
Socioeconomic burden of pain in rheumatic disease

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ABSTRACT

Socioeconomic inequities in the health outcomes of rheumatic diseases, including pain, have been well documented across countries and study designs. Nevertheless, health disparities remain surprisingly-poorly understood in the rheumatic diseases, owing both to the complex nature of those disorders, and to methodological challenges surrounding the evaluation of social class and of its ties to health. Methodological difficulties in measuring SES can complicate interpretation of results to understand mechanisms of these associations. Current research on associations between SES and pain in rheumatic diseases are summarised in this article. Our review indicates that inequalities in pain in patients with OA and RA with low individual SES are strong and well-established, although associations in other rheumatic conditions and with community or childhood SES are less well-established. Further, the range of proposed mechanisms underlying disparities is broad, encompassing numerous indicators of SES, such as occupation, income, and education and varying widely by disease.

Introduction

The observation that people with lower socioeconomic status (SES) shoulder a greater burden of disease is ubiquitous across health sectors, and finding methods to reduce these disparities is a fundamental priority among health disparities researchers and health equity advocates. The reduction of health disparities, including those by socioeconomic status, figures prominently in the goals of *Healthy People 2020*, the fourth edition of the *Healthy People* initiative that has connected thousands of governmental and private organisations in the pursuit of common public health priorities (1). *Healthy People 2020* is the first edition to include social determinants of health as a foundation health measure, indicating an increasing focus

on social factors like SES as targets to improve health outcomes (2).

As in other fields of health, socioeconomic patterns in the prevalence and health outcomes of the rheumatic diseases can be reliably discerned across half a century of occupational and observational data spanning countries and study designs. These patterns extend throughout the range of rheumatic diseases; increased prevalence of disease among those with lower socioeconomic status (SES) have been observed in osteoarthritis (OA) and rheumatoid arthritis (RA), with some evidence of a similar association in gout (3-6). Worse outcomes across a range of measures have been observed in OA, RA, and systemic lupus erythematosus (SLE), with some evidence of a similar association in ankylosing spondylitis (7-10). Although rheumatic diseases are remarkably heterogenous, most have in common the central role of pain. Patients may experience acute, regional pain in affected joints during flares, as well as chronic, widespread pain (11). Pain has a major impact on quality of life due to loss of function, inability to pursue everyday activities, necessity of developing coping strategies, difficulty with interpersonal relationships and feelings of fear and isolation (11). It is also the most common motivation for patients to seek medical care for rheumatic disease, and thus is an important driver of the \$116 billion spent yearly on healthcare utilisation for arthritis and joint pain (12, 13).

Nearly all health outcome measures in the rheumatic diseases are socioeconomically-patterned to some degree, and pain is no exception, with an abundance of data showing differences in multiple measures of pain among patients with arthritis, fibromyalgia, and ankylosing spondylitis. Nevertheless, there remain key limitations in our understanding of socioeconomic disparities in pain symptoms, stemming from the measurement of social class, and

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methodological difficulties in evaluating mechanistic pathways.

In this article, we introduce some of the challenges of defining and measuring SES, review extant data on pain inequities in the rheumatic diseases, and discuss potential mechanisms involved.

Challenges in measuring socioeconomic status in health disparities research

While adverse SES is uncontroversially associated with greater prevalence of disease and worse outcomes in the rheumatic diseases, the details of these relationships are muddled by the complexities of performing SES research. We will discuss the challenges of selecting measures of SES, complexities of interpretation given the choice of measure, issues of confounding with SES measures by variables such as race, gender, and age, and the need to account for potential gradient or life course effects of SES on health outcomes.

An enduring challenge is the lack of a unified definition and measure of social class in health research. While there is substantial multicollinearity among common SES measures like education, occupation, and income, each variable operationalises different aspects of the relationship between SES and health and cannot necessarily be used as a proxy for another variable (14). For example, researchers commonly measure educational attainment as a proxy for income or for SES overall, as income and wealth are often considered sensitive information and are difficult to ask in a questionnaire. However, variation in income among different social groups (age, race/ethnicity, sex) with the same education, and educational effects on noneconomic variables like health literacy, lessen correlations between income and education and weaken their ability to be used as proxies (14).

Studies of rheumatic diseases vary greatly in their use of different measures for SES, with community or individual-level metrics being used variably (3, 4). These measures quantify distinct, though overlapping, aspects of social stratification, and the magnitude of health disparities can vary widely depending on the SES measure used: for

instance, formal educational attainment could more tie into literacy, healthy behaviours, and health-services utilisation than occupation. The impact of certain measures may also vary by disease: for instance, patients with RA and low income may suffer reduced access to expensive biologic medications, which can impede successful disease management (8).

