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Improving behavioral and clinical indicators in Asians and Pacific Islanders with diabetes: Findings from a community clinic-based program

Michiyo Tomioka[a,*], **Kathryn L. Braun**[a], **Valerie Ah Cook**[b], **Merlita Compton**[c], and **Kristin Wertin**[b]

[a]Office of Public Health Studies, University of Hawaiʻi at Mānoa, 1960 East-West Road, Biomed, Honolulu, HI 96822, United States

[b]Hawaiʻi State Department of Health, Diabetes Prevention and Control Program, 601 Kamokila Boulevard, Room 344, Kapolei, HI 96707, United States

[c]Kokua Kalihi Valley Comprehensive Family Services, Elder Care Services Program, 1846 Gulick Avenue, Honolulu, HI 96819, United States

Abstract

Aims—This project tested the six-month impact of Stanford's Diabetes Self-Management Program (DSMP), adapted for Asians and Pacific Islanders (APIs), on behavioral and clinical indicators.

Methods—Participants attended DSMP workshops at a community health center. Employing a one-group, pre–post-test design, data were collected at baseline and six-months. Ninety-six eligible API adults were enrolled. All attended four or more of the six weekly sessions, and 82 completed data collection. Measures included body mass index, blood pressure, blood lipids, blood glucose, HbA1c, as well as health behaviors. Data were analyzed by descriptive statistics and paired *t*-tests.

Results—Adaptations to DSMP were minimal, but critical to the local acceptance of the program. At six-months, significant behavioral improvements included: (1) increased minutes in stretching and aerobic exercise per week ($p < 0.001$); (2) reduced symptoms of hypoglycemia and hyperglycemia ($p < 0.001$); (3) increased self-efficacy ($p < 0.001$); and (4) increased number of days and times testing blood sugar levels ($p < 0.001$). Significant clinical improvements included: (1) lower BMI ($p < 0.001$); (2) lower HbA1c ($p < 0.001$); (3) lower total cholesterol, triglycerides, and LDL ($p < 0.001$); and (4) lower blood pressure ($p < 0.001$).

Conclusions—Findings suggest that the DSMP can be successfully adapted to API populations and can improve clinical measures as well as health behaviors.

[*]*Corresponding author*. Tel.: +1 808 956 5768; fax: +1 808 956 9582. mtomioka@hawaii.edu (M. Tomioka).

Conflict of interest statement
None declared.

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Keywords

Asian Americans; Type 2 diabetes; Self-management; Community Health Services; Minority groups

1. Introduction

The prevalence of diabetes is projected to increase in the US [1], and is considered to be "one of the main threats to human health in the 21st century" [2]. People with diabetes experience more disability and lower health-related quality of life, and are more susceptible to other illnesses and depression than those without diabetes [3]. In addition, treating people with diabetes is expensive, costing the US an estimated $245 billion in 2012 [4].

Ethnic minority groups are disproportionately affected by diabetes [3]. In Hawai'i, the prevalence of diabetes is higher among Asians and Pacific Islanders (APIs), including Filipinos (10%), Japanese (6%), and Native Hawaiians (13%) compared to Caucasian (5%) [5,6]. Filipinos and Native Hawaiians in particular tend to be diagnosed with diabetes at earlier ages than Caucasian [5]. Compared to Caucasian, APIs also experience greater mortality from diabetes, both as an underlying and non-underlying cause of death [5].

Health promotion research has shown that Type 2 diabetes mellitus can be controlled through self-management education [7–10]. Yet, only 36% of Filipinos, 42% of Japanese, and 56% of Native Hawaiians with diabetes in Hawai'i have taken a course or class on how to manage diabetes, compared to 61% of Whites [11].

