The Natural History of Disability and Its Determinants in Adults with Lower Limb Musculoskeletal Pain

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ABSTRACT. ***Objective.*** To investigate determinants of deterioration or improvement in disability in people with chronic hip and knee pain.

Methods. We analyzed data from the Somerset and Avon Survey of Health, a longitudinal, community-based cohort study containing data collected in 1994-95 and again in 2002-03. The Medical Outcomes Study Short-Form 36 was completed by subjects at both timepoints, and used to categorize people as disabled or not. Baseline data were used to explore possible determinants of change in functional status over the 8-year time period. Adjusted odds ratios (OR) were derived from a multivariate, multinomial logistic model.

Results. Data were available on 1072 subjects, all of whom reported chronic hip and/or knee pain at baseline. At baseline, 56.8% of women and 42.0% of men were disabled. Of 545 people with disabilities at baseline, 107 (19.6%) reported no disability at followup; of 527 with no disability at baseline, 177 (33.6%) became disabled. The development of disability was significantly associated with older age (OR 2.1), living in the most deprived areas (2.4), the presence of 3 or more comorbidities (3.6), more problems with physical function at baseline (2.0), and more severe pain (2.4). The determinants of improvement mirrored those of deterioration. The data suggest a "threshold effect" at which recovery becomes unlikely.

Conclusion. Of people presenting with hip or knee pain, healthcare professionals should be most concerned about those who are older, of lower socioeconomic status, with comorbidities, and who have more severe pain. Much longstanding disability might be preventable. (First Release Jan 15 2009; J Rheumatol 2009;36:583–91; doi:10.3899/jrheum.080455)

Key Indexing Terms:
DISABILITY OSTEOARTHRITIS ITEM RESPONSE THEORY CHRONIC PAIN
MEDICAL OUTCOMES STUDY SHORT-FORM 36 PHYSICAL FUNCTION
INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

Physical disability is common in adults[1-3]. Disability is both a complex and a dynamic process, involving interactions between diseases and their consequent impairments, and the psychosocial makeup of the individual as well as the environment and culture in which they live. The International Classification of Functioning, Disability and Health (ICF) offers a useful framework for thinking about the complexities involved, and has the added advantage of differentiating impairments from activities limitations and restrictions in participation[4]. Here we use the term *disability* to refer to limitations in physical functions that threaten independent living and full participation in life.

The main disease-related causes of disability in adults include neurological disorders, such as strokes, sensory deficits, such as loss of vision, and musculoskeletal problems, including osteoarthritis (OA)[5-10]. Combinations of problems, such as the development of visual loss in someone with arthritis, are particularly likely to result in physical disability[7,11]. Increasing age alone, in the absence of disease, is also associated with the development of disability, due to factors such as the loss of muscle strength and coordination that occur as age advances[12,13]. Another important cause of physical disability that must be distinguished from disease is musculoskeletal pain[14-16]. Although prevalence estimates vary, chronic pain, most of it musculoskeletal, affects about 20% of all adults across Europe and increases with age[17,18]. Although OA is thought to be the main cause of this musculoskeletal pain in older adults, many people in pain have little or no discernable pathology, and the relationship between radiographic evidence of joint damage

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(OA) and pain is relatively poor[19,20]. Lower limb musculoskeletal pain is particularly important, as it is often associated with locomotor disabilities, such as reduced walking speed, that threaten independence[21].

Little is known about the natural history of physical disability, or of the determinants of any improvement or deterioration in functional status over time. It is clear that function can improve as age advances[2,22], but much of the available data come from people with conditions like strokes, where the impairment can naturally improve. There have been some studies of the natural history of OA that indicate that function can also improve over time in some people with this condition[23], but in this case the cause is unlikely to be an improvement in the disease or impairment, as spontaneous improvements in joint damage are rare[23-25].

In this article we describe an analysis of findings from a large longitudinal study that includes data on self-reported function at 2 timepoints, 8 years apart, in a community-based cohort of people who reported the presence of chronic lower limb (hip or knee) pain when first surveyed. Our aims were to document the changes in disability over the 8-year time period, to investigate determinants of deterioration or improvement, including demographic, socioeconomic and comorbidity, and to examine the hypothesis that there might be a "threshold effect" — i.e., a level of disability that, once reached, makes subsequent recovery unlikely. Such knowledge could help us predict which people presenting with hip or knee pain are most likely to become disabled in the future, and therefore help us target followup and interventions more appropriately.

