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ASSOCIATION BETWEEN SELF-REPORTED TYPE 2 DIABETES MELLITUS AND PHYSICAL FUNCTION IN OLDER AMERICAN INDIANS

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To the Editor

Type 2 diabetes mellitus (T2DM) is a common and serious chronic disorder associated with significant economic burden and profound negative effects on health, well-being, and quality of life.¹ Although vascular complications and related medical comorbidities have long been thought to explain the adverse health effects of T2DM, recent studies suggest that impaired function and mobility may also contribute.² A growing number of studies indicate that T2DM is strongly associated with impairment in physical function, in turn a strong predictor of dependency, morbidity, and mortality in older adults.^{2,3}

Older American Indians (also called Native American) have a disproportionately high prevalence of T2DM⁴ and physical disability⁵ and experience significantly higher T2DM-related mortality,⁶ but research regarding the association between T2DM and physical function in American Indians is lacking, and few studies in any population have assessed this relationship using performance-based physical functioning measures.^{7–9} The current study was designed to assess the relationship between self-reported T2DM and physical functioning in a population of older American Indians.

METHODS

Data for this investigation were drawn from the Native Elder Care Study, a cross-sectional, community-based investigation of 505 elderly adults from an American Indian tribe. Participants were community-dwelling, cognitively intact tribal members aged 55 and older. Those with missing data on T2DM or physical function (n = 18) or on covariates of interest (n = 104) were excluded, leaving a final sample of 383 adults.

Data were collected in in-person assessments and included in-depth information on physical functioning, mental and physical health, and personal assistance needs, including use of mobility aids. Presence of T2DM was assessed using self-reported physician diagnosis. Physical function was measured using the Short Performance Physical Battery (SPPB), an objective, well-validated assessment tool for evaluating lower extremity function in older persons.³ The SPPB measures three domains of lower body function: balance, gait speed, and ability to rise from and lower to a sitting position unassisted, assessed using chair stands.³ Other factors known or suspected to be associated with T2DM or physical function were also evaluated, including demographic and lifestyle characteristics and health-related factors (Table 1). The independent association between physical function and T2DM was evaluated using multiple logistic regression.

RESULTS

The prevalences of T2DM (42%) and poor physical function (44%) were high. Those with poor physical function were twice as likely to report a diagnosis of T2DM after adjustment for multiple demographic, lifestyle, and health-related factors (Table 1). Additional adjustment for average annual income did not alter this relationship (odds ratio = 2.1, 95% confidence interval = 1.0–4.3). T2DM was also significantly and inversely associated with SPPB total score (Table 1).

Likewise, T2DM was significantly and inversely associated with all components of the SPPB after adjustment for demographic factors, with participants having approximately 20% less risk per unit increment in gait speed, standing balance, and chair stands. Additional adjustment for lifestyle factors, pain, sleep, and medical history slightly attenuated these risk estimates. Participants with T2DM were also approximately twice as likely to report using a mobility aid (Table 1).

DISCUSSION

This is the first study to investigate the relationship between T2DM and physical function in American Indians and among the first to assess this association using objective tests of lower limb function.^{7–9} Prevalence of T2DM and poor physical function were high in this population. As expected, T2DM was significantly and negatively associated with physical function, consistent with findings of previous studies in other populations.^{9–13} In agreement with some,^{2,13,14} but not all⁹ studies, the relationship between T2DM and poor physical function in this population of elderly American Indians was independent of socioeconomic status, obesity, visual impairment, pain, depression, and comorbid chronic conditions. This association was also independent of sleep deficits, a factor associated with risk for T2DM¹⁵ and poor physical function.¹⁶

Although the cross-sectional nature of the data limits evaluation of causal relationships, it is likely that the observed inverse association between T2DM and physical function is bidirectional. Declining physical function can lead to lack of physical activity, depression, poorer sleep, obesity, and adverse changes in insulin resistance and glucose regulation, all significant predictors of incident T2DM.^{15,17,18} T2DM itself has been associated with

accelerated loss of leg muscle strength¹² and subsequent physical disability¹³ in older adults that were independent of demographic characteristics, common comorbidities, body mass index, and other factors. T2DM can also lead to cardiovascular disease, neuropathy, fatigue, visual impairment, peripheral arterial disease, depression, and poor sleep,^{10–12,19} all of which can contribute to poor physical function^{10,11} and incident disability.²⁰

