Racial and Ethnic Approaches to Community Health (REACH) Detroit Partnership: Improving Diabetes-Related Outcomes Among African American and Latino Adults

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Objectives. We sought to determine the effects of a community-based, culturally tailored diabetes lifestyle intervention on risk factors for diabetes complications among African Americans and Latinos with type 2 diabetes.

Methods. One hundred fifty-one African American and Latino adults with diabetes were recruited from 3 health care systems in Detroit, Michigan, to participate in the Racial and Ethnic Approaches to Community Health (REACH) Detroit Partnership diabetes lifestyle intervention. The curriculum, delivered by trained community residents, was aimed at improving dietary, physical activity, and diabetes self-care behaviors. Baseline and postintervention levels of diabetes-specific quality-of-life, diet, physical activity, self-care knowledge and behaviors, and hemoglobin A1C were assessed.

Results. There were statistically significant improvements in postintervention dietary knowledge and behaviors and physical activity knowledge. A statistically significant improvement in A1C level was achieved among REACH Detroit program participants ($P<.0001$) compared with a group of patients with diabetes in the same health care system in which no significant changes were observed ($P=.160$).

Conclusions. A culturally tailored diabetes lifestyle intervention delivered by trained community residents produced significant improvement in dietary and diabetes self-care related knowledge and behaviors as well as important metabolic improvements. (*Am J Public Health.* 2005;95:1552–1560. doi:10.2105/AJPH.2005.066134)

Although the overall health of the US population has improved over the last 2 decades, striking disparities continue in the burden of illness and death experienced by African Americans, Latinos, Native Americans/Alaska Natives, Asians, and Pacific Islanders.[1] Diabetes, in particular, presents a significant public health burden in terms of increased morbidity, mortality, and economic costs.[2,3] African Americans and Latinos experience a 50 to 100% higher burden of illness and mortality because of diabetes compared to White Americans.[4–6] The prevalence of blindness owing to diabetes is twice as high among African Americans as among Whites.[2] The incidence of kidney disease is 6 times higher in Native Americans, 4 to 6 times higher in Mexican Americans, and 4 times higher in African Americans than in Whites.[7] African Americans with diabetes have a higher rate of lower-extremity amputations,[7] and peripheral vascular disease is 80% more common in Mexican Americans than in non-Hispanic Whites with diabetes.[2]

Two landmark clinical trials have demonstrated that tight control of blood glucose can greatly reduce the risk of diabetes complications. Dietary and physical activity changes are among the principal strategies recommended for controlling blood glucose among individuals with type 2 diabetes.[2,8,9] A continuing question is how best to assist people in making the lifestyle changes necessary for optimal metabolic control. Diabetes self-management education interventions hold the promise of improving metabolic control and promoting protective lifestyle behaviors that can reduce the risk of diabetes complications and improve quality of life.[8,10,11] Although diabetes education interventions have generally yielded positive results, few African Americans and Latinos have been included in these studies. Even fewer studies have evaluated culturally appropriate, community health worker–led interventions that may be more acceptable and cost-effective than interventions led by health care professionals.[8,12,13]

Racial and Ethnic Approaches to Community Health (REACH) 2010 is the Centers for Disease Control and Prevention's (CDC's) effort to eliminate racial and ethnic disparities in 6 priority health areas, including diabetes.[14] The REACH Detroit partnership has used a community-based participatory approach at multiple levels to reduce risk factors for type 2 diabetes and its complications among African Americans and Latinos residing in low-resource neighborhoods of east and southwest Detroit. We assessed whether the REACH Detroit community-based diabetes lifestyle intervention delivered by trained community residents to African Americans and Latinos with type 2 diabetes resulted in significant diabetes-related knowledge and behavioral changes and glycemic control.

METHODS

Participants and Setting

REACH Detroit participants were recruited through 2 hospitals with specialty clinics and 1 community-based health center (Henry

Ford, St. John Riverview, and Community Health and Social Services [CHASS], respectively). Participating physicians gave consent for REACH Detroit staff to contact a list of patients with diabetes identified through administrative data systems as living in the 3 target neighborhoods. Participating physicians also agreed to provide clinical measures for patients who consented to participate in the REACH Detroit program. All Latino adults were recruited from CHASS, and African American adults were recruited from all 3 sites.

From March to June 2002, 10 African American and Latino community residents who had completed a 10-week "Family Health Advocate" (FHA) training program, invited potential participants by mail and telephone to participate in the diabetes lifestyle intervention. African American and Latino men and women were eligible if they had physician-diagnosed type 2 diabetes, were older than 18 years of age, had insurance or received care from a federally qualified health center, were mentally able, and resided in 1 of the 6 REACH Detroit zip code areas. Of the 600 patients identified, 300 met the eligibility criteria, and 151 agreed to participate, gave written informed consent, and completed a baseline survey administered in their home by an FHA. Refusals most frequently cited "no time" or "not interested" as reasons for nonparticipation. The study protocol was approved by the institutional review boards of the participating health systems and the University of Michigan.

Design

The intervention was planned and implemented with guidance from the REACH Detroit steering committee, which is composed of community health leaders, clinical providers, researchers, and REACH Detroit staff. Because of the legacy of distrust in the community about research, at the intervention's inception, the committee recommended a nonrandomized study. The effectiveness of the intervention was examined primarily through a nonrandomized, 1-group, before and after design. Baseline and postintervention A1C values (a measure of blood sugar control during the previous 3 months) of REACH Detroit participants were compared to A1C values abstracted from the medical charts of a random sample of insured non-REACH Detroit African American and Latino patients with type 2 diabetes receiving care in the same health care systems during the same period of time. Age, gender, and ethnicity data also were abstracted.

Intervention

Results from the focus group conducted with community residents during the REACH Detroit planning phase guided the content, format, and method of delivery of the diabetes lifestyle intervention.[15] A curriculum intervention, originally designed and evaluated for Native Americans, was adapted for the REACH Detroit participants.[16] The FHAs and steering committee members contributed local and cultural knowledge during adaptation.

