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Musculoskeletal pain and physical functioning in the oldest old

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Abstract

Background—Little is known about the impact of pain on physical functioning among the oldest-old subjects. In this study, we first examined the associations between number of painful sites and measures of physical functioning reflecting different stages of the disablement process (physical impairment, functional limitation and disability) among nonagenarians aged 92 to 93 years. Second, we described the effect of painful sites on disability during a two year follow-up period.

Methods—This study is based on baseline (n=1177) and 2-year follow-up (n=709) data of the nationwide Danish 1905 cohort study. Musculoskeletal pain was assessed as reported pain in back, hips or knees when moving or resting. Physical performance measures included maximum grip strength and habitual walking speed. Disability in performing activities of daily living, was defined as need for assistive device or personal help in transferring, dressing, washing, using toilet and/or walking indoors.

Results—At baseline, the number of painful sites was significantly associated with measured grip strength and walking speed as well as self-reported disability in a step-wise manner; the more sites with pain the poorer the physical functioning. The follow-up analyses showed corresponding but slightly weaker stepwise associations between baseline pain and disability level at follow-up, and indicated that although on the whole, single or multisite pain did not predict the onset of disability, multisite pain increased the risk of developing severe disability.

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AUTHOR CONTRIBUTIONS:

Mänty had full access to all the data gathered for the study and takes full responsibility for the integrity of the data and the accuracy of the data analyses. Concept and design: Mänty, Christensen, Avlund. Acquisition of data: Christensen, Thinggaard. Statistical analysis: Mänty. Interpretation of data: Mänty, Thinggaard, Christensen, Avlund. Drafting the manuscript: Mänty. Critical revision of the manuscript for important intellectual content: Mänty, Thinggaard, Christensen, Avlund. All authors have approved the version to be published.

Conclusions—The findings of this study suggest that musculoskeletal pain in nonagenarians is highly prevalent and associated with poor physical performance and disability.

Keywords

Pain; Muscle strength; Mobility limitation; Disability; Nonagenarians

INTRODUCTION

One of the most significant threats to an older person's ability to live and function independently is loss of mobility (Guralnik et al., 1994; Penninx et al., 2000). The oldest old, those aged 85 years and older, is the fastest growing segment of the older population in the western world, mainly due to a reduction in mortality rates in this population (Vaupel et al., 1998). To date, it has been well shown that physical functioning declines with increasing age and studies including the oldest-old have suggested that for the individual, long life brings an increasing risk of declining physical abilities and loss of independence (Andersen-Ranberg et al., 1999; Christensen et al., 2008; Berlau et al., 2009).

Musculoskeletal pain in the older population is a major health issue because of its high prevalence and impact on well being (Brattberg et al., 1996; Chapman and Gavrin, 1999; Hartvigsen et al., 2004). Cross sectional studies have shown that pain is associated with impaired physical functioning and disability in older adults (Leveille et al., 1999; Covinsky et al., 2009; Eggermont et al., 2009; Lihavainen et al., 2010; Karttunen et al., 2012) and longitudinal studies have suggested that pain may predict the progression of functional decline and disability (Leveille et al., 2001; Bryant et al., 2007; Leveille et al., 2007; Leveille et al., 2009; Buchman et al., 2010; Shah et al., 2011). It has been further suggested that multisite rather than single site pain or pain severity may be more important indicator of poor physical functioning (Eggermont et al., 2009). However, the role of musculoskeletal pain as a disabling condition is poorly understood among very old population segments (Onder et al., 2006; Zyczkowska et al., 2007; Hartvigsen and Christensen, 2008; Landi et al., 2009) and to our knowledge, only one previous study (Zarit et al., 2004) has reported correlations between multisite pain and physical functioning in the oldest old. Furthermore, previous studies are based on relatively small samples of the oldest old and have not included measures of physical functioning that would comprehensively reflect different stages of the disability process. According to the widely used framework of the disablement process (Verbrugge and Jette, 1994), impairments, such as decreased muscle strength, lead to functional limitations, such as poor walking ability, which in turn, may finally cause disability in basic activities of daily living. Given that the nature of disability in the oldest old may differ from that in younger age groups (Berlau et al., 2009), it is critical to understand and identify indicators and risk factors for declining physical abilities in this population segment, and thereby help to elucidate the aging process and develop potential preventive interventions appropriate for this age group.