The current study had several strengths, including the population-based design; large and representative study sample; high response rate; objective, well-validated measures of physical functioning; and comprehensive assessment of potential demographic, lifestyle, and health-related correlates. Limitations of the study include the cross-sectional nature of the data, which precludes causal inference, and the reliance on self-report in ascertaining T2DM. Information was also lacking on T2DM duration and on certain potential mediating factors, including peripheral neuropathy, glycemic control, and peripheral arterial disease. Study participants were restricted to community-dwelling, noncognitively impaired persons aged 55 and older, limiting generalizability.

CONCLUSIONS

Self-reported T2DM was strongly and independently associated with poor physical functioning in a sample of older American Indians. Larger prospective studies are needed to further investigate this association, to assess causal relationships, and to evaluate potential underlying mechanisms.

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Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper. None of the authors have a conflict of interest of relevance to this paper.

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References

1. Huang ES, Basu A, O'Grady M, et al. Projecting the future diabetes population size and related costs for the US. *Diabetes Care*. 2009; 32:2225–2229. [PubMed: 19940225]
2. Sinclair AJ, Conroy SP, Bayer AJ. Impact of diabetes on physical function in older people. *Diabetes Care*. 2008; 31:233–235. [PubMed: 18024850]
3. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower-extremity function—association with self-reported disability and prediction of mortality and nursing-home admission. *J Gerontol*. 1994; 49:M85–M94. [PubMed: 8126356]
4. Lee ET, Welty TK, Cowan LD, et al. Incidence of diabetes in American Indians of three geographic areas: The Strong Heart Study. *Diabetes Care*. 2002; 25:49–54. [PubMed: 11772900]

5. Goins RT, Spencer SM, Roubideaux YD, et al. Differences in functional disability of rural American Indian and white older adults with comorbid diabetes. *Res Aging*. 2005; 27:643–658.
6. Schiller, J, Lucas, J, Ward, B. , et al. Summary Health Statistics for US Adults: National Health Interview Survey, 2010. Hyattsville, MD: National Center for Health Statistics; 2012. (DHHS Publication No. (PHS) 2012–1580)
7. De Rekeneire N, Resnick HE, Schwartz AV, et al. Diabetes is associated with subclinical functional limitation in nondisabled older individuals: The Health, Aging, and Body Composition study. *Diabetes Care*. 2003; 26:3257–3263. [PubMed: 14633811]
8. Gregg EW, Mangione CM, Cauley JA, et al. Diabetes and incidence of functional disability in older women. *Diabetes Care*. 2002; 25:61–67. [PubMed: 11772902]
9. Volpato S, Blaum C, Resnick H, et al. Comorbidities and impairments explaining the association between diabetes and lower extremity disability —the Women’s Health and Aging Study. *Diabetes Care*. 2002; 25:678–683. [PubMed: 11919124]
10. Bruce DG, Davis WA, Davis TM. Longitudinal predictors of reduced mobility and physical disability in patients with type 2 diabetes: The Fremantle Diabetes Study. *Diabetes Care*. 2005; 28:2441–2447. [PubMed: 16186277]
11. Dolan NC, Liu K, Criqui MH, et al. Peripheral artery disease, diabetes, and reduced lower extremity functioning. *Diabetes Care*. 2002; 25:113–120. [PubMed: 11772911]
12. Park SW, Goodpaster BH, Strotmeyer ES, et al. Accelerated loss of skeletal muscle strength in older adults with type 2 diabetes: The Health, Aging, and Body Composition Study. *Diabetes Care*. 2007; 30:1507–1512. [PubMed: 17363749]
13. Wray LA, Ofstedal MB, Langa KM, et al. The effect of diabetes on disability in middle-aged and older adults. *J Gerontol A Biol Sci Med Sci*. 2005; 60A:1206–1211.
14. Sayer AA, Dennison EM, Syddall HE, et al. Type 2 diabetes, muscle strength, and impaired physical function: The tip of the iceberg? *Diabetes Care*. 2005; 28:2541–2542. [PubMed: 16186295]
15. Cappuccio FP, D’Elia L, Strazzullo P, et al. Quantity and quality of sleep and incidence of type 2 diabetes—a systematic review and meta-analysis. *Diabetes Care*. 2010; 33:414–420. [PubMed: 19910503]
16. Dam TT, Ewing S, Ancoli-Israel S, et al. Association between sleep and physical function in older men: The Osteoporotic Fractures in Men Sleep Study. *J Am Geriatr Soc*. 2008; 56:1665–1673. [PubMed: 18759758]
17. Mezuk B, Eaton WW, Albrecht S, et al. Depression and type 2 diabetes over the lifespan: A meta-analysis. *Diabetes Care*. 2008; 31:2383–2390. [PubMed: 19033418]
18. Rader DJ. Effect of insulin resistance, dyslipidemia, and intra-abdominal adiposity on the development of cardiovascular disease and diabetes mellitus. *Am J Med*. 2007; 120(3 Suppl 1):S12–S18.
19. Barone MT, Menna-Barreto L. Diabetes and sleep: A complex cause-and-effect relationship. *Diabetes Res Clin Pract*. 2011; 91:129–137. [PubMed: 20810183]
20. Penninx BWJH, Leveille S, Ferrucci L, et al. Exploring the effect of depression on physical disability: Longitudinal evidence from the established populations for epidemiologic studies of the elderly. *Am J Public Health*. 1999; 89:1346–1352. [PubMed: 10474551]

