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A Family-Based Diabetes Intervention for Hispanic Adults and Their Family Members

Jie Hu [Associate Professor],
University of North Carolina at Greensboro, School of Nursing Greensboro, NC 27402-6170, USA
jie_hu@uncg.edu

Debra Wallace [Professor],
University of North Carolina at Greensboro, School of Nursing Greensboro, NC 27402-6170, USA

Thomas McCoy [Visiting Assistant Professor, Statistician], and
Center for the Health of Vulnerable Populations University of North Carolina at Greensboro, School of Nursing Greensboro, NC 27402-6170, USA

Karen Amirehsani [Assistant Professor]
University of North Carolina at Greensboro, School of Nursing Greensboro, NC 27402-6170, USA

Abstract

Aims—The purpose of this quasi-experimental one group longitudinal study is to examine the effects of a family-based intervention program on diabetes self-management behaviors, HbA1c, other biomarkers, psychosocial factors and health-related quality of life in Hispanics with diabetes.

Methods—Adult patients with diabetes (n = 36) and family members (n = 37) were recruited from a community clinic in rural central North Carolina. Patients and family members attended an 8-week culturally tailored diabetes educational program taught in Spanish. Data was collected pre and post intervention for both patients and family members, with an additional data collection for patients 1 month post intervention.

Results—Most patients and family members were female and almost all were immigrants. HbA1c dropped by 0.41% on average among patients from pre-intervention to 1 month post intervention. Patients showed significant improvements in systolic blood pressure, diabetes self-efficacy diabetes knowledge, and physical and mental components of health-related quality of life. Higher levels of intake of healthy foods and performance of blood sugar tests and foot inspections were reported. Family members significantly lowered BMI and improved diabetes knowledge from pre- to immediate post-intervention. No significant changes in levels of physical activity were found among patients with diabetes or family members.

Conclusions—Findings suggest that including family members in educational interventions may provide emotional and psychological support to patients with diabetes, help to develop healthy family behaviors, and promote diabetes self-management.

Correspondence to: Jie Hu.

Keywords

Hispanics; Type 2 diabetes; diabetes self-management; family support; diabetes knowledge; diabetes self-efficacy and intervention

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Hispanic/Latino Americans are 66% more likely to develop diabetes than non-Hispanic Whites[1], and suffer disproportionately from diabetes-related complications, including hypertension, heart disease, stroke, kidney disease, blindness, nervous system disease and amputation [2]. Hispanics have significantly higher rates of hospitalization for uncontrolled diabetes and complications than Whites and are 1.5 times more likely to die from diabetes than Whites [3].

Diabetes self-management is key to achieving glycemic control and improving health outcomes [4]. There is strong evidence that following a healthy diet and exercise program, taking diabetes medications and monitoring glucose can improve diabetes outcomes [1]. However, Hispanics with type 2 diabetes (T2DM) show poorer self-management of the disease than non-Hispanic Whites; only 36.8% of Mexican Americans with diabetes have their hemoglobin A1C (HbA1c) under control, compared to 60% of non-Hispanic Whites [3]. Many Hispanics fail to adhere to the diabetes self-management recommendations of the American Diabetes Association (ADA) [5]. Hispanics are 2.09 times less likely than Whites to perform adequate physical activity[6], and 36% less likely to perform self-monitoring of glucose [5, 7]. Clearly interventions are needed to enhance diabetes-self management in Hispanic Americans.

Social and cultural influences play a large role for Hispanics in dealing with diabetes [8]. In particular, *familismo* is an important value: the 'family comes first.' Thus focusing on family involvement and family centeredness is an important interventions for Hispanics with diabetes [9, 10]. Hispanics face many challenges in making the lifestyle changes required for effective and sustained diabetes self-care [11, 12]. For these patients, social support, including peer and family involvement, has been related to improved healthy eating and improved physical activity [13], improved low-density lipoproteins (LDL) and total cholesterol [14], better glycemic control as measured by HbA1c [15], improved knowledge [16], improved self-efficacy [17] and better self-management [18].

