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Research Article

Global Pain and Aging: A Cross-Sectional Study on Age Differences in the Intensity of Chronic Pain Among Middle-Aged and Older Adults in 20 Countries

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Abstract

Objectives: This study aims to examine age differences in the intensity of chronic pain among middle-aged and older adults, where intensity is measured on a scale differentiating between chronic pain that is often troubling and likely requires intervention versus more endurable sensations. We aim to explore whether individual health and national gross domestic product (GDP) explain these differences as well.

Methods: Cross-nationally harmonized data from 20 countries on self-reported intensity of chronic pain (0 = no, 1 = mild, 2 = moderate, 3 = severe) in 104,826 individuals aged 50+ observed in 2012–2013. Two-level hierarchical ordinal linear models with individuals nested within countries were used to isolate estimations from heterogeneity explained by methodological differences across single-country studies.

Results: Overall, mean participant age was 66.9 (*SD* = 9.9), 56.1% were women, and 41.9% of respondents reported any chronic pain. Chronic pain intensity rose sharply with age in some countries (e.g., Korea and Slovenia), but this association waned or reversed in other countries (e.g., the United States and Denmark). Cross-country variation and age differences in chronic pain were partly explained (85.5% and 35.8%, respectively) by individual-level health (especially arthritis), country-level wealth (as indicated by GDP per capita), and demographics.

Discussion: Chronic pain intensity is not an inevitable consequence of chronological age, but the consequence of potential selection effects and lower activity levels combined with individual-level health and country-level wealth. Our findings suggest further investigation of health conditions and country affluence settings as potential targets of medical and policy interventions aiming to prevent, reduce, or manage chronic pain among older patients and aging populations.

Keywords: Cross-national, Life course, Old age, Pain intensity, Social epidemiology

Chronic pain among middle-aged and older adults has strong clinical and public health relevance (Blyth & Noguchi, 2017; Cohen et al., 2021; Reid et al., 2015; Vos et al., 2017; Zimmer et al., 2020). Reported chronic pain is more prevalent than heart disease, cancer, and diabetes combined (Institute of Medicine, 2011). Its direct societal costs are substantial, as patients with chronic pain consume almost twice as many health care resources compared to the general population (Henschke et al., 2015). Indirect chronic pain costs include reduced productivity, absenteeism, and early retirement. Population studies in the United States and around the world document a higher prevalence of chronic pain in adults over 65 as compared to the general adult population, with chronic unspecified joint pain (40%), chronic back pain (5–45%), and chronic neck pain (20%) being the most prevalent chronic pain conditions in old age (Domenichiello & Ramsden, 2019). Among middle-aged and older adults, chronic pain is a common factor underlying disability, and is associated with reduced mobility, work disability, avoidance of activity, falls, depression and anxiety, sleep impairment, isolation, and other detrimental health consequences, including loss of independence (Banks et al., 2009; Blyth & Noguchi, 2017; Boring et al., 2022; Gálvez-Barrón et al., 2020; Reid et al., 2015; van Schoor et al., 2022).

In a world experiencing rapid population aging and rising prevalence of chronic diseases which can also be associated with pain increases, chronic pain among middle-aged and older adults warrants closer scrutiny (Blyth & Noguchi, 2017; Reid et al., 2015; Vos et al., 2017; Zimmer et al., 2020). Some assume that as people get older, general health declines and pain increases (Thielke et al., 2012). Epidemiological studies have found an age-related increase in the prevalence of chronic pain, with older age predicting onset of, and failure to recover from, chronic pain (Larsson et al., 2017; Zimmer et al., 2020). Other studies, however, have found that chronic pain can plateau or even decrease after the sixth decade, although the mechanism behind these patterns is still unclear (Cimas et al., 2018; Grol-Prokopczyk, 2017; Lautenbacher et al., 2017).

Methods and measurement issues in chronic pain research related to age warrant consideration (Lazaridou et al., 2018; Tamrakar et al., 2021). The question of whether or not there is evidence of physiological changes within pain processing that can be attributed to age remains controversial. Some studies indicate that pain range may narrow in old ages, and that older people may underreport chronic pain because they view it as a normal part of aging (Lautenbacher et al., 2017; Thielke et al., 2012). Overall, one cannot assume that getting older will increase the risk of being in chronic pain or increase its intensity, as many old people describe minimal suffering and appear to be extremely active, though individuals with more intense pain may not survive into older ages or select out of surveys (Cimas et al., 2018; Grol-Prokopczyk, 2017).

