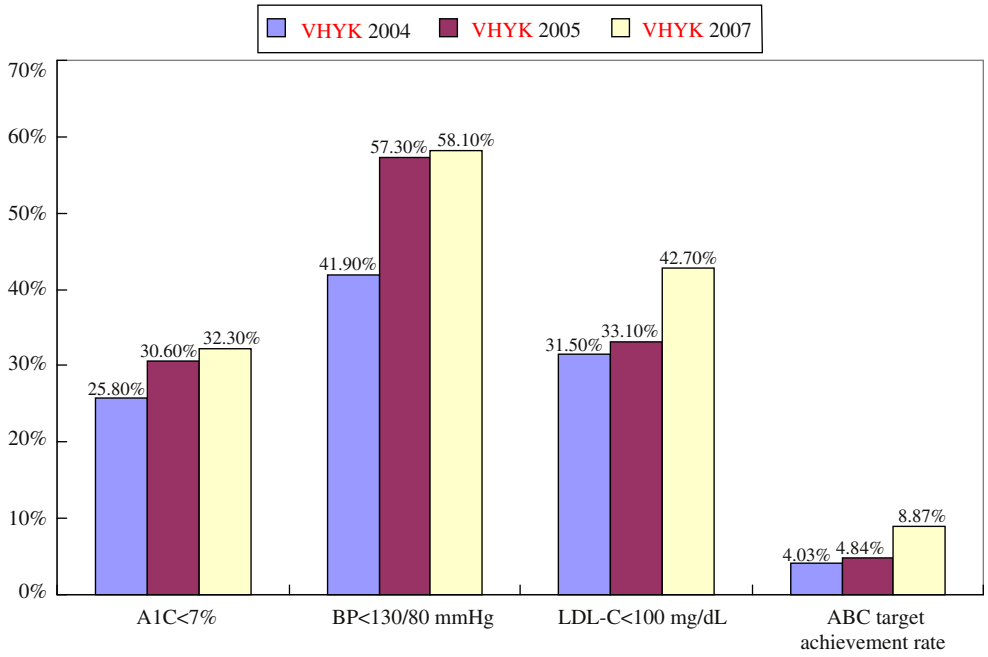

Fig. 1. ABC target achievement rate of VHYK (124 patients) after 1-year and 3-year Diabetes Shared Care Program (ABC = A1C, blood pressure, LDL-C; BP = blood pressure; LDL-C = low-density lipoproteins cholesterol; VHYK = Yongkang Veterans Hospital).

(SBP = 153.8 ± 15.9 mmHg, DBP = 95.4 ± 7.9 mmHg) and adding antihypertensive drugs might affect estimations of the effect of education on disease status. Gabbay et al. reported that self-care management could improve BP control after 1-year intervention.[21] Although their baseline BP (SBP = 137 ± 19 mmHg, DBP = 77±10 mmHg) was not as high as that in the PEDNID-LA study, they also acknowledged that the observed effects might be related to a higher number of antihypertensive medications. In our study, we found significant improvement in DBP (76.28 ± 10.65 *vs.* 72.36 ± 9.52 mmHg, d = 3.91, $p < 0.001$) after 1-year intervention and significant improvement in SBP (135.38 ± 17.67 *vs.* 130.65 ± 12.65 mmHg, d = 4.73, $p < 0.005$) and DBP (76.96 ± 10.32 *vs.* 73.26 ± 6.69 mmHg, d = 3.70, $p < 0.001$) after 3-year intervention. The observed effects might be related to the antihypertensive drugs and lifestyle behavior education.

Table 4
Multiple linear regression analysis of the metabolic outcome, ABC, after 1-year DSCP (total 162 patients)

Independent variable	Dependent variable			
	A1C	SBP	DBP	LDL-C
Constant	−2.252***	−63.414***	−65.934***	−8.333
Baseline SBP		0.481***		
Baseline DBP			0.730***	
Baseline A1C	0.597***			
Baseline cholesterol	−0.01**			
Baseline LDL-C				0.212**
Baseline HDL-C				−0.348*
Age			0.175**	
Duration of DM	−0.047**			
R^2	0.347	0.249	0.473	0.076
p-value	<0.001	<0.001	<0.001	0.002

ABC = A1C, blood pressure, LDL-C; DSCP = Diabetes Shared Care Program; DBP = diastolic blood pressure; HDL-C = high-density lipoproteins cholesterol; LDL-C = low-density lipoproteins cholesterol; SBP = systolic blood pressure.
*A *p* value <0.05; **$p < 0.01$; ***$p < 0.001$.