Adding to the complexity, ties between SES measures and proximal causes of health are likely to vary across populations. Income or occupation for instance is less likely to reflect access to care in societies with universal coverage, and educational achievement may yield less upward social mobility among racial minorities than among whites in the United States, owing to complex factors including economic and social discrimination (15). Health disparities also likely vary across age groups, as illustrated in a study of Singaporean adults with OA which found disparities in pain to increase with age (16).

Despite evidence that the SES and health association occurs along a gradient of worse health with lower status, many studies of socioeconomic disparities in rheumatic disease pain have measured SES with dichotomised indicators (17, 18). For example, RA studies have commonly contrasted high-school degree holders or college degree-holders with participants below that level of education, limiting their insight to a particular section of the SES continuum (3, 19). However, certain studies have employed more than two categories or used number of years of education to examine a potential gradient effect (20, 21).

A final methodological consideration in health disparities research is the importance of socioeconomic disadvantage throughout the life course and the influence of community SES above and beyond individual factors (14). Childhood SES can lastingly affect health outcomes irrespective of SES in later life, while neighbourhood or community SES can also impact outcomes regardless of individual SES. We found only one study that examined the impact of childhood SES on pain in the rheumatic diseases (3). Effects of community

level SES on pain in rheumatic diseases were evaluated in many studies, with results suggesting at least a modest relationship between increased pain and living in more deprived communities (20, 22-26).

SES and pain in rheumatic diseases

The literature on associations between SES and pain in rheumatic diseases is summarised in Table I. RA was the most commonly studied condition, followed by OA, fibromyalgia, ankylosing spondylitis, SLE, and scleroderma. While studies have found relationships between SES and the prevalence of gout (5), and between SES and poorer outcomes in SLE (9), (10), our search found no studies that have specifically measured associations between pain and SES in gout, and only one study that measured pain and SES in SLE (27). In both RA and OA, there is strong evidence of an association between individual level measures of SES and pain. With few exceptions, studies found that higher levels of SES were associated with lower pain reporting in both conditions. These associations were retained across numerous measures of SES, including education, occupation, income, and homeownership. Studies examining associations between pain and individual level measures of SES in other rheumatic conditions are sparse. Among fibromyalgia patients, one study found no difference in pain intensity with education, but did find poorer pain quality and higher disability from pain reported in patients with less education (28). Our search found no studies examining individual SES in ankylosing spondylitis.

Evidence of an association between individual level measures of SES and pain reporting in rheumatic conditions is fairly strong, however the association with community-level measures of SES is more modest. Six studies examined this association in RA, OA, and ankylosing spondylitis, with two finding a significant relationship, and one study approaching significance, between lower community SES and higher pain. Community level SES has been shown to be associated with

Table I. Overview of socioeconomic disparities in pain in rheumatic disease.