Age differences in chronic pain among middle-aged and older adults vary across studies conducted in different countries. Age-related increases in chronic pain have been documented in several countries (Domenichiello & Ramsden, 2019), while several other studies find nonexistent or inconsistent age differences in countries such as the United States (Zimmer & Zajacova, 2018), the United Kingdom (Docking et al., 2011), and Sweden (Larsson et al., 2017), and some studies even note decreases in chronic pain after age 60 (Grol-Prokopczyk, 2017). Comparative and cross-national research can help to clarify these mixed results, by isolating the heterogeneity in chronic pain trends across countries from the heterogeneity explained by methodological differences across studies (Calvó-Perxas et al., 2016; Cimas et al., 2018). In a study conducted in France, Germany, Italy, Spain, and the United Kingdom, respondents aged 40–59 years old were more likely to report severe pain than respondents 18–39 years old and 60 years and over (Langley, 2011). In a recent study analyzing 15 European countries, older age is associated with pain, though this association vanishes after adjusting for chronic conditions, presumably due to selection effects (Zimmer et al., 2020).

Given the importance of social factors for health and their plausible associations with chronic pain, more elaborate examination of chronic pain intensity patterns related to age across populations of varying wealth is necessary (Blyth & Noguchi, 2017; Cohen et al., 2021; Grol-Prokopczyk, 2017; Reid et al., 2015). Gross domestic product (GDP) is linked with health (Lee et al., 2018; Marmot, 2017; Ridhwan et al., 2022). In single-country studies, economic conditions and patterns of chronic pain contribute to the social conditions in which people live (Chou et al., 2016; Janevic et al., 2017; Vang et al., 2021). This can occur due to the presence of socially determined exposure to risk (e.g., physical injury in manual occupations); variations in risk exposure (e.g., smoking, obesity); impacts of social stressors (e.g., unemployment) on mental and physical health; barriers to obtaining health care (e.g., inadequate social safety nets, poor education); and high regional infectious disease rates, which are a greater threat to older adults. Cross-national comparisons thus present a unique opportunity to explore how the affluence of each country (measured by GDP) may be associated with chronic pain intensity and inequitable distribution of chronic pain intensity among groups of middle-aged and older adults, as several studies have documented the association between economic hardship and the experience of pain (Chou et al., 2016; Janevic et al., 2017; Vang et al., 2021).

Age variation in chronic pain intensity among middle-aged and older adults is likely associated with health variations. Several indicators of chronic diseases and unhealthy lifestyles have been associated with chronic pain intensity (Mills et al., 2019; Nijs et al., 2020; Yong et al., 2022). Limitations on performing activities of daily living (ADLs) have a reciprocal relationship with chronic pain intensity (Karasawa et al., 2019; Martinez-Calderon et al., 2018; Wettstein et al., 2019). Adjusting for individual-level health is therefore important for isolating age differences in pain that are associated with country-level wealth, but which are not due to population health composition differences across countries.

The present paper aims to examine age differences in the intensity of chronic pain among individuals 50 years and older across 20 countries, and to explore whether individual-level health and country-level GDP explain age differences in pain. We postulate that aging is not in and of itself driving age differences in chronic pain intensity. Instead, the conditions under which individuals age are the primary drivers. Our focus on chronic pain intensity is clinically relevant, as it separates individuals for whom pain is likely to present a problem and require intervention from individuals for whom pain is more endurable and may not impair functioning. We use cross-nationally harmonized data, creating an opportunity to develop a broader picture of how chronic pain intensity is associated with age at the individual level and across countries.

Method

Data and Sample

We used harmonized cross-sectional survey data for 104,826 individuals aged 50 and older, observed in 2012–2013 in 20 countries, with no missing data for the relevant variables. Because age eligibility varies across countries (see Supplementary Table A1) we chose age 50 as a cutoff to maximize cross-country comparability. The years 2012–2013 minimize period and methodological differences across countries, which is one of the strengths of our study. After 2013, chronic pain intensity was not measured consistently across countries and could only be harmonized for less than half of respondents. Data collection came from six ongoing cohort studies of middle-aged and older adults, the oldest and most established of which is the Health and Retirement Survey (HRS; Fisher & Ryan, 2018). The HRS became a model for the development of similar aging cohort studies, including: the Survey of Health, Ageing and Retirement in Europe (Börsch-Supan et al., 2013), the China Health and Retirement Longitudinal Study (Zhao et al., 2014), the English Longitudinal Study of Aging (Steptoe et al., 2013), the Korean Longitudinal Study of Aging (Jang, 2016), and the Mexican Health and Aging Study (Wong et al., 2017). All these nationally representative surveys of middle-aged and older adults focus on health, aging, and retirement issues. Due to the comparability of measures across countries, these studies have led to major contributions to cross-national medical and public health literature (see Supplementary Table A1 for more details; Calvo et al., 2020; Lee et al., 2018). These data are publicly available to registered users from multiple platforms that comply with their own Institutional Review Board requirements, and the principles embodied in the Helsinki Declaration.

