Journals of Gerontology: Social Sciences
cite as: J Gerontol B Psychol Sci Soc Sci, 2018, Vol. 00, No. 00, 1–12
doi:10.1093/geronb/gbx162
Advance Access publication March 20, 2018

THE GERONTOLOGICAL SOCIETY OF AMERICA®

OXFORD

Original Article

Persistent, Consistent, and Extensive: The Trend of Increasing Pain Prevalence in Older Americans

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Received: June 19, 2017; Editorial Decision Date: November 2, 2017

Decision Editor: Philippa Clarke, PhD

Abstract

Objectives: Assess trends in pain prevalence from 1992 to 2014 among older U.S. adults and by major population subgroups, and test whether the trends can be explained by changes in population composition.
Methods: Health and Retirement Study data include information on any pain, pain intensity, and limitations in usual activities due to pain. Average annual percent change in prevalence is calculated for any and for 2 levels of pain—mild/moderate and nonlimiting and severe and/or limiting—across demographic and socioeconomic characteristics, and for those with and without specific chronic conditions. Generalized linear latent and mixed models examine trends adjusting for covariates.
Results: Linear and extensive increases in pain prevalence occurred across the total population and subgroups. The average annual percent increase was in the 2%–3% range depending upon age and sex. Increases were consistent across subgroups, persistent over time, and not due to changes in population composition. Without increases in educational attainment over time, pain prevalence increases would be even higher.
Discussion: The increases in pain prevalence among older Americans are alarming and potentially of epidemic proportions. Population-health research must monitor and understand these worrisome trends.

Keywords: Health and Retirement Study, Longitudinal analysis, Population health, Quality of life, Trends

Pain is a major population-health problem, especially among older adults (McCracken & Marin, 2014). About 100 million U.S. adults experience chronic pain, a number greater than those affected by heart disease, cancer, and diabetes combined (Institute of Medicine, 2011). For the nation, the economic burden of pain is enormous, having been estimated at $600 billion (Gaskin & Richard, 2012). For individuals, pain is unmistakably a determinant of quality of life (Dueñas, Ojeda, Salazar, Mico, & Failde, 2016); it is also the single most highly reported health problem among older adults and one of the most commons reason for health care utilization (Elliott, Smith, Penny, Cairns Smith, & Alastair Chambers, 1999; Song, Jin, Ko, & Tak, 2016).

While chronic pain is an important health indicator across the life span, it is particularly salient at older ages. Older adults experience higher pain prevalence and severity than younger adults (Blyth, 2010). At the same time, the U.S. population is aging; older adults are increasing in absolute numbers as well as a share of the total population and average age of the 65+ population is growing as well (Arias, Heron, & Xu, 2017). Thus, changes in pain prevalence among older persons are relevant not just for this age group but for broader population health (Gibson & Lussier, 2012; Rottenberg, Jacobs, & Stessman, 2015). If trends in pain are increasing, then population aging and rising longevity will translate into more and more people living with pain. If trends are decreasing, there may be reason to be more sanguine.

It is therefore surprising that little attention has been paid to trends in pain among the U.S. population. Research that does exist is not entirely consistent. A recent study found a steep increase in the prevalence of pain in a nationally representative sample of older adults (Grol-Prokopczyk, 2017), corroborating an upward trend described for lower-back pain in North Carolina residents (Freburger et al., 2009). In contrast, a significant decline in pain was reported among Medicare beneficiaries in nursing homes (Shen, Zuckerman, Palmer, & Stuart, 2015). Another study suggested that pain prevalence was stable over 30 years, but only with respect to back pain (Deyo, Mirza, & Martin, 2006). Limited research outside of the United States is also mixed. Long-term trends showed steep increases in pain prevalence in the United Kingdom (Harkness, Macfarlane, Silman, & McBeth, 2005) and Sweden (Ahacic & Kåreholt, 2010), while studies in Finland and Germany concluded little change over time (Heistaro, Vartiainen, Heliövaara, & Puska, 1998; Hüppe, Müller, & Raspe, 2007).

Moreover, trends may vary across socioeconomic and health characteristics. Heistaro and colleagues (1998) found pain increases only among those with lower income; Shen (2015) reported that pain increases were particularly likely among adults with diabetes. Indirectly, population group differences in pain prevalence suggest the possibility of unequal trends as well. For instance, women have substantially higher pain prevalence than men (Grol-Prokopczyk, 2017; Patel, Guralnik, Dansie, & Turk, 2013). There are also racial differences although the patterns are mixed; some studies found whites to have higher prevalence of pain than blacks (Nahin, 2015; Riskowski, 2014), others show differences between whites and Hispanics (Grol-Prokopczyk, 2017) or Native Americans (Deyo et al., 2006). Age patterns are a matter of debate; prevalence of pain tends to increase into about the seventh decade, after which there is a plateauing effect (Cole, Farrell, Gibson, & Egan, 2010; Rubin & Zimmer, 2015), but this plateau may be a function of cohort differences or mortality selection (Grol-Prokopczyk, 2017).

Some of the inconsistencies in the pain trends may be due to different study samples and pain definitions. Few studies are nationally representative and instead concentrate on specific populations. Measures of pain are often limited to certain sites, like back pain, and specific measurement may not be identical over time. Comparisons are sometimes made using different data sources. Some studies cover very long periods of time, but others are basing conclusions on just a few years of observation; most trend studies compare only two time points.

