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The Rise in American Pain: The Importance of the Great Recession

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ABSTRACT

A significant literature has documented trend increases in pain among Americans over the last 2 or 3 decades. There is no consensus on the reason for the trend, with no single explanation seeming to work well. We show that, rather than resulting from a smooth upward trend, the increase was almost entirely concentrated in the 2007–2010 period, the time of the Great Recession, a result not uncovered in prior work. The disproportionate increase in pain among the less educated is also shown to have occurred primarily at the time of the Recession, with either little or no trend before or after. The Recession jump occurred only at older ages and primarily only at the points during each cohort's lifetime when they experienced the Recession. However, we too find the jump difficult to explain, for while there is necessarily a temporary decline in employment during a Recession, why there should be a permanent increase in pain as a result is unclear. We assess a number of explanations, related to family structure and the deterioration of family life, as well as possible biopsychosocial channels. While we find some speculative hypotheses to have potential explanatory power, we conclude that the rise in pain continues to be mysterious and deserves further research in light of our new findings.

1 | Introduction

A large literature has examined time trends in U.S. pain, with most studies showing a secular rise among adults over the last few decades (Case et al. 2020; Case and Deaton 2015, 2017, 2020; Cutler and Glaeser 2021; Glei et al. 2022; Grol-Prokopczyk 2017; Nahin et al. 2023; Stokes et al. 2020; Zajacova et al. 2021; Zimmer and Zajacova 2020). The magnitude of the increases varies with the type of pain examined and the dataset but a rise in pain has been found in most studies.

This short Note examines an understudied issue, which is whether the increase in pain after 1997 varied notably with the Great Recession, which occurred roughly in the 2007–2010 period. Past work has not examined this question and has typically estimated statistical models that allow only smooth, continuous time trend effects. Whether there are business cycle effects in pain has been little examined in the literature (at least for the U.S.) and only one paper to our knowledge, by Macchia and Oswald (2021), which used Gallup poll data from 2009–2018 on 146 countries, found pain to be higher in recessions and lower in booms. But that study did not assess the contribution of business cycles to trends in pain nor did it examine the Great Recession in the U.S. specifically, as we do. However, there is a large literature on the health effects of recessions and some on the specific effect of the Great Recession, where mixed effects on various health measures are found. Burgard and Kalousova (2015), for example, found that the mixed results arise because recessions affect health through different channels with different signs. However, pain is not examined in this literature.[1]

2 | Data

We use the National Health Interview Survey (NHIS), the nation's leading health survey covering adults of all ages and with many different measures of pain. We follow closely the methods of Case et al. (2020) in their influential study, which very clearly documented the rise in pain from 1997 to 2018 with the NHIS, by starting our analysis with the same NHIS measure of pain they used and over the same time period (the pain measures only began to be collected in 1997).[2] We use their measure of pain in the face, neck, or lower back and leg (which we hereafter label "FNLBL") but we also look at the subcomponents of that measure and examine additional measures of joint pain and "any pain," both of which have been used in the literature. [3] We follow Case et al. by selecting all adults 25–79 born between 1935 and 1990 but we do not restrict the sample by race or ethnicity (Case et al. (2020) only examined non-Hispanic Blacks and Whites). Case et al., like many studies in the literature, found very different trends by education, separating the sample into those with a bachelor's degree (BA) and those without one (No BA). We follow that educational split in our analysis. We also use variables for gender, age, family structure, and employment status in our analysis. Our employment indicator takes the value 1 if months worked last year are greater than or equal to 9 (0 otherwise). Our family structure measure has four categories, married or unmarried and with or without children under 18 present. The main sample has 522,504 observations (235,050 men and 287,454 women) pooled over all years. Table A1 has descriptive statistics for the sample.