Chronic Pain Intensity Outcome

Several studies have shown that self-reported chronic pain has adequate validity and reliability when used in many different populations (Lazaridou et al., 2018). We combined answers from a dichotomous variable indicating frequent pain (i.e., “Are you often troubled with pain?”), and respondents’ pain level when the answer is positive, to create a 4-point Likert scale for average chronic pain intensity (0 = no, 1 = mild, 2 = moderate, 3 = severe). Although the question does not bind responses to pain persisting for 24 hr or lasting at least 3/6 months, estimates are highly correlated (Banks et al., 2009). Focusing on “being often troubled with pain” has the double advantage of not priming respondents to privilege continuous over episodic pain, nor requiring them to be experiencing pain during the interview itself (Grol-Prokopczyk, 2017). Evidence suggests that respondents are far less likely to report being “often troubled with pain” than to report experiencing any pain in specific intervals (e.g., past day, past 30 days), capturing chronic pain intensity rather than transient acute pain (Banks et al., 2009; Grol-Prokopczyk, 2017). See the Supplementary Material for more information on the harmonization process and psychometric properties.

Age

The main independent variable was current age at the time of the survey. To facilitate interpreting the results, age was measured in 10-year units and centered around 50 years. Nonlinear age terms did not significantly add to explained variance.

Explanatory Variables

Individual- and country-level variables were added to explain age variation in chronic pain intensity. Individual-level health variables, selected due to their potential causal relationship with pain, were included to isolate age differences in pain that are not due to health. These included a dichotomous variable indicating the existence of limitations when performing at least one of three ADLs (bathe, dress, eat); five chronic disease dichotomies indicating whether the respondent reported being diagnosed by a physician with high blood pressure, diabetes, stroke, arthritis, or cancer; self-reported health (poor, fair, good, very good, and excellent); a five-category variable indicating alcohol consumption behavior (never, ever, occasional, moderate, and heavy drinking); current smoking status (yes/no); and body mass index (underweight, healthy weight, overweight, and obese).

Structural-level variables included nationality and country-level GDP per capita in $10,000 constant 2013 US dollars, adjusted for purchasing power parity and centered at the mean.

We adjusted for individual-level demographics as well, including sex, marital status (married or partnered; divorced or separated; widowed; and single/never married), educational attainment (no education or primary uncompleted; high school uncompleted; high school completed; some college; college completed or more), and labor-force status (employed; out of the labor force; retired; disabled; unemployed).

Statistical Analysis

We estimated two-level hierarchical ordinal linear models (HLMs), with individuals nested within countries, to assess cross-country variation in chronic pain intensity (country-level random intercept) and age-related differences (country-level random slope). In base Model 1 we added age, a country-level random slope for age, and a country-level random intercept. In final Model 2, we added individual-level explanatory variables as fixed effects, country GDP per capita, and an interaction term between GDP and individual age as a fixed effect. Supplementary Table A2 presents intermediate models adding explanatory variables to Model 2 in a stepwise fashion, starting with sex (Model 3), other sociodemographic variables (Model 4), health variables except arthritis or limitations to perform ADLs (Model 5), limitations to perform ADLs (Model 6, arthritis excluded), and finally arthritis (Model 7, limitations to perform ADLs excluded). For each model, we estimated variance partition coefficients to establish the relative importance of countries and individuals as variation sources. We further estimated likelihood ratio (LR) tests for significant variation in intercepts and slopes across countries. All models were estimated with Stata 16.1 MP (StataCorp LLC, College Station, TX), using independent covariance and fit via maximum likelihood. We used population weights to represent the aging and gender structure of every nation, while making each country sample size equivalent to 10,000 individuals, thus avoiding overrepresentation of countries with bigger sample sizes, like the United States or China. We further plotted observed distributions of chronic pain intensity by age and country, and predicted probabilities of severe pain by age and GDP.

Results

Among the 104,826 participants, mean age was 66.9 (*SD* = 9.9) and 56.1% were women. On average, 41.9% of respondents reported any pain, 63% reported having fair or good health, and 89.5% reported no limitations to perform ADLs. Sample characteristics by pain intensity appear in Table 1. Among respondents with severe pain, arthritis was the most commonly reported disease (66.2%).

Figure 1 shows that the observed distribution of chronic pain intensity varies substantially by age and country. On average, reports of any pain were highest in Korea (62.5%) and lowest in Switzerland (26%), while reports of severe pain were highest in France (17.7%) and lowest in the Netherlands (4.2%). Unadjusted chronic pain intensity increased with age in most countries (e.g., Korea and Slovenia) but this association was negligible or even reversed in some countries (e.g., United States and Denmark).

