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Physical Activity in Adults With Type 1 Diabetes

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Abstract

Purpose—The purpose of this study was to examine sociodemographic, clinical, and psychological factors associated with engaging in regular physical activity (PA) in adults with type 1 diabetes.

Methods—Secondary cross-sectional analysis based on data from the Type One Diabetes Exchange clinic registry was conducted. Adults 18 years old enrolled in the clinic registry who had completed PA self-report data ($n = 7153$) were included in this study.

Results—Mean age was 37.14 ± 17 years, and 54% ($n = 3840$) were men. Type 1 diabetes duration was 19.5 ± 13.5 years, and mean A1C level was $7.9\% \pm 1.5\%$ (62 mmol/mol). Twelve percent ($n = 848$) of the sample reported no PA; 55% ($n = 3928$) reported PA 1 to 4 days per week; and 33% ($n = 2377$) reported PA 5 days per week. Factors that were associated with increased odds of no PA were older age, less-than-excellent general health, increased body mass index, longer duration of diabetes, and increased depressive symptoms. More blood glucose meter checks per day decreased odds of no PA. Factors associated with lower odds of 5 days of PA included minority race/ethnicity, education, less-than-excellent general health, presence of a foot ulcer, increased body mass index, and depressive symptoms. Male sex, less-than-full-time employment, and being single increased the odds of 5 days of PA.

Conclusions—Several demographic, clinical, diabetes-related, and psychosocial factors were related to PA. Potential interventions may target those with depressive symptoms or self-reported poor general health, or they may be tailored to working adults who may find it harder to be physically active.

Diabetes is a complex chronic illness requiring lifelong medical care. In the United States, approximately 1.25 million people live with type 1 diabetes (T1DM), and >1 million of those are adults.¹ Self-management of diabetes requires multiple self-care behaviors, including being physically active.² Physical activity (PA) has been shown to have multiple

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health benefits for adults with T1DM, but engaging in regular PA requires insulin and food adjustment, with potential episodes of hypo- or hyperglycemia.³

Although there is mixed evidence that PA improves glycemic control as measured by A1C levels, there are known benefits, including improved weight loss, muscle strength,⁴ insulin sensitivity, mood, and, most importantly, optimization of long-term protection against cardiovascular disease.³ This protection is important, as at least 68% of people with diabetes (both T1DM and type 2 diabetes) die of some form of heart disease.⁵ In data from one European prospective trial of adults with T1DM ($n = 3250$; mean $\pm$ SD age, 33 ± 10 years), PA was found to have an inverse association with both all-cause mortality (in men and women) and cardiovascular disease (in women only).⁶ Increased sedentary behavior also places individuals at risk. Each additional hour of daily sedentary time (behaviors involving low levels of energy expenditure; eg, sitting) has been associated with lower levels of cardiorespiratory fitness,⁷ and lower levels of fitness are associated with higher lifetime risk of cardiovascular disease mortality.⁸

In the United States, there are no specific guidelines on how much PA is needed for optimal health benefits in those with T1DM.³ Current standards for adults with diabetes in general include a recommended 150 minutes per week of moderate-intensity aerobic PA.⁴ Similarly, Canadian guidelines recommend 150 minutes of moderate to vigorous PA per week.⁹ In a Canadian survey of adults with T1DM, >60% did not meet recommended levels of activity.¹⁰ Several barriers to PA in adults with T1DM have been identified, and they include work schedule, losing control of diabetes, and low fitness level, with the strongest factor being fear of hypoglycemia.¹¹

Attitudes and barriers to PA in adults with T1DM have been examined qualitatively. Barriers to PA included health and medical conditions, both diabetes and nondiabetes related; “time, work, and lifestyle concerns”; social and personal factors; and environmental factors.¹² Many adults recognized the link between PA and management of diabetes but did not fully understand it. However, “time, work, and lifestyle” was a greater barrier for most participants than was having diabetes. Working full-time, as well as demands at home, limited their ability to be physically active.¹² Additional health promotion education and support regarding incorporating PA safely into self-management, taking into account the special needs of adults with T1DM, may be needed.

