Health Extension for Diabetes: Impact of a Community-Based Diabetes Self-Management Support Program on Older Adults' Activation

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OBJECTIVE | The goals of this study were to determine whether completion of a community-based diabetes self-management support (DSMS) program delivered through a university Cooperative Extension network increased Patient Activation Measure (PAM) scores and to examine predictors of improvement in PAM score in individuals participating in the DSMS.

METHODS | The Health Extension for Diabetes (HED) is a 4-month program delivered via a paraprofessional extension agent in partnership with an established diabetes self-management education and support program. The study population included 148 adults (median age 69 years; interquartile range 60–74 years) with diabetes recruited from local community organizations. Data for the analysis were collected before and after participation in the intervention as part of a longitudinal study, using the PAM and Self-Efficacy for Diabetes instruments. Descriptive statistics were gathered, and hypothesis tests and simple and multivariable regression analyses were conducted.

RESULTS | The mean PAM score increased by 6.58 points, with a 5-point change considered clinically significant. From pre- to post-intervention, PAM scores significantly decreased for 23 participants, decreased for 6, did not change for 14, increased for 21, and significantly increased for 84. Higher pre-intervention PAM scores, younger age, greater educational attainment, and higher baseline self-efficacy scores were associated with increased post-intervention PAM scores when not controlling for potential covariates. Age was no longer associated with higher PAM scores after controlling for covariates.

CONCLUSION | Community-based DSMS interventions can be effective in generating positive change in individuals' activation. HED provides a feasible and accessible DSMS option that addresses key diabetes self-management components while effectively improving individuals' activation. It is recommended that people living with diabetes attend a DSMS program such as HED to increase their ability to effectively self-manage various components of their chronic condition.

Diabetes has reached epidemic proportions in the United States, with the national prevalence rate steadily increasing each year. As diabetes prevalence continues to increase, the challenge of managing diabetes throughout the population grows. South Carolina has one of the highest state diabetes prevalence rates, which increased from 11% in 2013 to 13% in 2019 (1).

To address the burden of diabetes, a recent consensus report from multiple organizations, including the American Diabetes Association (ADA) and the Association of Diabetes Care & Education Specialists (ADCES), emphasized the benefits of diabetes self-management education and support (DSMES) services (2). DSMES programs provide initial and ongoing education and support for individuals with diabetes through assistance in learning or maintaining skills to make behavior changes to effectively manage this chronic condition (2–4). These skills can include informed decision-making, problem-solving, and self-care behaviors (4). DSMES incorporates goals, life experiences/situations, and current individual needs to help ensure optimal self-management behaviors and health status (4). Every 5 years, the national standards for DSMES are updated to remain current with evidence-based practices.

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These standards define DSMES programs' quality, curriculum, individualization components, and various other features (3).

A strong foundation in effective self-management behaviors is necessary to achieve adequate diabetes management and glycemic control (4). Ongoing support is a crucial component of diabetes self-management. Standard 8 of the DSMES National Standards specifically addresses ongoing support for people with diabetes. Despite its foundational role, behavior change is complex and commonly hindered by many associated barriers such as financial limitations, environmental factors, personal beliefs, and beliefs about the power of factors to control or aid in conducting the behavior (5,6).

Community-based education programs, which are often peer-led, have been shown in the literature to address traditional barriers to diabetes self-management education and have yielded positive health outcomes for participants (7). Studies have shown that peer educators are able to provide accurate, evidence-based information in a culturally competent and cost-effective manner while empowering participants and fostering trust and feelings of support within the community.

Researchers have found that community-based diabetes self-management support (DSMS) programs led by peer educators have been effective in promoting a healthy lifestyle and behavior changes. The literature shows that peer-led education and support programs can lead to improvements in health behaviors such as healthy eating, increased physical activity, and increased blood glucose monitoring (8–11). Peer-led education and support programs have also yielded improvements in clinical measures, including A1C and blood pressure (8–11). Additionally, these programs have been shown to increase self-efficacy and patient activation (8–11).

However, because there are many barriers and enablers are associated with behavior change, one key component of support programs is the engagement of individuals with their own care. Sustainable behavior change often requires people to be highly activated. Those who are highly activated are said to believe they have an important role in managing their care, know how to manage their condition, and have the physical and behavioral skills to do so (12). Part of that behavioral skill set is knowing when and how to access appropriate higher-level care (12). Thus, measuring individuals' activation level may be an integral factor associated with their ability to achieve sustainable behavior change.