We report results from the HLMs in Table 2. Similar to the descriptive results presented in Figure 1, unadjusted Model 1 shows that for every 10-year increase in age, there is an average 22.2% ($e^{0.20}$) increase in chronic pain intensity when not accounting for other factors. Another consistency with Figure 1 is how variance partition coefficients show that this age association (random slope LR test p value < .001) and overall levels of chronic pain (random intercept LR test p value < .001) are heterogeneous across countries. Predicted age differences in the prevalence of any pain from age 50 to 80 range from −1.27 percentage points in the United States to 33.58 percentage points in Israel. There are countries where the majority of respondents (>50%) report any pain by age 80 (e.g., Czechia, Estonia, France, Israel, Italy, Korea, Slovenia, and Spain), and countries where it is the minority (e.g., Austria, Belgium, China, Denmark, Germany, Luxembourg, Mexico, Netherlands, Sweden, Switzerland, and the United States).

Cross-country differences persist after adjusting for explanatory variables in Model 2 (random intercept and random slope LR tests p value < .001), though the age coefficient reverses and decreases in magnitude. This change in direction is largely driven by chronic conditions where pain is one of the primary symptoms, especially arthritis (see Supplementary Table A2, Models 5–7). The GDP × age interaction term further suggests that the age differences in chronic pain intensity vary systematically for individuals living in lower-income countries relative to their counterparts in wealthier countries. To facilitate interpretation of these results, we plotted predicted probabilities of severe pain by age and GDP in Figure 2.

Regarding individual-level demographics, our findings are largely consistent with those reported in previous studies: being female, with lower educational level, disabled, and unemployed were all associated with higher reported chronic pain intensity (Reid et al., 2015). Relative to Model 1, Model 2 explained 28.42% of the total variance, 27.75% of between-individual variance, 36.67% of cross-country chronic pain intensity variance (random intercept), and 87.5% of cross-country variance in the association between age and chronic pain intensity (random slope), suggesting good model performance.

Discussion

In this study, we modeled chronic pain intensity among adults aged 50 and older from 20 countries. Harmonizing the nationally representative samples for the selected years allowed us to compare how age differences in chronic pain intensity vary across countries, isolating them from the heterogeneity explained by methodological differences across single-country studies, thereby helping to fill a current gap in the literature (Cimas et al., 2018; Langley, 2011; Tamrakar et al., 2021; Zimmer et al., 2020). While previous studies

Table 1. Descriptive Statistics, by Chronic Pain Intensity

Variable	None n = 60,898 (58.1%)		Mild n = 12,970 (12.4%)		Moderate n = 21,805 (20.8%)		Severe n = 9,153 (8.7%)		Total sample n = 104,826 (100%)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Age	66.29	9.75	66.63	9.72	68.32	10.07	68.31	10.33	66.93	9.91
Female	0.51	0.50	0.59	0.49	0.64	0.48	0.67	0.47	0.56	0.50
Any ADL limitation	0.08	0.38	0.13	0.48	0.26	0.64	0.53	0.87	0.16	0.53
Chronic diseases										
High blood pressure	0.44	0.50	0.48	0.50	0.57	0.49	0.60	0.49	0.48	0.50
Diabetes	0.14	0.35	0.17	0.37	0.21	0.41	0.25	0.44	0.17	0.37
Stroke	0.04	0.21	0.05	0.22	0.08	0.27	0.11	0.31	0.06	0.23
Arthritis	0.24	0.43	0.43	0.49	0.58	0.49	0.66	0.47	0.37	0.48
Cancer	0.08	0.28	0.08	0.27	0.11	0.31	0.12	0.33	0.09	0.29
Self-reported health										
Poor	0.05	0.21	0.11	0.31	0.19	0.39	0.42	0.49	0.12	0.32
Fair	0.22	0.42	0.36	0.48	0.42	0.49	0.39	0.49	0.30	0.46
Good	0.37	0.48	0.36	0.48	0.30	0.46	0.15	0.35	0.33	0.47
Very good	0.25	0.43	0.13	0.34	0.08	0.27	0.03	0.17	0.18	0.38
Excellent	0.11	0.31	0.03	0.18	0.02	0.12	0.01	0.09	0.07	0.26
Alcohol consumption										
Long-term abstainer	0.18	0.38	0.28	0.45	0.21	0.41	0.27	0.44	0.21	0.40
Current abstainer	0.20	0.40	0.21	0.41	0.25	0.43	0.30	0.46	0.22	0.41
Occasional drinker	0.17	0.37	0.15	0.36	0.18	0.38	0.15	0.36	0.17	0.37
Moderate drinker	0.39	0.49	0.29	0.46	0.30	0.46	0.23	0.42	0.34	0.48
Heavy drinker	0.07	0.25	0.07	0.25	0.06	0.24	0.05	0.21	0.06	0.25
Current smoker	0.16	0.37	0.15	0.36	0.16	0.37	0.19	0.39	0.16	0.37
Body mass index categories										
Underweight	0.02	0.13	0.02	0.15	0.02	0.14	0.02	0.15	0.02	0.13
Normal weight	0.39	0.49	0.42	0.49	0.31	0.46	0.31	0.46	0.38	0.49
Overweight	0.39	0.49	0.36	0.48	0.37	0.48	0.35	0.48	0.38	0.49
Obese	0.18	0.39	0.19	0.39	0.28	0.45	0.31	0.46	0.22	0.41
Marital status										
Married or partnered	0.75	0.43	0.75	0.43	0.70	0.46	0.67	0.47	0.73	0.44
Divorced or separated	0.08	0.27	0.07	0.25	0.09	0.28	0.10	0.30	0.08	0.27
Widowed	0.13	0.33	0.15	0.36	0.18	0.38	0.19	0.40	0.15	0.35
Single, never married	0.04	0.20	0.03	0.18	0.04	0.19	0.40	0.20	0.04	0.19
Educational level										
None or primary uncompleted	0.10	0.30	0.15	0.36	0.12	0.32	0.19	0.39	0.12	0.32
High school, uncompleted	0.29	0.45	0.36	0.48	0.38	0.48	0.41	0.49	0.33	0.47
High school, completed	0.32	0.47	0.28	0.45	0.32	0.47	0.26	0.44	0.31	0.46
College, uncompleted	0.05	0.23	0.04	0.20	0.04	0.21	0.03	0.18	0.05	0.22

