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Outcomes of a Weight Loss Intervention to Prevent Diabetes Among Low-Income Residents of East Harlem, New York

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Abstract

There is a need for diabetes prevention efforts targeting vulnerable populations. Our community–academic partnership, the East Harlem Partnership for Diabetes Prevention, conducted a randomized controlled trial to study the impact of peer led diabetes prevention workshops on weight and diabetes risk among an economically and racially diverse population in East Harlem, New York. We recruited overweight/obese adults from more than 50 community sites and conducted oral glucose tolerance testing and completed other clinical assessments and a health and lifestyle survey. We randomized prediabetic participants to intervention or delayed intervention groups. Intervention participants attended eight 90-minute peer-led workshop sessions at community sites. Participants in both groups returned for follow-up assessments 6 months after randomization. The main outcomes were the proportion of participants who achieved 5% weight loss, percentage weight loss, and change in the probability of developing diabetes over the next 7.5 years according to the San Antonio Diabetes Prediction Model. We enrolled 402 participants who were mainly female (85%), Latino (73%) or Black (23%), foreign born (64%), and non-English speaking (58%). At 6 months, the intervention group lost a greater percentage of their baseline weight, had significantly lower rise in HbA1c (glycated hemoglobin), decreased risk of diabetes, larger decreases in fat and fiber intake, improved confidence in nutrition label reading, and decrease in sedentary behavior as compared with the control group. Thus, in partnership with community stakeholders, we created an effective low-resource program that was less intensive than previously studied programs by incorporating strategies to engage and affect our priority population.

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Keywords

community-based participatory research; health disparities; health education; health equity; interventions; nutrition; obesity; quantitative methods

Diabetes is an urgent national health concern, causing significant morbidity and mortality (Beckles & Chou, 2013; Centers for Disease Control and Prevention [CDC], 2017). An estimated one in ten U.S. adults have diabetes, and one in three have prediabetes (a condition in which glucose levels are higher than normal but not yet high enough to diagnose diabetes). Not all U.S. populations are affected equally: lower-income and non-White populations have higher rates of diabetes and prediabetes (Beckles & Chou, 2016; Brown et al., 2004; CDC, 2017; Harris, Eastman, Cowie, Flegal, & Eberhardt, 1999; Link & McKinlay, 2009; McBean, Li, Gilbertson, & Collins, 2004; Robbins, Vaccarino, Zhang, & Kasl, 2005; Signorello et al., 2007). While diabetes incidence rates are leveling off in the United States overall, rates continue to increase among Black and Latino populations and those with a high school education or less (CDC, 2017; Geiss et al., 2014). Among Latino immigrants, diabetes risk increases with length of time living in the United States (Barcellos, Goldman, & Smith, 2012; Schneiderman et al., 2014). This evidence points to a need for diabetes prevention efforts targeting these vulnerable populations, including racial/ethnic minorities, immigrants, and low-income, low-education populations.

In the 1990s, multiple large randomized controlled trials showed that lifestyle modification interventions can result in weight loss, preventing or delaying the onset of diabetes in those at increased risk, with sustained positive impact for many years post intervention (Diabetes Prevention Program Research Group et al., 2009; Knowler et al., 2002; Li et al., 2014; Lindstrom et al., 2006; Pan et al., 1997; Tuomilehto et al., 2001). Diabetes risk reduction has been directly correlated with the degree of weight loss: in the Diabetes Prevention Program (DPP), there was an estimated 16% reduction in diabetes risk for every kilogram of weight loss (Hamman et al., 2006). Following these early studies, many more trials measured the effectiveness of diet- and exercise-focused interventions, and several systematic reviews and meta-analyses have confirmed that combined lifestyle interventions are associated with weight loss, decreased fasting plasma glucose, 2-hour glucose, glycated hemoglobin (HbA1c), and reduced incidence of diabetes (Balk et al., 2015; Barry et al., 2017; Schellenberg, Dryden, Vandermeer, Ha, & Korownyk, 2013; Sun, You, Almeida, Estabrooks, & Davy, 2017).