Study	Ref	Data (Country)	Sample Size	Rheumatic Conditions	Adjusted for	Socioeconomic Status (SES) Variables	Results (Pain)
ERAS Study Group 2000	[20]	England	869	RA	age, sex, treatment centre	Community SES: Carstairs deprivation score Education: university/national diploma, school leavers exam at 17/18 years, school leavers exam at 15/16 years, none	No significant trend observed between community SES and pain. Evidence of positive trend between education and pain ($p=0.006$).
Harrison 2005	[22]	England	466	RA	age, sex, disease duration, current smoking, treatment center, treatment group, EQ-5D health status measure	Community SES: Townsend index score	Significant linear relationship between community SES and Pain VAS scores ($p<0.001$).
Baldassari 2016	[33]	Consortium Evaluation of African-Americans with Rheumatoid Arthritis (CLEAR II) - Southeastern USA	516	RA	age, disease-duration, sex, medication use, BMI, smoking history	Education: greater than high school, high school or lower Homeownership Childhood SES: parental homeownership and parental education at time of participant's birth	High school or less had greater pain ($\beta = 0.99\text{cm}$, 95% CI: 0.49, 1.48). Homeowners rated pain 0.58cm lower than non-homeowners ($\beta = 0.58$, 95% CI: 0.27, 0.89). No differences in pain based on parental education. No differences in pain based on parental homeownership.
Callahan 1988	[41]	USA	385	RA	age, sex, clinical setting, duration of disease	Education: grade school, some high school, high school graduate, some college (at least one year)	Participants with only a grade school education had significantly higher odds of a greater than median score on a pain VAS (OR: 1.5) compared with those that had some college.
Baldassari 2014	[42]	Consortium Evaluation of African-Americans with Rheumatoid Arthritis (CLEAR II) - Southeastern USA	937	RA	sex, age, disease duration, BMI, comorbid conditions, smoking history, medication use	Education: < high school, \geq high school Occupation: high or low by U.S Census categories Household income: high = \geq \$30,000/yr, low = < \$30,000/yr Homeownership	Low household income significantly associated with increase in a 0-10 pain VAS score of 1.17 (95% CI 0.74, 1.60). Education less than high school degree significantly associated with increase in a 0-10 pain VAS score of 0.50 VAS (95% CI 0.06, 0.93). Low SES occupation significantly associated with increase in a 0-10 pain VAS score of 0.50 (95% CI 0.12, 0.87). Non-homeownership significantly associated with increase in a 0-10 pain VAS score of 0.95 (95% CI 0.56, 1.33).
Jiang 2015	[19]	Sweden	3021	RA	age at diagnosis, sex, smoking, alcohol consumption, BMI	Education: University/college degree (high education) vs. no university/college degree (low education)	Patients with high education had significantly less pain at baseline (100mm Pain VAS: baseline: 49 (95% CI: 28-67) vs. 53 (95% CI: 33-71), $p<0.0001$. They also had less pain throughout follow-up period (1-year visit RR for pain equal to/above median = 0.81 (95% CI 0.73-0.90)).
Berkanovic 1996	[21]	USA	118	RA	age, sex, disease activity, comorbidities, social structure block	Education: # of years Household Income	No significant association between education or household income and pain by multiple regression.
Andersson 2013	[36]	Sweden	1430	RA	--	Occupation: blue collar, upper or lower white collar, other, self-employed	mean pain VAS at baseline differed significantly between occupational groups ($p=0.005$).
Yang 2015	[43]	Canadian Early Arthritis Cohort (CATCH) study (Canada)	2023	early inflammatory arthritis	age, sex, symptom duration, meeting ACR/EULAR criteria for RA, smoking status	Education: \leq High school, > High school Income: \leq \$50,000 (low income), > \$50,000 (high income)	Pain VAS not significantly different between educational level cohorts. Pain VAS significantly greater in low income group compared with high income group ($p=0.035$).
Knight 2011	[23]	Johnston County Osteoarthritis Project (USA)	959	hip OA	age, gender, race, BMI, presence of knee symptoms	Education: <12 years or \geq 12 years Occupation: managerial or non-managerial Community SES: census block group poverty rate (<12%, 12-25%, \geq 25%)	Education <12 years significantly associated with pain. Non-managerial occupation significantly associated with pain. No significant association between pain and community SES.

Study	Ref	Data (Country)	Sample Size	Rheumatic Conditions	Adjusted for	Socioeconomic Status (SES) Variables	Results (Pain)
Cleveland 2013	[24]	Johnston County Osteoarthritis Project (USA)	782	knee OA	age, gender, race, BMI, occupational physical activity score, comorbidity count, presence of hip symptoms	Occupation: managerial or non-managerial Education: <12 years or ≥12 years Community SES: census block group poverty rate (<12%, 12-25%, ≥25%)	Occupation was significantly associated with WOMAC pain score ($\beta = 0.93$, 95% CI = 0.26-1.59), even after adjustment for other SES variables ($\beta = 0.78$ (0.08, 1.48). <12 years education and higher community poverty showed non-significant associations with WOMAC pain scores.
Hannan 1992	[44]	NHANES I	6880	Knee OA	age, race, sex, smoking, radiographic OA	Education: 0-8 yr, 9-11 yr, 12 yr (high school graduate), and ≥13 yr	Those with 0-8 yr of education had greater odds of reporting knee pain compared with those with ≥13 yr of education (OR (95% CI): 1.34 (1.09, 1.65)).
Thumboo 2002	[16]	Singapore	126	Knee or Hip OA	age, sex, ethnicity, questionnaire language	Education: 0 vs. ≥1 year	Subjects with ≥ 1 year education had less pain by multiple linear regression but non-significant ($p=0.132$).
Feldman 2015	[25]	Adding Value in Knee Arthroplasty (AViKA) cohort (USA)	316	patients scheduled for TKA	age, sex, BMI	Education: less than college, attended college or technical school, graduated college or technical school Community SES: composite SES measure based on census block	Lower mean pain WOMAC score among college graduates compared to those with less education ($p=0.02$). Lower mean pain catastrophising score among college graduates compared to those with less education ($p<0.01$). Lower mean pain WOMAC score among those with highest community SES compared with lower ($p=0.01$). No difference in mean pain catastrophising score among those with highest community SES compared with lower ($p=0.12$).
Desmeules 2009	[45]	Canada	197	patients on waiting list for TKA	age, sex	Education: high school or less vs. college or university Household income: < \$30,000/yr, ≥ \$30,000/yr	No significant association between socioeconomic variables and pain by multiple regression.
Fitzcharles 2014	[28]	Canada	246	Fibromyalgia	age, sex	Education: high school graduates, college graduates (technical education or pre-university education in Quebec), and university graduates	No significant differences in pain VAS between groups. Lower educational status sig associated with worse pain quality ($p=0.026$). Lower educational status significantly associated with increased pain disability index score ($p=0.031$).
Healey 2010	[26]	England	468	Ankylosing Spondylitis	age, gender, disease duration, region	Community SES: Index of Multiple Deprivation (IMD)	Non-significant trend toward more pain among those living in areas with community SES (OR 1.98, 95% CI: 0.97, 4.07).
Callahan 1989	[27]	USA	602	RA, OA, SLE, fibromyalgia, scleroderma	age, disease duration	Education: <12 yrs vs. ≥12 yrs	Those with <12 yrs education had significantly lower pain VAS scores compared with those with ≥12 yrs education by linear regression for osteoarthritis ($\beta = -0.22$, $p<0.01$) but not for any other rheumatic condition studied.