Given the risks associated with lack of PA, the benefits of PA, and the low levels of PA in adults with T1DM, the purpose of this study was to examine the sociodemographic, clinical, and psychological factors associated with engaging in regular PA in a large sample of adults with T1DM enrolled in the Type One Diabetes Exchange clinic registry.¹³

Research Design and Methods

Design and Sample

We conducted a secondary cross-sectional analysis using data from the Type One Diabetes Exchange clinic registry, which includes participants from 67 US-based pediatric and adult endocrinology practices.¹³ There are several advantages to secondary data analysis: the

analysis of an existing data set, including the quick access to data already collected by a previous researcher; larger data sets than what might be feasible by primary data collection; and a savings in resources in terms of time, staff, and cost.¹⁴ These existing large data sets containing numerous variables of interest provide an opportunity to generate new knowledge for practice.¹⁵

Adults 18 years enrolled in the registry who had completed PA self-report data (n = 7153) were included in this study. Data were collected by questionnaire and chart review at the time of enrollment in the registry and were not collected to answer a particular research question. Appropriate Institutional Review Board approval was obtained for this secondary analysis.

Measures

After a review of the diabetes and PA literature, the independent variables were chosen according to their potential to affect levels of PA. Correlates of PA in this sample included the following:

Sociodemographic factors: age, sex, race/ethnicity, marital status, education, employment, and income

Clinical and diabetes-related factors: general health, body mass index (BMI), diabetes duration, A1C, use of pump versus injections for insulin delivery, number of blood glucose meter checks per day, use of continuous glucose monitoring, the presence of a foot ulcer, and diagnosis of autonomic or peripheral neuropathy

Psychological factor: depressive symptoms

Self-reported PA was assessed with a single question: “In a typical week, how many days do you spend at least 30 minutes doing any physical activities or exercises such as running, working out, yoga or Pilates, aerobics, sports, gardening, physical education in school or walking for exercise?” General health was also measured with a single question: “In general, how would you describe your health?” Possible answers were “excellent” “very good” “good” “fair” or “poor.” Depressive symptoms were measured with the Patient Health Questionnaire–8 (PHQ-8), a well-validated tool for detecting depressive disorders.¹⁶

Data Analysis

Statistical analyses included performing descriptive statistics for participant characteristics. Chi-square and independent *t* tests were used to compare (1) adults who were physically active 0 days (no PA) versus adults who were physically active at least 1 day and (2) adults meeting recommended PA guidelines (≥ 5 exercise days) versus adults who did not meet guidelines (<5 days). The independent variables listed above were found to be statistically significant (*P* < .05) in the bivariate analysis and were included in the multivariate analysis. Multivariate logistic regression modeling based on standard backward, forward, and stepwise regression was used to examine the outcome measures of no PA (PA = 0 days) and meeting recommended PA guidelines (PA ≥ 5 days).

Results

Sample Characteristics

A total of 7153 adults 18 years old with T1DM were included in these analyses. The mean age was 37.14 ± 17 years. A majority (89%) was white Non-Hispanic, and slightly more than half were women (54%). The mean duration of diabetes was 19.44 ± 13.48 years, with a mean A1C level of $7.9 \pm 1.5\%$ (62 mmol/mol). Mean BMI was 26.8 ± 5.1 , with 37% ($n = 2010$) overweight (BMI 25 kg/m^2) and 22% ($n = 1200$) obese (BMI 30 kg/m^2). Although 88% of the sample was physically active at least 1 day per week for 30 minutes ($n = 6305$), just one-third were physically active at least 5 days per week ($n = 2377$). Nine percent of the sample had a PHQ-8 score ≥ 10 . PHQ-8 scores were negatively correlated with number of days per week of exercise ($r = -.16$; $P < .0001$). Only 3% ($n = 183$) stated they had experienced a severe hypoglycemic episode (resulting in a seizure or coma) in the past 12 months (Table 1).

