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Depressive Symptoms, Chronic Pain, and Falls in Older Community-Dwelling Adults: The MOBILIZE Boston Study

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Abstract

BACKGROUND—A better understanding is needed about the role of depression and chronic pain, two related chronic conditions, as predictors of falls in older persons.

OBJECTIVES—To examine whether overall depressive symptoms and symptom clusters are associated with fall risk, and to determine whether chronic pain mediates the relationship between depression and fall risk in aging.

DESIGN—Prospective cohort study.

SETTING—City of Boston and surrounding communities.

PARTICIPANTS—Older community-dwelling adults (n=722,mean age 78.3y).

MEASUREMENTS—Depressive symptomatology was assessed at baseline by the CESDR as overall depression and two separate domains, cognitive or somatic symptoms. Chronic pain was examined at baseline as: number of pain sites (none, single site, or multisite/widespread), pain severity, and pain interference with daily life activities. Participants recorded falls on monthly postcards during a subsequent 18-month period.

RESULTS—By using negative binomial regression, the rate of incident falls was highest among those with highest burden of depressive symptoms (indicated by total CESDR, Cognitive or Somatic CESDR domains). After adjustment for multiple confounders and fall risk factors, fall rate ratios comparing the highest CESDR three quartiles to the lowest quartile were 1.91, 1.26, 1.11, respectively. Similarly graded associations were observed according to CESDR domains. Although pain location and interference were mediators of the relationship between depression and falls, adjustment for pain reduced fall risk estimates only modestly. There was no interaction between depression and pain in relation to fall risk.

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Conflict of Interest: None.

CONCLUSION—Depressive symptoms are associated with fall risk in older adults and are mediated in part by chronic pain. Research is needed to determine effective strategies for reducing fall risk and related injuries in older people who have pain and depressive symptoms.

Keywords

Depression; Falls; Pain; Aging

INTRODUCTION

Depression poses a tremendous burden on patients and families and is common in old age. Estimates of the prevalence of depression in older community-dwelling adults range from 13%-23% according to population-based studies from several countries.[1-5] Depression in old age occurs more frequently in women[2] and is associated with lower socioeconomic status, disability and co-morbidity.[6,7] In addition, depressive symptoms are related to an increased risk for mortality[5] and falls[8]. Falls are, in turn, strongly associated with a number of poor health outcomes such as cognitive impairment[9], hip fracture[10], institutionalization,[10,11] and death.[12] Therefore, a better understanding of the relationship between depressive symptoms and other risk factors for falls in the older population is warranted.

A recent study shows that the presence of chronic pain also is strongly associated with increased fall risk.[13] Particularly in older age groups, chronic pain is associated with depressive symptomatology.[14,15] In fact, each has been found to predict the other, resulting in a negative spiral of increasing pain and depression.[16] Interestingly, chronic pain seems to be associated with certain depressive symptoms, but not all.[17,18] Somatic symptoms of depression are more strongly associated with pain than cognitive symptoms of depression.[18,19] Consequently, although depressive symptoms are associated with falls, some depressive symptom clusters may be more associated with falls than others. Indeed, many studies report an association between depressive symptomatology and increased risk for falls and/or fractures,[8,20,21] but others do not.[22] The presence of chronic pain may be a mediator of the relationship between depressive symptom clusters and risk for falls.

A better understanding of the impact of these comorbid and treatable conditions on fall risk could lead to more effective interventions to reduce the occurrence of falls and related injuries in older patients. Further we propose to go beyond general assessment of depression in order to separately examine somatic symptoms that are often associated with chronic pain. Aims of the present study are twofold: first, to examine separately whether somatic and cognitive depressive symptom clusters predict falls; second, to determine whether the presence of chronic pain mediates the relationship between depressive symptoms and risk for falls in the older population.