The Patient Activation Measure (PAM) is a frequently used tool to assess individuals' activation (12,13). Initial, ongoing, or re-established activation can be achieved through DSMS opportunities.

Many cross-sectional studies have been conducted among individuals with diabetes to assess the association of PAM scores with demographics, health behaviors, health management, clinical indicators, and health care utilization. Demographic indicators found to be associated with activation score are age (14), disease duration (15,16), sex (14,17), and educational attainment (18,19).

Studies have also found that patient activation is positively associated with engagement in healthy behaviors (15,17,20). Similarly, researchers have found that a higher PAM score is correlated with better health management. Individuals are more likely to obtain preventive screenings (20), live in their own home (15), have fewer difficulties managing diabetes care (15), seek/know where to find health information (17), have higher self-perceived knowledge (14), maintain continuity of care (19), have better disease perception (18,19,21), have better perceived health status (18), and have greater social support (18). Higher activation has been correlated to improved blood pressure management (14), health status (18), A1C testing (22), A1C level (22,23), and other clinical indicators (20,24). Another common area of interest for chronic disease management is health care utilization. Increased PAM scores have been found to be associated with lower-cost health utilization such as fewer emergency department visits and hospital admissions (20,22,24,25).

Research has been conducted on interventions to determine efficacy in creating movement in PAM scores for this population. Of the two trials that have been conducted assessing DSMES interventions, one resulted in a significant PAM score increase compared with the control group (+4.52 vs. +1.75 points) (26) and also concluded that changes in activation are positively associated with changes in self-management (26).

Researchers assessing results of an activation intervention found that individuals who attended three or more sessions had a significantly higher activation score than those who attended two or fewer sessions (76.8 vs. 61.4) (26). Several studies using diabetes self-management interventions found average increases in PAM scores of 4.93 (27), 6.4 (28), and 9.7 (29) points. These DSMES interventions were conducted in non–community-based settings such as primary care offices or via phone. When assessing DSMES interventions conducted in community-based settings, one study resulted in an average change of +8.57 points (6), and another resulted in an average change of +12.4 points (30).

A review of the literature found that patient activation is associated with better health outcomes, better health care experiences, and lower health care costs. The literature provides evidence that focused interventions can positively affect an individual's activation level (31). Therefore, the purpose of this study was to assess the effect of a community-based intervention delivered through a university Extension Service system on patient activation (as indicated by PAM score) in people with diabetes. It was hypothesized that the DSMS program would increase PAM scores for individuals who graduated from the program.

Research Design and Methods

This work was part of a longitudinal, mixed-methods research study conducted in upstate South Carolina from October 2017 to October 2022. The data presented were obtained from March 2018 to November 2019. The institutional review boards of Clemson University and Prisma Health–Upstate approved this study. All participants provided written informed consent.

Sample and Recruitment

Recruitment of participants occurred at community-based locations, including libraries, churches, and activity centers. Additionally, recruitment was conducted at health fairs and other health-related events in the region. Health Extension Agents (HEAs) and DSMES team members bring awareness to both DSMS and diabetes self-management education (DSME) programs and have a bidirectional referral process through which physician referrals for DSME are sought when indicated.

To participate in the study, participants had to be ≥18 years of age, spend the majority of their time working or living in Greenville County, SC, and have a clinical diagnosis of type 1 or type 2 diabetes (minimum of 50% of cohort) or a self-reported diagnosis of type 1 or type 2 diabetes. Potential participants who were unsure of their diagnosis had to score ≥5 on the ADA type 2 diabetes risk test (32). Additionally, there was a clinical discretion component in the inclusion criteria that allowed team members who were certified diabetes care and education specialists (CDCESs) to evaluate and determine whether a community-based DSMS program would be an appropriate fit for potential participants. Reasons for exercising this clinical discretion could include participants requiring a higher level of care such as DSMES (e.g., assistance with insulin pump management or continuous glucose monitoring) or having social or cognitive reasons for not being personally responsible for their diabetes management activities. Pregnant women, institutionalized individuals, and individuals with end-stage renal disease were excluded from the program. Excluded individuals were given information on other diabetes support groups and educational opportunities.

Intervention

Health Extension for Diabetes (HED) is a unique community-based, nonclinical DSMS program delivered by paraprofessionals through the Land-Grant University Extension System. DSMS "refers to the support that is required for implementing and sustaining coping skills and behaviors needed to self-manage on an ongoing basis," and DSME is "the active, ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care" (2). National standards for DSMES have been developed to ensure consistent internal structure, quality, and curriculum of such programs (3).

