

Impacts of persistent general and site-specific pain on activities of daily living and physical performance: a prospective analysis of the English Longitudinal Study of Ageing

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Short running title: Longitudinal impacts of persistent pain

Abstract

Aim: Pain is an increasingly common phenomenon as people age; pain over a long period can result in limited functioning. This study investigates the impacts of general and multi-site specific pain on activities of daily living and physical performance among older adults.

Methods: Data were analysed from the English Longitudinal Study of Ageing (ELSA), a representative sample of the population aged 50 years and older. Face-to-face interview and nurse records were used from Waves 2 to 6 (2004-2012) for analyses. General and site-specific pain (back, hip, and knee) were measured biennially between 2004 and 2008 (n=5010). Impaired activity of daily living and physical performance measures (chair rise and grip strength) between 2008 and 2012 were aggregated across assessments as outcomes. Multinomial logistic regressions were used for the former and linear regression for the latter, adjusting for potential covariates.

Results: General pain (moderate to severe) was prevalent with close to a quarter of participants reporting pain at least twice during the follow-up period. Multi-site pain reports were strong predictors of subsequent limited activities of daily living (Adjusted Odds Ratios range from 1.86 to 3.97 for back and hip 2.04 to 4.19 for back and knee, and 2.08 to 5.16 for hip and knee). Persistent pain was also strongly associated with worse physical performance outcomes.

Conclusions: Our data confirm the longitudinal impacts of persistent pain among older adults. The findings highlight the value of monitoring and management of both general and site-specific pain in order to promote sustained independence at older ages.

Keywords: epidemiology; musculoskeletal disorders; pain management; physical function

Introduction

Pain is an increasingly common phenomenon as people age. Intense pain can have a direct impact on higher levels of physical discomfort and limited mobility, and these issues may become severe among older people, affecting their quality of life and overall health (1-3).

Pain takes many forms and its impact may differ according to the duration, location, and severity. Musculoskeletal pain is common throughout the lifespan and has been identified as one of the top ten contributors to the global burden of diseases (4, 5). Chronic musculoskeletal pain was reported among adults in their 30s and pain occurred frequently in the lower back, neck, shoulders, and knees (6). Among older persons, back, hip, and knee pain are the most common types (7-10). Longitudinal evidence, albeit quite limited, indicates that pain in the lower back and knees is associated with impaired physical function and quality of life among older Chinese (11).

Given the increasing proportion of older people in Western countries, the detection and management of avoidable effects of pain on daily life pose public health challenges. To investigate these impacts in the older population, we analysed data from the English Longitudinal Study of Ageing, in which frailty, mobility, and disability have previously been reported (12-14). We tested the hypothesis that repeated reports of pain over 3 waves of biennial data collection would predict impaired activities of daily living and poorer performance of upper and lower body actions over the subsequent 6 years.

We were particularly interested in investigating the persistence of pain using repeated measures over several years and the magnitude of locations of pain, including the overall level of pain, individual site specific (eg back, hip, and knee) as well as multi-site pain. Longitudinal analyses reveal similarities and differences in patterns and gradients associated with the pain locations most affecting limitations of daily living and physical performance among older adults.

Materials and methods

The English Longitudinal Study of Ageing (ELSA) is a cohort of men and women aged 50 and older living in England. It was set up in order to investigate the economic, social and health dynamics of ageing (15). ELSA began in 2002 with a face-to-face interview every two years. On alternate waves, participants are visited by a research nurse who carries out physical and biomarker assessments. We investigated longitudinal associations between pain status (Waves 2 to 4) and subsequent activities of daily living (Waves 4 to 6) and physical performance (data available in Waves 4 and 6). All analyses were based on 5,010 participants successfully followed up from Waves 2 (2004) to Wave 6 (2012).