METHODS

Participants

The MOBILIZE Boston Study (MBS) is a longitudinal population-based study of risk factors for falls in older community-dwelling adults in Boston and nearby suburbs. This sampling area, bounded by a 5-mile radius from the study clinic at Hebrew Rehabilitation Center (HRC) in Boston, was chosen to capture a diverse urban and suburban population and limit transportation difficulties and expenses. Prospective participants, recruited door-to-door, were randomly sampled from town lists. Detailed descriptions of the recruitment and study design are published elsewhere.[23-24] Study participants (N=749) were women and men aged 70 and older, able to speak and read English, and able to walk 20 feet without assistance from another person, and expecting to stay in the area for 2 years. Following the

initial recruitment visit at home, study staff contacted potential study enrollees by telephone to confirm eligibility and to plan the baseline home and clinic visits. Persons were excluded from participation if they had a terminal disease, (receiving hospice services, diagnosed metastatic cancer). During the baseline home visit, participants signed informed consent and were screened and excluded for moderate or severe cognitive impairment using the Mini-Mental State Examination (MMSE score<18).[25,26] For this analysis we included the 722 participants who completed the depression and pain measures. All study procedures were approved by the Institutional Review Boards of the HRC and collaborating institutions (University of Massachusetts Boston and Beth Israel Deaconess Medical Center).

Depressive symptomatology

Presence of depressive symptomatology was determined based on the 20-item Hopkins Revision of the Center for Epidemiologic Studies Depression scale (CESDR).[27,28] In addition to the total score, items of the CESDR were categorized into Cognitive and Somatic domains, based on inter-item correlational analyses.[27] Examples of the Cognitive items include: 'I felt like a bad person', 'I could not focus on the important things', and 'I lost interest in my usual activities'. Somatic items include: 'I was tired all the time', 'My sleep was restless', and 'I felt like I was moving too slowly'. The total CESDR (cut points <2, <8, and <16), the Cognitive domain (cut points were <10, <12, and <17), and the Somatic domain (cut points <6, <8, and <12) each, were categorized into quartiles based on the distributions observed in the study cohort.

Falls assessment

A fall is defined as unintentionally coming to rest on the ground or other lower level not as a result of a major intrinsic event, (e.g., myocardial infarction, stroke, or seizure) or an overwhelming hazard, (e.g., hit by a vehicle).[29] Falls were recorded using a method that has been well-validated for use in epidemiological cohort studies.[30] Participants were requested during the home visit to complete and return monthly falls-calendar postcards. On these cards, participants were asked to write down an F for each fall on the day it occurred and to write down an N for the days there were no falls. Approximately one third of fall calendars were either missing information or not returned at the end of each month. Participants with missing falls information were contacted by telephone each month to complete the calendars. Further details of the fall assessments were published previously.[13]

Chronic Pain Assessment

Musculoskeletal pain was assessed using a 13-item questionnaire ascertaining pain in musculoskeletal sites (hand/wrist, shoulder, back, chest, hip, knee, or foot) lasting 3 or more months in the previous year and present in the previous month.[31] Responses were categorized into 3 groups: no pain, single site pain, and more than 1 pain site, ('multisite pain'). Severity of pain was measured by the Pain Severity Subscale of the Brief Pain Inventory (BPI) which has been validated in patients with chronic non-malignant musculoskeletal conditions.[32] This subscale assesses overall pain severity rather than site-specific ratings and is recommended for pain assessment in older persons.[33] Participants were asked to rate their pain severity according to 4 conditions in the past week: 1) worst pain, 2) least pain, 3) pain on average and 4) pain now, referring to an 11-point numeric rating scale, with 0 indicating no pain and 10 indicating, 'severe or excruciating pain as bad as you can imagine'. The severity score, an average of the 4 item ratings, was categorized into tertiles (cut points were <1 and <3.25), with the 3rd tertile indicating the most severe pain overall. Interference of pain with daily activities was measured by the 7-item BPI Pain Interference Subscale,[32] also categorized into tertiles (cut points were <.01 and <2), with the 3rd tertile indicating most interference. We selected tertiles because the lowest group who had no pain comprised one third of the population.

