

Diabetes-Related Complications, Glycemic Control, and Falls in Older Adults

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COMPOSITION STUDY

OBJECTIVE — Older adults with type 2 diabetes are more likely to fall, but little is known about risk factors for falls in this population. We determined whether diabetes-related complications or treatments are associated with risk of falls in older diabetic adults.

RESEARCH DESIGN AND METHODS — In the Health, Aging, and Body Composition cohort of well-functioning older adults, participants reported falls in the previous year at annual visits. Odds ratios (ORs) for more frequent falls among 446 diabetic participants whose mean age was 73.6 years, with an average follow-up of 4.9 years, were estimated with continuation ratio models.

RESULTS — In the first year, 23% reported falling; 22, 26, 30, and 31% fell in subsequent years. In adjusted models, reduced peroneal nerve response amplitude (OR 1.50 [95% CI 1.07–2.12], worst quartile versus others); higher cystatin-C, a marker of reduced renal function (1.38 [1.11–1.71], for 1 SD increase); poorer contrast sensitivity (1.41 [0.97–2.04], worst quartile versus others); and low A1C in insulin users (4.36 [1.32–14.46], A1C \leq 6 vs. $>$ 8%) were associated with risk of falls. In those using oral hypoglycemic medications but not insulin, low A1C was not associated with risk of falls (1.29 [0.65–2.54], A1C \leq 6 vs. $>$ 8%). Adjustment for physical performance explained some, but not all, of these associations.

CONCLUSIONS — In older diabetic adults, reducing diabetes-related complications may prevent falls. Achieving lower A1C levels with oral hypoglycemic medications was not associated with more frequent falls, but, among those using insulin, A1C \leq 6% increased risk of falls.

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Older adults with type 2 diabetes have an increased risk of falls, but little is known about risk factors for falls in this population (1–4). Factors of particular concern include diabetes-related complications of peripheral neu-

ropathy, reduced vision, and renal function. Insulin therapy is associated with increased falls (3,5), possibly because of more severe disease and/or hypoglycemic episodes. Reduced balance, strength, and gait are likely intermediaries

in any association between diabetes-related complications and risk of falls. Previous studies of falls among older diabetic adults were cross-sectional or had limited data characterizing glycemic control and diabetes-related complications. We used longitudinal data for diabetic participants in the Health, Aging, and Body Composition (Health ABC) Study to determine whether factors associated with diabetes progression or treatment increase risk of falls and whether associations are mediated by poor performance on tests of balance, gait, and strength.

RESEARCH DESIGN AND METHODS

Health ABC is a prospective study of 3,075 men and women aged 70–79 years recruited at University of Pittsburgh, Pittsburgh, Pennsylvania, and University of Tennessee, Memphis, Tennessee. Participants who reported any difficulty with activities of daily living, walking up 10 steps, or walking a quarter of a mile were excluded. Study procedures were approved by the institutional review boards, and participants provided written informed consent. Baseline examinations occurred during 1997–1998. Participants returned for annual visits.

Diabetes

Diabetes at baseline was ascertained by self-report of a physician diagnosis, self-reported use of hypoglycemic medication, or an elevated fasting glucose level (\geq 126 mg/dl) or 2-h oral glucose tolerance test (OGTT) (\geq 200 mg/dl). Of 2,940 participants with baseline data on diabetes, 719 (24%) participants had diabetes. Of these, 446 had peripheral nerve function measured 3 years after baseline and are included in these analyses. At baseline, the excluded 273 participants had similar A1C and diabetes duration but reduced renal function, poorer physical performance, and more frequent falls.

Falls

At annual visits, participants were asked: “In the past 12 months, have you fallen and landed on the floor or ground?” Possible responses for number of falls were 1, 2–3, 4–5, or \geq 6. These analyses include falls that occurred from baseline to visit six, reported at the first through fifth fol-

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Abbreviations: CMAP, compound muscle action potential; cysC, cystatin-C; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; Health ABC, Health, Aging, and Body Composition; NCV, nerve conduction velocity; OGTT, oral glucose tolerance test; SBP, systolic blood pressure.

