Published in final edited form as:

J Nutr Educ Behav. 2016 September ; 48(8): 538–543.e1. doi:10.1016/j.jneb.2016.06.007.

Evaluation of US Veterans Nutrition Education for Diabetes Prevention

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Abstract

Objective—Evaluate the effectiveness of nutrition education interventions for diabetes prevention.

Design—Retrospective cohort design.

Setting—Tertiary-care US Veterans' Hospital, July 2007 to July 2012, using pre-existing database.

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Conflict of Interest Disclosure: The authors' conflict of interest disclosures can be found online with this article on www.jneb.org.

CONFLICT OF INTEREST

Katie Braun and Donna White are currently employed with the MEDVAMC. The other authors have not stated any conflicts of interest.

Participants—Prediabetic, adult veterans (n = 372), mostly men (94.4%, n = 351).

Interventions—Visits with existing nutrition education classes were collected.

Main Outcome Measures—Primary outcome: diabetes status; predictors: visits/encounters, age, body mass index, weight change, and hemoglobin A1c.

Analysis—Cox proportional hazards method, χ^2 test, and logistic regression.

Results—In this sample, prediabetic veterans who received nutrition education were less likely to develop diabetes when compared with prediabetic veterans who did not receive nutrition education (hazard ratio, 0.71; 95% confidence interval, 0.55–0.92; $P < .01$). This difference remained significant after adjusting for body mass index and weight change.

Conclusions and Implications—Nutrition education was significantly associated with preventing the progression from prediabetes to diabetes in US Veterans participating in a nutrition education intervention at the Michael E. DeBakey Veterans Affairs Medical Center.

Keywords

diabetes; prediabetes; nutrition education; veterans

INTRODUCTION

Diabetes mellitus continues to develop around the world, and its treatment is a growing challenge. Type 2 diabetes is a multi-factorial, complex disease affecting nearly 25.8 million people in the United States, or 8.3% of the population (diagnosed or undiagnosed), and spans all age and ethnic groups.¹ In 2010, approximately 1.9 million people 20 years or older were newly diagnosed with diabetes.¹ Globally, the prevalence of diabetes is estimated to increase from 382 million to 592 million by 2035.²

The prevalence of diabetes among veterans is significantly greater than in the general population. One in 5 veterans receiving care from the Veterans Health Administration (VHA) has diabetes, and it is even higher (1 in 4) for veterans belonging to a racial or ethnic minority.³

The VHA is the nation's largest integrated healthcare system, operating with 152 medical centers, 819 community-based outpatient clinics,⁴ and 9.11 million veterans enrolled. In 2013, there were 86.4 million outpatient clinic visits.⁵ This span and influence provides a unique opportunity to address major health concerns, and the VHA has responded by developing and implementing programs. A substantial amount of evidence suggests that lifestyle changes can play a pivotal role in diabetes prevention and management. Hence, nutrition education and self-management training programs targeting diet and exercise modifications are ever evolving in an effort to curb the incidence and blunt the long-term effects of diabetes. The major contributions to the development of type 2 diabetes are dietary intake, physical inactivity, and obesity.¹ Prediabetic individuals are at risk of developing type 2 diabetes, and early interventions, such as weight loss and exercise, may reduce their risk by 58% in a research setting.⁶ However, whether these effects are seen in real practice is a matter of debate.

This study was a retrospective chart review conducted at the Michael E. De-Bakey Veterans Affairs Medical Center (MEDVAMC) and its outpatient clinics, serving approximately 140,000 veterans. Prediabetic patients at the MEDVAMC are typically referred for medical care to an appointment with a Registered Dietitian Nutritionist or 1-hour-long diabetes education classes taught by Certified Diabetes Educators and Registered Dietitian Nutritionists at the discretion of their primary care physician. These classes are based on the American Diabetes Association “Nutrition Therapy Recommendations for the Management of Adults with Diabetes” and include instruction on nutrient-dense eating patterns in appropriate portions to promote a healthy weight and cardiometabolic profile.⁷ Nutrition education is provided to build or reinforce nutrition-related knowledge for diabetes prevention and self-management.