The curricula, *The Journey to Health* for African American participants and *El Camino a la Salud* for Latino participants, were designed to reduce risk factors associated with diabetes complications by increasing participants' diabetes self-management understanding, self-efficacy, and autonomous motivation. Building on culturally relevant knowledge and activities, the program sought to help participants gain knowledge and skills related to healthy eating, physical activity, and stress reduction through 5 2-hour group meetings delivered every 4 weeks by 10 FHAs in 2 community locations from June to October 2002. The FHAs were trained by research staff and experts in patient empowerment approaches[17] to deliver the curriculum intervention. Research staff observed 1 intervention meeting for each FHA to document fidelity to the curriculum, questions asked by participants, and general satisfaction. Intervention classes were delivered in English and Spanish. Participants were encouraged to bring a family member or friend.

The first meeting provided an overview of diabetes; the relationship between diabetes, stress, and depression; and methods for stress reduction. Subsequent meetings focused on increasing physical activity, encouraging consumption of fruits and vegetables, and encouraging decreased dietary fat and sugar intake, respectively. The final meeting discussed maintenance of behavioral changes with social support as a key strategy. Current recommendations from the American Diabetes Association and the CDC guided dietary and physical activity content of the intervention.[18,19] Social cognitive theory constructs[20] were combined with selected cultural symbols and themes, cultural patterns and concepts, values, norms, and relationships to promote healthy eating, exercise, and stress-reducing activities.

Intervention Outcome Measures

A survey was administered to participants at baseline and postintervention to evaluate knowledge and behaviors related to diet, physical activity, diabetes self-care activities, and diabetes-specific quality of life. Pre- and postintervention A1C values and other clinical measures were abstracted from participants' medical charts within 1 month preceding and 1 month following the intervention. The specific measures were developed on the basis of the problems identified in the community focus groups as well as the theoretical underpinnings of the study.[15,21]

Knowledge questions assessed participants' understanding of the relationship between diet, exercise, and blood sugar control. Diet- and physical activity–related questions were derived from the Behavioral Risk Factor Surveillance Survey (BRFSS) to facilitate comparison of REACH Detroit results with those of other REACH sites, as well as those of the local, state, and national BRFSS. Diet-related questions from the BRFSS were asked to assess fruit and vegetable consumption. Participants were asked the number of servings of fruits and vegetables they ate per day and per week. Similarly framed questions were asked for consumption of fried and sweet foods, whole grains, and regular soda or fruit-flavored beverages. Participants were also asked if they poured the fat off of meat after cooking it. Quantity of food consumed was not assessed in this study.

The frequency of following a healthy eating plan and self-monitoring blood glucose were assessed through items from the Summary of Diabetes Self-Care Activities questionnaire.[22] To measure diabetes-specific quality of life, we administered the revised Problem Areas in Diabetes[23] scale. A1C, blood pressure, total cholesterol, low-density lipoprotein, high-density lipoprotein, triglycerides, weight, height, duration of diabetes, and medications, collected by participant's healthcare providers during baseline and postintervention clinic visits, were abstracted from participants' medical records before and after intervention.

Statistical Analyses

Summary statistics, including frequency distributions, means, and other descriptive analyses of variables, were calculated to provide an overview of the characteristics of REACH Detroit participants and the comparison group. One-way analysis of variance (ANOVA) and χ^2 tests were used to test differences from baseline as well as differences between groups among REACH Detroit racial/ethnic groups. To test for pre- and postintervention changes, continuous variables were evaluated with the Wilcoxon signed-rank test. For dichotomous outcomes, the McNemar test of symmetry was used to test the difference between proportions in the paired variables. Independent-sample Student *t* tests were used to assess differences between A1C for the comparison group and REACH Detroit participants at baseline and postintervention.

Multivariate procedures were used to identify predictors of outcomes that were shown to have significant pre- and postintervention changes during the previous analyses. Predictors included were those with conceptual relevance and significant statistical association with at least 1 of the outcomes during the prior analyses. Age, gender, ethnicity, and baseline scores on the dependent variable were entered into the regression models as covariates. For A1C, additional covariates of health care system, duration of diabetes, and medication were included. Outliers, multicollinearity, and the effect of interaction terms on the outcomes of interest also were investigated.

Because no participants formally withdrew from the REACH Detroit program, χ^2 and 1-way ANOVA statistics were used to compare characteristics of participants with and without postintervention data. For analyses, participants were grouped into 2 age categories, 18 to 59 and 60 years and older, with approximately equal numbers in both groups. All analyses were conducted with the statistical software package SPSS version 12 (SPSS Inc, Chicago, Ill).[24]

RESULTS

Participant Retention and Baseline Characteristics

Of the 151 baseline participants, 111 (74%) completed a postintervention survey, of which 91 had postintervention clinical measures (60%). Therefore, all knowledge and behavior change analyses were based on the 111 participants with pre- and postintervention surveys. To evaluate the effect of participation on the intervention on clinical measures, all analyses of clinical measures were based on the 91 participants with pre- and postintervention survey and clinical measures.

There were no significant differences in demographic characteristics, reported baseline knowledge, behaviors, or A1C between participants who completed a baseline survey (n=151) compared to participants with (n=111) and without (n=40) postintervention data, except for the number of intervention classes attended. Eighty-three percent of participants without postintervention data attended no classes; the mean for the group was 0.53 classes compared with 3.98 classes for participants with postintervention data ($P<.001$).

Of 111 REACH Detroit participants, 64% were African American and 36% were Latino (Table 1). The average age of participants was 59 years, with African American participants significantly older than Latino participants. Almost 80% of participants were female. Latino participants were significantly more likely to have less education and to be uninsured than African American participants. The mean A1C for all REACH Detroit participants at baseline was 8.4. There was no significant difference in mean baseline A1C owing to ethnicity. There were, however, significantly more African American participants who were in the 7 or less A1C category compared with Latino participants. Finally, African American participants had a significantly higher body mass index compared with Latino participants. There were no other significant clinical or medication differences between African American and Latino participants. There were also no significant differences in baseline knowledge, behaviors, or A1C between participants who had taken a diabetes course previously and those who had not.