Factors Associated With No PA

Six factors were independently associated ($P < .05$) with no PA: age, general health, BMI, duration of diabetes, number of blood glucose meter checks per day, and depressive symptoms (Table 2). Factors that increased odds of no PA included each 1-year increase in age, self-reported health less than excellent, each 1-point increase in BMI, each additional 1-year duration of diabetes, and each 1-point increase in PHQ-8. Each 1 additional blood glucose meter check per day decreased the odds of having no PA.

Factors Associated With Achieving PA Recommendations

Nine sociodemographic, clinical, and psychological factors were independently associated ($P < .05$) with achieving ≥ 5 days of PA (Table 3). Two sociodemographic factors decreased the odds of achieving recommended PA. As compared with white race, being black, Asian, or >1 race decreased odds. Having a bachelor degree versus a high school diploma also decreased odds.

Three sociodemographic factors (sex, marital status, employment) increased the odds of achieving ≥ 5 days of PA: being male versus female; being single versus married; and being on disability, being retired, or having other employment, as compared with working full-time.

Three clinical and diabetes-related factors independently associated with decreased odds of achieving PA recommendations included increased BMI, less-than-excellent general health, and the presence of a foot ulcer. One psychological factor—increased depressive symptoms—decreased the odds of achieving the recommended PA.

Discussion

This secondary analysis of data from the Type One Diabetes Exchange clinic registry examined the self-reported PA in adults with T1DM and the factors associated with no PA and with achievement of general PA recommendations for adults. There has been limited research on factors associated with PA in this population.⁶ In this study, a majority was

physically active at least 1 day per week, while only one-third of the sample achieved PA recommendations. Furthermore, 37% were overweight and 22% were obese. Therefore, promotion of PA in this population is needed.

Additionally, adults who worked less than full-time were more likely to be active 5 days per week. It is not surprising that those who were working full-time found it more difficult to be physically active. Results from a previous secondary analysis of a longitudinal study of older adults with type 2 diabetes ($n = 974$) enrolled in the Detection of Ischemia in Asymptomatic Diabetics also revealed that working full- or part-time was associated with physical inactivity (adjusted odd ratio [OR] = 2.38, 95% confidence interval [95% CI] = 1.67–3.40; $P < .0001$).¹⁷ Workplace interventions that promote PA alone or as part of an overall health promotion intervention may assist full-time employees in improving levels of PA. One example of a workplace intervention aimed at employees is “sit less, move more.” In this program, participants are encouraged to achieve a gradual increase in steps every 2 weeks, which has resulted in significant decreases in occupational sitting time and improvements in step counts as compared with a control group.¹⁸ In a 2009 meta-analysis of workplace PA interventions, a positive effect (effect size = 0.21) was found on PA behavior as well as less absenteeism (effect size = 0.19).¹⁹ In contrast, data from a recent systematic review of workplace pedometer interventions revealed insufficient evidence to assess their effectiveness, given the low quality of data provided in each report.²⁰ The current study adds to the literature in identifying the lower levels of ideal PA in full-time employees as compared with those working less than full-time.

Three additional factors were significantly associated with no PA and achievement of PA recommendations: less-than-excellent general health, higher BMI, and increased depressive symptoms. Adults who rated their health as less than excellent were more likely to report no PA and less likely to achieve ideal PA levels. In a cross-sectional study of self-reported general health and lifestyle factors, adults (40–44 years old) who reported adverse lifestyle behaviors also reported poor general health.²¹ We concluded that this 1 self-report question on general health might be a suitable measure for providers to assess subjective health and target health promotion efforts. The sample in the Type One Diabetes Exchange clinic registry was young (mean age, 37.14 ± 17 years) but had a mean duration of diabetes of almost 20 years, which might affect their perception of general health and reflect unhealthy lifestyle behaviors. There is also a need to fully understand the factors that contribute to this self-assessment of general health in this population, as well as its perceived barriers to PA.