HED has been recognized as an ADA practice-tested support program (33). This 4-month program is based on the ADCES7 Self-Care Behaviors (formerly known as the AADE7 Self-Care Behaviors) (34). HED was created through collaboration among clinicians, paraprofessionals, and researchers in a partnership between a land-grant university and a regionally integrated health care system's established DSMES program. HED consists of eight biweekly group sessions that deliver core content, with individual follow-up during intervening weeks (Table 1). This is a high-touch program offering standardized components combined with significant flexibility, allowing for personalization to meet participants' individual goals and needs.

HED is delivered by an HEA working at a Cooperative Extension. The HEA facilitating the program has a bachelor's degree in Public Health and a Paraprofessional Level 2 certificate from ADCES, with training in patient navigation, chronic disease management, motivational interviewing, and patient advocacy. The ADCES Paraprofessional Level 2 designation is available to HEAs, physical therapy assistants, licensed practical nurses, and others (35). The HED HEA works in community-based settings to deliver the intervention program in churches, activity centers, and local organizations. The maximum number of participants in a cohort is 22.

This program was designed to be delivered by an ADCES Paraprofessional Level 2, with one guest appearance by a CDCES at session 4. The CDCES assists with linking the community-based program to the clinical care system. Incentives such as gift cards and exercise bands were provided to participants after they completed specific programmatic milestones.

Demographic Information

Baseline demographic information was obtained from all participants. Demographic information included height, weight,

TABLE 1 HED Session Curriculum Overview

Session	Topics Covered
Session 0: Health Extension for Diabetes	• Program introduction • Importance of and how to create health goals
Session 1: Life With Diabetes	• Symptoms of high and low blood glucose • Overview of self-management behaviors • Low blood glucose treatment
Session 2: Healthy Eating With Diabetes	• Impact of the three main nutrients on blood glucose • Other factors related to food (e.g., portion sizes and meal timing) that affect blood glucose • Strategies for preparing and eating healthy snacks and meals
Session 3: Being Active With Diabetes	• Benefits of physical activity • Types of physical activity • Blood glucose safety and exercise
Session 4: Medications and Monitoring*	• Blood glucose monitoring (who, when, and why) • Types of medications for diabetes self-management
Session 5: Problem Solving and Resource Navigation	• Common barriers to self-management and strategies for overcoming them • Identifying and accessing evidence-based information
Session 6: Healthy Coping With Diabetes	• Types of stress • Impact of stress on blood glucose • Strategies for healthy coping • Depression and diabetes
Session 7: Reducing Risks With Diabetes	• Short- and long-term complications of diabetes • Strategies for reducing risks, including recommendations for regular primary care and/or specialty care visits

*Delivered by CDCES.

sex, birth date, race, ethnicity, educational attainment, annual income, history of hypertension, history of gestational diabetes, family history of diabetes, and other data. All measures were self-reported with the exception of weight.

PAM Instrument

The PAM instrument is a 13-item scale provided by Insignia Health that was completed by participants before and after the HED intervention. The PAM is a reliable and valid measure that has been tested across diverse populations. It was originally developed for use within specific populations with chronic conditions but, through rigorous evaluation, was later deemed to be acceptable across populations (12,13). This instrument incorporates Rasch analysis to create a unidimensional, probabilistic, Guttman-like scale. Its questions address various domains deemed important in activation based on literature and input from experts and lay community members.

The instrument is scored on a theoretical 0 to 100 scale, with lower scores indicating less activation. Congruently, there are four activation stages that align with the 0–100 scale. In level 1 (score 0.0–47.0), individuals do not consider themselves to be an active partner in their health care decisions and do not believe they need to be active decision-makers (12,28). In level 2 (score 47.1–55.1), individuals may lack basic knowledge or confidence, which inhibits them from taking action (12,28). Individuals in level 3 (score 55.2–67.0) are beginning to take action but are not fully confident or skilled to maintain these behaviors (12,28). The highest activation stage, Level 4 (score 67.1–100), includes individuals who have fully integrated the new behaviors and are able to maintain them even during times of stress (12,28).