In the baseline comparison of REACH Detroit participants and the health system comparison group, there were significant differences in ethnic and gender composition ($P=.006$) but not age. Latino representation was smaller ($P<.0001$), and male representation was higher in the comparison group compared to REACH Detroit participants ($P=.013$). Baseline A1C values from the REACH Detroit participants and those from the comparison group were not significantly different ($P=.751$).

Class Attendance

Of the 111 REACH Detroit participants with postintervention survey data, 98% attended at least 1 intervention meeting, and 41% attended all 5 intervention meetings. Attendance at each meeting ranged from 60% to 87%.

Changes in Knowledge

After intervention, a significant number of participants had a better understanding of the relationship between healthy eating and blood sugar control than at baseline ($P=.013$) (Table 2). Females and participants who were aged 18 and to 59 years improved the most compared to other REACH Detroit subgroups. Participants, overall, also improved significantly in their knowledge that exercise could improve blood sugar ($P=.035$).

Behavioral Changes

Dietary behaviors improved after intervention for REACH Detroit participants, including a significant increase in mean vegetable consumption ($P=.001$) and in the numbers of participants who reported pouring fat off of meats after cooking fatty foods ($P<0.001$) (Table 2). Women, African Americans, and participants aged 18 to 59 years improved the most compared to other REACH Detroit subgroups (Table 3). There was also a significant increase in participants reporting eating whole grain bread ($P=.004$), particularly among women, African Americans, and both age groups. All REACH Detroit subgroups reported a significant decrease in consumption of regular soda or fruit-flavored beverages

TABLE 1—Baseline Characteristics of Racial and Ethnic Approaches to Community Health (REACH) Detroit Participants

	Total	African Americans	Latinos
Sociodemographic Characteristics			
No.	111	71 (64.0)	40 (36.0)
Age,[a] mean years ±SD	58.5 ±14.5	60.9 ±13.9	54.3 ±14.9**
18–59, n (%)	58 (52.3)	34 (47.9)	24 (60.0)
≥60, n (%)	53 (47.7)	37 (52.1)	16 (40.0)
Gender			
Female, n (%)	88 (79.0)	55 (77.5)	33 (82.5)
Language,[a] n (%)			
English	76 (65.0)	71 (100.0)	5 (12.5)
Spanish	34 (29.0)	0	34 (85.0)***
Community,[a] n (%)			
East Side	59 (53.0)	57 (80.3)	2 (5.0)
Southwest	52 (47.0)	14 (19.7)	38 (95.0)***
Education,[a] n (%)			
Less than high school	48 (43.0)	16 (22.5)	32 (80.0)***
High school graduate	22 (20.0)	18 (25.4)	4 (10.0)*
Attended college	26 (23.0)	24 (33.8)	2 (5.0)***
Insurance[a]			
Yes, n (%)	86 (76.0)	65 (91.5)	21 (52.5)***
Duration of diabetes, y			
Mean ±SD	12 ±9.8	13.6 ±10.0	9.7 ±9.1
Range	1–39	2–34	1–39
Previous diabetes class			
Yes, n (%)	54 (49.0)	32 (45.0)	22 (55.0)
Clinical Characteristics			
Hemoglobin A1C			
Baseline,[a] mean ±SD	8.4 ±2.3	8.2 ±2.5	8.6 ±2.0
<7, n (%)	26 (28.6)	21 (38.9)	5 (13.5)**
≥7, n (%)	65 (71.4)	33 (61.1)	32 (86.5)
Weight, lbs,[a] mean ±SD			
Overall	207.1 ±52.8	225.1 ±55.8	180.8 ±34.4***
Females	205.8 ±48.3	223.9 ±47.9	180.6 ±36.7***
Males	212.8 ±70.6	229.9 ±82.7	181.3 ±21.2
Body mass index, n (%)			
Normal (18.5–24.9)	6 (7.0)	2 (3.0)	4 (10.0)
Overweight (25.0–29.9)	18 (19.0)	8 (11.0)	10 (25.0)
Obese (≥30)	67 (74.0)	44 (62.0)	23 (58.0)
Blood pressure, mean ±SD			
Systolic	137.3 ±19.8	140.6 ±18.0	132.9 ±21.4
Diastolic	78.3 ±9.0	79.3 ±8.9	77.1 ±9.3
Medications, n (%)			
Insulin	38 (42.0)	25 (47.0)	13 (35.0)
Oral	69 (76.0)	38 (70.0)	31 (84.0)
Hypertension (26% missing)	51 (56.0)	28 (51.9)	23 (62.2)

[a]Significantly different between African American and Latino participants.
*$P<.05$; **$P<.01$; ***$P<.001$; P values obtained with χ^2 test for education and body mass index; analysis of variance for age, duration, A1C, weight, and systolic and diastolic blood pressure; and with the Fisher exact test for gender, language, community, insurance, previous diabetes class, and medication.

($P<.0001$). The number of days participants reported following a healthy eating plan increased significantly ($P=.004$), particularly among women and participants who were aged 18 to 59 years. All REACH Detroit participants improved significantly in the number of days they monitored their blood sugar as often as their doctor recommended ($P<.0001$). No significant changes were observed in other dietary behaviors, such as fried and sweet food consumption. There was also no significant change observed in level of physical activity or diabetes-specific quality of life.

Change in A1C

REACH Detroit participants experienced a significant improvement in A1C values ($P<.0001$) in contrast to the health system comparison group ($P=.160$) (Table 2). A significant number of REACH Detroit participants moved out of the 7 or higher category and into the 7 or lower category ($P=.035$). Changes for African American and Latino adults were also assessed separately because of the underrepresentation of Latino adults in the comparison group. The separate changes for REACH Detroit African Americans and Latinos were each statistically significant ($P=.0001$ and $P=.001$, respectively) (Table 3). Other clinical measures of cholesterol, blood pressure, and weight did not change significantly from baseline.

