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Predictors of Physical Inactivity in Men and Women With Type 2 Diabetes From the Detection of Ischemia in Asymptomatic Diabetics (DIAD) Study

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Abstract

Purpose—The purpose of this secondary analysis was to determine changes in physical inactivity from baseline to 5 years and to identify factors associated with and predictive of physical inactivity among individuals with type 2 diabetes enrolled in the Detection of Ischemia in Asymptomatic Diabetics (DIAD) study.

Methods—DIAD was a prospective randomized screening trial that assessed the prevalence of silent ischemia in asymptomatic patients with type 2 diabetes. Subjects were recruited from diabetes and primary care practices at 14 centers throughout the United States and Canada. This is a secondary data analysis of the physical activity data (type and hours/week) collected. No intervention was conducted.

Results—In all subjects, physical inactivity rose from 24% at baseline to 33% at 5 years ($S = 28.93$; $P < .0001$). This change was significant in both men ($S = 11.44$; $P < .0001$), increasing from 23% to 31%, and women ($S = 18.05$; $P < .0001$), increasing from 25% to 36%. Gender differences were noted in several factors associated with baseline physical inactivity as well as in factors predictive of physical inactivity at 5 years. Important factors associated at both time points included lower level of education, current employment, presence of peripheral and autonomic

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Author contributions for current secondary data analysis:

Study concept and design: Drs McCarthy and Chyun

Recruitment of patients, acquisition of data: The DIAD Investigators (see below)

Analysis and interpretation of data: Drs McCarthy, Chyun

Drafting of the manuscript: Drs McCarthy, Chyun

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neuropathy, and indicators of overweight/ obesity. Baseline physical inactivity was strongly predictive of physical inactivity at 5 years (odds ratio, 3.27; 95% confidence interval, 2.36-4.54; $P < .0001$).

Conclusions—Gender-related differences were noted in factors associated with and predictive of physical inactivity.

Diabetes is a worldwide problem that is estimated to affect more than 550 million people by the year 2030, as a result of population growth, aging, and changes in lifestyle.¹ Physical inactivity is particularly important in individuals with diabetes, in whom as many as 61% are inactive.² Physically inactive adults with type 2 diabetes have a higher risk for cardiovascular disease mortality regardless of pharmacologic treatment and hemoglobin A1C control as compared with adults with type 2 diabetes who are physically active, treated, and with good glycemic control.³ Correlates of physical inactivity in populations with or at risk for diabetes include lower income, poorer physical function and general health status, depression, obesity, and female gender, although in individuals with diabetes, a lack of association with gender and education has been suggested.^{2,4} Physical inactivity is associated with lower life expectancy, poorer control of blood glucose and coronary artery disease (CAD) risk factors.⁵⁻⁷ Exercise capacity is an important predictor of all-cause mortality in both African American and Caucasian men with type 2 diabetes,⁸ and in older adults, diabetes-related factors have been shown to predict new disability with regard to activities of daily living.⁹ Importantly, in older adults, higher levels of physical activity are associated with less functional decline.¹⁰

Although physical activity is an essential element of diabetes management and disability prevention, limited longitudinal data are available on physical inactivity and factors, particularly sociodemographic and diabetes related, which may predict physical inactivity over time in older adults with type 2 diabetes. The aims of this secondary data analysis in subjects enrolled in the Detection of Ischemia in Asymptomatic Diabetics (DIAD) Study¹¹⁻¹³ were the following:

1. to determine changes in levels of physical inactivity over 5 years of follow-up and to identify factors associated with and predictive of physical inactivity and
2. to compare these physical inactivity-related factors in men and women.

