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ORIGINAL PAPER

Community-Based Diabetes Community Health Worker Intervention in an Underserved Chicago Population

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Abstract The Community Health Worker (CHW) model has been used to combat disparities in healthcare access by utilizing community members as healthcare liaisons to promote improved community health. CHW interventions have been effective in improving diabetes management. This case study reports on a low-intensity CHW intervention in a predominantly Hispanic and non-Hispanic Black population in two Chicago neighborhoods: North Lawndale and South Lawndale. CHWs conducted door-to-door outreach and, for individuals with self-reported type 2 diabetes, offered home visits at baseline and one-year follow-up to provide diabetes education, create an individual management strategy, and refer to clinic-based support services. During 2012, 459 participants were enrolled, with 343 completing follow-up visits in 2013 (75 % retention). The mean HbA1c decrease was 0.5 %. At follow-up, participants were less likely to be depressed, to forget to take their diabetes medications, and were more likely to report higher social support and score higher on an assessment of diabetes knowledge. Patients who were younger, Hispanic, had uncontrolled diabetes, and had lower levels of diabetes self-care at baseline demonstrated increased odds of a significant HbA1c decrease with the intervention than patients without these characteristics. This study demonstrates the effectiveness of a home-based, low-intensity CHW intervention in medically underserved communities, and identifies population groups who might benefit the most from future similar CHW interventions.

Keywords Community health worker · Diabetes · Underserved · Health disparities

Introduction

The prevalence of diagnosed diabetes in the United States has risen substantially over the past 3 decades from 5.1 % in 1988 to 9.1 % in 2012 [1–3]. While diabetes can be managed by proper maintenance of glycemic control [4–6], inadequate management can lead to severe, life-threatening complications such as retinopathy, neuropathy, and nephropathy [7].

Hispanics and non-Hispanic Blacks are disproportionately affected by type 2 diabetes, and are at higher risk of experiencing life-threatening complications due to poor disease management [1, 2]. Lack of access to primary care physicians is associated with increased morbidity and mortality due to poorer management of diabetes [8–11]. These racial/ethnic disparities have been attributed, in part, to these populations disproportionately living in medically underserved communities [12]. Thus, interventions to improve detection and management of diabetes in minority groups and medically underserved communities are critical to reduce the complications arising from this increasingly prevalent chronic illness.

One such intervention that has been used to counter disparities in healthcare access is the Community Health Worker (CHW) model, where CHWs act as liaisons between healthcare providers and community members to promote improved health. Prior implementations of

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diabetes CHW programs have demonstrated improved outcomes in persons with diabetes, including Hispanics and non-Hispanic Blacks [13–15]. In addition to improved HbA1c levels [13, 15–19], CHW interventions showed improvements in diabetes knowledge [13, 15], self-care activities [15, 20], medication adherence [15, 21], BMI [22], blood pressure [15, 17], and depression [20].

However, due to the variation in CHW interventions [23], further study of the effectiveness of a home-based, low-intensity, CHW program implementation on diabetes-related outcomes in minority and underserved communities is needed. Moreover, understanding the population groups in which a diabetes CHW intervention is most effective is important for identifying target groups for future interventions.

Purpose

The purpose of this case report was to describe and assess the impact of a CHW community-based diabetes intervention in reducing HbA1c levels among adults with type 2 diabetes in the North and South Lawndale communities of Chicago. The aim was also to examine participant characteristics associated with intervention success in reducing HbA1c levels.

Methods

Background

Results from the Sinai Community Health Survey identified a diagnosed diabetes prevalence of 10 and 3 % in the Chicago communities of North and South Lawndale, respectively, as compared to a national prevalence of 7 % [24]. However, the diabetes mortality rates in North and South Lawndale were 37 and 40 (per 100,000 population), respectively [24], well above the national average of 25. The study attributed this discrepancy between diagnosed prevalence and mortality to low insurance coverage in these communities, leading to lack of access to primary care, and consequent lack of diabetes screening, diagnosis, and treatment. These results led to the implementation of a CHW intervention, the Lawndale Diabetes Project (LDP), to address this high diabetes burden.

