



Community-Based Efforts to Prevent and Manage Diabetes in Women Living in Vulnerable Communities

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Abstract

Social determinants of health likely play a significant role in the development of type 2 diabetes for women in vulnerable communities. Adult African American women diagnosed with or at-risk for diabetes in Inkster, Michigan (n = 113) and a group of demographically similar women in Flint, Michigan (n = 48) participated in programs aimed at increasing diabetes-related self-management behaviors through peer coaching, health literacy training, and social support. Participants completed surveys to measure changes in health, health behaviors, health literacy, and social support. We found that these diabetes programs with a focus on increasing women's capacity to practice health management behaviors, navigate the health care system, and connect with social support, led to an increase in healthy behaviors and a reported increase in both overall and diabetes-specific health over an 18 month period. Overall health, general diet and specific diet improved significantly ($p < 0.05$) from baseline to follow-up, when controlled for age, diabetes status and site. Exercise also improved, but the change was not statistically significant. Women who participated in the intervention changed health behaviors, and increased their sense of health literacy and social support. Improvement in women's access to and use of community preventive services, and the provision of outreach support using community health workers (CHWs) and peer mentorship was an integral part of creating these changes. Although this study found that a variety of diabetes prevention and management programs provided opportunities for positive health changes, findings also suggest that it is critical to address the burdens women from vulnerable communities face in order to participate in these programs.

Keywords Community health · Health promotion · Diabetes prevention and management · Health disparities · Women's health

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Background

Social determinants of health likely play a significant role in the development of type 2 diabetes [1–3]. Individual-level health behaviors are shaped by social context, such as socio-economic status and neighborhood conditions, and because vulnerable populations experience health inequities as a result of social and environmental conditions, it is critical to address the underlying factors that limit opportunities for good health [4–7].

Development of type 2 diabetes is often complicated by co-occurring health conditions, and social experiences that are unevenly distributed across the population; experienced differently for women. Socio-cultural norms and gender-based constraints negatively affect a woman's ability to focus on self-care - placing the needs of family, work and others as primary [8–10].

From 2009 to 2016, a local community coalition, the Inkster Partnership for a Healthier Community (IPHC) worked with community leaders, block clubs, seniors, parents, and faith-based organizations to understand perceptions of the most important social determinants of health in their community and to develop strategies for addressing the problems identified. What emerged from these sessions confirms critical findings from the literature related to diabetes prevention and management [11–24].

The community needs assessment found that women in Inkster are disproportionately exposed to stressors that create a negative impact on their health, including high levels of poverty, low-literacy, and female-only heads of households. Women also suffer disproportionately from the lack of social support and access to community resources. In considering new paradigms for the prevention and treatment of women living with diabetes, this project aimed to mobilize a dynamic group of diverse organizations and community partners to promote social support [1, 14, 25–29], increase health literacy [30–34], and provide sustainable community programs to support improved health among African American women in two demographically similar Michigan communities [35–41].

In this study, it was hypothesized that evidence-based programs with a focus on increasing women's capacity to practice health management behaviors, navigate the health care system, and connect with social support, would lead to an increase in healthy behaviors and an accompanying increase in health, both overall and diabetes-specific.

Methods

Adult African American women (age 18+) diagnosed with or at-risk for diabetes in Inkster, Michigan and a group of demographically similar women in Flint, Michigan were eligible to participate in the intervention programs, which were well-established in Inkster, and were in the process of initially being rolled out in Flint. Eligibility for participation in the study was determined using the American Diabetes Association (ADA) Risk Test [42, 43]. Women who scored as high risk for diabetes, or those with an existing diabetes diagnosis, were invited to enroll in the study. All participants consented to take part in the study after receiving a description of the study and its risks and benefits. The study was approved by the Institutional Review Boards at the Michigan Department of Health and Human Services and the University of Michigan.