Exposure variables: Participants were asked "Are you often troubled with pain?" "If yes, "how bad is the pain most of the time?" Responses were mild, moderate, or severe. Subsequently the respondents were asked about specific sites "In which parts of the body do you feel pain?" Multiple answers were allowed, including back, hips, and knees. For example, "how would you rate the pain in your back? "Where 0 is no pain and 10 is severe or excruciating pain, as bad as you can imagine'.¹ Number of occasions across waves 2, 3 and 4 on which respondents rated their general pain as moderate/severe was counted, and individuals were categorised as never, once or twice. Similarly, site-specific pain rated as 5 and higher was classified as moderate/severe (16, 17), and the number of waves of pain reports was categorised (never, once, at least twice).

Activities of Daily Living and Instrumental Activities of Daily living (ADLs and IADLs): these measures have been widely used in international surveys (18). We identified five key ADL and IADL outcomes to investigate associations with pain, including three items related to mobility: difficulty walking 100 yards; climbing several flights of stairs without rest; and

¹ Full English Longitudinal Study of Ageing questionnaire can be obtained from <https://www.elsa-project.ac.uk>

1 stooping/ kneeling; and two sets of IADLs: dressing/showering and performing work
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3 around the house or garden. The number of limited ADLs/IADLs reported at least twice
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5 (Waves 4 to 6) were aggregated as 0-1, 2-3, and 4-5.
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9 *Physical performance* measures include: 1) chair stand test – a measure of lower
10 body strength in which participants are asked to stand up and down as quickly as they can
11 for five rises. The total length of time to complete the test was computed; 2) grip strength –
12 a measure of upper body strength in which the respondent is asked to squeeze a grip
13 gauge up to three times with each hand. The average in kilograms for dominant and non-
14 dominant hands was combined (19).
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24 The covariates in these analyses include age, sex, net total wealth income quintiles,
25 long-standing conditions, and pain treatment. Net total wealth derived in ELSA includes
26 housing and non-housing wealth (20). The former consists of primary house values subtract
27 mortgage debt. The latter comprises gross financial wealth (eg savings, bonds, shares)
28 minus financial debt (eg private loans, credit card), but also includes values of other
29 property, business, and other assets (eg cars). Long-standing conditions are part of the self-
30 perceived health module asking: "Do you have any long-standing illness, disability or
31 infirmity...that has troubled you over a period of time, or that is likely to affect you over a
32 period of time?" Pain treatment was assessed with question: "Are you currently receiving
33 any treatment for your pain?"² Analyses was also adjusted for Wave 2 body mass index
34 known to be associated with physical functioning (21). We also included initial chair rise
35 performance and initial grip strength as covariates in the analyses of chair rises and grip
36 strength, respectively. A flow diagram of the study design is included as Figure 1.
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54 ² Derived ELSA financial variables and documentation can be assessed at
55 http://doc.ukdataservice.ac.uk/doc/5050/mrdoc/pdf/5050_user_guide_financial_derived_vars.pdf
56 Full English Longitudinal Study of Ageing questionnaire can be obtained from <https://www.elsa-project.ac.uk>
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Statistical analysis

Descriptive analyses reported prevalence of pain by sex and age at Wave 2. We subsequently carried out multinomial logistic regressions on incident impaired ADLs/IADLs in Waves 4 to 6 categorised into 0-1, 2-3, and 4-5, excluding individuals who reported impaired ADLs/IADLs in Wave 2. The exposure variables were pain in Waves 2 to 4 and covariates as listed above. The analyses of objective physical performance, chair rise time and grip strength, averaged from Waves 4 and 6 involved multivariable linear regressions, with the same exposure measures as in the ADLs/IADLs analyses.

We tested three sets of association between pain and adverse outcomes. Model 1 assessed associations with general pain. Model 2 tested associations with each of the site-specific pain locations (back, hip and knee). In Model 3, we tested three combinations of site-specific pain: back and hip, back and knee, and hip and knee. Results are presented as covariate-adjusted multinomial logistic odds ratios and multivariate regression coefficients with 95% confidence intervals.

Results

There were 5,010 respondents (2,818 men and 2,192 women) and their characteristics are summarised in Table 1. The prevalence of moderate/severe general pain increased with age from 16.5% to 23.5% among men and 23.0% to 38.0% among women (Figure 2), and was greater in women than men. Moderate/severe site-specific pain was also generally increased in prevalence with age, and was more common in women than men.