Intervention

From January 2012 to December 2012, CHWs went door-to-door to identify and enroll adults with type 2 diabetes in Chicago's North Lawndale and South Lawndale communities. Individuals were included in the intervention if they answered yes to the question "Have you ever been told by a doctor that you have diabetes?" Participants were excluded if they were under 18 years of age, had type 1 diabetes, had gestational diabetes, or reported a mental illness. Informed consent was obtained from all participants. The protocol for the study was approved by the Mount Sinai Hospital (MSH) Institutional Review Board.

The intervention was a lifestyle management and education program based on the National Diabetes Education Program (NDEP) and included one baseline and one 12-month follow-up visit, both taking place in the participant's home. At baseline, CHWs educated participants on effective management of their diabetes, created action plans with each participant to make small behavioral goals, and offered referrals to resources to support diabetes self-management. Referrals were made to the MSH clinical diabetes team, which offered four types of support: (1) Diabetes Learning Circle—weekly group course held over 8 weeks led by a clinical dietician covering meal planning, healthy eating, cooking, medication use, diabetes survival skills, living with diabetes, exercise, and diabetes-related stress, (2) Walking club—twice-weekly walking group held at a community partner organization, (3) Diabetes clinic—medical referral to see a nurse or dietician, and (4) Cooking class—class on healthy cooking techniques. At 12-month follow-up, CHWs returned to participants' homes to update their individual action plans and make further referrals for diabetes support. The primary aim of the LDP was to reduce HbA1c levels by a minimum of 0.5 %.

Data Collection

Data were collected from participants during the initial home visit and at the follow-up visit (2012–2013). During the baseline visit, participants were administered a survey that included demographic information, insurance status, primary care physician status, and financial status.

At baseline and follow-up, HbA1c was measured using an A1CNow+ tester and three blood pressure readings were taken. Self-reported height and weight were recorded. Participants were also surveyed on additional topics, which included depression, social support, diabetes self-care activities, diabetes knowledge, medication adherence, and insurance coverage.

Variable Categorization and Constructs

Participants were classified as having controlled diabetes if their HbA1c was less than 7 % [25]. An HbA1c reduction greater than or equal to 0.5 % was considered a clinically significant improvement [26].

Three blood pressure measurements were taken per visit and the average result was used for analyses. Binary hypertension using a systolic blood pressure cutoff of <120 mmHg was calculated according to JNC-7 classification guidelines [27]. Body mass index (BMI) measurements were calculated using self-reported height (in inches), and weight (in pounds). Binary BMI classification, with normal BMI < 25 kg/m^2, was based on WHO obesity classification guidelines [28].

Depression was measured using the Center for Epidemiologic Studies Depression Scale (CES-D) 10-item depression assessment [29]. The 24-item Diabetes Knowledge Questionnaire was used to evaluate participants' knowledge about various aspects of diabetes [30]. The Summary of Diabetes Self-Care Activities (SDSCA) measure was used to assess diabetes maintenance activities [31]. The Multidimensional Scale of Perceived Support (MSPSS) included 12 items that measured perceived support from family (n = 4), friends (n = 4), and significant others (n = 4) [32].

Statistical Analysis

The analytic dataset was restricted to participants with both a baseline and follow-up visit. Baseline and follow-up summary measures (means for continuous variables, percentages for categorical variables) were calculated. Tests for statistical differences between time points were conducted using a paired t test for continuous variables and McNemar's test for dichotomous variables.

Bivariable logistic regression was performed to examine the association between baseline participant characteristics and a clinically significant decrease in HbA1C (≥0.5 %). p values less than 0.05 were considered statistically significant. Analyses were completed in Stata/SE 14.1 [33].

Results

Between January and December 2012, 2160 persons completed a baseline home visit for LDP. During this initial screening, 21 % (459) reported having diabetes. At one-year follow-up (January to December 2013), visits were completed for 343 participants identified as diabetic at baseline (75 % retention). Hispanics and South Lawndale residents were more likely to complete the follow-up visit than non-Hispanic Blacks or North Lawndale residents (93 vs. 66 %) (Supplemental table). The mean age of participants was 57 years with a female majority (71 %).