Enrollment initially required participation in one chronic disease self-management program and one health literacy program in Inkster and only one chronic disease self-management program in Flint to align with differences in program offerings in the two cities (see Table 1). The intervention utilized evidence-based programs related to diabetes prevention and management, and was aimed at developing participants' knowledge and capacity for the prevention and self-management of diabetes [44]. All programs included opportunities for formal or informal coaching, and peer-to-peer learning and exchanges.

Table 1 National Kidney Foundation of Michigan (NKFM) Intervention Programs

Program	Description
Evidence-based chronic disease prevention and management interventions	
Personal action toward health (PATH)	2½ h, once a week for 6 weeks. This workshop, provided in a group format, helps people living with long-term health problems to better manage symptoms and improve their health. There is an emphasis on creating personal action plans. Target dosage is at least 4 weeks
Diabetes-PATH	2½ h, once a week for 6 weeks. This workshop, provided in a group format, helps people living with diabetes learn ways to manage the challenges of living with diabetes, reduce the risk of complications, and improve their health. There is an emphasis on creating personal action plans. Target dosage is at least 4 weeks
Enhance fitness	1 h, three times per week. This class, provided in a group format, focuses on cardiovascular conditioning, strength training, flexibility, and balance. It is provided by trained instructors and offered at a variety of community locations. Exercise can be performed seated or standing based on participant ability and comfort level. Target dosage is an average of once per week for 8 weeks
Health literacy mentoring interventions	
Bodyworks	1½ h, once a week for 10 weeks. This activity, provided in a group format, helps parents/caregivers of adolescents navigate caring for their health and improve family eating and activity habits. Target dosage is at least 5 out of 8 weeks
Read your way to health	1–1½ h, once per week for 6 weeks. This activity, provided in a one-on-one format, helps adults improve reading ability and better understand how to care for their health. Target dosage is at least 4 out of 6 weeks
Internet health literacy	1 h, once per week for 2 weeks; or 2 h, one session. This activity, provided in a group format, helps adults learn what health literacy is and how to find reliable health information on the internet. Target dosage is 2 h

Because this requirement was difficult for many women to achieve, those participating in at least one program were included in the study, and additional information was collected to help understand the scope of difficulties related to enrollment and analyze differences in outcomes based on programs attended. Women were recruited into the study through the IPHC, community partner events, health fairs, social media, and the individual programs themselves.

Participants completed surveys at baseline and at 18-months follow-up. Initial enrollment occurred between April 2012 and April 2014 and included 414 women from Inkster and 316 from Flint (total = 730 women). Follow-up took place between June 2013 and June 2015, with 113 women from Inkster and 48 women from Flint completing an intervention and both baseline and follow-up surveys (total = 161 women). Women who completed a baseline survey and did not enroll in a program were compared with those who completed the intervention to determine differences. To better understand the hardships women faced related to their ability to participate in the intervention, women who did not complete a program, and who were not included in the analysis ($n = 69$) were asked to complete a follow-up survey, which included questions about barriers to participation.

The main outcomes of interest include health outcomes (overall health, healthy eating, physical activity, diabetes self-management, and health care utilization) health literacy and social support. Overall health status was measured using the following question: “How would you describe your health?” Possible responses ranged from 1 = poor to 5 = excellent. Healthy eating was determined through questions about both general and specific diet taken from the Diabetes Self-Care Activities Measure [45]. General Diet questions included “How many of the last 7 days have you followed a healthful eating plan?” and “On average, over the past month, how many days per week have you followed your eating plan?” Specific diet questions included: “On how many of the last 7 days did you eat five or more servings of fruits and vegetables?” and, “On how many of the last 7 days did you eat high fat foods such as red meat or full-fat dairy products?”

Exercise measures, part of the Diabetes Self Care Measure, included the following questions: “On how many of the last 7 days did you participate in at least 30 min of physical activity?” (Total minutes of continuous activity, including walking); and “On how many of the last 7 days did you participate in a specific exercise session (such as swimming, walking, biking) other than what you do around the house or as part of your work?” Items related to general diet, specific diet, and exercise were averaged according to Toobert’s Summary of Diabetes Self Care Activity Measure to create domain scores [45].