In contrast to limited population research on pain trends, there is a rich literature of carefully researched trends in functional limitation and disability among older persons. This research is informative for the current discussion given a clear powerful connection between pain and functional limitation and disability (Andrews, Cenzer, Yelin, & Covinsky, 2013; Covinsky, Lindquist, Dunlop, & Yelin, 2009). Pain and functioning are inextricably interconnected within the disablement process (Jette, 1994). A growing literature is connecting pain and broader measures of frailty (Lohman, Whiteman, Greenberg, & Bruce, 2016; Wade et al., 2017). With respect to trends in later-life functional limitation and disability, comprehensive analyses indicate that prevalence rates decreased in the United States from the early 1980s through the 1990s (Martin, Schoeni, & Andreski, 2010). However, improvements appeared to have halted or reversed in more recent years, especially among working-aged (Freedman et al., 2013; Iezzoni, Kurtz, & Rao, 2014; Zajacova & Montez, 2017) while older adults experienced continued decreases in these same outcomes (Martin & Schoeni, 2014). Additionally, trends in major chronic conditions that underlie the disablement processes, surprisingly, are different. For many conditions, studies documented gradual increase since the 1970s (Crimmins, 2004) and continuing through the 21st century (Chatterji, Byles, Cutler, Seeman, & Verdes, 2015). Thus, trends in two close correlates of pain, morbidity and disability, are inconsistent, failing to yield a clear expectation about pain trends.

The current study answers three questions central to our understanding of trends in pain in the older U.S. population. First: Has pain prevalence increased, decreased, or remained stable from the 1990s to 2014? Second: What are the trends in pain in major population subgroups across demographic and socioeconomic characteristics and chronic conditions? And third: To what degree are the aggregate gross trends in pain due to changes in population composition with respect to demographic and socioeconomic characteristics and chronic conditions? To address these questions, we use the large, longitudinal, nationally representative Health and Retirement Study, which has pain information on the older U.S. population for 22 years, from 1992 to 2014. By tackling these three questions, the analysis documents how pain, a critical health attribute, is evolving within the older U.S. population.

Methods

Data

Data are from 12 waves of the Health and Retirement Survey (HRS), collected biennially from 1992 to 2014, and one wave of its early counterpart AHEAD. HRS and AHEAD originated in 1992 and 1993, respectively with two separate community samples. The 1992 HRS sample consisted of individuals born between 1931 and 1941, who were about 51 to 61 years of age at time of survey. The 1993 AHEAD sampled those born between 1890 and 1923, who at the time were older than 70. The HRS sample was followed-up in 1994 and 1996 and the AHEAD sample in 1995. In 1998, the two samples were combined and 1924–1930 and 1942–1947 birth cohorts were added to create a nationally representative sample of the community dwelling U.S. population aged 51 and older. These respondents were then followed-up every 2 years. In 2004 and 2010, there were add-ons to refresh the sample.

Thus in each year of the HRS, the youngest respondent is a different age. This, plus a minor inconsistency in the measurement of pain in the first AHEAD wave, means that for the purpose of assessing trends the sample can be divided into broad age groups that cover different periods. For the current analysis, data for respondents aged 55–61 begin in 1992 and include 12 waves; data for those aged 62–71 start in 1998 and cover nine waves; for 72 and older data is from 1995 onward and cover ten waves. An overarching view is provided by also including a 55+ group with a 1998 baseline covering nine waves. Beginning in 2000 those moving into nursing homes were also followed up, however this portion of the sample is omitted since inclusion would make the later waves not comparable to the earlier.

The sample in each wave is considered as a cross-section of the population and thus the analysis is based on person-year rather than panel records. Therefore, there is an assumption that cross-sectional data in HRS is representative of the U.S. population within the three broad age groups. This assumption is fortified by several factors. First, weights are provided for each cross-sectional wave and all our analyses use these weights. While response rates for the HRS are quite high, weighting accounts for attrition due to nonresponse. Second, mortality surveillance is conducted in collaboration with the National Death Index, assuring that loss of follow-up due to death is proportionate to the population. Third, refreshment every few waves adds a new sample representative of the population not covered in the HRS at that time.

Table 1 indicates the first and last observed wave, number of waves, and sample sizes by sex and age group. Twenty-four thousand three ninety-eight males are observed over 75,291 wave or person-year observations, and 30,635 females over 90,992 wave or person-year observations. Further documentation and user guides can be found on the HRS website (Health and Retirement Study, 2015a, 2015b).