The primary objective for this study was to establish the association between attending a nutrition education intervention at the MEDVAMC and progression to diabetes. The hypothesis was that nutrition education prevented or delayed the progression from prediabetes to diabetes.

METHODS

Design and Procedure

This study involved a retrospective chart review. The primary outcome for the study was diabetes status; that is, whether or not prediabetic subjects developed diabetes. The researchers also sought to establish if there was a difference in the rate of progression from prediabetes to diabetes in veterans who attended the existing outpatient nutrition education program compared with veterans who did not attend. The predictors included visits/encounters and the covariates of age, body mass index (BMI), hemoglobin A1c (HbA1c). The database included patients who had prediabetes and were referred to an outpatient nutrition clinic or class between July 2007 and July 2010. Follow-up observation continued until July 2012. The Institutional Review Board at the MEDVAMC, Baylor College of Medicine, and Texas Woman's University approved the protocol.

The same nutrition programs and classes were offered to patients in both of the medical center and outpatient clinics. Nutrition clinics addressed nutrition education in group or individual sessions, typically lasting 1 hour. The frequency of the encounters was a shared decision-making process between the veteran and the Registered Dietitian Nutritionist or medical provider.

Classrooms and individual counseling offices were located in the MEDVAMC or in an outpatient clinic. Classes discussed the pathophysiology and medical nutrition therapy (MNT) of diabetes, including carbohydrate counting, label reading, portion control to lose weight/maintain healthy weight, meal planning, low sodium, and healthy fats. A pre-test and a post-test were given to participants to assess learning. After attending 1 group diabetes class, participants autonomously elected to participate in continued nutrition education or counseling. Individual education was tailored to the veteran's specific needs and knowledge base but included topics similar to those in the group classes. Individual sessions with a Registered Dietitian Nutritionist qualified as MNT because these visits followed the

nutrition care process⁸ and included a detailed nutrition assessment, diagnosis, and evidence-based interventions to address the nutrition-related problem. The group sessions did not qualify as MNT because the group education provided did not encompass all components of the nutrition care process.

For this study, veterans were categorized into 1 of 2 groups: (1) veterans who received education with 1 or more encounters in a nutrition clinic (attenders) or (2) veterans who were referred to the clinics but did not attend (non-attenders), having a documented cancellation or no-show. The subjects were then analyzed for change in primary diagnosis to diabetes. The observation period was from inclusion to July 31, 2012, with a mean observation period of 3 ± 2 years. Participants with a new diagnosis of diabetes, glucose greater than 200 mg/dL, or HbA1c greater than 6.5% in the observation period were considered to have developed diabetes. The time of developing diabetes was determined by subtracting 2 time points in days (time from their first encounter or referral until the time of diagnosis or July 31, 2012).

Database

An existing database with 5 years (July 2007–2012) of de-identified patient data from the MEDVAMC was used for the study. Inclusion criteria identified prediabetic veterans who were referred to diabetes nutrition education. Criteria identified glucose levels between 100 and 125 mg/dL or HbA1c between 5.7% and 6.4% at baseline. This study's outcome was development of diabetes in the patients in this retrospective cohort; therefore, diabetic veterans at baseline were excluded. Other exclusion criteria included patients who were prescribed glucocorticoids, diabetic medications such as insulin, oral hypoglycemic agents, and other hypoglycemic agents, phenytoin, and/or epinephrine at baseline. Patients with baseline diagnoses of diabetes, pancreatic cancer, cystic fibrosis, or hemochromatosis, those who had undergone pancreatectomy, or those with random glucose above 200 mg/dL were also excluded. Veterans for which exclusion criteria applied were not included in the original database. This database was created with the US Government computer system VistA. Standardized, automated computer programs extracted variables of individuals meeting search criteria. Demographic and laboratory data collected included age, sex, height, weight, BMI, glucose, and HbA1c. The variables of interest were weight, visits/encounters in specified nutrition clinics, and dates of no-shows.