Predictors of Outcomes

Table 4 shows the multivariate logistic and linear regression models for selected behavioral outcomes and A1C level for REACH Detroit participants adjusting for baseline values. Latino participants were 84% more likely than African American participants to understand the relationship between healthy eating and blood sugar control. This understanding was 4 times more likely among participants who attended class 3 (“Eat more fiber, fruits, and vegetables”) compared with those that did not.

Similarly, Latino adults were 89% more likely to follow a healthy eating plan than African American adults. Additionally, participants who understood the relationship between healthy eating and blood sugar control were 4 times more likely to follow a healthy eating plan compared to participants who

TABLE 2—Pre- and Postintervention Changes in Knowledge, Behaviors, Quality of Life (n = 111), and A1C (n = 91) for Racial and Ethnic Approaches to Community Health (REACH) Detroit Participants

Outcome	Preintervention	Postintervention	P[a]
Knowledge			
Dietary knowledge, n (%)			
Not at all/somewhat	26 (30.0)	13 (15.0)	
Well/very well	62 (70.0)	75 (85.0)	<.013
Exercise knowledge, n (%)			
Agree	96 (88.0)	84 (95.5)	
Don't Know	13 (12.0)	4 (4.5)	<.035
Behavioral Changes			
Vegetable consumption, mean ±SD	2.02 ±1.31	2.50 ±1.31	.001
Pour fat off meat, n (%)			
Yes	67 (60.4)	100 (97.3)	
No	24 (21.6)	8 (7.2)	<.0001
Whole grain bread, n (%)			
0–1/wk	35 (31.5)	27 (24.3)	
2–4/wk	24 (21.6)	47 (42.3)	
5–7/wk	50 (45.0)	36 (32.4)	.004
Beverages (times/week), n (%)			
0–1	43 (39.0)	84 (85.0)	
2–7	67 (61.0)	15 (15.0)	<.0001
Fruit consumption, mean ±SD	1.90 ±1.4	1.92 ±1.3	.880
Five per day, n (%)			
Yes	28 (25.0)	36 (32.0)	
No	83 (75.0)	75 (68.0)	.280
Sweet foods (times/week), n (%)			
0–1	59 (53.0)	69 (62.0)	
2–7	49 (44.0)	38 (34.0)	.126
Fried foods (times/week), n (%)			
0–1	68 (61.0)	77 (69.0)	
2–7	40 (36.0)	30 (27.0)	.200
Physical activity, n (%)			
None	34 (31.0)	27 (24.0)	
Some	37 (33.0)	41 (37.0)	
Meets recommendations	39 (35.0)	41 (37.0)	.327
Healthy eating plan (days), n (%)			
0–1	20 (18.0)	5 (5.0)	
2–3	26 (24.0)	18 (17.0)	
4–6	28 (25.0)	33 (31.0)	
7	36 (33.0)	52 (48.0)	<.004
Test blood sugar (days), n (%)			
0–1	30 (27.0)	9 (8.0)	
2–3	22 (20.0)	12 (11.0)	
4–6	9 (8.0)	20 (18.0)	
7	49 (45.0)	69 (63.0)	<.0001
Quality of Life			
Quality of Life (PAID-2) (mean ±SD)	18.5 ±16.8	20.4 ±17.6	.088

Continued

did not. Dietary knowledge was also a predictor of increased vegetable consumption. Although many studies have found that knowledge of diabetes self-management does not necessarily translate into behavioral change,[35] results indicated that dietary knowledge was a predictor of dietary behavior.

Statistically significant improvements in pre- and postglycemic control were associated with gender, self-monitoring blood glucose, and postintervention quality-of-life score. Male participants had larger improvements in A1C than did female participants. Participants who reported monitoring between 4 and 7 days during the preceding 7 days had a significant improvement in A1C compared to participants who reported monitoring on only 0 to 3 days during the preceding 7 days. Better postintervention quality-of-life scores were also associated with improved A1C. Postintervention changes for all dependent variables were significantly related to their respective baseline levels. Improving dietary knowledge and following a healthy eating plan were not predictors of the change in A1C.

DISCUSSION

These findings suggest that a culturally tailored, community-based healthy lifestyle intervention delivered by community residents over 5 sessions can significantly improve glycemic control and reduce risk factors associated with diabetes complications. There were significant improvements in some areas of diabetes self-care knowledge and dietary behaviors, and participants had a statistically significant improvement in A1C (0.8% reduction). A health system comparison group that did not receive the intervention did not experience a significant change in A1C over the same period.

The REACH Detroit findings are consistent with prior studies showing the efficacy of diabetes lifestyle interventions in improving knowledge, behaviors, and glycemic control.[10,16,25–34] The REACH Detroit study was unique in that (1) intervention materials were adapted for both African Americans and Latinos from a previously evaluated program for Native Americans; (2) trained community residents rather than health professionals delivered the program; and (3) urban African

TABLE 2—*Continued*

	Clinical Outcomes		
Hemoglobin A1C			
REACH DETROIT (n = 91), mean ±SD	8.4 ±2.3	7.6 ±1.9	<.0001
< 7, n (%)	26 (28.6)	35 (38.5)	
≥ 7, n (%)	65 (71.4)	56 (61.5)	.035
Comparison Group (n = 98), mean ±SD	8.4 ±2.0	8.6 ±2.0	.160

Note. Actual questions were Dietary knowledge: "How well do you understand the relationship between healthy eating and blood sugar control?"; Exercise knowledge: "Exercise helps to improve your blood sugar."; Pour fat off meat: "When you prepare foods or meals, do you pour the fat off meat after cooking?"; Whole grain bread: "How often do you eat whole grain bread?"; Beverages: "How many times per week do you drink regular soda and/or fruit-flavored drinks?"; 5 per Day: "5 servings of fruit and vegetables per day?"; Physical activity: None = no physical activity; Some = some moderate or vigorous activity but not ideal; Meets recommendations = 5–7 days of moderate exercise for at least 30 minutes, or 3–7 days vigorous for 20 minutes or longer; Healthy eating plan: "On how many of the last 7 days did you follow a healthy eating plan?"; Test blood sugar: "On how many of the last 7 days did you test your blood sugar at least as often as your doctor has recommended?"

