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A 2-Hour Diabetes Self-Management Education Program for Patients With Low Socioeconomic Status Improves Short-Term Glycemic Control

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Abstract

Diabetes self-management education (DSME) improves glycemic control, but patients with low socioeconomic status face institutional and personal barriers to receiving DSME. A retrospective single cohort study of a 2-hour group DSME program prioritizing accessibility and completion of a tightly focused curriculum was performed to determine if glycemic control improved and whether a longer, more comprehensive, prospective evaluation of the program is indicated. All patients who participated in the program from September 2017 to December 2018 were included in the analysis. The primary study endpoint was change in hemoglobin A1c (HbA1c) from baseline. A total of 58 out of 94 patients (61.7%) had paired measurements of HbA1c. Mean HbA1c improved from $9.8\% \pm 2.2\%$ (83.5 ± 24.2 mmol/mol) to $8.3\% \pm 2.0\%$ (67.7 ± 22.0 mmol/mol) at a median of 4 months after participation in the program ($P < 0.001$). The proportion of patients with any improvement in HbA1c was 75.9% (44 of 58; $P = 0.003$), and 65.5% of patients (38 of 58; $P = 0.066$) had an improvement in HbA1c of $\geq 0.5\%$. These results demonstrate the benefit of highly targeted DSME for low-income patients and justify a longer-term and prospective evaluation of the program. (*J Patient Cent Res Rev.* 2020;7:275-281.)

Keywords

diabetes education; low socioeconomic status; type 2 diabetes mellitus; glycemic control

There is a strong association between diabetes prevalence and socioeconomic status (SES). In the 2016 and 2017 National Health Interview Surveys, the prevalence of type 2 diabetes in the lowest quartile of income (15.2%) was more than twice the prevalence in the highest income quartile (7.1%).¹ Low SES is also associated with worsening glycemic control due to poor self-care practices and suboptimal diet from food insecurity.²

Diabetes self-management education (DSME) improves glycemic control and is recommended by the American Diabetes Association (ADA) and

American Association of Clinical Endocrinologists for all patients with diabetes.³⁻⁸ However, DSME is frequently unavailable or inaccessible for patients with low SES, and little has been published regarding DSME specifically for low-income diabetes patients.⁹ A DSME program for low-income and minority patients at the University of Miami was encouraging, with a 0.8% improvement in hemoglobin A1c (HbA1c) from baseline and 40% relative increase in the proportion of patients with HbA1c level of $< 7\%$ among participants completing the 4-week, 4-class, 12-hour program.¹⁰

The Southern Illinois University (SIU) Division of Endocrinology has partnered with Central Counties Health Center (CCHC) of Springfield, Illinois, a Federally Qualified Health Center, to provide on-site DSME free of charge for Medicaid and uninsured patients. Though research shows the largest

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improvements in glycemic control from programs with more than 10 hours of DSME contact time, certified diabetes educators from SIU created a 2-hour group DSME program at the request of CCHC administrative leadership, health care providers, and patients to prioritize accessibility and patient participation in a complete DSME curriculum.³ This study evaluates the effect of a short, single-session group DSME program on glycemic control in a low-SES population with type 2 diabetes mellitus.

METHODS

A retrospective cohort study approved by the Springfield Committee for Research Involving Human Subjects was performed. CCHC patients with type 2 diabetes mellitus who participated in the SIU on-site group DSME program from September 2017 through December 2018 and who had hemoglobin A1c (HbA1c) checked within 3 months before participation formed the study population. Referrals to the program were made entirely at the discretion of CCHC health care providers, and all patients were Medicaid beneficiaries, Medicare beneficiaries, or uninsured (Table 1).

Study-eligible patients participated in a free one-time, 2-hour group DSME session covering topics in the ADA national standards for DSME, but with adjustments for low health and numerical literacy modeled on the *Living With Diabetes* guidebook (Table 2 and Figure 1).^{7,11,12} The SIU Division of Endocrinology has an ADA-recognized DSME program, and the group DSME program for CCHC was developed and led by SIU Division of Endocrinology certified diabetes educators. Sessions were held monthly and limited to a maximum of 15 participants. There was no minimum enrollment. All patients were first-time DSME recipients. There were no significant changes in clinic operating procedures for patients with diabetes during the 15-month period for data analysis.

Age, gender, mode of diabetes management, and baseline HbA1c were recorded for all participants. HbA1c measured in a 3-to-6-month interval after participation was also recorded when available. All HbA1c measurements were obtained at point of care using a device in conformance with the National

Table 1. Income and Insurance Status of CCHC Diabetes Education Patients (N=94)

Parameter	Proportion of patients
Income	
100% of poverty level or below	73%
101%–150% of poverty level	15%
151%–199% of poverty level	6%
≥200% of poverty level	6%
Insurance*	
Illinois Medicaid only	78%
Medicare only	4%
Illinois Medicaid and Medicare	4%
Uninsured	13%

*Does not add up to 100% due to rounding.