Covariates

In the baseline assessment we measured a number of potential confounders of the relationship between pain, depression, and falls. Demographic characteristics included age, sex, race, and education (<12 years, 12-15 years, >15 years). Body mass index (BMI) was calculated as measured weight in kilograms divided by height in meters squared. Cognitive functioning was measured by the MMSE.[25] Physical activity levels of the previous week were assessed by using the Physical Activity Scale for the Elderly (PASE).[34] Vision was assessed at 10 feet by means of a letter chart (Good Light Chart Model 600A). We determined gait speed as the fastest of 2 trials of a 4 meter walk at a usual pace. Standing balance was based on 4 timed tests (side-by-side, semi-tandem, tandem, and 1-leg stands) as described previously.[35]

Comorbidity—Participants were asked if a physician had told them they had heart disease (myocardial infarction, atrial fibrillation, pacemaker, angina, or congestive heart failure), Parkinson's disease and stroke. Presence of diabetes was determined using an algorithm based on self-reported diabetes, use of oral hypoglycemics or insulin, and laboratory measures from the visit to the clinic including random glucose, (≥200 mg/dL, to convert to mmol/L, multiply by 0.0555) and hemoglobin A_{1c} (>7%).

Medication use—Use of prescription and over-the-counter medications in the previous 2 weeks was assessed during the home interview, with information recorded from the medication bottles. Medication codes were applied to each medication using the Iowa Drug Classification System (IDIS), with a method described previously.[36] Psychotherapeutic medications included sedative, hypnotic, anxiolytic, antidepressant, and antipsychotic agents. Use was categorized as 2 or more different medications daily, 1 daily, nondaily use, and no use. Analgesic medications included opioid and non-opioid analgesics and daily use was determined from dose and frequency information.

Statistics

Descriptive statistics were used to examine sociodemographic and health characteristics according to CESDR quartiles. Linear trends across quartiles were determined using Chi-square tests (1d.f.).

Predictive models of falls related to baseline pain and depressive symptoms were performed using negative binomial regression modeling (GENLIN) with an offset variable for log total years of follow-up (exposure time). Models generated multivariable-adjusted incidence rate ratios (IRR) and 95% confidence intervals (CI). Fall counts follow a Poisson distribution that assumes the mean equals the variance, however the variance is often much higher than the mean. This overdispersion may lead to underestimates of standard errors and overestimates of Chi-square statistics. To correct for this, negative binomial regression models were applied. Relationships between depressive symptoms and chronic pain as predictors of falls during follow-up were determined. We investigated different domains of baseline chronic pain in relation to fall risk: pain location (none, single site, multisite/ widespread), pain severity (tertiles of the BPI pain severity subscale), and pain interference (tertiles of the BPI interference subscale). For the 3 depressive symptom variables, we used total CESDR (quartiles), Cognitive CESDR items (quartiles), and Somatic CESDR items (quartiles). We also ran a set of models using continuous forms of the pain and depression variables. We constructed a series of multivariable models of the depression measures predicting risk for falls adjusting for potential confounders, then separately adding each pain characteristic to the model. We determined mediation by the pain measure, if it resulted in a 10% change in the fall rate ratio for the depression measure.[37] We used Akaike's Information Criterion (AIC) and likelihood ratio Chi-square test to compare model fit of the

different models. We also looked for possible interaction effects between the CESDR domains and the different pain measures by adding the interaction terms to the fully adjusted models. Data were analyzed using SPSS version 16 (Chicago, IL).

RESULTS

The response rate to the recruitment efforts was 53% and participants were largely representative of older adults in the Boston area according to age (mean = 78 years), sex (63% women), and race/ethnicity (19% non-white), based on comparisons with data from the US Census 2000. Average age of the 722 participants who completed the CESDR was 78.3 years (SD=5.3; range 70-97 years). Older persons with more depressive symptoms were significantly more likely to be female, have heart disease, a previous stroke, decreased cognitive function (lower MMSE score), were less physically active, lower BMI, had slower gait speed and poorer balance, and used more psychotherapeutic and analgesic medication (Table 1). Depressive symptoms (total CESDR domain, the Cognitive CESDR domain and the Somatic CESDR domain) were associated with each measure of chronic pain (trend p-value <0.001; Table 2).