Measures

Each wave of HRS data (except 1993 AHEAD data) contains the same three questions about pain. The first asks respondents whether they are “often troubled with pain.” Those who answer affirmatively are asked two additional questions. The first is in regards to intensity and asks: “how bad is the pain most of the time: mild, moderate or severe?” (1992 and 1996 also included, “how bad is the pain at its worst?” Since it is only asked twice, it is not used in the current analysis.) The second is in regards to functionality and asks: “does the pain make it difficult for you to do your usual activities such as household chores or work?” The possible responses to this question are simply yes and no. This analysis considers pain measured two ways. The first divides the sample into those troubled versus not troubled by pain. The second uses intensity and functionality to categorize levels of pain into mild/moderate nonlimiting or severe and/or limiting. That is, an individual who is often troubled by pain either reports that the pain is mild or moderate and does not make it difficult to perform usual activities; or the pain is severe, or does make it difficult to perform usual activities, or both. This categorization is clinically relevant since it divides those for whom pain is likely to present a problem, either due to its intensity or its impact on daily life, or both, and therefore who likely require intervention, versus those for whom pain at time of reporting is more trivial, endurable, and less likely to require intervention. Across 166,283 person-year observations, 31.8% report being troubled by pain; 10.7% report pain that is mild/moderate nonlimiting and 21.1% report pain that is severe and/or limiting.

The analysis explores whether pain trends are consistent across, and influenced by, demographic and socioeconomic characteristics and chronic conditions, each of which have been implicated in pain prevalence. Demographic measures include sex, age, race/ethnicity, and marital status. Age is measured as number of years older than the youngest age in the age group under analysis (e.g., a 55-year old in the 55–61 group is 0, a 56-year old is 1, etc.). Race is coded as non-Hispanic white, non-Hispanic black, Hispanic, and other. Marital status is partnered versus not. Socioeconomic characteristics are education and wealth. Education contains three categories: less than high school, completed high school, and one or more years of postsecondary. HRS collects detailed information on wealth and RAND has constructed detailed wealth measures based on the combination of numerous items (Pantoja et al., 2016). This analysis uses the sum total of nonhousing wealth, expressed in

Table 1. Waves and Weighted *N* by Age Group and Sex

Age	First year observed	Last year observed	Waves	*N* males	*N* male wave/person-year observations	*N* females	*N* female wave/person-year observations
55–61	1992	2014	12	9,583	31,319	11,798	34,116
62–71	1998	2014	9	7,596	22,535	9,338	25,749
72+	1995	2014	10	7,219	21,437	9,499	31,127
55+	1998	2014	9	15,220	64,839	19,992	78,619
Total				24,398	75,291	30,635	90,992

units of 100,000 dollars in regression models. For comparing trends across groups, wealth is divided into those whose wealth is higher versus lower than the median for a particular wave. We include six chronic conditions. Each has been assessed using the question: "has a doctor ever told you that you have" … arthritis, heart disease, diabetes, cancer, lung disease, stroke?

The amount of missing data for our measures is small. Age and sex have no missing values. Education is missing for 322 observations (0.2%). The 225 cases missing race information are coded as "other" and 57 missing wealth observations are coded as the mean for the respective wave. Across more than 166,000 person-year observations, 209 are missing the first pain question, and these are coded as not reporting being bothered by pain, while 791 observations missing the follow-up pain items are assumed to distribute proportionately to the nonmissing distribution. In multivariate models, observations missing pain information are deleted. However, the amount of missing data is so small that sensitivity tests showed barely any impact when treating missing values differently.

Analytic Strategy

Prevalence of any, mild/moderate nonlimiting and severe and/or limiting pain is calculated for each wave within age groups and by sex. A number of summary measures are used to describe the trends including a number that represents the average annual percent change in prevalence over the total period of observation. In addition, there is a measure for the average annual percent change weighted in proportion to the percentage of observations in each age group. This is a single encompassing number that is an overall weighed average representing trends across all ages. A large amount of supplementary information that further describes the trends are made available on the lead author's website [https://globalagingandcommunity.com/zzjgss2018si/]. This includes the average annual change from wave to wave, 95% confidence intervals for each wave to wave change, and levels of significance for each wave-to-wave change.

To model trends in a multivariate framework, a "years since baseline" measure is calculated. For instance, for the 55–61 age group, baseline is 1992. A 1994 observation would be coded as 2 years since baseline and a 2014 observation would be 22 years since baseline. Multivariate models assess how each passing year since baseline associates with the probability of reporting pain, other things adjusted. Coefficients for years since baseline are reported across a nested series of model. Due to the space limitations, we show only the effects of the years since baseline for the series. The full model is shown with all covariates. Supplementary information available on the website listed above includes additional multivariate models and related statistics not reported here.

Each individual in the data accounts for an average of about three observations over time. There will be heterogeneity in the tendency to report pain due to unmeasured characteristics that are common to the individual. The best way to account for this is a multilevel model with random intercepts (Rabe-Hesketh & Skrondal, 2008). Given the multi-categorical nature of the pain variable with various severity levels, the link function is a multinomial logit and models are estimated using generalized linear latent and mixed models (gllamm) software available as an add-on in STATA 14.0. The gllamm procedure provides coefficients for individual level effects and a variance and standard error of the variance for random effects.

Results

Population Composition

Table 2 compares the study sample over time to assess changes in population characteristics. To provide a snapshot of the changes, the table shows sex-stratified descriptive statistics for earlier years, defined as 1992–2002, and later years, defined as 2004–2014; and estimates the statistical significance of the differences. Over time, education and wealth increased substantially while the proportion of non-Hispanic whites and partnered individuals decreased. Older adults in the later years had a higher prevalence of arthritis, heart disease, diabetes, and cancer; the increase in diabetes was particularly large. The table also shows pain prevalence significantly higher in the later years than the earlier years across measures of pain and both sexes.