Table 1

Association Between Reported Physician Diagnosis of Diabetes Mellitus and Physical Function in Older American Indian (n = 383 American Indian Tribal Members Aged 55)

Physical Function	Odds Ratio (95% Confidence Interval) <i>P</i> -Value			
	Model 1	Model 2	Model 3	Model 3
Total Short Physical Performance Battery score				
8 (n = 170) >8 (reference, n = 213)	1.73 (1.14–2.60) .009	2.07 (1.31–3.26) .002	1.79 (1.08–2.97) .02	1.96 (1.14–3.39) .02
Per unit increment	0.91 (0.86–0.96) .001	0.91 (0.85–0.96) .002	0.92 (0.86–0.98) .01	0.92 (0.86–1.00) .05
Components per unit increment				
Gait function	0.80 (0.69–0.93) .004	0.81 (0.69–0.96) .01	0.85 (0.71–1.02) .08	0.86 (0.72–1.02) .09
Balance	0.80 (0.70–0.91) .001	0.80 (0.69–0.93) .002	0.81 (0.69–0.96) .01	0.85 (0.72–0.99) .04
Chair stand	0.83 (0.73–0.95) .008	0.83 (0.71–0.96) .01	0.86 (0.72–1.02) .08	0.87 (0.73–1.03) .11
Use of a mobility aid (n = 131)	1.63 (1.13–2.35) .009	1.86 (1.25–2.77) .002	2.00 (1.22–3.26) .01	1.72 (1.02–2.91) .04
Yes (n = 131); No (reference, n = 252) ^a				

Model 1 adjusted for age.

Model 2 adjusted for age, sex, education, and marital status.

Model 3 adjusted for age, sex, education, marital status, lifestyle factors (current smoker, regular physical activity, alcohol consumption), body mass index (BMI), depression (Center for Epidemiologic Studies Depression Scale score < 16), sleep deficit (sleep duration 6 hours, daytime sleepiness), vision loss, trauma/injury, pain (Medical Outcomes Study 8-item Short Form pain score), and chronic pain.

Model 4 adjusted for age, sex, education, marital status, lifestyle factors, BMI, depression, sleep deficit, vision loss, trauma/injury, pain, chronic pain conditions, hypertension, cardiovascular disease (reported heart attack, heart failure, or angina pectoris), and kidney disease.

Additional adjustment for income did not appreciably alter the association between diabetes mellitus and poor physical function (odds ratio = 2.1, 95% confidence interval = 1.01–4.32).

^aCane, crutch, walker, or wheelchair.