Older adults with more depressive symptoms had higher rates of falls, for each measure of depressive symptoms (Figure 1; total CESDR trend test: p-value<0.001, Cognitive CESDR domain: p<0.001, Somatic CESDR domain: p=0.005). After adjustment for sociodemographics, medical conditions, vision score, BMI, cognitive function (MMSE), physical activity (PASE), balance score, gait speed, psychotherapeutic medications, and daily use of analgesics, baseline depressive symptoms were associated with increased occurrence of falls during the 18 month follow-up (Table 3a-3c). Notably, the Cognitive CESDR domain was the most strongly associated with risk for falls. Specifically, the fall rate ratio for the highest quartile compared to the lowest quartile of the Cognitive CESDR domain (2.11, CI: 1.55-2.88) was somewhat higher than the rate ratio for the comparable quartiles of the Somatic CESDR domain (1.65, CI 1.22-2.22). Adjustment for chronic pain regardless of the pain measure resulted in a modest reduction in the fall risk estimates for depression, but the association remained statistically significant (Table 3a-3c). After adjustment for pain location, pain severity, and pain interference, fall rate ratios for the highest quartile of the CESDR were reduced by 15%, 7% and 13%, respectively (Table 3a). Based on the standard 10% change as an indication of mediation, pain location and pain interference mediated the relationship between CESDR and falls. The same was found for the Cognitive CESDR domain (reductions of 11%, 5%, and 14%, respectively, Table 3b) and the Somatic CESDR domain (reductions of 15%, 8%, and 14%, respectively, Table 3c); that is, pain location and pain interference were mediators. Tests of the model fit showed a significant improvement when pain variables were added to the CESDR models (Table 3). Similar results were found when we used the continuous pain and depression variables (data not shown). We did not find an interaction between pain and depressive symptoms in relation to risk for falls, on any of the measures (data not shown).

DISCUSSION

Our results show that both depressive symptoms and chronic pain, independently of one another, are associated with an increased risk for falls in community-dwelling older adults. Interestingly, both the Cognitive and Somatic CESDR domains were independently associated with increased risk for falls, with the Cognitive CESDR domain associated with a slightly greater magnitude of fall risk. Even though pain and depression are often cooccurring in older adults, it is clear that each of these conditions is related to fall risk, which suggests that both conditions may need to be effectively managed in order to reduce risk for falls.

We might have expected to see a stronger relationship between Somatic CESDR items and fall risk because of the relationship between pain and the more Somatic depressive symptoms reported from other studies.[18,19] In a previous MOBILIZE Boston research study, chronic pain measured according to number of sites or pain severity was found to be associated with an increased risk for falls.[13] In considering domains of depressive symptoms, we would have expected the Somatic CESDR domain to be more strongly associated with pain than the Cognitive CESDR domain if the depression-fall relationship was in part related to chronic pain. Consequently, we might have expected that the Somatic domain would be more strongly associated with falls than the Cognitive domain, but our findings were somewhat contrary to our hypothesis. For all depressive symptom domains, pain location and pain interference were mediators in the relationship between depression and falls. Not surprisingly, adjustment for chronic pain in our statistical models had the greatest impact on the fall risk estimates for the Somatic domain.

Our findings do not directly support the idea of a pathway whereby pain leads to depression which then leads to falls, or, alternatively, depression contributed to pain which leads to falls. If indeed they were on the same pathway, we might have expected that either pain or depression but not both would be independently associated with falls when studied together. This suggests that while pain and depression are associated chronic problems, their respective underlying mechanisms leading to falls may be independent of each other. Alternatively, the processes underlying these relationships may converge such as through a cognitively mediated pathway. For example, both pain and depression may interfere with attention and executive function resulting in a reduced ability to quickly respond to a fall hazard.[38-41] It is also possible that sleep difficulties related to pain or depression may be a common factor contributing to falls.[42,43] Further research is needed to better understand the role of both depression and pain as risk factors for falls in older adults. Even though we adjusted for a number of chronic conditions in our models, we cannot exclude the possibility that other pathology associated with either depression or pain could explain our findings. Also, we controlled for lower extremity mobility including gait speed and standing balance. Study strengths include the use of a representative sample of the older community-dwelling population and the extensive assessment of pain, other fall risk factors and possible confounders.