One of the promising diabetes self-management programs is an evidence-based, peer-led, diabetes self-management program called Stanford's Diabetes Self-Management Program (DSMP). DSMP is a derivative of Stanford's Chronic Disease Self-Management Program (CDSMP), which has been demonstrated to improve health behaviors among APIs in Hawai'i [12]. A few studies have demonstrated the effectiveness of DSMP for minority groups such as Hispanics [9] and American Indians and Alaska Natives [10], but research on its effectiveness with APIs is lacking. In addition, research on the ability of DSMP to lower HbA1c has shown mixed results [8–10].

In Hawai'i, a statewide healthy aging and public health initiative, the Hawai'i Healthy Aging Partnership (HHAP), was established in 2003 to adopt evidence-based health promotion programs, including CDSMP and DSMP, to improve the health of older adults [12]. Heretofore, evaluation of CDSMP and DSMP by HHAP was limited to self-reported behavioral measures. This study was undertaken in response to demand from medical and public health entities and insurance payers to evaluate clinical, as well as behavioral, outcomes.

2. Materials and methods

2.1. Planning

Partners in this endeavor included the Kokua Kalihi Valley Comprehensive Services Elder Care (KKV), the Hawai‘i State Department of Health’s Diabetes Prevention and Control Program (DOH), and the University of Hawai‘i Office of Public Health Studies (UH). Through the existing partnership of HHAP, KKV, a Federally Qualified Health Center, was selected as the test site for this one-year pilot because it served low-income and elderly API adults, had active and trained DSMP facilitators, and had available staff to measure clinical outcomes. UH was selected as the evaluation entity due to its in-depth experience with evidence-based program evaluation through HHAP. The DOH secured funding to support staff time to plan and evaluate the pilot and provided oversight of the project.

The evaluation pilot team met several times before implementation to strategize best ways to offer DSMP to this population and to obtain clinical measures. Adaptations to DSMP were minimal, such as adding: (1) a pre-workshop orientation by program leaders and a KKV physician; (2) time during and after each week’s session to reinforce key messages in participants’ native languages; (3) a graduation ceremony to which family members were invited, and (4) a six-month reunion to collect follow-up data [12].

In planning the pilot, the team decided to utilize the finger-prick, blood-sampling technique. KKV secured equipment to measure cholesterol using the Cholestech LDX and HbA1c using the DCA Vantage, both of which have been found to have good agreement with independent laboratory testing [13,14]. KKV clinical staff members also attended clinical laboratory training and were certified through the Clinical Laboratory Improvement Act to use this equipment. The team decided to offer eight cycles of six-week workshops, hoping to recruit 100 participants with Type 2 diabetes mellitus over the course of the year. The UH team finalized the study design and forms and secured approval from the UH Institutional Review Board.

2.2. Study sample

This evaluation pilot project was conducted at KKV in Honolulu between January 2012 and January 2013. Participants were recruited by KKV staff from community events, such as health fairs, and through recruitment flyers posted at KKV that included pictures of familiar KKV staff. Former DSMP graduates assisted with word-of-mouth recruitment of their friends and families. People who were interested in this project attended a pre-workshop orientation to learn about diabetes, the importance of self-management, and the study objectives. After the orientation, participants were asked to sign-up for the project.

2.3. Intervention

DSMP was developed by Stanford University’s Patient Education Research Center and originally tested in a Hispanic population [9]. It is a workshop of six weekly, 2½ hour sessions, led by two trained facilitators, which covers a variety of topics related to diabetes self-management. It aims to empower participants to take control of their Type 2 diabetes mellitus by providing information and skill-building tools and by using motivational interviewing and action planning to facilitate behavior change and increase self-efficacy.

2.4. Evaluation measures and analysis

DSMP was tested using a one-group, pre–post-test design. A controlled trial design was not feasible given time and funding constraints.

2.4.1. Fidelity—A UH evaluator monitored fidelity of DSMP workshop delivery using a 10-item checklist scored on a 4-point Likert scale (1 = poor to 4 = excellent) developed by the Stanford Patient Education Research Center [15]. Feedback was provided after monitoring so that facilitators could improve their skills and confidence in leading the DSMP workshops.

