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## High Prevalence of Falls, Fear of Falling, and Impaired Balance among Older Adults with Pain in the U.S.: Findings from the 2011 National Health and Aging Trends Study

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### Abstract

**Background/Objectives**—The role of chronic pain in the occurrence of falls and as a target for falls prevention has received limited attention. We sought to determine the prevalence of clinically relevant falls-related outcomes according to pain status in the older population of the United States.

**Design**—Cross-sectional analysis of the 2011 National Health and Aging Trends Study, a sample of Medicare enrollees aged 65 years (response rate= 71.0%).

**Setting**—In-person assessments were conducted in the home or residential care facility of the sampled study participant.

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**Author Contributions:** Kushang V. Patel conceived the study, analyzed the data, and wrote the initial draft of the manuscript and revised it; Elizabeth A. Phelan, Suzanne G. Leveille, Sarah E. Lamb, Celestin Missikpode, Robert B. Wallace, Jack M. Guralnik, and Dennis C. Turk interpreted the data, provided critical feedback, and revised the manuscript.

**Participants**—7,601 participants representing 35.3 million Medicare beneficiaries.

**Measurements**—Participants were asked whether they had been “bothered by pain” and the location of pain as well as questions about balance/coordination, fear of falls, and falls.

**Results**—Bothersome pain was reported by 52.9% of the population. Comparing participants with pain to those without pain, the prevalence of recurrent falls (≥ 2 falls) in the past year was 19.5% and 7.4%, respectively [age- and sex-adjusted prevalence ratio (PR)=2.63; 95% confidence interval (CI):2.28-3.05]. For fear of falls that limits activity, prevalence was 18.0% and 4.4% in those with and without pain, respectively (adjusted PR=3.98; 95% CI:3.24-4.87). Prevalence of balance and falls outcomes increased with number of pain sites. For example, prevalence of problems with balance/coordination that limited activity among participants with 0, 1, 2, 3, and 4 sites of pain was 6.6%, 11.6%, 17.7%, 25.0%, and 41.4%, respectively ( $P<0.001$  for trend). Associations were robust to adjustment for several potential confounders, including cognitive and physical performance.

**Conclusion**—Falls-related outcomes were substantially more common among older adults with pain than in those without pain. Accordingly, pain management strategies should be developed and evaluated for falls prevention.

### Keywords

pain; aging; falls, fear of falls; balance; epidemiology

## INTRODUCTION

Fall-related injury is a major public health problem that is associated with substantial health care costs and increased risk of disability, hospitalization, nursing home admission, and mortality among older adults.<sup>1-4</sup> Several risk factors for falling have been established, including a history of falls, balance impairment, decreased muscle strength, and gait impairment.<sup>5</sup> The American Geriatrics Society/British Geriatrics Society (AGS/BGS) practice guidelines for preventing falls recommend interventions for risk factors identified through screening and clinical assessment.<sup>6</sup> Interventions that address multiple risk factors have demonstrated significant reduction in the rate of falls among community-dwelling older adults.<sup>7</sup> However, the role of chronic pain in the occurrence of falls and as a target for falls prevention has received only limited attention.

Pain is a common symptom among community-dwelling older adults and is the most often cited cause of disability.<sup>8-12</sup> A recent analysis of a national sample of Medicare beneficiaries (the National Health and Aging Trends Study) indicated that bothersome pain afflicted over half of the population, three-fourths of whom had pain in multiple anatomic locations, and was significantly associated with decreased grip strength, gait speed, and lower extremity function as measured by the Short Physical Performance Battery, as well as decreased self-reported physical capacity.<sup>9</sup> Chronic pain might predispose older persons to falling through multiple pathways, including fear of movement,<sup>13</sup> decreased physical activity,<sup>14</sup> postural instability,<sup>15</sup> muscle weakness and inhibition of neuromuscular response,<sup>16, 17</sup> and altered gait and attention.<sup>18, 19</sup> Indeed, studies of older adults have shown that chronic pain is associated with falls.<sup>20-26</sup> However, the extent of falls-related outcomes in the community-