3 | Methods

First, we present graphical analysis of the trends in pain over the 1997–2018 period. We then estimate regressions to obtain average trends in pain and examine whether those trends were different around the time of the Great Recession (henceforth, "GR"). In the first step we estimate simple regressions of the form

$$y_{it} = \alpha + \beta * t + \epsilon_{it} \quad (1)$$

for different gender groups, where y is a pain outcome and "t" is year, expecting $\beta > 0$, consistent with the literature. In the second more important step, we test for discontinuities in the trend around the time of the GR by allowing a linear trend before the GR, a possible jump in pain occurring over the GR, and a linear trend after the GR. Define t_0 as the first year of the GR and t_1 as the last year of the GR.

$$y_{it} = \alpha + \beta * \text{Min}(t, t_0) + \delta * I\,(t = [t_0, t_1]) + \gamma * \text{Max}(t, t_1) + \epsilon_{it} \quad (2)$$

We omit the GR observations in the $[t_0, t_1]$ interval from the sample because the trend in pain within the GR period is not the object of interest, which is, instead, whether trends in pain were the same before and after the GR. The coefficient β indicates if there were trends in pain before the GR and γ indicates if there were trends after the GR. The coefficient δ is the object of the

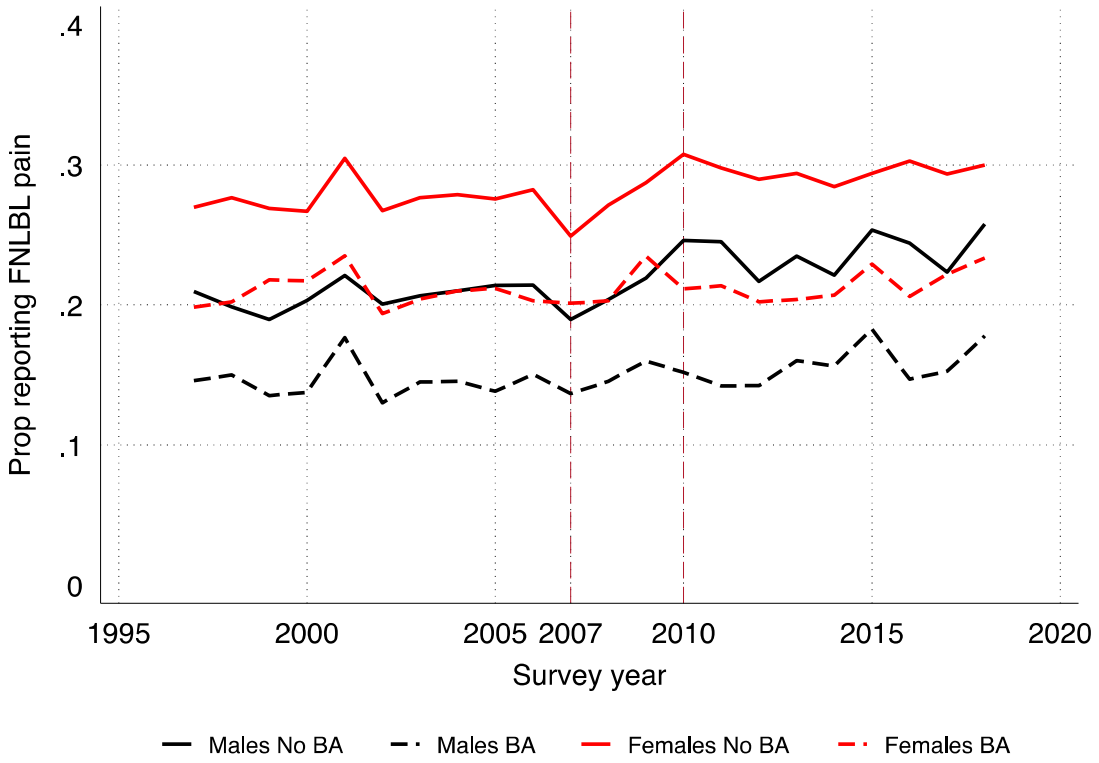

FIGURE 1 | Trends in prevalence of pain among 25–79-year-old males and females with (BA) and without a BA degree (No BA). We show results for "face, or neck, or lower back & leg pain" (FNLBL Pain) ($n = 163{,}170$ and $n = 70{,}031$ for males without and with BA. $n = 204{,}233$ and $n = 81{,}300$ for females without and with BA). All estimates are weighted using sample weights. [Colour figure can be viewed at wileyonlinelibrary.com]

estimation. If $\delta = 0$, then trends after the GR were on the same path as they were before the GR, and the GR (even if it had a temporary change in pain) did not alter the long-run trend in pain. But if $\delta \neq 0$, the long-run trend was altered. We test for robustness using alternative choices for the years t_0 and t_1.

