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Does life course socio-economic position influence chronic disabling pain in older adults? A general population study

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Background: Chronic pain is the leading cause of disability in developed countries. Prevalence is linked with socio-economic position (SEP), but little is known about the influence of SEP on disabling pain over the life course. We have investigated the influence of different life course trajectories of SEP on disabling pain ('pain interference') in postal surveys of adults aged ≥50 years sampled from the general population of adults registered with three UK general practices. **Methods:** Current pain interference was measured using the dichotomized 36-item Short-Form (SF-36) health survey. Three recalled SEP measures (age left school, longest job and current/most recent job) were dichotomized into low SEP (left school at or before minimum school leaving age; reported routine or manual occupations) and high SEP, from which eight life course SEP trajectories were constructed. Associations of (i) eight SEP trajectories and (ii) three individual SEP measures adjusted for each other, with pain interference, adjusted for potential confounders, were calculated using logistic regression. **Results:** A total of 2533 individuals provided data on all three SEP measures. A consistently low life course SEP trajectory was significantly associated with current pain interference compared with a high trajectory [odds ratio (OR) = 2.76, 95% confidence interval (CI): 2.19–3.47], even after adjustment for age and gender. Further adjustment reduced the association but it remained significant (OR = 2.04; 95% CI: 1.55–2.68). In the model with individual measures, low age left school (OR = 1.45; 95% CI: 1.15–1.82) and manual longest job (OR = 1.47; 95% CI: 1.13–1.91) were independently associated with pain interference. **Conclusions:** Our results highlight the potential for reducing chronic disabling pain in later life by addressing inequalities in both childhood education and adult occupational opportunities.

Introduction

Common pain conditions, which are dominated in the general population by musculoskeletal problems, such as osteoarthritis and back pain, contribute substantially to the onset[1] and prevalence[2,3] of disability in the older population. Furthermore, although overall pain prevalence remains relatively stable with increasing age,[4] pain that interferes with everyday life ('pain interference') clearly rises in frequency, and in incidence, with age up to the oldest old.[4–6] As the older population is increasing in size, pain interference in current and future populations of older adults represents a growing public health challenge.[7] The Marmot Review of health inequalities in England has highlighted that the impact of such problems may extend further because of the substantial social gradient in disability-free life expectancy that exists between poor and rich neighbourhoods.[8]

Although socio-economic factors at different stages during people's lives have been linked to many health outcomes,[9–15] life course influences on chronic musculoskeletal pain in adulthood have not been studied in detail.[16] Studies of individual socio-economic position (SEP) at different points in life, e.g. education, occupation and income,[17] consistently find an inverse relationship with osteoarthritis[18,19] and pain.[20–22] However, only two population-based studies have examined the relationship between individual measures of SEP and the consequences of any pain, specifically, pain interference or disabling pain. One prospective study of older adults found that although perceived inadequacy of income predicted onset of pain interference, current or most recent manual job or no further education did not.[5] In contrast, a study of middle-aged adults showed that lower education and occupational status were associated with disabling chronic pain but only in women.[23] These discrepancies may reflect different measures of disabling pain and SEP and contrastingly aged population samples; indeed, it has been suggested that an occupational classification based on current or last occupation may not be so relevant in cohorts of older adults.[24]

Different measures of SEP influence each other[13,17]—for example, education level may not only reflect early-life SEP but also strongly determine future employment and income.[17] However, multiple SEPs measured at different stages of the life course, which provide a more complete picture of the effect of SEP on health,[17,21] have rarely been explored in population-based studies of chronic pain.[22] Hence, for this study, we constructed trajectories of SEP through life, based on measures of education, longest job and current or most recent job, appropriate for use in a postal survey of an older population.[3,25,26] The objective of this study was to determine the associations of these different trajectories of SEP over the life course with chronic disabling pain (measured as pain interference) in later life in a general population-based study of older adults including the oldest old.

Methods

The North Staffordshire Osteoarthritis Project (NorStOP) is a large cohort study of adults aged ≥50 years sampled from the general population in North Staffordshire, UK. It has consisted to date of a baseline and two follow-up questionnaire surveys at 3 and 6 years. The current study is a cross-sectional analysis of the 6-year follow-up survey responders. Approval for all stages of the study was granted by the North Staffordshire Research Ethics Committee.