Social cognitive theory, which suggests that behavior change depends on the interaction of personal factors, the environment, the situation, and behavior, guided the intervention. Our intervention focused on increasing diabetes knowledge, overcoming barriers to self-management, and fostering behavioral changes through family support and development of self-efficacy. Therefore, we expected that after participants received the family-based intervention they would demonstrate:

1. improvements in self-management of diabetes, including physical activity, diet, and self-monitoring of blood glucose;
2. improvements in metabolic measures of body mass index (BMI), HbA1c, total cholesterol/high-density lipoprotein (HDL) ratio and blood pressure; and

3. increases in diabetes knowledge, and scores on perceived self-efficacy, family support, and health-related quality of life (physical and mental health).

Methods

Design

A quasi-experimental, one-group longitudinal design was used to examine the effects of the family-based intervention program. For participants with diabetes, data were collected at baseline, post intervention and 1 month follow-up. For family members, data were collected at baseline and post intervention.

Sample and setting

Participants with T2DM and at least one family member were recruited from a community clinic for the uninsured which serves a large population of Hispanics in rural central North Carolina. Criteria for inclusion for patients with diabetes included a) self-identity as Hispanic, b) age 18 years or older, c) self-report of a medical diagnosis of T2DM, and d) an adult family member willing to participate. Inclusion criteria for family members were a) residence in the patient's household and b) age 18 years or older. Participants and family members had to be able to speak either Spanish or English. Those who were pregnant, diagnosed with type 1 diabetes, reported prior (past year) or current participation in other diabetes self-management intervention programs, or were cognitively impaired were excluded.

Participants were recruited through flyers distributed by clinic staff, and in waiting room conversations with a bilingual and bicultural interpreter. Potential participants met a research assistant or the first author in a private room or made an appointment for a home visit/family session with the interpreter and research assistant/first author for consent and enrollment. Incentives were store gift cards. The university IRB approved the study.

Intervention

The intervention consisted of two family sessions and eight weekly group sessions for participants and family members conducted by a nurse practitioner/trained educator bilingual in Spanish. For the two family sessions, the family unit, including multiple members, was invited. This session explained the study purpose and format of the intervention and requirements of participants. Informed consent was obtained from the participant and family member; and baseline data were collected. After that, each participant was asked to bring at least one family member to the eight group intervention meetings.

The eight weekly interactive modules were modified from a family-based diabetes program [19] reflecting the *National Standards for Diabetes Self-Management Education* [20] and the *National Diabetes Education Program* (NDEP) (http://www.ndep.nih.gov/). In addition, the ADA the National Center for Health Statistics (Centers for Disease Control and Prevention) and U.S Department of Health and Human Services (US DHHS) educational materials, strategies, activities, and information were included. Approaches to success through family support were provided throughout the intervention. The modules included:

Introduction to Diabetes; Exercise and Food; Eating healthy; Blood sugar levels and glucometers; Diabetes medications; Taking care of your body; Coping Strategies, Problem Solving, and Action Plans; and Summary & Action plan for you and your family. A group discussion with open-ended questions on family support was facilitated at the end of the first and last group meetings. All of the eight modules were tailored to low-literacy needs and integrated cultural beliefs and values. Bilingual nurses and interpreters taught about dietary change, using modified ethnic foods and recipes and culturally relevant activities [21]. Picture illustrations, seminar discussions, educational flipcharts and games, video-tapes, visual aids (pictorial log sheets, pictorial food books), demonstrations, and self-monitoring demonstrations were used.