4 | Results

Figure 1 shows trends in FNLBL pain which we discovered, and which motivated the rest of the analysis reported in this Note. We find no visually apparent trends in pain for men and women with a BA but pain is higher in the last year (2018) than the first year (1997) for those without a BA. But it is visually apparent that the trend in pain for those without a BA took a sharp jump from about 2007 to 2010 (vertical lines shown for convenience) for both men and women. A discontinuity at the GR thus appears to have possibly occurred.

Table A2 shows estimates of Equation (1) confirming a positive and significant β and Figure 2 shows graphical estimates with year dummies. Table 1 shows the results of estimating Equation (2) for different datings of the GR, in all cases separating the sample by gender and by possession of a BA. We first begin with dating the GR from 2008–2010, given that the NBER dated the beginning of the GR as December 2007 and the trough in June 2009, when the recovery began (NBER 2024). We start with 2010 as representing the final year. The results in Panel A show that all groups had either no significant trend in pain or only a very small one prior to 2007. But the coefficients on the GR indicator are significant and positive for both men and women without a BA, but near zero and statistically insignificant for those with a BA. After the GR, there was a statistically significant upward trend for all groups, but small in magnitude relative to the discontinuity at the time of the GR for those without a BA. Thus, we find only a small trend in pain for those with a BA but only after the GR, while the more striking result is the large jump in pain at the time of the GR for those without a BA, and a continued upward trend afterward small in magnitude.[4]

Panels B and C in Table 1 test the sensitivity of these results to dating the GR as 2007–2010 and 2007–2009. The estimated pre-GR and post-GR trends are very close to those in Panel A and the magnitude of the jump in pain for those without a BA is still large and statistically significant for those without a BA, with magnitudes slightly smaller than those in Panel A.

Estimates by age are shown in Table A3. The GR discontinuity was largest for those 45–64, with some significant jumps for some groups at earlier ages (e.g., 25–34) or later ages (e.g., 65–74).

Table 2 shows estimates of the regression separately by race and ethnicity, but only for those without a BA given the results in