Subjects and Methods

Design

DIAD was a prospective randomized screening trial that assessed the prevalence of silent ischemia in asymptomatic patients with type 2 diabetes.¹² Study procedures have been described in detail in previous DIAD publications.^{11,13} This study is a secondary data analysis of the physical activity data collected during the course of the DIAD study. This cohort was a well-characterized sample of older adults with type 2 diabetes. The data on physical activity have not yet been analyzed. Researchers use secondary analysis to examine data previously collected by another researcher to answer new research questions.¹⁴

Sample/Setting

Patients (n = 1123) were randomized to screening with stress testing and follow-up or to follow-up only. Inclusion criteria were (1) history of type 2 diabetes with onset at age 30 years and no history of ketoacidosis and (2) age between 50 and 75 years. Exclusion criteria included (1) angina pectoris or anginal equivalent symptoms; (2) stress test or coronary angiography in the 3 years prior to entry into the study; (3) history of myocardial infarction, heart failure, or coronary revascularization; (4) electrocardiographic evidence of Q-wave myocardial infarction, ischemic ST-segment or T-wave changes, or complete left bundle branch block; (5) any clinical indication for stress testing; (6) active bronchospasm, precluding the use of adenosine; (7) pregnancy; and (8) limited life expectancy due to the cancer or end-stage renal or liver disease. The purpose of DIAD was to examine the prevalence and predictors of silent ischemia and the 5-year outcome of cardiac events.¹²

Data Collection Procedures

All participants were followed by telephone contact every 6 months for 5 years to assess the development of CAD events (myocardial infarction, cardiac death, acute coronary syndromes, heart failure, and revascularization), which were subsequently adjudicated after review of the medical records.¹³ Physical activity (type and number of hours per week) was assessed by the Framingham Physical Activity Index.¹⁵ These physical activity data were later dichotomized into none/any. Of the 1123 subjects randomized, 4 did not complete the first 6 months of follow-up and so were excluded from the present analysis. Over 5 years of follow-up, 15 subjects died.¹³ Only subjects who had physical activity data at baseline (n = 974) and 5 years (n = 957) were included in these analyses. The DIAD study was not designed to influence physical activity behavior. Nevertheless, it was one of many variables recorded at baseline and collected during follow-up, which provided an opportunity to observe changes in physical activity over time.

Statistical Analysis

All analyses were conducted using SAS (version 9.3). Descriptive statistics were used to describe the subjects. Bivariate analysis between subjects who were physically inactive versus active at baseline and 5 years were analyzed using χ^2 and *t* tests; comparisons between men and women at baseline and 5 years were made with analysis of variance and χ^2 statistics. The McNemar test was used to compare activity levels at baseline and 5 years. Logistic regression using a standard backward elimination strategy, adjusting for potentially confounding factors and assessing possible interactions, was used to assess factors predictive of physical inactivity at baseline and 5 years, as well as in men and women individually. Logistic regression is used when the dependent or outcome variable is dichotomous but the independent or predictor variables are of any measurement scale.¹⁶ In this analysis, logistic regression was used since the dependent variable (physical inactivity) was dichotomous (yes/no). Variables that were significant at .10 in the bivariate analysis were included in the multivariate analysis. This level of significance was chosen to capture predictor variables that may be only trending toward significance in the bivariate analysis but may be significant predictors or confounders in the multivariate logistic regression when controlling for additional factors.

Results

Subject Characteristics at Baseline

The mean age for men ($n = 533$) and women ($n = 441$) was 61 ± 6.7 years and 60.8 ± 6.5 years, respectively ($P = .5$). Both groups had a majority of white subjects, but the group of women had a higher percentage of African Americans than the group of men did (10% vs 18%; $P = .0005$; Table 1). Significantly more women (47%) than men (16%) lived alone ($P < .0001$), were more likely to earn less than \$25,000/year (18% vs 6%, respectively; $P < .0001$), and had fewer years of education (13.9 ± 3.7 years vs 15.7 ± 3.5 years; $P < .0001$). Men were more likely to have symptoms of autonomic (14% vs 6%; $P < .0001$) but not peripheral (38% vs 41%; $P = .37$) neuropathy. Men had a higher waist-to-hip ratio (0.98 ± 0.07 vs 0.89 ± 0.08 ; $P < .001$) but a lower body mass index (BMI; 30 ± 5.1 kg/m² vs 32.5 ± 7.1 kg/m²; $P < .0001$). There was no statistical difference between the percentage of men and women who were involved in any physical activity (24% vs 25%, $P = .65$). However, men spent significantly more hours per week in physical activity than women (4.20 ± 6.39 hours vs 3.53 ± 3.42 hours, respectively; $P = .04$).