Pharmacological treatment of depression also has been associated with an increased risk for falls in older adults.[44,45] However, it remains unclear whether this increased fall risk is related to the adverse effects of antidepressant use or to depression itself .[44-45] Although the adjustment for use of psychotherapeutic medications had little impact on the depression-falls association in our study, specific adjustment for antidepressant use would have represented an overadjustment for presence of depressive symptoms. Future studies should try to tease out whether better management of depression through cautious use of antidepressant medication or non-pharmacological therapies would reduce depressive symptoms and fall risk or instead, in some way aggravate fall risk. Clinicians are advised to offer non-pharmacological treatments of depression, including interventions that have proven to be beneficial in reducing both depression and pain.[46-48]

The findings show that both depressive symptoms and chronic pain are associated with fall risk, which is clinically relevant due to the relatively modifiable nature of both depression and pain. Although further research is needed to evaluate intervention strategies, our findings suggest that effectively managing depressive symptoms and pain could potentially reduce the occurrence of falls and related consequences which are a growing economic and social burden in our aging society.

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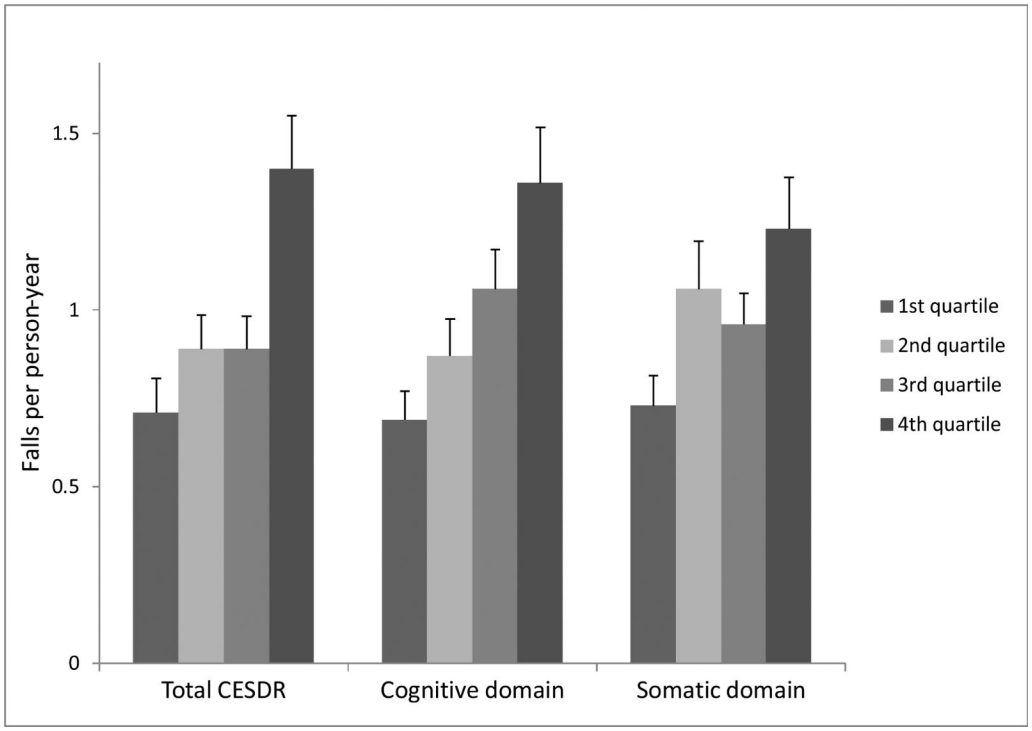

Figure 1.
Fall Rates According to Quartiles of the Total CESDR, CESDR Cognitive Domain, and CESDR Somatic Domain.

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Table 1

Participant Characteristics According to CESDR Quartiles.