Statistical Analysis

With the use of new diabetes diagnosis between groups of attenders and non-attenders, veterans were re-categorized into 1 of 4 groups: (1) veterans who attended outpatient nutrition education clinics and developed diabetes, (2) veterans who attended outpatient nutrition education clinics and did not develop diabetes, (3) veterans who did not attend outpatient nutrition education clinics and developed diabetes, and (4) veterans who did not attend outpatient nutrition education clinics and did not develop diabetes. Data were analyzed to evaluate if there was a difference in the development of diabetes in prediabetic veterans who received nutrition education vs those who did not. A Cox proportional hazards model was used to predict the time and likelihood for veterans to develop diabetes by using the development of diabetes as an event and the following predictors: attender/non-attender

group, age, BMI, and HbA1c. Additionally, an evaluation of weight loss was analyzed by means of logistic regression. Statistical significance was set at $P < .05$. The χ^2 test was used to count the number of veterans in each of the 4 categories. Laboratory and demographic characteristics were analyzed by use of the Statistical Package for the Social Sciences version 21 (IBM Corp, Armonk, NY, 2012).

RESULTS

Baseline/Preliminary Analyses

The study comprised 372 subjects; 204 attenders and 168 non-attenders, with a mean age of 60.9 ± 10.9 years. Scatterplots were reviewed, and 2 subjects were excluded as outliers. These 2 subjects had higher HbA1c values and a longer time from the first encounter until the development of diabetes compared with the other subjects (>2 SD from the mean) as well as no appointments scheduled and/or no-shows between measurements.

Baseline characteristics are shown in Table 1. HbA1c was shown to be significantly different ($P < .05$) between groups. A significant difference was detected in baseline weight between the group that received nutrition education and did not develop diabetes and the group that did not receive nutrition education and developed diabetes [$F(3, 366) = 3.1, P = .026$]. These differences between weight and HbA1c at baseline were handled as predictors during use of the Cox proportional hazards model. There was no significant difference between groups in percent weight change (group 1: $0.3\% \pm 0.39\%$, group 2: $0.08\% \pm 0.51\%$, group 3: $-0.5\% \pm 0.14\%$, and group 4: $-0.32\% \pm 0.58\%$; $P = .270$).

Primary Analyses

Significantly fewer veterans in the group of attenders developed diabetes compared with the group of nonattenders, tested by $\chi^2 [(1, n = 374) = 30.672; P < .0005]$. Thirty-three percent of attenders did not develop diabetes compared with the 9% of non-attenders who did not develop diabetes.

With the use of the Cox proportional hazard model, the median time for developing diabetes (event) in the group of attenders was 213 days compared with 143 days in the group of non-attenders. The 4 covariates (group, age, BMI, and HbA1c) displayed in Table 2 were associated with the event and the time to develop diabetes ($P < .001$). Patients attending nutrition education showed a protective effect on diabetes status (hazard ratio [HR], 0.706; 95% confidence interval [CI], 0.545–0.916). As shown by an HR of 0.706, nutrition education sessions in this setting protected patients from converting to diabetes. Conversely, increased age, BMI, and baseline HbA1c were associated with diabetes status (Table 2) [age (HR, 1.017; 95% CI, 1.006–1.029), BMI (HR, 1.021; 95% CI, 1.002–1.039), and HbA1c (HR, 1.231; 95% CI, 1.144–1.323)].

HbA1c was highly correlated with the outcome, diabetes status ($r = 0.36, P < .001$); furthermore, as HbA1c levels rose, the effect of the intervention became perfectly predictive of diabetes status. For example, among 153 individuals with the highest HbA1c levels (> 6.0) at baseline (approximately 41% of cohort), no one who attended outpatient nutrition education clinics developed diabetes, whereas everyone who did not attend did develop

diabetes. Six percent of attendees with lower baseline HbA1c (<6%) developed diabetes, whereas 20% of those with lower baseline HbA1c who did not attend developed diabetes (data not shown).