In this study, we first examine the associations between number of painful sites and different measures of physical functioning reflecting impairment (muscle strength), functional limitation (walking speed) and disability (disability in basic activities of daily living) among nonagenarians. Second, we describe the effect of painful sites on disability during a two year follow-up period.

METHODS

Study population

This observational study is based on baseline and 2-year follow-up data of the nationwide Danish 1905 cohort study (Nybo et al., 2001). The cohort members were traced through the Danish Civil Registration System and the total Danish 1905 cohort was contacted in 1998. A total of 3600 persons aged 92 to 93 years were alive at the beginning of the survey, and of these, 2262 (63%) participated in the study. In this current study, we included only 1814 participants with non-proxy interview. Of these, 637 did not have full information on all variables used, leaving a total of 1177 participants for the final baseline analyses. Two-thirds (68%, n=798) of the selected sample lived independently in a house or an apartment and one-third (32%, n=379) in sheltered housing, e.g. in supportive housing or nursing home. Of the final baseline sample, 709 participants (60 %) completed information on physical functioning at 2-year follow-up point in year 2000 whereas 328 (28 %) died prior to follow up and 140 (12 %) did not complete the follow-up due to other reasons, such as refusal or health reasons.

At the intake assessment, participants and nonparticipants were compared using population based registry information and the participants were found to represent a fairly nonselected group of the Danish 1905 cohort (Nybo et al., 2001). No differences were found in housing and marital status, but men and persons living in rural areas were more likely to participate than women and urban dwellers. An analysis of hospitalization patterns from 1973 to 1998 indicated that participants were not healthier than nonparticipants, but in the 6-month period after the initiation of the survey nonparticipants had higher mortality, suggesting that terminal illness was one of the main reasons for nonparticipation (Nybo et al., 2001). Furthermore, participants in the selected baseline and follow-up samples tended to have slightly better health and physical functioning compared to nonparticipants (data not shown). Scientific Ethical Committees of Denmark approved the study (19980073PMC).

Data collection and methods

Face-to-face interviews were conducted at participants' homes and included structured questions on musculoskeletal pain, physical limitations and other health factors. In addition, maximum handgrip strength and walking speed were measured during the interview.

Musculoskeletal Pain—Musculoskeletal pain was measured with questions: “Do you have pain in your hips/knees/back when you move/rest?” For the baseline analyses, the number of sites with pain (hips, knees, back) where participant reported movement or rest pain was summed (range 0–3), with higher scores indicating more sites of pain. For the follow-up analyses, the measure was recoded to three levels (no pain, single site pain and multi site pain), as the number of subjects at the more painful end of the scale was very small, leading to sparse cells.

Physical performance and disability—Maximum isometric *grip strength* was measured using a handheld dynamometer. The best performance of three measurements with the preferred hand was used (Nybo et al., 2001). Habitual *walking speed* was measured over a 3-meter (n=1088) or a 4-meter (n=89) distance (Nybo et al., 2001). Participants wore walking shoes or sneakers and use of a walking aid was allowed if needed. Walking time was measured with a stopwatch and walking speed was calculated as meters per second (m/s). The fastest time of two trials was used for the present analyses. There were no significant differences in the walking speed regarding the distance of the test.