	1st CESDR quartile* (n=183)	2nd CESDR quartile (n=187)	3rd CESDR quartile (n=173)	4th CESDR quartile (n=179)	p-value†
Characteristic	**n(%)**	**n(%)**	**n(%)**	**n(%)**	
Age					
70-74y	58(31.7)	61(32.6)	44(25.4)	51(28.5)	
75-79	66(36.1)	64(34.2)	49(28.3)	58(32.4)	
80-84y	37(20.2)	39(20.9)	50(28.9)	44(24.6)	
85y	22(12.0)	23(12.3)	30(17.3)	26(14.5)	.064
Gender					
female	106(57.9)	111(59.4)	115(66.5)	127(70.9)	.004
Race					
white	133(72.7)	153(81.8)	139(80.3)	133(74.3)	
black	39(21.3)	23(12.3)	24(13.9)	35 (19.6)	
other	11(6.0)	11(5.9)	10(5.8)	11(6.1)	.871
Education					
<12 y	14(7.7)	20(10.7)	20(11.6)	24(13.5)	
12-15 y	87(47.5)	66(35.3)	75(43.4)	77(43.3)	
>15 y	82(44.8)	101(54.0)	75(43.4)	77(43.3)	.152
BMI‡					
<25	44(24.9)	53(29.0)	55(32.4)	58(33.3)	
25-29	71(40.1)	88(48.1)	71(41.8)	75(43.1)	
≥ 30	62(35.0)	42(23.0)	44(25.9)	41(23.6)	.018
Heart disease	57(31.8)	85(46.4)	74(44.3)	86(49.7)	.002
Diabetes	34(18.7)	29(15.7)	28(16.8)	44(24.9)	.133
Parkinson's disease	0(0)	3(1.6)	0(0)	3(1.7)	.255
Stroke	10(5.5)	17(9.1)	17(9.9)	25(14.0)	.008
Visual deficit§	44(24.0)	43(23.0)	44(25.4)	50(27.9)	.328
MMSE <24¶	18(9.8)	17(9.1)	16(9.2)	32(17.9)	.022
Physical activity score#					

	1st CESDR quartile* (n=183)	2nd CESDR quartile (n=187)	3rd CESDR quartile (n=173)	4th CESDR quartile (n=179)	p-value†
Characteristic	**n(%)**	**n(%)**	**n(%)**	**n(%)**	
0 - 68	50(27.5)	59(31.9)	58(34.1)	72(40.7)	
68.01 - 125	59(32.4)	52(28.1)	67(39.4)	56(31.6)	
125.01 - 559	73(40.1)	74(40.0)	45(26.5)	49(27.7)	.001
Slow gait speed < 0.78m/s**	30(16.4)	31(16.6)	50(29.1)	69(38.5)	<.001
Impaired balance, score <4 out of 7††	36(19.8)	48(25.7)	54(32.0)	65(37.6)	<.001
Psychotherapeutic medication use					
None	163(89.6)	164(87.7)	136(78.6)	111(62.0)	
<Daily	5(2.7)	11(5.9	8(4.6	16(8.9)	
Single drug daily	13(7.1	6(3.2	20(11.6)	39(21.8)	
≥2 drugs daily	1(0.5)	6(3.2)	9(5.2)	13(7.3)	<.001
Daily analgesic use‡‡	28(15.4)	37(19.8)	51(29.5)	62(34.6)	<.001

*Cut points of the Center for Epidemiologic Studies Depression Scale - Revised (CESDR) quartiles are <2, <8, and <16.

†Chi-square test (1d.f.) for linear trend.

‡Body mass index is calculated as weight in kilograms divided by height in meters squared.

§Vision deficit assessed as lowest quartile in score of distant vision using Good Lite Box.

¶Mini-Mental State Examination (MMSE) cut point for cognitive impairment (normal range 24-30).

#Physical activity tertiles measured using the Physical Activity Scale for the Elderly.

**Slow gait speed (m/s) is the slowest 25% based on time of fastest of 2 usual-paced 4-meters walks.

††Balance score was based on 4 stands: feet by side, semi-tandem, tandem, and 1-leg stand.

‡‡Used 1 or more analgesic medications at least daily in the previous 2 weeks.

Table 2

Means and Standard Deviations of the Total CESDR, the Cognitive CESDR Domain and the Somatic CESDR Domain According to the 3 Different Chronic Pain Measures.

Chronic pain measures	Total CESDR * (range 0-67)	Cognitive CESDR domain * (range 0-41)	Somatic CESDR domain * (range 0-24)
Pain location			
No pain	7.29 (8.66)	3.17 (4.88)	3.12 (3.92)
Single site pain	9.72 (10.00)	4.08 (5.39)	4.31 (4.34)
Multisite/widespread pain	15.01 (12.53)	6.33 (7.10)	6.64 (5.44)
Pain severity †			
1st tertile (least severe pain)	7.15 (8.67)	2.85 (4.57)	3.34 (4.20)
2nd tertile	10.59 (9.03)	4.74 (5.13)	4.51 (4.20)
3rd tertile (most severe pain)	15.71 (13.78)	6.66 (7.80)	6.81 (5.69)
Pain interference †			
1st tertile (least interference)	6.45 (8.11)	2.67 (4.63)	2.92 (3.80)
2nd tertile	10.13 (9.24)	4.61 (5.30)	4.30 (4.14)
3rd (most interference)	16.69 (12.93)	6.96 (7.39)	7.31 (5.45)

* Test for trend (1d.f.) was significant for all CESD-pain relationships ($p<0.000001$)

† Pain severity and pain interference were measured using subscales of the Brief Pain Inventory

Table 3a

Adjusted fall rate ratios according to baseline (total) score on the CESDR, including different pain measures, the MOBILIZE Boston Study, 2005-2008.

CESDR quartiles	Adjusted Model Only CESDR	Adjusted Model CESDR + pain location	Adjusted Model CESDR + Pain severity	Adjusted Model CESDR + Pain interfere.
Q1 (least) (0-1)	(reference)	(reference)	(reference)	(reference)
Q2 (2-7)	1.11 (0.82–1.49)	1.02 (0.75–1.38)	1.09 (0.80–1.47)	1.06 (0.78–1.44)
Q3 (8-15)	1.26 (0.92–1.73)	1.14 (0.82–1.58)	1.21 (0.88–1.67)	1.07 (0.77–1.49)
Q4 (most) (16-67)	1.91(1.39–2.61)	1.62(1.16–2.28)	1.77(1.28–2.46)	1.66(1.19–2.33)
Pain location				
No pain		(reference)		
Single site		1.20 (0.90–1.61)		
Multisite		1.55 (1.17–2.04)		
Pain severity tertiles				
Low (0-0.99)			(reference)	
Middle (1.0-3.25)			1.17 (0.90–1.53)	
High (3.36-10)			1.42 (1.04–1.94)	
Pain interfere. tertiles				
Low (0)				(reference)
Middle (0.1-1.9)				1.46 (1.11–1.93)
High (2-9)				1.56 (1.14–2.13)
AIC	2093.787	2083.694	2086.883	2040.521
Log likelihood	-1025.894	-1018.847	-1020.442	-997.261
Chi-square		14.094†	10.904*	57.266†

The model presents the fall rate ratios and 95% confidence intervals, from negative binomial regression models for the total CESDR (quartiles), and for the 3 different pain measures (tertiles), adjusted for age, sex, race, and education, heart disease, Parkinson's disease, history of stroke, vision score, BMI, cognitive function (MMSE), physical activity (PASE), balance score, gait speed, psychotherapeutic medications, and daily use of analgesic. Chi-square test (2 d.f.) of the log likelihood statistics of the extended models including the pain variables compared to the multivariable models of CESDR without pain variables

CESDR=Hopkins Revision of the Center for Epidemiologic Studies Depression scale; interfere.=interference; Q=Quartile; AIC= Akaike's Information Criterion.

*p<0.01

†p<0.001.

Table 3b

Adjusted fall rate ratios according to baseline score on the Cognitive CESDR domain, including different pain measures, the MOBILIZE Boston Study, 2005-2008.