As shown in Table 3, the predictive value of attending classes on diabetes status at the end of the study was also tested using logistic regression adjusting by age, weight change, and baseline BMI. Attending nutrition education was a significant predictor of the primary outcome, diabetes status, even after adjusting for these variables (odds ratio [OR], 0.177; 95% CI, 0.095–0.331; $P < .0005$; Table 3).

DISCUSSION

The objective of the study was to establish the association between attending a nutrition education intervention at the MEDVAMC and progression to diabetes. Nutrition education intervention prevented or delayed the primary outcome: conversion to diabetic from a prediabetic status. Age, BMI, and HbA1c were found to have a positive association with the development of diabetes. The baseline weight of the group that received nutrition education and did not develop diabetes was significantly lower than in the group that did not receive nutrition education and developed diabetes. However, exposure to nutrition education intervention was associated with a decreased risk of developing diabetes even after adjusting for these factors.

In comparison to the crude analysis, the adjusted analysis appears to overinflate the impact of the intervention. This is a result of including HbA1c, which is highly correlated to and predictive of diabetes risk, in the multivariable analysis. Thus, the analyses were expanded to include stratified results and account for baseline prediabetes disease severity. This demonstrated a greater potential impact of the intervention among those with highest A1c levels: of individuals with highest HbA1c levels (≥ 6.0) at baseline, no one who attended outpatient nutrition education clinics developed diabetes, whereas everyone who did not attend did develop diabetes.

The results of this study add to the body of literature. The Diabetes Prevention Program⁶ was a major multicenter clinical study designed to investigate if weight loss through dietary changes, along with physical activity or through drug therapy (metformin), would prevent or delay the development of type 2 diabetes. Results from the Diabetes Prevention Program revealed that participants who lost the most weight through dietary changes and physical activity reduced their risk of developing diabetes by 58%.⁶ Participants who received metformin drug therapy also reduced their risk of developing diabetes but to a lesser extent.⁶

Similarly, a meta-analysis by Lin et al⁹ credits behavioral counseling with statistically significant reductions in fasting glucose and diabetes risk. Overall, the findings demonstrated a relative risk (RR) of 0.58 (95% CI, 0.37–0.89) at 12 to 24 months and an RR of 0.55 (95% CI, 0.45–0.67) in populations receiving high-intensity (> 360 minutes) interventions.⁹ A study specifically evaluating the role of MNT in reducing diabetes risk found MNT to significantly lower levels for HbA1c and diabetes risk in comparison to usual care.¹⁰ These and other studies follow the American Diabetes Association 2016 Standards of

Medical Care, which recommend that “individuals who have prediabetes or diabetes should receive individualized MNT as needed to achieve treatment goals.”¹¹

This study's results are limited in relation to those aforementioned. This could be expected, given that the level of intensity of the reviewed intervention was less than what was described in previous studies. However, this research suggests that results may be achieved without requiring a separate, distinct program for individuals with prediabetes. This may be useful for other groups in which resources are a limiting factor, which is commonly seen. A recent review of diabetes self-management education programs found that a significant proportion of programs have the capacity to also provide lifestyle services to prediabetics, but reimbursement is a barrier to offering services to distinct groups of prediabetics.¹² The participants, particularly those attending the diabetes class, engaged in existing programs that included but were not limited to the prediabetes population. Rationale for this subgroup was that “the strategies for supporting successful behavior change and the healthy behaviors recommended for people with prediabetes are comparable to those for diabetes.”¹¹ With this theory in mind, similar results were found in another study of the VHA's weight management program, MOVE!. Over a 3-year follow-up period, prediabetic patients in MOVE! reduced their incidence of diabetes by 33%.¹³

