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Effects Of Steno Diabetes Dialogue Cards (Steno Balance Cards) As A Teaching Aid On Blood Glucose Management In Adolescents With Type 1 Diabetes

I.H. Lin [1], F.Y. Lin [2], & H.F. Wang[3]
Ms, Rn / Department Of Nursing, Show Chwan Memorial Hospital
Assistant Professor / School Of Nursing, National Taipei University Of Nursing And Health Sciences
Ms, Rn / Changhua Cristian Hospital / Case Manager

ABSTRACT

Background: *Type 1 diabetes mellitus (T1D) is one of the most common metabolic diseases in children worldwide. It is believed to result from the destruction of β-cells by autoreactive antibodies. Therefore, insulin cannot be secreted regularly, leading to high blood sugar and the need for lifelong insulin injections. The Steno Balance Card method can improve the outcomes of self-management and glycemic management in adolescents.*

Purpose: *This study aimed to determine the effects of blood sugar management in adolescents with T1D after group health education sessions using Steno Balance Cards. The reliability and validity of the effect of blood sugar management and self-management, after health education sessions with Steno Balance Cards, were evaluated.*

Methods: *A quasi-experimental nonrandomized study design with convenience sampling was adopted in the study. Steno Balance Cards were used as a one-day intervention for the experimental group, while the control group only received general health education. Both groups were tested for HbA1c before intervention and again in the third month postintervention and were given a self-management posttest. The research tools included a general information form, Diabetes Conversation Map assessment questionnaire, self-management behavior scale, and Steno Balance Cards for adolescents with T1D (themed picture version). The subjects were 83 adolescents diagnosed with T1D.*

Results and Conclusions: *The results showed that the experimental group with the Steno Balance Card intervention was better at blood sugar management after three months ($p < 0.01$) than the control group that received only general health education. After the homogeneity test, the regression coefficient of the control group was 0.72 and of the experiment group was 0.39; the difference in the regression coefficient between the two groups was 0.33, which was statistically significant ($p < 0.05$). The experimental and the control groups did not differ in their scores three months after the intervention ($p = 0.82$), meaning that both health education methods improved the level of self-management in patients.*

Implications for Practice: *Therefore, we recommend implementing Steno Balance Cards as a group health*

education aid for adolescents with (T1D), which will help patients to improve their level of self-management of the disease and enhance their ability to management blood sugar.

Keywords: *type 1 diabetes mellitus, Steno Balance Cards, group health education, blood sugar management, self-management*

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I. Introduction

Piaget's theory of cognitive development suggests that individuals tend to become argumentative during adolescence as they begin to improve their critical thinking and comprehension skills, and use abstract reasoning to identify loopholes in others' explanations. According to Erikson's theory of psychosocial development, adolescence is characterized by opposition between identity and identity confusion. Adolescents desire to gain autonomy in their lives and tend to rely on their friends and peers for information. Therefore, they often conflict with their parents, which may cause psychological and health problems.[1] This study examined the reliability, validity, and effectiveness of the Steno Balance Cards (cartoon version) as a tool for group-based education of adolescents with T1D (Type 1 diabetes) to improve their blood glucose management. We anticipate that our results will benefit health care professionals and educators.

Impacts of diabetes on adolescents

Type 1 diabetes is caused by autoimmune destruction of β-cells by antibodies, which reduces insulin secretion and forces patients to rely on lifelong insulin injections to regulate their blood sugar levels. When patients have poor blood glucose management and their condition is severe, they may develop ketoacidosis, which requires intensive care and may even endanger their lives.[2] A chronic disease may affect adolescents physically, mentally, socially, and academically and cause them to continually rely on medications and hospitalization.[3]

The factors perceived by adolescents with diabetes have an impact on their T1D management capabilities, including school, friends, family, fear of complications, lack of disease-related information, and changes in body image.[4] Parents need to develop their own adaptability skills to ensure that their children are willing and able to manage their blood sugar levels[4]. These stressors negatively affected adolescents' personal and school lives, friendships, interpersonal interactions, and academic performance. This may lead to anxiety, dejection, and depression, which negatively affects subsequent self-care abilities.[5]