As a result of the DPP, Congress authorized the Centers for Disease Control (CDC) to establish the Diabetes Prevention Recognition Program to officially recognize and scale lifestyle modification diabetes prevention interventions (Mensa-Wilmot et al., 2017). For-profit providers, large employers, and health systems are also implementing diabetes prevention programs (Fontil et al., 2016; Rehm, Marquez, Spurrell-Huss, Hollingsworth, & Parsons, 2017; Wilson et al., 2017). Despite the proliferation of interventions, there are major barriers to broad availability of programs among the vast population at risk due to high cost, complexity of screening and referral processes, and varying interest of potential participants (Mensa-Wilmot et al., 2017; Rehm et al., 2017).

Problems of access, scalability, and sustainability of these programs are particularly salient in the very groups with the highest and most rapidly growing diabetes rates, namely economically disadvantaged and racial and ethnic minority populations. Although the DPP eliminated racial/ethnic disparities in incident diabetes and studies have shown that interventions culturally tailored to Hispanic/Latino adults in the United States may be effective (Knowler et al., 2002; McCurley, Gutierrez, & Gallo, 2017), there is limited evidence of the impact of community-based programs among Black and Hispanic populations. Existing prevention programs have largely not been designed to meet the specific needs of vulnerable populations. In addition, programs are often inaccessible to very low-income populations such as undocumented immigrants because they are excluded from government subsidized health insurance programs, program costs are too steep, and many programs require a clinician's approval to participate.

East Harlem, a largely Black (31%) and Hispanic/Latino (50%) neighborhood, has some of the highest rates of obesity (33%) and diabetes (13%) in New York City. One in three residents live in poverty and one in four have less than a high school education, were born outside the United States, and are uninsured (King et al., 2015). In 2005, a group of community, clinical, and academic leaders came together to address the alarming levels of diabetes in East Harlem. Together, we formed the East Harlem Partnership for Diabetes Prevention (EHPDP) and developed a diabetes prevention program based on principles derived from the DPP and the Stanford Chronic Disease Self-Management Program (Lorig, Ritter, Villa, & Armas, 2009). The overarching goals of Project HEED (Help Educate to Eliminate Diabetes) were to ensure that our intervention targeted the most underserved, at-risk populations in East Harlem, and to confer lasting benefit to the community through strong partnerships and capacity building. Our team of researchers and our Community Action Board (Board) developed a peer-led workshop series focused on diabetes prevention tailored to the economically and racially diverse population of East Harlem. A pilot study showed that participants in the intervention group lost significantly more weight than the control group (Parikh et al., 2010). We then refined our intervention based on these early promising results and conducted a larger, randomized controlled trial. The aim of the current study was to examine the impact of peer-led diabetes prevention workshops on weight and diabetes risk among a low-income, largely Black and Latino population in East Harlem, New York City.

Method

Trained, bilingual staff recruited participants for the Project HEED clinical trial from more than 50 community sites throughout East Harlem, New York, between March 2009 and July 2011 using strategies pioneered by community partners (Horowitz, Brenner, Lachapelle, Amara, & Arniella, 2009). Potential participants were adult, Spanish- or English-speaking residents of East Harlem, who were overweight or obese (body mass index [BMI] ≥ 25 kg/m²) with no reported diabetes diagnosis, use of hypoglycemic medications, pregnancy, cognitive or physical impairment that would preclude them from communicating or participating in a group, or contraindications to losing weight (Horowitz, Eckhardt, Talavera, Goytia, & Lorig, 2011). Eligible adults underwent oral glucose tolerance testing (OGTT), and those with blood glucose levels in the prediabetic range (fasting blood glucose of 100 to

125 mg/dL and/or blood glucose 2 hours after a 75-gram oral glucose load of 140–199 mg/dL) were eligible for participation (American Diabetes Association, 2014). We administered a detailed health and lifestyle survey and collected additional clinical data (HbA1c, lipids, and blood pressure). After completion of baseline assessments, we allocated participants to intervention or control (delayed intervention) groups using cluster, blinded randomization for each enrollment site to account for site differences. Participants received their baseline results in writing and were encouraged to discuss these results with their health care provider. Participants received a stipend for evaluation visits but did not receive material incentives for participation in the workshop.