We saw statistically significant results for the primary outcome to decrease HbA1c levels. The mean decrease in HbA1c levels was 0.5 % ($p < 0.01$) (Table 1). There was an 8 % absolute increase in the percentage of participants with controlled diabetes ($p < 0.01$). At follow-up, participants were less likely to be depressed, to forget to take their diabetes medications, and were more likely to report higher social support and score higher on an assessment of diabetes knowledge. For diabetes self-care activities, participants improved in all categories (diet, blood sugar testing, and foot care) except exercise. We saw no statistically significant changes between baseline and follow-up for BMI or systolic blood pressure.

As compared to younger participants, older participants had lower odds of showing a clinically significant decrease in HbA1c levels (Table 2). Hispanic participants and South Lawndale residents had an approximately 2.7 increased odds of an HbA1c decrease compared to non-Hispanic Blacks and North Lawndale residents ($p < 0.01$). Participants with uncontrolled diabetes at baseline had 6.5 times greater odds of a clinically meaningful reduction in HbA1c levels compared to those with controlled diabetes at baseline ($p < 0.01$). Participants who had higher levels of diabetes self-care at baseline (excluding diet) were slightly less likely to show significant decreases in HbA1c at follow-up compared to those with lower levels of diabetes self-care at baseline ($p = 0.04$). Baseline sex, education level, financial hardship, insurance type, diabetes medication coverage, BMI, blood pressure, depression status, social support, diabetes knowledge, and medication adherence were not statistically significantly associated with a ≥0.5 % reduction of HbA1c levels at follow-up.

Discussion

The LDP lifestyle management and education program was effective in decreasing HbA1c levels in participants in two underserved, minority communities. The intervention's mean 0.5 % HbA1c reduction is comparable to HbA1c decreases observed in more intensive clinic- and hospital-based interventions [34] as well as other community-based CHW interventions [13, 15–17, 20, 35, 36]. Additionally, improvements observed in many behavioral and psychosocial outcomes were consistent with those seen in other CHW interventions, including diabetes knowledge [13, 15], diabetes self-care activities [15, 20], medication adherence [15, 21], social support, and depression [20]. This demonstrates that a very low intensity program such as ours (only two home visits plus referrals), lacking integration of CHW support with a medical team, may be as effective as the predominating more intensive, team-based CHW interventions [14, 17–19, 23, 37]. Further, our intervention is one of very few diabetes CHW interventions using exclusively a door-to-door recruitment strategy, likely making our study population more generalizable than studies recruiting at community centers, clinics or hospitals [20, 36].

Table 1 Comparison of diabetic participant characteristics at baseline and follow-up

	Number (n = 343)	Baseline		Follow-up		Change				p value[a]
Diabetes control	N	Mean	%	Mean	%	Difference	95 % CI			
HbA1c (%)	341	8.3		7.8		−0.5	−0.7	–	−0.3	**<0.01**
Controlled diabetes[b]	341		36 %		45 %	8 %	3 %	–	14 %	**<0.01**
Biological/clinical										
Body mass index (kg/m^2)	341	32.7		32.8		0.1	−0.3	–	0.5	0.63
Systolic blood pressure (mmHg)	342	132.9		133.4		0.5	−1.6	–	2.6	0.62
Behavorial and psychosocial										
Depressed[c]	337		32 %		19 %	−12 %	−18 %	–	−6 %	**<0.01**
Perceived social support[d]	340	5.9		6.1		0.1	0.0	–	0.2	**<0.01**
Diabetes knowledge (%)[e]	335	76.4		86.0		9.6	7.1	–	12.2	**<0.01**
Forgot to take medications	328		35 %		18 %	−17 %	−24 %	–	−11 %	**<0.01**
Diabetes self-care activities[f]										
Diet	339	3.5		3.9		0.4	0.2	–	0.6	**<0.01**
Exercise	334	2.5		2.4		−0.1	−0.3	–	0.2	0.68
Blood sugar testing	338	3.6		4.1		0.5	0.2	–	0.9	**<0.01**
Foot care	325	5.3		6.2		0.9	0.5	–	1.2	**<0.02**