Disability in basic activities of daily living (ADLs), was assessed using a modified version of the Katz Basic ADL scale (Katz et al., 1970; Buchman et al., 2010). Participants were asked their ability to perform five basic daily activities that hypothetically would be affected by musculoskeletal pain in back, knees or hips: 1) transferring from bed or chair, 2) dressing, 3) bathing, 4) using the toilet and 5) walking indoors. Response choices with regard to ability to perform each of the five activities were: able independently without assistive device or help, able independently with assistive device, able only with help from another person, and unable. Participants who reported needing assistive device or personal help, or being unable to perform the task were classified as having disability in that specific task. For the baseline analyses, the number of individual tasks with disability were summed for a total disability score (range 0–5), with higher scores indicating higher prevalence of disability. In the follow-up analyses, a recoded disability variable was used: No disability, moderate disability (disability in 1–2 tasks) and severe disability (disability in 3–5 tasks).

Covariates—Information on self-reported physician diagnosed diseases and prescription medication was collected during the face-to-face interview. The used medicine was coded according to the Anatomical Therapeutic Chemical (ATC) classification system by a physician. Depressive symptoms were assessed using the depression section from the Cambridge Mental Disorders of the Elderly Examination (CAMDEX) diagnostic interview (Roth et al., 1986), comprising 17 items concerning depressive symptoms (total score range from 0–34 points), with a higher score indicating higher level of depressive symptoms. Body mass index (BMI, kg/m²) was calculated using self-reported data on height and weight. Physical activity was evaluated with a single question about the frequency of participation in light exercise, for example, in light gardening, short walks or bicycle rides. The responses were categorized into sedentary (less than once a week) or active (weekly or more often).

Statistical analyses

Baseline analyses—Characteristic comparisons between pain groups were examined with chi-square test for categorical variables, Kruskal-Wallis test for skewed continuous variables, and one-way analysis of variance (ANOVA) for normally distributed continuous variables. The associations between pain and baseline physical functioning were examined using linear (grip strength and walking speed) and negative binomial (disability score) regression models. Relative Risks (RRs) for disability score were calculated.

Follow-up analyses—To describe the association between baseline pain and the level of disability (no – moderate –severe) in the follow-up sample, and to estimate whether baseline pain is associated with onset of disability during the follow-up, Relative Risks (RRs) were calculated with nonlinear mixed models using the NLMIXED procedure in SAS. Two separate models were constructed to calculate risks for developing moderate and/or severe disability among participants without the outcome at baseline.

All analyses were performed using SAS software version 9.1 (SAS Institute Inc., Cary, NC).

RESULTS

Around two thirds of the participants were women (n=838, 71 %) and one third lived in sheltered housing (n=379, 32 %). In total, half (n=609, 52 %) of the participants reported musculoskeletal pain; 32 % in one, 14 % in two and 6 % in three sites. Descriptive data of the study population are presented in Table 1. Higher number of painful sites was progressively associated higher number of diseases, medications and depressive symptoms. Further, a bigger proportion of participants reporting pain were women than men and they were more likely to live in sheltered housing and be sedentary (Table 1).

Baseline analyses

The mean grip strength and walking speed in the total sample were 16.9 kg (SD 6.6) and 0.57 m/s, respectively. Around half of the participants (n=613, 52 %) reported disability in one or more basic activities of daily living; 18 % (n=208) in one, 11 % (n=128) in two, 10 % (n=118) in three, 8 % (n=98) in four and 5 % (n=61) in all five tasks.