In this analysis, higher BMI was associated with increased odds of reporting no PA and decreased odds of achieving PA guidelines. These findings are similar to those found in the Detection of Ischemia in Asymptomatic Diabetics study of older adults with type 2 diabetes.¹⁷ In that sample, each 1-unit increase in BMI was associated with no PA at baseline (adjusted OR = 1.06, 95% CI = 1.04–1.09; $P < .0001$) and was predictive of no PA at 5 years (adjusted OR = 1.06, 95% CI = 1.02–1.11; $P = .003$). Weight gain and lack of PA may explain the increased prevalence of cardiometabolic risk factors in adults with T1DM.²² Obesity in individuals with T1DM has been associated with increased risks for macrovascular disease, retinopathy, and metabolic syndrome.²³ In the current sample, almost

60% were overweight or obese, and this combination of elevated BMI and insufficient PA may indicate higher risk of cardiovascular disease.

When depression is a comorbid condition to diabetes, each condition is made worse in the presence of the other.²⁴ In this sample, there was a low but significant negative correlation between depressive symptoms and exercise, but 9% had PHQ-8 scores ≥ 10 , indicating depressive symptoms. This rate is similar to a sample of adolescents and adults with T1DM ($n = 209$), wherein 11% had high levels of depressive symptoms.²⁵ In a previous analyses of the Type One Diabetes Exchange clinic registry data, elevated depressive symptoms were associated with higher A1C levels, more missed insulin doses, and more frequent diabetic ketoacidosis events.²⁶ In this sample, higher PHQ-8 scores were associated with increased odds of no PA and decreased odds of achieving PA guidelines. The finding of the inverse correlation of PA and depression in this large cohort supports the results of the Pittsburgh Epidemiology of Diabetes Complications prospective study.²⁷ In that sample of adults with T1DM ($n = 264$), levels of PA (measured by total estimated energy expenditure) were significantly and negatively correlated with depressive scores. There is prior evidence that increasing levels of PA have a positive impact on depressive symptoms. In a sample of adults with heart disease and type 2 diabetes, those randomized to a 16-week exercise intervention had half the prevalence of depressive symptoms at the outcome (17% vs 34%) as compared with the control group.²⁸

Several important diabetes-related factors were not found to be significant predictors of PA behavior, such as A1C and recent episodes of severe hypoglycemia. In this sample, A1C was only slightly above recommended levels. Furthermore, exercise is generally not expected to significantly affect A1C in adults with T1DM.³ In this sample, reports of severe hypoglycemia were low (3%). This may be due to the wording of the question in the Type One Diabetes Exchange clinic registry enrollment form: “In the past 12 months, has the participant had a severe hypoglycemic episode in which seizure or coma occurred?” Nevertheless, participants may have had multiple unpleasant episodes of hypoglycemia during the year. These episodes may not have been severe enough to cause seizure or coma but enough to elicit a fear of hypoglycemia, which has been found to be a barrier to PA in this population.¹¹

Study Limitations

There are several limitations to this analysis. First, data on PA were collected via self-report and did not include any information on intensity of the activity. Self-reported vigorous PA has been overreported as compared with accelerometer activity count data,²⁹ while other researchers have found low correlations between self-report and light- to moderate-intensity PA.³⁰ More detailed descriptions of activity need to be collected to fully assess patterns of PA in this population. Additionally, although the incidence of severe hypoglycemic events in this sample was low, no data were collected on fear of hypoglycemia. However, almost half of these participants made adjustments to insulin before or during PA, and about one-quarter made adjustments to insulin doses after PA. This may have been an attempt to minimize potential episodes of hypoglycemia. More information on how this fear directly affects adults with T1DM may assist providers in promoting safe, appropriate PA.

Practice Implications

These data highlight some of the sociodemographic, clinical, diabetes-related, and psychological factors associated with patterns of PA in a large sample of adults with T1DM. General health, elevated BMI, and depressive symptoms were associated with no PA as well as achievement of adequate PA. To effectively engage this population in adequate levels of PA through appropriate interventions, more needs to be done to better understand its unique barriers to PA. Moreover, providers need to understand the factors that facilitate PA. This may include encouraging patients to exercise with others, which provides motivation as well as security, or providing one-to-one advice from a health or fitness advisor, especially one familiar with diabetes.¹²