2.4.2. Demographics—Demographic data (age, gender, marital status, education, chronic conditions, and health insurance) were collected at baseline for all enrollees.

2.4.3. Attendance—DSMP facilitators tracked attendance and recorded the reasons for absence.

2.4.4. Health behaviors—Health behavior data were collected at baseline and six-months through the self-administered Diabetes Health Outcome Survey, previously validated by the Stanford Patient Education Research Center [15]. This questionnaire assesses health status, health behaviors, diabetes-related self-efficacy, communication with physicians, and health care utilization. Health status items include self-rated health (0 = poor to 5 = excellent), health distress (0 = none of the time to 5 = all of the time), levels of fatigue, shortness of breath, and pain (0 = none to 10 = severe), and symptoms of hyperglycemia and hypoglycemia (0–7, a higher score indicating more symptoms). Health behavior items include minutes spent in exercise, frequency of using recommended coping styles to manage chronic conditions (0 = never to 5 = always), social/role activity limitations, weekly frequency of glucose monitoring, and self-rated ability to bathe, dress, bend, get in/out of bed, lift a cup to the mouth, turn faucets on/off, walk on flat ground, and get in/out of a car (0 = without any difficulties to 4 = unable to do). Eight items measured diabetes-related self-efficacy (0 = not at all confident to 10 = totally confident). Communication with physicians items examined frequency of proactive strategies, such as listing questions, asking questions, and discussing personal problems (0 = never to 5 = always). Health care utilization items assessed the number of physician and emergency room (ER) visitations and hospitalizations within the past six months. The pre- and post-findings are analyzed by paired *t*-test analysis.

2.4.5. Clinical measures—Clinical measures were obtained two weeks before the beginning of each DSMP workshop and within two weeks of the six-month follow-up date. Trained KKV staff drew blood through a finger prick to assess fasting glucose, HbA1c, and lipids (total cholesterol, triglycerides, HDL and LDL). Blood pressure (systolic and diastolic) was measured using a blood pressure cuff by trained KKV staff. Height and weight were measured, and BMI calculated by the project staff. The pre- and post-data were analyzed by paired *t*-test analysis.

3. Results

3.1. Enrollment and demographics

Between January 2012 and July 2012, eight DSMP workshops (class sizes ranged from 9 to 20) were offered in English by four trained, bilingual facilitators from KKV. In all, 101 API adults were enrolled, although five were excluded from the analysis (one had Type 1 diabetes mellitus, and another four had pre-diabetes). As shown in Table 1, the mean age of 96 participants with Type 2 diabetes mellitus was 73 years old. The majority were Filipino (92%) and female (87%). Participants also had other chronic diseases, such as hypertension (74%) and arthritis (52%). More than half of them reported to have less than a high school education (56%) and English-language limitations (67%).

3.2. Program fidelity and attendance

The average fidelity score for the eight DSMP workshops was 3.83 (out of 4), suggesting that facilitators led their classes with a high degree of fidelity. All participants (n = 96) attended four or more of the six sessions (per DSMP developers, four session is the minimum number to attend to be considered a “program completer”) and, on average, participants attended 5.6 sessions. The high attendance was facilitated by concurrently running two DSMP workshops, but on different days of the week, so participants had two opportunities in a week to attend the week’s session. Reasons for missing class included illness (32%), doctors’ appointments (29%), conflicting work schedule (16%), babysitting/caregiving (13%), and other (10%).

Of the 96 completing the program, 82 (85%) completed the self-administered Diabetes Health Outcome Survey and clinical measures at six months. Of the 14 participants that did not participate in follow-up data collection, nine had relocated prior to follow-up, two were on long trips, one refused, one could not be located, and one was excluded from follow-up data collection because the delay between the collection of the participant’s baseline data and the workshop start date was greater than two weeks.