dwelling older adult population has not been characterized according to pain status in a nationally-representative study. Further, most previous studies have not examined the total number of pain sites or specific sites of pain with falls, adjusted for multiple measures of physical capacity, or assessed the association of pain with falls among those without depressive symptoms, a common comorbidity of pain that is associated with increased risk of falling.<sup>5, 27</sup> In addition, few studies have investigated the association of pain with fear of falling, a well-established risk factor for falls and activity avoidance among older adults.<sup>28</sup> A systematic review published in 2014 identified 12 studies of older adults that examined pain in relation to fear of falling,<sup>29</sup> but only 2 of the studies included a non-pain control group, sample sizes were relatively small, and generalizability was limited. Finally, relatively few studies have investigated the relationship of pain with self-perceived and objective measures of balance, another widely recognized factor associated with falls risk.<sup>5</sup> Therefore, using data from a national survey of Medicare beneficiaries, the aims of the current study were to (1) determine the prevalence of falls, fear of falling, and balance impairment according to pain status in the community-dwelling older population of the United States (US); and (2) investigate the association of overall pain status, multisite pain, and site-specific pain with falls, fear of falling, and balance performance.

## METHODS

### Study Population

Data from the 2011 National Health and Aging Trends Study (NHATS) were analyzed. The NHATS is funded by the US National Institute on Aging, National Institutes of Health to investigate multiple aspects of functioning among older adults.<sup>30</sup> Detailed descriptions of the methods and measures used in the NHATS have previously been published.<sup>9, 30</sup> A stratified, multistage sampling design was used to enroll 8,245 adults ages 65 and older from the Medicare enrollment file [response rate = 71% (8,245/11,637)]. This sample is representative of Medicare beneficiaries living in the contiguous US. There were no exclusion criteria related to health status, cognitive function, or physical function. The study protocol was approved by the Johns Hopkins University Institutional Review Board; all study participants or their proxy-respondents provided written informed consent.

Trained survey research staff conducted in-person interviews and assessments in the homes of study participants living in the community or in residential care facilities (e.g., retirement or assisted living communities). There were 468 (5.7%) participants who were not interviewed because they were living in a nursing home and were not expected to return to their original home residence (instead, a questionnaire was completed by facility staff). Nursing home participants were excluded from the data analysis. The study sample is representative of persons living in all other residential care settings (there were 168 participants in residential care who were not interviewed, but the weights for those in residential care with sample person interviews,  $n=353$ , were adjusted to represent those who were missing interviews).<sup>30</sup> An additional 5 individuals were excluded because of missing data on the pain questions. Accordingly, the final analytic sample size of the current study was 7,601, which is representative of 35.3 million Medicare beneficiaries living in the US.

## Measures

Pain was assessed by asking, “In the last month, have you been bothered by pain?” If the participant answered “yes”, then they were asked to identify the location of pain from a card listing the following anatomic sites: back, hips, knees, legs, feet, hands, wrists, arms, shoulders, stomach, head, and neck. The side of the body where pain occurred was not recorded. The total number of pain sites and selected musculoskeletal sites were analyzed. Participants were also asked how often they took medications for pain: everyday (7 days/week), most days (5-6 days/week), some days (2-4 days/week), rarely (once a week or less), or never.

Several questions about falling were included in the interviews with “yes/no” response options. These questions were prefaced by the following definition: “By falling down we mean any fall, slip, or trip in which you lose your balance and land on the floor or ground or at a lower level.” Participants were asked if they had fallen down in the last 12 months and, if so, had they fallen more than one time in the last 12 months (i.e., recurrent falls). Fear of falling was assessed with the question, “In the last month, did you worry about falling down.” If the participant answered “yes”, then they were asked if this worry ever limited their activities.

Balance was assessed through self-report and performance-based testing. Study participants were asked if they had problems with balance or coordination in the last month and, if so, whether these problems ever limited their activities. Both questions had “yes/no” response options. Standing balance was objectively measured using the protocol of the Short Physical Performance Battery (SPPB)<sup>31</sup> and the single legged stand test with eyes open. The SPPB balance protocol instructs participants to stand and maintain their feet in the side-by-side, semi-tandem, and tandem positions for 10 seconds each. If a participant was unable to hold a balance position for a full 10 seconds, then the next more challenging test was not administered. Participants who were able to hold the tandem stand position were then instructed to balance on one leg for 30 seconds with their eyes open. A single timed-trial holding this position was recorded. Participants selected the leg that they preferred to stand on, but there were no practice trials. The following values were assigned for an overall balance score that combines performance on all 4 tests: 0 if participants were unable to hold the side-by-side position for 10 seconds, 1 if participants could only hold the side-by-side standing position for 10 seconds; 2 if they could hold a semi-tandem position for 10 seconds, but were unable to hold a full-tandem position for more than 2 seconds; 3 if they could stand in a full-tandem position for 3 to 9 seconds; 4 if they could stand in a full-tandem position for 10 seconds but did not complete the single-legged balance test; 5, 6, 7, and 8 were assigned to correspond with quartiles of time holding the single-legged stand position; and 9 if they were able to balance on one leg for 30 seconds. Accordingly, balance scores ranged 0-9 with higher scores indicating better performance.