The frequency of general and site-specific pain (Waves 2 to 4) was reported in Table 2. A quarter of respondents reported moderate/severe general pain and 10.3%,

1 6.6%, and 9.9% reported back, knee, and hip pain at least twice across the three waves.
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3 Incident limitations in ADLs were aggregated across Waves 4, 5, and 6. Among those who
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5 never reported moderate/severe pain in Wave 2, 3, and 4, approximately 4% reported
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7 incident limitations in walking, dressing/bathing, or performing work around the house
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9 in waves 4 to 6, while difficulties climbing several flights of stairs and stooping/kneeling
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11 were more common (14%-15%).
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15 The proportions reporting impaired ADLs/IADLs increased markedly for those
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17 reporting moderate/severe pain at least once or twice. (Table 2) For example, there was a
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19 five-fold increase (from 3.3% to 19.5%) in the prevalence of difficulty with walking 100
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21 yards or dressing/bathing at follow-up in participants who reported moderate/severe pain
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23 at least twice between 2004 and 2008. Multi-site pain was reported at least twice for the
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25 combination of back and knee pain (4.9%), back and hip pain (5.6%), and knee and hip
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27 pain (4.4%). The time taken for chair rises was longer and grip strength less for participants
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29 reporting persistent general pain and site-specific pain
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33 After adjusting for covariates (Table 3), respondents reporting general and
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35 specific-site pain were 1.5 to 5 times more likely to report multiple impaired ADLs/IADLs
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37 on follow-up, compared with the no pain group. The effects were strongest for hip
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39 followed by knee and back pain. Persistent multi-site pain were strong predictors of
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41 subsequent adverse outcomes (Adjusted Odds Ratios range from 1.86 to 3.97 for back
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43 and hip 2.04 to 4.19 for back and knee, and 2.08 to 5.16 for hip and knee).
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47 Pain during the exposure period was also associated with worse physical
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49 performance outcomes on follow-up. Persistent pain was associated with longer time
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51 taken to complete the chair rise tests in comparison with the no pain group, and there
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53 were stronger associations when pain was present more often, and from more sites of the
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1 body. For grip strength, results were statistically significant only for respondents who
2 reported pain at least twice between Wave 2 (2004) and Wave 6 (2008).
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8 **Discussion**

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10 We set out to investigate the longitudinal impact of pain on impaired activities of
11 daily living as well as objective measures of physical performance among older adults in
12 England. Moderate to severe general pain reports were quite prevalent, with close to a
13 quarter reporting pain at least twice across Waves 2, 3, and 4. Persistent reporting of multi-
14 site pain across the 4-year exposure period was particularly significant for future impaired
15 activities of daily living and poor objective physical performance, with the strongest effects
16 merging from the combination of hip and knee pain. These multivariable estimates have
17 taken into account other potential covariates at initial Wave 2 such as body mass index,
18 longstanding conditions, and pain treatment.
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31 Our longitudinal results support other findings on the effects of pain on adverse
32 outcomes. A US based study among older persons reported the impact of multi-site
33 musculoskeletal pain, with two or three sites of pain associating with a 30% and 80%
34 greater hazard for incident disability, respectively, compared with participants with no
35 report on musculoskeletal pain (10). A longitudinal study conducted among Australian men
36 aged 70 years and older reported that chronic knee pain is significantly associated with
37 marked mobility disability, co-morbidity burden, and functional decline (9). A special
38 feature of our study lies in the examination of both recurrent measures of exposures and
39 repeat assessments across time. By using both subjective measure (self-reported ADLs and
40 IADLs) and objective measure (physical performance during nurse visit), we confirm similar
41 patterns and gradients of persistent general and specific pain on both adverse outcomes.
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1 Tests for trend of increasing exposure on the dose-response relationships were statistically
2 significant at $p < 0.05$ (data not shown).
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6 In interpreting these findings, some limitations of the study should be noted. First,
7 self-reported pain was used as the main exposure of interest. Since this is common among
8 older adults, we used a threshold on the rating scale to define moderate/severe pain over
9 the five-year period, rather than total pain reports. Second, since data are only collected in
10 ELSA biennially, we were not able to take into account pain occurring between waves, and
11 objective measures of physical performance were only available every 4 years. Third, there
12 was no information whether the exact location of the pain or whether the pain occur in one
13 of both sides of the knees or hips. Additional descriptive comparisons of respondents and
14 non-respondents in 2004 showed that attrition was more common among older age groups
15 (70+ years). However, this would be unlikely to affect the multivariate analyses.
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28 By using prospective cohort data, we are able to measure the longitudinal impacts
29 of recurrent and persistent pain among older adults. In particular, we captured gradients
30 between site-specific pain and outcomes, which were strongest for the hip followed by the
31 knee and back. Reports of hip and knee pain had the worst impact on future limitations in
32 activities of daily living. Multiple-site pain requires more complex and specialised
33 treatment than pain from a single site. Self-reported musculoskeletal pain is known to be a
34 predictor of independence, unmet long-term needs for health care, and overall quality of
35 life (22, 23). Our findings highlight the value of monitoring and management of both
36 general and specific pain in order to promote sustained independence at older ages.
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Disclosure statement