[a]*P* values obtained using the McNemar test for dichotomous variables and Wilcoxon signed-rank test for continuous variables.

Americans and Latinos with significant impediments to healthy lifestyles were included, and both groups benefited from aspects of the intervention in a number of ways and to varying degrees.[10,13]

This study reinforces the belief that interventions using community health workers can result in improved knowledge and health practices.[35–39] Improvements in outcomes may be due, in part, to the commitment and persistence of the FHAs, the cultural tailoring of the intervention materials for both African Americans and Latinos (English- and Spanish-speaking), and the frequency and community location of the intervention classes. Adaptation of intervention materials is especially salient as there is minimal documentation as to whether interventions successful for one group can be replicated or adapted and be successful for another group.[40–42] This may be the first study to demonstrate that an intervention developed for and tested with Native Americans can be adapted for and effective among African Americans and Latinos.

Although various diabetes self-care behaviors are relatively independent of one another,[43–46] dietary aspects of the regimen are the most difficult to maintain,[47–49] followed by exercise. REACH Detroit participants made significant positive improvements in several dietary behaviors. Postintervention data indicated modest, but not statistically significant, positive improvements in level of physical activity. Two factors may have affected the lack of significant change in physical activity. First, there was only 1 intervention class devoted to physical activity compared to 2 classes for diet regulation. Second, the physical activity intervention class presented walking as an inexpensive, easy method for increasing physical activity. In the REACH communities, and elsewhere, environmental conditions, such as crime and lack of sidewalks, facilities, and programs have been reported as hindrances to physical activity.[15,25,28,50] REACH Detroit community-level intervention is working to ameliorate identified environmental factors. This and other programs may need to incorporate a stronger or more structured focus on ways to make physical activity a part of an everyday routine in various environmental contexts.

Postintervention data also indicated modest, but not statistically significant, positive improvements in diabetes-specific quality of life. The intervention period may not have been long enough for participants to experience changes in quality of life. Also, baseline responses indicated few participants reported high emotional distress related to their diabetes.

Strengths and Limitations

It is more difficult to draw conclusions about causality from nonexperimental designs that may be subject to selection bias.[51] Nonexperimental designs, if methodologically sound, may, however, reveal important information about the effectiveness of interventions.[52] Randomized controlled trials are not always feasible, or even desirable, particularly when examining community educational interventions.[53] These limitations are modified somewhat by the significant positive changes in A1C, an objective measure, and by comparison of A1C with a health system comparison group followed during the same time period.

Although this study demonstrated improved glycemic control among intervention participants, only 1 behavioral variable, frequency of self-monitoring blood glucose, significantly predicted this outcome in the multivariate regression analyses. Other investigators have had difficulty linking changes in knowledge and behaviors targeted by the intervention to changes in A1C.[16,28] Other factors, both measured and unmeasured, may have influenced outcomes of this study. Improvements in physiological outcomes, such as A1C, may not be parallel to reported changes in knowledge, diet, or physical activity. Measurement of knowledge and behaviors were based on self-report and may under- or overestimate actual knowledge and behavior changes. Future studies should include objective measures of dietary change and physical activity. Additional measures could also include medication adherence and changes in medication during the intervention period. A longer intervention period may also be required to observe change in some outcomes.

Many of the participants in this study had few personal resources; this factor, along with limited literacy and knowledge of diabetes self-management and longstanding lifestyle habits, negatively impacts health. Impediments, such as the low socioeconomic status of some residents in Detroit and the lack of necessary community resources, were only partially discussed by the study. During the planning phase, participants reported difficulties with the cost and lack of availability of the foods that were recommended for improving dietary habits, such as fruits and vegetables. Overcoming such environmental barriers is a crucial component to the design of effective interventions to enhance health behaviors in low-resource communities.

Conclusions

We have demonstrated that an appropriately designed, community-based program

TABLE 3—Significant Pre- and Postintervention Changes for Racial and Ethnic Approaches to Community Health (REACH) Detroit, by Gender, Race/Ethnicity, and Age