Table 2 describes the association between physical functioning and number of painful sites. The number of painful sites was significantly associated with measured grip strength (kg) and walking speed (m/s) as well as self-reported disability in basic activities of daily living in a step-wise manner; the more sites with pain the poorer the physical functioning (Table 2). Table 3 shows the corresponding regression coefficients (β) and Relative Risks (RRs) of the associations. Pain in single site was associated with 0.58 kg lower grip strength (β -0.58, $p=.06$), 0.06 m/s slower walking speed (β -0.06, $p<.001$) and 55 % higher disability score (RR 1.55, $p<.001$) as compared to those with no pain while adjusting for gender, housing type, years of education, body weight and height (Table 3, Model 1). Correspondingly, pain in two or three sites was associated with 0.88 kg and 1.26 kg lower grip strength (β -0.88, $p=.037$ and β -1.26, $p=.036$, respectively), 0.09 m/s and 0.12 m/s slower walking speed (β -0.09, $p<.001$ and β -0.12, $p<.001$, respectively), and 65 % and 122 % higher disability score (RR 1.65, $p<.001$ and RR 2.22, $p<.001$, respectively) compared to participants with no pain (Table 3, Model 1). Further adjustments for chronic diseases, depressive symptoms, medications, muscle strength, walking speed and physical activity decreased the presented estimates between 44 % and 67 % (Table 3, Models 2–5).

Follow-up analyses

In total, 60 % (n=709) of the baseline sample completed the 2-year follow-up assessment on disability. The number of painful sites was not associated with loss to follow-up; the participation rates among those with no pain, single- or multisite pain were 60 %, 62 %, and 59 %, respectively ($p=.677$). However, the level of disability at baseline was significantly ($p<.05$) higher among those who were lost to follow-up as compared to follow-up participants; the prevalence of disability among the lost to follow-up participants who reported no, single site or multi site pain were 49 %, 63 %, and 70 %, respectively (data not shown).

Figure 1 illustrates the association of baseline musculoskeletal pain with disability level at baseline and 2-year follow-up. In total, the proportion of people with moderate and severe level of disability was relatively high already at baseline, with higher level of disability observed among those with more sites of pain, and the proportions of those with disability increased during the follow-up. (Figure 1). At baseline, participants with single site or multisite pain had 1.3 to 1.5 times higher risk (RR 1.31, $p=.003$, and RR 1.50, $p<.001$, respectively) of having at least moderate disability and over two times more likely of having severe disability (RR 2.04, $p<.001$ and RR 2.40, $p<.001$, respectively) as compared to those with no pain while adjusting for gender, housing, education, weight and height. Correspondingly, the risk for having at least moderate disability at two-year follow-up were 1.10 to 1.14 times higher (RR 1.10, $p=.087$, and RR 1.14, $p=.035$, respectively) and for severe disability 1.22 to 1.46 times higher (RR 1.22, $p=.057$, and RR 1.46, $p<.001$, respectively) among those with single site or multisite pain as compared to those with no pain at baseline while adjusting for gender, housing, education, weight and height. Further longitudinal analyses indicated, that on the whole, single or multisite pain did not predict the onset of disability, however, multisite pain increased the risk of developing severe disability (RR 1.32, $p=.003$) (Table 4).

DISCUSSION

In this study, we first examined the associations between number of painful sites and measures of physical functioning reflecting different stages of the disablement process among nonagenarians. Second, we described the effect of painful sites on disability, during a two year follow-up period. In the present sample of nonagenarians, musculoskeletal pain was associated with poorer muscle strength, walking speed and disability in basic activities of daily living in a stepwise manner; the more sites with pain the poorer the physical functioning. The follow-up analyses showed corresponding but slightly weaker stepwise associations between baseline pain and disability level at follow-up, and indicated that although on the whole, single or multisite pain did not predict the onset of disability, multisite pain increased the risk of developing severe disability.

Our baseline observations are consistent with those reported earlier in younger older adults showing inverse relationship between number of sites with musculoskeletal pain and physical functioning (Leveille et al., 2001; Onder et al., 2006; Leveille et al., 2007; Eggermont et al., 2009). However, only one previous study has reported these associations in the oldest old population segment (Zarit et al., 2004), indicating a significant negative correlation between number of painful sites and self-reported mobility in a small sample (n=98) of individuals aged 86 years and older. Furthermore, previous studies have not included measures of physical functioning that would comprehensively reflect different stages of the disability process. The results of this current paper extend the previous literature by including various measures of physical function in a representative sample of the oldest old, and consequently showing that pain, and especially multisite pain, is an important indicator of poor overall functioning among nonagenarians.