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low-up visits (visit 2–visit 6). Average number of follow-up visits among participants included in these analyses was 4.9 (range 2.9–5.4) years. Of the 446 participants, 27 (6%) died between visit 4 and visit 6, and 11 (2.5%) did not complete visit 6 for other reasons.

Diabetes-related complications

At visit 3, high-contrast distance visual acuity, contrast sensitivity, and depth perception were measured. Peripheral nerve function was measured at visit 4. Light touch discrimination was measured on a warmed great toe using Von-Frey type esthesiometer probes. Lower extremity vibration sensitivity was measured with the “method of limits” using the VSA-3000 Vibratory Sensory Analyzer (Medoc, Minneapolis, MN) (6). Motor nerve conduction studies of the peroneal nerve were conducted using the XL-Tek NeuroMax 8 (Oakville, ON, Canada) (6). Peroneal nerve compound muscle action potential (CMAP) amplitude was determined at the popliteal fossa, fibular head, and ankle. Nerve conduction velocity (NCV) was determined between the ankle and the popliteal fossa or fibular head. NCV results >80 m/s are outside the physiological range and were excluded. Estimated glomerular filtration rate (eGFR) at baseline was calculated with the abbreviated Modification of Diet in Renal Disease equation, and eGFR <60 ml/min per 1.73 m² was defined as chronic kidney disease (7).

Physical performance

Physical performance tests were obtained at baseline, visit 4, and visit 6. Strength was additionally measured at visit 2. Test methods have been described previously (8,9). Briefly, participants completed a 6-m walk at their usual speed, a 6-m narrow walk, and five chair stands. Standing balance was assessed with semi-tandem, full tandem, and one-leg balance stands. Grip strength was assessed on the stronger hand with a handheld dynamometer (Jamar; Sammons Preston, Bolingbrook, IL). Knee extensor strength was measured on the right leg using an isokinetic dynamometer (125 AP; Kin-Com, Chattanooga, TN).

Laboratory measurements

Fasting plasma glucose, OGTT, A1C, and serum creatinine were measured using standard procedures. Cystatin-C (cysC) was measured on baseline serum stored at -70°C for an average of 6.5 years using a

BNII nephelometer (Dade Behring Inc., Deerfield, IL) using a particle-enhanced immunonephelometric assay (N Latex Cystatin C). Intra- and interassay coefficients of variation for cysC were 2.0–2.8 and 2.3–3.1%, respectively.

Other measurements

Blood pressure was measured with the participant seated and then 1 minute after standing up (baseline, visit 2, visit 4, and visit 6). Postural hypotension was estimated as the difference between the seated and standing measurements. Change in weight between visits was categorized as stable weight (change of <2 kg) or weight loss or weight gain (change of ≥ 2 kg). Participants were asked to bring all prescription and over-the-counter medications used in the previous 2 weeks to all visits except visit 4. Medications were coded using the Iowa Drug Information System (10). Cognitive function was assessed with the Teng Mini-Mental State examination (baseline, visit 3, and visit 5). Depression was assessed with the Center for Epidemiologic Studies Depression Scale (baseline and visit 3). History of stroke was ascertained by self-report at all visits.

Statistical analyses

Some measures were obtained at more than one visit. Linear interpolation was used to estimate A1C values. For weight loss, the closest nonmissing value was used. For medication use, we averaged the reports of current use at the beginning and end of each interval. For other variables, the last value was carried forward. Variables measured only once, including vision and peripheral nerve function, were treated as fixed.