MATERIALS AND METHODS

Sample. The Somerset and Avon Survey of Health Study (SASH) is a community-based, age-sex stratified health survey. The initial sample included 28,080 individuals, aged 35 years or over, randomly selected from 40 general practices in the South West of England. Sampled individuals were first screened using a postal questionnaire that included specific questions on current hip and knee pain. At first-stage screening 22,376 responded, as reported[26]. Current pain in the knee, hip, or both joints was reported by 6,416 (28.7%), of whom 4,304 were invited for further assessment and 2,703 (63%) attended a clinic between January 1994 and October 1995 where questionnaires were completed, examination took place, and radiographs were obtained[21]. The screening questions used were those taken from the first US NHANES survey and were as follows: "During the past 12 months have you had pain in either of your knees (or hips, separate question) on most days for one month or longer?" This question was designed and validated to identify chronic pain rather than transient acute pain after injury[27]. Reassessment of the 2,703 people on whom comprehensive data on musculoskeletal status and disability had been obtained in 1994-95 was undertaken between April 2002 and April 2003. At that time we attempted to obtain further data on some of the variables recorded during the first examination. Participants were asked to complete the Medical Outcomes Study Short-Form 36 (SF-36) questionnaire[28] on both occasions. The study was approved by the South West Multi Centre Research Ethics Committee based at Dartington, Devon, UK.

As shown in Figure 1, of the 2,703 who were examined at baseline, 497 had died, 60 refused to take part or were excluded for known health reasons (such as dementia), and 450 could not be contacted. Of the remaining 1,696 individuals, 270 did not wish to take part, 129 were excluded mostly due to health conditions such as terminal illness, and 2 had emigrated; 1,295 (76.4%) completed the followup questionnaires and 1,117 were clinically examined. The excluded group was assessed on their baseline characteristics, and no difference was found between them and those included in the study with regard to comorbidity, socioeconomic status, or pain. However, the proportion of younger people (aged 35–44 yrs at baseline) among the nonresponders was a little higher (15%) than that among the responders (9%); this was common in longitudinal studies. Our analysis is based on 1,072 individuals who responded fully to the SF-36 physical function dimension items at baseline and at followup, representing 83% of those who completed the followup questionnaire.

Assessment of disability and change in physical function. We used the physical function dimension within the SF-36 questionnaire. This domain has 10 questions. The answers to one of these (ability to undertake vigorous activity) seemed to perform quite differently from the others, with far more people reporting a lot of limitation of this item. Further testing, using item response theory (IRT), confirmed that this item responded differently from all others, both at baseline and followup. It was therefore omitted from subsequent analyses.

Reporting "limited a lot" in any of the remaining 9 items was treated as having activities limitations (i.e., being disabled). The use of a binary definition of disability is common in studies of this sort[26,27], and we thought that use of "limited a lot" (rather than some limitation) was more likely to identify serious limitations (disability) for this binary definition. The sample was divided at baseline into 2 groups, "A," without limitations, and "B," with limitations. Each group was further divided into 2 subgroups, based on the followup assessment. Those in group A, who remained without limitations, composed subgroup "Independence," and those who reported limitations at followup (i.e., deteriorated or became disabled) subgroup "Decline." Similarly in group B, participants who remained disabled formed subgroup "Limitations," and those who reported no limitations at followup (i.e., recovered) subgroup "Recovery" (Table 1). Our main comparisons were, first, between those who declined and those who did not, from the group starting without limitations (A), and second, between those who recovered compared with those who did not, from the group who started with limitations (B).

A score of physical function at baseline was also conventionally calculated, so that those reporting "a lot of limitation" in an item score 1, "some limitation" 2, and "no limitation" 3, as described by the SF-36 manual[29]. This results in total scores ranging from 9 (very disabled) to 27 (no disability). We also dichotomized the data into those above the median disability score (median 22, standard deviation 4.9), and those below or equal to the median. The resulting variable was used to allow for the physical function status at baseline, which is an important potential risk factor for disability at followup.

Explanatory variables. Baseline data were used to explore possible determinants of change. Age was treated as a binary variable; we classified people into 2 age groups: < 65 years, and ≥ 65 years. Body mass index (BMI) was used to classify people into obese or not obese, using the WHO recommended cutoff point[30] of BMI ≥ 30 kg/m^2. Townsend affluence/deprivation scores[31] were derived from the 1991 UK census data and postcodes, resulting in 5 categories, as reported[32]. People were also put into 4 categories of employment: paid employment, unpaid employment, retired, or sick/disabled. Data on self-reported comorbidities were also explored, these being initially grouped into 7 categories according to the system or type of disease involved (arthritis, heart, other cardiovascular, respiratory, visual, malignant disease, depression). As small numbers became a problem in the analysis, they were then further grouped by number of problems per individual, with those with no reported comorbidity being the reference group, those with 1 or 2 conditions the second group, and those with 3 or more comorbidities a third group.