	Males (n = 23)		Females (n = 88)		AA (n = 71)		Latinos (n = 40)		18–59 Years (n = 58)		≥60 Years (n = 53)	
Outcomes	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Dietary knowledge												
Well/very well	18 (78.3)	19 (82.6)	55 (64.7)	68 (78.2)	44 (62.0)	49 (70.0)	29 (78.4)	38 (95.0)	36 (63.2)	48 (84.2)	37 (72.5)	39 (73.6)
Not at all/somewhat	5 (21.7)	4 (17.4)	30 (35.3)	19 (21.8)*	27 (38.0)	21 (30.0)	8 (21.6)	2 (5.0)	21 (36.8)	9 (15.8)**	14 (27.5)	14 (26.4)
Exercise knowledge												
Agree	22 (95.7)	17 (100)	74 (86.0)	67 (94.4)	62 (88.6)	64 (94.1)	34 (87.2)	20 (100)	51 (87.9)	47 (100)	45 (88.2)	37 (90.2)
Don't know	1 (4.3)	0	12 (14.0)	4 (5.6)	8 (11.3)	4 (5.9)	5 (12.8)	0	7 (12.1)	0	6 (11.8)	4 (9.8)
Vegetable consumption, mean ±SD	2.23 ±1.57	2.66 ±1.84	1.97 ±1.24	2.46 ±1.14***	2.1 ±1.4	2.7 ±1.4**	1.9 ±1.2	2.1 ±1.0	1.9 ±1.4	2.6 ±1.3***	2.2 (1.3)	2.4 (1.3)
Pour fat off meat												
Yes	11 (78.6)	20 (95.2)	56 (72.7)	80 (92.0)	40 (67.8)	62 (91.2)	27 (84.4)	38 (95.0)	39 (73.6)	54 (96.4)	28 (73.7)	46 (88.5)
No	3 (21.4)	1 (4.8)	21 (27.3)	7 (8.0)***	19 (32.2)	6 (8.8)***	5 (15.6)	2 (5.0)	14 (26.4)	2 (3.6)**	10 (26.3)	6 (11.5)
Whole-grain bread (times/wk)												
0–1/wk	9 (39.1)	7 (30.4)	26 (30.2)	20 (23.0)	17 (24.6)	10 (14.3)	18 (45.0)	17 (42.5)	23 (40.4)	13 (22.8)	12 (23.1)	14 (26.4)
2–4/wk	3 (13.0)	10 (43.5)	21 (24.4)	37 (42.5)	14 (20.3)	31 (44.3)	10 (25.0)	16 (40.0)	15 (26.3)	26 (45.6)	9 (17.3)	21 (39.6)
5–7/wk	11 (47.8)	6 (26.1)*	39 (45)	30 (34.5)**	38 (55.1)	29 (41.4)**	12 (30.0)	7 (17.5)	19 (33.3)	18 (31.6)*	31 (59.6)	18 (34)**
Beverages (times/wk)												
0–1	10 (43.5)	17 (89.5)	33 (37.9)	67 (83.8)	21 (30.0)	45 (76.3)	22 (55.0)	39 (97.5)	20 (34.5)	44 (83.0)	23 (44.2)	40 (87.0)
2–7	13 (56.5)	2 (10.5)**	54 (62.1)	13 (16.3)***	49 (70.0)	14 (23.7)***	18 (45.0)	1 (2.5)***	38 (65.5)	9 (17.0)***	29 (55.8)	6 (13.0)***
Follow a healthy eating plan (days)												
0–1	3 (13.0)	1 (4.5)	17 (19.5)	4 (4.7)	13 (18.3)	5 (7.2)	7 (17.9)	0	13 (22.4)	3 (5.4)	7 (13.5)	2 (3.8)
2–3	6 (26.1)	4 (18.2)	20 (23.0)	14 (16.3)	18 (25.4)	16 (23.2)	8 (20.5)	2 (5.0)	17 (29.3)	10 (17.9)	9 (17.3)	8 (15.4)
4–6	5 (21.7)	4 (18.2)	23 (26.4)	29 (33.7)	17 (23.9)	17 (24.6)	11 (28.2)	16 (41.0)	13 (22.4)	13 (23.2)	15 (28.8)	20 (38.5)
7	9 (39.1)	13 (59.1)	27 (31.0)	39 (45.3)***	23 (32.4)	31 (44.9)*	13 (33.3)	21 (53.8)***	15 (25.9)	30 (53.6)***	21 (40.4)	22 (42.3)
Test blood sugar (days)												
0–1	5 (21.7)	1 (4.3)	25 (28.7)	8 (9.2)	17 (24.3)	8 (11.4)	13 (32.5)	1 (2.5)	16 (27.6)	6 (10.3)	14 (26.9)	3 (5.8)
2–3	5 (21.7)	1 (4.3)	17 (19.5)	11 (12.6)	14 (20.0)	9 (12.9)	8 (20.0)	3 (7.5)	14 (24.1)	7 (12.1)	8 (15.4)	5 (9.6)
4–6	5 (21.7)	5 (21.7)	4 (4.6)	15 (17.2)	5 (7.1)	13 (18.6)	4 (10.0)	7 (17.5)	6 (10.3)	9 (15.5)	3 (5.8)	11 (21.2)
7	8 (34.8)	16 (69.6)**	41 (47.1)	53 (60.9)**	34 (48.6)	40 (57.1)*	15 (37.5)	29 (72.5)***	22 (37.9)	36 (62.1)*	27 (51.9)	33 (63.5)**
A1C	7.8 (2.3)	6.8 (1.3)**	8.5 (2.3)	7.9 (2.0)***	8.2 (2.5)	7.5 (2.2)***	8.6 (2.0)	7.9 (1.5)***	8.9 (2.6)	8.2 (2.4)***	7.8 (1.8)	7.0 (1.1)**

Note. Actual questions were Dietary knowledge: "How well do you understand the relationship between healthy eating and blood sugar control?"; Exercise knowledge: "Exercise helps to improve your blood sugar."; Pour fat off meat: When you prepare foods or meals, do you pour the fat off meat after cooking?"; Whole grain bread: "How often do you eat whole grain bread?"; Beverages: "How many times per week do you drink regular soda and/or fruit-flavored drinks?"; Follow healthy eating plan: "On how many of the last 7 days did you follow a healthy eating plan?"; Test blood sugar: "On how many of the last 7 days did you test your blood sugar at least as often as your doctor has recommended?"
*$P<0.05$. **$P<0.01$, ***$P<0.001$.

requiring little technology and few health care resources can have positive effects, such as improving knowledge, health behaviors, and glycemic control among urban African Americans and Latinos with type 2 diabetes. If the significant improvement in A1C among REACH Detroit participants can be sustained, the *Journey to Health* and *El Camino a la Salud* interventions have the potential to substantially reduce microvascular complications, morbidity, and health care utilization costs.[54–56] Future research efforts should be aimed at confirming, enhancing, and sustaining the effect of this type of intervention among populations in which health disparities exist.

Risk factors for preventing or delaying the onset of diabetes complications are complex and interdependent. To attend to this complexity, the REACH Detroit intervention combined community-based lifestyle education, social support, and behavior change approaches. Meta-analyses indicate that a combination of these approaches is associated with better outcomes compared with any single approach.[57] Diabetes self-care is influenced on multiple levels. Further research is needed to investigate how best to design and implement multilevel, culturally tailored, community-based

TABLE 4—Multivariate Logistic and Linear Regression Models for Selected Behavioral Outcomes and A1C for Racial and Ethnic Approaches to Community Health (REACH) Detroit Participants

