FEATURE ARTICLE

Evaluating the Implementation of the Diabetes Self-Management Program in a Rural Population

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The evidence-based Diabetes Self-Management Program (DSMP) has been shown to improve a variety of health-related outcomes, but the program has been challenging to implement in rural areas, and rural dissemination has been low. The purpose of this project was to evaluate the effect of implementing the DSMP on self-reported outcomes in a rural region. Through a collaboration with multiple partners, the Living Well program delivered 28 DSMP workshops from 2017 to 2019. Data were collected to determine whether there were post-intervention changes in patient-reported outcomes on measures of diabetes distress, self-management, and patient activation. In addition, secondary analysis of A1C was abstracted from the medical records of participants with type 2 diabetes who completed at least four sessions of a DSMP workshop between 2017 and 2019 and whose medical records had an A1C value in the year before the program and at least one A1C value >3 months after the program. Statistically significant improvements were seen for the Diabetes Distress Scale ($P = 0.0017$), the Diabetes Self-Management Questionnaire ($P < 0.0001$) and the 10-item Patient Activation Measure ($P < 0.0001$). There was no evidence of change in A1C over time in analyses of all participants ($P = 0.5875$), but a consistent though nonsignificant ($P = 0.1087$) decline in A1C was seen for a subset of participants with a baseline A1C ≥8%. This evaluation provides preliminary support for implementing the DSMP as part of a comprehensive treatment and self-management plan for people living with diabetes in rural areas.

Diabetes is the seventh leading cause of death in the United States, directly accounting for 83,564 deaths annually (1). In 2017, the estimated costs of diabetes was $327 billion ($90 billion of which were indirect costs). Excess health care costs for a person living with diabetes are nearly $10,000 per year (1). Nationally, the Centers for Disease Control and Prevention (CDC) estimates that 34.1 million people ≥18 years of age (13.0% of the U.S. adult population) have diabetes (1).

Best-practice guidelines from the CDC and the American Diabetes Association (ADA) indicate that the provision of diabetes self-management education and support (DSMES) plays a major role in the treatment of this pervasive chronic disease (2). Meta-analyses of DSMES interventions indicate that they significantly improve clinical and quality-of-life outcomes (3–5).

The Diabetes Self-Management Program (DSMP) is an evidence-based, peer-facilitated program included in the ADA's Diabetes Support Directory (6). It was developed at the Stanford Patient Education Center and is now licensed through the Self-Management Resource Center. The DSMP is based in Bandura's social learning and self-efficacy theories (7,8), which hold that people learn from others and their environment (through modeling, persuasion, vicarious experience, and actual experience), which allows them to build their own confidence in initiating certain behaviors.

Although various studies have indicated the effectiveness of the DSMP (9–11), there is limited research reporting individual-level outcomes in rural areas. This project is pertinent because rural counties face several disparities with regard to DSMES. First, rural areas have fewer ADA-approved DSMES programs. Data from 2016 indicated that nearly two-thirds of rural counties lacked a DSMES program (12). The fact that rural areas suffer from a chronic provider shortage, including professionals who are certified to meet DSMES standards, contributes to this disparity (12). Although rural self-management programs have equivalent success in retaining participants (13), it is more difficult to access these interventions in rural areas because of their lack of availability, as well as additional contextual factors. For example, rural counties have higher rates of unemployment, which is also negatively associated with utilization of DSMES (12). Finally, the food and physical activity environments in rural areas may not be as conducive to self-management behaviors

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(14,15). For example, rural individuals are more likely to live in food desert communities, and the absence of well-maintained sidewalks may create a barrier to physical activity.

In rural New York, a DSMP program was implemented as a quality improvement project in response to a rural health care network's interest in decreasing the prevalence of uncontrolled diabetes in a region that had higher levels of both diabetes prevalence and diabetes mortality compared with the overall values for New York State (16,17). The purpose of this project was to evaluate diabetes health-related outcomes for individuals with diabetes who participated in the DSMP in this rural region of New York.

Design and Methods

The plan for evaluating implementation of the DSMP was reviewed by the Mary Imogene Bassett Hospital Institutional Review Board and determined to have met the federal criteria for exemption as an evaluation of an existing practice. The intervention took place between March 2017 and November 2019, with follow-up data collected through May 2020.