Table 1. Continued

Variable	None n = 60,898 (58.1%)		Mild n = 12,970 (12.4%)		Moderate n = 21,805 (20.8%)		Severe n = 9,153 (8.7%)		Total sample n = 104,826 (100%)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
College or more	0.23	0.42	0.17	0.37	0.15	0.35	0.11	0.31	0.20	0.40
Labor-force status										
Working	0.38	0.49	0.35	0.48	0.23	0.42	0.20	0.40	0.33	0.47
Out of the labor force	0.09	0.28	0.15	0.36	0.13	0.33	0.12	0.33	0.11	0.31
Retired	0.49	0.50	0.45	0.50	0.56	0.50	0.55	0.50	0.50	0.50
Disabled	0.02	0.13	0.03	0.16	0.05	0.22	0.10	0.30	0.03	0.18
Unemployed	0.02	0.15	0.02	0.14	0.03	0.16	0.03	0.16	0.02	0.15

Notes: Proportions reported for categorical variables. ADL = activities of daily living; *SD* = standard deviation.

have looked at heterogeneity in pain prevalence (Cimas et al., 2018; Jackson et al., 2015; Zimmer et al., 2022), these studies do not focus on age variation in pain.

If chronic pain intensity was due to chronological age alone, one would expect neither cross-country variability nor much room for intervention, because we cannot stop time. However, we found that chronic pain intensity does increase with age in some countries (e.g., Korea and Slovenia), but age differences are nonexistent or even reversed in other countries (e.g., United States and Denmark). Heterogeneity in age differences across country settings aligns with previous studies focusing on pain prevalence (Cimas et al., 2018; Jackson et al., 2015; Zimmer et al., 2022) and suggests that there are other factors contributing to chronic pain intensity, which could potentially be malleable, by contrast with chronological age.

Our results suggest that, contrary to what has generally been thought about aging and pain, aging is not in and of itself associated with age differences in chronic pain; rather, it is the conditions through which individuals age (Chou et al., 2016; Cimas et al., 2018; Grol-Prokopczyk, 2017; Langley, 2011; Thielke et al., 2012; Vang et al., 2021). The raw association between age and chronic pain intensity was significant and direct. However, once we included individuals' health and social characteristics, the age/pain association changed direction and decreased in magnitude.

This key finding has at least two possible explanations that point to potential selection effects, the importance of healthy aging, or a combination of both. Selection effects or survival bias are plausible among the older adult people with comparable health to the middle-aged people (i.e., individuals with severe pain are more likely to die younger and less likely to be interviewed). It is also possible that if we could eliminate arthritis and improve aging quality, chronic pain intensity would not increase with age. Another explanation is that middle-aged and older adults are less physically active with age, and would be less likely to report presence or intensity of chronic pain.