	Dietary Knowledge n = 107 OR (95% CI)	Healthy Eating Plan n = 106 OR (95% CI)	Vegetable Servings/Day N = 95 ß	Hemoglobin A1C n = 90 ß
Baseline response	4.37 (1.19, 12.82)**	3.48 (1.15, 10.6)*	.584***	.691***
Age	.976 (.94, 1.01)	.963 (.922, 1.01)	.095	.059
Gender				
Male	1.10 (.275, 4.36)	.962 (.251, 3.68)	−.028	.187*
Female	Referent	Referent		
Race/Ethnicity				
African American	.162 (.034, .769)*	.107 (.019, .594)**	−.099	.010
Latino	Referent	Referent		
Class 3 attendance	4.17 (1.36, 12.7)**	1.07 (.189, 6.10)	.082	. . .
Dietary knowledge	. . .	4.20 (1.26, 14.1)*	.186*	. . .
Monitoring blood glucose				
0–3 days/wk	. . .	. . .	. . .	Referent
4–7 days/wk	. . .	. . .	. . .	−.266**
PI QOL	. . .	. . .	. . .	−.254**

Note. OR = odds ratio; CI = confidence interval; ß = standardized regression coefficient; PI QOL = postintervention quality-of-life score. Dietary knowledge = participants' understanding of the relationship between healthy eating and blood sugar control; healthy eating plan = frequency with which the participant followed a healthy eating plan during the last 7 days; class 3 attendance = eat more fiber, fruits, and vegetables; monitoring blood glucose = frequency with which the participant monitored during the past 7 days as often as their doctor recommended. A1C is the log-transformed pre- and postintervention change value; A1C model adjusted for all variables listed as well as for duration of diabetes, medication, and health care system.
*P < .05; **P < .01; ***P < .001.

behavior change interventions in greater depth. We must determine what elements of interventions are most effective (e.g., skills training, problem solving, cognitive techniques), for what outcomes, and in what context.[58] We need to continue to develop our understanding of the critical components of successful interventions that encourage and sustain healthy lifestyle behaviors among populations at high risk for diabetes and its complications. ■

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Contributors

J. Two Feathers led the design and implementation of the study, led the writing of the article, and conducted the statistical analysis. E. Kieffer contributed to the study design and implementation. R. Guzman, G. Palmisano, and M. Anderson assisted with study design and interpretation. B. Sinco assisted with data management and statistical analysis. M. Spencer and J. Thompson assisted with statistical analysis and helped conceptualize ideas. N. Janz, M. Heisler, K. Wisdom, and S. James helped conceptualize ideas and reviewed drafts of the article. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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Human Participant Protection

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References

1. National Institutes of Health. *Racial and Ethnic Health Disparities.* Bethesda, Md: National Institutes of Health; 1999.

2. American Diabetes Association. *Diabetes 2001 Vital Statistics.* Alexandria, Va: American Diabetes Association; 2001.

3. American Diabetes Association. Economic consequences of diabetes mellitus in the US in 2002. *Diabetes Care.* 2003;26:917–932.

4. Harris M, Eastman R, Cowie, C, Flegal K, Eberhardt M. Racial and ethnic differences in glycemic control of adults with type 2 diabetes. *Diabetes Care.* 1999;22:403–408.

5. Karter A, Ferrara A, Liu J, Moffet H, Ackerson L, Selby J. Disparities in incidence of diabetic end-stage renal disease according to race and type of diabetes. *N Engl J Med.* 1989;321:1074–1079.

6. Pugh J, Stern M, Haffner S, Eifler C, Zapata M. Excess incidence of treatment of end-stage renal disease in Mexican Americans. *Am J Epidemiol.* 1988;127:135–144.

7. Centers for Disease Control and Prevention. *National Diabetes Fact Sheet.* Atlanta, Ga: Centers for Disease Control and Prevention, Division of Diabetes Translation; April 2002.

8. Clement S. Diabetes self-management education. *Diabetes Care.* 1995;18:1204–1214.

9. Nelson K, Reiber G, Boyko E. Diet and exercise among adults with type 2 diabetes. *Diabetes Care.* 2002;25:1722–1728.

10. Brown S. Meta-analysis of diabetes patient education research: variations in intervention effects across subjects. *Res Nurs Health.* 1992;15:409–419.

11. Norris S, Engelgau M, Narayan V. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes Care.* 2001;24:561–587.

12. Brown S. Effects of educational interventions in diabetes care: A meta-analysis of findings. *Nurs Res.* 1988;37:223–230.

13. Norris S, Lau J, Smith S, Schmid C, Engelgau M. Self-management education for adults with type 2 diabetes. *Diabetes Care.* 2002;25:1159–1171.

14. Centers for Disease Control and Prevention. *Racial and Ethnic Approaches to Community Health.* Atlanta, Ga: Centers for Disease Control and Prevention; 1999.

15. Kieffer EC, Willis SK, Odoms-Young AM, Guzman JR, Allen AJ, Two Feathers J, Loveluck J. Reducing disparities in diabetes among African American and Latino

residents of Detroit: the essential role of community planning focus groups. *Ethn Dis.* 2004;14(3 Suppl 1): S27–S37.

16. Gilliland S, Azen S, Perez G, Carter J. Strong in body and spirit: lifestyle intervention for Native American adults with diabetes in New Mexico. *Diabetes Care.* 2002;25:78–83.

17. Anderson R, Funnell M, Arnold M. Using *Empowerment Approach to Help Patients Change Behavior.* 2nd ed. Alexandria, Va: American Diabetes Association; 2002.

18. American Diabetes Association. Standards of Medical Care. *Diabetes Care.* 2001;27(Suppl 1):S15–S35.

19. Centers for Disease Control and Prevention. *Dietary and Physical Activity Recommendations.* Atlanta, Ga: Centers for Disease Control and Prevention; 2001.

20. Baranowski T, Perry C, Parcel G. *How Individuals, Environments, and Health Behavior Interact: Social Cognitive Theory.* 2nd ed. San Francisco, Calif.: Jossey-Bass; 1997.

21. REACH. REACH Detroit Partnership grant (CDC grant U50/CCU517264–01). Atlanta, Ga: Centers for Disease Control and Prevention; 1998.

22. Toobert D, Hampson S, Glasgow R. The summary of diabetes self-care activities measure. *Diabetes Care.* 2000;23:943–949.