Factors Associated With Physical Inactivity at Baseline

When comparing subjects who were physically active versus those with no activity at baseline (Table 2), those who were inactive were significantly younger ($P = .01$); had fewer years of education ($P = .003$); were more likely to be working full- or part-time ($P < .0001$); had a higher waist circumference ($P < .0001$), BMI ($P < .0001$), triglycerides ($P = .049$), and A1C level ($P = .003$); and were more likely to use insulin ($P = .001$) and have symptoms of peripheral ($P < .001$) and autonomic neuropathy ($P = .004$).

In multivariate logistic regression analysis, 4 factors were independently associated with physical inactivity at baseline: lower level of education (odds ratio [OR], 0.93 for every 1-year increase in education; 95% confidence interval [CI], 0.89-0.97; $P = .0009$), working (OR, 2.38; 95% CI, 1.67-3.40; $P < .0001$), higher BMI (OR, 1.06 for each 1 kg/m² increase; 95% CI, 1.04-1.09; $P < .0001$), and the presence of peripheral numbness (OR, 1.54; 95% CI, 1.13-2.11; $P = .01$).

While gender was not associated with physical inactivity in the adjusted logistic model (OR_{men}, 1.24; 95% CI 0.89-1.72; $P = .21$) at baseline, when analyzed separately, different factors were associated with physical inactivity at baseline for men and women (Table 3). Factors independently associated with baseline physical inactivity in women included working (OR, 2.15; 95% CI, 1.29-3.59; $P = .004$), the presence of peripheral neuropathy (OR, 2.42; 95% CI, 1.52-3.86; $P = .0002$), and higher BMI (OR, 1.07; 95% CI, 1.04-1.11; $P < .001$). For men, factors independently associated with physical inactivity included living alone (OR, 2.07; 95% CI, 1.24-3.46; $P = .005$), working (OR, 2.25; 95% CI, 1.38-3.67; $P = .001$), education (OR, 0.90 per each 1-year increase in education; 95% CI, 0.85-0.96; $P = .0007$), the presence of autonomic neuropathy (OR, 1.75; 95% CI, 1.01-3.04; $P = .04$), and higher waist circumference (OR, 1.05 per 1-in increase; 95% CI, 1.01-1.09; $P = .02$).

Factors Associated With Physical Inactivity at 5 Years

In all subjects, the level of physical inactivity rose from 24% at baseline to 33% at 5 years ($S = 28.93$; $P < .0001$), while the mean hours of physical activity decreased from 3.94 ± 5.30 to 2.63 ± 2.74 ($t = 7.47$; $P < .0001$). The increase in physical inactivity was statistically significant in both men ($S = 11.44$; $P = .0007$), increasing from 23% to 31%, and in women ($S = 18.05$; $P < .0001$), increasing from 25% to 36%. The mean number of hours of physical activity decreased in both men (mean, 2.89 ± 2.89 h/wk; $t = 4.69$; $P < .0001$) and women (mean, 2.31 ± 2.53 h/wk; $t = 7.45$; $P < .0001$), and the difference between men and women at 5 years was statistically significant ($t = -3.31$; $P = .001$).

Subjects who were inactive at 5 years (Table 2) were more likely to be black ($P = .002$), living alone ($P = 0.10$), have an income of less than \$25,000 ($P = .03$), and have less than a high school education ($P = .009$). They were also more likely to have symptoms of peripheral neuropathy ($P = .0003$), use insulin ($P = .001$), have a longer duration of diabetes ($P = .009$), and have a higher A1C level ($P = .0003$). In addition, subjects with physical inactivity had higher triglycerides ($P = .06$), mean systolic blood pressure ($P = .019$), waist circumference ($P < .0001$), and BMI ($P < .0001$).