Setting and Participants

The health care network serves an eight-county region of rural New York. The DSMP intervention was implemented in six counties based on network data indicating the need for improved self-management of chronic conditions. Participants enrolled in the network's DSMP between March 2017 and September 2019. Individuals were recruited through a variety of methods, including provider referral, targeted social media ads, newspaper inserts, and traditional flyers and newspaper advertisements. Participants were able to enroll in the program by calling or emailing the program office or registering on the health care organization's public website.

A total of 474 individuals enrolled in the DSMP. The analyses of patient-reported outcomes were limited to those participants who met the following inclusion criteria: they must have completed the program (attended four of the first six sessions), had a diagnosis of type 2 diabetes in the medical record, were patients within the health care system, and completed both the pre- and post-intervention survey instruments (n = 221). The A1C analysis included participants who met the following criteria: they must have had an A1C value in the medical record within 1 year before their program start date and at least one A1C value at least 3 months after completion of the DSMP (n = 210). A participant flow diagram for each analysis is depicted in Figure 1.

Intervention

The DSMP intervention was implemented as a quality improvement clinical-community collaboration between a rural health care network and non–safety net provider network (Offices for the Aging, New York State Department of Health–funded Rural Health Networks). The program was offered in five discrete cycles in spring 2017, spring 2018, fall 2018, spring 2019, and fall 2019, with 8–13 separate workshops occurring throughout the region during each cycle.

The intervention consisted of seven consecutive weeks of 2.5-hour, small-group meetings (usually including eight to 10 individuals) led by two trained peer facilitators. The groups met at available community spaces such as libraries, senior centers, health care clinics, and churches. The first 6 weeks consisted of the evidence-based DSMP curriculum, and the week 7 session was a group meeting with a diabetes nurse educator from the rural health care network who provided a general overview of current treatments and management strategies for diabetes. The DSMP is grounded in self-efficacy theory and focuses on the processes of action-planning, problem-solving, and decision-making to facilitate improved self-management skills. Diabetes-specific content, particularly around monitoring blood glucose, healthy eating, and physical activity, is reviewed, as well as content around emotional regulation and communication. Classes are highly interactive. The program is not intended to replace the services provided by certified diabetes care and education specialists, but rather to complement them. The week 7 visit with the diabetes nurse educator functioned as a warm hand-off to those clinical educational services, thus reminding participants of additional available DSMES resources in the region.

Measures

This prospective, observational study compared pre- and post-intervention measures, including primary self-reported data collected via paper survey immediately before the first session and immediately after the intervention and secondary measures (A1C) that were abstracted from the medical record and followed longitudinally. Self-reported measures included the Diabetes Distress Scale (DDS), the Diabetes Self-Management Questionnaire (DSMQ), and the 10-item Patient Activation Measure (PAM-10), as well as the single-item Self-Rated Health Question (18). Sociodemographic characteristics (including types of chronic conditions) were also collected at baseline.

The DDS (19) is a 17-item questionnaire that assesses overall diabetes distress using a 6-point scale in which 1 = no problem and 6 = a serious problem. There are four subscales contained within the instrument: emotional burden, regimen distress, interpersonal distress, and physician distress. Scores are calculated as sums of the overall questionnaire, as well as subscales divided by the number of questions, so that possible values range from 1 to 6.

The 16-item DSMQ (20) assesses challenges to self-care activities using a 4-point scale in which 0 = "does not apply to me at all" and 3 = "applies to me very much." The DSMQ has an overall score and scores for four subscales, including glucose management, dietary control, physical activity, and health care use. Scale scores are calculated as sums of item scales (0–3) and then transformed into a score ranging from 0 to 10 (raw score/theoretical maximum score × 10). A score of 10 represents the highest level of self-reported self-management for the overall score and the subscales (20).

The PAM-10, licensed through Insignia Health, is a 10-item, 4-point scale (plus an option for not applicable) that measures how activated patients are to engage in their own care, a predictor of improved health outcomes. It was originally developed as a 22-item scale (21) and then subsequently shortened to 13 items and 10 items (22,23). A numerical score is generated with a possible range from 0 to 100. In the course of implementing this project, it was suggested that we start using this measure, as it is an important indicator that the health care network uses to track patient engagement. Thus, the PAM-10 was only administered to DSMP participants beginning in 2019, so analyses of this measure were limited to 80 participants.