We identified and explained chronic pain intensity variation both at the individual and country levels. A large body of literature identifies individual-level risk for pain, and how pain in the general population can be managed through medicine and alternative treatments (Blyth & Noguchi, 2017; Cohen et al., 2021; Docking et al., 2011; Institute of Medicine, 2011; Reid et al., 2015). One major contribution from our study is to demonstrate that country-specific influences on pain are also significant and warrant policy attention. Several studies focusing on middle-aged and older adults rely on data from a single country to identify chronic pain prevalence and distribution, as well as associated individual-level risk factors (Cohen et al., 2021; Docking et al., 2011; Grol-Prokopczyk, 2017; Larsson et al., 2017; Zimmer & Zajacova, 2018). Fewer studies are cross-national in nature or are centered on European countries (Calvó-Perxas et al., 2016; Cimas et al., 2018; Langley, 2011; Zimmer et al., 2020).

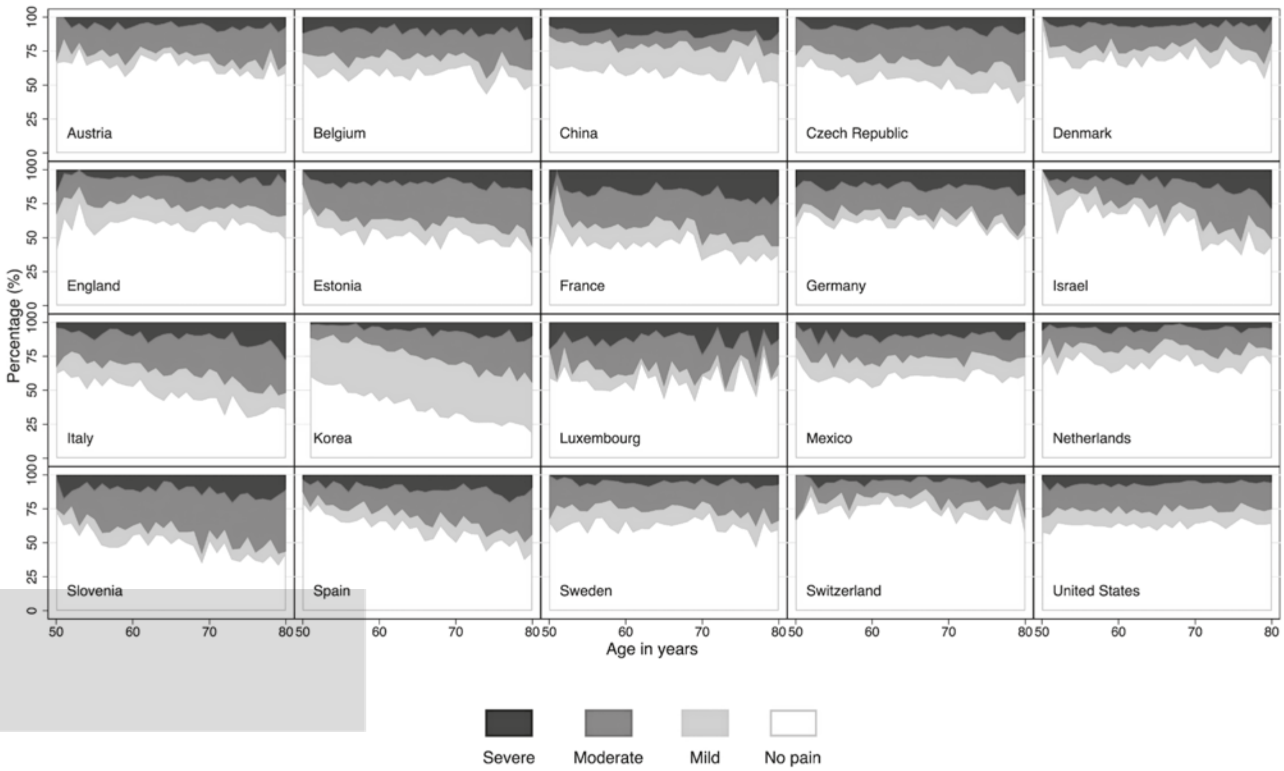

Figure 1. Unadjusted chronic pain intensity, by age and country.

We focused on country-level GDP per capita as a relevant factor explaining cross-country variation in chronic pain intensity, along with age differences. Although the main effect of individual socioeconomic conditions has been previously documented (Chou et al., 2016; Ho & Nair, 2018; Janevic et al., 2017), our study further suggests that age differences in chronic pain intensity are more pronounced for individuals living in poorer countries than their counterparts in wealthier countries (Lee et al., 2018; Marmot, 2017; Ridhwan et al., 2022). This finding suggests that country contexts are relevant for understanding age differences in chronic pain.