NorStOP population

Details of the NorStOP study population and the response and non-response to each stage of the study have been published previously[4,6,26,27] and are summarized as follows. The sampling frame at baseline consisted of all adults aged ≥50 years registered with three general practices in North Staffordshire ($n = 11\,309$). Following 79 exclusions by the general practitioners (GPs) before mailing (e.g. due to severe psychiatric or terminal illness), 7878 people responded at baseline, giving an adjusted response of 71.3%.[4] Of these, 5366 people also gave consent to further contact and, following 308 exclusions (by GPs or due to deaths), 5058 were sent a 3-year follow-up questionnaire to which 4234 responded (an adjusted response of 84.7%).[6] A total of 3596 responders to the 3-year survey gave consent to further contact and, after 186 exclusions (by GPs or due to deaths), 3410 were mailed the 6-year follow-up questionnaire to which 2831 people responded (an adjusted response of 83.9%).[27]

Population for current analysis

The 2831 people who completed and returned Health Questionnaires in the 6-year follow-up survey of NorStOP in 2008 are the population for the current analysis. The 6-year survey provided data on current pain and its interference with daily life. The items on the life course SEP measures were taken from questions included in various of the three cohort questionnaires completed by these 2831 persons, as were data on potential confounding factors.

Measures of recalled SEP

Age left school (young adulthood SEP) was included in a set of questions on education in the Health Questionnaire[25,26] and dichotomized into low SEP (those who left school at or before the legal minimum school leaving age at that time) and high SEP (those who left school after the legal minimum school leaving age).

Adult SEP was based on occupation, assessed by both current or most recent job and longest job (the job done for most of working life). In older people, obtaining information on the job done for most of working life gives an indication of the occupationally based SEP accumulated throughout adult working life,[24] whereas current or most recent job assesses current SEP or SEP before retirement (which may not represent older adults' SEP during the main part of their working lives), and therefore provides a reasonable estimate of SEP in the last phase of older adults' SEP trajectories. Hence, in this study, longest job (adult working life SEP) was obtained by questions about the job done for most of working life in the Health Questionnaire,[25] and a separate single question was used to obtain information about current or most recent job (most recent adult SEP).[26] The question on current or most recent job was asked in the 3-year survey and not repeated at 6 years; there may therefore be a small number of persons in the younger age groups whose most recent adult SEP in relation to their current pain status has changed but the misclassification is likely to be minimal.

Occupational data were classified according to the Standard Occupational Classification 2000 (SOC2000)[28] from which the National Statistics Socio-economic Classification (NS-SEC)[29] was derived. Both current or most recent and longest job data were dichotomized into low SEP ('Routine and manual occupations') and high SEP ('Intermediate occupations' and 'Managerial and professional occupations') as described previously.[3] Eight life course SEP trajectories were constructed from the three dichotomized measures of SEP, e.g. the life course SEP trajectory 'HLH' represents high SEP for age left school, low SEP for longest job and high SEP for current or most recent job.

Pain interference

The outcome for this analysis was current pain interference, measured using a single item from the Medical Outcomes Study (MOS) 36-item Short-Form health survey (SF-36)[30] in the Health Questionnaire: 'During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?' The five response categories to this question were dichotomized as previously in this population: persons marking 'extremely', 'quite a bit' or 'moderately' were coded as having pain interference and those marking 'a little bit' and 'not at all' as having no pain interference.[4,6]

Potential confounding factors

Psychological and social factors were included in the Health Questionnaire as potential confounders based on previous evidence of links with SEP and/or disability.[3,5,8,31] Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS).[32] A single question assessed perception of adequacy of income: 'Thinking about the cost of living as it affects you, which of these descriptions best describes your situation?' as described previously. The four response categories were 'find it a strain to get by from week to week', 'have to be careful with money', 'able to manage without much difficulty' and 'quite comfortably off'.[26] A question regarding perception of control over health was hypothesized to have links with disability and asked 'In your opinion, is it a matter of luck whether you are well or ill, or is it something which can be controlled?' The five response categories were 'all luck', 'mostly luck', 'bit of both', 'mostly under control' and 'almost all under control'.[33] Other factors collected in the Health Questionnaire were included as potential confounders due to their possible association with pain interference and/or SEP: cancer, diabetes and body mass index [BMI; calculated from self-reported height and weight (weight/height^2)].[9,34,35]