Health literacy was measured broadly, as described above, and focused on confidence related to navigating health care information and systems. Questions asked related to requiring help with reading materials and medical labels; confidence in filling out medical forms, finding information on the internet, and asking questions of a healthcare provider; difficulty understanding written information; and knowing where to get free or low-cost medical care. The questions used a 5-point Likert-type scale. Chew and colleagues, evaluated the performance of these screening questions for identifying inadequate or marginal health literacy based on the two most widely used health literacy assessment instruments, the Short Test of Functional Health Literacy in Adults (S-TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM), in a large, random sample of primary care patients at four VA Medical Centers. Findings from their studies demonstrated that a single screening question, “How confident are you filling out medical forms by yourself?” may be able to identify 80% of adult patients with inadequate health literacy. Therefore, we used this single question to analyze health literacy [13, 14].

Social support was defined in this study as the ability to engage in key relationships within the community, and engage with support for healthful lifestyle behaviors. Social support questions were taken from the brief form of the Chronic Illness Resources Survey (CIRS), a multilevel, social-ecologic-based conceptualization of disease management resources and support that evaluates support for healthful lifestyle behaviors and chronic illness self-management from multiple sources, including family and friends, the neighborhood, community, media, and health policies [11, 12]. This instrument contains measures for overall social support, and specific domain subscales, including *health care* (e.g. “Has your doctor involved you as an equal partner in making decisions about illness management strategies and goals?”); *friends/family*, *dietary*, *exercise* (e.g. “Have family or friends exercised with you?” and “Family or friends bought food or prepared food for you that were especially healthy or recommended”); *personal* (e.g. “Have you arranged your schedule so that you could more easily do the things you needed to do for your illness?”); *neighborhood* (e.g. “Have you gone to parks for picnics, walks or other outings?”); *media/policy* (e.g. “Have you read articles in newspapers or magazines about people who were successfully managing a chronic illness?” and “Have you had health insurance that covered most of the costs of your medical needs including medicine?”); *organizational* (e.g. “Have you attended wellness programs or fitness facilities?”); and *work/volunteer* (e.g. “Have you had a flexible work schedule that you could adjust to meet your needs?”). Some questions span multiple domains.

All data related to the participant survey were assessed for missing values, duplicate records and responses out of

range. For continuous variables, distributions were examined to determine if skewness was present. Frequencies of each categorical variable and means, standard deviations, minimum and maximum values for continuous variables were produced and reviewed. Scores were created for outcomes from validated scales based on the literature, as described above. For other outcomes, items were assessed using a principal component analysis to see which variables were similar and these similar items were averaged to create scores.

For longitudinal analysis, only those subjects who completed a program and had both a baseline and follow-up interview were included in models. To analyze the relationship between site (Inkster vs. Flint) and change over time in the outcomes, general linear mixed models were conducted. Health related and behavioral outcomes were the dependent variables and time, age, site, diabetes status, program participation, type of program, number of comorbidities and an interaction between site and time were the independent variables. Overall health score is based on self-report of 1 = poor to 5 = excellent. All health behavior values are based on report of the mean number of days using a scale of 0–7. All analyses were conducted using SAS/STAT software, version 9.3.

Results

Demographic data on those participants for which both baseline and follow-up data was available, broken down by site (Inkster and Flint) is reported in Table 2. The demographic characteristics are similar across the study populations in both communities. The vast majority of participants identified as black or African American. The majority of respondents are from Inkster ($n = 113$) compared to Flint ($n = 48$), likely a result of the established presence of the NKFM in Inkster prior to implementation. As with demographic characteristics measured, the number and types of co-morbidities were similar between Inkster and Flint. The average number of comorbidities reported by women in both Inkster and Flint was two, with hypertension, arthritis, and depression most frequently reported in both sites. No significant differences were found in demographic characteristics or comorbidities between women who participated in an intervention and those who did not.