Pain at baseline was measured by self-reporting pain or stiffness in the hip or knee while doing any of 4 activities. These were: standing up from a

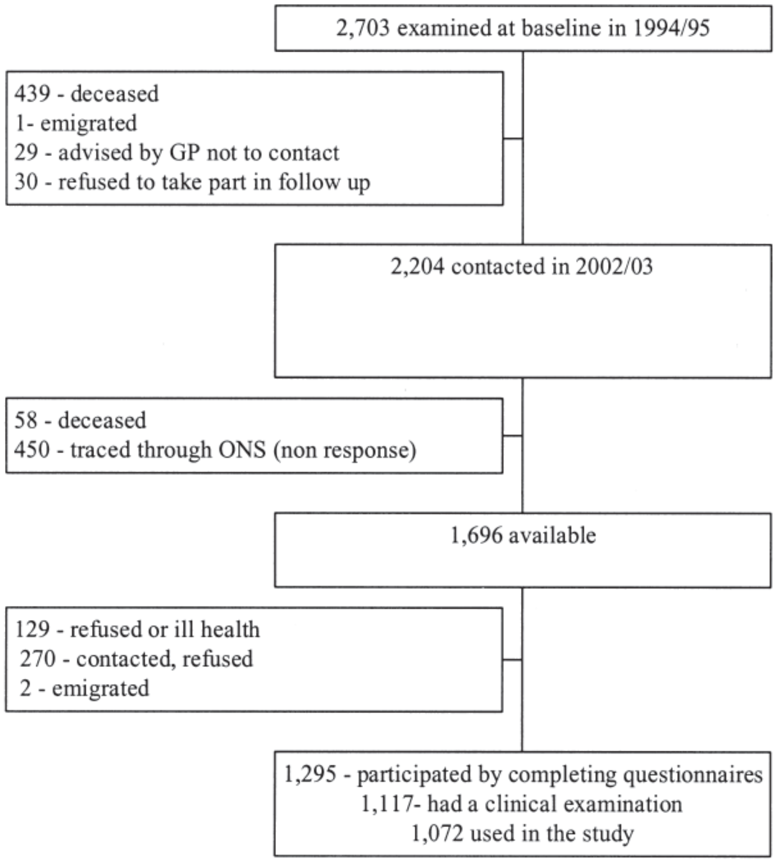

Figure 1. The progress of participants through the study. GP: general practitioner; ONS: Office for National Statistics

chair, putting on socks or shoes, going up steps or stairs, and going down steps or stairs. Reporting pain in any of the activities was coded "1" and reporting no pain "0." A score was calculated from the 4 questions for both hips and knees, taking a range of 0–8, 0 indicating no pain during any of the activities and 8 indicating pain in both hip and knee while doing each of the 4 activities. The score was further categorized into 3 groups, ≤ 2 a reference category (mild pain), 3–5 a second category (moderate pain), and a third category for 6+ scores (severe pain).

Missing data. Little information was missing on any key variables, with the exception of BMI and pain, where data were unavailable for 20% and 10%, respectively. Data distribution was examined, and there did not appear to be any obvious bias in the pattern of missing data. In order to maximize the data available for analysis, those with missing BMI or pain scores were assigned to a separate category. A similar approach was adopted for other explanatory variables, although the proportion with missing data was less than 3%.

Analysis. Odds ratios (OR) derived from a multivariate logistic model were used for comparisons between different groups. Initially unadjusted OR were obtained for each of the potential explanatory variables, and those associated with the outcome at 10% significance level or less were considered as potential predictors, and were included in a multivariable model. In the final multivariable model, any variable with association at 10% level or less was retained and others were excluded. For the IRT model, Mplus[33] software was used, and Stata (v 9.2; Stata Corp., College Station, TX, USA) was used for all other analysis.

RESULTS

Figure 1 shows the people involved in the cohort study, including the loss of subjects between initial screening of people in 1994 and the followup of some of those reporting hip and/or knee pain in 2002-03. At baseline, 45% of those reporting hip or knee pain had knee pain alone, 22% hip pain alone, and 32% reported both hip and knee pain.