Self-Efficacy for Diabetes

The Self-Efficacy for Diabetes (SED) scale (α = 0.84) is an eight-item questionnaire developed by the Self-Management Resource Center (36,37). The instrument uses a 10-point scale ranging from 1 to 10 to assess an individual's confidence regarding certain diabetes activities (38,39). A higher score correlates with higher self-efficacy for diabetes. The SED was originally developed in Spanish and later translated to English (37). Both versions were found to be reliable and to maintain good test-retest reliability (26,37,40).

Data Collection and Management

Participants completed a paper copy of the PAM instrument. Study team members scored each completed PAM using the license package from Insignia Health. The resulting score and level were entered into REDCap (Research Electronic Data Capture), a Health Insurance Portability and Accountability Act–compliant, secure, web-based software platform designed to support data for research studies. The SED was administered via REDCap. All demographic variables were entered directly into REDCap. The data were collected, stored, and managed using REDCap electronic capture tools hosted at Prisma Health–Upstate (41,42).

Statistical Analysis

Continuous outcomes are reported as medians and interquartile ranges (IQRs). Categorial outcomes are reported as numbers and percentages. A Wilcoxon sign-rank test was conducted to assess differences in PAM scores before and after HED participation. A χ^2 test was conducted to determine whether there were significant differences in the proportion of participants in the various levels of PAM before and after HED participation. Simple and multivariable linear regressions were conducted to examine predictors of improvement in PAM score while controlling for baseline PAM score, age, sex, educational attainment, and race. These covariates were selected based on literature on potential associations (14,16,18,20,23,26). Income data were recategorized from seven to four groups to reduce the degrees of freedom in the model. Educational attainment was recategorized from eight to five groups. Statistical significance was set at $P < 0.05$. All analyses were conducted using SAS, v.9.4, software (SAS Institute, Cary, NC).

Results

Description of Sample

The sample consisted of 148 individuals with a median age of 69 years (IQR 60–74 years). Among these participants, 4% self-reported having type 1 diabetes, 88% self-reported type 2 diabetes, and 8% were unsure or undiagnosed. A majority of the sample (62%) self-identified as African American/Black, and 74% were female. Almost 40% of the participants reported having a high school or general education diploma or less education, and more than half (54%) reported an annual income less than $34,999. Additionally, 79% reported a family history of diabetes, 74% had a history of hypertension, and 16% of the females had a history of gestational diabetes (Table 2). Prior exposure to DSME was not directly measured, but given the community-based recruitment and sociodemographic nature of our population, it is likely that only a limited number of individuals had previous DSME.

TABLE 2 Characteristics of Participants in HED Cohorts 1–10 (N = 148)

Characteristic	Value
Age, years	69 (60–74)
BMI, kg/m^2	33.46 (28.84–39.14)
Sex	
Male	39 (26.4)
Female	109 (73.6)
Race	
Black or African American	92 (62.2)
White	50 (33.8)
Prefer not to answer/other	6 (4.06)
Ethnicity	
Hispanic or Latino	3 (2.03)
Not Hispanic or Latino	143 (96.6)
Prefer not to answer/other	2 (1.36)
Educational attainment	
Less than high school	20 (3.3)
Some high school	15 (10.1)
High school or general education diploma	39 (26.4)
Technical degree	5 (3.38)
Some college	32 (21.6)
Associate's degree	14 (9.46)
Bachelor's degree	18 (12.2)
Some postgraduate education	20 (13.5)
Annual income, $	
<15,000	37 (25.0)
15,000–24,999	32 (21.6)
25,000–34,999	11 (7.43)
35,000–49,999	18 (12.2)
50,000–74,999	13 (8.78)
≥75,000	7 (4.73)
Prefer not to answer	30 (20.3)
Family history of diabetes	
No	31 (21.1)
Yes	116 (78.9)
History of gestational diabetes	
No	92 (84.4)
Yes	17 (15.6)
History of hypertension	
No	38 (25.7)
Yes	110 (74.3)
Baseline SED score	7.75 (6.31–8.69)

Data are median (IQR) or *n* (%).

Impact of HED on PAM Score

Before the intervention, participants' average PAM score was 63.44 (95% CI 61.28–65.60). After undergoing the intervention, their average PAM score was 70.02 (95% CI 67.63–72.42). The range of change in PAM score from before to after the intervention was −36.40 to +48.0. The average change was +6.58 points, which was significant ($P < 0.001$) (Table 3).