There is a need for clinicians to discuss specific management of PA, including strategies to adjust insulin doses and food requirements before, during, and after PA to minimize hypo- or hyperglycemic events. Other factors to be considered when counseling patients include an understanding of the difference between aerobic and anaerobic exercise, as well as the role of resistance and intermittent high-intensity exercise, which may have potential role in minimizing hypoglycemia during and after exercise.³¹

Comprehensive diabetes care has a focus on glycemic control and the management of A1C depending on level of individual risk.⁴ Although PA is a component of this comprehensive care approach, the small percentage of adults meeting recommended levels of PA indicates that this aspect of diabetes care may not be strongly encouraged. Increasing levels of PA has the potential to improve insulin sensitivity, body weight, and depressive symptoms; reduce inflammation; and, most important, protect against cardiovascular disease. PA should be strongly recommended in appropriate patients with T1DM.

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References

1. Prime Group for JDRF. Type 1 diabetes, 2010 <http://jdrf.org/about-jdrf/fact-sheets/type-1-diabetes-facts/>. Updated 2011. Accessed March 18, 2014.
2. Mulcahy K, Maryniuk M, Peeples M, et al. Diabetes self-management education core outcomes measures. *Diabetes Educ.* 2003;29(5):768–770, 773. [PubMed: 14603868]
3. Galassetti P, Riddell MC. Exercise and type 1 diabetes (T1DM). *Compr Physiol.* 2013;3(3):1309–1336. [PubMed: 23897688]
4. American Diabetes Association. Standards of medical care in diabetes: 2014. *Diabetes Care.* 2014;37(suppl 1):S14–S80. [PubMed: 24357209]
5. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics—2015 update: a report from the American Heart Association. *Circulation.* 2015;131(4):e29–e322. [PubMed: 25520374]