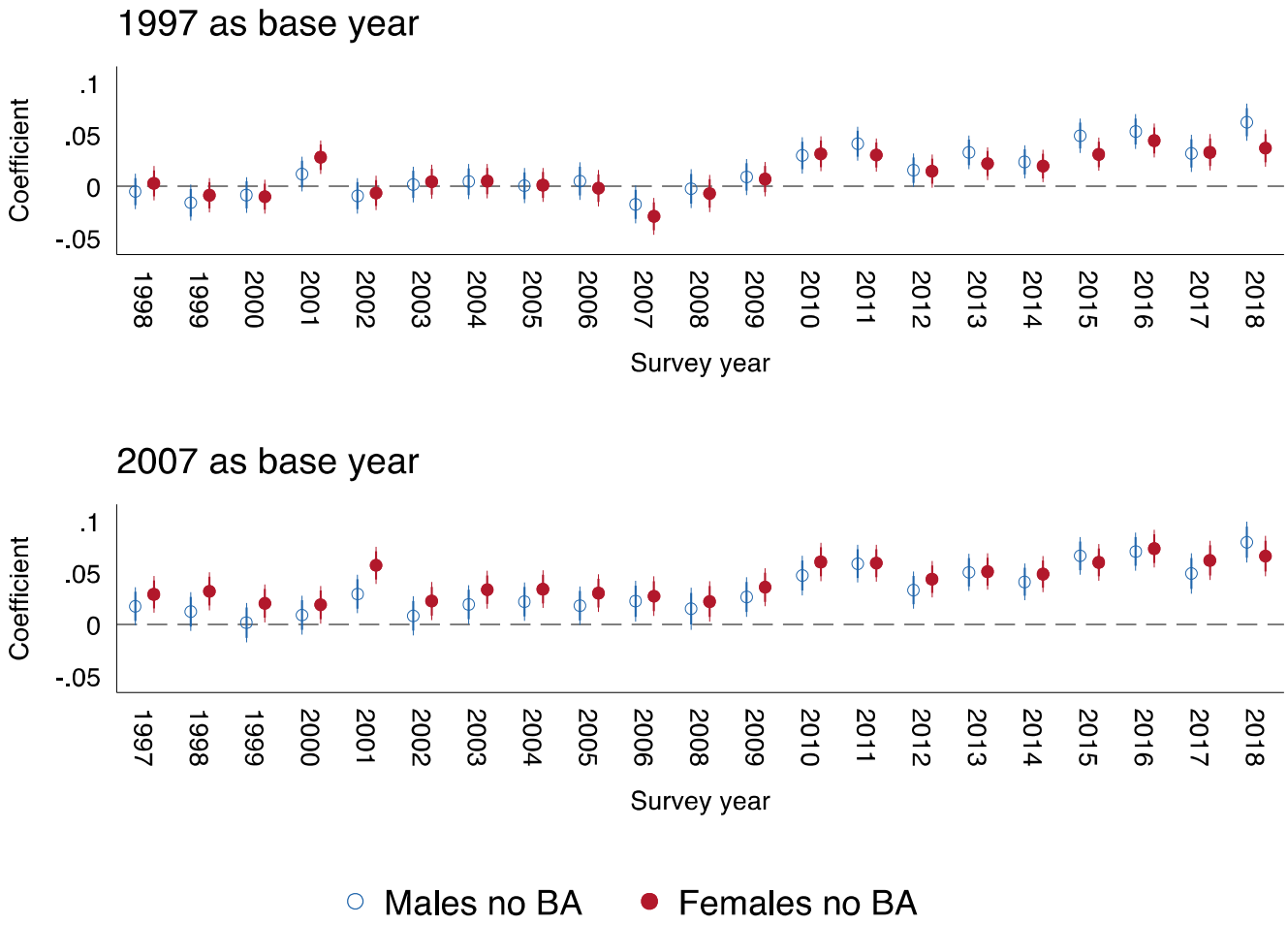

FIGURE 2 | Time trends with year dummies for 25–79-year-old males and females with (BA) and without a BA degree (No BA). [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 | Regressions for FNLBL pain (estimated separately for males and females with and without BA).

Dependent variable: FNLBL pain				
Variables	**(1) All males No BA**	**(2) All males with BA**	**(3) All females No BA**	**(4) All females with BA**
Panel A: 2008–2010				
Min (Year, 2007)	0.000	−0.001	−0.001**	−0.001*
Recession (2008–2010)	0.023***	0.002	0.022***	−0.001
Max (Year, 2010)	0.004***	0.004***	0.003***	0.004***
Constant	−7.840***	−5.777**	−3.220*	−4.128*
Observations	143,939	61,775	179,845	71,696
R-squared	0.002	0.001	0.001	0.000
Mean of DV	0.221	0.155	0.286	0.218
Panel B: 2007–2010				
Min (Year, 2007)	0.001**	−0.001	0.000	−0.001
Recession (2007–2010)	0.017***	0.000	0.013***	−0.003
Max (Year, 2010)	0.004***	0.004***	0.003***	0.004***
Constant	−9.595***	−6.419***	−5.756***	−4.753*
Observations	138,215	59,306	172,678	68,935
R-squared	0.002	0.001	0.001	0.000
Mean of DV	0.223	0.155	0.288	0.219
Panel C: 2007–2009				
Min (Year, 2007)	0.001**	−0.001	0.000	−0.001
Recession (2007–2009)	0.019***	0.003	0.018***	0.001
Max (Year, 2010)	0.003***	0.004***	0.002***	0.003***
Constant	−8.568***	−5.577**	−3.876**	−3.491
Observations	145,034	62,297	181,334	72,370
R-squared	0.002	0.001	0.001	0.000
Mean of DV	0.223	0.155	0.289	0.218

Note: These results are for regressions estimated on the pooled sample where the dependent variable is a binary variable for FNLBL pain ("face, or neck, or lower back & leg pain") and there are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly in Panel A. Observations in 2007, 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly in Panel B. Observations in 2007, 2008, and 2009 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly in Panel C. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2007 (2008) to 2010, and the post-2010 trend.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 1 (and only for the Panel A which defines the GR as occurring between 2008–2010). The table shows that the previous results are especially strong for non-Hispanic Blacks and Hispanics, whose GR jumps in pain were much larger than those for other races and ethnicities. There was also no post-GR trend for these groups (nor a pre-GR trend), so the long-term upward trend in pain was entirely occurring during the GR.