Instruments

Demographic forms included family history, health history, socioeconomic information and the number and frequency of family members attending the home visits and group meetings. *Hemoglobin A1c* was tested with a Bayer A1C NOW kit using finger stick blood taken by a registered nurse; HbA1c > 7.0% (53 mmol/mol) indicated poor glycemic control [4]. *Fasting glucose and lipid profiles*, including total cholesterol, HDL, LDL, and triglycerides (TG), were obtained through capillary finger stick. A Cholestech © LDX machine was used for glucose and the lipid profiles. The accuracy and precision of the Cholestech© profiles are comparable to those obtained by reference methods used routinely in clinical diagnostic laboratories [22]. The Cholestech© machine was calibrated at each session to assure the accuracy of readings.

Height and weight were measured using standard procedure [23], and *BMI* was calculated. A participant was categorized as overweight if BMI was 25 to 29.9 kg/m^2 and obese if BMI was 30 kg/m^2 or more [24] *Waist circumference* was measured using Gantt tape measure. Measurements were recorded to the nearest 0.1cm [24] participant was categorized as high risk if waist circumference was greater than 40 inches (102cm) for men, and greater than 35 inches (88cm) for women [24]. *Blood pressure* was measured using a standardized blood pressure protocol based on the guidelines of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure [25]. Participants were considered hypertensive if they used antihypertensive medications or had blood pressure ≥130/80 mmHg.

Physical Activity (PA) was measured using the Short International Physical Activity Questionnaire (IPAQ) form, Last 7 Days Recall, a 9-item scale. The short IPAQ provides information on time spent walking, in vigorous and moderate intensity activities, and in sedentary activities in the last 7 days. Total physical activity measured in minutes per week was used to determine whether participants met the *2008 Physical Activity Guidelines for Americans* [26] Reliability and validity for the IPAQ have been established in 12 countries [27] and for patients with T2DM [28].

Diet was measured using items from the *Behavioral Risk factor Surveillance Survey (BRFSS)* (6-items) [29] which include daily intake of fruits and vegetables. Reliability and validity have been established [30].

Diabetes knowledge was assessed by the Spoken Knowledge in Low Literacy Patients with Diabetes (SKILLD) [31]. The 10-item SKILLD assesses knowledge of glucose management, lifestyle modifications, recognition and treatment of hyper and hypoglycemia and activities to prevent long-term consequences of the disease. Answers were considered correct if they were acceptable responses [31]. Internal reliability (KR-20) of the SKILLD was .72 in patients with diabetes. Validity has been established [31]. KR-20 for the current study was 0.65.

Family support was examined using the Diabetes Family Support Behavior Checklist (DFBC-II) (17-items).The DFBC-II uses a 5-point Likert scale to assesses perceptions of family member support of the person with T2DM in medication taking, glucose testing, exercise and diet. Positive and negative items are summed separately, and higher scores indicate stronger perceptions of family support [32]. Cronbach's alphas have been reported as .71 and .64 in Hispanics with diabetes [33]. Cronbach's alphas for the current study were 0.70 for the supportive subscale and 0.64 for the non-supportive subscale.

Diabetes Self-efficacy was examined by the 8-item Stanford Self-Efficacy Scale, which measures the confidence of a person with diabetes to manage diet, exercise, knowledge of blood sugar and the illness, and control over diabetes [34]. Scores range from 1–10, from no confidence to totally confident; higher scores indicate greater confidence. Internal reliability was .85 in Spanish-speaking adults with diabetes (Spanish version) and .83 in English-speaking individuals with diabetes [35]. Cronbach's alpha for the current study was 0.87.

Diabetes self-management was measured by the Revised Summary of Diabetes Self-Care Activities (SDSCA) (19–items), which assessed self-care activities in diet, exercise, glucose testing, medication and foot care. The mean number of days per week that activities were performed was calculated on a scale of 0–7. Internal consistencies using inter-item correlations have ranged from .47 to .90 in adults with diabetes. The validity of the SDSCA scale is established [36]. Validity and reliability of the Spanish version of the SDSCA have been reported [37].