Peer support and diabetic adolescents

Erikson's theory of psychosocial development suggests that when adolescents are diagnosed with an illness or are hospitalized because of it, their daily life changes drastically, and they become angry, frustrated, and miserable when they are separated from their peers. Consequently, they tend to overexert, withdraw, or refuse to cooperate.[6] Adolescents with diabetes emphasize their body image and privacy and are unwilling to let others know about their differences from their peers. Therefore, they do not dare to measure their blood sugar level or

inject insulin into public, and these insecurities may easily result in emotional and psychological imbalances.[7] Peer relationships may be a stressor in T1D patients. Adolescents with diabetes are at risk of being ostracized and humiliated, which could strip them of their dignity.[8]

Research has shown that patients with diabetes with peer support have higher adherence because they feel secure and protected. During this process, they build peer support systems conducive to health.[8] Learning the correct way to inject insulin in diabetic support group activities boosts their confidence, strengthens their blood glucose management skills and motivation to engage in self-care, and reduces their anxiety.

Self-management of health

Type 1 diabetes is a common endocrine disorder in children and adolescents. Since poor diabetes management increases the likelihood of severe complications, it is important for adolescents to learn how to effectively manage their blood sugar levels. Adolescents with T1D require sufficient knowledge and support for self-care. The better they are at adjusting to their illness, the more autonomy and the greater their competence in diabetes management.[9] Educational and mental health interventions provide adolescents with effective support to overcome the barriers to self-management of their blood sugar levels and illness. The best approach to diabetes self-management is to learn measures to prevent diabetes-related complications and maintain stable blood sugar levels.[10] Effective communication with family members and good problem-solving skills are key to the success of diabetes patients in self-managing their illness. Schools should coordinate and communicate with diabetic students so that they can monitor their blood sugar and inject insulin into class.[5] Our literature review indicated that poor self-management by diabetics increases the likelihood of developing irreversible and severe health problems. Effective self-management education provided by healthcare professionals to patients with diabetes improves self-care abilities.

Pedagogical theories on dialogue tools for diabetes care

In 1920, Leonard Nelson, a German mathematician–philosopher from the University of Göttingen, advocated the Socratic dialogue approach, which emphasizes cooperative thought through intergroup interactions.[11] By interacting with others and engaging in clarification and reflection, participants gain recognition from their peers, become more confident, and begin to think rationally and positively.[12] Support and mental health monitoring are important for diabetes patients. Steno Balance Cards are a teaching aid that helps diabetic patients overcome adversities and improve their prognosis and quality of life.[13] A Pakistani cross-sectional study found that the use of dialogue cards as teaching aids for diabetic patients helped improve their knowledge.[14] A Brazilian randomized clinical trial found that the use of diabetes dialogue cards led to a significant reduction in body weight, abdominal circumference, blood pressure, blood sugar, cholesterol, and triglyceride levels in diabetic patients.[15] In Taiwan, the use of Steno Balance Cards as a health education tool not only significantly improved patients' blood sugar and cholesterol levels but also enabled them to maintain their self-management and health management skills over long periods.[16]

II. Material and Methods

This quasi-experimental, non-randomized group study with a pretest–posttest design examined the effectiveness of Steno Balance Cards (Steno Diabetes Dialogue Cards) for blood glucose management in adolescents with T1D.

The participant inclusion criteria in this study were adolescents with T1D aged 10–18 years who were able to read and write in Chinese. The HbA1c level of each participant was measured before intervention. Effect assessment published in *The Journal of Nursing Research* showed that six months after intervention the mean HbA1c level of participants who used Steno Balance Cards was 6.8 (*SD* = 0.8) while that of the control was 7.4 (*SD* = 0.7).[13] This result served as the basis for effect size assessment in the present study. Assuming that the post-matching dependence between the intervention and control group was 0.15, then the predicted intervention effect was expected to reach 0.61. By performing a two-tailed test with a type I error of 0.05, we expected to achieve a statistical power of up to 90%. As the intervention effects could vary, the statistical power might also vary. A statistical power of 80% was attained with an intervention effect of 0.28.