HDL-C has emerged as an important independent predictor of CAD. In our study, we found DSCP had a significant positive influence on the lipid profile especially the total cholesterol, LDL-C, and HDL-C levels after 3-year intervention. Although we did not find significant improvement in the LDL-C and TG levels after 1-year intervention, the trend of improvement in the HDL-C and LDL-C levels was obvious after 3-year intervention. Glycemic control, obesity, the diet pattern, renal disease, hepatic disease, drugs, alcohol, exercise, and smoking are associated with TG level. It is more difficult to reveal the significant differences, because basal TG levels (148.49 ± 101.27 mg/dL) were fairly well in control. Furthermore, there was a wide standard deviation in TG level. A significant improvement might only be observed over the long-term.[18] All patients with low HDL and/or high TG should receive recommendations for lifestyle modifications that include low saturated fat diet and increased physical activity. Lipid-lowering drugs were prescribed if lifestyle modifications failed.

Non-compliance with instructions for taking medications and non-adherence to suggestion about lifestyle changes has been shown to counter any positive pharmacological effects. Such problems can be addressed by a comprehensive diabetic program.[18] The dietitian plays a pivotal role in counseling patients on diet modification and in designing a diet for patients based on their preferences and health status. Diabetes specialist nurses regularly reinforce compliance and the concept of a healthy life. The adherence to exercise recommendations is also deemed crucial. To evaluate the change of lifestyle, we checked the diet records and exercise performance records at

every visit. The patients' caregivers or peer groups were invited to supervise the patients, participate in the discussion groups, and provide information about compliance. De Bont et al.[16] reported that their diabetic education program led to an improvement in the BW; this was not surprising as the participants were obese and were only followed up for 6 months. In our program, we also found significant improvement in BW after 1 year and 3 years of intervention (0.58 kg and 0.73 kg, respectively). The observed effects were mainly because of the diet modification and exercise education. The importance of controlling glycemic levels is well known in clinical practice. Survey data from the National Diabetes Health Promotion Center in Taiwan [24] indicated that only 32.4% of adults with diagnosed diabetes achieved an A1C of <7%, only 30.9% had a BP <130/80 mmHg, and just 35.3% had a total cholesterol <160 mg/dL or LDL-C <100 mg/dL. Most distressing was that only 4.1% of people with diabetes achieved all the 3 treatment goals.[24] Diabetic individuals with diagnosis of Type 1 diabetes, lesser body mass index and those not using insulin were more likely to attain all ABC goals.[24] Our program showed only 8.87% of 124 patients met all three, ABC, of the control targets after 3-year intervention. However, in the US,[25] the prevalence of diagnosed diabetes was 6.5% from 1999 to 2002 and 7.8% from 2003 to 2006 and increased significantly in women, non-Hispanic whites, and obese people. Although there were no significant changes in the pattern of antidiabetic treatment, the age-adjusted percentages of people with diagnosed diabetes achieving glycemic and LDL targets increased from 43.1% to 57.1% and from 36.1% to 46.5%, respectively. A1C decreased from 7.62% to 7.15% during this period. The age-adjusted percentage achieving all three targets increased insignificantly from 7.0% to 12.2%. There is an escalating demand for health professionals and medication to treat diabetes in the general population.[25]

Our study has some limitations. Although we could clearly evaluate the effect of our DSCP on biophysical parameters, it was difficult to assess and quantify its effect on the realization and behavior change. Another limitation was that there was no randomized control group with which to compare the difference. Furthermore, although we excluded subjects involved in the same program previously, we could not totally obviate the effect of mass media or messages provided by other health organizations. Variations in the improvement of examination results may have also been affected by other causes, such as the medication dosage to control the hyperglycemia, hypertension and dyslipidemia, change of medication, cooperation of patients, efforts of physicians, or pre-existing health conditions of patients. We cannot judge the impacts of medication on goal attainment in the study. It is worth, using a longitudinal approach, to evaluate the long-term effect of different care models. Moreover, it may be interesting to perform studies similar to ours in different regions of Taiwan to scrutinize the impact of geographic variables. It is difficult to assess the contribution of each component; however, it is clear that optimal diabetes management requires an organized, systematic approach and involvement of a coordinated team of health care professionals.[26]

In conclusion, this was a study without controls, and the sample size was too small to draw conclusions about the promotion of the system to every patient diagnosed with Type 2 diabetes. Although our results failed to compare the effectiveness of the DSCP for the patients in the system and patients who did not enter into the shared care system, it showed 4.84% and 8.87% of diabetic patients met all the ABC target values after the 1- and 3-year interventions, respectively, through education program. The DSCP is suggestive to patients with lower DM duration, high baseline A1C, SBP, DBP, LDL-C, and low baseline HDL-C levels. Furthermore public health efforts are needed to control risk factors for vascular disease among diabetes.