Statistical analysis

Analysis was confined to participants who provided complete data on all three SEP measures. Age is presented as age at the time of the 6-year survey. The demographic distribution of the three measures of SEP in the population is presented as percentages. Estimates of prevalence of pain interference overall, and within each individual SEP measure and SEP trajectory, were calculated. Logistic regression [giving odds ratios (ORs) and 95% confidence intervals (CIs)] was used to examine the association of pain interference with (i) each of the eight life course SEP trajectories, unadjusted, adjusted for age and gender and further adjusted for BMI, anxiety, depression, health locus of control, adequacy of income, cancer and diabetes [with consistently high SEP (HHH) as the reference; Model 1] and (ii) each of the three individual SEP measures (univariate), unadjusted and adjusted through three stages (mutual, age and gender and covariates as listed above; Model 2). The data from each fully adjusted model were then compared using the likelihood ratio statistic to investigate whether the eight-item SEP trajectory model (Model 1) explained more of the variance in pain interference than the three-item SEP measures model (Model 2).

The association between the number of low SEPs accumulated across the life course and pain interference was also analysed by logistic regression (accumulation model; Model 3); using zero low SEPs as the reference category (HHH), the unadjusted ORs and 95% CIs for the association of pain interference with one low SEP (HHL or HLH or LHH), two low SEPs (HLL or LHL or LLH) and three low SEPs (LLL) during the life course were calculated, with adjustment for age and gender and full covariate adjustment as above.

The standard residual diagnostics were applied to assess model fit. Statistical analysis was carried out using PASW Statistics 18.0.0 (IBM SPSS Statistics, 2009).

Table 1 Demographic distribution of the sample overall and the three measures of SEP

	Total, *n* (%)	Prevalence of pain interference, *n* (%)	Age left school,[a] *n* (%)		Longest job NS-SEC class,[b] *n* (%)		Current/most recent job[c] NS-SEC class,[b] *n* (%)	
			Low	High	Low	High	Low	High
Gender								
Males	1144 (45.2)	466 (40.7)	774 (67.7)	370 (32.3)	588 (51.4)	556 (48.6)	619 (54.1)	525 (45.9)
Females	1389 (54.8)	602 (43.3)	966 (69.5)	423 (30.5)	737 (53.1)	652 (46.9)	796 (57.3)	593 (42.7)
Age group (years)								
56–65	1079 (42.6)	354 (32.8)	675 (62.6)	404 (37.4)	543 (50.3)	536 (49.7)	623 (57.7)	456 (42.3)
66–75	918 (36.2)	413 (45.0)	693 (75.5)	225 (24.5)	509 (55.4)	409 (44.6)	526 (57.3)	392 (42.7)
76–85	455 (18.0)	244 (53.6)	319 (70.1)	136 (29.9)	237 (52.1)	218 (47.9)	229 (50.3)	226 (49.7)
86+	81 (3.2)	57 (70.4)	53 (65.4)	28 (34.6)	36 (44.4)	45 (55.6)	37 (45.7)	44 (54.3)
Total	2533 (100)	1068 (42.2)	1740 (68.7)	793 (31.3)	1325 (52.3)	1208 (47.7)	1415 (55.9)	1118 (44.1)

NS-SEC, National Statistics Socio-economic Classification.
a: Low = left school at or before minimum school leaving age; high = left school after minimum school leaving age.
b: Low = routine and manual occupations; high = managerial, professional and intermediate occupations.
c: Current or most recent job recalled 3 years previously.

Table 2 Association of life course SEP trajectories with pain interference (Model 1)