3.3. Health behaviors

As shown in Table 2, the 82 DSMP participants showed significant improvements in self-rated health, coping with symptoms, and diabetes self-efficacy. Additionally, participants reported significant increases in number of minutes per week spent in physical activity (stretching/strengthening and aerobic exercises), and number of days per week monitoring glucose. Findings also showed significant reduction in health distress, fatigue, shortness of breath, pain, hyperglycemia, hypoglycemia, social/role activity limitations, and self-rated physical abilities. In terms of health care utilization, participants showed significant reductions in self-reported physician visits and ER visits. However, we did not find significant improvements in communication with physicians, the number of times hospitalized, or hospital days.

3.4. Clinical measures

Findings showed significant reductions in BMI, HbA1c, total cholesterol, triglycerides, LDL, fasting blood glucose, and blood pressure (systolic and diastolic). However, we also found a significant reduction in HDL ($p < 0.001$) when we hoped to show no change or an increase.

4. Discussion

Our evaluation project demonstrated that DSMP works well with API groups. Findings suggest that DSMP can be successfully adapted to an API population and can improve clinical measures as well as health behaviors.

Adaptations to DSMP were minimal but critical to the local acceptance of the program. For example, the orientation session helped educate participants about self-management and its importance. The graduation ceremony was appreciated, with participants proud to have a certificate referencing the Stanford program. Six-month reunions proved to be an efficient strategy for collecting follow-up data, yielding an 85% completion rate and providing opportunities for the participants to share their successes in managing their diabetes. Fidelity monitoring and pre–post findings suggested that these DSMP modifications did not jeopardize program effectiveness, and likely increased its attractiveness to participants and their engagement in the workshop. Using the existing partnership for this pilot project was also beneficial, as the DSMP facilitators were well informed about the importance of maintaining fidelity due to their long-term affiliation with HHAP.

Our API participants showed six-month improvements similar to the Hispanic participants in Stanford's initial controlled trial of DSMP, including improvements in HbA1c, health distress, and symptoms of hypo- and hyperglycemia [9]. An online version of the same program with American Indians and Alaska Natives also found a significant reduction in HbA1c for intervention patients compared with controls [10].

Although HHAP has been evaluating CDSMP and DSMP offerings in Hawai‘i since 2007, data collection has been limited to self-reported behavioral measures [12]. This study was our first attempt to also collect clinical measures. This required the purchase of new equipment for the health center and extra training for staff in the collection and recording of clinical data. Because KKV is a Federally Qualified Health Center, nurses and other professional staff were available to assist in the project.

Offering DSMP at a community health center may have also influenced attendance and success rates. Almost 70% of participants were clients of KKV and participated in its elderly services programs, which regularly offers social and physical activities. It was observed by KKV staff that many DSMP participants joined other KKV activities, and healthy lifestyle behaviors were reinforced by this environment. Staff also reported that some DSMP participants appeared to be competing with each other to lose weight and increase exercise. Other investigators have suggested that ongoing, personal, direct support can have a positive impact on diabetes self-management behaviors and clinical outcomes [16,17], and studies have reported this relationship in African Americans [18], Native Americans [19], and Native Hawaiian and Pacific Islanders [20].

One of the limitations for this study was that participants' chronic conditions and health behaviors were collected through self-report, which may have been compromised by misunderstanding of diagnoses and inability to recall past health care utilization experiences. Also, we did not have a control group and used a convenience sampling technique for this study due to time and funding constraints. This lack of a control group reduces the internal validity of the study, and findings cannot rule out the possibility that people without the intervention may demonstrate similar improvements in clinical outcomes. Also, there is a chance that participants of this study were more motivated to improve their diabetes than people who did not participate in the intervention. Unfortunately, we were unable to compare the characteristics of our sample with characteristics of other older KKV clients due to clinic administrative and data systems restrictions. Finally, the majority of participants were Filipino, likely due to the predominant use of the word-of-mouth recruitment method. The API label encompasses more than 50 distinct cultural groups that differ from each other in significant ways [21]. Thus, future studies should use randomized sampling techniques and should explore the impact of DSMP on other API groups with diabetes, especially Native Hawaiians and Japanese who have a high prevalence of diabetes in Hawaiʻi.