In addition to the patient-reported outcomes that were analyzed for all completers of the program, A1C served as a clinical outcome, with values extracted from the medical record system. The medical records of participants for the year before the first session of the DSMP were reviewed, and the last A1C value before they started the DSMP served as the baseline measure. All A1C results recorded ≥3 months after the final DSMP session were included in the pre-/post-intervention A1C analyses. Follow-up time for A1C measurements using this method of secondary data analysis ranged from 4.5 to 37.5 months, depending on the year and season participants were enrolled in the DSMP.

Statistical Methods

The patient-reported outcomes were analyzed to determine pre-/post-intervention differences in mean scores for responses to the DDS, the DSMQ, and the PAM-10. These were analyzed using the Wilcoxon signed rank test. For the DDS scale, only subjects with complete data (≤1 missing data element) were analyzed. Patient-reported health outcomes were also stratified by age, education, self-reported health status, and number of classes attended (4, 5, or 6 of the first 6 sessions).

A total of 210 participants were included in the A1C analyses. Linear regression analysis was used to model the relationship of A1C (as a continuous variable) and time relative to the start of the program. This model included a random effect for subject to account for multiple observations. A subanalysis was performed for participants with a baseline A1C ≥8%. In addition, a stratified analysis was conducted to examine the change in A1C by length of follow-up period to determine whether the change in A1C levels varied with increased time after completing the DSMP. Finally, a stratified linear regression was used to examine potential predictors of change in A1C.

Results

Characteristics of the study population are summarized in Table 1. The DSMP participants averaged 65 years of age (range 19–90 years), nearly 70% were female, and the majority had at least some college education. Although presence of other chronic conditions was common (66% reported hypertension, 57% high cholesterol, 42% arthritic disease, and 29% depression or anxiety disorders), two-thirds of participants rated their general health as good or better.

The results for patient-reported outcomes are shown in Table 2. Statistically significant reductions in distress were

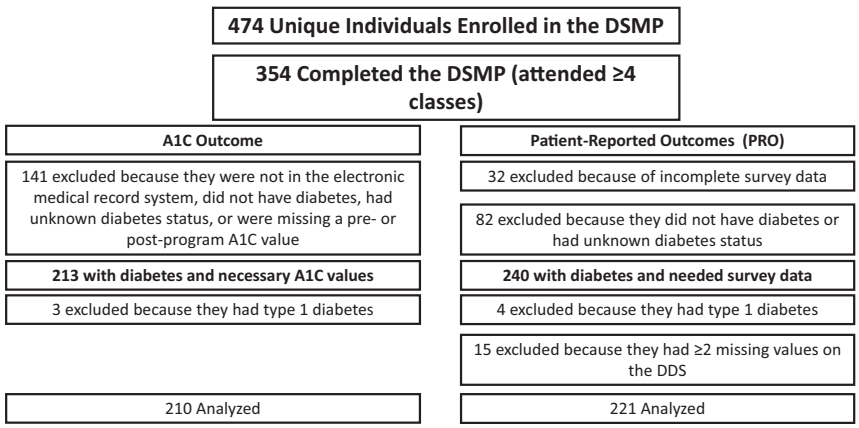

FIGURE 1 Inclusion criteria flowchart for analyses.

TABLE 1 Participant Self-Reported Demographics ($N = 221$)

Age, years	65.00 ± 10.76 (19–90)
Sex	
Male	67 (30.45)
Female	153 (69.55)
Education	
Less than high school graduate or GED	9 (4.11)
High school graduate or GED	60 (27.40)
Some college or technical school	94 (42.92)
College ≥4 years	56 (25.57)
General health	
Excellent	6 (2.76)
Very good	37 (17.05)
Good	104 (47.93)
Fair	62 (28.57)
Poor	8 (3.69)
Chronic conditions	
Hypertension	146 (66.06)
High cholesterol	127 (57.47)
Arthritis/rheumatic disease	92 (41.63)
Depression or anxiety disorders	63 (28.51)
Breathing/lung disease	50 (22.62)
Heart disease	47 (21.27)
Chronic pain	45 (20.36)
Cancer	36 (16.29)

Data are *n* (%) except age, which is mean ± SD (range). GED, general education diploma.