Life course SEP trajectory[a]	Total, *n* (%)	Prevalence of pain interference, *n* (%)	Pain interference		
			Unadjusted ($n = 2533$) OR (95% CI)	Partially adjusted[b] ($n = 2533$) OR (95% CI)	Fully adjusted[c,d] ($n = 2378$)[e] OR (95% CI)
HHH	499 (19.7)	138 (27.7)	1.00	1.00	1.00
HHL	105 (4.1)	25 (23.8)	0.82 (0.50–1.33)	0.96 (0.58–1.58)	0.88 (0.51–1.52)
HLH	37 (1.5)	18 (48.6)	2.48** (1.26–4.86)	2.59** (1.30–5.16)	2.93** (1.33–6.45)
LHH	452 (17.8)	198 (43.8)	2.04*** (1.56–2.67)	1.95*** (1.48–2.56)	1.70** (1.24–2.32)
HLL	152 (6.0)	55 (36.2)	1.48* (1.01–2.18)	1.67* (1.13–2.48)	1.60* (1.02–2.53)
LHL	152 (6.0)	55 (36.2)	1.48* (1.01–2.18)	1.55* (1.05–2.29)	1.40 (0.89–2.20)
LLH	130 (5.1)	63 (48.5)	2.46*** (1.66–3.66)	2.34*** (1.56–3.50)	1.79* (1.12–2.87)
LLL	1006 (39.7)	516 (51.3)	2.76*** (2.19–3.47)	2.75*** (2.17–3.48)	2.04*** (1.55–2.68)

a: HHH = high SEP for age left school, high SEP for longest job and high SEP for current or most recent job. The same order of SEPs is used in the other life course SEP trajectories, with L = low SEP.
b: Adjusted for age (continuous variable) and gender.
c: Adjusted for age, gender, BMI, anxiety, depression, health locus of control, adequacy of income, cancer and diabetes. Age, gender and BMI were entered in the first step of the logistic regression; anxiety, depression, health locus of control, adequacy of income, cancer and diabetes were entered forward stepwise in the second step of the logistic regression. Age and BMI were entered as continuous variables.
d: In the fully adjusted regression model, per 10 years of age (OR 1.82; 95% CI: 1.63–2.06; $P < 0.001$), BMI (OR 1.08; 95% CI: 1.06–1.11; $P < 0.001$), depression (OR 1.30; 95% CI: 1.26–1.34; $P < 0.001$), adequacy of income [(strain: OR 2.15; 95% CI: 1.16–4.00; $p = 0.015$; careful: OR 1.77; 95% CI: 1.32–2.36; $P < 0.001$; manage: OR 1.11; 95% CI: 0.84–1.47; $P = 0.460$) compared to comfortably off] and diabetes (OR 1.69; 95% CI: 1.25–2.27; $P = 0.001$) were significantly associated with pain interference.
e: Subject to missing data.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Results

Of the 2831 individual participants in the 6-year follow-up, 2533 (89.5%) provided data on all three SEP measures.

SEP measures

Table 1 shows the demographic distribution of the sample overall and the three measures of SEP. Of the 2533 participants, the mean (SD) age at 6-year follow-up was 68.5 (±8.3 years).

Pain interference

The overall prevalence of pain interference was 42.2%, with females reporting a marginally higher prevalence than males and prevalence increasing with age (table 1).

Model 1—association of SEP trajectories with pain interference

In the unadjusted regression analysis of the eight SEP trajectories, there was a significant, near tripling of odds of pain interference from the HHH to the LLL trajectory (table 2). Adjustment for age and gender did not alter this association. Additional adjustment for the seven remaining potential confounding variables modestly attenuated the association to a doubling of odds of pain interference in the LLL trajectory compared to the HHH trajectory (fully adjusted Model 1; table 2). Of the trajectories between the two extremes of LLL and HHH that had a significant association with pain interference, those starting with a low SEP and those with two low SEPs (LHH, LLH and HLL) showed comparable strengths of association with pain interference but smaller than that of LLL (table 2). HLH also showed an association with pain interference relative to HHH but based on small numbers.

Table 3 Association of individual SEPs with pain interference (Model 2)

SEP	Pain interference					
	Unadjusted ($n = 2533$)		Partially adjusted[a] ($n = 2533$)		Fully adjusted[b] ($n = 2378$)[c]	
	OR	95% CI	OR	95% CI	OR	95% CI
Unadjusted						
Age left school	2.16**	1.81–2.59	2.04**	1.70–2.45	1.63**	1.32–2.02
Longest job	1.84**	1.57–2.17	1.86**	1.58–2.19	1.55**	1.28–1.88
Current/most recent job	1.43**	1.22–1.68	1.52**	1.29–1.79	1.29*	1.06–1.56
Mutually adjusted						
Age left school[d]	1.86**	1.53–2.25	1.72**	1.41–2.09	1.45*	1.15–1.82
Longest job[e]	1.66**	1.33–2.08	1.62**	1.29–2.04	1.47*	1.13–1.91
Current/most recent job[f]	0.86	0.69–1.07	0.93	0.75–1.17	0.90	0.70–1.17