Health-related quality of life was measured by the Medical Outcomes Study Short Form (SF-12) Health Survey [38] (Spanish version). The SF-12 consists of two major constructs: physical health and mental health, with eight health concepts represented by the 12 items that have a Likert scaling for responses. Subscale scores are transformed from normal scaling to a 0 to 100 standardized score, with higher scores indicating more positive health and better quality of life. The SF-12 has demonstrated good validity [39], and has been used with multiple genders, ages and ethnic populations in multiple settings [21]. Cronbach's alphas for the current study were 0.70 for physical health, and 0.74 for mental health component.

Data collected on family members included demographic data, diabetes knowledge, blood glucose and blood pressure at baseline and post intervention. It took approximately one hour for data collection at each data collection point. All written instruments were verbally administered in participants' language of choice, to prevent embarrassment about low literacy.

Statistical analyses

Growth curve analyses were used to model change over time from baseline and estimate mean differences from pre- to post-intervention and from pre- to 1 month follow-up for participants with diabetes. Linear splines with knots located at the mean time for the post-intervention patients [40] were incorporated where appropriate. Models with linear trends for time or linear splines were adequate using AICC information criteria [41]. Final models specified random intercepts and random slopes for time with an unstructured covariance structure in mixed-effects regressions [40]. When normality assumptions were questionable, ranks of outcome values were alternatively modeled for tests of trends over time. For family members, paired t-tests or Wilcoxon signed rank tests were used to examine change from pre- to post-intervention. All analyses were performed in SAS v9.2 (SAS Institute, Cary, NC). A two-sided *p*-value < 0.05 was considered statistically significant.

Results

Thirty-six patients and 37 family members were enrolled in the study, providing 80% power to detect a small change in diet and exercise with an alpha of .05 (nQuery, Statistical Solutions, Saugus, MA). Of these, 32 patients (89%) remained in the study at post-intervention, and 31 (86%) at the 1 month follow-up. The average length of time between baseline and immediate post-intervention was 10.1 weeks (*SD*=2.1), while the average length of time between baseline and 1-month follow-up was 14.6 weeks (*SD*=1.7).

Patient characteristics at baseline the average age of patients was 50 years (*SD*=11); 75% were female. The average patient BMI was 35.1 ± 5.6 kg/m^2, with a range from 23.2 to 47.7. Most patients (83%) were classified as obese, and 13.9% were classified as overweight. Also, 80% had a waist circumference greater than 102 cm for males or 88 cm for females. Almost all patients (90%) had a systolic blood pressure of at least 130 mmHg, diastolic blood pressure of at least 85 mmHg, and a history of hypertension or taking medications for cardiovascular disease or hypertension. The average HbA1c of patients was 8.1% (65 mmol/mol) ± 2.2 (range from 5.3% [34 mmol/mol] to 13.0% [119 mmol/mol]), and 60% had HbA1c > 7.0% (53 mmol/mol). Thirty-nine percent had LDL > 100 mg/dL.

Almost three-fourths (72%) of the patients had less than 12 years of education and none had a college degree. Three reported Guatemala as their country of origin, two were born in El Salvador, two in Honduras, one in the U.S. and the rest in Mexico (78%). For those not born in the U.S., the average number of years living in the U.S. was 15.0 years ± 8.1, with a range from half a year to 41 years. Half of the patients were married; only two lived alone; 94% reported a household income less than $10,000, but 72% said they were able to pay monthly bills. Only 2.8% had health insurance. Eleven percent of patients with diabetes reported being current smokers, while 31% had ever smoked. Two patients reported having had a previous heart attack, and 58% said they had high blood pressure. Five patients (14%) reported ever being hospitalized because of high blood sugar. One-fourth reported ever having trouble with their kidneys, and 14% had sores that would not get better. More than half (58%) reported visiting a doctor more than two times in the past 12 months, but 58% reported not visiting an eye doctor in the past 12 months. Almost all patients (94%) reported taking medicines for their diabetes or blood sugar, with 8% taking insulin, 61% taking an oral hypoglycemic agent, and 11% taking both; 8% did not know. More than four-fifths (83%) also took medicines for high blood pressure or cardiovascular disease (36%), cholesterol or triglycerides (42%), or blood thinning (36%), or for other conditions (11%). Less than half of the patients had a parent with diabetes (44%); the average length of time having diabetes was 7.8 years ± 7.8 (range of 0.5 to 42 years). Half of the patients reporting walking more than three times each week, and 64% reporting doing household work. Less than half (47%) reported receiving printed diabetes materials in the past year, and only 36% had ever attended a diabetes class.