Previous longitudinal studies have indicated that multisite musculoskeletal pain predicts progression (Leveille et al., 2001; Leveille et al., 2007) as well as incident disability (Soldato et al., 2007; Landi et al., 2009; Buchman et al., 2010; Shah et al., 2011) among younger older adults. In our sample of nonagenarians, single or multisite pain did not predict the onset of disability, however multisite pain increased the risk of developing severe disability (Table 4). It is possible that due to high susceptibility to functional decline in the oldest old population segment, multisite pain may cause severe physical constraints that are likely to hinder multiple daily activities. Furthermore, it can be argued that in this advanced age, most of the main chronic disease that are likely to cause physical disabilities may already play a role in contributing to disability and new disability is likely to be caused by new acute illness, such as stroke. However, the differential characteristics of the baseline populations as well as differences in the measures of pain and function, and follow-up times may also explain some of the differences in the results compared to previous studies. It is also possible, that the more limited amount of sites with pain available in this study may have resulted in under ascertainment of pain, thus potentially limiting the strength to detect some of the associations between pain and disability. All in all, more studies including the oldest-old population segment are needed to confirm the observations of this current study.

The mechanisms underlying the association between pain and impaired physical functioning are not fully understood. It has been argued that pain may have a direct impact on physical function because of a reduced range of joint movement as a consequence of reflex inhibition of skeletal muscles, resulting in muscle weakness and impaired physical function (Young, 1993). Furthermore it is likely that subjects with musculoskeletal pain tend to avoid physical activity because of an increase in pain (Steultjens et al., 2002), and in long term, low activity levels will result in deterioration of physical performance (Manini and Pahor, 2009), especially muscle weakness that gradually leads to functional limitations and disability (Rantanen et al., 1999; Rantanen et al., 2002). Finally, it is also possible that muscle

weakness and impaired physical function are consequences of medical conditions which are also associated with pain. The results of our study support the two latter hypotheses by showing that chronic diseases, depressive symptoms, medications, muscle strength, walking speed and physical activity accounted substantially of the cross-sectional baseline associations between pain and physical functioning in our sample of the oldest old. However, some previous studies among younger older adults have indicated contradictory results by showing that the relationship between pain and physical function may be independent of decrements in physical performance such as strength and gait speed (Leveille et al., 1999; Onder et al., 2006; Manini and Pahor, 2009). Further research is needed to better understand the development of pain-related impaired physical functioning in order to determine optimum approaches to prevent and treat declined physical functioning in older persons with musculoskeletal pain.

Our observations suggest that musculoskeletal pain may be an important marker of wide range of physical disabilities, and that pain hinders functioning with a magnitude that can be considered as clinically meaningful. Previous studies have reported estimates for small (-0.05 m/s) and substantial (-0.10 m/s) clinically meaningful changes in walking speed in older adults (Perera et al., 2006). Our results corroborate these results by indicating 0.06 m/s, 0.09 m/s and 0.12 m/s slower walking speed among participants with pain in one, two or three sites, respectively, as compared to those without pain while adjusting for gender, housing, education and body size. Furthermore, as the disability outcome includes essential everyday activities, any increment in the disability score may have detrimental effects on independent living. Given that individuals in the oldest old population segment have an increased risk of disability for each additional year of life (Christensen et al., 2008), and that the nature of physical disabilities may differ from that in younger age groups (Berlau et al., 2009), it is crucial to understand and identify risk factors for declining physical abilities in this oldest old population segment, and thereby help to elucidate the aging process and develop potential preventive interventions appropriate for this age group (Berlau et al., 2009). All in all, the results of this study together with previous observations with younger older adults suggest that the public health efforts to encourage lifestyle changes and interventions that would ameliorate pain might potentially increase the efficacy of efforts to decrease the burden of disabilities in the rapidly aging population.