In the final logistic regression model including all subjects, 5 variables were significant predictors of physical inactivity at 5 years (Table 3): lower level of education (OR, 0.91 for each additional year of education; 95% CI, 0.87-0.94; $P < .0001$), higher A1C level (OR, 1.14 for each 1% increase; 95% CI, 1.03-1.26; $P = .01$), peripheral pain (OR, 1.67; 95% CI, 1.07-2.61; $P = .02$), and higher BMI (OR, 1.05 for each kg/m^2 increase; 95% CI, 1.02-1.07; $P = .0002$). In addition, having no physical activity at baseline was strongly associated with being inactive at 5 years (OR, 3.27; 95% CI, 2.36-4.54; $P < .0001$). Gender was not a significant independent predictor of physical inactivity at 5 years (OR, 1.08; 95% CI, 0.80-1.48; $P = .61$).

Some differences were noted between the predictors for men and women. For men, in addition to BMI (OR, 1.06; 95% CI, 1.02-1.11; $P = .003$), A1C level (OR, 1.17; 95% CI, 1.02-1.33; $P = .02$), level of education (OR, 0.93; 95% CI, 0.88-0.99; $P = .017$), and no exercise at baseline (OR, 3.56; 95% CI, 2.28-5.57; $P < .0001$), the level of high-density lipoproteins (HDL; OR, 1.02 for each 0.03mmol/L increase; 95% CI, 1.002-1.04; $P = .03$) and the presence of peripheral neuropathy symptoms (OR, 1.5; 95% CI, 1.02-2.32; $P = .04$) were significant predictors of physical inactivity at 5 years.

For women only, in addition to no exercise at baseline (OR, 3.38; 95% CI, 2.08-5.49; $P < .0001$), predictors included level of education (OR, 0.88; 95% CI, 0.82-0.93; $P < .0001$), black ethnicity (OR, 1.73; 95% CI, 1.01-2.97; $P = .045$), and waist circumference (OR, 1.06; 95% CI, 1.02-1.09; $P = .002$).

Discussion

This study demonstrated a pattern of physical inactivity that increased over 5 years of follow-up in older men and women with type 2 diabetes. At baseline, multiple factors were associated with physical inactivity in all subjects (lower levels of education, working, higher

BMI, and peripheral numbness, indicative of peripheral neuropathy). At 5 years, lower levels of education and higher BMI remained predictive of physical inactivity, along with higher A1C levels assessed at baseline and baseline physical inactivity. While significant differences were observed with regard to factors associated with physical inactivity at baseline and predictive of physical inactivity at 5 years between men and women, baseline physical inactivity was shown to be prevalent and equally important in both men and women with type 2 diabetes.

An association of lower levels of education and higher BMI in relation to physical inactivity has also been demonstrated in the Third National Health and Nutrition Survey (NHANES III) data in adults with type 2 diabetes ($n = 1480$). Those with less than a high school degree were more likely to report no physical activity (OR, 1.8; 95% CI, 1.0-3.3) as compared with those with a college degree.¹⁷ In addition, those with a BMI ≥ 30 were 1.2 times more likely to engage in no physical activity (95% CI, 0.7-2.2) as compared with those with a BMI <25 . A recent study examining the factors associated with dropping out of a supervised exercise program for sedentary individuals with type 2 diabetes¹⁸ demonstrated there were significantly more dropouts in the exercise group versus control group. Factors associated with dropping out of the exercise intervention included lower fitness level, higher insulin resistance, higher percentage total body fat, and higher subcutaneous abdominal fat. While the subjects included 42% women, gender was not a significant predictor of dropping out of the exercise program. The current study adds to these data by identifying additional diabetes-related factors associated with physical inactivity.

Both autonomic (men at baseline) and peripheral neuropathies (women at baseline and men at 5 years) were found to be associated with physical inactivity. Cardiac autonomic neuropathy (CAN) is a common complication in diabetes and is often a contraindication to exercise or at least demands that the individual take special precautions. CAN is prevalent in individuals with type 2 diabetes, occurring in as many as 44.3% of patients.¹⁹ Importantly, exercise has been shown to improve CAN in individuals with type 2 diabetes, with as little as 6 months of an exercise intervention.²⁰ While those with CAN had lower aerobic capacity in this study and impaired heart rate variability as compared with those without CAN, both CAN and aerobic capacity were improved.