We divided the 1,072 people into 2 initial categories, according to the presence (545) or absence (527) of limitations (disability) at baseline, and then subsequently divided them further depending on whether they reported limitations or not 8 years later. This provided 4 main groups for analysis of the determinants of changes in disability. Our main analyses have been comparisons of those with no disability (group A) at baseline who either remained with no problem, or subsequently developed a disability (to ascertain the determinants of decline in function over time), and of those with disability (group B) at baseline who either remained disabled, or subsequently improved their functional status (to ascertain the determinants of improvement in function).

Table 1 provides comparative data on the characteristics of the 4 subgroups to ascertain the determinants of change (either improvement or deterioration) in physical function. It shows that of the 527 people with no disability at baseline, 177 (33.6%) developed problems 8 years later, whereas of the 545 with disabilities at baseline, 107 (19.6%) had no

Table 1. Characteristics of participants of 4 groups: Independence (no limitations at baseline or at followup), Decline, Limitations (limitations at baseline and at followup) and Recovery. Data in parentheses are percentages of column total.

	n	Group A, without limitations at baseline		Group B, with limitations at baseline	
		Independence (n = 350)	Decline (n = 177)	Limitations (n = 438)	Recovery (n = 107)
Age, yrs					
< 65	679	263 (75.1)	102 (57.6)	231 (52.7)	83 (77.6)
65+	393	87 (24.9)	75 (42.4)	207 (47.3)	24 (22.4)
Sex, women	643	175 (50.0)	103 (58.2)	296 (67.6)	69 (64.5)
Men	429	175 (50.0)	74 (41.8)	142 (32.4)	38 (35.5)
Social class					
Professional I	62	35 (10.0)	11 (6.2)	12 (2.7)	4 (3.7)
Intermediate II	343	116 (33.1)	56 (31.6)	140 (32.0)	31 (29.0)
Skilled nonmanual IIINM	225	73 (20.9)	30 (17.0)	94 (21.5)	28 (26.2)
Skilled manual IIIM	232	77 (22.0)	42 (23.7)	92 (21.0)	21 (19.6)
Partly skilled IV	162	37 (10.6)	31 (17.5)	74 (16.9)	20 (18.7)
Unskilled V	43	12 (3.4)	6 (3.4)	22 (5.0)	3 (2.8)
Area deprivation quintiles					
First (most affluent)	293	109 (31.1)	50 (28.3)	103 (23.5)	31 (28.9)
Second	253	89 (25.4)	35 (19.8)	109 (24.9)	20 (18.7)
Third	169	61 (17.4)	25 (14.1)	64 (14.6)	19 (17.8)
Fourth	186	58 (16.6)	32 (18.1)	77 (17.6)	19 (17.8)
Fifth (most deprived)	170	33 (9.4)	34 (19.2)	85 (19.4)	18 (16.8)
BMI					
Not obese (< 30 kg/m^2	613	238 (68.0)	100 (56.5)	213 (48.6)	62 (57.9)
Obese (≥ 30 kg/m^2)	239	50 (14.3)	37 (20.9)	132 (30.1)	20 (18.9)
No. health problems					
None	135	87 (24.9)	22 (12.4)	16 (3.7)	10 (9.4)
1 or 2	535	192 (54.9)	87 (49.2)	197 (45.0)	59 (55.1)
3 or more	402	71 (20.3)	68 (38.4)	225 (51.4)	38 (35.5)
Physical function (PF) score at baseline					
PF at baseline ≤ median	524	26 (7.4)	27 (15.2)	392 (89.5)	79 (73.8)
PF at baseline > median	548	324 (92.6)	150 (84.8)	46 (10.5)	28 (26.2)
Knee and hip (pain or stiffness)					
Mild (≤ 2)	407	211 (60.3)	80 (45.2)	85 (19.4)	31 (29.0)
Moderate (3–5)	383	82 (23.4)	60 (33.9)	202 (46.1)	39 (36.5)
Severe (6+)	158	19 (5.4)	18 (10.2)	101 (23.1)	20 (18.7)

Pain or stiffness are measured by pain or stiffness in hip or knee, during performance of any of 4 activities (standing up from a chair, putting on socks or shoes, going up steps or stairs, going down steps or stairs). BMI: body mass index.

reported problems at followup 8 years later. When we look at the demographic data of the 4 groups tabulated, it was clear that people who developed disability (Decline) or did not improve (Limitations) were more likely to be older, to be obese, to live in more deprived areas, to have comorbid conditions, and to have more pain and stiffness, than those whose status stayed the same or whose disabilities improved.