Table 3 shows results for other types of pain. The first two columns show trends for "Any Pain"[5] and joint pain, both of which have been studied in the literature (e.g., Zajacova et al. 2021). The GR jump in Any Pain is larger than our previous results for FNLBL pain but the post-GR trend is also larger, shifting to a degree the relative contributions of the GR and post-GR increases in pain to the long-run trend (but the pre-GR trend is now more negative). Joint pain exhibits the same GR discontinuity and post-GR trend as for Any Pain. The remaining columns break down the FNLBL measure into its subcomponents. Significant GR discontinuities appear in all subcomponents of the measure except for only lower back, with the magnitude of the discontinuity largest for lower-back combined with leg pain (these are combined in the NHIS question, with the question on leg pain only asked to those who responded that they experienced lower back pain). Leg pain can have many different causes, but one is chronic sciatica, which arises from pressure on the sciatic nerve from a herniated disk or other conditions that causes pain to radiate down the leg. Our main conclusion from Table 3 is that the discontinuity in pain is not limited to only one location or kind of pain.

Finally, we briefly examine two other variables that have been suggested as relating to pain. One is employment, for downturns in employment may trigger increases in pain, for example.[6] The other is family structure, in particular the rise in single mother families. Case et al. (2020) suggest that the long-run deterioration in family life among the lower income population in the US

TABLE 2 | Regressions for FNLBL pain (estimated separately for males and females without BA belonging to each race/ethnicity).

Dependent variable: FNLBL pain				
Variables	**(1) Non-Hispanic White**	**(2) Non-Hispanic Black**	**(3) Hispanic**	**(4) Others**
Panel A: Males No BA				
Min (Year, 2007)	0.001**	−0.001	−0.000	−0.002
Recession (2008–2010)	0.019***	0.052***	0.035***	−0.011
Max (Year, 2010)	0.003***	0.001	−0.000	0.008**
Constant	−8.737***	−0.119	0.910	−10.698
Observations	88,774	20,541	28,934	5690
R-squared	0.002	0.004	0.002	0.001
Mean of DV	0.246	0.192	0.174	0.190
Panel B: Females No BA				
Min (Year, 2007)	−0.000	−0.002**	−0.001	0.001
Recession (2008–2010)	0.019***	0.048***	0.027***	−0.007
Max (Year, 2010)	0.002*	0.001	0.001	0.003
Constant	−3.035	1.526	0.341	−7.722
Observations	104,205	31,607	36,785	7248
R-squared	0.001	0.003	0.001	0.000
Mean of DV	0.313	0.248	0.254	0.245

Note: These results are for regressions estimated on the pooled sample where the dependent variable is a binary variable for FNLBL pain ("face, or neck, or lower back & leg pain") and there are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2008 to 2010, and the post-2010 trend.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

may have been a major contributor to trends in pain, mortality, etc. To examine whether pain and family structure are plausible explanations for the GR jump, we simply estimate regressions like Equation (2) using measures of those two variables as outcomes. The results will indicate whether pre- and post-GR trends in those variables, and any GR discontinuity, follow the same patterns as for pain.[7]

Table 4 shows the results. For men, there was, an expected, a discontinuous drop on employment during the GR. However, as is well known from the literature (Abraham and Kearney 2020; Juhn et al. 2002), employment levels of less educated men have been declining for at least 4 decades, which is inconsistent with the lack of a trend in pain for that group. The decline in employment for less educated men did stop its decline after the GR, again inconsistent with the small trend increase in pain in that period. For women, the same decline occurred prior to the Great Recession, employment dropped during the GR, and continued to decline slightly thereafter.[8] The table also shows that the rate of single motherhood among women experienced no discontinuity during the GR. Generally, family structures trend slowly and do not experience sudden short-term shifts. In Table A4 we show that pain increased discontinuously in the GR across all marital and child status subgroups for males without a BA, but only for unmarried women without children (and not for single mothers) in the GR.