The results of the present study may also be weaker because of population specific challenges. Compared with the general population, veterans are typically older, have more physical limitations, achieve lower levels of education, and have a higher prevalence of homelessness and mental health disorders.¹⁴ An understanding of the population served and the benefits of nutrition intervention support early engagement with veterans. All healthcare team members should be involved in health screenings, help veterans understand health risk and disease prevention strategies, and refer veterans to effective resources and programs that will support self-efficacy and individualized health goals. Multiple intervention options may exist, which increase shared decision-making and patient empowerment as well as offering flexibility for facilities with limited resources. In these settings, for example, participation in the VHA MOVE! weight management program may be a viable intervention for patients in facilities that do not have distinct prediabetes intervention groups.¹⁵

The study had a number of limitations. Its retrospective design with possible selection bias that decreases the ability to directly determine the effectiveness of these interventions is one of those limitations. Women are under-represented because the study population was predominantly male. The study may not be generalized to the entire US population because it focused on the veteran population. It did not address physical activity, and it is possible that individuals attending classes and nutrition appointments changed their level of physical activity or dietary habits in a way that allowed them to avoid an increase in glucose while maintaining their weight. In addition, both individual and group education classes were identified as treatment but did not distinguish between the 2 types of nutrition education. On the basis of this, one should not assume that a single visit would provide a suitable fidelity to prevent or delay the progression of prediabetes to diabetes. Also, use and compliance with other medications such as statins, ACE inhibitors, or other medications that may affect body weight or the risk of developing diabetes were not captured here. These variables should be taken into account in the design of future studies.

IMPLICATIONS FOR RESEARCH AND PRACTICE

In summary, the results of this study further support the hypothesis that nutrition education can have a positive impact on the prevention of diabetes in veterans. Attendance was a significant predictor of future diabetes status: prediabetic veterans who received nutrition education delayed or prevented the progression of prediabetes to diabetes vs those who did not attend. A simple and relatively inexpensive nutrition education program may play a role in the overall disease prevention. The nutrition education program in VHA is taught by Registered Dietitian Nutritionists and Certified Diabetes Educators and is based on the American Diabetes Association “Nutrition Therapy Recommendations for the Management of Adults with Diabetes.” Further prospective studies should be randomized to compare group education with individual visits, including women, and measure physical activity and medication compliance. With the significant increase of telehealth modalities in VHA (telephone visits, home telehealth monitors), a future study could also compare diabetes telehealth with face-to-face encounters. Both the videoconference MOVE! program¹⁶ and the home telehealth MOVE! program¹⁷ have been shown to be effective for weight management, and it would be advantageous to investigate telehealth and diabetes prevention in veterans. Also, the cost effectiveness of diabetes self-management and MNT to slow the progression of prediabetes to diabetes is receiving more attention. Health plan costs can be decreased by up to 34% for high-risk populations with diabetes and obesity who receive MNT.¹⁸

The study found that exposure to nutrition education intervention was associated with a decreased risk of developing diabetes. This effect was stronger in individuals with higher baseline HbA1c and was found despite lack of weight loss during the study period. Further research is warranted to provide mechanistic insight, given that weight loss was not present. Additionally, the number of nutrition education sessions that each individual attends should be controlled to determine if prediabetic patients further prevent their progression of the disease with the more classes they attend. For better analysis, controlling for random and fasting glucose is advised.

Acknowledgments

Dr Garcia received research support from the Department of Veterans Affairs (MERIT grants: I01-BX000507 and I01 CX000174 and the NIA T32AG000183 and AG040583). The content is solely the responsibility of the authors and does not necessarily represent the official view of the funding agencies. Dr White's effort was supported in part by the National Institute of Diabetes Digestive and Kidney Diseases (DK095082, PI: White) and the Center for Innovations in Quality, Effectiveness, and Safety (No. CIN 13-413), Michael E. DeBakey VA Medical Center, Houston, TX. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the National Institutes of Health. The authors would also like to acknowledge the following individuals for their technical and written contributions to the original works in which this project stems: Dr Charles Wright, Karen Moreland, Caroline Nelson, Rose Bush, John Radcliffe, Mary Watson, and Shanil Juma. The Institutional Review Boards at Baylor College of Medicine, The Michael E. DeBakey VA Medical Center, and Texas Woman's University approved both protocols.