Disability was very common in the group studied. At baseline 56.8% of women and 42.0% of men reported some limitations in at least one of the 9 physical function items of the SF-36 that we studied. Eight years later the percentages had risen to 62.1% and 50.4%, respectively. The percentages of people reporting a lot of limitation in each of the 9 items of the SF-36 physical function domain, at both baseline and followup, are shown in Table 2. It is clear that the numbers reporting problems with the first 6 items are similar, as is the amount of increase in problems with time, but the last 3 items, which cover less arduous tasks, crucial to independent living, were less often a problem. Difficulties with bathing or dressing were both particularly uncommon at baseline, and were least likely to develop over time.

Table 3 shows the data on the 2 main comparisons undertaken to explore the baseline determinants of either development of disability (Decline compared to Independence) or of improvement (Recovery compared to Limitations). The most striking associations with the development of disability were older age [OR 2.1, 95% confidence interval (CI) 1.2–3.7], living in the most deprived areas (OR 2.4, 95% CI 1.2–4.7), the presence of 3 or more comorbidities (OR 3.6, 95% CI 1.9–6.6), more problems with physical function at baseline (OR 2.0, 95% CI 1.3–3.3), and severe pain and

Table 2. Percentage reporting limitations, item difficulty; and standard errors based on a 1 Parameter logistic item response theory (IRT) model, for all items of the physical function domain of SF-36.

Physical Function Item	Reporting "Limited a lot", %		Item Difficulty (se)	
	Baseline	Followup	Baseline	Followup
Vigorous activities, such as running	56	60	–0.18 (0.05)	–0.29 (0.04)
Walking more than a mile	32	41	0.53 (0.06)	0.25 (0.05)
Climbing several flights of stairs	32	40	0.56 (0.06)	0.28 (0.05)
Bending, kneeling, stooping	33	42	0.59 (0.05)	0.25 (0.04)
Walking half a mile	17	27	1.02 (0.7)	0.64 (0.05)
Lifting and carrying	18	26	1.12 (0.05)	0.71 (0.04)
Moderate activities such as moving a table	14	23	1.26 (0.05)	0.80 (0.04)
Climbing one flight of stairs	10	19	1.49 (0.06)	0.94 (0.05)
Walking 100 yards	5	14	1.77 (0.09)	1.19 (0.06)
Bathing/dressing	5	8	1.97 (0.09)	1.64 (0.07)

SF-36: Medical Outcomes Study Short-Form 36.

Table 3. Unadjusted and adjusted odds ratios for groups, Decline vs Independence (no decline) and Recovery vs Limitations (no recovery).

	OR: Decline vs Independence (95% CI)			OR: Recovery vs Limitations (95% CI)		
	Unadjusted	Adjusted (n = 350)	p (n = 177)	Unadjusted (n = 438)	Adjusted (n = 107)	p
Age, yrs						
< 65	1.0	1.0		1.0	1.0	
65+	2.2 (1.5, 3.3)	2.1 (1.2, 3.7)	< 0.01	0.3 (0.2, 0.5)	0.4 (0.2, 0.8)	< 0.01
Sex, women	1.0			1.0	1.0	
Men	0.7 (0.5, 1.0)	0.7 (0.5, 1.1)	0.16	1.1 (1.0, 2.1)	1.1 (0.7, 1.9)	0.61
Social class						
Professional I	1.0	1.0		1.0	1.0	
Intermediate II	1.5 (0.7, 3.2)	1.5 (0.7, 3.3)	0.36	0.7 (0.2, 2.2)	0.7 (0.2, 2.4)	0.56
Skilled nonmanual IIINM	1.3 (0.6, 2.9)	1.1 (0.5, 2.8)	0.71	0.9 (0.3, 3.0)	1.0 (0.3, 3.5)	0.96
Skilled manual IIIM	1.7 (0.8, 3.8)	1.5 (0.6, 3.5)	0.35	0.7 (0.2, 2.3)	0.7 (0.2, 2.5)	0.58
Partly skilled IV	2.7 (1.2, 6.1)	2.2 (0.9, 5.5)	0.09	0.8 (0.2, 2.8)	0.9 (0.3, 3.4)	0.90
Unskilled V	1.6 (0.5, 5.2)	1.1 (0.3, 4.1)	0.91	0.4 (0.1, 2.1)	0.5 (0.1, 3.2)	0.50
Area deprivation quintiles						
First (most affluent)	1.0			1.0	1.0	
Second	0.85 (0.5, 1.4)	0.7 (0.4, 1.3)	0.29	0.6 (0.3, 1.1)	0.7 (0.4, 1.3)	0.25
Third	0.89 (0.5, 1.6)	0.7 (0.4, 1.3)	0.26	1.0 (0.5, 1.9)	1.2 (0.6, 2.4)	0.63
Fourth	1.2 (0.7, 2.1)	1.1 (0.6, 1.9)	0.84	0.8 (0.4, 1.6)	0.7 (0.4, 1.5)	0.39
Fifth (most deprived)	2.2 (1.3, 4.0)	2.4 (1.2, 4.7)	0.01	0.7 (0.4, 1.3)	0.8 (0.4, 1.6)	0.50
BMI						
Not obese (< 30 kg/m^2	1.0	1.0		1.0	1.0	
Obese (≥ 30 kg/m^2)	1.8 (1.1, 2.9)	1.6 (1.0, 2.7)	0.07	0.5 (0.3, 0.9)	0.5 (0.3, 0.8)	0.01
No. health problems						
None	1.0	1.0		1.0	1.0	
1 or 2	2.3 (1.4, 3.7)	1.8 (1.0, 3.2)	0.04	0.4 (0.2, 0.9)	0.5 (0.2, 1.2)	0.10
3 or more	9.2 (2.2, 38.6)	3.6 (1.9, 6.6)	< 0.01	0.2 (0.0, 0.8)	0.4 (0.1, 0.9)	0.02
Physical function (PF) score at baseline						
PF at baseline ≤ median	1.0			1.0	1.0	
PF at baseline > median	0.4 (0.3, 0.8)	0.5 (0.3, 0.8)	0.01	3.0 (1.8, 5.1)	3.1 (1.7, 5.7)	< 0.01
Knee and hip (pain or stiffness)						
Mild (≤ 2)	1.0			1.0		
Moderate (3–5)	1.9 (1.3, 2.9)	1.8 (1.2, 2.8)	0.01	0.5 (0.3, 0.9)	0.6 (0.3, 1.0)	0.04
Severe (6+)	2.5 (1.2, 5.0)	2.4 (1.2, 4.9)	0.01	0.5 (0.3, 1.0)	0.6 (0.3, 1.1)	0.07