One potential explanation is that individuals living in affluent countries are surrounded by increased knowledge and resources to address chronic pain as they age. In some high-income countries, people are constantly being informed about potential treatment options for pain, and thus face fewer barriers to chronic pain assessment and treatment. Low- and middle-income countries face lower access to pain assessment and treatment, while simultaneously facing cultural barriers to getting pain medications (Ho & Nair, 2018). More research is needed to directly assess potential connections between access to treatments that reduce chronic pain intensity, changes in access and use connected to opioid use disorder and overdose epidemics, and age differences in chronic pain intensity within and across populations. Compared to high-income countries, lower-income countries may have fewer pain management options, including access and utilization of pain medications and opioids (Ho & Nair, 2018). Some evidence suggests that opioid use is associated with relatively small improvements in physical functioning and chronic pain; however, most patients under long-term treatment with opioids continue experiencing high levels of pain-related interference with activities. Medical and nonmedical use of opioids has resulted in pain sensitization (i.e., opioid-induced hyperalgesia) and in a number of adverse events, including substance use disorders and epidemics of preventable deaths (Cohen et al., 2021; Delle & Gazley, 2021; Institute of Medicine, 2011; Reid et al., 2015).

This study has several notable limitations. We harmonized measurements of chronic pain intensity, and although the variations were minimal for the selected years and high standards were used, certain validity/reliability issues could remain in Korea, where high reports of pain may be the result of the specific question wording. However, age differences within Korea are unlikely to be biased unless question wording differentially influences responses across age. Because the studies we harmonized covered specific years for a limited number of mostly high-income countries, our estimates may not be generalizable to lower-income countries or other time periods. Generalizability of findings to lower-income countries is less plausible than generalizability to more recent years (see Supplementary Table A3 replicating the main findings in more recent years, 2015–2017). Given that the sample includes individuals 50 years and older, our study could not identify

Table 2. Multilevel Regression Models for Chronic Pain Intensity

	Model 1		Model 2	
	Est.	95% CI	Est.	95% CI
Age (in 10-year units)	0.20***	0.10, 0.30	−0.05**	−0.11, 0.00
Country GDP (per capita, in 10,000 units)			0.07**	0.01, 0.12
Country GDP × age			−0.04***	−0.05, −0.02
Any limitations to perform ADLs			0.35***	0.30, 0.40
Chronic diseases				
High blood pressure			0.04***	0.01, 0.07
Diabetes			−0.03	−0.07, 0.02
Stroke			−0.08**	−0.15, −0.01
Arthritis			1.19***	1.08, 1.31
Cancer			−0.02	−0.07, 0.04
Self-reported health (ref.: Excellent)				
Poor			3.04***	2.87, 3.21
Fair			2.18***	2.01, 2.35
Good			1.29***	1.15, 1.44
Very good			0.55***	0.39, 0.71
Alcohol consumption (ref.: Never)				
Ever			−0.00	−0.06, 0.05
Occasional			−0.01	−0.09, 0.06
Moderate			−0.06	−0.13, 0.00
Heavy			−0.03	−0.10, 0.05
Current smoker			0.10***	0.04, 0.15
Body mass index categories (ref.: Normal weight)				
Underweight			−0.11*	−0.22, 0.01
Overweight			0.13***	0.09, 0.17
Obese			0.32***	0.28, 0.37
Female			0.37***	0.30, 0.44
Marital status (ref.: Married)				
Divorced or separated			0.01	−0.08, 0.10
Widowed			−0.06***	−0.11, −0.02
Single, never married			−0.18***	−0.26, −0.11
Educational level (ref.: College completed or more)				
Primary, uncompleted			0.25***	0.12, 0.37
High school, uncompleted			0.14***	0.06, 0.23
High school, completed			0.08***	0.01, 0.15
College, uncompleted			0.05	−0.06, 0.17
Labor-force status (ref.: Worker)				
Out of the labor force			−0.02	−0.11, 0.06
Retired			−0.01	−0.06, 0.04
Disabled			0.47***	0.35, 0.60
Unemployed			0.29***	0.16, 0.42
Cut points				
Cut 1	0.68	0.46, 0.89	2.56	2.34, 2.79
Cut 2	1.20	0.96, 1.43	3.24	2.96, 3.52
Cut 3	2.72	2.45, 2.99	5.15	4.87, 5.43
Variance partition coefficients				
Individual-level residual	1.074 (96.61%)	1.005, 1.148	0.776 (97.46%)	0.722, 0.834
Random intercept: country	0.030 (2.67%)	0.017, 0.051	0.019 (2.39%)	0.009, 0.043
Random slope: age	0.008 (0.73%)	0.005, 0.014	0.001 (0.15%)	0.001, 0.002
Total variance	1.112 (100%)		0.796 (100%)	
Explained variance				
Individual-level	—		27.75%	
Random intercept: country	—		36.67%	
Random slope: age	—		87.50%	
Total	—		28.42%	

Notes: Individuals (Level 1) nested within countries (Level 2). Explained variance was calculated using variance of Model 1 as denominator. ADLs = activities of daily living; CI = confidence interval; GDP = gross domestic product. ***$p < .01$, **$p < .05$, *$p < .1$.