Participants in the intervention group took part in eight 90-minute peer-led workshop sessions conducted in English or Spanish at community sites. Participants could bring a family member, friend, or caregiver to the sessions if they chose. Pairs of peer leaders with similar socioeconomic backgrounds and health problems as the participants led the groups after receiving 4 days of training. An intervention committee comprised of East Harlem residents with prediabetes, community leaders, physicians, social workers, nutritionists, DPP-involved faculty, and health educators developed the curriculum based on the Stanford Chronic Disease Self-Management Program (Lorig et al., 2009). The program was tailored to meet the needs of a low-income, undereducated population with limited access to health care. The sessions focused on portion control, simple label reading, managing monthly food budgets, learning to cook healthy food with limited resources, cutting down on intake of unhealthy foods and drinks, reducing sedentary time, environmental factors that promote unhealthy habits (such as limited access to healthy food and poor neighborhood safety/walkability), strategies to deal with stress and emotions that negatively affect health (such as problem solving, contingency management, coping skills, and social support), and incorporating physical activity into daily life. Participants made “action plans,” practiced exercising together, brainstormed ideas to address challenges they identified, and contacted each other through a buddy system between meetings.

Participants in the wait-list control group were invited to take part in the peer education workshops at no cost after a 1-year waiting period. They received written materials in English and Spanish about diabetes prevention and a copy of their results (blood sugar, blood pressure, and low-density lipoprotein cholesterol) to share with their health care providers.

Six months after randomization, participants in both groups returned for in-person follow-up assessments conducted by research assistants blinded to their group assignment. The main outcomes were the proportion of participants who achieved 5% weight loss, percentage weight loss, and change in the probability of developing diabetes over the next 7.5 years according to the San Antonio Diabetes Prediction Model (Chou, Burnet, Meltzer, & Huang, 2015; Stern, Williams, & Haffner, 2002). Secondary outcomes included change in weight, BMI, HbA1c, diet (fruit, vegetable, fat, and fiber intake), nutrition label reading frequency and confidence, and sedentary (screen) time (Rezende et al., 2016; Thompson et al., 2004).

Statistical Power and Sample Size Calculations

We powered the study to detect a 10% difference between the two groups in achieving 5% weight loss (proven in other studies to prevent/delay diabetes). With 80% power and a .05 significance level, a sample size of 153 people in each trial arm (306 patients in total) was needed (Fleiss, Levin, & Paik, 2002; Tuomilehto et al., 2001). We inflated our sample by 10% to account for the unpredictable effect on statistical power of clustering of cases by site, bringing the total to 337. We conservatively estimated a sample attrition rate of 20% between enrollment and 6-month assessment. We thus estimated that enrolling 403 patients at baseline would afford us a large enough sample of patients.

Analyses

We conducted bivariate analyses to compare participants randomized to intervention and control groups using *t* tests for continuous variables and chi-square tests for categorical variables and used intention to treat analyses to compare participants on all key outcomes. We used generalized estimating equations (GEE) to compare the likelihood of achieving 5% weight loss at 6-months in the intervention group compared with the control group after accounting for baseline weight. We used mixed-models to assess intervention effect over time on weight, BMI, HbA1c, dietary intake (fruit, vegetable, fiber, and fat intake), nutrition label reading, and sedentary time. Missing values were imputed using multiple imputations under the assumption that values were missing completely at random. Statistical significance was set at a level of .05. All analyses were conducted using SAS 9.3 (SAS Institute Inc., Cary, NC).

Results

We enrolled 402 participants into Project HEED. As shown in Figure 1, fewer than 10% of eligible individuals declined participation. Of those who consented 73% returned for oral glucose tolerance testing. Only 29% of those tested had a normal glucose tolerance test, 10% had previously undiagnosed diabetes, and 60% had previously undiagnosed prediabetes and were enrolled. Participants were mainly female (85%), Latino (73%) or Black (23%), foreign born (64%), and non-English speaking (58%). Nearly half reported that they were uninsured and food insecure (Table 1). We did not ask about immigration status. Intervention and control groups were not significantly different on any measures at baseline except that intervention participants had more reported moderate to severe depressive symptoms (Table 1). Overall, 64% of intervention participants attended at least 4 workshop sessions and 25% were lost to follow-up.