When examining change in PAM score, 70.95% (n = 105) had a score increase, with 56.76% (n = 84) having a clinically significant (≥5-point) increase (12,16,30). The average increase was 12.76 points (range 0.40–48 points) (Table 4). When examining change in PAM score level, 40.54% (n = 60) increased in PAM level, with 8.78% (n = 13) increasing by two or more levels (Table 5).

TABLE 3 Pre- and Post-Intervention Average PAM Scores and Changes in PAM Scores

PAM Score Measure	Value
Average, pre-intervention	63.44 (61.28–65.60)
Average, post-intervention	70.02 (67.73–72.42)
Average change Range of score change	6.58* (4.37–8.79) −36.40 to 48.0
Average change, individuals with decreased scores (*n* = 29) Range of score decrease	−12.62 (−15.65 to −9.59) −36.4 to −1.90
Average change, individuals with increased scores (*n* = 105) Range of score increase	12.76 (10.86–14.67) 0.40–48

Data are mean (95% CI) unless otherwise noted. *$P < 0.001$.

Twenty-nine participants (19.59%) had a score decrease, with 23 (15.54%) having a clinically significant decrease. The average decrease was 12.62 points (range −36.4 to −1.90). Examination of change in PAM score level showed that 12.17% (n = 18) decreased in PAM level, with 2.03% (n = 3) decreasing by two or more levels. Additionally, 9.46% (n = 14) had no change in PAM score, and 47.30% (n = 70) had no change in PAM level.

Associations of Change in PAM Score With Covariates and SED Score

Table 6 shows the results of the simple and multivariable linear regressions. The unadjusted linear regression found that baseline self-efficacy was associated with a 2.093 increase in post-HED PAM score ($P_{unadjusted}$ = 0.001, $B_{adjusted}$ = 1.515, $P_{adjusted}$ = 0.008). The unadjusted linear regression found that baseline PAM score was associated with a 0.592 increase in post-HED PAM score ($P_{unadjusted} < 0.001$, $B_{adjusted}$ = 0.559, $P_{adjusted} < 0.001$). When controlling for covariates, baseline self-efficacy and baseline PAM score continued to be significant positive predictors of post-HED PAM score and were found to be slightly moderated.

A 1-year increase in age was associated with a decrease in post-HED PAM score of 0.236 points ($P_{unadjusted}$ = 0.028). After controlling for covariates, age was not a significant predictor of post-HED PAM score ($B_{adjusted}$ = −0.149, $P_{adjusted}$ = 0.102).

TABLE 4 Pre- to Post-Intervention Change in PAM Score

PAM Score Change	*n* (%)
Clinically significant decrease*	23 (15.54)
Decrease	6 (4.05)
No change	14 (9.46)
Increase	21 (14.19)
Clinically significant increase*	84 (56.76)

*Clinically significant is defined as an increase or decrease of ≥5 points (1–3).

In both unadjusted and adjusted models, income was not found to be a significant predictor of post-HED PAM score. In the multivariable model, high school education was associated with a 1.479-point increase in post-HED PAM score ($P_{adjusted}$ = 0.653, $B_{unadjusted}$ = 2.565, $P_{unadjusted}$ = 0.506), some college education was associated with a 9.458-point increase ($P_{adjusted}$ = 0.005, $B_{unadjusted}$ = 13.395, $P_{unadjusted} < 0.001$), college education was associated with a 7.298-point increase ($P_{adjusted}$ = 0.080, $B_{unadjusted}$ = 9.943, $P_{unadjusted}$ = 0.030), and some postgraduate education was associated with a 0.814-point decrease ($P_{adjusted}$ = 0.835, $B_{unadjusted}$ = 6.530, $P_{unadjusted}$ = 0.142) compared with less than high school education.

Discussion

Our study assesses the impact of the HED, a paraprofessional-led, community-based DSMS program, on change in patient activation. The primary finding of this study was that the average change in PAM score was a 6.58-point increase. We also found that certain levels of educational attainment, baseline self-efficacy, age, and baseline PAM score were significantly associated with post-intervention PAM score.

When comparing our sample's baseline PAM level to the United States national average for individuals aged 65–74 years, our sample had significantly fewer individuals in level 4 (24.32 vs. 39.6%) and a greater percentage of individuals in

TABLE 5 Pre- to Post-Intervention Movement Among PAM Levels

Pre-HED PAM Level	Post-HED PAM Level				Total
	1	2	3	4	
1	1 (0.68)	3 (2.03)	3 (2.03)	2 (1.35)	9 (6.08)
2	1 (0.68)	9 (6.08)	18 (12.16)	8 (5.41)	36 (24.32)
3	3 (2.03)	8 (5.41)	30 (20.27)	26 (17.57)	67 (45.27)
4	0 (0)	0 (0)	6 (4.05)	30 (20.27)	36 (24.32)
Total	5 (3.38)	20 (13.51)	57 (38.51)	66 (44.59)	148 (100)

Data are *n* (%).