No potential conflicts of interest were disclosed.

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Figure Legends

Figure 1 Study design flow diagram, English Longitudinal Study of Ageing (ELSA)

Figure 2 Prevalence of general and [site-specific pain](#) by age groups and sex, English Longitudinal Study of Ageing Wave 2 (2004)

For Peer Review

Table 1 Sociodemographic characteristics, English Longitudinal Study of Ageing (ELSA), Wave 2 2004

Attributes	% (N)
Sex	
Male	56.3 (2,818)
Female	43.7 (2,192)
Age	
50-59 years	35.6 (1,795)
60-69 years	26.7 (1,840)
70-79 years	21.9 (1,099)
80+ years	5.7 (286)
Net total wealth quintiles	
Quintile 1	17.2 (849)
Quintile 2	15.3 (753)
Quintile 3	19.9 (982)
Quintile 4	22.6 (1,117)
Quintile 5	25.0 (1,231)
Body mass index (BMI)	
BMI < 18.5	3.9 (198)
BMI 18.5 to <25	23.6 (1,182)
BMI 25 to <30	39.7 (1,988)
BMI 30+	32.8 (1,642)
Long-standing conditions	
Yes	54.3 (2,719)
Pain treatment	
Yes	7.5 (378)

Table 2 General and site-specific pain on activities of daily living and physical performance, English Longitudinal Study of Ageing (ELSA)

Frequency of pain across Waves 2, 3, 4	Difficulty with activities of daily living* (Row %)					Physical performance (Mean±SD)	
	Waves 4, 5, and 6					Waves 4 and 6**	
	Walking 100 yards	Climbing several flight of stairs	Stooping, kneeling, crouching	Dressing, bathing or showering	Doing work around the house, garden	Chair rise (seconds, 5 attempts)	Grip strength (kgs, 3 attempts for each hands)
Pain (moderate to severe)							
Never (57.6%)	3.3	13.7	12.8	4.4	3.9	10.5±2.6	29.5±9.5
Once (19.1%)	8.4	27.9	31.0	12.1	11.7	11.4±2.9	27.2±9.6
At least twice (23.1%)	19.5	39.5	45.4	22.9	20.0	12.4±3.4	23.8±9.9
Specific pain (back, hip, knee)							
Never (70.4%)	3.5	14.9	14.4	5.5	4.5	10.6±2.7	29.2±9.6
Back pain rating (5 of 10)							
Once (10.6%)	12.9	34.7	40.5	19.0	18.0	11.9±2.9	25.2±9.8
At least twice (10.3%)	30.5	52.4	56.3	30.6	25.8	13.4±3.8	22.4±9.6
Hip pain rating (5 of 10)							
Once (10.2%)	18.8	43.6	46.6	19.8	19.5	12.4±3.4	24.4±9.9