6. Tielemans SM, Soedamah-Muthu SS, De Neve M, et al. Association of physical activity with all-cause mortality and incident and prevalent cardiovascular disease among patients with type 1 diabetes: the EURODIAB prospective complications study. *Diabetologia*. 2013;56(1):82–91. [PubMed: 23052062]
7. Kulinski JP, Khara A, Ayers CR, et al. Association between cardiorespiratory fitness and accelerometer-derived physical activity and sedentary time in the general population. *Mayo Clin Proc*. 2014;89(8):1063–1071. [PubMed: 25012770]
8. Berry JD, Willis B, Gupta S, et al. Lifetime risks for cardiovascular disease mortality by cardiorespiratory fitness levels measured at ages 45, 55, and 65 years in men: the Cooper Center longitudinal study. *J Am Coll Cardiol*. 2011;57(15):1604–1610. [PubMed: 21474041]
9. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee; Sigal RJ, Armstrong MJ, Colby P, et al. Physical activity and diabetes. *Can J Diabetes*. 2013;37(suppl 1):S40–S4. [PubMed: 24070962]
10. Plotnikoff RC, Taylor LM, Wilson PM, et al. Factors associated with physical activity in Canadian adults with diabetes. *Med Sci Sports Exerc*. 2006;38(8):1526–1534. [PubMed: 16888470]
11. Brazeau AS, Rabasa-Lhoret R, Strychar I, Mircescu H. Barriers to physical activity among patients with type 1 diabetes. *Diabetes Care*. 2008;31(11):2108–2109. [PubMed: 18689694]
12. Lascar N, Kennedy A, Hancock B, et al. Attitudes and barriers to exercise in adults with type 1 diabetes (T1DM) and how best to address them: A qualitative study. *PLoS One*. 2014;9(9):e108019. [PubMed: 25237905]
13. Beck RW, Tamborlane WV, Bergenstal RM, et al. The T1D exchange clinic registry. *J Clin Endocrinol Metab*. 2012;97(12): 4383–4389. [PubMed: 22996145]
14. Miller RL, Brewer JD, eds. *The A-Z of Social Research: A Dictionary of Key Social Science Research Concepts*. London, UK: Sage Publications Ltd; 2003.
15. Magee T, Lee SM, Giuliano KK, Munro B. Generating new knowledge from existing data: the use of large data sets for nursing research. *Nurs Res*. 2006;55(2):S50–S56. [PubMed: 16601635]
16. Kroenke K, Spitzer RL, Williams JB, Lowe B. The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. *Gen Hosp Psychiatry*. 2010;32(4):345–359. [PubMed: 20633738]
17. McCarthy MM, Davey J, Wackers FJ, Chyun DA. Predictors of physical inactivity in men and women with type 2 diabetes from the detection of ischemia in asymptomatic diabetics (DIAD) study. *Diabetes Educ*. 2014;40(5):678–687. [PubMed: 24942531]
18. Puig-Ribera A, Bort-Roig J, Gonzalez-Suarez AM, et al. Patterns of impact resulting from a “sit less, move more” web-based program in sedentary office employees. *PLoS One*. 2015;10(4): e0122474. [PubMed: 25830782]
19. Conn VS, Hafdahl AR, Cooper PS, Brown LM, Lusk SL. Meta-analysis of workplace physical activity interventions. *Am J Prev Med*. 2009;37(4):330–339. [PubMed: 19765506]
20. Freak-Poli RL, Cumpston M, Peeters A, Clemes SA. Workplace pedometer interventions for increasing physical activity. *Cochrane Database Syst Rev*. 2013;4:CD009209.
21. Jepsen R, Dogיסso TW, Dysvik E, Andersen JR, Natvig GK. A cross-sectional study of self-reported general health, lifestyle factors, and disease: the hordaland health study. *PeerJ*. 2014;2:e609. [PubMed: 25289193]
22. Leroux C, Brazeau AS, Gingras V, Desjardins K, Strychar I, Rabasa-Lhoret R. Lifestyle and cardiometabolic risk in adults with type 1 diabetes: a review. *Can J Diabetes*. 2014;38(1):62–69. [PubMed: 24485215]
23. Polsky S, Ellis SL. Obesity, insulin resistance, and type 1 diabetes mellitus. *Curr Opin Endocrinol Diabetes Obes*. 2015;22(4):277–282. [PubMed: 26087341]
24. Holt RI, de Groot M, Golden SH. Diabetes and depression. *Curr Diab Rep*. 2014;14(6):491. [PubMed: 24743941]
25. Knychala MA, Jorge ML, Muniz CK, Faria PN, Jorge PT. Highrisk alcohol use and anxiety and depression symptoms in adolescents and adults with type 1 diabetes mellitus: a cross-sectional study. *Diabetol Metab Syndr*. 2015;7:24. [PubMed: 25821523]
26. Trief PM, Xing D, Foster NC, et al. Depression in adults in the T1D exchange clinic registry. *Diabetes Care*. 2014;37(6):1563–1572. [PubMed: 24855157]

27. Lloyd CE, Pambianco G, Orchard TJ. Does diabetes-related distress explain the presence of depressive symptoms and/or poor self-care in individuals with type 1 diabetes? *Diabet Med.* 2010;27(2):234–237. [PubMed: 20546270]
28. Gallagher R, Zelestis E, Hollams D, Denney-Wilson E, Kirkness A. Impact of the healthy eating and exercise lifestyle programme on depressive symptoms in overweight people with heart disease and diabetes. *Eur J Prev Cardiol.* 2014;21(9):1117–1124. [PubMed: 23572477]
29. Mader U, Martin BW, Schutz Y, Marti B. Validity of four short physical activity questionnaires in middle-aged persons. *Med Sci Sports Exerc.* 2006;38(7):1255–1266. [PubMed: 16826022]
30. Strath SJ, Bassett DR Jr, Swartz AM. Comparison of the college alumnus questionnaire physical activity index with objective monitoring. *Ann Epidemiol.* 2004;14(6):409–415. [PubMed: 15246329]
31. Yardley JE, Sigal RJ. Exercise strategies for hypoglycemia prevention in individuals with type 1 diabetes. *Diabetes Spectr.* 2015;28(1):32–38. [PubMed: 25717276]

Table 1

Demographic and Clinical Characteristics (n = 7153)