Trends in Pain for the Aggregate Population and by Sex and Age

Figure 1 displays prevalence trends in any, mild/moderate nonlimiting and severe and/or limiting pain for males and females across three age groups. The overwhelming pattern, consistent across all age and sex groups, is a persistent and relatively linear increase in all three measures of pain over time. There is more wave-to-wave variation in mild/moderate nonlimiting pain than in severe and/or limiting pain, but the overall pattern is the same.

Table 3 quantifies the average pain levels and average annual increases. The grand average column shows the prevalence for all observations when aggregated across all data waves, and the weighted average row presents these results after adjusting by proportion of the sample in each age group. The weighted average of the grand average is thus an overall estimate of the total prevalence of pain for the total sample across all years. In aggregate, 28.7% of males and 35.0% of females report pain. The gender difference is entirely a function of higher rates of severe and/or limiting pain as the rate of mild/moderate nonlimiting pain is nearly equal for both males and females.

There has been a tremendous amount of change in pain prevalence over time, with some age and sex groups experiencing a doubling. The prevalence of pain increased by an average of 2.44% annually for males and 1.99% for

Table 2. Comparing Distributions of Study Variables Across Earlier and Later Waves, by Sex[a]

	Males			Females		
	Earlier years	Later years	*p*-Values[b]	Earlier years	Later years	*p*-Values[b]
N	31,911	43,384		39,233	51,763	
Age	66.5	69.3	.00	67.5	69.7	.00
Race			.00			.00
% White	84.0	81.2		82.7	79.5	
% Black	8.4	8.6		9.7	10.2	
% Hispanic	5.4	7.5		5.6	7.3	
% Other/unknown	2.3	2.7		2.1	2.6	
Marital status						
% Partnered	79.4	76.1	.00	54.0	54.6	.25
Schooling			.00			.00
% less than high school	27.3	17.8		28.1	18.5	
% high school graduate	30.6	28.7		38.0	35.2	
% postsecondary	42.0	53.6		33.9	46.3	
Wealth (in $100,000 units)	2.6	3.6	.00	2.0	2.7	.00
Chronic conditions						
% Arthritis	44.1	51.0	.00	57.4	65.8	.00
% Heart disease	24.1	27.2	.00	19.3	22.0	.00
% Diabetes	14.7	22.4	.00	12.8	19.5	.00
% Cancer	10.6	14.7	.00	11.8	14.9	.00
% Lung disease	9.3	9.3	.93	9.6	11.0	.00
% Stroke	6.6	7.3	.01	6.2	6.2	.89
Pain						
% Any pain	24.3	31.9	.00	30.8	38.2	.00
% Mild/moderate nonlimiting	9.2	12.1	.00	9.0	11.8	.00
% Severe and/or limiting	14.6	19.6	.00	21.4	26.1	.00

[a]Earlier and later waves grouped as: Earlier—any data from 1992 to 2002. Later—2004 to 2014.

[b]Comparison of earlier versus later waves, based on chi-square for categorical variables and *t*-test for continuous variables.

females. The largest increase, 3.37% annually, was for mild/moderate nonlimiting pain among 62–71 year old males; the smallest increase, 1.47% annually, was for severe and/or limiting pain by females age 72 and older. The trends are generally steeper for mild/moderate nonlimiting versus severe and/or limiting pain, and steeper for males versus females, but the overarching pattern is unambiguous: the change from first to last observation is extensive and statistically significant at $p < .01$ for every group and pain definition.

Trends in Pain Across Demographic, Socioeconomic, and Health Characteristics

Table 4 summarizes the trends for subgroups according to demographic (race, marital status) and socioeconomic (education and wealth) characteristics and chronic conditions. The numbers indicate the average annual percent change in pain, weighted across age groups. Also indicated is whether the change across any of the three age groups is statistically significant. The key finding is that the trends are positive in every subgroup and pain definition, indicating an increase in prevalence. The increases are substantively large for most subgroups, on the order of 1.5%–3.5% annual change on average. There are some differences across groups; for instance, the change in the prevalence of severe and/or limiting pain is lower for females than for males. Those with higher levels of education and greater wealth experienced higher rates of increase. Still, the increases are systemic across population groups.

Trends in Pain Adjusted for Demographic, Socioeconomic, and Health Characteristics

As shown in Table 2, population composition changed over time with respect to nearly all considered characteristics. Different prevalence rates associated with each subgroup could be explaining or possibly suppressing population-wide changes. To test this possibility, we estimated a series of multinomial linear mixed models predicting the probability of mild/moderate nonlimiting and severe and/or limiting pain relative to no pain, stratified by age group. Figure 2 shows how each year since baseline (trend) is associated with the odds of reporting pain given a series of different models (numbered M1–M7) that include different sets of covariates. That is, this is the coefficient for