Continuation ratio models (11) were used to assess potential predictors of falls. Because participants reported falls as none, 1, 2–3, 4–5, or ≥ 6 , it was not possible to use the rate or number of falls as an outcome. In the continuation ratio model, this ordinal variable for number of falls was modeled as a sequence of dichotomous outcomes or stages of continuation: first, any falls versus none; then among those with at least one fall, ≥ 2 versus 1; and so forth. An intercept for each stage of the outcome was included in the model, flexibly modeling the risk of continuation at each stage. The odds ratio (OR) for each predictor is interpretable as the relative increase in odds of continuation per unit increase in the predictor. These ORs are assumed to be constant

across stages. For example, it is assumed that the OR associated with each additional year of age is the same for having 1 versus no falls as the OR for having 2–3 versus 1 fall. Variables generally met this assumption. A participant could contribute one to four observations, depending on the number of falls, at each of up to five visits. A normal logistic model with a random effect for participant was used to account for within-subject correlation of these outcomes across visits. Repeatedly measured predictors could also vary from visit to visit.

Bivariate associations with falls, adjusted for clinic site and visit year, were first considered. To assess linearity, we considered categorical versions of continuous predictors, using either quartiles or established clinical cut points; when we observed threshold effects, we contrasted the extreme quartile or group with the remainder. Age, race, and sex as well as clinic site and visit year were included in the multivariate model by default. Variables for vision, peripheral nerve function, renal function, weight change, and diastolic blood pressure (DBP) change, plus interaction terms for A1C levels and insulin therapy, were included in the initial multivariate model. Potential confounders considered in bivariate models included medications associated with risk of falls in previous studies, comorbid conditions, depression, and cognitive function. Variables associated with risk of falls in these bivariate models ($P < 0.10$) were included in the multivariate models: depression, antidepressant use, selective serotonin reuptake inhibitor antidepressants, loop diuretics, calcium channel blockers, history of stroke, and Teng Mini-Mental State Examination score. In the multivariate model, we retained potential confounders that remained statistically significant ($P < 0.10$) or that changed the estimated effect of the variables of primary interest by $\geq 20\%$. We then evaluated physical performance measures as potential intermediaries in the associations between diabetic complications and fall risk. To identify the A1C level at which risk of falling may increase, we smoothed an indicator of any falls against A1C level using the Lowess non-parametric scatterplot smoother with an observation for each visit (12). Statistical analyses were performed in SAS (version 9.1; SAS Institute, Cary, NC) and Stata (version 9.2; Stata, College Station, TX).

Table 1—Characteristics of diabetic participants (Health ABC Study)

Characteristic	Value
Age at baseline (years)	73.6 ± 2.7
Male sex (%)	55.4
White race (%)	52.9
Weight (kg)	80.7 ± 14.6
BMI (kg/m ²)	28.8 ± 4.5
Duration of diabetes (years)*	12.8 ± 12.4
A1C (%)	7.6 ± 1.6
Insulin use (%)	14.1
Among those who were not using insulin (%)	
Sulfonylurea use	40.7
Metformin use	9.7
Thiazolidinedione use	1.3
No hypoglycemic medication use	57.4
Peripheral nerve function	
Loss of light touch discrimination (unable to detect 5.07 monofilament) (%)†	22.5
Peroneal nerve conduction velocity: popliteal fossa–ankle (m/s)†‡	41 ± 8
Peroneal nerve CMAP amplitude at popliteal fossa (mV)†§	3.0 ± 1.9
Vibration perception threshold (μm)†	57.8 ± 37.2
Vision	
Corrected visual acuity 20/50 or worse (%)	6.7%
Poor contrast sensitivity ¶	12.6%
Poor depth perception #	15.2%
Renal function	
CysC (mg/l)**	1.04 ± 0.27
eGFR <60 ml/min per 1.73 m ² (%)	18.8%
Blood pressure	
Seated SBP (mmHg)	138 ± 20
SBP: standing-seated (mmHg)	2.6 ± 10.6
Seated DBP (mmHg)	71 ± 11
DBP: standing-seated (mmHg)	4.4 ± 9.6

n = 446. Data are mean ± SD or %. *Excludes those with diabetes diagnosed at the baseline visit. †Measured at visit 4. ‡NCV <40 m/s is usually considered abnormal (13). §CMAP <1.5 mV is usually considered abnormal (13). ||Measured at visit 3. ¶Log contrast sensitivity ≤1.3. #Worst score (999) on Frisby stereopsis test. **Reference range for ≥65 years: 0.61–1.23 mg/l (14).