Several other measures of physical capacity were assessed during the home visit. Maximum grip strength was measured in kilograms using a dynamometer (the highest value of 2 trials was analyzed). Usual gait speed was measured in meters per second over a 3 meter course from a standing start (the fastest of 2 timed trials was analyzed). Chair rising performance was assessed and scored according to the SPPB protocol.<sup>31</sup> Participants were instructed to

rise from a chair and return to the seated position 5 times as quickly as possible while keeping their arms folded over their chest. The time to complete the 5 chair rises was recorded. Scores ranged 0-4, with 0 indicating the inability to complete the test and 4 indicating the highest level of performance.

Tests of verbal recall and orientation were used to assess cognitive function.<sup>30</sup> Ten words (common nouns) were read out loud to participants, who were then immediately asked to recall as many words as possible. After an approximately 5-minute delay during which participants answered other survey questions, they were asked again to recall as many of the 10 words as possible. Also assessed was orientation to the day, date, month, and year. The numbers of correct answers to the 3 tests were summed into a composite cognitive performance score, ranging from 0 to 24 possible points.

Demographic and health status variables were also collected during the interview. Participants were asked to report their race/ethnicity and their highest grade of education completed. Smoking status (i.e., never, former, or current smoker) was determined through a standard set of questions. Physical activity was assessed with 2 questions that asked participants whether they walked for exercise or spent time doing vigorous activities that increased their heart rate and breathing in the last month. Participants were assigned to 1 of 3 groups: “sedentary” if they responded ‘no’ to both questions; “walkers” if they answered ‘yes’ to only the question about walking for exercise; or “physically active” if they answered ‘yes’ to the question about vigorous activity. Body mass index (BMI) was calculated by dividing measured weight in kilograms (kg) by measured height in meters squared (m<sup>2</sup>). Obesity was defined by BMI >30.0 kg/m<sup>2</sup>. Participants were also asked if a doctor has ever told them that they had any of the following medical conditions: a heart attack or myocardial infarction; high blood pressure or hypertension; arthritis (including osteoarthritis or rheumatoid arthritis); osteoporosis or thinning of the bones; diabetes; lung diseases, such as emphysema, asthma, or chronic bronchitis; a stroke; dementia or Alzheimer’s disease; cancer; a broken or fractured hip (since age 50). The Patient Health Questionnaire-2 (PHQ-2) was used to assess depressive symptoms; a PHQ-2 score >3 was used to define high depressive symptoms.<sup>32</sup>

## Data Analysis

All analyses were weighted to account for unequal probabilities of selection into the NHATS sample. The analytic sample weights account for differential selection of subgroups (e.g., oversampling of black individuals and oldest-old adults) and adjust for non-response. Variance estimates were calculated using a Taylor series linearization that incorporated the complex sample design of the survey. Data management and statistical analysis were performed with Stata/SE version 12.1 (Stata Corp., College Station, Texas).

The characteristics of study participants were compared according to pain status using adjusted Wald and t-test statistics (Table 1). Prevalence ratios (PR) and 95% confidence intervals (CI) were estimated using Poisson regression to compare prevalence of the falls-related binary outcomes by pain status adjusting for age and sex (Table 2).<sup>33</sup> Poisson regression was also used to model the associations of pain status, total number of pain sites, and site-specific pain with falls-related binary outcomes adjusting for multiple potential

confounding factors (Tables 3 and 4). Logistic regression models were not fitted as odds ratios can be overestimated when the study outcomes are common.<sup>33</sup> Linear regression was used to model the association of pain with the balance performance score of 0-9 points (Table 3a). An ordinal variable was entered in the models to test for linear trend across the total number of pain sites (Table 3ab). For sensitivity analyses, Poisson regression was used to assess the association of pain with the falls-related outcomes in participants without arthritis, high depressive symptoms, or both conditions.

## RESULTS

The characteristics of study participants are shown in Table 1 by pain status. Pain did not vary significantly by age or race/ethnicity, but was more common in women than in men and in those with lower levels of education. Older adults with pain were more sedentary and had higher BMI values, greater disease burden, and lower cognitive and physical performance than those without pain. As expected, daily analgesic use was more common among older adults with pain than in those who did not report pain.