In summary, diabetes is a growing public health concern, especially among APIs [1–3,5,6]. Our study suggests that the DSMP with APIs in a community setting can improve health behavior and clinical measures.

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REFERENCES

1. Boyle JP, Thompson TJ, Gregg EW, Barker LE, Williamson DF. Projection of the year 2050 burden of diabetes in the US adult population: dynamic modeling of incidence, mortality, and prediabetes prevalence. Popul Health Metr. 2010; 8:29. [PubMed: 20969750]
2. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. Nature. 2001; 414(6865):782–787. [PubMed: 11742409]
3. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011.
4. American Diabetes Association. Economic costs of diabetes in the U.S. in 2012. Diabetes Care. 2013; 36:1033–1046. [PubMed: 23468086]
5. Pobutsky, A.; Balabis, J.; Nguyen, D-H.; Tottori, C. Hawaii diabetes report. Honolulu, HI: Hawaii State Department of Health, Chronic Disease Management and Control Branch, Diabetes Prevention and Control Program; 2010.

6. Fujimoto, WY. Diabetes in Asian and Pacific Islander Americans. In: Harris, MI.; Cowie, CC.; Stern, MP.; Boyko, EJ.; Reiber, GE.; Bennett, PH., editors. Diabetes in America. second. Washington, DC: U.S. Department of Health and Human Services, National Institutes of Health; 1995. [DHHS Publ. No. NIH 95-1468].
7. Fitzpatrick SL, Schumann KP, Hill-Briggs F. Problem solving interventions for diabetes self-management and control: a systematic review of the literature. Diabetes Res Clin Pract. 2013; 100(2):145–161. [PubMed: 23312614]
8. Lorig K, Ritter PL, Villa FJ, Armas J. Community-based peer-led diabetes self-management: a randomized trial. Diabetes Educ. 2009; 35(4):641–651. [PubMed: 19407333]
9. Lorig K, Ritter PL, Villa F, Piette JD. Spanish diabetes self-management with and without automated telephone reinforcement: two randomized trials. Diabetes Care. 2008; 31:408–414. [PubMed: 18096810]
10. Lorig K, Ritter PL, Laurent DD, Plant K, Green M, Jernigan VB, et al. Online diabetes self-management program: a randomized study. Diabetes Care. 2010; 33(6):1275–1281. [PubMed: 20299481]
11. Hawaii Department of Health. Honolulu, HI: Hawaii Department of Health; 2010. Hawaii behavioral risk factor surveillance. http://hawaii.gov/health/statistics/brfss/brfss2010/brfss10.html [accessed 20.03.13]
12. Tomioka M, Braun KL, Compton M, Tanoue L. Adapting Stanford's Chronic Disease Self-Management Program to Hawaii's multicultural population. Gerontologist. 2012; 52(1):121–132. [PubMed: 21719630]
13. Lenters-Westra E, Slingerland RJ. Six of eight hemoglobin A1C point-of-care instruments do not meet the general accepted analytical performance criteria. Clin Chem. 2010; 56(1):44–52. [PubMed: 19926777]
14. Parikh P, Mochari H, Mosca L. Clinical utility of a fingerstick technology to identify individuals with abnormal blood lipids and high-sensitivity C-reactive protein levels. Am J Health Promot. 2009; 23(4):279–282. [PubMed: 19288850]
15. Evaluation tools. Palo Alto, CA: Stanford Patient Education Research Center; 2008. http://patienteducation.stanford.edu/research/ [accessed 30.09.08]
16. Gao J, Wang J, Zhu Y, Yu J. Validation of an information-motivation-behavioral skills model of self-care among Chinese adults with Type 2 diabetes mellitus. BMC Public Health. 2013; 13:100. [PubMed: 23379324]
17. van Dam HA, van der Horst FG, Knoops L, Ryckman RM, Crebolder HF, van den Borne BH. Social support in diabetes: a systematic review of controlled intervention studies. Patient Educ Couns. 2005; 59(1):1–12. [PubMed: 16198213]
18. Keyserling TC, Samuel-Hodge CD, Ammerman AS, Ainsworth BE, Henríquez-Roldán CF, Elasy TA, et al. A randomized trial of an intervention to improve self-care behaviors of African–American women with Type 2 diabetes mellitus: impact on physical activity. Diabetes Care. 2002; 25(9):1576–1583. [PubMed: 12196430]
19. Gilliland SS, Azen SP, Perez GE, Carter JS. Strong in body and spirit: lifestyle intervention for Native American adults with diabetes in New Mexico. Diabetes Care. 2002; 25(1):78–83. [PubMed: 11772905]
20. Sinclair KA, Makahi EK, Shea-Solatorio C, Yoshimura SR, Townsend CK, Kaholokula JK. Outcomes from a diabetes self-management intervention for Native Hawaiians and Pacific People: partners in care. Ann Behav Med. 2013; 45(1):24–32. [PubMed: 23086589]
21. Park CB, Braun KL, Horiuchi BY, Tottori C, Onaka AT. Longevity disparities in multiethnic Hawaii: an analysis of 2000 life tables. Public Health Rep. 2009; 124(4):579. [PubMed: 19618795]