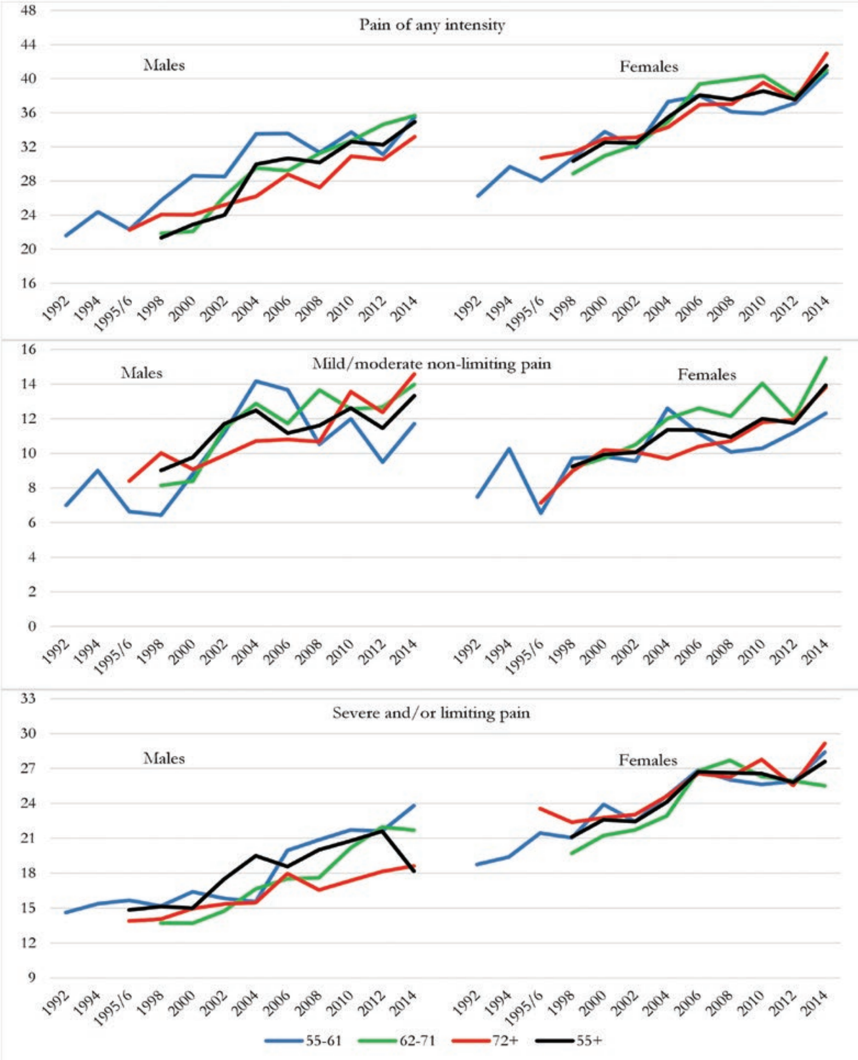

Figure 1. Prevalence of any, mild nonlimiting, and severe and/or limiting pain, by year, age, sex.

the variable "years since baseline" across models containing different controls. There is generally a spike in the effect of years since baseline for Model 4, which is the model that includes education. This indicates that education has a suppressing effect on the trend. For the group 72+, there is a sharp reduction in the odds of reporting pain (trend) when adjusting for chronic conditions, implying that rising rates of chronic conditions explains some of the increase in pain reporting for those 72 and older.

Table 5 shows results from the final full model (Model M7) in detail. The main predictor of interest is the number of years since baseline, which captures the trend. The results corroborate the descriptive analyses above. Adjusting for all covariates, each year since baseline is associated with significantly higher log-odds and therefore higher probability of mild/moderate nonlimiting and severe and/or limiting pain in each age group. For instance, for those 55–61, the log odds of reporting mild/moderate nonlimiting and severe and/or limiting pain are .055 and .057, respectively for each additional year since baseline, or about 1.06 higher odds of pain each year. There is little difference between mild/moderate nonlimiting and severe and/or limiting annual increases.

Age has inconsistent associations with pain reporting. It is negative for 55–61 year olds and positive but nonsignificant for those 72 and older, suggesting that pain reporting may decrease across age during the transition from middle to older ages but age has less impact as older persons continue to age. This pattern, however, could be confounded by cohort and/or period trends. Females are more likely than men to report pain. In concurrence with previous research in the United States (Nahin, 2015), non-Hispanic blacks have significantly lower probabilities than whites. Educational attainment is associated with less pain but net of education, wealth has generally little notable association. Chronic conditions are strongly associated with both mild/moderate nonlimiting and severe and/or limiting pain. Arthritis stands out as being particularly important. Log odds for reporting severe and/or limiting pain are larger than 2 for severe and/or limiting pain for some age groups,

Table 3. Summary Measures of Trends in Pain Prevalence Across Pain Measures, by Sex and Age

Age group	Grand average[a]	Average annual percent change	*p*-Value for total change[b]	Grand average[a]	Average annual percent change	*p*-Value for total change[b]
	Males			Females		
Any pain						
55–61	29.2	+2.25	.00	33.8	+1.99	.00
62–71	29.5	+3.06	.00	36.2	+2.19	.00
72+	27.1	+2.08	.00	35.4	+1.83	.00
55+	29.7	+3.08	.00	36.0	+1.96	.00
Weighted average	28.7	+2.44	—	35.0	+1.99	—
Mild/moderate nonlimiting pain						
55–61	10.4	+2.34	.00	10.1	+2.26	.00
62–71	11.8	+3.37	.00	12.0	+3.29	.00
72+	10.9	+2.08	.00	10.4	+2.39	.00
55+	11.5	+2.44	.00	11.2	+2.56	.00
Weighted average	11.0	+2.57	—	10.7	+2.60	—
Severe and/or limiting pain						
55–61	18.8	+2.21	.00	23.7	+1.89	.00
62–71	17.7	+2.87	.00	24.2	+1.61	.00
72+	16.2	+1.57	.00	25.0	+1.47	.00
55+	18.2	+2.36	.00	24.8	+1.67	.00
Weighted average	17.7	+2.23	—	24.3	+1.67	—