a: Adjusted for age (continuous variable) and gender.
b: Adjusted for age, gender, BMI, anxiety, depression, health locus of control, adequacy of income, cancer and diabetes. Age, gender and BMI were entered in the first step of the logistic regression; anxiety, depression, health locus of control, adequacy of income, cancer and diabetes were entered forward stepwise in the second step of the logistic regression. Age and BMI were entered as continuous variables.
c: Subject to missing data.
d: Adjusted for longest job and current/most recent job.
e: Adjusted for age left school and current/most recent job.
f: Adjusted for age left school and longest job.
$*P < 0.01$; $**P < 0.001$.

Table 4 Association between the number of low SEPs accumulated across the life course and pain interference (Model 3)

Number of low SEPs	Total, *n* (%)	Pain interference					
		Unadjusted ($n = 2533$)		Partially adjusted[a] ($n = 2533$)		Fully adjusted[b] ($n = 2378$)[c]	
		OR	95% CI	OR	95% CI	OR	95% CI
0	499 (19.7)	1.0		1.0		1.0	
1	594 (23.5)	1.79**	1.38–2.31	1.78**	1.37–2.30	1.57*	1.17–2.12
2	434 (17.1)	1.73**	1.32–2.28	1.81**	1.37–2.40	1.58*	1.14–2.19
3	1006 (39.7)	2.76**	2.19–3.47	2.76**	2.18–3.49	2.04**	1.55–2.68

a: Adjusted for age (continuous variable) and gender.
b: Adjusted for age, gender, BMI, anxiety, depression, health locus of control, adequacy of income, cancer and diabetes. Age, gender and BMI were entered in the first step of the logistic regression; anxiety, depression, health locus of control, adequacy of income, cancer and diabetes were entered forward stepwise in the second step of the logistic regression. Age and BMI were entered as continuous variables.
c: Subject to missing data.
$*P < 0.01$;$**P < 0.001$.

Model 2—association of individual SEP measures with pain interference

Univariate analysis showed associations between each of the three individual SEP measures and pain interference, with age left school showing the strongest association; these associations were not altered by adjustment for age and gender but were reduced although still significant after full covariate adjustment (table 3). Mutual adjustment of the SEP measures, also fully adjusted for covariates, modestly reduced the associations of pain interference with age left school and longest job, both of which remained significant and independent. However, current or most recent job was no longer significantly or independently associated with pain interference (fully adjusted Model 2; table 3).

Comparison of model fit showed no significant improvement in using the fully adjusted eight-item SEP trajectory Model 1 over the fully adjusted three-item SEP measure Model 2 (−2 ln likelihood ratio statistic = 3351.04 vs. 3346.62, respectively; difference of 4.32 on chi-squared test with 4 degrees of freedom, $P = 0.36$).

Model 3—association of accumulated measures with pain interference

One, two and three low SEPs during the life course were each associated with pain interference; there was a similar strength of association for one or two low SEPs with the strongest association for three low SEPs during the life course (fully adjusted accumulation Model 3; table 4).

Hosmer–Lemeshow goodness-of-fit tests showed that the fully adjusted Models 1–3 were reasonable approximations of the data ($P > 0.05$ in each case).

Discussion

To our knowledge, this study is the first to show that older adults, including the oldest old, with a life course trajectory of consistently low SEP had almost three times the odds of reporting chronic disabling pain (as measured by current pain interference), compared with those with a consistently high SEP trajectory throughout life. Accounting for age, BMI, adequacy of income, diabetes and depression reduced the strength of this association; this is unsurprising, given that previous research into these factors has shown links with SEP or pain interference.[3–5,9,34] However, these covariates did not explain all the observed association, although they may well underlie mechanisms by which events during the life course influence future health.[10]

Our results also showed that the detailed eight SEP trajectory model did not add to the explanation of variance in pain interference provided by the three-item SEP measure model. This supports the conclusion that low education and persistently low occupational class for most of working life were the key and independent components of the trajectories. Although current or most recent job was not independently associated with pain interference once education and longest job had been taken into account, it did contribute to the accumulation model, suggesting that the more individual low SEPs accumulate across the life course, the greater the odds of pain interference in later life; taken together with our SEP measures being limited to older childhood and adult life, the data fit with a model of cumulative risk or a chain of risk of low SEP across those periods of the life course.