CCHC, Central Counties Health Center (Springfield, IL)

Table 2. Topics and Time Allocation in Diabetes Education Sessions

Component	Time
Sign in and self-assessment	15 minutes
Education topics:	90 minutes
➤ What is diabetes?	
➤ Health problems when a person has diabetes	
➤ Medication changes in diabetes treatment with time	
➤ Lowering risk of health problems when you have diabetes	
➤ Physical activity	
➤ Meal planning	
➤ Foot care basics	
Goal setting and adjourn	15 minutes

Glycohemoglobin Standardization Program (DCA Vantage® Analyzer, Siemens Medical Solutions, Inc.); the coefficient of variance for low and high HbA1c standards was 1.8% and 3.7%, respectively.¹³

The primary study endpoint was change in paired HbA1c measurements from baseline. Secondary endpoints were proportions of patients with any improvement in HbA1c and HbA1c improvement of

Each of the food portions listed = 1 carbohydrate choice = 15 grams carb

Starches	Starchy Vegetables & Beans	Milk & Yogurt	Sweets, Snacks & Drinks
5-7 crackers 20 oyster crackers 2 rice cakes 1 slice of bread (1 oz) 1 small tortilla (6 inch) ½ hamburger/hotdog bun 2-inch square cornbread ¼ bagel ½ English muffin ½ pita 1 small dinner roll 1 toaster waffle 1 small pancake (4 inch) ½ cup cooked noodles 1/3 cup cooked rice 1/3 cup cooked polenta ½ cup cooked grits or oatmeal ¾ cup of MANY cold cereals ¼ cup granola 3 cups of plain popcorn	1 small baked potato (3 oz.) 10 French fries ½ cup mashed potatoes ½ cup of sweet potato ½ cup corn ½ cup peas ½ cup cooked beans/lentils 1 cup winter squash 1 cup pumpkin	1 cup non-fat, low-fat, whole milk ½ cup evaporated milk 1 cup buttermilk 1 cup goat's milk ½ cup chocolate milk 1 cup of soymilk 1 cup rice milk ½ cup eggnog ¾ cup yogurt 6 oz. artificially sweetened yogurt 2/3 cup yogurt with fruit 3 oz. flavored smoothie	2 Oreos 5 vanilla wafers 2 small chocolate chip cookies 3 small gingersnaps 5 Hershey's kisses 3 Snickers miniature candy pieces 3 peppermint candies 3 pieces hard candy ½ cup regular Jell-O ½ cup sugar free pudding 1 ¼-inch square brownie (unfrosted) 2- inch square cake (unfrosted) ½ plain cake doughnut ½-inch slice banana nut bread 1 tbsp. jelly 1 tbsp. honey 1 tbsp. sugar 1 tbsp. agave nectar 1 tbsp. chocolate/caramel syrup ½ cup regular ice cream ¼ cup sherbet or sorbet 10 potato chips 1 oz. trail mix 10 tortilla chips ¾ oz. pretzels
	Combination Foods 1 cup soup 1 cup beef stew 6 chicken nuggets ¼ cup of potato or macaroni salad 1/3 cup baked beans 1-10 th 14 in. thin crust pizza ¼ of 12 in. (5oz) thin crust pizza ½ cup casserole (lasagna, tuna noodle) ½ fried fish fillet pieces ½ cup chili with beans ½ cup macaroni & cheese	Fruit 1 cup Fresh Fruit 1 small piece of fruit (3 oz.) 15 grapes ½ cup canned or frozen fruit ¼ cup of dried fruit ½ cup of 100% fruit juice ½ cup of applesauce	

Breakfast ____ carb choices/ ____ grams **Lunch** ____ carb choices/ ____ grams **Dinner** ____ carb choices/ ____ grams

Total grams of carbohydrate per day = _____

Figure 1. Representative page from the handout provided to class participants.

≥0.5%, which is considered clinically significant.¹⁴ Continuous variables are expressed as means ± standard deviations and categorical variables as proportions unless indicated otherwise. Student's *t*-test and Fischer's exact test were used to compare continuous and categorical variables, respectively. Logistic regression was performed to identify factors predictive of an improvement in HbA1c of ≥0.5%. A sample size calculation indicated that 25 patients with paired HbA1c values were required to detect a 0.7% improvement in HbA1c at α of 0.05 and β of 0.08. Prism 5 for Windows (GraphPad Software) and SPSS Statistics 19.0 (IBM Corporation) were used for statistical analyses. P-values less than 0.05 were considered statistically significant.