[a]Average of all observations aggregated across waves.
[b]Probability that prevalence did not change from first to last observed wave.

meaning that the odds of reporting severe and/or limiting pain is about seven times higher for those with arthritis relative to those without. Random variance and standard errors are highly significant and thus indicate that the mixed model method is appropriate owing to the fact that many individuals are in the data for greater than one observation.

We conducted extensive supplementary analyses to test the robustness of our findings to different model specifications. The findings are available on the lead author's website listed above. Included are models that interact sex by years since baseline. These are nonsignificant across all ages, meaning that the increase in pain prevalence has been statistically similar across sexes. We also estimated models with a quadratic time trend that squared year since baseline. This term was only significant for those aged 62–71.

Discussion

The increases in the prevalence of pain among older persons in the United States are persistent, consistent, and extensive. They persist from 1992 to 2014 in a fairly linear fashion. They are consistent across population subgroups: increases have been experienced by younger and older persons, by males and females, across categories of race, marital status, education, wealth, and across those with and without a number of chronic diseases that are often linked to pain such as arthritis. Given extensive average annual increases in the neighborhood of 2% across many subgroups, it is not hyperbole to say that the increase in pain prevalence is potentially of epidemic proportions among older persons in the United States. While not everyone will seek medical treatment for pain conditions, there is a link between pain and health care costs (Gaskin & Richard, 2012), suggesting that trends may result in increases in costs and possibly lower quality of life and less chance for independent living among the elderly.

The pain increases are not due to changes in population composition. Taking into account such changes does little to explain the increase in pain. On the contrary, had it not been for the rise in educational levels among older persons, with more having postsecondary and fewer having less than high school education, the prevalence of pain would have increased even faster.

The relatively linear increases in pain prevalence seen in this analysis obviously cannot continue indefinitely. Eventually, the rate of increase has to decline. Even in the current analysis, there is some evidence of this. Supplementary testing indicated that a quadratic term for the variable years since baseline is negative and significant for those 62–71, suggesting that increases in prevalence may have begun to slow for this group.

Determining the causes of the pain increases is beyond the scope of a single study; though we offer several places to continue this inquiry. A medical model associates pain with a pathological condition, especially chronic diseases or injuries. The increasing pain prevalence among older adults in our study, however, was not explained by the rising prevalence of the chronic conditions we included.

Table 4. Average Annual Percent Change in Mild/Moderate Nonlimiting and Severe and/or Limiting Pain Across Demographic, Socioeconomic, and Health Characteristics by Sex[a]

	Males		Females	
	Mild/moderate nonlimiting	Severe and/or limiting	Mild/moderate nonlimiting	Severe and/or limiting
Race/ethnicity				
Non-Hispanic white	+3.11**	+2.56**	+2.96**	+1.46**
Non-Hispanic black	+4.56*	+1.73**	+4.05**	+2.32**
Hispanic	+1.50	+0.63*	+2.70**	+1.05*
Other	+2.48	+2.72**	+4.59	+1.78*
Marital status				
Unpartnered	+2.04**	+2.62**	+3.48**	+1.53**
Partnered	+3.39**	+2.10**	+2.83**	+1.56**
Education				
Less than high school	+2.72**	+2.11**	+2.40**	+1.89**
Complete high school	+3.35**	+3.36**	+3.18**	+2.04**
Postsecondary	+3.13**	+3.45**	+3.16**	+2.54**
Wealth				
< Median wealth	+2.84**	+2.12**	+2.68**	+1.50**
> Median wealth	+3.15**	+2.74**	+3.44**	+1.66**
Chronic conditions				
Arthritis	+2.59**	+1.64**	+2.75**	+0.87**
Heart disease	+1.78**	+1.90**	+3.00**	+0.84**
Diabetes	+1.97**	+2.13**	+2.64**	+1.03**
Lung disease	+2.61*	+2.06**	+1.49**	+1.83**
Stroke	+2.76	+1.82**	+2.38**	+0.85*
Cancer	+3.07**	+2.14**	+2.37**	+1.14**

[a]Because the figures in this table represent a weighted average across three age groups, there is no single measure of statistical significance. The test shown here indicates if the change is statistically significant for at least one of the three age groups. For tests for individual age groups, see author's website: [https://globalagingandcommunity.com/zzjgss2018si/].

**$p < .01$. *$.01 < p < .05$.

A logical possibility is that the increase in pain is a function of pathological pathways beyond those included in this study. Two candidates include obesity and mental health. Obesity rates have been rising rapidly in the United States, and obesity has long been linked to both pain and related outcomes (Reynolds, Saito, & Crimmins, 2005; Shen et al., 2015). Mental health conditions such as depression and anxiety have also been on the rise in the United States and there is an evident link between psychological distress and pain (Bierman & Lee, 2017). Another potential source of the increases may pertain to changes in access to health care. Lack of health insurance could obstruct timely or adequate treatment of chronic or acute conditions and injuries, which could result in increased pain. A particularly pernicious spiral could occur whereby pre-Medicare aged adults would, due to illness or injury, become disabled and lose health insurance, making it more difficult to treat pain. Questions related to the complex association between access to health care and pain are particularly important with respect to health care policy.