Table 3 depicts the level of participation in programs by women in Inkster and Flint. Program participation was the only significant difference found between sites, with a greater proportion of those in Inkster participating in more than one program than in Flint (86 vs. 47%), which can be attributed to the initial requirement of two programs for participants in Inkster and one in Flint. As reported in Table 1, programs were classified as chronic disease prevention/self-management or health literacy mentoring interventions.

Although differences existed between the two sites related to the number of programs completed, and all women could choose the programs they enrolled in, there were similarities across all programs. All programs were provided in community settings, and trained community health workers (CHWs) and health coaches played an integral role in their implementation. CHWs and health coaches helped build individual capacity by providing women with informal counseling, social support, culturally appropriate health education, advocacy, and access to needed resources.

Table 4 shows the differences between baseline and follow-up related to health outcomes and behaviors. Overall health, general diet (following a healthy eating plan), and specific diet (eating five or more servings of fruits and vegetables) improved significantly from baseline to follow-up, when controlled for age, diabetes status and site. Participation in physical activity also improved over time, but the change was not statistically significant by site. These changes suggest that regardless of type of program or number of programs participated in, overall women in both Inkster and Flint reported positive health and health behavior changes over this 18-month period.

Program objectives for improving health literacy among the women of Inkster focused on the ability to find and use information to manage health. Results from our analysis showed a change over time related to all health literacy items. For the single item, “How confident are you filling out medical forms by yourself?” we found a statistically significant change over time ($p < 0.05$). Both sites improved similarly, when controlling for age, gender, number of comorbidities, program participation and site (Table 5).

Table 5 also shows results of the measures for social support, which were statistically significant ($p < 0.05$) related to changes in overall and domain-specific social support. The following domains showed significant improvement from baseline to follow-up: friends and family, dietary, and organizations, indicating that people are getting more support from friends and family and organizations in managing their diabetes or pre-diabetes, particularly for eating a healthy diet. All other domains (neighborhood and community, media and policy, work, physical activity, and personal) showed improvement, however not significantly. The model for the relationship between social support and overall health was statistically significant in overall participants (p value < 0.0001) and in both sites (Flint p value = 0.0412) Inkster (p value = 0.0004), confirming a relationship between social support and health in this group of women.

Barriers to Participation

In order to assess the difficulties women faced related to participation in the programs, we added questions to the follow-up survey related to participation barriers. Individuals who

Table 2 Demographic characteristics of those who completed the program and have completed a follow-up survey, overall and by site

	Overall n = 161		Flint n = 48		Inkster n = 113		p value*
	Mean	Range	Mean	Range	Mean	Range	
Age	59.5	22.88	62.5	22.88	58.2	22.83	0.0598
	n	%	n	%	n	%	
Race/ethnicity							0.8012
Native American	1	0.6	0	0.0	1	0.9	
Black/African American	149	92.5	46	95.8	103	91.2	
Black/African American and one other race	6	3.7	1	2.1	5	4.4	
Unknown	3	1.9	1	2.1	2	1.8	
Education level							0.2435
Less than high school	8	5.0	1	2.1	7	6.2	
High school education	33	20.5	8	16.7	25	22.1	
GED	3	1.9	0	0.0	3	2.7	
Some college/vocational training	64	39.8	17	35.4	47	41.6	
College graduate	48	29.8	19	39.6	29	25.7	
Annual income							0.1340
Less than \$15,000	45	28.0	13	27.1	32	28.3	
\$15,000–\$25,000	24	14.9	5	10.4	19	16.8	
\$25,000–\$50,000	30	18.6	10	20.8	20	17.7	
\$50,000–\$75,000	12	7.5	8	16.7	4	3.5	
More than \$75,000	4	2.5	1	2.1	3	2.7	
Don't know/not sure	6	3.7	1	2.1	5	4.4	
Don't want to say	25	15.5	6	12.5	19	16.8	
Employment status							0.1699
Working full time, 35+ hours per week	15	9.3	4	8.3	11	9.7	
Working part time, less than 35 h per week	13	8.1	1	2.1	12	10.6	
Unemployed or laid off and looking for work	15	9.3	2	4.2	13	11.5	
Homemaker	5	3.1	1	2.1	4	3.5	
In school	2	1.2	1	2.1	1	0.9	
Retired	75	46.6	29	60.4	46	40.7	
Disabled, not able to work	29	18.0	7	14.6	22	19.5	
Other	3	1.9	0	0.0	3	2.7	
Diagnosed with diabetes	70	43.5	18	37.5	52	46.0	0.2359
Total number of comorbidities	1.9	0.7	2	0.6	1.9	0.7	0.7443
Most frequent comorbidities							
Hypertension	103	67.8	31	68.9	72	67.3	
Arthritis	89	58.6	29	64.4	60	56.1	
Depression	32	21.1	13	28.9	19	17.8	
Considers self a person with disability	60	37.3	21	43.8	39	34.5	0.2584