Peripheral neuropathy is also prevalent in the population with type 2 diabetes. In one cross-sectional study, the presence of painful diabetic peripheral neuropathy ($n = 269$) was found in 26.4% of subjects, with 80% describing their pain as moderate to severe.²¹ There is also evidence that a 10-week exercise intervention including both aerobic and strengthening exercise may improve symptoms of peripheral neuropathy, including pain.²² However, the challenges of increasing physical activity in the presence of autonomic and peripheral neuropathy, as well as when the individual is overweight or obese, are substantial and require creativity in engaging these individuals in a program of regular activity. Modifications such as shorter periods of activity with more frequent intervals throughout the day, water-based activities, and planning so that there is an opportunity to stop and rest may assist in adoption. In addition, daily physical activity has been shown to decrease later functional decline in older adults with peripheral artery disease (32.5% with diabetes).¹⁰ Those subjects with higher daily physical activity showed less annual decline in function.

These are significant findings in an aging population with type 2 diabetes and peripheral neuropathy, particularly if individuals desire to continue working and living independently.

Current employment was a strong predictor of physical inactivity at baseline, with all subjects twice as likely to be physically inactive if they were working. While this may be related to lack of time to engage in physical activity outside of the work setting, this finding has important implications. Lack of physical activity may lead to more functional decline and an inability to continue working. In addition, the cost of lost work days, restricted activity days, mortality, and disability due to diabetes in the United States is high: almost 40 billion dollars in 2002.²³ A recent systematic review found that diabetes was related to absenteeism, productivity, and early retirement, thus having significant economic consequences for employers.²⁴ Functional limitations, common in older adults with diabetes, are also found in adults with prediabetes, as noted in the Health and Retirement Study.²⁵ Therefore, strategies in and outside of the workplace to engage all adults, and in particular those with type 2 diabetes, in physical activity may have work-related and wider economic benefits.

The self-perception of how diabetes may affect the future independence and employment of working adults with diabetes was explored in a sample (n = 190) composed of a majority (87%) of ethnic minority individuals.²⁶ Results indicated that 34% believed their diabetes would affect employment, and 57% felt it would have an effect on their independence. This latter group tended to be younger and in poor physical and mental health. Testing interventions to improve both physical activity and general health may allow those with diabetes to remain productive in the workplace.

The effect of a lifestyle intervention on lost productivity and disability was tested in a sample of working adults with type 2 diabetes and obesity.²⁷ The intervention consisted of sessions with a dietitian to set goals related to national dietary recommendations. The dietitian also measured waist circumference and weight and followed laboratory results. At 4 months, there were significant differences in the intervention group as compared with usual care in work days lost ($P = .05$) and disability ($P = .003$). In addition, there continued to be significant differences at each time point through 12 months. Efforts are needed to assist working patients with type 2 diabetes in incorporating routine physical activity into a working lifestyle. Use of a pedometer may assist in goal setting, increased daily physical activity, and improved glycemic control, as was noted in a sample of subjects with impaired glucose tolerance.²⁸ In this study, subjects were given a structured education program to promote walking, in addition to a pedometer. At 12 months, the intervention group had significant increases in walking and significant decreases in 2-hour postchallenge glucose and fasting glucose as compared with the control group.

Several studies have examined the effects of interventions on improving physical activity in type 2 diabetes. The Italian Diabetes and Exercise Study (IDES) examined the effect of an intensive exercise intervention plus physical activity counseling as compared with a control group receiving only physical activity counseling.²⁹ Both groups significantly increased total physical activity levels ($P < .001$), but the intensive intervention resulted in significantly greater total weekly physical activity ($P < .001$) and improved cardiovascular

risk as compared with the control. Given these results, more intensive strategies may be needed to promote and maintain higher physical activity levels in this population, particularly those who are at high risk of continuing physical inactivity.

