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An Educational Intervention Using Steno Balance Cards to Improve Glycemic Control in Patients With Poorly Controlled Type 2 Diabetes Mellitus

Yueh-Chu WU[1] • Edy KORNELIUS[2] • Yi-Sun YANG[3] • Yih-Fen CHEN[4]
Chien-Ning HUANG[5]*

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is largely attributable to lifestyle factors. Although physiological and medical care needs must be met, psychosocial factors should not be neglected.

Purpose: The aim of this study was to determine whether a 6-month intervention consisting of educational sessions using Steno Balance Cards, which involves guided group dialogue, resulted in better glycemic outcomes than conventional diabetes education.

Methods: Patients with T2DM whose glycolated hemoglobin A1c levels were higher than 8% were recruited from September to October 2015. Ninety-two patients were assigned to either the psychosocial balance dialogue (PBD) group (n = 46) or the standard care (SC) group (n = 46). The PBD group received instructions about diabetes using the Steno "Balance Card" method, which involves the use of themed picture cards to elicit group dialogue. The Balance Cards were developed by the Danish Steno Diabetes Center. In the SC group, patients received general diabetes education using a conventional teaching mode.

Results: In the PBD group, glycolated hemoglobin A1c decreased 1.3% from 8.1% ± 0.7% to 6.8% ± 0.8%, whereas it decreased 0.6% in the SC group from 8.0% ± 0.6% to 7.4% ± 0.7%, with $p < .05$. At the end of the 6-month study period, the PBD group and the SC group completed a health-related quality of life questionnaire (12-item Short-Form Health Survey) and a well-being index (WHO-5) questionnaire. In the PBD group, the difference before and after the intervention showed that the well-being (WHO-5) score increased by 45.4 points, whereas the physiological score increased by 28.0, and the mental component score increased by 29.0. In the SC group, the well-being (WHO-5) score increased by 6.4, whereas the physiological score increased by 4.7, and the mental component score increased by 9.6. There were statistically significant differences in questionnaire scores between the two groups ($p < .05$).

Conclusions/Implications for Practice: The results of this study indicate that the dialogue sessions using Steno Balance Cards are beneficial for patients with T2DM in terms of improved glycemic control and quality of life.

KEY WORDS:
steno balance cards, diabetes education, Type 2 diabetes mellitus, poorly controlled.

Introduction

The prevalence of Type 2 diabetes mellitus (T2DM) is increasing worldwide, creating a global healthcare burden. According to the International Diabetes Federation, there were 415 million people with T2DM worldwide in 2015. It is expected that, among individuals aged 40–59 years, the number of people with T2DM will rise to 642 million by 2040 (International Diabetes Federation Diabetes Atlas Group, 2015). During the period of 2000–2009, the total population of people with T2DM in Taiwan increased by almost 70% (Jiang, Chang, Tai, Chen, & Chuang, 2012). Adopting a well-structured, comprehensive approach to treating patients with chronic disease has been shown to be effective in improving clinical outcomes (Dorland & Liddy, 2014). In Taiwan, the percentage of patients who achieved a glycolated hemoglobin A1c (HbA1c) value of less than 7% was 32.4% in 2006 and 34.5%

[1]*MSN, RN, Certified Diabetes Educator, Department of Nursing, Chung Shan Medical University Hospital* • [2]*PhD, MD, Attending Physician, Department of Endocrinology and Metabolism, Chung Shan Medical University Hospital, and Adjunct Instructor, School of Medicine, Chung Shan Medical University* • [3]*PhD, MD, Attending Physician, Department of Endocrinology and Metabolism, Chung Shan Medical University Hospital, and Adjunct Assistant Professor, School of Medicine, Chung Shan Medical University* • [4]*PhD, Associate Professor, Department Counseling and Applied Psychology, National Taichung University of Education* • [5]*PhD, MD, Professor, Department of Endocrinology and Metabolism, Chung Shan Medical University Hospital, and School of Medicine, Chung Shan Medical University.*

in 2011. Although a shared care plan made available in Taiwan's National Health Insurance program has been successful in helping patients with T2DM achieve better glycemic control, the percentage of patients who achieved their target HbA1c value remained low (Yu et al., 2013, 2009). One possible reason is that, although most patients appear to understand that obtaining a drug prescription to manage T2DM is of utmost importance, many are apparently unclear about the rationale for following a comprehensive diabetes care plan (Hung, Fu, Lau, & Wong, 2015).