At 6 months, the intervention group had lost a small but significantly greater percentage of their baseline weight than the control group (−1.4% vs. −0.5%, $p = .008$; Table 2). There was no significant difference between the intervention and control groups for success in losing at least 5% of their baseline weight. However, the intervention group lost significantly more weight than the control group (2.7 vs. 0.9 lbs; $p = .005$) and had a negligible increase in BMI (mean change of 0.07 kg/m²) compared with the control group whose BMI increased more substantially (mean change of 0.34 kg/m²), $p = .03$. Compared with the control group, the intervention group experienced a significantly greater drop in probability of developing

diabetes over the next 7.5 years (from 0.41 to 0.37 vs. 0.42 to 0.41, $p = .025$). Mean HbA1c increased by only 0.001% in the intervention group but increased by 0.05% in the control group, $p = .03$ (Table 3).

In addition to finding improvements in clinical outcomes, we observed differences in behavior changes between the intervention and control groups. Fat and fiber intake decreased in the intervention group to a greater degree than in the control group (Table 3), though there were no significant changes in fruit and vegetable intake. More intervention participants became confident in nutrition label reading than control participants (a 9% increase vs. a 2% decrease at 6 months, $p = .0007$). Intervention participants also had a 7% decrease in reported sedentary activity (defined as daily screen time >3 hours) at 6 months while the control group had a 1% increase, $p = .038$ (Table 3).

Discussion

We developed a group lifestyle change program in which trained peer leaders delivered a culturally appropriate, low literacy curriculum developed by and for their own community with simple, actionable messages for behavior modification. We recruited a more vulnerable cohort than most previous diabetes prevention studies (non-White, low-income, undereducated, underinsured, largely immigrant population). We conducted oral glucose tolerance testing on almost 700 eligible adults, of whom 10% were diagnosed with diabetes and 60% were diagnosed with prediabetes and randomized to intervention (peer education workshop) and wait list control groups. At 6 months, the intervention group had lost a significantly greater percentage of their baseline weight and had significantly lower HbA1c rise, decreased risk of diabetes, larger decreases in fat and fiber intake, improved confidence in nutrition label reading, and decrease in sedentary behavior, as compared with the control group.

Examination of previous studies allows us to understand and interpret our results in the broader context of diabetes prevention research. While some published studies had larger effect sizes than ours, these studies included more resource intense interventions and did not engage the very vulnerable population we targeted. Involvement by health providers, including dietitians, results in a larger relative weight loss than use of peer educators or community health workers (Sun et al., 2017), but many vulnerable communities have limited access to such professionals (Segal & Opie, 2015). These high resource interventions are also harder to sustain and scale.

Even among studies that employed community health workers or lay health educators, those that resulted in more weight loss than our study generally targeted White, well-educated, employed, high-income participants (Benyshek et al., 2013; Katula et al., 2011). These studies often set a high bar for enrollment (e.g., high literacy levels for activities such as food journaling and clinician referral/involvement), which would have made participation impossible for many HEED participants. In contrast, we recruited and retained a very vulnerable population with limited literacy, formal education, income, and English fluency. This priority population is both underrepresented in and underserved by research despite being significantly more likely to develop diabetes and suffer from its sequelae.

Although there is a great need to serve such vulnerable populations by developing and tailoring interventions for them, only a handful of studies have culturally tailored interventions using CBPR and included racially and ethnically diverse populations from lower socioeconomic backgrounds. These studies have had results similar to ours (Islam et al., 2013; Islam et al., 2014; Kaholokula et al., 2014; Ruggiero, Oros, & Choi, 2011; Yeh et al., 2016), but our study had a much larger sample size. In addition, we assessed diabetes risk using clinical measures, while most other studies used nonclinical tools. For example, only one other study measured impact on HbA1c (one of the two ways to accurately identify participants with prediabetes and diabetes; Yeh et al., 2016). Interventions that resulted in similar amounts of weight loss as our study also had either a greater number or duration of intervention sessions, or they were delivered by health professionals in partnership with lay peer leaders (Islam et al., 2013; Islam et al., 2014; Kaholokula et al., 2014). Finally, in addition to addressing common challenges that underserved communities face such as environmental and economic factors that promote unhealthy lifestyles, our program incorporated elements specifically relevant to higher risk immigrant populations such as providing social connections, removing language barriers, promoting healthy lifestyle behaviors from their native countries/cultures, and delivering information about existing community resources and how to access them.