The prevalence of balance/coordination problems, fear of falls, and falls in the past year are shown in Table 2 according to pain status. All 6 balance/falls outcomes were approximately 2 to 4 times more common among older adults with bothersome pain than in those without pain adjusting for age and sex ( $P<0.001$  for all comparisons). In terms of absolute numbers in the Medicare population, there were 3.6 million older adults with pain who reported recurrent falls (≥ 2 falls) in the past year compared with 1.2 million older adults without pain ( $P<0.0001$ ). For fear of falls that limits activity, the absolute numbers were 3.4 million and 0.7 million in those with pain and without pain, respectively ( $P<0.0001$ ). Accordingly, the subpopulation of older adults with pain comprises the majority of fallers in the total older adult population.

In addition to pain status, Figure 1 illustrates that the prevalence of falls-related outcomes increased with the total number of pain sites. When adjusting for potential confounding factors, including cognitive performance, chair rising ability, gait speed, and grip strength, the association of total number of pain sites with self-reported problems with balance/coordination remained significant and graded in a stepwise fashion (Table 3a;  $P$  for trend $<0.001$ ). Further, objectively measured standing balance performance decreased with greater number of pain sites (Table 3a;  $P$  for trend $<0.001$ ). Similar associations of pain status and number of pain sites were observed with falls in the past year and fear of falls adjusting for potential confounders, including balance performance (Table 3b). Excluding head and stomach pain did not meaningfully change any of the associations of total number of pain sites with the falls-related outcomes ( $P$  for trend $<0.001$  for each fall-related outcome; results not shown).

The associations of specific musculoskeletal pain sites with falls outcomes are shown in Table 4. Although back pain alone and foot pain alone were each individually associated with increased prevalence of a fall in the past year, relatively few older adults had pain only in these locations or in any other single location. Importantly, each of the musculoskeletal pain sites was associated with falls when it co-occurred with pain in other locations.

To assess the pain-falls relationship further, sensitivity analyses were performed by excluding participants with arthritis and/or high depressive symptoms, 2 common conditions that are established risk factors for falls and that are often comorbid with pain. Adjusting for the same covariates listed in Table 3b, pain was associated with increased likelihood of recurrent falls in the past year even when excluding participants with arthritis (adjusted PR=1.49; 95% CI: 1.11-2.00), high depressive symptoms (adjusted PR=1.84; 95% CI: 1.48-2.29), or both conditions (adjusted PR=1.60; 95% CI: 1.18-2.16). Pain also remained significantly associated with balance problems that limited activity (adjusted PR=2.15; 95% CI: 1.52-3.04) and fear of falls that limited activity (adjusted PR=1.92; 95% CI: 1.26-2.93) when excluding participants with arthritis and depressive symptoms. Notably, the associations of pain with activity limiting balance problems (adjusted PR=3.89; 95% CI: 2.34-6.48) and activity limiting fear of falls (adjusted PR=2.21; 95% CI: 1.07-4.56) remained after further exclusion of participants who reported a fall in the previous year.

## DISCUSSION

In this nationally representative sample of Medicare beneficiaries in 2011, problems with balance or coordination, fear of falls, and a history of falls were substantially more common among older adults with bothersome pain than in those without pain. Indeed, approximately three-fourths of older adults who reported recurrent falls had bothersome pain (Table 2). Similar distributions of pain were observed in older adults who limited their activity because of problems with balance or coordination and in those who reported a fear of falling that limited their activity. Importantly, the prevalence of falls-related outcomes increased with the total number of pain sites, particularly for recurrent falls—an outcome strongly associated with a high risk of serious injury. Given that 40% of community-dwelling older adults have pain in 2 or more locations,<sup>9</sup> the findings of the current study indicate that older adults with multisite pain should be targeted for falls prevention services.

Prior studies have also demonstrated an association between pain and falls among older adults.<sup>20, 22-24, 34</sup> For example, in a cohort of 749 older adults living in Boston, Leveille and colleagues prospectively showed that greater pain intensity, increased pain interference with function, and polyarticular (multisite) pain were associated with increased risk of falls over an 18-month period.<sup>24</sup> Additionally, prospective studies of hip pain and knee pain have reported associations with falls.<sup>21, 34</sup> Interestingly, the association of osteoarthritis with fractures is mixed with some studies indicating increased risk,<sup>21, 35, 36</sup> no significant risk<sup>21, 37</sup>, or even decreased risk.<sup>38-40</sup> The current study extends this previous work by estimating the prevalence of falls according to pain status in a large sample of community-dwelling older adults that is representative of 35.3 million Medicare beneficiaries in the US. We also extend previous findings from the NHATS showing that not only is pain strongly associated with decreased muscle strength, gait speed, and overall lower extremity function,<sup>9</sup> but also associated with impaired balance and activity-limiting fear of falling—2 common, well-established risk factors for falls. Pain was associated with self-reported problems with balance or coordination and with performance-based assessment of balance, indicating that both self-appraisal of balance ability and actual balance capacity are reduced among older adults with pain. Further, the pain-falls relationship was robust even when