The factor most strongly associated with physical inactivity at 5 years was physical inactivity at baseline. Subjects were more than 3 times more likely to be inactive at 5 years if they were inactive at baseline. In DIAD, while levels of physical activity were low, participants did not suffer from functional limitations and would have been able to participate in a program to enhance physical activity. This suggests that early assessment of patterns of physical activity is an important component of diabetes care. Unfortunately, exercise as therapy has often failed in primary care settings despite the knowledge that exercise is an important lifestyle intervention to treat type 2 diabetes.³⁰ A physician counseling intervention has led to improvement in physical activity in patients with type 2 diabetes when using a structured counseling approach followed by phone follow-up.³¹ At 12 months, 69% of the intervention group were achieving target levels of physical activity, as compared with 18% of the control group ($P < .001$).

Important differences between men and women were noted at both time points. Knowledge of these factors may assist in identifying men and women at high risk of physical inactivity over time. For men only, in addition to lower level of education, peripheral and autonomic neuropathy, and measures of obesity (BMI, increased waist circumference), current employment, living alone, and higher levels of A1C and HDL were predictors of inactivity. Although this HDL result is seemingly contradictory, the level of HDL was measured only at baseline and may have changed during the 5 years of the study.

For women, in addition to lower levels of education, working, measures of obesity (BMI and waist circumference), peripheral neuropathy, and black ethnicity were found to be an important predictor of physical inactivity. According to NHANES III data, those subjects with type 2 diabetes who were inactive were more likely to be female and African American or Mexican American.¹⁷ Similar to this study's findings, previous research has shown that women with type 2 diabetes mellitus engage in less leisure time physical activity than men do.³² In addition, blacks with diabetes are less likely to engage in physical activity than whites are.³³ Addressing specific predictors of inactivity in men and women or racial/ethnic groups may guide gender- and culturally-appropriate physical activity interventions.

There were several limitations to the study. Predictors were measured only at baseline and could have changed over the 5 years of the study. Physical activity was measured by self-report and was only a crude estimate of actual hours of activity. In addition, study coordinators found it difficult to assess the type of activity—low, moderate, and heavy physical activity—and amount of hours, so only total hours were used.

Furthermore, psychological factors such as depression and anxiety, which are known to be prevalent in patients with diabetes, may contribute to physical inactivity. For example, in a study done in 2009 of almost 3000 men and women who were post-myocardial infarction, anxiety and depression were found in almost 30% of participants.³⁴ In a smaller study of individuals with diabetes ($n = 109$), the prevalence of psychological symptoms was high.

Overall, 28% of those studied had symptoms of depression, anxiety, or both.³⁵ Given these data, and the dual prevalence of diabetes and cardiovascular disease, inclusion of psychological measures as possible predictors of inactivity is warranted. In a smaller subset of the DIAD cohort (n = 109), 16% of DIAD subjects had elevated levels of depressive symptoms, and 82% had elevated levels of somatic anxiety.³⁶ However, the strengths were a large cohort study with follow-up over 5 years including an extensive assessment of diabetes-related factors. Despite the limitations, significant predictors of physical inactivity in this population of older adults with type 2 diabetes were identified.

Clinical Implications

Given the rising prevalence of diabetes and the low levels of physical activity in the United States, understanding the predictors of inactivity is an important step in improving clinical outcomes in individuals with type 2 diabetes. Individuals at risk of inactivity can be identified and efforts made to improve activity levels.

In addition, the role of provider support and recommendation can be assessed to identify its influence on participation in physical activity. Patients' beliefs and attitudes regarding the role of physical activity in improving their diabetes as well as overall health also need be clarified. In a large analysis of cross-sectional data involving adults with diabetes (n = 6852 patient visits), the authors found that physician counseling/referral for exercise occurred in only 18% of patient visits.³⁷ Although there were no significant differences found between counseling/referral for whites as compared with African Americans, clearly the low rates of referral to this important lifestyle intervention need to be addressed.