*p value for the difference between sites, from T-test for age and Chi square for all other variables

completed both baseline and follow-up surveys, but were not able to enroll in programs were asked to identify barriers that prevented them from attending. The information collected is presented in Table 6. Four categories emerged from the analysis of responses. They include logistics related to the participant, physical or emotional health problems for the participant or a family member, logistics related to

the way programs were offered, as well as instability and socioeconomic concerns. Logistics related to the programs had the greatest number of selections, with participants finding the location of programs, times programs were offered, and the time commitment of the programs as a challenge. Physical and emotional health problems, particularly for the participant, were also frequently selected. Participant-related

Table 3 Program completion

	Overall n = 161		Flint n = 48		Inkster n = 113		p value*
	Mean	Range (%)	Mean	Range (%)	Mean	Range (%)	
Program participation							< 0.0001
Only 1 program	48	31.6	27	60.0	21	19.6	
More than 1 program	113	74.3	21	46.7	92	86.0	

Italic value indicates statistical significance at the 0.05 level

*p value for the difference between sites, from Chi square tests

Table 4 Health outcomes and behaviors

Outcome	SITE	Mean BL	Mean FU	p-value*
Overall health				
NOTE: Higher Score indicates better health	Overall	2.74	2.92	Overall change over time: 0.0131
Poor(1), fair (2), good (3), very good (4), excellent(5)	Flint	2.71	3.02	Difference between sites: 0.4116
	Inkster	2.75	2.87	
Health behaviors				
General diet	Overall	4.15	4.78	Overall change over time: 0.0032
	Flint	4.49	5.01	Difference between sites: 0.6803
	Inkster	4.00	4.69	
Specific diet	Overall	4.16	4.60	Overall change over time: 0.0022
	Flint	4.27	4.82	Difference between sites: 0.5394
	Inkster	4.11	4.51	
Exercise	Overall	2.74	3.14	Overall change over time: 0.0539
	Flint	2.94	3.47	Difference between sites: 0.6509
	Inkster	2.65	3.00	

P values from mixed models examining change over time controlling for, age, site, diabetes status, program participation, number of comorbidities. The p-value for the change over time is from the time factor and the p-value for the difference in change over time between sites is from an interaction between site and time. A linear distribution was used for all of the dependent variables. Overall health score is based on self-report of 1 = poor to 5 = excellent. All health behavior values are based on report of the mean number of days using a scale of 0–7

logistical challenges were described most frequently as scheduling conflicts and transportation issues. In addition, 17 of 69 respondents reported that financial issues prevented them from participating and 12 of 69 reported that they were able to find other ways to manage their health without taking programs. Most women described multiple barriers across these categories, stressing the lack of resources and the complications of setbacks due to injuries, accidents, and other diagnoses. They mention their role as caretakers for family members including parents and grandchildren. One woman summed up the barriers as follows: “I don’t have time. I work from home and I care for my mother who requires 24 h home care, plus I have my own medical issues.”