excluding older adults with comorbid arthritis and/or high depressive symptoms, a finding not previously reported.

Several potential and not necessarily independent mechanisms might underlie the association of pain with falls. Considering, for example, that chronic musculoskeletal pain is associated with decreased physical activity, it is conceivable that pain predisposes older persons to cycles of disuse or bouts of disability that contribute to muscle weakening, reduced endurance, and gait slowing over time. Pain, particularly in the lower body (i.e., back, hips, knees, and feet), can also alter gait biomechanics and postural stability,<sup>15, 18, 19, 41-44</sup> which over time possibly increase feelings of unsteadiness and a fear of falling that in turn can reduce the pattern, volume, and intensity of physical activity. Pain-associated inhibition of muscle function and knee buckling may contribute to falls as well.<sup>16, 17, 45</sup> An increased risk for falls might also result from changes in brain structure and function that are associated with chronic pain, such as decreased gray matter volume in regions involved with pain processing and motor control as well as decreased attention and executive function.<sup>46-48</sup> Finally, certain pharmacological treatments of chronic pain (e.g., opioids) are associated with increased risk for falls and fractures,<sup>49, 50</sup> although the proportion of older adults on long-term prescription analgesics and adherence to these treatment regimens are relatively low when considering the high prevalence of falls observed among those with pain.<sup>51, 52</sup> It is likely that any causal effect of pain on falls evolves from a combination of maladaptive behavior and physiologic impairments.

There are several strengths and limitations that should be considered when interpreting the study findings. The primary aim of the current study was to determine the scope of clinically relevant falls-related outcomes according to pain in the community-dwelling older adult population. Although the cross-sectional design is appropriate for this study purpose, a recognized limitation is that causal relationships cannot be inferred and that falls were assessed by self-reported recall over the past year. It is certainly possible that some proportion of pain cases among older adults results from falls-related injuries and that participants with pain might be more likely to report a fall (i.e., recall bias); however, as previously noted, several prospective studies have demonstrated an increased risk for falls associated with chronic pain. Indeed, using monthly assessments, Leveille et al. showed that greater pain severity significantly increased the risk of falls in the subsequent month.<sup>24</sup>

Another limitation of the current study was that detailed information about pain characteristics, such as quality, severity, duration, or frequency, were not collected. Nonetheless, asking older adults whether they are bothered by pain has good face-validity, and this questionnaire item was previously shown to be strongly associated with depressive symptoms, chronic musculoskeletal conditions, and several self-reported and performance-based measures of physical capacity.<sup>9</sup> Specific treatment information for pain also was not available, but the frequency of analgesic medication use was assessed and accounted for in the statistical models. A strength of the study was that the location of pain was assessed, which enabled examination of the associations of site-specific pain as well as the number of pain sites with the falls outcomes. In addition, several measures of health and function were assessed that allowed us to adjust for many potential factors that may confound the pain-falls relationship, including cognitive function, physical performance, and exercise. The



large sample size permitted a series of sensitivity analyses that demonstrated the robust association of pain with falls, fear of falls and balance problems after excluding participants with arthritis and high depressive symptoms. Finally, a clear strength is the generalizability of the study sample to the older, community-dwelling Medicare population.

In summary, pain is a common condition that is strongly associated with falls-related outcomes that are known to increase risk for serious injury among older adults. In fact, the NHATS falls-related questions are similar to the screening questions recommended in the AGS/BGS clinical practice guidelines for falls prevention<sup>6</sup> and recommended by the Centers for Disease Control and Prevention<sup>53</sup> as well as ones mandated by the Center for Medicare and Medicaid Services.<sup>54</sup> Although pain is increasingly recognized as a risk factor for falls,<sup>5, 55</sup> few intervention studies, if any, have targeted pain to prevent falls in community settings. In view of the findings of the current study and others, effective pain management strategies should be developed and integrated into multifactorial falls prevention programs.