Beginning at the idea generation phase of our study, all partners were committed to developing an intervention that would be as simple and low intensity as possible, so that, if effective, it would be sustainable with minimal resources, both in the community where it was developed and tested, and in similar low-resource communities. While higher program intensity is generally associated with greater weight loss (Ali, Echouffo-Tcheugui, & Williamson, 2012; Aziz, Absetz, Oldroyd, Pronk, & Oldenburg, 2015; Balk et al., 2015), lower intensity programs may be effective if they have high uptake, as was the case with HEED (Aziz et al., 2015). In addition, it may not be realistic for members of vulnerable communities to achieve 5% weight loss due to the many challenges to lifestyle modification these individuals face (Lovasi, Hutson, Guerra, & Neckerman, 2009). Thus, rather than using a strict 5% weight loss threshold, there may be a continuum of benefit with any amount of weight loss or behavior change providing some benefit (Ross & Bradshaw, 2009). Our practical, low-resource/low-intensity intervention resulted in significant differences in mean percentage weight change. Our intervention also led to decrease in sedentary behavior, which has been found to have an association with diabetes risk independent of physical activity (Biswas et al., 2015).

In addition to examining changes in weight, HbA1c, and behaviors, we also found that the intervention group had a significantly greater decrease in probability of developing diabetes than the control group (Stern et al., 2002). This is important, as it avoids a limitation of many studies that report on different primary outcomes or focus on a single outcome such as weight loss without taking into account the many factors that predict diabetes risk (Chou et al., 2015). This type of multifactorial risk assessment may thus be more clinically meaningful (Stern et al., 2002).

Conducting community-based health intervention research with high-risk populations can be challenging, given the many barriers to participation (George, Duran, & Norris, 2014).

However, we were able to meet our recruitment goals in 40 months with low refusal and high retention rates through partnership with more than 50 community-based organizations (such as schools, food pantries, churches, and social service organizations) and by using proven effective strategies (Horowitz et al., 2009). Some of these strategies included collaboration with community partners to develop recruitment materials, conduct outreach, build trust and rapport, offer flexible schedules, and employ trusted community gatekeepers to lead recruitment efforts. The longstanding relationships and history of service between our community partners and residents broke down barriers to study participation and engendered trust. By developing an intervention that was created by and for community members, we were able to facilitate participation and include a diverse, at-risk population in a real-world community setting.

Limitations

Our study had some limitations. Contamination between intervention and control participants is possible because we randomly assigned participants from the same community to the study's two arms, which could have led to an underestimation of the intervention's impact. We conducted oral glucose tolerance testing, which is the gold standard for screening for diabetes and prediabetes. However, we did not repeat testing on a different day as is sometimes recommended because community members deemed this approach infeasible and burdensome. Women were overrepresented in our study, in part because our partner community organizations which serve very vulnerable populations predominantly aid women and children. Finally, we evaluated secondary outcomes such as diet and physical activity behaviors based on participant self-report, which could be affected by recall or social desirability bias.

Conclusions

We sought to study how diabetes prevention programs can succeed in neighborhoods like East Harlem with many undereducated, low-income, non-English speaking, uninsured immigrants. Few previous studies have proven that it is feasible to gain participation of individuals from these hard to reach populations or examined the impact of lifestyle interventions on members of such vulnerable populations. In terms of impact on clinical practice, health care providers struggling to address high levels of diabetes risk in their patient populations may benefit from referral to and collaboration with community-based prevention programs like ours. In addition, our study identified at-risk individuals who may not engage in regular primary and preventive health care due to several barriers to access of care. Thus, we were able to recruit and benefit our high-risk population with low access to preventive care and interventions like the DPP. We created an effective program that required fewer resources and had a less intensive intervention duration than other similar studies in high-risk populations with results similar to ours. We attribute this success to our CBPR approach and partnership with community and clinical stakeholders which allowed us to incorporate specific strategies to engage and positively affect our target population. For example, our program included strategies for overcoming some of the social determinants known to affect diabetes (such as food affordability and neighborhood safety/walkability; Auchincloss, Diez Roux, Brown, Erdmann, & Bertoni, 2008; Rachele, Giles-Corti, & Turrell, 2016). In addition, given that the Affordable Care Act does not include any