[a] McNemar's test used for dichotomous variables; Paired t test used for continuous variables; Boldface indicates statistical significance ($p < 0.05$)

[b] HbA1c < 7 %

[c] 10 item CES-D assessment with response range from 0 ("rarely or none of the time") to 3 ("most or almost all the time"). A score of 10 or more (out of 30) was classified as having depression. If <8 questions were answered, depression status was assigned as missing, per the scale protocol

[d] Multidimensional Scale of Perceived Social Support (MSPSS)—mean score of 12 questions measured on a 7-point Likert scale (1 = very strongly disagree [low support] to 7 = very strongly agree [high support])

[e] 24-item Diabetes Knowledge Questionnaire—mean percent correct

[f] Summary of Diabetes Self-Care Activities (SDSCA)—mean score of questions measured on an 8-point scale (0 = 0 days in the past week to 7 = 7 days in the past week) covering four self-care categories: diet (n = 4), exercise (n = 2), blood sugar testing (n = 2), and foot care (n = 2)

This intervention was particularly effective in participants who were younger, Hispanic, South Lawndale residents, had lower diabetes self-care, and were diagnosed with uncontrolled diabetes. Participants with uncontrolled diabetes at baseline showed greater odds of achieving significant HbA1c improvement with the intervention than those with controlled diabetes, consistent with previous findings [14, 16, 34]. Similarly, those with lower levels of diabetes self-care at baseline had greater opportunity to make behavioral changes to improve diabetes control compared to those already practicing higher levels of diabetes self-care at baseline. The high success seen in the youngest participants may have been due to this population having an easier time adopting behavioral changes to improve diabetes control compared to older participants. Although studies have examined the efficacy of CHW models on diabetic outcomes in either African Americans or Hispanics [18, 38], comparisons within a single intervention between these high-risk populations are lacking [13, 39]. While the REACH trial found no differences in HbA1c improvement, it demonstrated that Latino participants were much more likely to understand the relationship between healthy eating and blood sugar control and develop a healthy eating plan compared to African Americans [40]. Our finding that Hispanic participants were more likely to reduce their HbA1c levels builds upon the REACH trial's finding that CHW interventions may differ in effectiveness between communities, a phenomenon that warrants further examination. Further, previous CHW interventions have shown inconsistent results in retention differences between Hispanic and African American participants [13, 41–43]. Our study experienced significantly higher attrition in non-Hispanic Blacks compared to Hispanics (34 vs. 7 %). While evaluation of the impact of participant characteristics on the effectiveness of CHW interventions in reducing HbA1c levels has not extensively been studied, better understanding of these differences can help us identify and target patient populations who will yield the greatest benefit from diabetes CHW interventions.