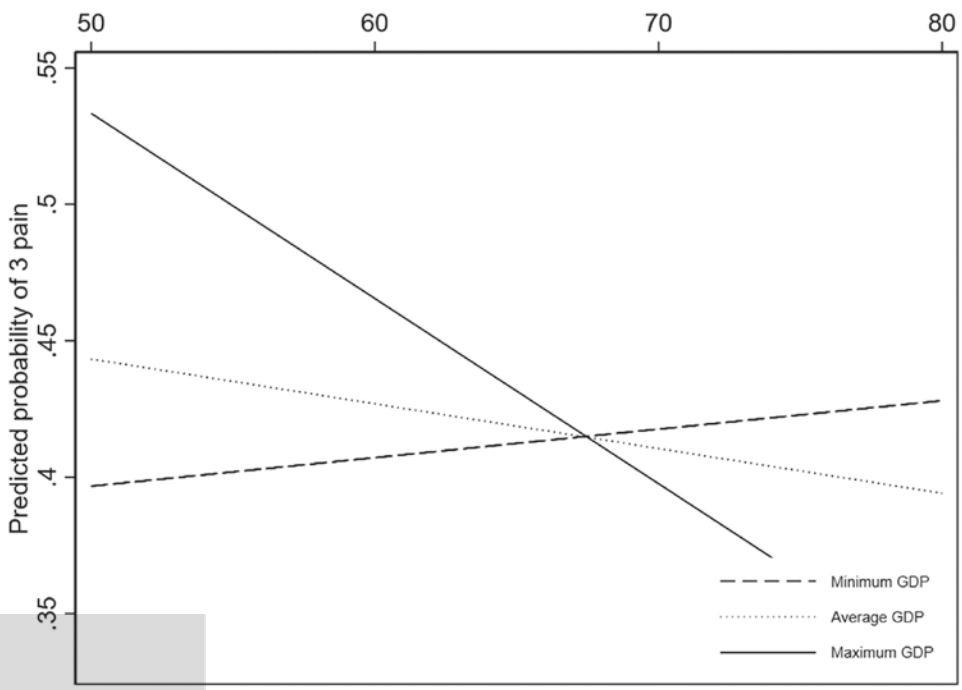

Figure 2. Adjusted predicted probability of severe pain, by age and gross domestic product (GDP) per capita. Predictions are based on results from Model 2 in Table 2. Reference categories were: limitations to perform activities of daily living, diagnosis of chronic diseases, poor self-reported health, lifetime or heavy drinker, smoker, obese, male, married, college completed or more, and employed.

associations at earlier ages. Finally, we could only account for harmonized individual-level variables, and did not have statistical power to adjust for multiple country-level variables, potentially failing to adjust for other relevant characteristics (e.g., pain treatment data could not be readily harmonized and average life expectancy was not significant). As more data are harmonized, future studies could explore other subdomains of chronic pain such as interference, as well as including a wider sample of countries and longitudinal associations between chronic pain and different individual- and country-level factors, considering how changes in individuals' contexts and countries' affluence might be associated with changes in pain, adjusting for selection effects, and to attempt to identify causal effects using quasi-experimental designs. Including more countries in the sample could also help disentangle whether cultural differences around country-level GDP could also at least partially explain some of our findings. Although country-level GDP is strongly correlated with cultural values, dispositions, and beliefs, the latter likely have an independent role in shaping pain reports, as well as responses by practitioners and policymakers (Gatchel et al., 2007).

Our findings document substantial variation in the age-pain association across countries, and highlight the importance of chronic and social conditions when assessing chronic pain in later life, pointing out potential intervention areas. Our study is a first step toward developing a broader picture of how chronic pain intensity is associated with age at individual and national levels. Future research should focus on addressing underlying causes and modifiable risk factors of chronic pain intensity among middle-aged and older adults.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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Conflict of Interest

None declared.

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Author Contributions

E. Calvo, A. Castillo-Carniglia, K. M. Keyes, C. Mauro, P. P. Mauro, T. Mielenz, and S. S. Martins planned and conceptualized the study. E. Calvo, C. Córdova, K. Allel, and J. T. Medina performed data curation, formal analysis, and visualization. E. Calvo, C. Córdova, and R. Shura wrote the original draft. E. Calvo and S. S. Martins supervised the overall study. E. Calvo acquired funding. All authors contribute writing, review and editing the final manuscript.

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