At baseline, average age of family members was 40.6 years (*SD*=13.1); 70% were female. Their average BMI was 32.7 ± 4.9 kg/m^2, with a range from 21.9 to 43.5. Seventy percent were classified as obese, and 22% as overweight. More than half (51%) had systolic blood pressure of at least 130 mmHg, diastolic blood pressure of at least 85 mmHg, and a history of hypertension or taking medications for cardiovascular disease or hypertension. Eighty-seven percent of the family members had a high school education or less. Most reported Mexico (78%) as country of origin, with very small numbers from Guatemala El Salvador, Honduras, U.S., and Columbia. For those not born in the U.S., the average number of years living in the U.S. was 16.5 years ± 8.2, with a range from 5 to 36 years. Sixty percent of family members were married; two lived alone. Most (89%) reported that their household income was less than $10,000, but 84% said they were able to pay monthly bills; 18.9% had health insurance. Almost half (49%) reported not visiting a doctor in the past 12 months, and 81% reported not visiting an eye doctor in the past 12 months. Almost half had a parent with diabetes (49%). Fifty-one percent reported walking more than three times a week, and 65% reported doing household work. Only one-fifth (19%) reported receiving printed diabetes materials in the past year, and only 5% had ever attended a diabetes class.

Results from growth curve analyses are given in Table 1 for patients with diabetes. There were significant improvements over time in systolic blood pressure ($p = 0.0124$), diabetes self-efficacy ($p < 0.0001$), SDSCA general diet scores from pre- to post-intervention ($p < 0.0001$), SDSCA specific diet scores ($p = 0.0016$), SDSCA blood sugar testing scores from pre-to 1-month follow-up ($p = 0.0265$), SDSCA foot care scores from pre-intervention to post-intervention ($p = 0.0002$), diabetes knowledge scores from pre- to post-intervention ($p < 0.0001$), BRFSS scores from pre- to post-intervention ($p = 0.0006$), SF-12 physical component scores ($p = 0.0006$) and SF-12 mental component scores ($p = 0.0134$).

Table 2 provides data on family members collected pre- and post-intervention. There were significant improvements found in BMI ($md = -0.3$ kg/m^2, $p = 0.0234$) and diabetes knowledge scores ($md = 5.9$, $p < 0.0001$); improvements were found in systolic blood pressure, kilocalories burned per week in physical activity measured by the IPAQ, and frequency of fruits and vegetables consumption measured by the BRFSS tool, but these were not significant.

Discussion

This pilot study examined the efficacy of an 8-week culturally tailored intervention focusing on diabetes self-management for Hispanic adults with diabetes and their family members.

Overall, the findings indicated that the intervention had positive effects on participants' 1) systolic blood pressure, 2) diabetes knowledge, 3) diabetes self-efficacy, 4) self-management of general diet, specific diet, blood sugar testing, and foot care, 5) fruit and vegetable consumption, and 6) both the physical and mental components of health-related quality of life. Also, significant changes were found among family members, including improvements in BMI and diabetes knowledge. Clinical improvements were found in participant with diabetes' HbA1c, waist circumference, LDL, and family support, and in family members' systolic blood pressure, kilocalories burned per week in physical activity and frequency of fruit and vegetable consumption, but these were not statistically significant.

Despite barriers to diabetes self-management [42], including low income [43] and low literacy [5, 44], lack of health insurance [3], limited social support [45], and poor access to health care [43] in this population, the intervention enhanced participants' knowledge and skills in diabetes management and led to improvements in family members as well. The study findings suggest that a culturally tailored educational program benefits Hispanics adults with diabetes and their family members.