observed for the overall DDS score and the regimen-related subscale. Changes in other DDS subscales were smaller in magnitude and did not achieve statistical significance. Analyses of the DSMQ showed statistically significant improvement in self-management for the overall score and for three subscales (glucose management, dietary control, and physical activity). In additional analyses of change in DDS and DSMQ, regression models with adjustment for baseline levels of DDS and DSMQ did not identify any sociodemographic characteristics, self-perceived health level, or the number of chronic conditions as statistically significant predictors of reduced diabetes distress or improved self-management after completion of the DSMP. Significant increases in patient activation (PAM-10) were also noted for the subset of the study population completing the DSMP (n = 80) when this instrument was included in data collection.

Overall, there was no significant change in A1C over time for completers of the program (β [month] = −0.003; 95% CI −0.016 to 0.009, P = 0.5875). A separate analysis of participants with a baseline A1C ≥8% (40.5% of the study population) indicated a modest reduction in A1C that was consistent as follow-up time increased but lacked sufficient power to achieve statistical significance (Table 3). Age, self-reported health, and education did not predict change in A1C.

Discussion

Among individuals living with type 2 diabetes in a rural area, self-reported diabetes distress, diabetes self-management, and patient activation significantly improved upon completion of the DSMP. Although there was not a significant reduction in A1C over time, this study suggests that relevant health outcomes were positively affected for rural program participants.

The overall DDS mean score at baseline was 2.10 (SD 0.76), which is considered clinically important in that experiencing a moderate level of distress (2–2.99) is associated with less favorable diabetes-related indicators (e.g., A1C, self-efficacy, physical activity, and diet) (24). Post-program, the overall mean decreased to 1.95 (SD 0.69). Because the intervention focuses on improving self-management skills through action-planning and problem-solving, it makes sense that the regimen-related distress subscale of the DDS improved significantly. Similarly, the self-management aspects of glucose management, dietary control, and physical activity were important focus areas of the intervention, so it is not surprising that there were significant changes on the DSMQ. The DSMQ subscale of health care use ("I keep all doctors' appointments recommended for my diabetes treatment"; "I tend to avoid diabetes-related doctors' appointments"; and "Regarding my diabetes care, I should see my medical practitioner(s) more often") did not show any significant change, possibly because the pre-/post-intervention time frame of 6 weeks was too short.

Of the 10 questions that make up the PAM-10, the only two responses that did not significantly improve for our population were "I am confident that I can tell whether I need to go to the doctor or whether I can take care of a health problem myself" and "I am confident that I can tell a doctor concerns I have even when he or she does not ask." Although the results for change in the overall PAM-10 score were significant, our sample started with a relatively high activation level of 2.71. Hibbard et al. (25) acknowledge that an intervention that effectively moves a person from a level 2 ("some knowledge") to a level 3 ("beginning to take action") may not be effective in moving a person from a level 1 ("passive recipient to care") to a level 2 ("some knowledge"). Thus, further exploration into the effect of this intervention on patients who have low activation is needed.

Our overall results are similar to other observational studies and controlled trials of the DSMP in that changes in self-reported outcomes were more robust than changes seen in physiological measures such as A1C. Lorig et al. (9) reported a significant improvement in A1C in the Spanish version of

TABLE 2 Participant-Reported Outcomes at Baseline and 6 Weeks Post-Program

	n	Pre-Intervention, mean ± SD	Post-Intervention, mean ± SD	*P*
DDS score	221	2.10 ± 0.76	1.95 ± 0.69	0.0017
Emotional burden	221	2.24 ± 0.88	2.15 ± 0.87	0.1091
Physician-related distress	221	1.42 ± 0.69	1.46 ± 0.73	0.0952
Regimen-related distress	221	2.62 ± 1.17	2.14 ± 0.94	<0.0001
Interpersonal distress	221	1.87 ± 1.08	1.93 ± 1.06	0.1994
DSMQ score	219	6.48 ± 1.64	7.15 ± 1.46	<0.0001
Glucose management	210	7.12 ± 2.33	7.80 ± 1.95	<0.0001
Dietary control	218	4.94 ± 2.02	5.70 ± 1.85	<0.0001
Physical activity	215	6.01 ± 2.48	6.76 ± 2.28	<0.0001
Health care use	219	8.44 ± 1.97	8.63 ± 1.90	0.1560
PAM-10 score	80	62.40 ± 16.08	72.70 ± 15.99	<0.0001
PAM-10 level	80	2.71 ± 0.96	3.28 ± 0.76	<0.0001