In response to a question about what could be done differently to make it easier for participation in health-related programs, transportation was cited most frequently as a need. Women also suggested offering more programs at different times, and in easy access within their neighborhoods. One woman mentioned a need to be healthier in order to

participate in exercise classes. Another mentioned that it is always difficult to participate in classes no matter when they are scheduled since her work hours change and she does not have flexibility.

Overall, the barriers between the two sites appeared to be quite similar, with the times the programs were offered appearing to be a slightly larger barrier in Flint than in Inkster. These responses point to the importance of providing a variety of options and times for health-related programs, and the importance of making these programs easily accessible, especially in vulnerable communities.

Discussion

The evaluation results show that those who participate in the intervention programs do change behaviors related to diet and physical activity. Results also show that women increased their sense of health literacy and social

Table 5 Health literacy and social support

Outcome	SITE	Mean BL	Mean FU	p value
Health literacy	Overall	3.62	3.97	Overall change over time: 0.0042
	Flint	3.79	4.15	Difference between sites: 0.8865
	Inkster	3.55	3.89	
Social support	Overall	2.20	2.49	Overall change over time: 0.0022
	Flint	2.38	2.69	Difference between sites: 0.9176
	Inkster	2.12	2.41	
Family and friends	Overall	2.20	2.49	Overall change over time: 0.0022
	Flint	2.38	2.69	Difference between sites: 0.9176
	Inkster	2.12	2.41	
Dietary	Overall	2.33	2.60	Overall change over time: 0.0015
	Flint	2.42	2.77	Difference between sites: 0.7480
	Inkster	2.30	2.53	
Neighborhood and community	Overall	2.25	2.32	Overall change over time: 0.5474
	Flint	2.24	2.23	Difference between sites: 0.5913
	Inkster	2.25	2.36	
Media and policy	Overall	3.47	3.57	Overall change over time: 0.4481
	Flint	3.59	3.58	Difference between sites: 0.6208
	Inkster	3.42	3.56	
Organizations	Overall	2.35	2.68	Overall change over time: 0.0162
	Flint	2.25	2.52	Difference between sites: 0.6996
	Inkster	2.39	2.74	
Work	Overall	2.46	2.66	Overall change over time: 0.4085
	Flint	2.70	2.77	Difference between sites: 0.7004
	Inkster	2.38	2.63	
Physical activity	Overall	2.09	2.22	Overall change over time: 0.3034
	Flint	2.20	2.25	Difference between sites: 0.6927
	Inkster	2.04	2.21	
Personal	Overall	2.99	3.27	Overall change over time: 0.0861
	Flint	2.98	3.10	Difference between sites: 0.3074
	Inkster	3.00	3.35	
Overall	Overall	2.63	2.84	Overall change over time: 0.0133
	Flint	2.68	2.82	Difference between sites: 0.4562
	Inkster	2.61	2.85	

All values are based on the mean response using a Likert-type scale of 0–5, where 5 indicates the most positive response. P-values from mixed models examining change over time controlling for, age, site, diabetes status, program participation, number of comorbidities. The p-value for the change over time is from the time factor and the p-value for the difference in change over time between sites is from an interaction between site and time. A linear distribution was used for all of the dependent variables

support—important elements of chronic disease prevention and self-management Improvement in women's access to and use of community preventive services, and the provision of outreach support using community health workers (CHWs) and peer mentorship was an integral part of creating these changes. CHWs and peer mentors helped participants navigate the healthcare system and better understand health information. They also served to bridge the gap between individuals and clinics in the community. The effects of peer coaching and social support in this study involved efforts to improve health literacy and ongoing education, encouragement, and a sense of connection through shared goals, which are all elements of the evidence-based programs

implemented. Social support and influences for these women not only provided reinforcements to self-management of health and well-being, but also counteracted social forces related to being women and their roles as caretakers of families, which often results in a disservice to their own health.