Table 1

Participants demographic characteristics (n = 96).[a]

	Characteristics	*N* (%)
Age, years	Mean	73.22
	Range	36–90
	<60	6 (6.3)
	60–74	43 (44.8)
	75+	47 (49.0)
Gender	Male	13 (13.5)
	Female	83 (86.5)
Ethnicity	Filipino	88 (91.7)
	Japanese	3 (3.1)
	Chinese	2 (2.1)
	Micronesian	2 (2.1)
	Native Hawaiian	1 (1.0)
Education	Less than high school graduate	54 (56.3)
	High school graduate	13 (13.5)
	Some college/vocational school	10 (10.4)
	Greater than college graduate	19 (19.8)
Marital status	Married	42 (43.8)
	Divorced	3 (3.1)
	Widowed	48 (50.0)
	Other	3 (3.1)
Household size	Mean	3.34
	Range	1–14
	Alone	19 (19.8)
	Two	28 (29.2)
	Greater than two people	49 (51.0)
Have English limitation		64 (66.7)
Chronic conditions	Type 2 diabetes mellitus	96 (100.0)
	High cholesterol	61 (63.5)
	Heart disease	7 (7.3)
	Hypertension	71 (74.0)
	Stroke	9 (9.4)
	Arthritis	50 (52.1)
	Osteoporosis	10 (10.4)
	Cancer	6 (6.3)
Health insurance	None	11 (11.5)
	Medicare	40 (41.7)
	Medicaid	31 (32.3)
	Private insurance	12 (12.5)
	Other	20 (20.8)

[a] Participants without Type 2 diabetes mellitus were excluded from this analysis.

Table 2

Summary of participants' health outcome and clinical measure results (total: n = 82).