TABLE 6 Relationships Between PAM and Associated Factors, Controlling for Covariates

	Unadjusted B Coefficient	95% CI	*P*	Adjusted B Coefficient	95% CI	*P*
Baseline self-efficacy	2.093	0.86–3.33	0.001*	1.515	0.39–2.63	0.008*
Income						
<$25,000	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
$25,000–$50,000	3.958	−2.50 to 10.41	0.227	−0.314	−6.07 to 5.44	0.914
>$50,000	4.673	−2.73 to 12.08	0.214	1.475	−5.76 to 8.71	0.688
Prefer not to answer	0.368	−6.01 to 6.75	0.909	−1.563	−7.05 to 3.92	0.574
BMI	−0.153	−0.47 to 0.16	0.334	−0.188	−0.46 to 0.08	0.171
Family history of diabetes						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	3.413	−2.45 to 9.27	0.252	3.542	−1.38 to 8.46	0.157
History of hypertension						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.329	−5.17 to 5.83	0.906	2.515	−2.31 to 7.34	0.305
Age	−0.236	−0.45 to −0.03	0.028*	−0.149	−0.33 to 0.03	0.102
Sex						
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Female	−1.935	−7.38 to 3.51	0.484	−1.099	−6.05 to 3.85	0.662
Race						
White	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Black/African American	−0.742	−5.89 to 4.40	0.776	−0.098	−4.62 to 4.42	0.966
Prefer not to answer/other	−3.476	−16.13 to 9.18	0.588	−6.555	−16.90 to 3.79	0.212
Educational attainment						
Less than high school or GED	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
High school or GED	2.565	−5.03 to 10.17	0.506	1.479	−5.02 to 7.98	0.653
Less than bachelor's degree	13.395	6.10–20.69	<0.001*	9.458	2.98–15.94	0.005*
Bachelor's degree	9.943	0.97–18.92	0.030*	7.298	−0.88 to 15.48	0.080
Some postgraduate education	6.530	−2.21 to 15.27	0.142	−0.814	−8.51 to 6.89	0.835
Baseline PAM score	0.592	0.44–0.75	<0.001*	0.559	0.40–0.71	<0.001*

Baseline PAM score, age, categorized educational attainment, race, and sex are also controlled for in adjusted models. *Significant at $P < 0.05$. GED, general education diploma; Ref., reference category.

the lowest activation levels (30.4 vs. 20%) (43). After the intervention, our sample had a greater percentage in the highest activation level (44.59%) and a lower percentage in the lowest activation levels (16.89%) compared with the national average for individuals aged 65–74 years (43). When comparing the post-intervention scores against a national average for adults with diabetes, our sample had a greater percentage in the highest activation level (44.59 vs. 37.9%) and a lower percentage in the lowest activation levels (16.89 vs. 26.8%) (43). Increases such as these show promise for this community-based DSMS intervention to aid in increasing activation for adults with diabetes (31).

The HED program has yielded results further validating that interventions can be helpful in generating movement in an individual's activation level. The average change in PAM score (+6.58 points) for individuals who completed the HED program falls in the range of PAM score changes associated with similar interventions (6,21–30,44–46). This increase is also clinically significant (12,16,29). The literature has shown that there is a difference of ~5 points between those who engage in healthy behaviors and those who do not (16). This suggests that the 84 individuals who experienced this clinically significant increase are more likely to engage in healthy behaviors than their counterparts who did not have such an increase. Additionally, care should be taken to address the 23 individuals who experienced a significant decrease in PAM score. The predictors identified to be associated with movement in PAM score can help improve programs through tailoring interventions.

Self-efficacy is a component of patient activation (13) and is also recognized as a component of behavior change (5,47,48). Given that self-efficacy is a crucial component of behavior change, determining whether baseline diabetes self-efficacy is associated with patient activation was of interest. This study provided evidence of a positive association between these two factors, showing that baseline self-efficacy could increase the post-intervention PAM score by 1.515 points when controlling for baseline PAM score, age, categorized educational attainment, race, and sex. Further research should be conducted to examine the relationship between self-efficacy and change in patient activation in larger populations to determine whether this relationship holds.