5 | Discussion

As noted in the Introduction, only one paper has studied business cycles and pain (Macchia and Oswald 2021). However, there is a large literature, mostly in non-economics journals, on the relationship between employment or economic insecurity and pain, unhappiness, and distress. Chou et al. (2016) found a strong relationship between feelings of economic insecurity and pain, including when the former was experimentally manipulated, and Wiech and Tracey (2009) found a strong relationship between emotions and pain, with the former often related to employment. Blanchflower and Oswald (2019) found a relationship between unhappiness and pain, while the same authors found that the single most important stated reason for extreme distress was an inability to work (Blanchflower and Oswald 2019). Blanchflower and Bryson (2022) found a strong relationship between pain and employment in a cross-country study. The important literature on biopsychosocial models of pain has shown that the experience of pain is filtered through personal characteristics and perceptions and is partly biological but partly psychological and social (Gatchel et al. 2007; Turk et al. 2016). Distress, particularly emotional distress, can induce biological mechanisms which generate pain. While this literature has not focused on environmental stressors like job loss in a recession (but Smart (2023) explicitly links it to financial worry), it would be consistent with such a mechanism. Related is the large literature on allostatic

TABLE 3 | Regressions for each type of pain (estimated separately for males and females without BA).

Variables	(1) Any pain	(2) Joint	(3) Face	(4) Neck	(5) Only lower back	(6) LB + Leg	(7) Migraine
Panel A: Males No BA							
Min (Year, 2007)	−0.003*	0.001	0.000	−0.000	−0.002***	0.001***	−0.002***
Recession (2008–2010)	0.039***	0.033***	0.006***	0.010**	0.007	0.019***	0.009***
Max (Year, 2010)	0.010***	0.011***	−0.000	0.004***	0.004***	0.001**	0.001
Constant	−14.768***	−22.203***	0.133	−6.639***	−2.938*	−5.052***	2.437*
Observations	106,645	106,679	143,957	143,970	143,970	143,970	143,985
R-squared	0.007	0.009	0.000	0.001	0.001	0.003	0.000
Mean of DV	0.502	0.303	0.0330	0.150	0.192	0.114	0.113
Panel B: Females No BA							
Min (Year, 2007)	−0.003**	0.002*	−0.001***	−0.001*	−0.001***	0.002***	−0.004***
Recession (2008–2010)	0.039***	0.029***	0.007***	0.012***	0.004	0.017***	0.012***
Max (Year, 2010)	0.007***	0.010***	−0.000	0.002**	0.003***	0.002***	−0.003***
Constant	−6.987**	−24.887***	2.090**	−1.565	−2.312	−7.201***	14.372***
Observations	131,502	131,532	179,853	179,867	179,856	179,856	179,867
R-squared	0.004	0.008	0.000	0.000	0.000	0.003	0.001
Mean of DV	0.580	0.340	0.0690	0.201	0.198	0.142	0.233

Note: These results are for regressions estimated on the pooled sample where the dependent variable is the pain outcome mentioned in each column heading. There are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2008 to 2010, and the post-2010 trend. Any pain is a binary variable that takes the value 1 for those who report either face, neck, lower back, joint pain, or migraine in the last 3 months. Joint pain is a binary variable that combines two variables in the NHIS. It takes the value 1 for those who report joint pain ("any symptoms of pain, aching, or stiffness in or around a joint" during the past 30 days) and report that these symptoms started 3 months or more ago ("Did your joint symptoms first begin more than 3 months ago?"). Joint pain is only available for the years 2002–2019. Face pain is a binary variable that takes the value 1 for those who report "facial ache or pain in the jaw muscles or joint in front of the ear" during the past 3 months. Lower back pain is a binary variable that takes the value 1 for those who report "low back pain" during the past 3 months. Those who replied in the affirmative were asked "Did this pain spread down either leg to areas below the knees?". Only LB is a binary variable that takes the value 1 for those who report lower back pain but do not have leg pain (lower back pain that spread down to either leg or areas below the knees). Neck pain is a binary variable that takes the value 1 for those who report neck pain in the last 3 months. Migraine is a binary variable that takes the value 1 for those who report severe headache or migraine during the past 3 months.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE 4 | Regressions for employment status and marital status (estimated separately for males and females without BA).