Pain or stiffness are measured by pain or stiffness in hip or knee, during performance of any of 4 activities (standing up from a chair, putting on socks or shoes, going up steps or stairs, going down steps or stairs). Adjusted odds ratios (95% CI) derived from a multinomial logistic regression model. Adjusted estimates are based on a full model and adjustment was made for all variables included in the table. Pain severity estimates were adjusted for all factors listed in the table, with the exception of physical function at baseline and number of health problems, due to strong correlation between these factors.

stiffness in hips and knees (OR 2.4, 95% CI 1.2–4.9). The findings for the determinants of improvement in function mirror those for decline, with younger age, better physical function at baseline, fewer health problems, normal weight, and less pain being the strongest determinants of likely recovery from disability.

Severity of pain, physical disability at baseline, and the number of health problems reported all correlated strongly with the risk of subsequent deterioration or improvement in function. However, pain and the degree of limitation in physical function at baseline also correlated very strongly, as 78% of those with below-average function at baseline had moderate to severe pain, while only 22% had mild pain ($p < 0.05$). Similarly, the association between pain and the number of reported health problems was significant. Consequently, pain became insignificant in the model when adjustment was made for both health problems and physical function at baseline. The pain severity estimates reported in Table 3 were adjusted for all factors listed in the table, with the exception of these 2 variables.

Finally, we explored the possibility that there is a threshold effect within the association between baseline disability levels and the likelihood of improvement over time. The data are illustrated in Figure 2A, which charts the amount of disability at baseline in each of the 2 groups, calculated from the 9-item SF-36 physical function scale described (27 = no problems, 9 = severe limitation in all items). It is apparent that improvement was rare in those with a baseline score of 15 or less, as only about 15% among the recovery group had scored 15 or less at baseline, in comparison to 41% from the group with limitations. In addition, the overall distribution of the physical function scores also reflects a threshold