In our study, a consistently low life course SEP trajectory starts with a low level of education which may reflect prior adverse early-life socio-economic circumstances,[15,17] such as low parental education, low parental occupation or family financial pressures. Some studies have suggested that much of the effect of parental socio-economic circumstances on health is mediated by a person's own education,[13] emphasizing the potential of raising education levels as a means to improving future health. A crucial issue in disabling pain may also be the extent to which access to appropriate and accurate treatment information (considered essential to pain management[36]), utilization of health services and ability to understand health messages[37] are influenced by education level. Since education has been linked previously to adult osteoarthritis and pain,[18–21] our finding that leaving school at or below the minimum age was associated with pain interference in those aged $\geq$56 years substantiates and develops this research further, suggesting that the influence of a minimum level of education may be important not only for the current musculoskeletal health of adults, but extends throughout life into older age and affects not only pain but the likelihood that the pain will interfere with normal activities.

A second low SEP in this study (a routine or manual job for most of working life) may be the result of a lack of education beyond the minimum, which subsequently restricts occupational opportunities. Adults with a low SEP also experience less favourable health outcomes such as higher levels of BMI and depression,[8] both of which contributed to pain interference in our study. Although our study did not demonstrate a separate additional specific influence of current or most recent job, the accumulative model suggested that persistence of a manual job class into the final years before retirement continues to add risk of chronic pain that interferes with life in those later years. This is supported by Jordan *et al.*[5] who found no evidence of an association between current or most recent occupationally based adult social class and the onset of disabling pain in adults aged $\geq$50 years, adjusted for other factors including further education, whereas a study of adults aged 40–60 years showed that current occupational class adjusted for other socio-economic indicators was associated with disabling chronic pain in women.[23] In studies of older people, longest job may give a better representation of the cumulative effect of lifetime occupationally based SEP than current or most recent job.[24] The discrepancy between the immediate effect of current or most recent job and the cumulative effect of occupationally based SEP over the working life, combined with the effect of education level on later adult chronic disabling pain, provides evidence that this syndrome in older adults is shaped by events across the life course.

A strength of this study is that the sample is from a large general population, including the oldest old.[4,6,27] This has to be balanced against the potential weakness of the non-response rates. Although the original sample recruited at the baseline survey to establish the NorStOP cohort, and who consented to further contact, represented almost 50% of the sampling frame, and in the current analysis, we have studied responders to the 6-year follow-up survey who had complete data and who represent 53% of those originally recruited at baseline, we have previously shown that non-response bias at baseline and follow-up in this cohort is low.[4,6,27,38] Moreover, any selectivity in the responding population is unlikely to have affected the results of the 'internal comparison' analysis presented in this article. A second strength is that our outcome measure of chronic disabling pain was based on pain interference, a single item from the widely used and validated physical functioning scale of the SF-36.[4–6,26,30]

The limitations of this study are that, first, the retrospective collection of SEP data may have been subject to recall and item-response bias; however, levels of missing data for the SEP measures of age left school and longest job were low in this population,[25] and similar measures have been used in previous studies.[12,39] Although we did not measure early-life SEP using parental occupation or education, as in some life course studies,[11,12] education has been used as a measure of young adulthood SEP,[14] as it captures the transition from parental SEP to adult SEP,[17] likely reflects childhood socio-economic circumstances and, as considered above, is potentially related to adult chronic pain by a number of mechanisms. Indeed, in this study, the individual SEP measure of age left school remained independently associated with later pain interference in older adults even after adjustment for longest job and current or most recent job; this supports the rationale for including age left school as part of a life course trajectory of SEP. Secondly, 59% of this cohort reported being in a trajectory with a consistent SEP; the remainder were in one of the six SEP trajectories between the two extremes, some of which had small numbers, which may have limited the power of the analysis. Thirdly, the study was carried out in a relatively poor area of the UK, socio-economically, where historically the industries included heavy manual occupations such as pottery, mining and farming. This may limit the generalizability of our findings although the main associations should not be substantially affected. Linked to this, the results may be limited by the longest job measure in this age cohort, as younger populations might experience job trajectories that include several different occupations over a lifetime, providing a different picture in the future.[17] Lastly, there is potential in this analysis for the order of effect over the life course to be in the opposite direction to our hypothesis, i.e. that early chronic disabling pain would influence educational attainment and occupational choices throughout the life course, although this is likely to apply to only a small minority of the population because pain interference in children is less prevalent than in adults later in life.[4,40]