Table 2 Association of baseline characteristics with decrease in HbA1c ≥0.5 %

	N	%	OR[a]	95 % CI[b]			*p* value[c]
Age							
18–39 years	34	65	1.0				
40–59 years	171	49	0.51	0.24	–	1.1	0.09
≥ 60 years	136	46	0.46	0.21	–	1.0	**0.05**
Sex							
Male	98	44	1.0				
Female	243	51	1.3	0.83	–	2.1	0.23
Race/ethnicity							
Non-Hispanic Black	205	39	1.0				
Hispanic	127	63	2.7	1.7	–	4.2	**<0.01**
Other	8	75	4.7	0.9	–	23.8	0.06
Education							
<High school	180	52	1.0				
≥High school	161	46	0.80	0.52	–	1.2	0.29
Community							
North Lawndale	207	39	1.0				
South Lawndale	134	64	2.8	1.8	–	4.4	**<0.01**
Difficulty paying for necessities							
Not hard at all	69	41	1.0				
Somewhat hard	150	48	1.4	0.76	–	2.4	0.31
Very hard	122	55	1.8	0.98	–	3.2	0.06
Insurance							
Private	35	60	1.0				
Medicaid	82	44	0.52	0.23	–	1.2	0.11
Medicare	49	55	0.82	0.34	–	2.0	0.66
Medicare and Medicaid	65	43	0.50	0.22	–	1.2	0.11
No insurance	98	53	0.75	0.34	–	1.7	0.48
Insurance covers medications							
No	103	54	1.0				
Yes	228	46	0.72	0.45	–	1.1	0.16
Primary care physician							
No	41	51	1.0				
Yes	296	49	0.91	0.48	–	1.8	0.79
Baseline HbA1c	341		1.6	1.4	–	1.8	**<0.01**
Uncontrolled diabetes							
No (HbA1c < 7 %)	124	22	1.0				
Yes (HbA1c ≥ 7 %)	217	65	6.5	3.9	–	10.9	**<0.01**
Body mass index							
Normal (<25 kg/m^2)	33	36	1.0				
Overweight (≥25 kg/m^2)	307	50	1.8	0.85	–	3.8	0.13
Systolic blood pressure							
Normal BP (<120 mmHg)	103	49	1.0				
High BP (≥120 mmHg)	237	49	1.0	0.65	–	1.6	0.89
Depressed[d]							
No	235	51	1.0				
Yes	103	44	0.73	0.46	–	1.2	0.19
Perceived social support[e]	341		0.94	0.76	–	1.2	0.58
Diabetes knowledge[f]	340		0.48	0.17	–	1.3	0.15

Table 2 continued

	N	%	OR[a]	95 % CI[b]			*p* value[c]
Forget to take medications[g]							
No	212	47	1.0				
Yes	120	53	1.3	0.81	–	2.0	0.31
Diabetes self-care[h]							
Diet	341		0.90	0.78	–	1.0	0.15
Exercise	340		0.91	0.83	–	1.0	**0.04**
Blood sugar testing	341		0.93	0.86	–	1.0	**0.04**
Foot care	340		0.92	0.84	–	1.0	**0.04**

[a] Odds Ratio from bivariable logistic regression

[b] 95 % confidence interval

[c] Boldface indicates statistical significance ($p < 0.05$)

[d] 10 item CES-D assessment with response range from 0 ("rarely or none of the time") to 3 ("most or almost all the time"). A score of 10 or more (out of 30) was classified as having depression. If less than 8 questions were answered, depression status was assigned as missing, per the scale protocol

[e] Multidimensional Scale of Perceived Social Support (MSPSS)—mean score of 12 questions measured on a 7-point Likert scale (1 = very strongly disagree [low support] to 7 = very strongly agree [high support])

[f] 24-item Diabetes Knowledge Questionnaire—mean percent correct

[g] Response to the question "Do you ever forget to take your medicine?"

[h] Summary of Diabetes Self-Care Activities (SDSCA)—mean score of questions measured on an 8-point scale (0 = 0 days in the past week to 7 = 7 days in the past week) covering four self-care categories: diet (n = 4), exercise (n = 2), blood sugar testing (n = 2), and foot care (n = 2)

Limitations

Our study had several limitations. First, data regarding the number of referrals made and usage of referral sources by our participants were not available. We are thus unable to connect diabetes service uptake through these referrals with improvement in diabetes management. Second, data for weight and height were self-reported and therefore may have been misreported by participants. Third, the intervention was implemented in two community areas in Chicago, and therefore our success in these populations may not be generalizable to other communities with different demographic and socioeconomic characteristics.

Conclusions

Our intervention resulted in positive changes in HbA1c and other behavioral and psychosocial outcomes. Moreover, we identified particular subgroups, including those with uncontrolled diabetes, of younger age, and of Hispanic ethnicity, who may receive the most benefit from a similar intervention. This study supports the effectiveness of a non-team based, low-intensity, CHW intervention as an effective tool to improve diabetes management and related health outcomes in medically underserved communities.

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