References

1. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2011. http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf [Accessed October 17, 2015]

2. McLellan K, Wyne K, Trejo Villagomez E, Hsueh W. Therapeutic interventions to reduce the risk of progression from prediabetes to type 2 diabetes mellitus. *Ther Clin Risk Manag.* 2014; 10:173–188. [PubMed: 24672242]
3. Miller DR, Safford MM, Pogach LM. Who has diabetes? Best estimates of diabetes prevalence in the Department of Veterans Affairs based on computerized patient data. *Diabetes Care.* 2004; 27(Suppl 2):B10–B21. [PubMed: 15113777]
4. National Center for Veterans Analysis and Statistics. VA benefits & health care utilization. National Center for Veterans Analysis and Statistics; <http://www.va.gov/vetdata/docs/pocketcards/fy2015q2.pdf> [Accessed October 17, 2015]
5. National Center for Veterans Analysis and Statistics. Trends in the utilization of VA programs and services: FY2009 to FY2013. National Center for Veterans Analysis and Statistics; http://www.va.gov/vetdata/docs/QuickFacts/Utilization_quickfacts_FY2014.pdf [Accessed October 17, 2015]
6. Knowler WC, Barrett-Conner E, Fowler SE, et al. for the Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med.* 2002; 346:393–403. [PubMed: 11832527]
7. Evert AB, Boucher JL, Cypress M, et al. American Diabetes Association. Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care.* 2013; 36:3821–3842. [PubMed: 24107659]
8. Academy of Nutrition and Dietetics. International Dietetics & Nutrition Terminology (IDNT) Reference Manual. 3. Chicago, IL: American Dietetic Association; 2011.
9. Lin, JS., O'Connor, EA., Evans, CV., Senger, CA., Rowland, MG., Groom, HC. Behavioral counseling to promote a healthy lifestyle for cardiovascular disease prevention in persons with cardiovascular risk factors: an evidence update for the US. Preventive Services Task Force. Rockville, MD: Agency for Healthcare Research and Quality; 2014. Evidence Report No. 113. AHRQ Publication No. 13-05179-EF-1 http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0066955/pdf/PubMedHealth_PMH0066955.pdf [Accessed January 10, 2016]
10. Parker AR, Byham-Gray L, Denmark R, Winkle PJ. The effect of Medical Nutrition Therapy by a Registered Dietitian Nutritionist in patients with prediabetes participating in a randomized controlled clinical research trial. *J Acad Nutr Diet.* 2014; 114:1739–1748. [PubMed: 25218597]
11. American Diabetes Association. Prevention or delay of type 2 diabetes. Sec 4 In Standards of Medical Care in Diabetes 2016. *Diabetes Care.* 2016; 39(Suppl 1):S36–S38. [PubMed: 26696678]
12. Butcher MK, Vanderwood KK, Hall TO, Gohdes D, Helgersson SD, Harwell TS. Capacity of diabetes education programs to provide both diabetes self-management education and to implement diabetes prevention services. *J Public Health Manag Pract.* 2011; 17:242–247. [PubMed: 21464686]
13. Romanova M, Liang L, Deng ML, Li-Jung Z, Heber D. Effectiveness of the MOVE! multidisciplinary weight loss program for veterans in Los Angeles. *Prev Chronic Dis.* 2013; 10:1–8.
14. Forman-Hoffman V, Little A, Wahls T. Barriers to obesity management: a pilot study of primary care clinicians. *BMC Fam Pract.* 2006; 7:35. [PubMed: 16756673]
15. U.S. Department of Veterans Affairs. [Accessed January 19, 2016] MOVE! Weight Management Program. <http://www.move.va.gov/>
16. Ahrendt A, Kattelman K, Rector T, Maddox D. The effectiveness of telemedicine for weight management in the MOVE! Program. *J Rural Health.* 2014; 30:113–119. [PubMed: 24112223]
17. Skoyen J, Rutledge T, Wiese J, Woods G. Evaluation of TeleMOVE: a telehealth weight reduction intervention for Veterans with obesity. *Ann Behav Med.* 2015; 49:628–633. [PubMed: 25697133]
18. Urbanski P, Wolf A, Herman W. Cost-effectiveness of diabetes education. *J Am Diet Assoc.* 2008; 108:S6–S11. [PubMed: 18358259]