In conclusion, our results reveal the link between education level, adult SEP and chronic disabling pain later in life in adults aged $\geq$56 years. Persons who started life with a minimum level of education or less and subsequently spent most of their working life in a manual or routine occupation were twice as likely to report pain in later life, which interfered with their normal activities, compared with those starting with more than the minimum level of education, followed by an occupationally based high SEP during their working life. The Marmot Review highlighted that substantial social inequalities in health still remain in the 21st century and emphasised the need for giving every child the best start in life to reduce the impact of socio-economic disadvantage on future health.[8] Our results support the view that this may also be the case for the important public health problem of chronic disabling pain.[7] Improvements in educational and occupational opportunities may be important primary prevention targets for this common problem.

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Conflicts of interest: None declared.

Key points

- Chronic disabling pain in older adults is a major challenge for public health.
- A low SEP over the life course doubles the odds of chronic disabling pain at age ≥56 years.
- The more individual low SEPs accumulated across the life course, the greater the odds of pain interference in later life.
- A low level of education followed by a manual job for most of working life exert greater influence on later pain interference in older adults than their current or most recent job.
- Addressing inequalities in childhood education and adult occupational opportunities may be important public health targets for reducing chronic disabling pain in later life.

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Small-area analysis of social inequalities in residential exposure to road traffic noise in Marseilles, France

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Background: Few studies have focused on the social inequalities associated with environmental noise despite its significant potential health effects. This study analysed the associations between area socio-economic status (SES) and potential residential exposure to road traffic noise at a small-area level in Marseilles, second largest city in France. **Methods:** We calculated two potential road noise exposure indicators (PNEI) at the census block level (for 24-h and night periods), with the noise propagation prediction model CadnaA. We built a deprivation index from census data to estimate SES at the census block level. Locally estimated scatterplot smoothing diagrams described the associations between this index and PNEIs. Since the extent to which coefficient values vary between standard regression models and spatial methods are sensitive to the specific spatial model, we analysed these associations further with various regression models controlling for spatial autocorrelation and conducted sensitivity analyses with different spatial weight matrices. **Results:** We observed a non-linear relation between the PNEIs and the deprivation index: exposure levels were highest in the intermediate categories. All the spatial models led to a better fit and more or less pronounced reductions of the regression coefficients; the shape of the relations nonetheless remained the same. **Conclusion:** Finding the highest noise exposure in midlevel deprivation areas was unexpected, given the general literature on environmental inequalities. It highlights the need to study the diversity of the patterns of environmental inequalities across various economic, social and cultural contexts. Comparative studies of environmental inequalities are needed, between regions and countries, for noise and other pollutants.

Introduction

Noise imposes the second largest environmental burden on health, after ambient air pollution.[1] Relatively few studies examine inequalities in environmental noise exposure (from transportation, industrial or domestic sources), compared with the abundant literature about exposure to other environmental risks and pollutants (e.g. proximity to industrial and toxic waste sites or air pollution from industry and transportation).[2,3] The evidence is conflicting. Several studies show that individuals of low socio-economic status (SES)[2,4–6] or living in deprived areas[7,8] are more likely than others to report noise annoyance. Similarly, studies based on noise exposure modelling or indicators of proximity to noise sources (roads, railways and airports) report greater noise exposure among people of low SES[2,9–11] or belonging to specific communities (black ethnic groups).[12] Nonetheless, studies in the Netherlands and France report that environmental noise exposure levels are highest in advantaged neighbourhoods.[9,10,13]

Among these studies, only one attempted to take spatial autocorrelation (referred to hereafter as autocorrelation) into account[13] as recommended for studying environmental inequalities.[14,15] It refers to the non-independence of observations of neighbouring geographical areas.[16] More intuitively, spatial autocorrelation can be loosely defined as the coincidence of value similarity with locational similarity. Failure to take autocorrelation into account violates the hypotheses of independence that underlie the application of ordinary least square regression models and increases the risk of false-positive findings (type I error).[17]

Correction for autocorrelation might modify the relative size of regression coefficients corresponding to explanatory variables and their categories[17–19] differently, depending on the specific spatial