the DSMP but did not see an improvement in A1C in the English-language version, which was the version used in this study (10). McGowan (26) conducted a randomized, controlled trial and reported improvements in A1C that were marginally significant. However, that study did not show any differences between groups when baseline A1C was stratified to >7 or <7% (26). A more recent translational pragmatic study of in-person and internet-based DSMP (11) did show improvement at 6 months in A1C (n = 489, mean change −0.151%, P = 0.002). In that study, Lorig et al. noted that those with a baseline A1C ≥9% experienced a mean reduction of −0.93% (P <0.001), whereas those who had a baseline A1C <9% saw a mean increase of 0.05% (P = 0.26). Our study showed similar trends, indicating that the effects of DSMP on A1C may be more evident for those with higher baseline A1C values.

Similar to the DSMP studies by Lorig et al., as well as studies of other types of diabetes self-management interventions (27,28), our results show substantial improvements in self-reported outcomes (DDS, DSMQ, and PAM-10) that have previously been associated with improved diabetes management and glycemic control (20,24,25). The value of peer-led self-management programs lies in the development of self-efficacy for self-management strategies that can ultimately change health behaviors and potentially lower health care utilization (29,30). Thus, it is not surprising that the program is effective in this regard. Furthermore, qualitative studies of self-management programs have illuminated several benefits for participants, including increased physical activity, improved social relationships, improved eating habits, and better coping skills (31), all of which may indirectly improve health outcomes.

To our knowledge, this is the first study describing health-related outcomes, including A1C, from a completely rural DSMP intervention. After the DSMP was demonstrated to be an evidence-based intervention (9,10), most studies focused on effectively scaling the program and investigating barriers to participant engagement (32,33). This is also one of the few studies that follows A1C longitudinally for up to 3 years. However, the nonexperimental design of this evaluation did not include a control group to compare the potential and separate impact

TABLE 3 Mean Change in A1C by Month Stratified by Follow-Up Period for Participants With Baseline A1C ≥8%

	Baseline A1C ≥8%		
	Those With A1C Values, *n*	β (Month)	*P*
Full follow-up	85	−0.020	0.0972
Up to 6 months post-intervention	74	−0.021	0.1310
Up to 12 months post-intervention	83	−0.020	0.0989
Up to 18 months post-intervention	84	−0.020	0.0992
Up to 24 months post-intervention	85	−0.020	0.0972

of regular care or other concurrent influences on self-management skills and perceptions. There was also no systematic schedule for the timing or frequency of A1C testing, which led to a varying number of values for each patient over time. Although we cannot generalize our results to other rural areas, the study does add to the knowledge base that health-related outcomes in a rural setting are similar to those found in other populations.

Rural settings often do not have the resources or population density to support diverse interventions for diabetes self-management. To increase the likelihood of success in reaching those who could benefit, health promotion programs should be carefully integrated into the community and clinical settings. Asynchronous Web-based programs and individualized mobile phone applications may allow for more diverse offerings of programs in rural areas (34). However, the infrastructure—namely, internet connectivity—as well as potential participants' willingness to use a computer or mobile device are antecedents to successful implementation. Therefore, future research could focus on implementation studies and efficacy trials of different self-management program delivery modes in rural areas.

Our quality improvement project demonstrated that completion of the DSMP led to improved patient-reported outcomes and perhaps an improvement in A1C for those with a baseline A1C ≥8%. The DSMP, when integrated into a health care system through the collaborative efforts of community-based organizations and clinical partners, can be an important part of diabetes management for rural populations.

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DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

K.P. conceptualized the project, developed the methodology, participated in the investigation, and wrote and edited the manuscript. M.S. developed the methodology, conducted the formal analysis, and edited the manuscript. L.W. was responsible for project administration, participated in the investigation, and edited the manuscript. N.K. was responsible for data curation, conducted the formal analysis, and edited the manuscript. J.F and C.H. participated in the investigation and edited the manuscript. D.S. supervised the project, developed the methodology, and reviewed and edited the manuscript. K.P. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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