When interpreting the results, some limitations and strengths of the study should be considered. We included only participants with non-proxy interview and full information on all of variables used in this study. As a result, individuals who had the poorest functioning and highest level of pain are likely to be underrepresented in the sample, potentially causing some underestimation in the associations reported between pain and function. Furthermore, generalizations of the findings should be limited to groups of nonagenarians with similar characteristics. Prior studies have shown that location and severity are the key pain characteristics associated with disability (Onder et al., 2006), and that multisite pain (Leveille et al., 2001; Eggermont et al., 2009) seems to be the most disabling. Although the available information on various pain sites in this study was limited to back, knees and hips, these locations represent the sites that play essential roles in everyday mobility. The strengths of the study are a well-characterized nationwide cohort with follow-up design, and standardized measures of physical function and health related factors.

CONCLUSIONS

Musculoskeletal pain in advanced later life is highly prevalent and associated with poor physical performance and disability.

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What's already known about this topic?

- Musculoskeletal pain in the older population is a major health issue because of its high prevalence and impact on well being.
- The role of musculoskeletal pain as a disabling condition is poorly understood among the oldest old, the fastest growing segment of the older population in the western world.

What does this study add?

- The findings of this study showed that musculoskeletal pain in nonagenarians is highly prevalent and associated with poor physical performance and daily functioning.

Figure 1. Unadjusted prevalence of disability at baseline and 2-year follow-up by number of painful sites at baseline (n=709).

Table 1

Baseline characteristics of participants (N=1177) by number of painful sites.

	No pain (n=568)	Pain in 1 site (n=372)	Pain in 2 sites (n=167)	Pain in 3 sites (n=70)	P for trend
Sheltered housing	180 (32 %)	107 (29 %)	69 (41 %)	23 (33 %)	.038
Women	376 (66 %)	267 (72 %)	136 (81 %)	59 (84 %)	<.001
Formal education 7 years	438 (77 %)	293 (79 %)	131 (78 %)	48 (69 %)	.304
Body Mass Index	22.9 (3.3)	23.4 (3.5)	23.3 (3.1)	23.5 (4.3)	.135
Number of diseases	2.8 (2.1)	3.5 (2.2)	4.6 (2.5)	5.5 (2.8)	<.001
Number of medications	2.7 (2.3)	3.1 (2.4)	4.1 (2.7)	4.4 (2.6)	<.001
Depressive symptoms (CAMDEX score ^a)	6.6 (5.4)	8.0 (5.6)	9.5 (6.3)	10.5 (5.7)	<.001
Sedentary	252 (44 %)	203 (55 %)	92 (55 %)	51 (73 %)	<.001

Continuous variables are presented as mean (SD); categorical variables are presented as n (%)

SD = Standard deviation

^aModified Cambridge Mental Disorders of the Elderly Examination score, range 0–29

Table 2

Baseline physical functioning by number of painful sites (N=1177).

Measures of physical function ^a	No pain mean ± SE	Pain in 1 site mean ± SE	Pain in 2 sites mean ± SE	Pain in 3 sites mean ± SE	P for trend ^b
Grip strength (kg)	17.73 ± 0.28	16.83 ± 0.34	15.30 ± 0.51	15.04 ± 0.79	<.001
Walking speed (m/s)	0.62 ± 0.01	0.56 ± 0.01	0.52 ± 0.02	0.49 ± 0.03	<.001
ADL disability score (range 0–5)	1.04 ± 0.07	1.53 ± 0.09	1.70 ± 0.12	2.13 ± 0.18	<.001

SE = Standard error

^a Adjusted for gender, housing type, weight and height

^b Tests for trend from adjusted linear regression models

Table 3

Baseline associations of musculoskeletal pain with hand grip strength, walking speed, and ADL disability (n=1177).^a