It is also possible that it is the way in which pain is reported that has changed over time. There may be period and/or cohort changes in the older U.S. population that influence thoughts and attitudes about pain. Increased awareness of pain as a treatable medical condition may have led to a greater acceptance and willingness to report incidences (Palmer, Walsh, Bendall, Cooper, & Coggon, 2000). The Joint Commission published pain management standards for clinical settings in 1999 that directed accredited health care organizations to change the way in which pain was evaluated and increase the normalization of pain reporting (Berry & Dahl, 2000). This likely resulted in some change in the way pain is evaluated, which may impact reporting. The way pain is evaluated has also been found to associate with opiate consumption and there may be a connection between opioid prescription and its use as therapy and the inclination to report pain symptoms that derive from various conditions (Frasco, Sprung, & Trentman, 2005).

There are other ways of categorizing the pain items that are available in HRS and these were examined and tested in supplementary analyses. The current analysis combined pain intensity (mild, moderate, or severe) and impact on functionality (limitation of usual activities due to pain) to get a measure of level of pain which we defined as

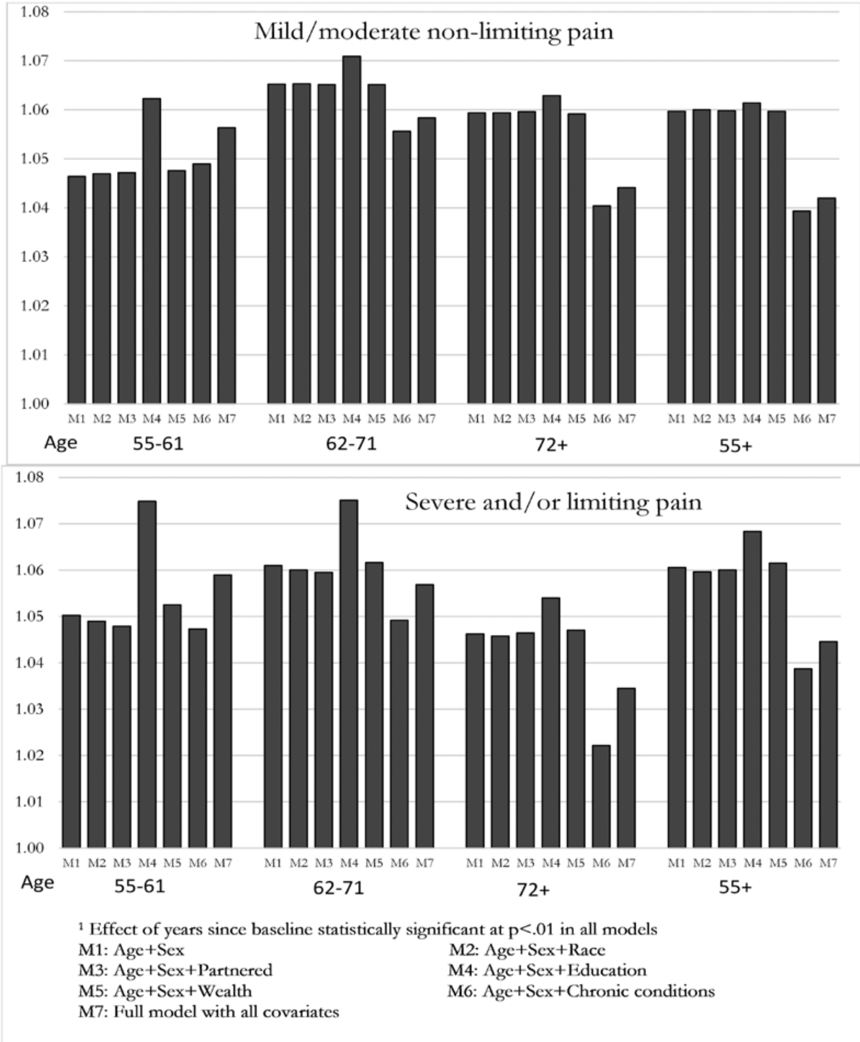

Figure 2. Effect of each additional year since baseline on the odds of reporting mild/moderate nonlimiting, and severe and/or limiting versus no pain across nested generalized linear latent and mixed models, by age group 1.

mild/moderate nonlimiting versus severe and/or limiting. Ways of combining these items that differ from the treatment in the current analysis result in similar conclusions. Very few people (less than 1% of observations) report severe pain without also reporting activity limitation. However, there is quite a large proportion that have limitations but report only the lesser mild/moderate intensity (roughly 15%). The prevalence of this combination has been rising very rapidly. There is also a substantial proportion of people that report severe pain with limitations (roughly 5%). The prevalence of this is also on the rise. In sum, there has been increasing prevalence of mild/moderate pain, severe pain, and pain that limits activities and the conclusion is that any way pain is measured across available indicators leads to the finding of increasing prevalence. Further analysis would be needed to uncover whether, how and why more detailed indicators of pain have been changing differently over time.