The intervention in this study was a group course for adolescents with T1D in which the pre- and post-intervention HbA1c levels of each participant were measured. The course involved the use of Steno Balance Cards (cartoon version). The experimental group completed a one-day learning program involving traditional health education and the Steno Balance Cards. Three months after the Steno intervention, the experimental group participants completed a post-test questionnaire and their HbA1c levels were measured. The control group only completed a program of traditional health education; three months later, these participants completed a post-test questionnaire, and their HbA1c levels were measured. Questionnaire validity and reliability, and the effectiveness of Steno cards as a health education intervention for improving diabetic adolescents' blood glucose management and self-management of health.

Study instruments

Reliability and validity of the assessment scale of the graphical diabetes health dialogue: The scale was originally created covers five dimensions: group dialogue and interactions, emotions and feelings, motivations and behaviors, role of health educators, and environmental factors. The expert validity, as indicated by the content validity index (CVI), was 0.97. The Cronbach's α of the scale reliability ranged from 0.735 to 0.858, and the internal consistency was acceptable. The retest reliability yielded a within-group correlation coefficient of .664 ($p = 0.00$).[17]

Reliability and validity of Steno Balance Cards (cartoon version) for adolescents with T1D: In light of the lack of studies exploring the effectiveness of dialogue tools for diabetic adolescents, this study measured the reliability and validity of the Steno Health Education Cards (cartoon version) for adolescents with T1D.

Ethical approval

This study was approved by an institutional review board (Changhua Christian Hospital:200908) and all participants and their parents signed a consent form prior to participation in the study. Data processing and analysis (Collection Date: 2020/10/07-2022/10/01). All relevant data are within the paper and its Supporting Information

files.

To validate the appropriateness of each response, we consolidated, analyzed, and reviewed the recovered questionnaire data with the teachers and statisticians. First, the data were filed; then, the questionnaire responses were coded, input into a computer, and analyzed using SPSS statistical software. The data analyzed included descriptive statistics, such as participants' basic information, Hb1Ac level, and quality of self-care. Based on the objectives of the study and the properties of the variables, the statistical analysis included both categorical and continuous variables, and the chi-square test was used for the former and the independent *t*-test for the latter.

III. Result

Regarding the homogeneity test results of the participants' basic information, the categorical and continuous variables related to the basic information of the 64 participants were analyzed using chi-square tests and independent *t*-tests, respectively. There were no significant differences in participants' basic information (sex, mean age, mean disease duration, and education level; Table 1) between the two groups. In other words, the background information of the two groups was highly homogenous.

Table 1

Comparisons of demographic data of the experimental group (EG) and the control group (CG) at baseline (*N* = 64).

	CG (*n* = 32)		**EG (*n* = 32)**		***p*-value**	
	n	%	n	%		
Sex					**0.81**	
Female	20	63	17	53		
Male	12	38	15	47		
Attending physician						
Physician A	17	53	11	34	0.14	
Physician B	15	47	21	66		
Education level					**0.56**	
Elementary school	9	28	9	28		
Junior high school	8	25	12	38		
Senior high school	15	54	11	34		
	Mean	***SD***	***Mean***	***SD***	***t***	***p*-value**
Age	14.44	2.82	14.47	2.54	0.47	0.75
Duration of illness	7.25	3.79	6.41	4.53	0.81	0.19
CG: control group; EG: experimental group						

Internal consistency and Cronbach's α were used to measure the reliability of the Steno Balance Cards. The assessment scale for the graphical diabetes health dialogue had 27 items, and the self-management behaviors

scale comprised nine items. The intrinsic Cronbach's α of the former was 1 and that of the latter was 0.89, indicating that the reliability and validity of the Steno Balance Cards were high.

The effectiveness of the Steno Balance Cards for managing participants' blood sugar levels is shown in Table 2 and Figure 2. The blood glucose management skills of the two groups were significantly different ($p < 0.01$) three months after the interventions. Following homogeneity testing, the within-group regression coefficients (b) of the control and experimental groups was 0.72 and 0.39, respectively, with a difference of 0.33. A significant difference was observed when the difference between the regression coefficients was not zero ($p < 0.05$).

Table 2

Effects of adherence therapy on patients' HbA1c level at baseline and three-month follow-up (N = 64).