RESULTS

Clinical parameters at time of participation in the group DSME program are summarized in Table 3. A total of 94 patients participated in the program, and 58 (61.7%) had HbA1c rechecked 3–6 months after DSME. Patients with and without paired HbA1c measurements were very similar across all clinical parameters. Mean baseline HbA1c for the entire patient population was 9.7% ± 2.3% (82.1 ± 25.2 mmol/mol), and 43.6% of patients were treated with either insulin alone or in combination with noninsulin therapeutics.

Comparison of paired HbA1c measurements before and after participation in the DSME program is

Table 3. Key Clinical Parameters

Parameter	Paired HbA1c (n=58)	No paired HbA1c (n=36)	P
Mean age $\pm$ SD	56 $\pm$ 9 years	55 $\pm$ 11 years	0.733
Female gender	55%	60%	0.672
Preclass mean HbA1c $\pm$ SD	9.8% $\pm$ 2.2% (83.5 $\pm$ 24.2 mmol/mol)	9.4% $\pm$ 2.5% (79.6 $\pm$ 27.0 mmol/mol)	0.486
Mode of treatment			
Diet only	3.4%	5.6%	0.636
Oral medications	36.2%	33.3%	0.827
Oral meds + GLP-1 agonist	12.1%	2.9%	0.148
Oral meds + insulin	27.6%	27.8%	1.000
Insulin only	13.8%	19.4%	0.565
Not recorded	6.9%	11.1%	0.477

HbA1c, hemoglobin A1c; SD, standard deviation.

Figure 2. Whisker plots of hemoglobin A1c (HbA1c) before and after participation in class. Lines are medians, boxes define interquartile ranges, and error bars are 95% confidence intervals. Individual outliers are plotted as dots. Median time to postclass HbA1c was 4 months (range: 3–6).

presented in Figure 2. Median time to the next HbA1c measurement after DSME was 4 months (range: 3–6). Mean HbA1c improved from 9.8% $\pm$ 2.2% (83.5 $\pm$ 24.2 mmol/mol) before DSME to 8.3% $\pm$ 2.0% (67.7 $\pm$ 22.0 mmol/mol) after participation (P<0.001). The proportion of patients with any improvement in HbA1c

from baseline as well as those with improvement in HbA1c of $\geq 0.5\%$ is presented in Table 4. A total of 44 patients (75.9%; P=0.003) had an improvement from baseline, while 38 patients (65.5%; P=0.066) showed an improvement of $\geq 0.5\%$.

Logistic regression analysis was performed to determine if any clinical parameters were predictive of a $\geq 0.5\%$ improvement in HbA1c from baseline. Results are presented in Table 5. Baseline HbA1c of $\geq 10\%$ was the only parameter predictive of a $\geq 0.5\%$ improvement in HbA1c (odds ratio: 10.23, 95% CI: 2.48–42.26; P=0.001).

DISCUSSION

There is strong evidence that DSME improves glycemic control. In a systematic review of 118 studies, mean improvements in HbA1c from baseline compared to controls for individual and group diabetes education program participants were 0.78% and 0.62%, respectively.⁶ Unfortunately, only about half of patients with diabetes receive DSME, and Medicaid and uninsured patients are 20%–30% less likely to receive DSME than patients with commercial insurance.^{15,16} Low-income patients often receive health care in clinics where the availability and quality of DSME programs are limited and have personal barriers to participation such as lack of transportation, inability to take time off work, requirements for child care, and

Table 4. Proportion of Patients With Improved Hemoglobin A1c (n=58)

Parameter	Yes	No	%	P
Any improvement in hemoglobin A1c	44	14	75.9	0.003
Hemoglobin A1c improved by $\geq 0.5\%$	38	20	65.5	0.066
Hemoglobin A1c improved by $\geq 1.0\%$	30	28	51.7	---
Hemoglobin A1c improved by $\geq 1.5\%$	23	35	39.7	---

Table 5. Predictors of Hemoglobin A1c Improvement of $\geq 0.5\%$ (n=58) by Logistic Regression

Parameter	Odds ratio (95% CI)	P
Preclass hemoglobin A1c of $\geq 10\%$ (n=28)	10.23 (2.48–42.26)	0.001
Age in years	0.88 (0.24–3.24)	0.844
Gender (reference: female)	1.04 (0.29–3.71)	0.958
Mode of treatment (reference: diet only)		
Noninsulin therapies only	0.24 (0.05–1.21)	0.085
Insulin (with or without oral medications)	1.60 (0.41–6.31)	0.499

unaffordable fees or copayments.⁹ The attrition rate for multisession DSME programs is generally high, and fewer than half of participants fully completed the University of Miami multisession DSME program for low-income patients.^{3,10} Since completion of DSME programs is predictive of improved glycemic control, it is reasonable to explore the effectiveness of a highly focused and short DSME program.³