23. Polonsky W, Anderson B, Lohrer P, et al. Assessment of diabetes-related distress. *Diabetes Care.* 1995; 18:754–760.

24. SPSS 12.0 [computer program]. Chicago, Ill: SPSS Inc; 2003.

25. Brown S, Garcia A, Kouzekanani K, Hanis C. Culturally competent diabetes self-management education for Mexican Americans. *Diabetes Care.* 2002;25: 259–268.

26. Ciliska D, Miles E, O'Brien AM, et al. Effectiveness of community-based intervention to increase fruit and vegetable consumption. *J Nutr Educ Behav* 2000; 32:341–352.

27. Coates V, Boore J. Knowledge and diabetes self-management. *Patient Educ Couns* 1996;29:99–108.

28. Agurs-Collins T, Kumanyika S, Ten Have T, Adams-Campbell L. A randomized controlled trial of weight reduction and exercise for diabetes management in older African American subjects. *Diabetes Care.* 1997;20:1503–1511.

29. Diabetes Prevention Program. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med.* 2002;346:393–403.

30. Gary T, Genkinger J, Guallar E, Peyrot M, Brancati F. Meta-analysis of randomized educational and behavioral intervention in type 2 diabetes. *Diabetes Educ.* 2003;29:488–501.

31. Kaplan R, Hartwell S, Wilson D, Wallace J. Effects of diet and exercise interventions on control and quality of life in non–insulin-dependent diabetes mellitus. *J Gen Intern Med.* 1987;2:220–227.

32. Lorig K, Ritter P, Gonzalez V. Hispanic chronic disease self-management. *Nurs Res.* 2003;52: 361–369.

33. Warsi A, Wang P, LaValley M, Avorn J, Solomon D. Self-management education programs in chronic disease. *Arch Intern Med.* 2004;164:1641–1649.

34. Wing R, Anglin K. Effectiveness of a behavioral weight control program for blacks and whites with NIDDM. *Diabetes Care.* 1996;19:409–413.

35. Corkery E, Palmer C, Foley M, Schechter C, Frisher L, Roman S. Effect of a bicultural community health worker on completion of diabetes education in a Hispanic population. *Diabetes Care.* 1995;20:254–257.

36. Lorig K, Gonzalez V. Community-based diabetes self-management education: definition and case study. *Diabetes Spectrum.* 2000;13:234–242.

37. Love M. Community health workers: Who they are and what they do. *Health Educ Behav.* 1997;24: 510–522.

38. Meister J, Warrick L, deZapien J, Wood A. Using lay health workers: case study of a community-based prenatal intervention. *J Community Health.* 1992;17: 37–51.

39. Quinn M, McNabb W. Training lay health educators to conduct a church-based weight-loss program for African Americans. *Diabetes Educ.* 2001;27:231–238.

40. Glasgow R, Hiss R, Anderson R, et al. Report of the health care delivery work group: behavioral research related to the establishment of a chronic disease model for diabetes care. *Diabetes Care.* 2001;24: 124–130.

41. Anderson R. Into the heart of darkness: reflections on racism and diabetes care. *Diabetes Educ.* 1998;24: 689–692.

42. Wisdom K, Fryzek JP, Havstad SL, Anderson RM, Dreiling MC, Tilley BC. Comparison of laboratory test frequency and test results between African Americans and Caucasians with diabetes: opportunity for improvement: findings from a large urban health maintenance organization. *Diabetes Care.* 1997;20:971–977.

43. Johnson S. Health behavior and health status: concepts, methods and applications. *J Pediatr Psychol.* 1994;19:129–141.

44. Eakin E, Glasgow R. The physician's role in diabetes self-management: helping patients to help themselves. *Endocrinologist.* 1996;6:1–10.

45. Orme C, Binik Y. Consistency of adherence across regimen demands. *Health Psychol.* 1989;8:27–43.

46. Rubin R, Peyrot M, Saudek C. Effect of diabetes education on self-care, metabolic control, and emotional well-being. *Diabetes Care.* 1989;12:673–679.

47. Fisher EJ, Arfken C, Heins J, Houston C, Jeffe D, Sykes R. *Acceptance of Diabetes in Adults.* New York, NY: Plenum Press; 1997.

48. Ary D, Toobert D, Wilson W, Glasgow R. Patient perspective on factors contributing to nonadherence to diabetes regimen. *Diabetes Care.* 1986;9:168–172.

49. Schlundt D, Rea M, Kline S, Pichert J. Situational obstacles to dietary adherence for adults with diabetes. *J Am Diet Assoc.* 1994;94:874–879.

50. Jack L Jr, Liburd L, Vinicor F, Brody G, Murry VM. Influence of the environmental context on diabetes self-management: a rationale for developing a new research paradigm in diabetes education. *Diabetes Educ.* 1999;25:775–790.

51. Richter B, Berger M. Randomized controlled trials remain fundamental to clinical decision making in type II diabetes mellitus: a comment to the debate on randomized controlled trials. *Diabetologia.* 2000;43: 254–258.

52. Vijan S, Kent D, Hayward R. Are randomized controlled trials sufficient evidence to guide clinical practice in type II diabetes mellitus? *Diabetologia.* 2000; 43:125–130.

53. Glasgow R, Bogt T, Boles S. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health.* 1999;89: 1322–1327.

54. United Kingdom Prospective Diabetes Study Group. Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. *Lancet.* 1998;352:837–853.

55. Khaw K, Wareham N, Luben R, et al. Glycated haemoglobin, diabetes, and mortality in men in Norfolk cohort of European Prospective Investigation of Cancer and Nutrition (EPIC-Norfolk). *BMJ.* 2001;322:15–18.

56. Wagner E. Effect of improved glycemic control on health care costs and utilization. *JAMA.* 2001;285: 182–189.

57. Brown S, Harris C. Culturally competent diabetes education for Mexican Americans: the Starr County Study. *Diabetes Educ.* 1999;25:226–236.

58. Glasgow RE, Fisher EB, Anderson BJ, et al. Behavioral science in diabetes. *Diabetes Care.* 1999; 22:832–841.