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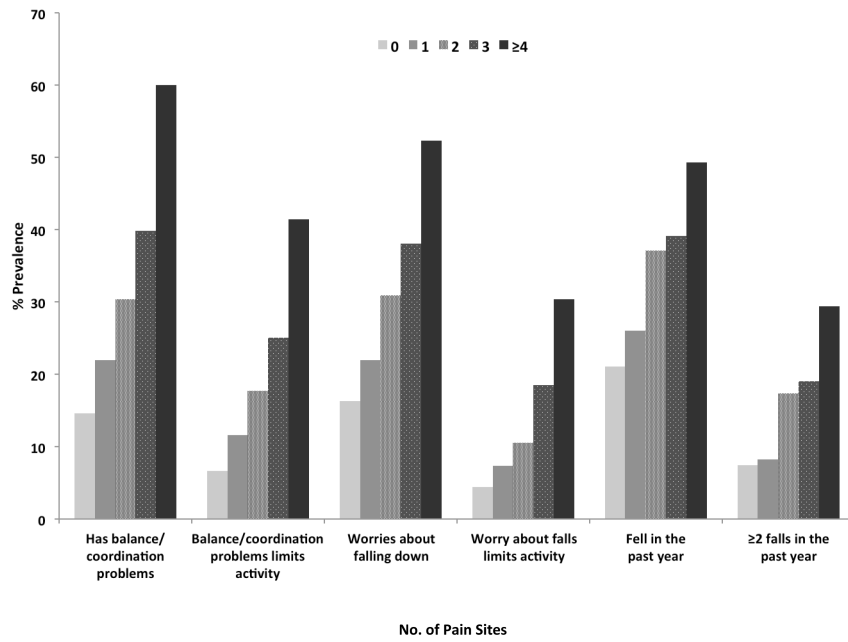
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**Figure 1.** Prevalence of balance/coordination problems, fear of falling, and falls according to the number of pain sites in adults 65 years and older, United States: National Health and Aging Trends Study, 2011

**Table 1**

Percent distribution of demographic and health characteristics according to pain status in adults 65 years and older, United States: National Health and Aging Trends Study, 2011

Characteristic	Bothersome Pain		P-Value
	Yes	No	
Age, n (weighted %)			
65-69 years	753 (27.6)	654 (28.3)	0.185
70-74 years	822 (24.5)	756 (25.5)	
75-79 years	832 (19.4)	679 (18.7)	
80-84 years	795 (14.4)	710 (15.0)	
85-89 years	532 (9.6)	419 (8.5)	
90 years	369 (4.5)	280 (4.0)	
Sex, n (weighted %)			
Women	2593 (61.8)	1840 (50.9)	<0.001
Race/Ethnicity, n (weighted %)			
Non-Hispanic White	2763 (80.5)	2418 (80.6)	0.121
Non-Hispanic Black	934 (8.5)	726 (7.6)	
Hispanic	248 (6.8)	206 (6.7)	
Other	114 (3.3)	104 (3.7)	
Education, n (weighted %)			
<9 years	576 (11.1)	411 (9.5)	<0.001
9-11 years	614 (12.3)	444 (10.4)	
High school graduate	1107 (28.0)	961 (27.2)	
Some college/vocational	1017 (27.4)	797 (24.9)	
College graduate	413 (11.6)	450 (14.7)	
Masters or professional degree	331 (9.6)	385 (13.3)	
Smoking history, n (weighted %)			
Never smoked	1994 (46.2)	1763 (48.6)	0.055
Former smoker	1803 (45.7)	1442 (42.4)	
Current smoker	301 (8.1)	286 (9.0)	
Body mass index, Mean (SE)	28.3 (0.1)	26.9 (0.1)	<0.001
Physical activity, n (% weighted)			
Sedentary	1635 (35.9)	985 (24.3)	<0.001
Walks	1286 (30.7)	1121 (30.8)	
Physically active	1182 (33.3)	1389 (44.9)	
Medical conditions, n (weighted %)			
Arthritis	2960 (70.0)	1285 (35.5)	<0.001
Osteoporosis	1060 (26.8)	497 (14.9)	<0.001
Hip fracture	253 (5.2)	126 (2.9)	<0.001
Cancer	1119 (28.0)	831 (23.4)	<0.001
Myocardial infarction	720 (16.3)	441 (11.5)	<0.001
Diabetes	1193 (27.7)	730 (19.5)	<0.001