RESULTS— In this cohort of older diabetic adults, mean ± SD age at baseline was 73.6 ± 2.7 years, A1C was 7.6 ± 1.6%, and 14% reported insulin use (Table 1). Among those using insulin, the participants had A1C ≤6% at 17 (6.1%) of the 278 total visits, A1C of 6–7% at 49 (17.6%) visits, A1C of 7–8% at 95 (34.2%) visits, and A1C >8% at 117 (42.1%) visits. At baseline, 62% of participants had known diabetes, with an average duration of 12.8 ± 12.4 years; diabetes was identified in the remaining 28% from elevated fasting glucose or 2-h OGTT. In the first year, 23% reported any falls, followed by 22, 26, 30, and 31% in subsequent years.

A1C levels were not associated with risk of falls in those who were not using insulin (Table 2). However, in those using insulin, A1C ≤6% was associated with falling (multivariate-adjusted OR 4.36

[95% CI 1.32–14.46]) compared with A1C >8%. A1C ≤6% was identified at 17 visits in seven insulin-using participants. The interaction between A1C and insulin use persisted after multivariate adjustment (Table 2) (*P* value for test of homogeneity 0.09). In Lowess smooth curves for the outcome of “any falls,” risk of falls was similar at all A1C levels in those not using insulin but appeared to increase at lower A1C levels in insulin users (Fig. 1). In those using an oral hypoglycemic medication but not insulin, low A1C levels were not associated with falling (1.29 [0.65–2.54]; A1C ≤6 vs. >8%). A1C ≤6% was reported for 42 of these participants at 59 visits, and sulfonylurea use was reported at 81% of the visits. Results for sulfonylurea use were similar to those for any oral hypoglycemic medication (1.09 [0.52–2.30]; A1C ≤6 vs. >8%).

In bivariate models (Table 2), loss of

light touch discrimination and low peroneal nerve response amplitude (CMAP) at the popliteal fossa were both associated with risk of falls. NCV, ankle to popliteal fossa or to fibular head, was not associated with risk of falls. In the multivariate model, only low CMAP remained independently associated with risk of falls (Table 2). The first 3 years of follow-up for falls occurred before the peripheral nerve function measurements. In models that included only falls after visit 4, results for peripheral nerve function were similar. Visual acuity, contrast sensitivity, and depth perception were associated with falls in bivariate models. In a model combining these vision variables, contrast sensitivity remained statistically significant and was selected for inclusion in multivariate models. After multivariate adjustment, the effect estimate for contrast sensitivity was marginally significant (*P* = 0.068). The first 2 years of follow-up for falls occurred before the vision measurements. However, in models including only falls after visit 3, the results for vision were similar. Higher cysC, a marker of decreasing GFR (15), was associated with risk of falls in bivariate and multivariate models.

Seated or standing blood pressure was not associated with falling in bivariate models. Change in blood pressure was associated with risk of falls for DBP but not for systolic blood pressure (SBP). Baseline weight was not associated with falls. Compared with stable weight, weight loss was associated with a higher risk of falls. Weight gain was associated with falling in bivariate but not multivariate models.

Grip strength, knee extensor strength, standing balance time, chair stands, and the 6-m walk, but not the 6-m narrow walk, were associated with falling in bivariate analyses. In a model combining these variables, grip strength, standing balance time, and the 6-m walk remained associated with risk of falls. When these three variables were added to the multivariate model separately or as a group, there were modest changes in the effect estimates for peroneal CMAP, contrast sensitivity, and cysC.