The significant changes in diabetes self-management in general and in diet and fruit and vegetable consumption in particular suggest that including a family member in the intervention with a focus on the entire family may help with behavior change. Other studies have shown the effectiveness of family involvement in educational interventions for lifestyle changes and dietary changes [12]. We used goal setting for each family and identified barriers to diabetes self-management [46], and this may have helped participants with diabetes change their behaviors. In addition, pictorial materials for vegetables and fruits and a checklist recording vegetable and fruit intake each day during the 8-week intervention may have reinforced behavior change.

Our eight-week intervention lowered patients' HbA1c from pretest (M=8.1% [65 mmol/mol]) to post test (M=7.8% [63 mmoml/mol]) by 0.28% on average, and at 1 month follow-up (M=7.7% [61 mmol/mol]) by 0.41% on average. A reduction of every 1% in HbA1c is associated with a 35% decrease in risk of complications [47]. Thus, participants' drop of 0.41% in HbA1c would translate into a 24% reduction in diabetes-related complications, according to the United Kingdom Prospective Diabetes data [47].

Physical activity did not change significantly in either patients or family members in this study although family-focused physical activities were introduced. Previous intervention studies for Latinas with diabetes also did not find significant changes in physical activity [12]. However, one study of a 3 month intervention for Hispanics with diabetes showed positive changes in moderate and high intensity physical activity energy expenditure [48]. Interventions for engaging the family in physical activity may need to focus more specific action plans that emphasize time, place, and type of exercise and ways families can encourage each other.

On average, the participants showed poor knowledge of diabetes at baseline (M=4.02); however, after receiving the eight-week intervention tailored to those with low literacy, both patients with diabetes and family members showed significant increases in knowledge of diabetes. Participants significantly improved in knowledge of glucose management, lifestyle modifications, recognition and treatment of acute complications, recognition of symptoms of high or low blood glucose, and activities to prevent long-term consequences of the disease. The greatest improvement in diabetes knowledge was in identification of normal HbA1c and glucose level, followed by identification of symptoms of hyperglycemia. Many Hispanics in the U.S. have low literacy or illiteracy, making it difficult for them to understand diabetes self-management [21] or have minimal knowledge of normal blood glucose or the complications associated with diabetes [44].

Patients with diabetes significantly increased their confidence in the management of diet, exercise, knowledge about blood sugar and the illness, and control over diabetes. In addition to the effects of our intervention on self-efficacy, the family's willingness to provide support [46] may have enhanced participants' confidence in diabetes self-management. Our findings are consistent with a study by [13] which found that self-efficacy was strongly associated with diabetes self-management, healthy eating and physical activity and behavior-specific support from family, friends or community.

Our findings suggest that including family members in educational interventions may provide emotional and psychological support to patients in understanding diabetes, and help to develop family healthy behaviors [9, 46].

The intervention had a positive effect on health-related quality of life in patients with diabetes; improvements were seen in both the physical and mental components of health-related quality of life at post intervention and at 1-month follow-up. Previous studies have found that older Mexican Americans with diabetes had poor health-related quality of life [49]. Further, Latinos have had lower scores on the mental health component of health-related quality of life than other ethnic groups [50]. Few other studies have shown improvement in health-related quality of life in Hispanics with diabetes in such a short period of time. One longitudinal study found no improvements in physical and mental health at 12 months after a culturally tailored intervention for Latinas [10]. The improvements in both physical and mental health observed in our study suggest that the intervention may have improved perceptions of physical and mental health-related quality of life.

The study had limitations. The small, non-probability sample reduced the potential to detect significant changes at post intervention and 1-month follow-up and limited the generalizability of the results. The use of one group with no control group limited the reliability of the findings on the effects of the intervention.