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At least twice (6.6%)	28.4	58.5	60.0	33.5	32.4	13.7±4.0	22.5±9.8
Knee pain rating (5 of 10)							
Once (10.4%)	18.6	41.4	52.1	18.8	19.1	12.2±3.1	25.0±10.1
At least twice (9.9%)	29.2	57.0	74.1	31.2	29.4	13.4±3.8	22.9±3.0
Multi-site pain							
Back and hip							
Once (8.0%)	20.3	48.6	53.5	23.0	22.0	12.8±3.6	23.5±9.6
At least twice (4.9%)	28.4	56.8	59.4	37.3	33.9	13.8±7.9	22.2±9.9
Back and knee							
Once (7.9%)	23.9	48.0	52.8	25.6	21.5	12.7±3.2	24.4±4.3
At least twice (5.6%)	35.8	55.3	81.4	39.8	35.5	13.9±4.1	21.4±3.0
Hip and knee							
Once (8.1%)	23.8	48.3	56.4	23.4	22.3	12.9±3.7	24.5±10.5
At least twice (4.4%)	34.5	68.5	73.6	39.2	37.0	13.9±3.8	21.5±10.0

*Reported at least twice across Waves 4, 5, 6

**Nurse visit data were not available in Wave 5

Table 3 Longitudinal analyses of general and site-specific pain on activities of daily living and physical performance , English Longitudinal Study of Ageing (ELSA)

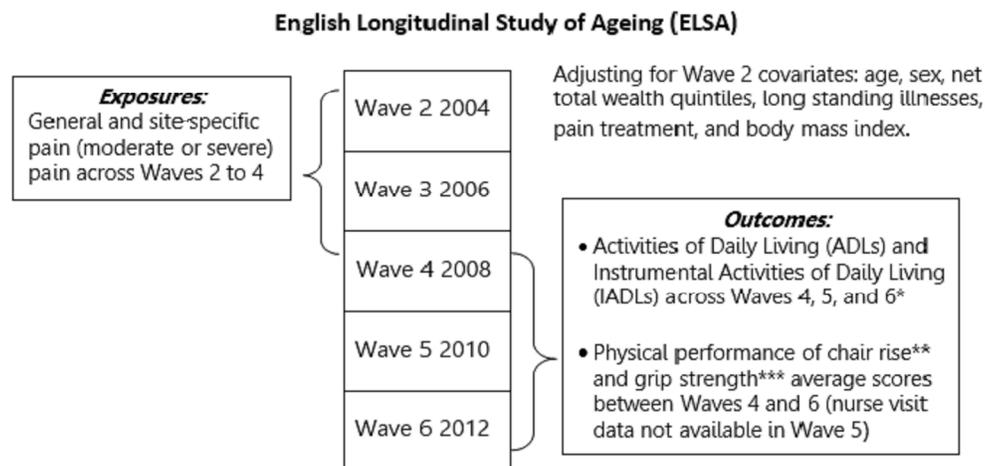
General and specific pain reported at Waves 2, 3, 4	Multinomial odds ratios [95% CI]			Multivariable linear regression coefficient [95% CI]	
	Number of limitations of daily activities*			Chair rise, 5 attempts**	Grip strength, 3 times***
	0-1 (Ref)	2-3	4-5	(seconds)	(kilograms)
Model 1					
Pain (moderate to severe)					
Once (19.1%)	1.56 [1.21-2.01]	2.31 [1.60-3.34]		0.31 [0.06, 0.56]	-0.18 [-0.54, 0.17]
At least twice (23.1%)	1.77 [1.42-2.20]	2.48 [1.70-3.61]		0.74 [0.46,1.03]	-0.87 [-1.25,-0.50]
Model 2					
Back pain					
Once (10.6%)	1.47 [1.12-1.94]	2.21 [1.96-4.52]		0.37 [0.04, 0.70]	-0.24 [-0.68, 0.21]
At least twice (10.3%)	1.83 [1.27-2.65]	3.02 [1.91-4.78]		1.14 [0.71,1.57]	-0.73 [-1.23,-0.23]
Hip pain					
Once (10.2%)	1.91 [1.43-2.56]	3.18 [2.14-4.74]		0.58 [0.22, 0.94]	-0.19 [-0.66, 0.27]
At least twice (6.6%)	2.51 [1.55-4.07]	4.26 [2.42-4.79]		1.47 [0.93, 2.02]	-0.71 [-1.34,-0.08]
Knee pain					
Once (7.3%)	2.07 [1.49-2.56]	3.25 [2.21-4.89]		0.39 [0.03, 0.75]	-0.33 [-0.79, 0.14]