Characteristic	Result
Age	37.14 ± 17
Sex: female	54 (3840)
Race/ethnicity	
White non-Hispanic	89 (6363)
Black non-Hispanic	3.2 (225)
Hispanic	4.9 (348)
Marital status	
Single	44 (3124)
Married	44 (3142)
Divorced	5 (363)
Education	
<High school diploma	5 (319)
High school diploma/GED	43 (3033)
Associate degree	8 (558)
Bachelor degree	27 (1908)
Employment	
Full-time	43 (3018)
Part-time	12 (834)
Student	23 (1644)
Annual income	
<25 000	10 (686)
25 000 to <50 000	15 (1054)
50 000 to <100 000	27(1940)
100 000	26 (1872)
Duration of type 1 diabetes, y	19.5 ± 13.5
Hemoglobin A1C, % (mmol/mol)	7.9 ± 1.5 (62)
No. of blood sugar checks per day	
3–4	37 (2679)
5–6	28 (1968)
7–9	15 (1087)
Body mass index, kg/m ²	26.8 ± 5.1
Overweight, 25	37 (2010)
Obese, 30	22 (1200)
Patient Health Questionnaire–8 score (depression), 10	9 (635)
Foot ulcer present: yes	0.6 (44)
Diagnosed with peripheral neuropathy	11 (781)
Physical activity	
0 d/wk	12 (848)
30 min, 1–4 d/wk	55 (3928)

Characteristic	Result
30 min, 5 d/wk	33 (2377)
Severe hypoglycemic episode in past year	3 (183)
Change insulin dose	
Before/during physical activity	48 (2995)
After physical activity	27 (1693)

^aData presented as mean $\pm$ SD or % (n).

Table 2

Factors Associated With No Physical Activity

Factor	Odds Ratio (95% CI)	P Value
Age (each 1-year increase)	1.02 (1.002–1.019)	.014
No. of meter checks per day (each 1-meter check increase)	0.91 (0.86–0.95)	<.0001
Body mass index, kg/m ² (each 1-unit increase)	1.02 (1.01–1.04)	.016
Diabetes duration (each 1-year increase)	1.02 (1.01–1.03)	.003
PHQ-8 (each 1-point increase)	1.06 (1.03–1.08)	<.0001
General health		
Excellent	Reference	
Good	1.61 (1.06–2.45)	.025
Fair	2.3 (1.43–3.7)	.001
Poor	4.04 (2.11–7.73)	<.0001

Abbreviations: CI, confidence interval; PHQ-8, Patient Health Questionnaire–8.

Table 3
Factors Associated With Achieving Recommended Physical Activity Guidelines (≥ 5 d/wk)

Factor	Odds Ratio (95% CI)	P Value
Sex		
Female	Reference	
Male	1.3 (1.09–1.44)	.002
Race/ethnicity		
White	Reference	
Black	0.65 (0.43–0.98)	.042
Asian	0.40 (0.17–0.90)	.028
>1 race	0.54 (0.31–0.95)	.033
Education level		
<High school diploma	Reference	
Bachelor degree	0.54 (0.38–0.77)	.0007
Employment		
Full-time	Reference	
On disability	1.53 (1.01–2.3)	.043
Retired	2.33 (1.77–3.06)	<.0001
Other	2.94 (1.75–4.95)	<.0001
Marital status		
Married	Reference	
Single	1.55 (1.28–1.88)	<.0001
General health		
Excellent	Reference	
Very good	0.50 (0.41–0.62)	<.0001
Good	0.40 (0.32–0.51)	<.0001
Fair	0.36 (0.26–0.49)	<.0001
Poor	0.19 (0.10–0.37)	<.0001
Foot ulcer		
No	Reference	
Yes	0.13 (0.03–0.58)	.007

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Factor	Odds Ratio (95% CI)	P Value
Body mass index (each 1-unit increase)	0.95 (0.93–0.96)	<.0001
PHQ-8 (each 1-point increase)	0.96 (0.95–0.99)	.001

Abbreviations: CI, confidence interval; PHQ-8, Patient Health Questionnaire–8.