Implications

Despite these limitations, the findings indicate that the intervention was effective for both patients with diabetes and family members. Integration of *familismo* in interventions with Hispanics with diabetics is clearly useful for improving diabetes outcomes. Guidelines for diabetes care and education emphasize self-management education and support, including a move toward patient centered and family care [4, 20] and management plans that represent a "collaborative therapeutic alliance among the patient and family" and providers [4] Family members should be allowed to participate in programs to avoid emotional isolation of the person with diabetes, maintain family cohesion, and assist with health behaviors that reduce risk and early onset of diabetes in family members. Community agencies, Accountable Care Organizations and patient medical homes may experience better patient, provider and system outcomes through family engagement. The goal of better health, fewer disparities and less costly health care requires the engagement of all stakeholders.

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Table 1

Growth curve modeling results for the patients with diabetes

Outcome	Pre-intervention Estimate, (95% CI)	Post-intervention[1] Estimate, (95% CI)	1-Month F/U[2] Estimate, (95% CI)	Slope, (95% CI), *P*-value
HbA1c (%)	8.1 (7.38, 8.89)	7.9 (7.15, 8.55)	7.7 (7.01, 8.44)	−0.028 (−0.059, 0.002) 0.0683
BMI (kg/m^2)	35.10 (33.21, 36.98)	34.88 (33.03, 36.74)	34.79 (32.93, 36.64)	−0.021 (−0.045, 0.003) 0.0808
Waist (cm)	106.26 (102.65, 109.65)	105.42 (101.96, 108.89)	105.05 (101.58, 108.52)	−0.083 (−0.167, 0.001) 0.0516
SBP (mmHg)	133.82 (126.38, 141.25)	126.98 (120.88, 133.07)	123.90 (117.03, 130.77)	−0.684 (−1.210, −0.158) 0.0124
DBP (mmHg)	82.46 (78.52, 86.40)	80.49 (77.49, 83.49)	79.60 (76.28, 82.93)	−0.197 (−0.471, 0.077) 0.1536
LDL (mg/dL)	92.90 (82.67, 103.13)	85.57 (75.98, 95.16)	82.27 (70.76, 93.78)	−0.733 (−1.553, 0.087) 0.0788
MET-min/week	6,494.46 (4,579.69, 8,409.22)	6,796.76 (4,788.15, 8,805.37)	6,932.80 (4,310.24, 9,555.35)	30.230 (−171.72, 232.18) 0.7618
Kcal/week	9,108.76 (6,411.07, 11,806)	9,615.33 (6,611.31, 12,619)	9,843.29 (5,954.07, 13,733)	50.658 (−234.50, 335.82) 0.7187
Diabetes Self-efficacy (α=.87)	6.55 (5.92, 7.18)	7.84 (7.43, 8.25)	8.42 (7.98, 8.86)	0.129 (0.084, 0.174) <0.0001
DFBC nonsupportive (α=.64)	19.27 (17.70, 20.84)	20.69 (19.58, 21.80)	21.33 (19.85, 22.800	0.142 (−0.010, 0.294) 0.0658
DFBC Supportive (α=.70)	25.64 (23.61, 27.67)	27.33 (26.01, 28.65)	28.09 (26.38, 29.80)	0.169 (−0.015, 0.354) 0.0711
SDSCA Diet (α=.50)	2.32 (1.84, 2.80)	4.93 (4.42, 5.44)	4.58 (4.04, 5.11)	≤10 weeks: 0.261 (0.186, 0.335) <0.0001 increment >10: −0.340 (−0.543, −0.137) 0.0019