RA: rheumatoid arthritis; OA: osteoarthritis; CI: confidence interval; SES: socioeconomic status; EQ-5D: EuroQol five dimensions questionnaire; VAS: visual analogue scale; BMI: body mass index; RR: risk ratio; ACR: American College of Rheumatology; EULAR: European League against Rheumatism; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; TKA: total knee arthroplasty.

general health independent of individual SES, possibly through such mechanisms as increased environmental stressors, fewer community resources, or influences on health behaviours by the social environment (29). Future research should continue to explore the

extent of such an association with pain in rheumatic diseases.

An additional area that merits further exploration is the extent to which childhood SES influences pain in the rheumatic diseases. Socioeconomic disparities throughout the lifecourse

have increasingly been viewed as an enduring determinant of health, with some models placing special emphasis on childhood as a critical period for the determination of future health status (30). Studies have found relationships between lower childhood SES

and increased prevalence and worse outcomes in arthritis (31, 32). We reviewed only one study that examined relationships between childhood SES and pain, which found no difference in pain levels based on parental homeownership or parental education (33). However, more research is necessary to establish whether a relationship exists between childhood SES and pain in rheumatic disease.

Pathways to socioeconomic disparities in pain

Rheumatic diseases are diverse, aetiologically complex disorders; therefore, a range of mechanisms plausibly underlie relationships between SES and pain in these conditions. Inequities in access to care are often discussed as a primary factor contributing to disparities in disease outcomes – for example, RA patients who cannot afford expensive biologic medications may experience greater pain and worse disease outcomes (34, 35). However SES disparities in RA joint pain persist even in countries with universal healthcare systems like Sweden, suggesting the relationship extends beyond disparities in access (19, 36). The persistence of SES disparities in pain and other outcomes despite increasing universality of access to care in many countries suggests that factors outside the healthcare system, like disadvantageous social conditions and ineffective self-management, may play a greater role in contributing to poor health outcomes among socioeconomically disadvantaged groups (37).

Certain studies have examined the role of social conditions beyond the medical system as contributors to rheumatic disease pain. The PROGRESS-Plus framework, which can be used to characterise populations by social determinants of health, has been used to identify the role of place of residence, race and ethnicity, occupation, gender, education, socioeconomic status, social capital and networks, age, disability and sexual orientation in creating or maintaining inequities in OA (38), (35). Financial stress and worry, which directly tie into adverse levels of SES, have also been associated with pain in OA and fibromyalgia (39). Addressing

the social determinants of health, which is a primary goal of the *Healthy People 2020* initiative, could have a broad impact on the experience of pain by people with rheumatic diseases (37, 2).

Finally, exploring socioeconomic disparities of pain may not only reveal mechanisms of pain's relationship with SES, but may also help determine how SES impacts other rheumatic disease outcomes. For rheumatic disease patients, pain can be a driving factor of health status. In OA, pain is often the primary symptom, and the severity of pain is well linked to the degree of functional limitation experienced (40). In RA, pain also seems to be an influential factor of health status, with one study finding that improvements in pain during RA treatment helped to reduce socioeconomic inequalities in general health status (22). As socioeconomic disparities exist in a variety of rheumatic disease outcomes, understanding the disparities in pain can provide a deeper understanding of socioeconomic influences on rheumatic disease outcomes as a whole.

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