Characteristic	Bothersome Pain		P-Value
	Yes	No	
Stroke	555 (11.6)	337 (8.3)	0.001
Dementia	288 (5.4)	166 (3.2)	<0.001
Depressive symptoms	849 (19.0)	362 (9.6)	<0.001
Total No. of medical conditions, n (weighted %)			
0	149 (4.4)	467 (14.7)	<0.001
1	484 (13.6)	809 (24.9)	
2	912 (23.2)	996 (28.2)	
3	1049 (24.9)	676 (18.4)	
4	1509 (33.9)	550 (13.8)	
Cognitive performance score, Mean (SE)	11.3 (0.1)	11.6 (0.1)	0.007
Grip strength in kilograms, Mean (SE)	25.8 (0.2)	28.6 (0.3)	<0.001
Balance performance score, Mean (SE)	4.4 (0.1)	5.5 (0.1)	<0.001
Gait speed in meters/second, Mean (SE)	0.79 (0.01)	0.88 (0.01)	<0.001
SPPB chair rise score, Mean (SE)	2.2 (0.03)	2.8 (0.03)	<0.001
Frequency of analgesic use, n (weighted %)			<0.001
Never	699 (16.6)	2120 (59.9)	
Rarely (once a week or less)	807 (20.9)	811 (24.8)	
Some days (2-4 days a week)	876 (21.2)	262 (7.4)	
Most days (5-6 days a week)	328 (8.2)	43 (1.1)	
Every day (7 days a week)	1386 (33.1)	257 (6.9)	

SE=standard error

**Table 2**

Prevalence of balance/coordination problems, fear of falls, and falls according to pain status in adults 65 years and older, United States: National Health and Aging Trends Study, 2011

	Bothersome Pain		Age- and Sex-adjusted Prevalence Ratio (95% CI) Pain : No Pain
	Yes (n=4,098) %*	No (n=3,492) %*	
<i>Balance or Coordination Problems</i>			
Has problems with balance or coordination	40.2	14.6	2.67 (2.38-3.00)
Balance or coordination problems limits activity	25.7	6.6	3.83 (3.27-4.49)
<i>Fear of Falls</i>			
Worried about falling down	37.3	16.3	2.19 (1.98-2.42)
Worry about falling down limits activity	18.0	4.4	3.98 (3.24-4.87)
<i>Falls</i>			
Falls Fell in the past year	38.9	21.0	1.82 (1.67-1.98)
Falls 2 falls in the past year	19.5	7.4	2.63 (2.28-3.05)

\* Weighted percents are shown



**Table 3ab**

Association of pain and number of pain sites with (A) self-reported problems with balance/coordination and performance-based assessment of standing balance, and (B) fear of falling and falls in adults 65 years and older, United States: National Health and Aging Trends Study, 2011

<b>A.</b>				
	<b>Problems with balance/coordination PR (95% CI)</b>	<b>Balance/coordination problems limits activity PR (95% CI)</b>	<b>Standing balance performance <math>\beta</math> (95% CI)</b>	
<b>Pain status</b>				
No pain	1.00	1.00	Ref.	
Pain	1.80 (1.59-2.02)	2.15 (1.79-2.59)	-0.18 (-0.33, -0.02)	
<b>No. of pain sites</b>				
0	1.00*	1.00*	Ref. *	
1	1.32 (1.12-1.55)	1.57 (1.16-2.12)	-0.04 (-0.25, 0.16)	
2	1.61 (1.38-1.87)	1.93 (1.56-2.39)	-0.12 (-0.39, 0.15)	
3	1.94 (1.62-2.31)	2.08 (1.56-2.78)	-0.33 (-0.57, -0.08)	
4	2.47 (2.13-2.87)	2.99 (2.42-3.70)	-0.34 (-0.55, -0.13)	
<b>B.</b>				
	<b>Fell in the past year PR (95% CI)</b>	<b>2 falls in the past year PR (95% CI)</b>	<b>Worries about falling down PR (95% CI)</b>	<b>Worry about falling limits activity PR (95% CI)</b>
<b>Pain status</b>				
No pain	1.00	1.00	1.00	1.00
Pain	1.48 (1.33-1.66)	1.76 (1.48-2.09)	1.55 (1.37-1.75)	2.06 (1.59-2.67)
<b>No. of pain sites</b>				
0	1.00*	1.00*	1.00*	1.00*
1	1.21 (1.06-1.38)	1.00 (0.72-1.39)	1.26 (1.06-1.50)	1.49 (1.02-2.19)
2	1.53 (1.31-1.79)	1.96 (1.61-2.40)	1.53 (1.28-1.84)	1.65 (1.18-2.32)
3	1.54 (1.30-1.83)	1.81 (1.32-2.47)	1.63 (1.39-1.91)	2.41 (1.68-3.46)
4	1.75 (1.51-2.04)	2.44 (1.96-3.03)	1.84 (1.59-2.14)	2.78 (2.04-3.79)