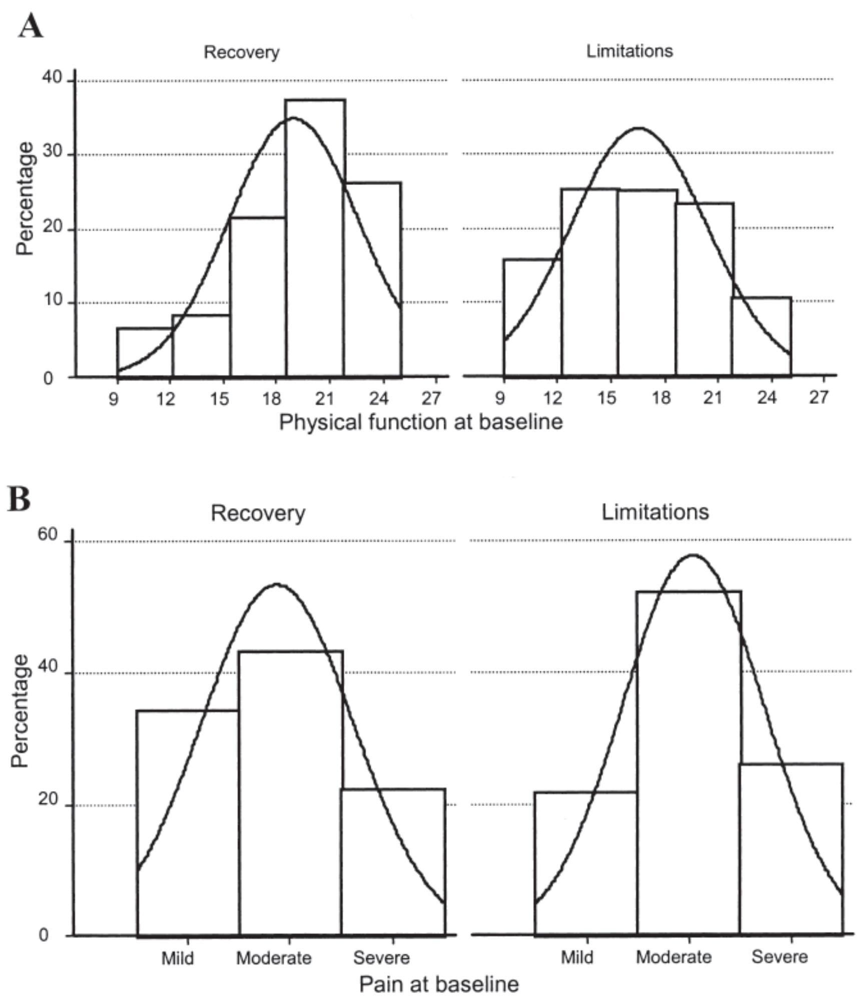

Figure 2. A. Distribution of physical function scores at baseline for group B1 (limitations at baseline and at followup) in comparison to group B2 (limitations at baseline but recovered); disability calculated from the 9-item SF-36 physical function scale (9 = severe limitation in all items, 27 = no problems). Curve indicates normal physical function. B. Pain at baseline in the 2 groups was assessed by pain or stiffness in the hip or knee while doing any of 4 activities (standing up, putting on socks, going up stairs, going down stairs). A 0–8 score was calculated, and further divided into 3 categories for mild (≤ 2), moderate (3–5), and severe (6+) pain. Curve indicates normal pain.

effect possibility, as for the recovery group it was skewed to the right, suggesting a high score (15 or more), indicating a good start for the majority, while for the group with limitations the distribution was approximately normal, suggesting a more mixed physical ability. In Figure 2B, pain at baseline was treated similarly, and the same pattern emerged: higher percentages of improvement were apparent among people with mild and moderate pain at baseline than among those with severe pain.

DISCUSSION

Our investigation has shown that in adults reporting current hip or knee pain physical disability is common, and that it can either deteriorate or improve in different individuals over an 8-year time period. Further, it is clear that the likelihood of deterioration or improvement in function depends on a complex mixture of disease-related, psychosocial, and environmental factors. The data suggest that those at highest risk of developing severe disability are older people, those with more severe pain, those with multiple pathologies, and those who are the most deprived in society.

Our study has both strengths and weaknesses. Its strengths include the fact that it is based on a large, longitudinal cohort study containing a wide range of information on sociodemographics, morbidity, and healthcare utilization, with a long duration of followup. The cohort was drawn from the community, and is representative of the population of South West England, and the self-reported morbidity data were validated using general practice records and hospital letters[32]. The use of the SF-36 physical function domain as the outcome measure is another strength, as this is a well validated measure, valuable in a wide range of diseases[28], developed for use in population surveys as well as clinical research.

Weaknesses include the attrition of the cohort over time, and some missing data. In addition, as in any longitudinal cohort study of this sort, the analysis of determinants of change is dependent on the data collected at baseline, and we did not have data on some variables that might have been important predictors of change in function, such as major social events like bereavement. However, unmeasured major events, such as a serious new disease or a significant change in social life, were relatively uncommon in the group studied, so we think it is unlikely that such factors are a major limitation to our findings. The longterm followup also might have had phases of disability and recovery that were not encountered; some studies have recommended short-term assessment[34], for example. To minimize that we have used a more stringent definition of disability as limited a lot, rather than some/little limitation, which is often used as a marker of the onset of disability and which may be more liable to temporary phases of disability. Our way of assessing pain severity at baseline was not conventional, we were not able to take account of medical interventions over time (because of lack of data), and we did not use standard diagnostic criteria to try to categorize the subjects into groups with or without a specific rheumatic disease, as discussed below.