Outcome	**Pre-intervention Estimate, (95% CI)**	**Post-intervention[1] Estimate, (95% CI)**	**1-Month F/U[2] Estimate, (95% CI)**	**Slope, (95% CI), *P*-value**
SDSCA General diet (α=.81)	1.98 (1.37, 2.60)	4.75 (4.03, 5.47)	4.51 (3.89, 5.14)	≤10 weeks: 0.277 (0.172, 0.381) <0.0001 increment >10: −0.329 (−0.604, −0.055) 0.0209
SDSCA Specific diet (α=.32)	3.59 (3.04, 4.14)	4.42 (3.97, 4.87)	4.79 (4.23, 5.35)	0.083 (0.034, 0.132) 0.0016
SDSCA Exercise (α=.66)	2.05 (1.26, 2.83)	2.10 (1.62, 2.57)	2.12 (1.63, 2.62)	0.005 (−0.048, 0.059) 0.8444
SDSCA Blood (α=.94)	1.29 (0.58, 1.99)	1.12 (0.32, 1.92)	2.32 (1.32, 3.31)	≤10 weeks: −0.017 (−0.097, 0.064) 0.6776 increment >10: 0.282 (0.035, 0.530) 0.0265
SDSCA foot	4.21 (3.19, 5.24)	6.63 (6.04, 7.22)	5.91 (5.11, 6.71)	≤10 weeks: 0.242 (0.125, 0.358) 0.0002 increment >10: −0.401 (−0.636, −0.165) 0.0016
SDSCA smoke	7.4% (2.0%, 24.1%)	3.3% (0.8%, 12.0%)	2.2% (0.3%, 13.2%)	−0.087 (−0.244, 0.071) 0.2763
SDSCA meds	6.14 (5.35, 6.92)	6.08 (5.41, 6.74)	6.05 (5.22, 6.87)	−0.006 (−0.075, 0.063) 0.8590
SKILLD Score (*KR-20*=.65)	4.07 (3.32, 4.82)	9.08 (8.32, 9.85)	8.62 (8.08, 9.17)	≤10 weeks: 0.501 (0.389, 0.614) <0.0001 increment >10: −0.604 (−0.900, −0.307) 0.0003

Outcome	Pre-intervention Estimate, (95% CI)	Post-intervention[1] Estimate, (95% CI)	1-Month F/U[2] Estimate, (95% CI)	Slope, (95% CI), *P*-value
BRFSS item #1	3.38 (2.81, 3.95)	3.59 (3.18, 4.00)	3.68 (3.19, 4.17)	0.021 (−0.026, 0.067) 0.3734
BRFSS score (mean of reversed items 2–6) (α=.60)	3.46 (3.18, 3.73)	4.06 (3.87, 4.25)	3.70 (3.44, 3.96)	≤10 weeks: 0.060 (0.028, 0.092) 0.0006 increment >10: −0.140 (−0.227, −0.054) 0.0021
PCS-12 (α=.70)	61.53 (53.62, 69.45)	69.42 (63.30, 75.54)	72.96 (66.78, 79.15)	0.788 (0.364, 1.213) 0.0006
MCS-12 (α=.74)	58.40 (52.41, 64.38)	63.98 (59.51, 68.46)	66.50 (61.45, 71.55)	0.559 (0.123, 0.994) 0.0134

[1]Mean time from pre- of all patients post-intervention was approximately 10 weeks

[2]Mean time from pre- of all patients at 1-month follow-up was approximately 14.5 weeks

Table 2

Change in outcomes at pre- vs. post- intervention for family members

Outcome	Mean difference	95% CI for Mean difference	*P*-value
BMI (kg/m^2)	−0.25	(−0.47, −0.04)	0.0234
Waist circum. (cm)	−2.61	(−7.65, 2.43)	0.1830
SBP (mmHg)	−3.94	(−8.38, 0.51)	0.0804
DBP (mmHg)	−1.87	(−4.77, 1.02)	0.1415
Met-minutes/week	3,430.4	(−882.3, 7,743.2)	0.1147
Kilocalories/week	5,219.7	(−784.8, 11,224.1)	0.0860
SKILLD (*KR-20*=.65)	5.89	(4.90, 6.89)	<0.0001
BRFSS fruits & veggies (α=.72)	0.30	(−0.01, 0.61)	0.0558

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