CONCLUSIONS— In older diabetic adults, we found that poorer peroneal CMAP, higher levels of cysC, and poor contrast sensitivity each increased risk of falls. Clinical trials have established that improved glycemic control prevents progression of these diabetes-related complications. Thus, improved control over the

Table 2—Association between selected variables and more frequent falls in older adults with diabetes

Variable (units)	Minimally adjusted*	Model 1†	Model 2‡
Weight change			
Weight loss (≥ 2 kg)	1.54 (1.21–1.95)	1.56 (1.22–1.98)	1.58 (1.23–2.01)
Stable weight (< 2 kg)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Weight gain (≥ 2 kg)	1.34 (1.03–1.75)	1.25 (0.95–1.64)	1.26 (0.96–1.66)
Insulin use and A1C			
Among those using insulin			
A1C $> 8\%$	1.00 (reference)	1.00 (reference)	1.00 (reference)
$7\% < \text{A1C} \leq 8\%$	1.08 (0.57–2.07)	1.09 (0.57–2.11)	1.15 (0.60–2.22)
$6\% < \text{A1C} \leq 7\%$	1.19 (0.53–2.68)	1.31 (0.58–2.99)	1.27 (0.56–2.91)
A1C $\leq 6\%$	3.78 (1.14–12.51)	4.36 (1.32–14.46)	4.10 (1.24–13.54)
Among those not using insulin			
A1C $> 8\%$	1.00 (reference)	1.00 (reference)	1.00 (reference)
$7\% < \text{A1C} \leq 8\%$	0.88 (0.60–1.29)	0.81 (0.55–1.19)	0.83 (0.56–1.23)
$6\% < \text{A1C} \leq 7\%$	1.00 (0.68–1.49)	1.00 (0.67–1.49)	0.98 (0.65–1.45)
A1C $\leq 6\%$	0.93 (0.59–1.44)	0.84 (0.53–1.33)	0.83 (0.52–1.31)
Insulin use in those with A1C $> 8\%$	1.15 (0.65–2.04)	0.97 (0.55–1.72)	0.88 (0.50–1.55)
Peripheral nerve function			
Peroneal nerve response amplitude ($\leq 1.5\text{mV}$)§	1.71 (1.19–2.44)	1.50 (1.07–2.12)	1.38 (0.98–1.94)
Vibration perception threshold ($\leq 26.79 \mu\text{m}$)§	1.38 (0.94–2.03)	—	—
Monofilament detection (neither versus either)	1.74 (1.10–2.78)	—	—
Vision			
Contrast sensitivity (≤ 1.4)§	1.86 (1.27–2.73)	1.41 (0.97–2.04)	1.24 (0.86–1.79)
Visual acuity (≥ 0.20 logmar)§	1.53 (1.05–2.23)	—	—
Depth perception (worst score versus all others)	1.47 (1.05–2.05)	—	—
Renal function			
CysC (mg/l) (per 0.38 mg/l)	1.52 (1.23–1.88)	1.38 (1.11–1.71)	1.25 (1.01–1.55)
eGFR < 60 ml/min per 1.73 m^2	1.44 (0.96–2.16)	—	—
Blood pressure			
Change in DBP: standing-seated (below median)	1.50 (1.18–1.90)	1.54 (1.21–1.95)	1.53 (1.21–1.95)
Physical performance			
Grip strength (per 10 kg)	0.80 (0.69–0.93)	—	0.85 (0.68–1.05)
Standing balance (per 10 s)	0.74 (0.67–0.82)	—	0.79 (0.70–0.88)
6-m normal walk (s)	1.15 (1.03–1.30)	—	0.99 (0.87–1.12)
Knee extensor strength (per 10 Nm)	0.93 (0.90–0.98)	—	—

Data are ORs (95% CI). *Adjusted for clinic site and visit year. †Model 1 includes weight change, insulin use, A1C, peroneal nerve response amplitude, contrast sensitivity, cysC, change in DBP, plus clinic site, visit year, age, race, sex, use of antidepressant drugs, use of calcium channel blocker, and high depression score (Center for Epidemiologic Studies Depression Scale score > 9). ‡Model 2 includes model 1 plus grip strength, standing balance, and 6-m normal walk. §Worst quartile versus all others. ||4.17 and 5.07 filaments.

long term is likely to prevent falls. We found that intensive glycemic control with oral hypoglycemic medications did not appear to increase risk of falls, but intensive control (A1C $\leq 6\%$) achieved with insulin therapy was associated with falling.