The SF-36 is a well validated generic health status measure, and it is widely used to assess outcomes in studies of people with musculoskeletal diseases[28,35]. However, one of our important findings was that one of its 10 questions was of little value in this large prospective study of people with hip or knee pain. The question about "ability to undertake vigorous activity" performed quite differently from the other 9 questions, as shown by our use of IRT, which offers a practical and reliable solution to measuring health by a single continuum as an alternative to using several items and a range of scores[36,37]. The method takes into account the difficulty of each item and its discrimination power, in contrast to the conventional summation method that gives all items an equal weight. The IRT models showed that this item was different both at baseline and at followup, and in agreement with similar previous findings[38], most people with a musculoskeletal problem cannot undertake vigorous activity. In addition, it was clear from our data that 2 other items ("walking 100 yards" and "bathing or dressing"), in contrast to the "vigorous activity" item, covered activities that nearly everyone in the group could do. The 2 items, however, have a high discriminatory power, when tested by a 2-measure (IRT) logistic model, suggesting their importance in identifying people with severe disability.

Little is known about the natural history of disability in people with musculoskeletal disease, and the main focus of this investigation was to document changes in function over time and to explore their determinants. This large cohort of people all reported hip or knee pain at the baseline examination. Chronic hip and knee pain in adults can have a multiplicity of causes, which include referred pain from above (the spine), soft tissue periarticular problems, and arthritis; but it is generally agreed that OA is by far the most common cause[18,39]. It is conventional to use radiographs, or criteria such as those developed by the American College of Rheumatology (ACR)[40], to help categorize people into those with or without OA or another definable diagnosis. However, radiographs correlate poorly with symptoms[19,20] and the ACR criteria for OA simply describe features that distinguish people with OA from those with an inflammatory arthropathy[41]. Radiographs were taken of the people studied here, and as expected, most of them show some evidence of OA. We plan to describe the findings and their correlations with symptoms in other articles. However, we have not included those data here because we are addressing the important issue of disability and its determinants in people who might present with lower limb pain, rather than the fraught question of how to diagnose OA.

We found that disability was common, particularly in women, that on average it tended to deteriorate over time, but that a significant minority of people (10% of the whole cohort) improved in function during the 8 years of the study. This is consistent with longitudinal studies of people seeking help for symptomatic OA that also show that a minority improve over time[23]. What has not been well described before are the factors that determine improvement or deterioration in function in such people. These data reinforce previous findings that suggest comorbidities are important[9], and that excess weight can negatively affect recovery chances and is a predictor of decline in physical function[5,6]; and show that disability, like many other health problems, depends on socioeconomic status as well as health status[42,43]. The reasons for this are not clear, and the mechanism underlying the association is not fully understood[44]. The hypothesis that childhood disadvantage has influences on health in adult life seems plausible[45]. For example, it could be that people who do not have the opportunity to exercise in childhood, due to socioeconomic disadvantage, continue to live relatively sedentary lives as adults, resulting in their having less muscle strength and "reserve capacity" within the musculoskeletal system, making them less able to adapt to pain or disease in later life, and thus more prone to progressive disability[46].

Another important finding that may have clinical significance was our data that suggest there may be a "threshold effect," in other words, a level of pain or physical disability at baseline that is sufficiently severe to make subsequent improvement in outcome unlikely. As shown in Figure 2, limitations in function in 4 or more of the 9 SF-36 physical function items used, or severe pain as defined in our study, indicate a poor prognosis for both the persistence of or subsequent development of disability.

Chronic lower limb pain and locomotor disability are very common, particularly in older adults, and represent a major public health problem[3,37]. These data, and some of our other work in this field[19,42], indicate that more severe disability is determined by socioeconomic position and the extent of comorbidities as much as it is by joint pain or joint damage. The implications of these findings for rheumatologists, geriatricians, and public health physicians are extensive, as they suggest that we need to target the psychosocial circumstances and general health of our patients (or the population), rather than concentrating on pain and joint disease alone, if we are to prevent serious locomotor disability developing in people presenting with lower limb joint pain. In addition, the data suggest that, as we hypothesized, there may be a threshold level of function that, once reached, makes it unlikely that an individual will improve. This could have implications for public health screening programs aimed at detecting and intervening in the health of older people, as well as on the way individual physicians deal with their patients, and what prognosis they offer.

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