Table 1
Demographic, Anthropometric, and Laboratory Baseline Characteristics for Prediabetes Study Participants

Variable	Attendees			Non-Attendees		
	All	Attendees, Did Develop DM, Group 1	Attendees, Did Not Develop DM, Group 2	Non-Attendees, Did Develop DM, Group 3	Non-Attendees, Did Not Develop DM, Group 4	
No. of participants	372	136 (36.5)	71 (19.1)	151 (40.6)	14 (3.8)	
Age (y)	60.9 ± 10.9	62.0 ± 10.8	60.1 ± 11.8	59.9 ± 10.6	65.1 ± 11.7	
No. of participants	351	132 ^a	62 ^{a,b}	143 ^b	14 ^{a,b}	
(% men)	94.4	97	87	95	100.0	
Ethnicity (%)						
White	191 (52.8)	75 (54.3)	34 (47.9)	72 (47.7)	10 (71.4)	
Black or African American	159 (43.9)	57 (41.3)	32 (45.1)	66 (43.7)	4 (28.6)	
American Indian or Alaska native	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	
Asian	1 (0.3)	0 (0.0)	1 (1.4)	0 (0.0)	0 (0.0)	
Native Hawaiian or other Pacific Islander	10 (2.8)	3 (2.2)	1 (1.4)	6 (4.0)	0 (0.0)	
Height (cm)	176.3 ± 8.9	176.8 ± 8.4	175.3 ± 9.4	175.8 ± 8.9	177.8 ± 6.9	
Weight (kg)	103.7 ± 24.7	105.0 ± 23.9	95.8 ± 24.5 ^a	105.3 ± 24.7 ^a	109.9 ± 24.4	
Body mass index (kg/m ²)	33.4 ± 7.1	33.9 ± 6.6 ^a	31.0 ± 6.8 ^{a,b}	34.0 ± 7.6 ^b	35.2 ± 6.4	
HbA1c (%)	5.1 ± 1.0	5.1 ± 0.8 ^{a,b}	6.0 ± 0.1 ^a	6.0 ± 0.2 ^b	5.8 ± 0.1	

DM indicates diabetes mellitus; HbA1C, hemoglobin A1c.

^{a,b} Means in a row with a common letter are significantly different between groups.

Note: $P < .05$. Descriptive statistics were used.

Table 2

Factors Affecting the Development of Diabetes and Hazard Ratios (n = 372)

Predictor	B	Standard Error	P	Hazard Ratio	95% Confidence Interval
Group ^a	−0.348	0.133	.009	0.706	0.545, 0.916
Age	0.017	0.006	.004	1.017	1.006, 1.029
Baseline BMI	0.020	0.009	.027	1.021	1.002, 1.039
Baseline HbA1c	0.208	0.037	.0005	1.231	1.144, 1.323

BMI indicates body mass index (weight divided by height squared [kg/m²]); HbA1c, hemoglobin A 1c.

^aPatients were categorized into 2 groups: attenders (received nutrition education) and non-attenders (did not receive nutrition education).
Note: *P* < .05, Cox proportional hazards model.

Table 3

Logistic Regression Evaluating Predictors of Diabetes Status (n = 372)

Predictor	B	Standard Error	P	Odds Ratio	95% Confidence Interval
Age	0.011	0.012	.357	1.011	0.987 1.036
Baseline BMI	0.013	0.006	.030 ^a	1.013	1.001 1.025
Weight change (kg)	0.009	0.016	.588	1.009	0.978 1.041
Program attendance	-1.730	0.319	.0005 ^a	0.177	0.095 0.331

BMI indicates body mass index (weight divided by height squared [kg/m²]).

^a *P* < .05, logistic regression.