\*  $P$ -value <0.001 for test of trend

PR=Prevalence Ratio; CI=Confidence Interval;  $\beta$ =unstandardized regression coefficient

All 6 models adjusted for age, sex, race/ethnicity, education, smoking history, body mass index, obesity, depressive symptoms, dementia, arthritis, osteoporosis, hip fracture, cancer, chronic lung disease, myocardial infarction, diabetes, hypertension, stroke, total number of medical conditions, cognitive performance, exercise, and frequency of analgesic medication use as well as for performance in chair rising, usual gait speed, and grip strength.

\*  $P$ -value <0.001 for test of trend

PR=Prevalence Ratio; CI=Confidence Interval

All 8 models adjusted for age, sex, race/ethnicity, education, smoking history, body mass index, obesity, depressive symptoms, dementia, arthritis, osteoporosis, hip fracture, cancer, chronic lung disease, myocardial infarction, diabetes, hypertension, stroke, total number of medical conditions,

cognitive performance, exercise, and frequency of analgesic medication use as well as for performance in balance standing, chair rising, usual gait speed, and grip strength.

**Table 4**

Association of specific musculoskeletal pain sites with falls in adults 65 years and older, United States: National Health and Aging Trends Study, 2011

	No. (Weighted %)	Fell in the past year PR (95% CI)	2 falls in the past year PR (95% CI)
<b>Back and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than back	1,003 (19.3)	1.45 (1.27-1.66)	1.46 (1.15-1.84)
Back only	247 (4.8)	1.33 (1.06-1.68)	1.40 (0.91-2.17)
Back and other pain sites	1,152 (22.2)	1.56 (1.37-1.78)	2.16 (1.76-2.65)
<b>Knee and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than knee	1,294 (25.7)	1.42 (1.25-1.61)	1.67 (1.34-2.08)
Knee only	153 (2.9)	1.12 (0.84-1.49)	0.59 (0.28-1.26)
Knee and other pain sites	955 (17.8)	1.67 (1.45-1.92)	2.11 (1.73-2.57)
<b>Hip and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than hip	1,637 (31.5)	1.46 (1.31-1.64)	1.65 (1.35-2.02)
Hip only	62 (1.2)	0.65 (0.35-1.21)	1.08 (0.47-2.48)
Hip and other pain sites	703 (13.6)	1.64 (1.41-1.92)	2.10 (1.69-2.61)
<b>Feet and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than feet	1,657 (31.9)	1.42 (1.25-1.61)	1.63 (1.34-1.99)
Feet only	87 (1.8)	1.73 (1.30-2.31)	1.50 (0.80-2.80)
Feet and other pain sites	658 (12.6)	1.64 (1.45-1.86)	2.16 (1.70-2.73)
<b>Shoulder/neck and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than shoulder/neck	1,308 (25.0)	1.46 (1.30-1.64)	1.63 (1.32-2.01)
Shoulder/neck only	115 (2.4)	1.14 (0.75-1.74)	0.96 (0.43-2.14)
Shoulder/neck and other pain sites	979 (19.0)	1.58 (1.37-1.82)	2.06 (1.66-2.55)
<b>Hand/wrist/arm and other pain sites</b>			
No pain	2,721 (53.7)	1.00	1.00
Pain sites other than hand/wrist/arm	1,695 (32.5)	1.43 (1.28-1.59)	1.63 (1.35-1.98)
Hand/wrist/arm only	43 (0.9)	1.54 (1.01-2.34)	0.97 (0.28-3.37)
Hand/wrist/arm and other pain sites	664 (12.9)	1.63 (1.39-1.92)	2.16 (1.71-2.73)

PR=Prevalence Ratio; CI=Confidence Interval

All 12 models adjusted for age, sex, race/ethnicity, education, smoking history, body mass index, obesity, depressive symptoms, dementia, arthritis, osteoporosis, hip fracture, cancer, chronic lung disease, myocardial infarction, diabetes, hypertension, stroke, total number of medical conditions, cognitive performance, exercise, and frequency of analgesic medication use as well as for performance in balance standing, chair rising, usual gait speed, and grip strength.