The results of this study indicate that a 2-hour, single-session group DSME program for uninsured and underinsured low-income patients can significantly improve glycemic control in the first 3–6 months after participation. Mean improvement in HbA1c from baseline for participants with paired measurements before and after DSME was highly significant at 1.5% ($P < 0.001$) and compares favorably to the improvement in glycemic control in meta-analyses of group DSME programs (0.46% and 0.62%), for low-income patients completing the University of Miami multisession DSME program (0.82%), and a randomized controlled trial of Federally Qualified Health Center patients receiving standard DSME (1.4%) or DSME augmented with telephonic support (1.7%).^{6,10,17,18} More than 75% of CCHC/SIU patients had an improvement in

HbA1c from baseline, and approximately two-thirds had an improvement in HbA1c that was $\geq 0.5\%$. Although the proportion of patients with improvement in HbA1c of $\geq 0.5\%$ was not quite statistically significant, the majority of patients completing the program had a clinically meaningful improvement in glycemic control.¹⁴

The logistic regression analysis found that baseline HbA1c of $\geq 10\%$ was the only patient factor predictive of a $\geq 0.5\%$ improvement in HbA1c. However, the finding that very poor baseline glycemic control is predictive of significant glycemic improvement is unexpected. In Project Dulce, a program in San Diego County for low-income and underserved patients with diabetes, high baseline HbA1c, along with duration of diabetes, lack of insurance, treatment with insulin or multiple oral diabetes medications, and high baseline cholesterol, was associated with continued poor glycemic control.¹⁹ Relatively few patient characteristics (HbA1c before class, age, gender, and mode of diabetes management) were assessed in this study, and it is possible a more comprehensive evaluation could identify additional factors that are also predictive of significant glycemic improvement.

Our study has several strengths. First, all participants completed a common DSME program developed and presented by experienced registered dietitians/certified diabetes educators in a university-based and ADA-recognized DSME program. Second, all HbA1c measurements for the study were obtained by a common point-of-care testing device in the clinic, allowing for accurate timing of measurements relative to participation in the DSME program and direct comparisons of results before and after class. Third, patients were managed by a relatively small panel of primary care providers at CCHC and could fill prescriptions for medications and devices (eg, glucose meters and strips) at the clinic, limiting variability of health care providers and inconsistent access to therapeutic agents as potential confounding factors. Finally, all patient documentation and laboratory results were in a single medical record that helped ensure completeness and fidelity of data collection.

Some study limitations need to be recognized. Measurement of HbA1c in the stipulated interval after participation in class was incomplete, and it is possible that results are skewed due to selection bias. However, there was no difference in baseline characteristics of program participants with or without paired HbA1c measurements. Measurement of glycemic benefit is limited to 6 months from participation in class, with HbA1c measured a median of 4 months after participation. It is possible that glycemic benefit wanes with time, and the durability of improved hyperglycemia after this single DSME session needs to be assessed in another study. Other potential clinical variables of interest, such as blood pressure, weight, and lipids, were not assessed. Also, there was no formal assessment of diabetes knowledge before and after sessions. Finally, a relatively small number of patient characteristics were recorded, limiting the ability to identify potential factors that predict significant benefit from this DSME program. However, the primary goal of this study was to determine if the impact of this new DSME program on glycemic control is significant and indicates that a longer, more comprehensive, and prospective evaluation is appropriate.

In summary, the 2-hour, single-session SIU/CCHC diabetes self-management education program

significantly improved glycemic control as indicated by changes in paired HbA1c measurements before and 3–6 months after participation. Though the Patient Protection and Affordable Care Act of 2010 has extended health insurance to many adults with diabetes, there is still a large population of patients who remain uninsured or have insurance that does not cover the costs of DSME. If confirmed by a prospective and longer-term study, this program could serve as a model for DSME at other Federally Qualified Health Centers and community health centers that provide care to patients with significant barriers to participation in other DSME forums that are presented over multiple sessions and several hours of contact time.

Patient-Friendly Recap

- Diabetes self-management education is recommended for all patients with diabetes mellitus because it teaches them how to control their blood sugar.
- Low-income patients are less likely than those with private health insurance to benefit from multiple-session educational programs, due in part to barriers such as lack of transportation or child care.
- In testing a short (2-hour), single-session group diabetes education program, the authors found that blood sugar (hemoglobin A1c) levels of federally insured or uninsured patients improved ~4 months after participation.
- If confirmed by a prospective study with longer follow-up, this novel program could serve as a blueprint for effective diabetes education offered to low-income patients.

Author Contributions

Study design: Jakoby, Burns. Data acquisition or analysis: Jakoby, Luff, Botchway, Burns. Manuscript drafting: all authors. Critical revision: all authors.

Conflicts of Interest

None.

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