Education is the foundation of care for all patients with T2DM who want to achieve successful health-related outcomes (Boren, 2007; Campbell, Redman, Moffitt, & Sanson-Fisher, 1996). Appropriate education, lifestyle changes, medication, and blood glucose monitoring are required to effectively manage T2DM. Diabetes self-management education (DSME) may be used with individuals or groups. In DSME, patients interact and discuss issues related to the management of diabetes. Diabetes education is a complex intervention, and it is often difficult to define the main structural components. There is considerable variation in the literature regarding the impact of DSME, as there is no standardized description of either the content or form of related interventions. No definitive diabetes self-care education protocols have been reported, and thus the most effective and most comprehensive formats have yet to be established (Molsted, Tribler, Poulsen, & Snorgaard, 2012; Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012). Screening tools such as generic and disease-specific instruments may be used to help determine the current health status of patients receiving clinical care. The American Association of Diabetes Educators (AADE) developed a list of seven diabetes self-care behaviors that promote the achievement of optimum glycemic control targets, including healthy eating, being active, monitoring, taking medication, problem solving, reducing risks, and healthy coping. The risk of acute and chronic complications and psychosocial problems may be reduced by addressing patient behaviors (Boren, 2007; Hill-Briggs et al., 2011). Given the fact that education appears to be the cornerstone of efforts to control diabetes by changing attitudes and behaviors, it is crucial that new ways of delivering diabetes education be explored.

Type 2 diabetes is a disease that predominantly affects older adults. In Taiwan, many older adults have a lower level of education than the general population; many are illiterate or have attended only elementary school. Thus, it may be somewhat intimidating for these patients to receive diabetes education from a healthcare professional, whereas a group-based method involving proactive dialogue may help put patients at ease and enable them to express diabetes-related problems, which may then be addressed. Although a number of alternative approaches to diabetes education have been developed, they have not been rigorously examined or compared with conventional educational methods. Thus, in this study, we compared results from a group that received standard education on diabetes with results from a group that used Steno Balance Cards to determine whether there were any differences in glycemic and behavioral outcomes after 6 months. Steno Balance Cards are an educational tool that supports the goal of focusing on patients' concerns (Jensen & Pals, 2015). This innovative educational method emphasizes group interaction and empowers people with diabetes to actively participate in disease management (Engelund, Hansen, & Willaing, 2014; Hansen, Engelund, Rogvi, & Willaing, 2014). Steno Balance Cards are now used in many countries, although their effectiveness has not been rigorously evaluated to date. Steno Balance Cards comprise 25 picture cards covering five themes: the balancing person, bodily infirmities, lowered bar, challenging relationships, and changeable moods (Engelund, Vinther-Andersen, Hansen, & Willaing, 2011).

The main objective of this study was to compare the primary outcome (i.e., the change in HbA1c from baseline to 6 months) between the two groups. Secondary outcomes were self-care behaviors, adherence to advice provided in the education sessions, and use of the AADE7 patient self-assessment 6 months before and 6 months after the intervention (Boren, 2007). The authors hypothesized that the use of the Steno Balance Cards would help the patients in the intervention group achieve better glycemic control, measured via HbA1c levels, than their SC group peers.

Methods

Study Design

In total, 95 patients with T2DM who were attending the metabolism outpatient department of a medical center in central Taiwan were enrolled. Patients were enrolled consecutively, with the first participant assigned to either the psychosocial balance dialogue (PBD) group (n = 47) or the standard care (SC) group (n = 48) based on the toss of a coin. Subsequently, participants were alternately assigned to the PBD group or the SC group, resulting in a roughly equal number of participants in the two groups and an allocation ratio of 1:1. Three participants were later lost to follow-up. The enrollment process is shown in Figure 1.

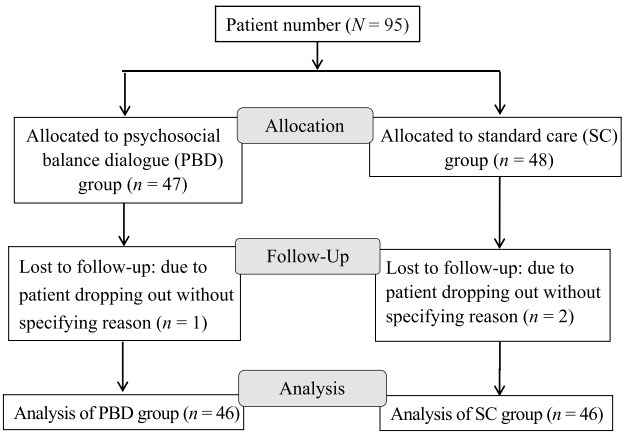

Figure 1. Flowchart of patient selection and group allocation.

Inclusion criteria were T2DM duration of more than 1 year, age of more than 20 years, HbA1c of more than 8%, current treatment by oral diabetic medications or insulin, and nonparticipation in any other research during the past 90 days. Exclusion criteria were cognitive deficits (based on medical records, such as dementia), severe depression, and other severe psychiatric conditions. The study protocol was approved by the institutional review board of Chung Shan Medical University Hospital (CS13227) and was in compliance with the Helsinki Declaration. Written informed consent was obtained from all of the participants. The primary outcome was the change in HbA1c from baseline to 6 months. Secondary outcomes were changes in fasting plasma glucose (FPG), weekly self-monitoring of blood glucose (SMBG) behavior (times per week), daily carbohydrate amount per day (grams per day), and weekly physical activity (minutes per week) from baseline to 6 months. Two questionnaires, the Well-Being Index questionnaire (WHO-5) and the 12-item Short-Form Health Survey (SF-12), were used to evaluate patients' 6-month blood glucose parameters as well as physical and mental health behaviors. The treatment changes were evaluated at baseline and at 6 months. Levels of HbA1c were measured by high-performance liquid chromatography using variant assay (Tosoh HLC-723 G7 variant mode). FPG concentration was determined by the hexokinase method using a Synchro glucose analyzer system.

Psychosocial Balance Dialogue Group

In the PBD group, Steno Balance Cards were used. The cards apply a health education model focusing on patient perception. The Steno Balance Cards were developed by the Danish Steno Diabetes Center, which provided training resources to the Taiwanese Association of Diabetes Educators. The purpose of the Steno Balance Cards is to let the participants discuss the impact that diabetes has had on various aspects of their lives as well as the imbalances they may have experienced. By engaging in a dialogue, the participants can identify and reflect on their own challenges and then identify goals and solutions. Perhaps most important, the cards are used to motivate patients to be proactive in managing T2DM. Group participation and conversations on broad concepts in health, as well as more specific health-related issues, are based on an equal-status relationship between the educator and patients.

The Steno Balance Card sessions were conducted in a private meeting room at the hospital. Two sessions were held a week apart; each session lasted 2 hours. Both sessions were guided by one diabetes educator and were conducted in groups of 10–12 participants. The 6-month postintervention period commenced 1 month after the second and final Steno Balance Card session (in September 2015) and ended in March 2016. During the first 3 months of this period, patients were asked to keep a record of their dietary intake (such as the amount and types of fruit and the number of bowls of rice or noodles consumed) and their blood sugar level six times daily (preprandial and 2-hour postprandial testing for each of the three daily meals) for 3 consecutive days of their choice each month. A simple journal was provided for this purpose. The researchers then used these data to estimate carbohydrate intake. A month later, the patients were contacted by telephone and asked about their experience managing blood glucose in the context of dietary intake. For the next 3 months, the PBD patients relied on their own initiative to manage diet and blood glucose. Six months after the intervention, they visited the hospital for a routine checkup.

The Steno Balance Cards cover five discrete themes. At the beginning of a group discussion, the educator placed the 25 cards on the wall and each patient was asked to pick three cards that best fit their own situation (Engelund et al., 2011). The participants then shared the reasons they selected the three cards and discussed their experiences as well as any confusion they might have. The educator guided the discussion to cover key points that arise with each picture, such as concepts, emotions, and behaviors. These issues were discussed in a chronological context, beginning with the present, then the past, and, finally, the future. The patients used the top three cards that they selected as a starting point to discuss feelings and thoughts about their disease with the educator. The educator encouraged participants to make decisions and take action to improve long-term health (Andersen, Hempler, & Willaing, 2014; Hansen et al., 2014). A detailed guide to using the Steno Balance Cards is provided by the Steno Diabetes Center (Engelund et al., 2011).

Standard Care Group

The SC group received general education about T2DM using a conventional teaching mode. They were all treated under the Diabetes Shared Care System, which provides standardized diabetes care and included a medical history assessment, physical examination, laboratory evaluation, management plan evaluation, and DSME. Standard care was provided by a general practitioner, a nurse, and a nutritionist. Diabetes education was provided at clinic visits, which were scheduled every 3 months. Carbohydrate intake was estimated by a nutritionist at these visits, based on participants' 24-hour recall of dietary intake.

Statistical Analysis

All statistical analyses were carried out using IBM SPSS Statistics Version 22.0 (IBM, Armonk, NY, USA). Primary outcome was analyzed on an intention-to-treat basis and included all participants. The data analysis set included participants who were enrolled at the beginning of the study. Dropouts and missing data (as a result of failure to comply with the measurement protocol) were replaced with the immediately preceding values. All changes between the groups were evaluated by analysis of student's t test. All tests of intervention effects were carried out at a two-sided significance level of .05, unless otherwise stated.

Results

Characteristics of participants in the experimental group are summarized in Table 1. There were no differences between

TABLE 1.
Baseline Characteristics (N = 92)

Variable	All (*N* = 92)		PBD Group (*n* = 46)		SC Group (*n* = 46)		
	n	%	*n*	%	*n*	%	*p*
Gender							.83
Male	43	46.7	21	45.7	22	47.8	
Female	49	53.3	25	54.4	24	52.2	
Educational level							.60
Illiterate	29	31.5	16	34.8	13	28.3	
Elementary school	39	42.4	20	43.5	19	41.3	
Junior high school or higher	24	26.1	10	21.7	14	30.4	
Family history of diabetes	41	44.6	21	45.7	20	43.5	.83
Treatment							.60
Oral antidiabetic drugs	61	66.3	31	67.4	30	65.2	.82
Use of insulin treatment	31	33.7	15	32.6	16	34.8	.82
Diabetes complications	27	29.3	14	30.4	13	28.3	.81
	M	*SD*	*M*	*SD*	*M*	*SD*	*p*
Age (years)	61.8	11.7	62.5	6.1	61.1	10.0	.40
Diabetes duration (years)	10.7	5.2	11.0	5.9	10.5	4.5	.63
HbA1c (%)	8.1	0.6	8.1	0.7	8.0	0.6	.35
FPG (mg/dL)	171.2	24.5	174.9	19.9	167.6	28.1	.15

Note. PBD = psychosocial balance dialogue; SC = standard care; HbA1c = glycolated hemoglobin A1c; FPG = fasting plasma glucose.
*Significant differences between groups, $p < .05$ (PBD vs. SC group).

participants' baseline demographics and disease-related characteristics. The participants' average age was 61.8 ± 11.7 years; approximately 42.4% (n = 39) had a primary school level of education, the average duration of diabetes was 10.7 ± 5.2 years, 44.6% (n = 41) had a family history of diabetes, 66.3% (n = 61) used oral hypoglycemic drugs, 33.7% (n = 31) were treated with insulin, 29.3% (n = 27) had diabetic complications, mean HbA1c was 8.1% ± 0.6%, and mean fasting blood glucose was 171.2 ± 24.5 mg/dL.

Glycemic Outcomes

Percentage changes in FPG (milligrams per deciliter) and HbA1c changes from baseline to 6 months are shown in Table 2. From baseline to 6 months, both groups had a significantly lower HbA1c (%), with a greater reduction in the PBD group than in the SC group. The mean change in HbA1c from baseline to the first 6 months in the PBD group was 8.1% ± 0.7% to 6.8% ± 0.8%, compared with 8.0% ± 0.6% to 7.4% ± 0.7% in the SC group ($p < .001$). In the PBD group, the fasting blood glucose level decreased from 174.9 ± 19.9 to 131.2 ± 32.3 mg/dL, whereas in the SC group, it decreased from 167.6 ± 28.1 to 165.0 ± 42.6 mg/dL ($p < .001$).

Changes in Behavior

There were significant behavioral changes (see Table 2), including increased frequency in SMBG, reduced intake of carbohydrates per day (grams per day), and elevated weekly duration of physical exercise (minutes per week) in both groups. In the PBD group, frequency of SMBG (times per week) increased from 1.5 ± 1.8 to 6.5 ± 1.6 compared with 1.5 ± 2.0 to 1.6 ± 2.2 in the SC group ($p < .001$). Carbohydrate intake (grams per day) in the PBD group decreased from 215.7 ± 25.6 to 179.1 ± 16.4 g compared with an increase of 214.0 ± 40.8 to 255.0 ± 34.2 g in the SC group ($p < .001$). Physical exercise (minutes per week) increased from 21.1 ± 38.4 to 161.5 ± 85.2 minutes in the PBD group compared with 35.9 ± 34.7 to 38.0 ± 35.3 minutes in the SC group ($p < .001$). The diabetes medication change was minimal: 5% in the PDB group and 6.5% in the SC group.

Mental and Physical Behavior Outcomes

Questionnaire results for mental and physical behavior are displayed in Table 2 and show an improved ability to cope with T2DM. The WHO-5 score increased from 43.9 ± 22.8 to 89.3 ± 25.5 in the PBD group and from 43.2 ± 22.5 to 49.6 ± 27.2 in the SC group ($p < .001$). Regarding SF-12 Physical and Mental Health Composite Scale scores, the PBD group showed a significant increase but there were no significant changes in the SC group. The SF-12 (Physical Component Summary) score increased from 28.4 ± 2.4 to 56.4 ± 2.3 in the PBD group and from 28.2 ± 4.2 to 32.9 ± 7.2 in the SC group ($p < .001$). Regarding SF-12 (Mental Component Summary), the score increased from 29.4 ± 3.7 to 58.4 ± 0.9 in the PBD group and from 29.2 ± 5.0 to 38.8

TABLE 2.
Changes and Comparison Outcomes at Baseline and at the End of the Study Period (N=92)

	PBD Group (*n* = 46)		SC Group (*n* = 46)		PBD vs SC (6 months)	
	Baseline	6 months	Baseline	6 months		
Variable	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*t*	*p*
Glycemic Outcomes						
HbA1c (%)	8.1 (0.7)	6.8 (0.8)	8.0 (0.6)	7.4 (0.7)	-3.5	< .001
FPG (mg/dL)	174.9 (19.9)	131.2 (32.3)	167.6 (28.1)	165.0 (42.6)	-8.7	< .001
Behaviors						
Frequency of SMBG (times/week)	1.5 (1.8)	6.5 (1.6)	1.5 (2.0)	1.6 (2.2)	5.6	< .001
Diet, Carbohydrates (grams/day)	215.7 (25.6)	179.1 (16.4)	214.0 (40.8)	255.0 (34.2)	-11.1	< .001
Physical activity (minutes/week)	21.1 (38.4)	161.5 (85.2)	35.9 (34.7)	38.0 (35.3)	16.5	< .001
Diabetes Mental and Physical Behavior						
WB (WHO-5)	43.9 (22.8)	89.3 (25.5)	43.2 (22.5)	49.6 (27.2)	9.1	< .001
SF-12 (PCS)	28.4 (2.4)	56.4 (2.3)	28.2 (4.2)	32.9 (7.2)	21.0	< .001
SF-12 (MCS)	29.4 (3.7)	58.4 (0.9)	29.2 (5.0)	38.8 (5.5)	23.7	< .001

Note. PBD group= psychosocial balance dialogue; SC group = standard care; HbA1c= glycolated hemoglobin A1c; FPG = fasting plasma glucose. SMBG = self-monitoring of blood glucose. WB (WHO-5) = WHO-5 Well-being Index questionnaire; SF-12 = 12-Item Short-Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary.

± 5.5 in the SC group ($p < .001$). The results further showed that the PBD group had greater improvements in mental health behavior and sense of well-being as well as decreased diabetes-related difficulties compared with the SC group.

Discussion

The study results revealed that the PBD group, which received motivational instruction using the Steno Balance Cards, had significantly improved HbA1c levels and physical and psychosocial health behaviors. The Steno Balance Card method was shown to be a more effective educational tool compared with the standard teaching approach for patients with T2DM. The provision of psychosocial health support plays an important role in health education for patients with T2DM, as it has a beneficial effect on mood and provides patients with useful tools to cope with difficulties they may encounter while managing their disease. It is vital to support and monitor psychosocial well-being, as this promotes quality of life and improves outcomes for patients with diabetes. Problem solving is a skill that can be taught using the interactive Steno Balance Cards, which also enable patients to participate in group discussions; problem-solving skills help patients adjust to new dietary and blood glucose self-monitoring regimens and better understand the importance of blood glucose control (Hill-Briggs et al., 2011).