	CG (*n* = 32)		**EG (*n* = 32)**			
Mean	7.84		7.36			
SD	1.97		1.14			
Regression coefficient (B)	0.72		0.39			
95% Wald CI						
	B	SE	Lower	Upper	*p*-value	ES
Intercept	4.26	0.93	2.40	6.12	<0.01	0.26
Group = 1	-2.33	1.15	-4.64	-0.02	0.05	0.06
Group = 1*before HbA1c	0.33	0.14	0.05	0.61	0.02	0.09

CG: control group; EG: experimental group

The effectiveness of Steno Balance Cards for improving participants' self-management is shown in Table 3. The participants scored Item 9 (Regularly following-up blood sugar levels at healthcare institutions) the highest, with a mean score of 4.52; they scored Item 3 (Engaging in regular exercise for at least 150 minutes per week) the lowest, with a mean score of 3.77. There were no differences between the scores of the two groups after three months ($p = 0.82$), suggesting that Steno Balance Cards and traditional health education did not differ significantly in their effectiveness in improving the participants' self-management of their health. This result suggests that Steno Balance Cards and traditional health education are both effective in improving patients' health self-management.

Table 3

Effects of adherence therapy on patients' self-management skills

(*N* = 64).

	CG (*n* = 32)	EG (*n* = 32)	*p*-value
Mean	37.41	37.72	
SD	5.79	5.37	

			0.82

CG: control group; EG: experimental group; SD: standard deviation

IV. Conclusion

Steno Balance Cards function as a patient-centered means of consultation for teachers to initiate open-ended conversations with patients who also participate in interpreting card content. The goal is to help patients build their self-management skills by strengthening their thoughts and motivations, and fostering effective communication to achieve the best therapeutic outcomes. Patients' acceptance of health education was measured using a questionnaire. Their self-management skills improved, although there were no significant differences in improvement between the experimental and control groups after the Steno Balance Card intervention.

Identified several factors contributing to constant anxiety in children with T1D, such as poor self-management skills, fear of low blood sugar levels, fear of needles, ambivalence toward adopting new technologies or receiving complex diabetes treatment methods (including continuous blood sugar monitoring and percutaneous injections), and uncertainty about the future. The early detection of a child's physical and mental stability is important because of the complexity of diabetes care and lifelong insulin injections.[18] Family participation is essential for the management of children's blood sugar levels. The preliminary results of showed that psychotherapy for adolescents with T1D significantly improves their quality of life. However, intensive or persistent intervention is necessary to sustain these effects and to improve self-management and blood glucose management.[19] A study of Kuwaiti adolescents with T1D suggested that one-to-one semi-structured interviews, each 30–45 minutes long, could boost their self-confidence, improve their own and their mothers' outlook on life, and strengthen their understanding of the illness.[20] Showed that adolescents' self-management skills are positively associated with their quality of life at home and that diabetes education and mental support interventions can effectively improve their self-management, blood glucose management, and quality of life[10]. In short, studies from different countries agree that adolescent patients' self-management skills are associated with their family environment, routine care, health education interventions, health educators' education level, and relationships with patients.

According to local and international studies, the health education interventions provided by case managers are effective in improving children's self-management and blood glucose management skills. An Israeli retrospective cohort study[21] used the Diabetes Conversation Map and found that HbA1c, glucose, and lactate dehydrogenase levels were significantly lower, and the frequency of blood sugar monitoring was significantly improved in the intervention group compared to the control group. In addition, the patients stabilized their blood pressure management and showed better medication adherence. Although there are many clinical approaches to blood sugar management, most case managers implement only traditional health education sessions for adolescent patients, which do not significantly improve their adherence because of their ongoing experience of physical and psychological changes. Healthcare professionals should diversify their health education approaches to include not only verbal teaching, but also teaching aids and personalized teaching modes to provide care services that pay closer attention to the needs of child patients and their families.

V. Limitations and recommendations

The participants in this study were recruited at a medical center in central Taiwan and were followed up for only three months due to workforce shortage and time constraints. The Steno Balance Cards (cartoon version) have been developed for adolescents with diabetes aged 10–18 years undergoing specific phases of physiological and social development. Therefore, the cards are unsuitable for children below 10 years of age or for young adults above 18 years of age. Our results can serve as a reference to facilitate the development of diverse and innovative educational interventions in diabetes education centers in various hospitals.

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