Current recommendations for those with diabetes include incorporating routine physical activity to benefit overall fitness, body weight management, and blood glucose control.³⁸ However, there is a need to understand the barriers to physical activity in older adults with type 2 diabetes and to develop strategies that take into consideration the particular circumstances facing this population. Guidelines can be issued regarding the minimum amount of physical activity recommended per week, but it is getting individuals to move from inactive to active that is the primary challenge.

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Contributions (DIAD):

Study concept and design: Drs Wackers, Young, Chyun, Inzucchi, and Zaret

Recruitment of patients, acquisition of data: The DIAD Investigators (see below)

Analysis and interpretation of data: Drs Chyun, Wackers, and Young

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Table 1 Sample Characteristics at Baseline (n = 974)^a

Demographic Characteristic	Male (n = 533)	Female (n = 441)	P Value
Mean age, y	61 ± 6.7	60.8 ± 6.5	.5
Race/ethnicity			
White	450 (84)	343 (78)	.0005
African American	52 (10)	80 (18)	
Other	31 (6)	18 (4)	
Employment			
Work full- or part-time	331 (62)	207 (47)	<.0001
Income			
<\$25,000	34 (6)	81 (18)	<.0001
Marital status			
Lives alone	87 (16)	208 (47)	<.0001
Education, y	15.7 ± 3.5	13.9 ± 3.7	<.0001
Duration of type 2 diabetes mellitus, y	8.5 ± 7.3	8.3 ± 6.9	.7
Insulin used	108 (20)	104 (24)	.2
Mean A1C (mmol/mol)	7.0 ± 1.5 (53)	7.0 ± 1.4 (53)	.6
Autonomic neuropathy symptoms	77 (14)	27 (6)	<.0001
Peripheral neuropathy symptoms	204 (38)	181 (41)	.37
Waist-to-hip ratio	0.98 ± 0.07	0.89 ± 0.08	<.0001
Body mass index, kg/m ²	30 ± 5.1	32.5 ± 7.1	<.0001
No exercise at baseline	126 (24)	110 (25)	.64
No exercise at 5 y	162 (31)	156 (36)	.1
Baseline hours of exercise	4.2 ± 6.4	3.5 ± 3.4	.04

^a Data are presented as n (%) or mean ± standard deviation.

Table 2 Results of Bivariate Analysis: Factors Associated With Physical Inactivity at Baseline and 5 Years^a

Factor	Baseline (n = 974)		P Value	5 Years (n = 957)		P Value
	Some Activity (n = 738)	No Activity (n = 236)		Some Activity (n = 639)	No Activity (n = 318)	
Age, y	61 ± 6.7	60 ± 6.1	.01	NS	NS	
Gender						
Male	NS	NS		361 (57)	162 (51)	.10
Female				278 (43)	156 (49)	
Race						
White	606 (82)	187 (79)		529 (83)	250 (79)	
Black	92 (12.5)	40 (17)	.15	71 (11)	58 (18)	.002
Other	40 (5.4)	9 (4)		39 (6)	10 (3)	
Employment						
Working full-time or part-time	383 (52)	155 (66)				
Retired	304 (41)	55 (23)	<.0001	NS	NS	NS
Not working	51 (7)	26 (11)				
Income <\$25,000	91 (12)	24 (10)	.26	71 (11)	42 (13)	.036
Lives alone	214 (29)	81 (34)	.12	182 (28)	107 (34)	.001
Education, y	15.1 ± 3.7	14.3 ± 3.5	.003	15.3 ± 3.5	13.9 ± 3.8	<.0001
Duration of type 2 diabetes mellitus, y	8.2 ± 7	9.0 ± 7.0	.15	8 ± 6.9	9 ± 7.4	.008
Insulin used	143 (19)	69 (29)	.001	121 (19)	89 (28)	.001
A1C, % (mmol/mol)	6.9 ± 1.4 (52)	7.3 ± 1.6 (56)	.003	6.9 ± 1.3	7.3 ± 1.7	.0003
Autonomic neuropathy symptoms	67 (9)	37 (16)	.004	58 (9)	40 (13)	.092
Peripheral neuropathy symptoms	261 (35)	124 (53)	<.001	226 (35)	151 (47)	.0003
Waist circumference, in	40.8 ± 5.6	43.2 ± 5.8	<.0001	41 ± 5.7	43 ± 5.7	<.0001
Body mass index, kg/m ²	30.4 ± 5.9	33.3 ± 6.7	<.0001	30 ± 6.0	33 ± 6.4	<.0001
Low-density lipoprotein, mmol/L	2.94 ± 0.85	2.97 ± 0.83	.59	NS	NS	NS
High-density lipoprotein, mmol/L	1.27 ± 0.39	1.27 ± 0.35	.73	NS	NS	NS
Triglycerides, mmol/L	1.88 ± 1.14	2.08 ± 1.43	.049	166±106	180±110	.06
Mean systolic blood pressure, mm Hg	130.6 ± 17	130.5 ± 15.5	.97	130 ± 16	132 ± 17	.019
Mean diastolic blood pressure, mm Hg	78.9 ± 8.6	78.5 ± 7.9	.93	NS	NS	NS