Item	Mean (standard deviation)			t	df	P value
	Baseline	6-month	Change			
Self-rated health (1–5, a higher score indicates poor health)	3.12 (0.79)	1.87 (0.58)	1.26 (0.87)	13.04	81	0.001
Health distress (0–5, a higher score indicates more distress)	2.30 (1.39)	1.08 (0.73)	1.22 (1.14)	9.71	81	0.001
Level of symptoms (0–10, higher score indicates more severe symptoms)						
Fatigue	5.17 (2.14)	2.33 (1.11)	2.84 (1.62)	15.87	81	0.001
Shortness of breath	3.98 (2.49)	1.49 (1.64)	2.49 (2.32)	9.73	81	0.001
Pain	4.72 (1.87)	1.93 (1.24)	2.79 (1.73)	14.65	81	0.001
Diabetes related symptoms (0–7, a higher score indicates more symptoms)						
Hyperglycemia	3.05 (1.34)	2.17 (1.00)	0.88 (1.49)	4.78	65	0.001
Hypoglycemia	1.82 (1.54)	0.69 (0.63)	1.13 (1.65)	4.62	44	0.001
Exercise behaviors (minutes per week)						
Stretching/strengthening	46.83 (49.97)	71.16 (50.93)	−24.33 (62.39)	−3.53	81	0.001
Aerobic exercise	105.18 (65.85)	149.09 (89.17)	−43.90 (102.79)	−3.87	81	0.001
Coping with symptoms (0–5, a higher score indicates greater use of skills)	1.38 (0.89)	2.46 (0.79)	−1.08 (1.20)	−8.18	81	0.001
Social/Role activities limitations (0–4, a higher score indicates greater limitations)	1.74 (1.39)	0.84 (0.70)	0.91 (1.13)	7.25	81	0.001
Glucose monitoring (days per week)	0.82 (1.84)	2.61 (2.28)	−1.79 (2.62)	−6.20	81	0.001
Self-rated physical abilities (0–4, a higher score indicates greater difficulties)	0.58 (0.52)	0.20 (0.25)	0.38 (0.42)	8.16	81	0.001
Diabetes self-efficacy (1–10, a higher sore indicates higher self-efficacy)	6.89 (0.90)	9.46 (0.40)	−2.57 (0.87)	−26.84	81	0.001
Communication with physicians (0–5, a higher score indicates better communication with physicians)	1.17 (0.97)	1.21 (0.66)	−0.04 (0.87)	−0.38	81	0.703
Health care utilization in the past 6 months						
Physician visit	2.38 (1.18)	0.98 (0.61)	1.40 (1.23)	10.36	81	0.001
ER visit	0.23 (0.50)	0.01 (0.11)	0.22 (0.52)	3.81	81	0.001
Hospitalization	0.05 (0.27)	0.01 (0.11)	0.04 (0.29)	1.14	81	0.259
Hospital days	0.05 (0.31)	0.04 (0.33)	0.01 (0.46)	0.24	81	0.810
Clinical measures						
BMI	25.20 (3.41)	24.43 (3.06)	0.76 (1.39)	4.95	80	0.001
HbA1c						
%	6.9 (0.70)	6.3 (0.51)	0.6 (0.59)	9.35	80	0.001

Item	Mean (standard deviation)			t	df	P value
	Baseline	6-month	Change			
mmol/mol	52 (8)	45 (6)	7 (6)			
Total cholesterol	195.72 (34.88)	171.41 (35.31)	24.31 (38.42)	5.69	80	0.001
Triglycerides	139.06 (46.96)	125.31 (40.18)	13.75 (49.68)	2.49	80	0.015
HDL	58.84 (14.37)	52.23 (13.89)	6.60 (13.98)	4.25	80	0.001
LDL	105.21 (27.21)	92.14 (28.46)	13.07 (31.20)	3.77	80	0.001
Fasting blood glucose level	138.80 (30.11)	116.98 (27.56)	21.83 (21.43)	9.17	80	0.001
Systolic blood pressure	134.32 (13.77)	124.43 (11.09)	9.89 (13.12)	6.78	80	0.001
Diastolic blood pressure	76.89 (8.58)	72.42 (7.43)	4.47 (10.39)	3.87	80	0.001

Abbreviation: df, degrees of freedom; BMI, body mass index; HbA1c, hemoglobin A1c, HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol.