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Pain Characteristics Associated With the Onset of Disability in Older Adults: The MOBILIZE Boston Study

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Abstract

Background/Objectives—To determine the effects of chronic pain on the development of disability and decline in physical performance over time among older adults.

Design—Longitudinal cohort study with 18 months follow-up.

Setting—Urban/suburban communities

Participants—634 community-dwelling older adults aged >64 years.

Measurements—Chronic pain assessment consisted of musculoskeletal pain locations, and pain severity and pain interference by subscales of the Brief Pain Inventory. Disability was self-reported as any difficulty in mobility and basic and instrumental activities of daily living (ADL,

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Conflict of Interest

All authors declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

Author Contributions

All authors had access to the data and can take responsibility for the integrity of the data and the accuracy of the data analysis. L. Eggermont analysed and interpreted data and drafted the manuscript, S. Leveille made substantial contributions to study conception and design, data gathering and interpretation, and critical revision of the manuscript. J. Bean made substantial contributions as a clinical expert in all phases of the research, and to the data gathering and interpretation, and critical revisions of the manuscript. L. Shi and R. Jones contributed to statistical analyses and interpretation, and provided critical revision of the manuscript. D. Kiely, R. Shmerling, and J. Guralnik all contributed to data interpretation and provided critical feedback on the manuscript for important intellectual content. All authors approved the final version of the manuscript before submission and will approve the final version to be published.

IADL). Mobility performance was measured using the Short Physical Performance Battery (SPPB). Relationships between baseline pain and incident disability in 18 months were determined using risk ratios (RRs) from multivariable Poisson regression models.

Results—Almost 65% of participants reported chronic musculoskeletal pain at baseline. New onset of mobility difficulty at 18-months was strongly associated with baseline pain distribution: 7% (no sites), 18% (1 site), 24% (multisite) and 39% (widespread pain, p -value for trend <0.001). Similar graded effects were found for other disability measures. Elders with multisite or widespread pain had at least a three-fold increased risk for onset of mobility difficulty compared to their peers without pain after adjusting for disability risk factors (multisite pain: $RR=2.95$, 95% CI, 1.58–5.50; widespread pain: $RR=3.57$, 95% CI, 1.71–7.48). Widespread pain contributed to decline in mobility performance (1 point decline in SPPB, $RR=1.47$, 95% CI, 1.08–2.01). Similar associations were found for baseline pain interference predicting subsequent mobility decline and (I)ADL disability. Weaker and less consistent associations were observed with pain severity.

Conclusion—Older community-dwelling adults living with chronic pain in multiple musculoskeletal locations have a substantial increased risk for developing disability over time and for clinically meaningful decline in mobility performance.

Keywords

widespread chronic pain; older adults; mobility limitation; activities of daily living

INTRODUCTION

Chronic pain is common in the older population¹ and is associated with several negative health outcomes including cognitive deficits,² and falls.³ Highly prevalent, painful conditions such as osteoarthritis are related to mobility limitations and functional disability in the older population.^{4,5} Accumulating evidence, primarily from cross-sectional studies, links pain and mobility problems, with most studies reporting pain in selected sites associated with impairments in balance and gait.^{4,6} Several studies link site-specific pain including hip or knee pain,⁷ and low back pain,⁸ to functional disability.

Similarly, in the clinical setting, pain treatment is typically focused on selected pain sites directly related to specific conditions such as knee osteoarthritis, when in fact, chronic pain in older persons is most commonly a multisite or generalized condition.^{9,10} As we reported previously, 62% of participants in the MOBILIZE Boston Study who had musculoskeletal pain reported pain in 2 or more sites.³ Recently, longitudinal studies, using global pain assessments, have found associations between chronic pain and subsequent increased risk for mobility decline and disability in selected groups of elders; these studies included older adults in religious orders, residents of retirement communities, older women with disabilities, and home care patients.^{11–14} Nonetheless, studies to date have been limited by the lack of generalizability of the findings or limited pain assessments. The economic burden of disability is clear in terms of health care resources and caregiver and societal burden.^{15–16} The growing concern about the impact of chronic pain in the lives of older adults is reflected by the accumulating research published on this topic.^{17–19} If the

functional impact of chronic pain in older adults is a progressive problem whereby chronic pain leads to deteriorating function over time, the need for effective long-term management of chronic pain conditions will have growing urgency, especially with the rapid growth of the older population in coming decades. We hypothesize that chronic musculoskeletal pain contributes to the onset of physical disability in older adults. The present study aims to prospectively examine the association between multiple domains of chronic pain and subsequent self-reported and observed disability in a population-based cohort of older adults.

METHODS

Participants

The Maintenance of Balance, Independent Living, Intellect, and Zest in the Elderly (MOBILIZE) Boston Study is a longitudinal population-based study of older community-living adults.²¹ Participants, enrolled from 2005 to 2008, live in Boston and surrounding suburbs. Potential participants were randomly sampled from town lists and recruited door-to-door. Criteria for study participation included: 1) aged 70 years or older; 2) able to speak and read English; 3) able to walk independently across a small room; and 4) plans to remain in the area for at least 2 years. Spouses or domestic partners of eligible participants could join the study if they were within 6 months of their 65th birthday or older, and met eligibility criteria. People were excluded if they had a terminal disease or cognitive impairment. Baseline assessment included a home visit by a trained research assistant followed by a nurse exam at the study clinic. During the home visit, participants provided informed consent and were screened for moderate to severe cognitive impairment based on a score of 17 or lower on the Mini-Mental State Examination.²⁰ The assessments were repeated approximately 18 months following baseline. Further details of the study design and methods were published previously.²¹ All study procedures were approved by the Institutional Review Boards of the HRC, University of Massachusetts Boston, and Beth Israel Deaconess Medical Center.

Chronic Pain Assessment

Chronic musculoskeletal pain was assessed according to pain distribution, pain severity, and pain interference with daily activities. Pain distribution was determined by a 14-item questionnaire (see Appendix 1) ascertaining pain in major musculoskeletal sites (back, chest, shoulder, hand/wrist, hip, knee, foot) lasting 3 or more months in the previous year and present in the previous month.^{9,22} Pain assessment did not include laterality, therefore pain in one or both knees was counted as 1 site of pain. Chest pain was excluded if associated with angina, measured using the Rose Angina questionnaire²³ or use of nitrates recorded in the medication inventory. Responses were categorized into 4 groups: no pain, single site pain, more than 1 pain site ('multisite pain') but not meeting criteria for 'widespread pain', and widespread pain. Criteria for widespread pain were as follows: pain above and below the waist, and axial skeletal pain (back or non-anginal chest pain). Because we did not include laterality, this is a modification of the widespread pain classification by the American College of Rheumatology (ACR).²²

Pain severity was measured by the pain severity subscale of the Brief Pain Inventory (BPI), a validated questionnaire for patients with chronic musculoskeletal conditions.^{24,25} This instrument assesses global pain severity and is recommended for use in older adults.²³ Participants rate their pain in the past week according to 4 conditions: 1) pain at its worst, 2) at its least, 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 was based on the average of the 4 item ratings and categorized into quartiles (cut points <0.5, 0.5 and <1.75, 1.75 and <3.71, and 3.71); the 4th quartile indicating moderate to severe pain.

Pain interference with daily activities was measured by a 7-item subscale of the BPI addressing general activity, mood, walking, normal work including housework, relations with others, sleep, and enjoyment of life. Participants rate pain interference with each activity from 0 to 10, indicating does not interfere at all to completely interferes.²⁴ The average score of the 7 ratings was categorized into quartiles (cut points were <.01, .01 and <0.57, 0.57 and <2.57, and 2.57).

Assessment of Disability and Performance Outcomes

Three domains of self-reported disability were assessed at baseline and follow-up: mobility in walking (i.e. walking for a quarter of a mile, about 2 or 3 blocks) and stair-climbing (i.e. walking up 10 steps, or 1 flight of stairs), activities of daily living (ADL), including bathing, dressing, transferring, using the toilet, and eating, and instrumental activities of daily living (IADL), including shopping, preparing meals, and light and heavy housework.²³ Response options were to identify level of difficulty, i.e. none, a little, some, or a lot, or inability in performing each activity. Incident disability was defined as report of any difficulty in one or more tasks within a disability domain at the follow-up assessment among persons who had no difficulty in the specific domain at baseline.

Mobility performance was measured using the well-validated Short Physical Performance Battery (SPPB),²⁶ which comprises 3 sets of lower body mobility tests: gait speed, standing balance, and repeated chair stands. Gait speed was assessed by the faster of 2 trials of a timed usual-pace 4-meter walk. Standing balance was assessed in three 10-second stands: standing with feet side-by-side, semi-tandem stand with the side of the heel of one foot touching the side of the big toe of the other foot, full tandem (heel to toe) stand. Timed repeated chair stands tests measured the ability and time required to stand up and down from a chair as fast as possible 5 times with the arms folded across the chest. The SPPB was scored using the standard scoring protocol, ranging from 0 to 12, was calculated from the sum of categorical scores on the 3 tests, each ranging from 0–4.²⁶ Higher values indicate better function. Decline in SPPB score was measured by subtracting the follow-up score from the baseline score.

Covariates

Several potential confounders of the association between chronic pain and disability were assessed at baseline. Demographic characteristics included age, sex, race, and education in years. Body mass index (BMI) was determined by measured weight in kilograms divided by

height in squared meters. The MMSE was used to assess global cognitive functioning²⁰ and the Physical Activity Scale for the Elderly (PASE) quantified level of physical activity in the previous 7 days.²⁷

Comorbidity—Participants were asked if a physician had told them they had heart disease (myocardial infarction, atrial fibrillation, pacemaker, angina, or congestive heart failure), rheumatoid arthritis, Parkinson's disease, asthma/lung disease and stroke. Peripheral neuropathy was assessed using the Semmes Weinstein monofilament test.²⁸ Diabetes was assessed using an algorithm based on self-reported diabetes, use of oral hypoglycemics or insulin, and laboratory measures including random glucose (≥ 200 mg/dL, to convert to mmol/L, multiply by 0.0555) and hemoglobin A_{1c} ($>7\%$). Osteoarthritis of the hand and knee was assessed according to American College of Rheumatology (ACR) clinical criteria by nurses trained by the study rheumatologist (RS).²³ Presence of depressive symptoms was determined based on the Hopkins Revision of the Center for Epidemiologic Studies Depression Scale.²⁹

Medication use—Use of prescription and over-the-counter medications in the previous 2 weeks was determined using information recorded from the medication bottles during the home interview. Medication codes were applied to each medication using the Iowa Drug Classification System (IDIS).³⁰ Analgesic medications included opioid and non-opioid analgesics and were classified according to daily use versus other or non-use. Psychotherapeutic drugs included sedative, hypnotic, anxiolytic, antidepressant, and antipsychotic medication. Use of psychotherapeutics was summarized into 4 groups as follows: no use, nondaily use, use of one medication at least daily or daily use of 2 or more different medications.

Statistics

Descriptive statistics were used to examine sociodemographic and health characteristics of the study cohort according to pain distribution. Linear trends across pain categories were determined using Chi-square tests (1df). Incident mobility difficulty and (I)ADL difficulty, and clinically meaningful SPPB decline (1 point)³¹ were examined according to the 3 pain measures and compared using Chi-square tests. Relationships between baseline pain and onset of disability and physical performance outcomes at the 18-month follow-up were determined by risk ratios (RR) derived from Poisson regression modeling with robust error variances and adjusted for potential confounders.³² Using data from the hand and knee OA assessment, we adjusted for the presence of the non-pain OA criteria, because including the pain criteria would have been an overadjustment in our models. To study incident disability in each of the 3 domains, we performed models including only those people with no disability in the specific domain at baseline. With respect to the physical performance outcome, we excluded persons who had a very low SPPB score (≤ 3) at baseline. Models generated multivariable-adjusted RRs and 95% confidence intervals (CI). We separately investigated the 3 different domains of baseline chronic pain in relation to disability outcomes: pain distribution (none, single site, multisite, widespread according to a modification of the ACR criteria), pain severity (quartiles of the BPI pain severity subscale), and pain interference (quartiles of the BPI interference subscale). We did not include

multiple pain measures in the same models because the measures were highly correlated ($r > .53$). We ran separate analyses using either pain severity and pain interference tertiles, quartiles, and quintiles. We calculated the population attributable risk percent (PAR%) for new mobility difficulty and IADL difficulty related to multisite (including widespread) pain (using the formula: $(\text{Total Incidence} - \text{Incidence in the unexposed (people with no pain or single site pain)}) / \text{Total Incidence} \times 100\%$). We also performed analyses determining the change of pain distribution category over time in relation to the disability outcomes, using the following 4 categories: 1) no change: no pain or single site pain at baseline and no pain or single site pain at follow-up; 2) change from multisite pain at baseline to no pain or single site pain at follow-up; 3) change from no pain or single site pain at baseline to multisite pain at follow-up; 4) multisite pain at baseline and multisite pain at follow-up (persistent multisite pain). Lastly, separate Poisson regression models were performed to determine the relationship between specific pain sites (back, hand, hip, knee, and foot) and subsequent disability. Data were analyzed using SPSS version 16 (Chicago, IL).

RESULTS

Mean age of participants at baseline was 78 years ($SD=5$; range 64–97 years), the majority of participants were female (64%) and 19% were non-white, largely representative of older adults in the Boston area according to US Census 2000. Of the 765 people who completed baseline assessment, 21 people (3%) died and 84 (11%) people dropped out before the 18-month follow-up assessment, with main reasons for withdrawal being unable to continue due to illness ($n=24$, 29% of those dropping out) or decided not to continue in the study ($n=20$, 24% of those dropping out).

Older persons who had more sites of pain were significantly more likely to be female, have fewer years of education, higher BMI, decreased cognitive function (lower MMSE score), have rheumatoid arthritis, lung disease, hand/knee osteoarthritis, depression, and be more likely to use psychotherapeutic or analgesic medication daily (Table 1). Persons with widespread pain were more likely to be women, with fewer years of education, lower MMSE scores, and a high prevalence of obesity (45%) compared to other pain groups. Persons with multisite or widespread pain at baseline also had significantly more difficulty with respect to mobility and (I)ADL, and a larger percentage had an SPPB score of 9 or lower (Table 1).

Of the 634 people who completed the follow-up assessment (median of 16 months, $SD=2.2$ months), almost 65% reported chronic musculoskeletal pain at baseline. Almost 40% reported multisite or widespread pain at baseline and of those, 67% continued to report multisite or widespread pain at follow-up. We observed significant trends for incident disability across all outcomes according to each of the 3 pain domains at baseline over the 18 month follow-up (Fig. 1a-1c). The onset of new mobility difficulty at 18-months according to baseline pain distribution was 7% (no sites), 18% (1 site), 24% (multisite) and 39% (widespread pain, p -value for trend <0.001). Similar graded effects were observed for (I)ADL disability. SPPB decline at 18-months according to pain distribution was 32% (no sites), 46% (1 site), 36% (multisite), and 49% (widespread pain, p -value for trend $<.05$). We found similar strong associations between baseline pain *severity* and (I)ADL disability and

SPPB decline (Figure 1b), and pain *interference* in relation to (I)ADL disability (Figure 1c), but not SPPB decline (p-value for trend, 0.08) at the 18-month follow-up.

We observed a three-fold increased risk for onset of self-reported mobility difficulty adjusted for age, sex, race, education, body mass index, cognitive function, comorbid conditions, level of physical activity, daily analgesic use, and number of psychotherapeutic medications, comparing those with multisite pain to their counterparts with no pain (RR=2.95, 95% CI, 1.58–5.50), and for widespread pain versus no pain (RR=3.57, 95% CI, 1.71–7.48) (Table 2). There was also more than a two-fold increased risk for incident IADL difficulty for those with multisite pain (RR=2.1, 95% CI, 1.4–3.3) and those with widespread pain (RR=2.7, 95% CI, 1.6–4.5) compared to those with no pain, after adjusting for the same potential confounders (Table 2). For SPPB decline, single site pain and widespread pain were each associated with decline in performance (RR=1.5, 95% CI, 1.1–2.0 for widespread pain versus no pain) (Table 2). Similar associations were found of pain interference contributing to mobility difficulty, ADL difficulty and declining mobility performance (Table 2). Any report of pain interference, compared to no pain interference, was associated with at least a two-fold increased risk for IADL difficulty (Table 2). We did not observe a consistent relationship between pain severity and disability outcomes after adjusting for other risk factors (Table 2). Results were similar when using tertiles or quintiles concerning pain severity and interference (data not shown). In these multivariable analyses, there were 18 persons who were missing outcome or covariate information; when compared to those who had complete information, we did not find that they differed according to participants' characteristics.

With the additional adjustment for the presence of non-pain hand and knee osteoarthritis criteria, we did not find these factors to independently predict disability, nor did they influence the relationships between pain characteristics and incident disability (data not shown). We did not observe any interactions between pain distribution and pain severity in relation to the disability or performance outcomes (data not shown).

To estimate the burden of disability related to multisite and widespread pain, we determined that the PAR% for new mobility difficulty related to multisite (including widespread) pain was 51% and similarly the PAR% for onset of IADL difficulty was 46%. In other words, multisite and widespread musculoskeletal pain combined at baseline contributed to (almost) half of all new reports of mobility and IADL difficulty at the 18-month follow-up. Similarly, in terms of the impact of change in pain distribution over time, it was the persistence of multisite pain over time that was associated with increased risk of self-reported mobility difficulty and difficulty in performance of (I)ADL. We did not observe that the change from no sites or single site pain at baseline to more sites of pain at follow-up was associated with disability risk (Table 3).

When we examined the impact of *site-specific* pain on risk for incident disability, hip and knee pain either in the absence or presence of other pain sites compared to no pain were each independently associated with risk for incident mobility difficulty (Table 4). Also, single-site back, hip, and knee pain compared to no pain were each associated with clinically meaningful SPPB decline (Table 4). In general, single site pain was a rarity in the cohort and

persons with multisite pain regardless of the sites involved consistently had an increased risk for onset of disability (Table 4).

DISCUSSION

In this population of older community-dwelling adults, chronic pain measured across 3 global domains was strongly associated with a substantial increased risk for incident disability after 18 months, adjusting for several potential confounders. Although we observed associations between selected site-specific pain and disability risk, multisite pain was most consistently related to disability onset. Chronic pain in the older population is highly prevalent and leads to tremendous burden on individuals and society.^{1,15,16} Although clinicians may generally view chronic pain as a ‘steady state’ in older adults, our findings suggest that chronic pain may contribute to progressive disability over time. Our results consistently show that pain distribution and pain interference are the best predictors of mobility difficulty, (I)ADL difficulty, and clinically meaningful mobility performance decline. Global pain severity did not show similar or consistent relationships. It could be that severity alone does not capture the heterogeneity of the problem of pain in older adults. Although global measures of pain are correlated, severity and pain distribution do not measure the same characteristic; persons may have more localized problems of pain that are more severe but not as disabling as a more disseminated pain condition. We have shown in previous cross-sectional studies that pain distribution, rather than pain severity, is more strongly associated with disability and worse mobility.^{14,33} Also in a recent longitudinal study, pain severity was not a significant predictor of a combined outcome of disability and death after controlling for confounders in an older population.³⁴

A number of possible explanations for the relationship between pain and disability can be considered. One explanation lies in the neuromuscular effects of pain. People with pain may experience unfavorable neuromuscular adaptations to preserve function.³⁵ Indeed, neuromuscular changes during movement have been reported in older people with lower back pain,³⁶ and people with widespread pain.³⁷ For example, chronic back pain may contribute to weakness in major muscles involved in trunk stability resulting in a reliance on other weaker muscles of the back and lower extremities to maintain stability during walking and other movements. Inappropriate adaptive strategies may cause injury of muscles and joints, creating a progressively debilitating cycle.³⁵ Older persons with pain in multiple sites may be particularly vulnerable to the neuromuscular changes over time with greater functional consequences. Another explanation could be that the increased risk for disability may be caused by central mechanisms whereby cognitive effects of chronic pain may interfere with mobility. The experience of pain is associated with attentional and executive function deficits,³⁸ which are in turn associated with reduced mobility, falls, and functional dependence.^{39,40}

Arguably the measures of difficulty in IADL and pain interference are overlapping constructs. However, when we excluded all participants who had difficulty in IADL at baseline, our results showed that *any* interference of pain, regardless of the level of pain interference, was a strong predictor of new IADL difficulty at follow-up. Pain interference may encompass “preclinical disability”, indicating modification of the performance of a task

in the absence of perceived difficulty.^{41,42} In the Women's Health and Aging Study, task modification with mobility tasks was predictive of later declines in mobility function, and was identified as a potential target for intervention.⁴¹ Pain interference in our results may be akin to task modification and may be a potential clinical indicator of disability risk in older adults.

Objective assessment of physical function of older individuals (e.g. by use of the SPPB) is not a common component of standard clinical practice. However, our results indicate that SPPB scores are sensitive to chronic widespread pain classified according to a modification of the ACR criteria and more pain interference. Previous reports have shown that this measure of lower body mobility performance is predictive of functional disability, hospitalization and mortality.^{28,42,43} Standard clinical assessment using the SPPB to monitor mobility over time may shed light on underlying mechanisms leading to disability including chronic pain.

Among the sites of pain we studied, isolated back, hip and knee pain were associated with deteriorating mobility, particularly mobility performance. Notably, in our specific pain site analyses, only few participants with musculoskeletal pain reported having single site pain *only*. Our results revealed that multisite pain regardless of specific sites involved, was highly prevalent and consistently associated with a decline in function across domains. In fact, we found that about half of the incident disability was related to chronic pain based on our estimates of the population attributable risk. Additionally the persistence of multisite pain over time was related to increased risks of disability. Thus, the evidence we present makes a strong case for assessing the global aspect of pain distribution and its persistence over time for the purpose of assessing disability risk in older adults. Of note, widespread pain is not equated with fibromyalgia in the geriatric population as it sometimes is in younger adults. In fact, we have shown previously that prevalence of fibromyalgia based on widespread pain and tender point counts is very low in older persons.⁴⁴

The associations we observed between chronic pain and subsequent onset of disability were independent of analgesic use. However, it is important to note that even daily use of an analgesic is not synonymous with *adequate* pain management. A recent report from the MOBILIZE Boston Study shows that very few participants had pain management consistent with current pain management guidelines.⁴⁵ Similarly, others have found that chronic pain is undertreated in older adults.⁴⁶ Our results point to the need for intervention research to examine approaches to pain management that will reduce risk for functional decline in older adults who live with chronic musculoskeletal pain. New approaches are needed because medications commonly used to treat pain often have side effects that create other risks or can increase disability risk, e.g., some analgesics might cause dizziness, fatigue or altered mental status leading to reduced mobility or falls.^{47,48} Current guidelines for pain management in older adults call for combined use of pharmacologic and non-pharmacologic approaches.⁴⁹ Evidence supports use of non-pharmacological pain management such as cognitive-behavioral approaches, self-management of pain by providing education and teaching coping skills, exercise, and physical therapy.^{50,51} However, the overall effectiveness of these approaches in controlling pain and preventing disability is unknown.

The generalizability of our findings is strengthened by having a representative cohort of older community-dwelling people who were recruited door-to-door. We included extensive measures of the characteristics of chronic pain, confirming the consistency of the impact of these global pain domains. Our study also has some weaknesses that should be addressed. Although we adjusted for a number of chronic conditions, we cannot be certain that pathology rather than pain was the cause of the effects that we observed. There may have been other unmeasured factors associated with pain that could contribute to disability in this cohort of older adults. Finally, we used a follow-up period of 18-months which might be considered short. However, we observed substantial functional decline in 18 months in this aged population.

In sum, chronic musculoskeletal pain measured according to distribution, severity and interference is strongly associated with increased risk for developing mobility and IADL difficulty, and for clinically meaningful decline in mobility performance in older adults. In view of the progressively disabling impact of multisite musculoskeletal pain, future studies are urgently needed to determine whether pain management strategies targeting this chronic pain condition can prevent or control disability among older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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a.

b.

c. **Figure 1.**

a. Onset of Self-reported Mobility Difficulty, (I)ADL Difficulty and Clinically Meaningful SPPB Decline in 18 Months by Baseline Pain Distribution Categories.

^aChi-square test for trend p-value <.001

^bChi-square test for trend p-value <.05

ADL=Activities of Daily Living; I=Instrumental; SPPB=Short Physical Performance Battery

b. Onset of Self-reported Mobility Difficulty, (I)ADL, Difficulty- and Clinically Meaningful SPPB Decline in 18 Months by Baseline Pain Severity Quartiles.

^aChi-square test for p-value <.01

^bChi-square test for p-value <.05

ADL=Activities of Daily Living; I=Instrumental; SPPB=Short Physical Performance Battery

c. Onset of Self-reported Mobility Difficulty, (I)ADL Difficulty and Clinically Meaningful SPPB Decline in 18 Months by Baseline Pain Interference Quartiles.

^aChi-square test for p-value <.01

^bChi-square test for p-value <.001

ADL=Activities of Daily Living; I=Instrumental; SPPB=Short Physical Performance Battery; inter.=interference

Table 1

Baseline Participant Characteristics According to Pain Distribution (n=633^a)

	No pain (n=227)	Single site pain (n=157)	Multisite pain (n=166)	Widespread pain ^b (n=83)	<i>p</i> ^c
	M (SD)	M (SD)	M (SD)	M (SD)	
Age, y	77.7 (5.3)	77.8 (5.4)	77.7 (5.5)	78.6 (4.9)	.344
Education, y	14.6 (2.9)	14.7 (3.0)	14.1 (3.2)	13.6 (3.3)	.003
MMSE ^d	27.5 (2.5)	27.4 (2.3)	27.2 (2.5)	26.6 (2.9)	.011
PASE ^e	115.0 (67.1)	110.2(74.0)	102.2 (64.5)	107.3 (64.9)	.121
	n (%)	n (%)	n (%)	n (%)	
Gender (female)	135 (60)	90 (57)	118 (71)	64 (77)	.001
Race (white)	182 (80)	123 (78)	123 (74)	62 (76)	.180
Obesity (BMI ≥30) ^f	51 (23)	44 (28)	45 (27)	37 (45)	.001
Peripheral neuropathy	22 (10)	15 (10)	22 (13)	12 (15)	.126
Heart disease	82 (36)	73 (47)	79 (48)	31 (37)	.252
Diabetes	22 (10)	22 (14)	23 (14)	12 (15)	.176
Rheumatoid arthritis	6 (3)	5 (3)	13 (8)	5 (6)	.029
Lung disease	18 (8)	20 (13)	36 (22)	18 (22)	<.001
Stroke	19 (8)	15 (10)	15 (9)	9 (11)	.569
Hand osteoarthritis ^g	85 (37)	50 (32)	76 (46)	43 (52)	.008
Knee osteoarthritis ^g	105 (46)	80 (51)	99 (60)	53 (64)	.001
Depression ^h	9 (4)	7 (5)	20 (12)	9 (11)	.001
Daily analgesic use ⁱ	28 (12)	35 (22)	54 (33)	34 (41)	<.001
Daily psychother. drugs ^j	26 (11)	21 (13)	20 (12)	23 (28)	.005
Any baseline mobility diff.	42 (19)	39 (25)	80 (48)	46 (58)	<.001
Any baseline ADL diff.	26 (11)	25 (16)	50 (30)	33 (40)	<.001
Any baseline IADL diff.	49 (22)	57 (36)	84 (51)	52 (63)	<.001
Baseline SPPB score	9	34 (22)	63 (38)	35 (42)	<.001

- ^aOne person had missing data with respect to the pain distribution variable.
- ^bWidespread pain was classified according to a modification of the criteria of the American College of Rheumatology that did not include laterality.
- ^cTest for linear trend across categories of pain distribution.
- ^dCognitive functioning measured using the Mini-Mental State Examination (MMSE).
- ^eLevel of physical activity measured using the Physical Activity Scale for the Elderly (PASE).
- ^fBody Mass Index (BMI) is calculated as weight in kilograms divided by height in meters squared.
- ^gOsteoarthritis was determined by use of clinical criteria by the American College of Rheumatology.
- ^hPresence of depression as measured by the Centers for Epidemiologic Studies Depression scale.
- ⁱUse of 1 or more analgesic medications at least daily in the previous 2 weeks.
- ^jUse of 1 or more psychotherapeutic (psychother.) medications at least daily in the previous 2 weeks.
- ADL = Activities of Daily Living; diff. = difficulty; IADL = Instrumental Activities of Daily Living; SPPB = Short Physical Performance Battery

Adjusted Risk Ratios for Onset of Self-reported Mobility Difficulty, Difficulty in Performance of (Instrumental) Activities of Daily Living ((I)ADL), and Clinically Meaningful Decline in Short Physical Performance Battery (SPPB) Score According to Pain Measures in Adults Aged 70 and Older, MOBILIZE Boston Study.

Table 2

Pain categories	Mobility difficulty			ADL difficulty			IADL difficulty			SPPB decline (1 point)		
	N ^a	RR (95%CI) ^c	N ^a	RR (95%CI) ^c	N ^a	RR (95%CI) ^c	N ^a	RR (95%CI) ^c	N ^b	RR (95%CI) ^{c,d}	N ^b	RR (95%CI) ^{c,d}
Pain distribution												
No pain	177	1.0	194	1.0	174	1.0	217	1.0	217	1.0	217	1.0
One pain site	114	1.88 (0.97–3.64)	128	1.76 (0.79–3.88)	98	1.25 (0.77–2.03)	149	1.34 (1.04–1.74)	149	1.34 (1.04–1.74)	149	1.34 (1.04–1.74)
Multisite pain	86	2.95 (1.58–5.50)	111	3.63 (1.78–7.41)	79	2.14 (1.37–3.34)	147	1.10 (0.82–1.48)	147	1.10 (0.82–1.48)	147	1.10 (0.82–1.48)
Widespread pain ^e	36	3.57 (1.71–7.48)	48	2.25 (0.90–5.64)	30	2.69 (1.61–4.50)	73	1.47 (1.08–2.01)	73	1.47 (1.08–2.01)	73	1.47 (1.08–2.01)
BPI pain severity^e												
1 st quartile (least pain, <0.5)	121	1.0	134	1.0	119	1.0	148	1.0	148	1.0	148	1.0
2 nd quartile (<1.75)	113	1.50 (0.77–2.90)	125	0.50 (0.21–1.22)	104	1.26 (0.75–2.13)	141	1.27 (0.92–1.74)	141	1.27 (0.92–1.74)	141	1.27 (0.92–1.74)
3 rd quartile (<3.71)	115	2.00 (1.13–3.55)	130	1.03 (0.55–1.93)	83	1.89 (1.16–3.08)	156	1.26 (0.94–1.70)	156	1.26 (0.94–1.70)	156	1.26 (0.94–1.70)
4 th quartile (most pain)	62	1.70 (0.81–3.57)	91	1.66 (0.87–3.16)	73	1.64 (0.99–2.73)	140	1.33 (0.95–1.85)	140	1.33 (0.95–1.85)	140	1.33 (0.95–1.85)
BPI pain interference^f												
1 st quartile (least interf, <.01)	201	1.0	217	1.0	184	1.0	234	1.0	234	1.0	234	1.0
2 nd quartile (<0.57)	48	1.95 (0.98–3.88)	53	0.47 (0.12–1.93)	39	2.19 (1.24–3.86)	57	1.16 (0.80–1.69)	57	1.16 (0.80–1.69)	57	1.16 (0.80–1.69)
3 rd quartile (<2.57)	107	2.01 (1.34–3.55)	121	1.29 (0.65–2.56)	98	2.22 (1.43–3.45)	159	1.09 (0.84–1.41)	159	1.09 (0.84–1.41)	159	1.09 (0.84–1.41)
4 th quartile (most interf.)	55	2.46 (1.34–4.54)	89	2.74 (1.51–4.96)	58	2.56 (1.55–4.22)	134	1.32 (1.00–1.74)	134	1.32 (1.00–1.74)	134	1.32 (1.00–1.74)

^a Analyses included only people without any disability at baseline; i.e. no mobility difficulty (n=426) and no IADL difficulty (n=391).

^b Analyses included 608 (persons with SPPB score of 3 were excluded).

^c Risk ratios and 95% confidence intervals (CI) generated from multivariable Poisson regression (GENLIN) with robust variance estimators predicting onset of disability or physical performance decline adjusted for age, sex, race, education, body mass index (BMI), cognitive function (MMSE), comorbid conditions (neuropathy, heart disease, diabetes, rheumatoid arthritis, asthma/lung disease, stroke and depression), level of physical activity (PASE score), daily analgesic use, and number of psychotherapeutic medications.

^d In the SPPB analyses we adjusted additionally for baseline physical performance.

^eWidespread pain was classified according to a modification of the criteria of the American College of Rheumatology that did not include laterality.

^fPain severity and pain interference subscales of the Brief Pain Inventory, each scored from 0 to 10.

Adjusted Risk Ratios for Onset of Self-reported Mobility Difficulty, Difficulty in Performance of (Instrumental) Activities of Daily Living ((I)ADL), and Clinically Meaningful Decline in Short Physical Performance Battery (SPPB) Score According to Change in the Distribution of Pain over Time in Adults Aged 70 and Older, MOBILIZE Boston Study.

Table 3

Change in pain distribution	Mobility difficulty			ADL difficulty			IADL difficulty			SPPB decline (1 point)		
	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^b	RR (95% CI) ^{c,d}	N ^b	RR (95% CI) ^{c,d}
No pain/single site → no pain/single site	250	1.0	276	1.0	237	1.0	237	1.0	310	1.0	310	1.0
Multisite pain → no pain/single site	53	1.08 (0.87–2.42)	63	2.10 (1.00–4.39)	47	1.60 (0.92–2.76)	47	1.60 (0.92–2.76)	78	0.97 (0.69–1.36)	78	0.97 (0.69–1.36)
No pain/single site → multisite pain	44	1.12 (0.48–2.59)	48	0.82 (0.23–2.91)	35	1.40 (0.78–2.52)	35	1.40 (0.78–2.52)	57	1.17 (0.84–1.64)	57	1.17 (0.84–1.64)
Persistent multisite pain	69	3.07 (1.98–4.77)	101	2.39 (1.32–4.33)	66	2.72 (1.86–3.97)	66	2.72 (1.86–3.97)	149	1.17 (0.91–1.52)	149	1.17 (0.91–1.52)

^a Analyses included only people without any disability at baseline; i.e. no mobility difficulty (n=426) and no IADL difficulty (n=391).

^b Analyses included 608 (persons with SPPB score of 3 were excluded).

^c Risk ratios and 95% confidence intervals (CI) generated from multivariable Poisson regression (GENLIN) with robust variance estimators predicting onset of disability or physical performance decline adjusted for age, sex, race, education, body mass index (BMI), cognitive function (MMSE), comorbid conditions (neuropathy, heart disease, diabetes, rheumatoid arthritis, asthma/lung disease, stroke and depression), level of physical activity (PASE score), daily analgesic use, and number of psychotherapeutic medications.

^d In the SPPB analyses we adjusted additionally for baseline physical performance.

Table 4

Adjusted Risk Ratios (RR) for Onset of Mobility Difficulty, Difficulty in Performance of (Instrumental) Activities of Daily Living (IADL), and Clinically Meaningful Decline in Short Physical Performance Battery (SPPB) Score According to Specific Pain Sites, the MOBILIZE Boston Study, 2005–2008.

Pain categories	Mobility difficulty			ADL difficulty			IADL difficulty			SPPB decline (1 point)		
	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^b	RR (95% CI) ^{c,d}	N ^b	RR (95% CI) ^{c,d}
Back and other joint pain												
None	176	1.00	193	1.00	174	1.00	216	1.00				
Pain other than back	154	2.17 (1.18 – 3.99)	183	2.27 (1.12–4.63)	146	1.55 (1.01 – 2.37)	230	1.19 (0.92 – 1.53)				
Back only	15	1.74 (0.42 – 7.11)	20	2.42 (0.68–8.64)	8	1.37 (0.39 – 4.83)	20	1.61 (1.04 – 2.49)				
Back and other pain	67	3.30 (1.72 – 6.33)	84	2.80 (1.26–6.21)	53	2.51 (1.59 – 3.94)	119	1.44 (1.09 – 1.90)				
Hand/wrist and other joint pain												
None	176	1.00	193	1.00	173	1.00	216	1.00				
Pain other than hand/wrist	151	2.22 (1.20 – 4.08)	189	2.23 (1.09–4.53)	132	1.49 (0.96 – 2.30)	224	1.36 (1.07 – 1.73)				
Hand/wrist only	19	0.62 (0.08 – 4.98)	18	1.11 (0.16–7.57)	18	0.93 (0.37 – 2.31)	23	0.63 (0.30 – 1.35)				
Hand/wrist and other pain	66	3.67 (1.96 – 6.88)	80	3.19 (1.47–6.94)	57	2.89 (1.84 – 4.54)	122	1.27 (0.94 – 1.70)				
Hip and other joint pain												
None	177	1.00	194	1.0	174	1.00	217	1.00				
Pain other than hip	189	1.95 (1.06 – 3.57)	228	2.15 (1.06–4.35)	165	1.52 (1.00 – 2.30)	278	1.27 (1.00 – 1.60)				
Hip only	10	4.46 (1.68 – 11.83)	9	4.17 (1.10–15.87)	6	2.07 (0.67 – 6.39)	9	1.95 (1.10 – 3.47)				
Hip and other pain	36	4.84 (2.33 – 10.04)	49	3.52 (1.46–8.49)	36	2.94 (1.79 – 4.85)	81	1.24 (0.89 – 1.73)				
Knee and other joint pain												
None	177	1.00	194	1.0	174	1.00	217	1.00				
Pain other than knee	144	2.09 (1.13 – 3.86)	160	2.02 (0.95–4.31)	114	1.81 (1.19 – 2.76)	194	1.28 (0.99 – 1.66)				
Knee only	27	2.74 (1.06 – 7.10)	35	1.56 (0.49–4.98)	30	1.14 (0.53 – 2.45)	46	1.48 (1.06 – 2.07)				
Knee and other pain	65	3.27 (1.67 – 6.36)	91	3.72 (1.77–7.83)	63	2.04 (1.23 – 3.37)	128	1.24 (0.93 – 1.66)				
Feet and other joint pain												

Pain categories	Mobility difficulty			ADL difficulty			IADL difficulty			SPPB decline (1 point)		
	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^a	RR (95% CI) ^c	N ^b	RR (95% CI) ^{c,d}	N ^b	RR (95% CI) ^{c,d}
None	177	1.00	194	1.0	174	1.00	174	1.00	217	1.00	217	1.00
Pain other than feet	157	2.21 (1.22 – 4.02)	187	2.82 (1.13–4.63)	144	1.80 (1.19 – 2.72)	144	1.80 (1.19 – 2.72)	237	1.34 (1.05 – 1.70)	237	1.34 (1.05 – 1.70)
Feet only	22	1.76 (0.62 – 4.97)	25	3.12 (1.10–8.89)	20	0.96 (0.44 – 2.11)	20	0.96 (0.44 – 2.11)	30	1.13 (0.68 – 1.88)	30	1.13 (0.68 – 1.88)
Feet and other pain	57	3.71 (1.88 – 7.32)	75	2.66 (1.13–9.25)	43	2.20 (1.27 – 3.82)	43	2.20 (1.27 – 3.82)	106	1.26 (0.92 – 1.71)	106	1.26 (0.92 – 1.71)

^a Analyses included only people without disability at baseline; i.e. no mobility difficulty (n=426) and no IADL difficulty (n=391).

^b Analyses included 608 (persons with SPPB score of 3 were excluded).

^c Risk ratios and confidence intervals (CI) generated from multivariable Poisson regression (GENLIN) with robust variance estimators predicting onset of disability or physical performance decline according to specific pain sites, adjusted for age, sex, race, education, body mass index (BMI), cognitive function (MMSE), comorbid conditions (neuropathy, heart disease, diabetes, rheumatoid arthritis, asthma/lung disease, stroke and depression), level of physical activity (PASE score), daily analgesic use, and number of psychotherapeutic medications.

^d In the SPPB analyses we adjusted additionally for baseline physical performance.