Although the benefits of glycemic control are well established and current guidelines recommend an A1C goal of $\leq 7\%$ for older diabetic adults, with a higher goal for those who are frail (16), most of the diabetic participants in Health ABC were not meeting the 7% goal. Only a small proportion of participants using hypoglycemic medications had A1C $\leq 6\%$ during follow-up. Our results suggest that low A1C levels can be achieved

without increased falls using oral hypoglycemic medications.

This is the first study of falls to report an interaction between insulin use and A1C levels. Some (3,5), but not all (17), previous studies have reported increased risk of falls among those using insulin. Miller et al. (1) reported a lack of association between glycemic control and risk of falls, whereas Tilling et al. (18) reported increased risk of falls with poor glycemic control (A1C $> 7\%$). We found that poor control was not associated with increased risk of falls regardless of insulin therapy status. However, in those using insulin, A1C $\leq 6\%$ was associated with increased risk of falls. Although hypoglycemia can occur with sulfonylurea use, we

did not find an increased risk of falls with low A1C levels and sulfonylurea use.

Our findings underscore the difficulty of balancing the benefits and risks of intensive glycemic control with insulin therapy, particularly in elderly individuals (19). Intensive control with insulin increases the possibility of hypoglycemic episodes, the most likely explanation for the increased risk of falls with low A1C and insulin use reported here. Health ABC participants were not queried regarding hypoglycemic episodes so we could not test this hypothesis. Another possibility is nerve damage during the rapid achievement of glycemic control with insulin therapy attributable to hypoglycemia and/or hyperinsulinemia (20).

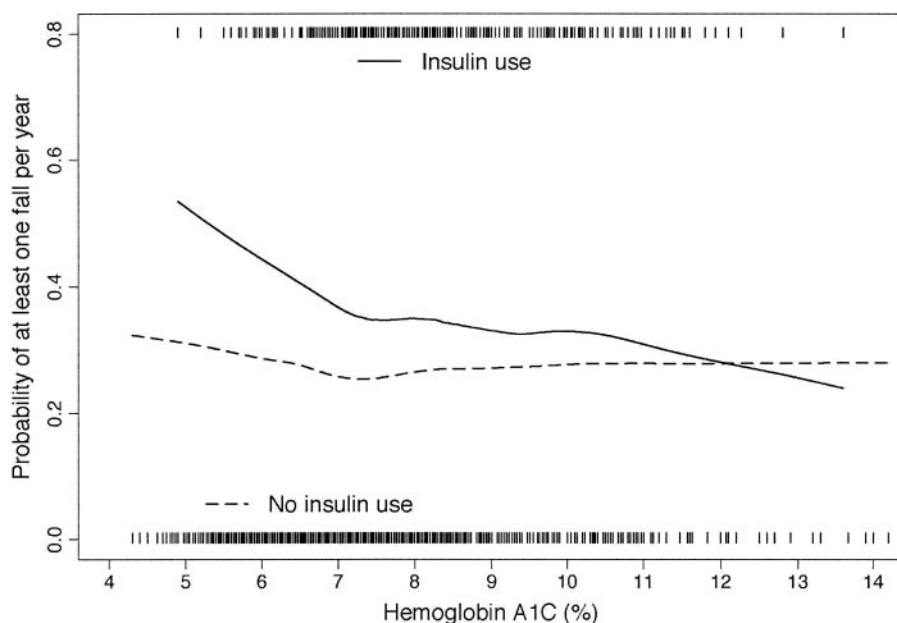


Figure 1—Lowess smooth curve of A1C level and estimated probability of having any fall during a year of follow-up, stratified by insulin use. This approach rests on the assumption that risk of falling varies smoothly, although not linearly, with A1C level. The ticks on the x-axis represent the visits among those using insulin (upper) and those not using insulin (lower) with particular A1C levels.