provisions to improve health insurance coverage for undocumented individuals, we deliberately incorporated program components to support both legal and undocumented immigrants. Thus, the expansion of community-based diabetes prevention programs such as the one tested here, has the potential to reduce diabetes burden in the most vulnerable populations. We found that rigorous, community-based screening programs are quite feasible and may help identify individuals with the highest risk for diabetes and motivate them to action, especially if simple, effective interventions are made available to them. Peer-led weight loss groups delivered through community-based organizations constitute a promising diabetes prevention strategy among hard to reach populations with high rates of diabetes.

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Figure 1.
Study design and recruitment numbers.

Note. OGTT = oral glucose tolerance testing; HbA1c = glycated hemoglobin.

Table 1.
Baseline Characteristics of Participants and Comparison Between Randomization Groups.

Characteristic	Overall (<i>N</i> = 402), <i>n</i> (%)	Control (<i>n</i> = 192), <i>n</i> (%)	Intervention (<i>n</i> = 210), <i>n</i> (%)	<i>p</i>
Age (years), <i>M</i> (<i>SD</i>)	44.5 (14.8)	44.5 (14.5)	44.5 (15.0)	.9803
Female	343 (85)	165 (86)	178 (85)	.7394
Race/ethnicity				.2590
Non-Hispanic Black	93 (23)	41 (21)	52 (25)	
Hispanic	294 (73)	141 (73)	153 (73)	
Non-Hispanic White	3 (1)	3 (2)	0	
Other	12 (3)	7 (4%)	5 (2)	
Income <\$15,000/year	161 (48)	78 (49)	83 (47)	.6967
Insurance status				.1575
Uninsured	164 (41)	89 (47)	75 (36)	
Medicaid	85 (21)	36 (19)	49 (23)	
Medicare	39 (10)	16 (8)	23 (11)	
Commercial	112 (28)	49 (26)	63 (30)	
Foreign born	257 (64)	125 (66)	132 (63)	.4944
Spanish speaking	233 (58)	115 (60)	118 (56)	.4522
Less than high school education	181 (45)	89 (47)	92 (44)	.5390
Married/living with partner	242 (61)	121 (64)	121 (58)	.2153
Tobacco smoker	35 (9)	20 (11)	15 (7)	.2317
Self-rated health: fair/poor	185 (46)	91 (48)	94 (45)	.5068
Describe life as extremely/very stressful	72 (18)	37 (20)	35 (17)	.4776
Screen time 3 hours/day	207 (52)	90 (47)	117 (56)	.0953
Moderate/severe depressive symptoms (PHQ-8 10)	56 (14)	19 (10)	37 (18)	.0283
Food insecure	183 (46)	83 (43)	100 (48)	.3773
BMI (kg/m ²), <i>M</i> (<i>SD</i>)	32.6 (5.9)	32.55 (5.7)	32.6 (6.1)	.9541
BMI category				.8811
Overweight (BMI 25–29 kg/m ²)	149 (37)	73 (38)	76 (36)	
Obese (BMI 30–39 kg/m ²)	204 (51)	97 (51)	107 (51)	
Morbidly obese (BMI 40 kg/m ²)	49 (12)	22 (11)	27 (13)	

Note. M = mean; SD = standard deviation; PHQ-8 = eight-item Patient Health Questionnaire; BMI = body mass index.

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Table 2.
Main Outcomes at 6-Month Follow-Up From Baseline in Groups Randomized to Control and Intervention.