The results of this study show that dialogue-based group education for patients with poorly controlled T2DM, supervised by general practitioners, resulted in significant improvements in blood sugar control and self-management behaviors. These results are consistent with previous findings. Patients who received a psychosocial health education intervention using group discussion achieved blood sugar control targets; the teaching modality had a positive effect (Steed et al., 2005; Steinsbekk et al., 2012). A few studies have compared one-on-one education, and a number of investigations have analyzed the effects of group education. The current literature indicates that, although both individual and group education provide excellent benefits, neither method is clearly superior (Dorland & Liddy, 2014; Duke, Colagiuri, & Colagiuri, 2009). In the traditional teaching mode, general education about diabetes is provided by the treating physician, nurse, nutritionist, and possibly other members of a healthcare team, who interact one-on-one with the patient. This is the predominant method of education in current clinical practice. It is unclear why the group using Steno Balance Cards achieved better outcomes compared with the SC group. However, the mechanism may be explained by the interactive nature of the Steno Balance Cards compared with the passive nature of conventional diabetes education. Discussing issues with their peers "forces" patients with diabetes to reflect on ways to overcome obstacles. Patients may be more motivated to achieve goals that they have set as a result of group discussions. This may lead to better behaviors and, ultimately, to improved glycemic outcomes (HbA1c levels).

The findings of this study indicate that the Steno Balance Card method was effective in reducing levels of HbA1c, as shown in Table 2. Lower levels of HbA1c have clinically significant effects on the prevention of small vascular complications (Ismail-Beigi et al., 2010; Stratton et al., 2000). However, greater improvements in general well-being and other problems associated with diabetes are still needed. Previous studies have shown inconsistent results in patients with T2DM who received education using a group teaching

approach with respect to quality of life, but an overall trend in favor of active intervention has been found (Toobert et al., 2003). During the intervention period, there was a general increase in participants' physical activity and a general decrease in carbohydrate intake. Therefore, study results support the use of an educational intervention based on group interaction and patient empowerment. The validated Steno Balance Card tool was shown to be an effective method of education for patients with poorly controlled T2DM. The educational intervention offered support that led to a significant improvement in HbA1c levels. The therapeutic effectiveness of empowerment principles in adult health education has been shown (Deakin, McShane, Cade, & Williams, 2005; Duke et al., 2009).

One of the strengths of our study was the use of serial telephone interviews to track participant SMBG and other health behaviors that facilitate glycemic control. Telephone interviews offer a minimally disruptive way for researchers and educators to remind participants about upcoming education sessions and to help with any issues related to glycemic control. Most of the patients in this study were not clear about the carbohydrate content of individual food items and had not followed oral hypoglycemic drug regimens. The Steno Balance Card method, an intensive and structured approach to diabetes education, enabled participants to better understand the benefits of treatment in terms of lowering the risk of diabetic complications. The compliance rate was very high in this study, with almost all participants completing all stages of the education intervention. Changes in clinical treatment may be needed for individual patients based on the decisions of the attending physician.

A limitation of this study was the lack of a cost–benefit analysis of the education method compared with conventional, one-on-one diabetes education (Molsted et al., 2012). However, group education is expected to take less time per person than the one-on-one education mode. Furthermore, if the better glycemic control achieved with the group approach is sustained, medical costs should decrease as a result of reduced complications from diabetes. Another limitation is that there was no way to determine with certainty whether the benefits seen in the PBD group were due to primarily to the Steno Balance Card modality or to the peer support provided by the weekly group sessions. Further study is needed to clarify this issue. Patients in the PBD group also received telephone call reminders to bring their records to their next clinic visit to ensure complete data. These brief telephone calls may have provided extra support to participants in the PBD group. In this study, the group status of patients was known to the researchers, owing to the nature of the intervention and the fact that one of the researchers conducted it. Furthermore, these results should be interpreted with caution, as they may not be generalizable to patients from other cultures or other age groups.

In conclusion, this study showed that the use of Steno Balance Cards in the PBD group resulted in significantly lower HbA1c levels as well as improved psychosocial and health behaviors, compared with the results achieved in the SC group. The Steno Balance Card modality was shown to be an effective educational tool compared with the conventional approach used in the SC group. The use of Steno Balance Cards greatly improved the psychosocial health of patients with poorly controlled T2DM, including mood and quality of life. These findings may be useful to clinical staff. Given the apparent effectiveness of the Steno Balance Cards as shown in this study, we recommend that diabetes educators consider incorporating this teaching modality into patient education programs.

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*Address correspondence to: Chien-Ning HUANG, No. 110, Sec 1, Chien-Kuo N. Rd., Taichung City 40201, Taiwan, ROC.
Tel: +886-4-2473-9595 ext. 34111; E-mail: cshy049@csh.org.tw
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