However, in our model adjusted for peripheral nerve function, low A1C and insulin use remained associated with falls, suggesting that reduced peripheral nerve function owing to hypoglycemia is not the underlying mechanism.

We found that the diabetes-related complications of reduced peripheral nerve function, poorer vision, and decreased renal function are associated with increased risk of falls. Reduced peripheral nerve function (21) and visual function, particularly contrast sensitivity (22), are established risk factors for falls among older adults. Previous studies of falls among those with diabetes reported mixed results for peripheral neuropathy as a risk factor and found no independent association for visual impairment (5,17).

Recent studies have reported that poor renal function is a risk factor for falls in older adults (23). We found a linear association between fall risk and cystatin C, suggesting that even modest declines in renal function are a risk factor for falls. A previous report demonstrated that baseline cystatin C levels are associated with gait, balance, and strength in the Health ABC cohort (24). Poorer renal function reduces the renal conversion of 25-hydroxyvitamin D₃ to 1,25-dihydroxyvitamin D₃. Lower levels of active vitamin D may increase falls through reduced muscle strength and nerve function (23,

25,26). We are not aware of previous reports on renal function and falls in older diabetic adults.

Our finding of increased falls with a change in DBP (seated to standing) but not with a change in SBP is difficult to interpret. Postural hypotension associated with autonomic neuropathy is more prevalent in those with diabetes (27). However, there is only weak evidence that postural hypotension is a risk factor for falls in broader populations (28,29). A lack of data on changes in heart rate during the blood pressure tests limited our ability to explore this finding further. In addition, we used the change in blood pressure from a seated to standing position rather than the standard measure of postural hypotension from a prone to standing position. Our findings need to be investigated further with better measures of postural hypotension.

In broader populations, lower weight and weight loss are both risk factors for falls, presumably because of their association with frailty. Our finding that weight loss was a risk factor for falls suggests that even in this overweight population, weight loss may be an indicator of increasing frailty.

We anticipated that diabetes-related complications would increase risk of falls by decreasing balance, strength, and gait (24,30,31). The modest differences be-

tween our two models (Table 2) suggest that some, but not all, of the effects of these complications are mediated by physical performance. It is also possible that our measurements may not capture aspects of strength, balance, and gait that are important for predicting falls.

Our study was observational, so our ability to draw conclusions about causal relationships is limited. Falls were self-reported, and some misclassification is possible. This misclassification was likely to be nondifferential with respect to our predictors and would therefore result in an attenuation of any real association. Peripheral nerve function and vision were measured 3 and 2 years, respectively, after baseline so that some falls occurred before these assessments. However, when we considered models restricted to falls after the measurements, results were similar. Participants excluded from these analyses were more likely to report a history of falls at the baseline visit and had poorer renal function and physical performance. Health ABC enrollment was also limited to well-functioning participants. Thus, our results may not apply to older diabetic adults with more physical impairments. We did not have a gold standard measurement of GFR, but studies have demonstrated that cystatin C and eGFR are both reasonable surrogates. Finally, participants were not queried about hypoglycemia, so we could not assess the association between hypoglycemic episodes and falls. However, our study had several important strengths, including an average of almost 5 years of follow-up, well-characterized diabetes, and a range of measures related to risk of falls.

In summary, we found that diabetes-related complications (reduced peripheral nerve function, renal function, and vision) contribute to risk of falls in older adults with diabetes. Our results suggest that improving glycemic control to reduce diabetes-related complications may prevent falls. In older diabetic adults who were not using insulin, low A1C levels did not increase risk of falls. However, achieving A1C levels $\leq 6\%$ with insulin use resulted in more frequent falls.

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