Other limitations in the analysis should be acknowledged. The data are representative of the community-based population and therefore omit those in nursing homes or other institutional settings. However, this definition of the target population does not bias our findings. While exclusion of nursing-home residents may impact the one-time estimates of prevalence rates for some health outcomes, particularly among the very old, it has minimal impact on the estimates of trends (Brown, Zajacova, & Verbrugge, 2017; Verbrugge, Brown, & Zajacova, 2017).

This analysis of trends in pain parallels extensive literature on trends in disability. The issue is particularly important given the discourse around compression of morbidity, the reductions in morbidity and increases in quality of life that may accompany an increasing human lifespan (Fries, 1980). While disability has been front and center in this discourse, the connection between pain and quality of life means that pain too is an important element of this compression (Zimmer & Rubin, 2016). In this regard, it is of consequence that results of the current study are in contrast with recent evidence regarding trends in disability among

Table 5. Full Generalized Linear Latent Mixed Models Predicting Any, Mild/Moderate Nonlimiting, and Severe and/or Limiting Pain, by Age Group

	55–61		62–71		72+		55+	
Pain measure	Mild[a]	Severe[b]	Mild[a]	Severe[b]	Mild[a]	Severe[b]	Mild[a]	Severe[b]
Years since baseline	0.055**	0.057**	0.057**	0.055**	0.043**	0.034**	0.041**	0.044**
Age	−0.024*	−0.047**	−0.034	−0.067**	0.007	0.006	−0.003	−0.013**
Female	0.118	0.265**	0.201**	0.384**	0.207**	0.681**	0.221**	0.461**
Race (vs white)								
Black	−0.348**	−0.095	−0.463**	−0.315**	−0.263**	−0.265**	−0.164**	0.019
Hispanic	−0.140	−0.130	0.262*	0.253*	0.099	0.209*	0.240**	0.340**
Other	−0.187	0.111	0.096	0.232	−0.354*	−0.019	−0.087	0.222*
Partnered	0.002	−0.373**	0.190**	−0.158**	0.216**	0.123**	0.257**	−0.009
Schooling (vs <high school)								
Complete high school	−0.374**	−0.775**	−0.101	−0.428**	−0.116*	−0.363*	−0.059	−0.326**
Postsecondary	−0.745**	−10.292**	−0.243**	−0.689**	−0.262**	−0.567**	−0.306**	−0.648**
Wealth (per $100,000)	−0.009	−0.031**	−0.002	−0.009	−0.001	−0.004	−0.001	−0.012**
Chronic conditions								
Arthritis	1.169**	1.820**	1.590**	2.287**	1.489**	2.035**	1.226**	1.861**
Heart disease	0.319**	0.790**	0.348**	0.765**	0.169**	0.554**	0.177**	0.548**
Diabetes	0.332**	0.501**	0.271**	0.519**	0.138**	0.307**	0.175**	0.367**
Lung disease	0.362**	10.014**	0.422**	0.962**	0.256**	0.635**	0.282**	0.805**
Stroke	0.130	0.635**	0.138	0.607**	0.064	0.321**	0.032	0.369**
Cancer	0.237*	0.498**	0.115	0.293**	0.097	0.188**	0.076	0.194**
Constant	−3.293	−2.622	−3.900	−3.712	−3.793	−3.890	−3.537	−3.363
Random variance	5.837		4.177		2.641		3.706	
Random *SE*	0.167		0.126		0.087		0.066	

Log odds shown.
[a]Mild/moderate nonlimiting versus no pain.
[b]Severe and/or limiting versus no pain.
$^{**}p < .01$. $^{*}.01 < p < .05$.

older Americans (Freedman et al., 2013). While disability appeared to be on the decline in 1980s and 1990s more recent data indicate the possibility of an increase in more recent years. The current analysis shows no decrease in pain during 1990s and a steady increase until the present. In addition, the rate at which pain prevalence is rising is much greater than has ever been seen with disability, as is the consistency in increases across subgroups of the population. While pain and disability are inextricably linked, the evidence provided here implies different underlying factors are affecting long-term trends in each.

The increases in pain prevalence found in this study can be linked to a series of present-day concerns expressed in the media, in political and academic circles and across the general public, that underscore an increased attention on pain, its causes, and consequences. These include rates of opioid use, normalization of pain reporting, management of pain, and transition from acute to chronic pain. The current study may therefore be reflecting broad societal shifts in how pain is understood, diagnosed, interpreted, and treated. Clearly, deeper investigations using interdisciplinary approaches are required if we are to better understand the connection between rising prevalence and these other societal concerns. Studies to understand major socioeconomic, lifestyle, psychosocial, and medical correlates of pain would be beneficial for helping to inform effective leverage points for intervention and treatment.

Acknowledgment

The lead author acknowledges support of the Social Sciences and Humanities Research Council through the Canada Research Chairs Program. *Author Contributions*: Both authors contributed substantively to the article. The lead author conceptualized the article, conducted the analyses and wrote the first draft. The second author commented and consulted on the first draft, reworked the article and the presentation of results and wrote subsequent drafts. The authors worked collaboratively on article revisions.

Conflict of Interest

All authors have no conflicts of interest.

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