Cognitive CESDR quartiles	Adjusted Model Only CESDR	Adjusted Model CESDR + pain location	Adjusted Model CESDR + Pain severity	Adjusted Model CESDR + Pain interfere.
Q1 (least) (0-9)	(reference)	(reference)	(reference)	(reference)
Q2 (10-11)	1.30 (0.96–1.77)	1.22 (0.90–1.66)	1.26 (0.93–1.72)	1.19 (0.87–1.63)
Q3 (12-16)	1.37 (1.02–1.85)	1.29 (0.95–1.74)	1.32 (0.98–1.78)	1.27 (0.94–1.71)
Q4 (most) (17-55)	2.11(1.55–2.88)	1.87(1.35–2.58)	2.01(1.46–2.75)	1.82(1.32–2.53)
Pain location				
No pain		(reference)		
Single site		1.14 (0.86–1.53)		
Multisite		1.52 (1.15–1.99)		
Pain severity tertiles				
Low (0-0.99)			(reference)	
Middle (1.0-3.25)			1.12 (0.85–1.46)	
High (3.36-10)			1.46 (1.07–1.99)	
Pain interfere.tertiles				
Low (0)				(reference)
Middle (0.1-1.9)				1.37 (1.03–1.81)
High (2-9)				1.53 (1.13–2.08)
AIC	2090.011	2080.060	2082.021	2039.426
Log likelihood	-1024.005	-1017.030	-1018.010	-996.713
Chi-square		13.950†	11.990*	54.584†

The model presents the fall rate ratios and 95% confidence intervals, from negative binomial regression models for the Cognitive CESDR domain (quartiles), and for the 3 different pain measures (tertiles), adjusted for age, sex, race, and education, heart disease, Parkinson's disease, history of stroke, vision score, BMI, cognitive function (MMSE), physical activity (PASE), balance score, gait speed, psychotherapeutic medications, and daily use of analgesic. Chi-square test (2 d.f.) of the log likelihood statistics of the extended models including the pain variables compared to the multivariable models of Cognitive CESDR items without pain variables

CESDR=Hopkins Revision of the Center for Epidemiologic Studies Depression scale; interfer=interference; Q=Quartile; AIC= Akaike's Information Criterion.

*p<0.01

†p<0.001.

Table 3c

Adjusted fall rate ratios according to baseline score on the Somatic CESDR domain, including different pain measures, the MOBILIZE Boston Study, 2005-2008.

Somatic CESDR quartiles	Adjusted Model Only CESDR	Adjusted Model CESDR + pain location	Adjusted Model CESDR + Pain severity	Adjusted Model CESDR + Pain interfere.
Q1 (least) (0-5)	(reference)	(reference)	(reference)	(reference)
Q2 (6-7)	1.38 (1.02–1.87)	1.29 (0.95–1.75)	1.34 (0.99–1.82)	1.27 (0.93–1.73)
Q3 (8-11)	1.23 (0.91–1.65)	1.11 (0.82–1.51)	1.17 (0.86–1.58)	1.07 (0.78–1.46)
Q4 (most) (12-29)	1.65(1.22–2.22)	1.40(1.03–1.92)	1.52(1.12–2.07)	1.42 (1.04–1.95)
Pain location				
No pain		(reference)		
Single site		1.20 (0.90–1.60)		
Multisite		1.61(1.22–2.12)		
Pain severity tertiles				
Low (0-0.99)			(reference)	
Middle (1.0-3.25)			1.22 (0.94–1.60)	
High (3.36-10)			1.49 (1.09–2.03)	
Pain interfere.tertiles				
Low (0)				(reference)
Middle (0.1-1.9)				1.52 (1.16–2.01)
High (2-9)				1.61 (1.19–2.19)
AIC	2101.409	2089.402	2093.037	2046.745
Log likelihood	-1029.705	-1021.701	-1023.519	-1000.375
Chi-square		16.008†	12.372*	58.666†

The model presents the fall rate ratios and 95% confidence intervals, from negative binomial regression models for the depression domains (quartiles), and for the 3 different pain measures (tertiles), adjusted for age, sex, race, and education, heart disease, Parkinson's disease, history of stroke, vision score, BMI, cognitive function (MMSE), physical activity (PASE), balance score, gait speed, psychotherapeutic medications, and daily use of analgesic. Chi-square test (2 d.f.) of the log likelihood statistics of the extended models including the pain variables compared to the multivariable models of Somatic CESDR items without pain variables

CESDR=Hopkins Revision of the Center for Epidemiologic Studies Depression scale; interfer=interference; Q=Quartile; AIC= Akaike's Information Criterion.

*p<0.01

†p<0.001.