Improving individuals' patient activation can have a significant impact on their health outcomes. Numerous studies have shown that high PAM scores are associated with improved health outcomes for people with diabetes (14,16,20,22,31,49–53). Self-management behaviors are a crucial outcome for people with diabetes that have been linked to increased patient activation (6,14,15,19,28,31,49,50,54). Other studies have shown that an increase in patient activation can result in improved clinical outcomes such as BMI, triglyceride level, and A1C (6,14,16,20,22–24,30–32,49,50,52). This change in health outcomes as a result of increased patient activation can play a crucial role in a health care system increasingly burdened by chronic illness.

In addition to its link to improved health outcomes, increased patient activation is also associated with lower health care costs. With one in four health care dollars spent treating diabetes and its complications, decreasing health care expenditures related to this disease remains a focus (2,54). Increases in patient activation have been linked to less costly health utilization (24,25,31,55), whereas lower activation levels have been related to higher costs of care (33,50,55). One study showed that previous PAM scores predicted future health care costs (55). This same study found that individuals in the lowest level of activation had costs that were 21% higher than those in the highest level of activation (55). Another study found that individuals who moved from the highest activation levels (level 3 or level 4) to the lowest activation levels (level 1 or level 2) had projected costs that were 27% higher than those who remained at the highest activation level (50).

Our study found that 60 individuals had an increase in their activation level, 70 remained at the same level, and 18 had a decrease in their level. Based on these findings, the HED program could be a way to potentially ease the financial burden of diabetes care on the health care system through increased patient activation.

Limitations

A potential limitation of the study could be that post-intervention PAM scores were collected only by individuals who completed the intervention. Although the retention rate was high (93.16%), there is the potential that those who did not complete the full intervention differed from those who did. Additionally, although the national PAM average score is high, another potential limitation of this study is that this population had a high baseline PAM score. This finding may be a reflection of a population of individuals who self-select to participate in this type of program. The descriptive statistics of this sample do not indicate that this finding was a result of previous exposure to DSME; a very small portion of our sample had received previous DSME. Another limitation is that all collected data were self-reported. Given the nature of community-based recruitment, this was a diverse but not generalizable sample. Although our sample size was larger than other diabetes education intervention studies assessing patient activation, it was still a small sample, and findings should be explored with a larger, more generalizable sample. Finally, the PAM measure has been found to naturally fluctuate over time, which should be considered when interpreting the results (56).

Conclusion

Individuals who completed the HED program saw an average increase of 6.58 points in their PAM score, with 105 (70.95%) experiencing an increase in their PAM score. This clinically significant increase shows that individuals who have completed HED are more likely to engage in healthy behaviors. Based on the literature, these increases in patient activation are associated with improved health outcomes and reduced health care costs (6,14,16,20,22–25,30–32,49,50,55). Additionally, baseline self-efficacy, baseline PAM score, and certain levels of educational attainment were found to be predictive of an increased post-intervention PAM score. These identified predictors can be used to improve other programs by tailoring interventions to participants' characteristics and needs.

Future research should be conducted to determine whether this increase remains with a larger, more generalizable sample and to further explore the relationship between self-efficacy and patient activation in people with diabetes.

It is recommended that all adults with diabetes receive DSMES (2). However, because of numerous barriers such as lack of access, many people with diabetes do not receive these services. The HED program assessed in this study, which provides quality diabetes support in a community setting, may be a more accessible option for individuals to obtain DSMS. Partnerships between community-based DSMS programs and health care organizations can also provide benefits such as referrals and linkages to clinical services.

The predictors associated with improvements in PAM scores could be used to tailor future interventions to the specific characteristics and needs of target populations. In general, it is recommended that people living with diabetes participate in a DSMS program such as HED to increase their ability to effectively self-manage this chronic condition.

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DUALITY OF INTEREST

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

AUTHOR CONTRIBUTIONS

C.J.D. wrote the first draft of the manuscript, conducted the statistical analysis, and edited the manuscript. W.W.S. is the principal investigator and reviewed/edited the manuscript. M.S. and M.P. are co-investigators and reviewed/edited the manuscript. L.R. aided in statistical analysis plan development and reviewed/edited the manuscript. D.M. reviewed/edited the manuscript. C.J.D. 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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