At least twice (4.0%)	2.36 [1.48-3.20]	3.63 [2.22-5.91]	0.90 [0.42, 1.38]	-0.76 [-1.30,-0.22]
Model 3				
Back and hip				
Once (8.0%)	1.86 [1.32-2.61]	2.93 [1.88-4.57]	0.60 [0.19, 1.01]	-0.40 [-0.94, 0.12]
At least twice (4.9%)	2.35 [1.34-4.12]	3.97 [2.10-7.51]	1.66 [1.01, 2.32]	-0.79 [-1.50,-0.07]
Back and knee				
Once (7.9%)	2.04 [1.46-2.87]	3.51 [2.26-5.46]	0.68 [0.26, 1.09]	-0.45 [-1.14, 0.23]
At least twice (5.6%)	2.19 [1.25-3.85]	4.19 [2.21-7.93]	1.29 [0.63, 1.95]	-0.68 [-1.20,-0.15]
Hip and knee				
Once (8.1%)	2.08 [1.48-2.94]	3.92 [2.53-6.07]	0.64 [0.22, 1.06]	-0.09 [-0.61, 0.44]
At least twice (4.4%)	3.24 [1.66-6.32]	5.16 [2.47-10.8]	1.47 [0.70, 2.24]	-0.95 [-1.72,-0.19]

*Adjusted for age, sex, wealth quintiles, body mass index, long standing conditions, limitations of daily living at Wave 2, pain treatment at Wave 2

**Adjusted for age, sex, wealth quintiles, body mass index, long standing conditions, chair rise scores at Wave 2, and pain treatment at Wave 2

***Adjusted for age, sex, wealth quintiles, body mass index, long standing conditions, grip strength scores at Wave 2, and pain treatment at Wave 2.



*Excluding individuals with impaired ADLs/IADLs in Wave 2

**Adjusting for Wave 2 initial chair rise performance scores

*** Adjusting for Wave 2 initial grip strength performance scores

Figure 1 Study design flow diagram, English Longitudinal Study of Ageing (ELSA)

1455x878mm (96 x 96 DPI)

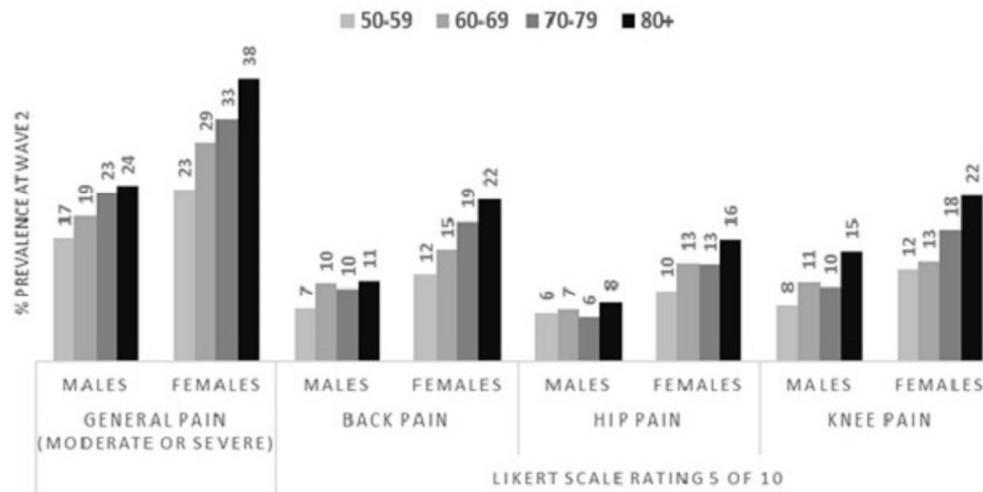


Figure 2 Prevalence of general and site-specific pain by age groups and sex, English Longitudinal Study of Ageing Wave 2 (2004)

1455x733mm (96 x 96 DPI)