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References

1. Goff DC, Gerstein HC, Ginsberg HN, Cushman WC, Margolis KL, Byington RP, et al. Prevention of cardiovascular disease in persons with type 2 diabetes mellitus: current knowledge and rationale for the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial. *Am J Cardiol* 2007;**99**:4i−20i.
2. Brown JB, Pedula KL, Bakst AW. The progressive cost of complications in type 2 diabetes mellitus. *Arch Intern Med* 1999;**159**:1873−80.
3. Tseng CH. Prevalence and risk factors of diabetic foot problems in Taiwan: across-sectional survey of non-type 1 diabetic patients from a nationally representative sample. *Diabetes Care* 2003;**26**:3351 [letter].
4. American Diabetes Association. Clinical practice recommendations. *Diabetes Care* 2001;**24**:S1−133.
5. Menzin J, Langley-Hawthorne C, Friedman M, Boulanger L, Cavanaugh R. Potential short-term economic benefits of improved glycemic control: a managed care perspective. *Diabetes Care* 2001;**24**:51−5.
6. Wagner EH, Sandhu N, Newton KM, McCulloch DK, Ramsey SD, Grothaus LC, et al. Effect of improved glycemic control on health care costs and utilization. *JAMA* 2001;**285**:182−9.
7. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993;**329**:977−86.
8. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;**352**:837−53.
9. Bartlett EE. Historical glimpses of patient education in the United States. *Patient Educ Couns* 1986;**8**:135−49.
10. Clement S. Diabetes self-management education. *Diabetes Care* 1995;**18**:1204−14.
11. Caliskan D, Ozdemir O, Ocaktan E, Idil A. Evaluation of awareness of diabetes mellitus and associated factors in four health center areas. *Patient Educ Couns* 2006;**62**:142−7.
12. Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes Care* 2002;**25**:1159−71.
13. Rachmani R, Slavacheski I, Berla M, Frommer-Shapira R, Ravid M. Treatment of high-risk patients with diabetes: motivation and teaching intervention: a randomized, prospective 8-year follow-up study. *J Am Soc Nephrol* 2005;**16**:S22−6.

14. Tankova T, Dakovska G, Koev D. Education of diabetic patients: a one year experience. *Patient Educ Couns* 2001;**43**:139−45.
15. Bloomgarden ZT, Karmally W, Metzger MJ, Brothers M, Nechemias C, Bookman J, et al. Randomized, controlled trial of diabetic patient education: improved knowledge without improved metabolic status. *Diabetes Care* 1987;**10**:263−72.
16. De Bont AJ, Baker IA, St Leger AS, Sweetnam PM, Wragg KG, Stephen SM, et al. A randomised controlled trial of the effect of low fat diet advice on dietary response in insulin independent diabetic women. *Diabetologia* 1981;**21**:529−33.
17. Falkenberg MG, Elwing BE, Goransson AM, Hellstrand BE, Riis UM. Problem oriented participatory education in the guidance of adults with on-insulin-treated type-II diabetes mellitus. *Scand J Prim Health Care* 1986;**4**:157−64.
18. Tien KJ, Hung HC, Hsiao JY, Hsu SC, Shin SJ, Hsieh MC, et al. Effectiveness of comprehensive diabetes care program in Taiwanese with type 2 diabetes. *Diabetes Res Clin Pract* 2008;**79**:276−83.
19. Stratton IM, AdLer AI, Neil HA, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 2000;**321**:405−12.
20. Gagliardino JJ, Etchegoyen G. A model educational program for people with type 2 diabetes: a cooperative Latin American implementation study (PEDNID-LA). *Diabetes Care* 2001;**24**:1001−7.
21. Gabbay RA, Lendel I, Saleem TM, Shaeffer G, Adelman AM, Mauger DT, et al. Nurse case management improves blood pressure, emotional distress and diabetes complication screening. *Diabetes Res Clin Pract* 2006;**71**:28−35.
22. Michael J. Primary and secondary prevention of coronary heart disease. In: *Heart disease. A textbook of cardiovascular medicine*. 6th ed. USA: W.B. Sounders Co; 2001.
23. Cook NR, Cohen J, Hebert PR, Taylor JO, Hennekens CH. Implications of small reductions in diastolic blood pressure for primary prevention. *Arch Intern Med* 1995;**155**:701−9.
24. Yu NC, Su HY, Tsai ST, Shiu RS, Hsieh YC, Sheu WH, et al. ABC control of diabetes: survey data from National Diabetes Health Promotion Centers in Taiwan. *Diabetes Res Clin Pract* 2009;**84**:194−200.
25. Cheung BMY, Ong KL, Cherny SS, Sham PC, Tso AWK, Lam KSL, et al. Diabetes prevalence and therapeutic target achievement in the United States, 1999 to 2006. *Am J Med* 2009;**122**:443−53.
26. American Diabetes Association. Standards of medical care in diabetes-2010 (position statement). *Diabetes Care* 2010;**33**:S11−61.