One of the major issues facing women with diabetes and pre-diabetes is the scope of lifestyle changes needed in diet and exercise. Underlying these changes are changes in shopping behaviors, cooking behaviors, and eating behaviors—not just for themselves, but for their families. Opportunities to hear about other people's experiences with similar health and wellness challenges, as well as a sense that they were not alone in their struggle with health management were

Table 6 Barriers to participation in diabetes prevention and self-management programs

Barriers to those who did not attend a single program	Overall n = 69		Flint n = 42		Inkster n = 27	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Logistics for participant	58		35		23	
Scheduling conflict w/work/family	27	39.1	17	40.5	10	37.0
Transportation issues	25	36.2	15	35.7	10	37.0
Childcare issues	6	8.7	3	7.1	3	11.1
Physical or emotional health problems	54		36		18	
Physical health problems for me	20	29.0	12	28.6	8	29.6
Emotional health problems for me	17	24.6	11	26.2	6	22.2
Emotional health problems for a family member	9	13.0	7	16.7	2	7.4
Physical health problems for a family member	8	11.6	6	14.3	2	7.4
Logistics related to programs	67		45		22	
Time the programs were offered	28	40.6	20	47.6	8	29.6
Location of programs	22	31.9	13	31.0	9	33.3
Time commitment of the programs	17	24.6	12	28.6	5	18.5
Instability and socioeconomic concerns	21		14		7	
Financial issues	17	24.6	11	26.2	6	22.2
Living conditions	4	5.8	3	7.1	1	3.7
Other	29		23		9	
Found other ways to manage my health without taking the programs	12	17.4	8	19.0	4	14.8
Lack of interest in programs	6	8.7	5	11.9	1	3.7
Moved	2	2.9	2	4.8	0	0.0
Other	9	13.0	5	11.9	4	14.8

most likely instrumental in creating opportunities for health changes. In addition, peer approaches to health management allowed individuals to engage with one another, share knowledge, and learn new strategies.

It is interesting to note that the greatest difference between Inkster and Flint women, the level of participation in programs, or dose of the intervention, did not result in differences in the behavioral health changes measured. Because programs and program requirements varied, and women were expected to participate in only one program, it was expected that differences would emerge based on which programs were attended. All analyses of these differences however showed that no matter which program was attended, the women reported changes in their overall health behaviors. It is difficult to determine the mechanisms that were most critical to these changes. It is possible that the level of social interaction and support that was available across all programs might have been the contributing factor that helped create positive change in these women's lives.

The intervention study could have benefitted from a comparison or control group. The original intent to treat Flint as a comparison group was not feasible due to the difficulty in limiting program exposure given the needs for health programs and services in that community and the finding that level and type of program exposure did not influence the

magnitude of improvement in health outcomes. The loss to follow-up from initial enrollment to participation in the intervention was extensive, and most likely related to the fact that during the first part of recruitment women were paid after completion of the baseline survey. This practice was modified during the course of enrollment to delay payment until the end of the study. This learning will inform future work, especially in vulnerable communities where resources are low and the burdens to participation are high. As described earlier, as it became evident that there were many barriers to program participation, the decision was made to collect follow-up data on women in Inkster who only completed one program over the course of the enrollment period, rather than consider them lost to follow-up.

Another limitation of the study was a lack of biological measures such as a test of hemoglobin A1c, an indicator of control over blood glucose levels. Instead, we relied on self-reported control and confidence related to management of diabetes and diabetes risk factors. Given the intent of the intervention, to increase the capacity and resources of women to practice diabetes self-management behaviors and navigate the healthcare system, self-reported control and confidence are suitable measures.

Future practice and research implications of this work include creating opportunities for women who have already

made significant lifestyle changes to maintain those changes over time. Continued research is needed to discover specific aspects of interventions that work best and what women really need to improve and maintain health from their point of view.

Conclusion

Interventions aimed at increasing self-management behaviors through peer coaching, health literacy training, and social support have multiple benefits related to capacity to manage health, and changes in health behaviors. Although this study found that a variety of diabetes prevention and management programs provided opportunities for positive health changes, it is critical to address the burdens women from vulnerable communities face in order to participate in these programs.

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