Outcome	Control (<i>n</i> = 192)	Intervention (<i>n</i> = 210)	^a <i>p</i>	^b <i>p</i>
Lost 5% of baseline weight, <i>n</i> (%)	21 (11%)	32 (15%)	.203	
Percent weight change, <i>M</i> (<i>SD</i>)	-0.49 (0.03)	-1.4 (0.03)	.008	
Diabetes risk at baseline, <i>M</i> (<i>SD</i>) ^c	0.42 (0.22)	0.41 (0.21)	.716	.025
Diabetes risk at 6 months, <i>M</i> (<i>SD</i>) ^c	0.41 (0.24)	0.37 (0.22)	.125	

Note. *M* = mean; *SD* = standard deviation.

^aFrom bivariate comparison.

^bFrom mixed or generalized estimation equation models, statistical significance tests were based on interaction term of time and intervention.

^cProbability of developing diabetes over the next 7.5 years as defined by the San Antonio Diabetes Prediction Model (Stern et al., 2002).

Table 3.
Secondary Outcomes at 6-Month Follow-Up From Baseline in Groups Randomized to Control and Intervention.

Outcome	Control (<i>n</i> = 192)	Intervention (<i>n</i> = 210)	^a <i>p</i>	^b <i>p</i>
Weight at baseline (lbs), <i>M</i> (<i>SD</i>)	180.9 (42.83)	185.4 (45.63)	.3153	.0111
Weight at 6 months (lbs), <i>M</i> (<i>SD</i>)	179.9 (42.51)	182.8 (44.93)	.5185	
Weight change (weight _{6 months} – weight _{baseline}) (lbs), <i>M</i> (<i>SD</i>)	–0.92 (6.25)	–2.70 (6.39)	.005	
BMI (kg/m ²) at baseline, <i>M</i> (<i>SD</i>)	32.55 (5.66)	32.58 (6.15)	.9541	.1782
BMI (kg/m ²) at 6 months, <i>M</i> (<i>SD</i>)	32.34 (5.63)	32.29 (6.58)	.9304	
Change in BMI (kg/m ²), <i>M</i> (<i>SD</i>)	–0.20 (1.19)	–0.29 (1.91)	.5790	
HbA1c (%) at baseline, <i>M</i> (<i>SD</i>)	5.60 (0.43)	5.60 (0.31)	.9462	.0531
HbA1c (%) at 6 months, <i>M</i> (<i>SD</i>)	5.66 (0.39)	5.61 (0.35)	.2023	
HbA1c change (6 months – baseline) (%), <i>M</i> (<i>SD</i>)	0.05 (0.27)	–0.001 (0.24)	.03	
Fruit and vegetable intake at baseline (grams/day), <i>M</i> (<i>SD</i>)	6.24 (0.88)	6.26 (0.92)	.7904	.6753
Fruit and vegetable intake at 6 months (grams/day), <i>M</i> (<i>SD</i>)	6.17 (0.88)	6.16 (0.84)	.9141	
Change in fruit and vegetable intake (grams/day), <i>M</i> (<i>SD</i>)	–0.06 (0.78)	–0.07 (0.79)	.93	
% Fat intake at baseline, <i>M</i> (<i>SD</i>)	33.98 (2.05)	34.15 (2.08)	.4263	.0242
% Fat intake at 6 months, <i>M</i> (<i>SD</i>)	33.85 (1.85)	33.66 (1.95)	.3161	
Change in % fat intake, <i>M</i> (<i>SD</i>)	–0.24 (1.63)	–0.53 (1.52)	.06	
Nutrition label reading often at baseline, <i>n</i> (%)	57 (30)	69 (33)	.4938	.4682
Nutrition label reading often at 6 months, <i>n</i> (%)	72 (38)	98 (47)	.0631	
Very confident in reading nutrition labels at baseline, <i>n</i> (%)	51 (27)	47 (22)	.3294	.0007
Very confident in reading nutrition labels at 6 months, <i>n</i> (%)	48 (25)	66 (31)	.1532	
Screen time 3 hours/day at baseline, <i>n</i> (%)	90 (47)	117 (56)	.1090	.0384
Screen time 3 hours/day at 6 months, <i>n</i> (%)	92 (48)	103 (49)	.8207	

Note. *M* = mean; *SD* = standard deviation; BMI = body mass index; HbA1c = glycated hemoglobin.

^aFrom bivariate comparison.

^bFrom mixed or generalized estimation equation models, statistical significance tests were based on interaction term of time and intervention.