	Pain	Handgrip (kg)	Walking speed (m/s)	Disability score (range 0–5)
		β (95 % CI)	β (95 % CI)	RR (95 % CI)
Model 1	<i>No pain</i>	ref.	ref.	ref.
	<i>1 site</i>	−0.58 (−0.20, 0.03)	−0.06 (−0.09, −0.03)	1.55 (1.31, 1.85)
	<i>2 sites</i>	−0.88 (−1.71, −0.07)	−0.09 (−0.14, −0.05)	1.65 (1.32, 2.05)
	<i>3 sites</i>	−1.26 (−2.44, −0.09)	−0.12 (−0.18, −0.06)	2.22 (1.65, 2.99)
Model 2	<i>No pain</i>	ref.	ref.	ref.
	<i>1 site</i>	−0.37 (−0.98, 0.25)	−0.04 (−0.07, −0.01)	1.50 (1.20, 1.88)
	<i>2 sites</i>	−0.50 (−1.34, 0.34)	−0.06 (−0.10, −0.02)	1.47 (1.24, 1.75)
	<i>3 sites</i>	−0.79 (−1.99, 0.42)	−0.07 (−0.13, −0.01)	1.88 (1.38, 2.57)
Model 3	<i>No pain</i>	-	ref.	ref.
	<i>1 site</i>	-	−0.05 (−0.08, −0.02)	1.29 (1.07, 1.55)
	<i>2 sites</i>	-	−0.08 (−0.12, −0.04)	1.35 (1.17, 1.57)
	<i>3 sites</i>	-	−0.10 (−0.16, −0.04)	1.70 (1.33, 2.16)
Model 4	<i>No pain</i>	ref.	ref.	ref.
	<i>1 site</i>	−0.36 (−0.96, 0.24)	−0.04 (−0.07, −0.01)	1.44 (1.22, 1.70)
	<i>2 sites</i>	−0.69 (−1.51, 0.09)	−0.08 (−0.12, −0.04)	1.56 (1.27, 1.92)
	<i>3 sites</i>	−0.71 (−1.84, 0.46)	−0.07 (−0.13, −0.02)	1.82 (1.38, 2.41)
Model 5	<i>No pain</i>	ref.	ref.	ref.
	<i>1 site</i>	−0.24 (−0.85, 0.35)	−0.03 (−0.06, −0.01)	1.23 (1.03, 1.49)
	<i>2 sites</i>	−0.48 (−1.30, 0.34)	−0.05 (−0.09, −0.01)	1.30 (1.12, 1.50)
	<i>3 sites</i>	−0.50 (−1.66, 0.71)	−0.04 (−0.9, 0.01)	1.48 (1.16, 1.90)

^aFrom adjusted linear (hand grip strength and walking speed) and negative binomial (disability score) regression models.

Model 1: Adjusted for gender, housing type, education (years), weight (kg) and height (cm)

Model 2: Model 1 + number of diseases, depressive symptoms and number of medications

Model 3: Model 1 + grip strength (only in walking speed and disability score) and walking speed (only in disability score)

Model 4: Model 1 + Physical activity

Model 5: All variables from models 1, 2, 3 and 4

Table 4

Longitudinal associations of baseline musculoskeletal pain with onset of disability during 2-year follow-up^a

	Moderate or severe disability ^b		Severe disability ^b	
	% with outcome	RR ^c (95 % CI)	% with outcome	RR ^c (95 % CI)
<i>All</i>	49		30	
<i>No pain</i>	48	ref.	29	ref.
<i>Single site</i>	51	1.09 (0.87–1.30)	29	1.16 (0.97–1.35)
<i>Multi site</i>	50	1.13 (0.95–1.32)	35	1.32 (1.08–1.55)

^aFrom adjusted nonlinear mixed models

^bAmong those without the outcome at baseline

^cRelative Risk (RR) adjusted for gender, housing type, years of education, weight and height