^aData are presented as n (%) or mean ± standard deviation. NS, not significant.

Table 3

Results of Logistic Regression Analysis: Factors Associated With Physical Inactivity at Baseline and Predictive at 5 Years^a

Predictor	Baseline			5 Years		
	All (n = 974)	Men (n = 533)	Women (n = 441)	All (n = 957)	Men (n = 523)	Women (n = 434)
Black ethnicity	NS	NS	NS	NS	NS	1.73 (1.01-2.97) <i>P</i> = .045
Working full-time or part-time	2.38 (1.67-3.40) <i>P</i> < .0001	2.25 (1.38-3.67) <i>P</i> = .001	2.15 (1.29-3.59) <i>P</i> = .004	NS	NS	NS
Living alone	NS	2.07 (1.24-3.46) <i>P</i> = .005	NS	NS	NS	NS
Education (each 1-y increase)	0.93 (0.89-0.97) <i>P</i> = .0009	0.90 (0.85-0.96) <i>P</i> = .0007	NS	0.91 (0.87-0.94) <i>P</i> < .0001	0.93 (0.88-0.99) <i>P</i> = .017	0.88 (0.82-0.93) <i>P</i> < .0001
A1C	NS	NS	NS	1.14 (1.03-1.26) <i>P</i> = .007	1.17 (1.02-1.32) <i>P</i> = .02	NS
Peripheral neuropathy	NS	NS	2.42 (1.52-3.86) <i>P</i> = .0002	NS	1.5 (1.02-2.32) <i>P</i> = .04	NS
Peripheral numbness	1.54 (1.13-2.11) <i>P</i> = .01	NS	NS	NS	NS	NS
Peripheral pain	NS	NS	NS	1.67 (1.07-2.61) <i>P</i> = .02	NS	NS
Autonomic neuropathy	NS	1.75 (1.01-3.04) <i>P</i> = .04	NS	NS	NS	NS
Body mass index (each kg/m ² increase)	1.06 (1.04-1.09) <i>P</i> < .0001	NS	1.07 (1.04-1.11) <i>P</i> < .001	1.06 (1.02-1.11) <i>P</i> = .003	1.06 (1.02-1.10) <i>P</i> = .003	NS
Waist circumference (each 1-in increase)	NS	1.05 (1.01-1.09) <i>P</i> = .02	NS	NS	NS	1.06 (1.02-1.09) <i>P</i> = .002
Level of high-density lipoprotein	NS	NS	NS	NS	1.02 (1.002-1.04) <i>P</i> = .03	NS
No exercise at baseline	—	—	—	3.27 (2.36-4.54) <i>P</i> < .0001	3.56 (2.28-5.57) <i>P</i> < .0001	3.38 (2.08-5.49) <i>P</i> < .0001

^aData are presented as odds ratios (95% confidence intervals). NS, not significant.