	Dependent variable: Employed for 9 months or more last year		Dependent variable: Unmarried and has kids below 18
Variables	(1) All males No BA	(2) All females No BA	(3) All females No BA
Min (Year, 2007)	−0.011***	−0.008***	−0.003***
Recession (2008–2010)	−0.090***	−0.061***	0.003
Max (Year, 2010)	−0.002***	−0.004***	−0.005***
Constant	27.364***	25.934***	17.669***
Observations	143,479	179,374	179,233
R-squared	0.039	0.021	0.044
Mean of DV	0.684	0.542	0.181

Note: These results are for regressions estimated on the pooled sample where the dependent variable is whether the individual reported being employed for 9 months or more last year (Columns 1 and 2), and whether the individual reported being unmarried with children below the age of 18 (Column 3). There are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2008 to 2010, and the post-2010 trend.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

overload, which argues that cumulative stresses of life and general "wear and tear" can, at some point, lead to poorer physiological health outcomes and to chronic pain (Khalatbari-Soltani and Blyth 2022; McEwen and Seeman 1999; Slade et al. 2012).[9]

The role of opioids has been heavily discussed by Case and Deaton (2020) as a possible contributor to mortality but less on its possible contribution to the rise in pain. Case and Deaton note that opioid use should ostensibly be a response to a rise in pain,

not a cause, but also note that it could result in longer-run increases in pain from opioid-induced hyperalgesia or other forms of central sensitization. But the timing is not strongly supportive of a role in the 2007–2010 period alone, for the first wave of the opioid epidemic began in the 1990s and the second wave did not begin until 2010. The former is too long before 2007–2010 to plausibly explain the GR jump and the latter should have generated a stronger trend increase only in the years after 2010.

In any case, this literature does not explain the central finding of this Note, which is that the increase in pain during the GR was not followed by a decline in pain and a resumption of the pre-GR pain trend (which was, in any case, zero or small). None of the studies cited above would suggest why pain would suddenly increase and then not return to trend after the distress or economic insecurity returned to normal levels.[10] A different type of explanation is required. One possibility explored in other contexts in economics is that an economic downturn could act as a "trigger" which acts on long-term trends to move them over a threshold and hence have long-term impacts. Macroeconomists have heavily studied such "hysteresis" effects where what is a presumed short-term, temporary decline in national output has a permanently negative effect on output thereafter (Ball 2014; Blanchard and Summers 1986) and Yagan (2019) has studied it specifically for employment in the Great Recession.[11] Evidence for what are called "scarring effects" on workers occur when the recession results in workers losing long-term good jobs to which they never return, resulting in permanently lower wages and permanently lower quality jobs (Davis and Von Wachter 2011; Huckfeldt 2022). While speculative, it is possible that a related mechanism could occur for pain, with the well-documented economic distress induced by the Great Recession, layered on top of a long-term decline in the job quality and wages of less educated workers resulting from deindustrialization and skill-biased technological change, having triggered increases in pain associated with that sudden increase in distress.

6 | Concluding Remarks

We have reported in this Note the unexpected finding that much, if not most, of the long-term trend in pain since about 1997 occurred during the Great Recession. We recommend that this finding be followed up with additional research into possible causes of such a discontinuous shift, as well as an examination of other data sets to determine whether that pattern is also found there. Case et al. (2020) refer to the "mystery" of American pain and Case and Deaton (2020) titled their pain chapter the "mystery" of pain; our findings increase that mystery.

Acknowledgments

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the Interuniversity Consortium for Political and Social Research, https://doi.org/10.3886/E222061V1.

Endnotes

[1] Case and Deaton (2020) argue that the Great Recession was not a significant contributor to mortality trends but, as they note, trends in mortality and pain are not the same. We do not study mortality in this Note.

[2] We stop before the Pandemic Recession and leave that period for future work.

[3] Joint pain was only measured starting from the year 2002 in the NHIS. Apart from Case et al., the excellent study by Zajacova et al. (2021), which also used the NHIS and looked at a variety of pain types, is the closest to our study.

[4] We thank a referee for noting that if nonresponse or mortality is changing over time in the U.S. (or as an effect of the GR, as suggested by Finkelstein et al. (forthcoming)), the demographic composition of the sample could also be changing and could affect our estimates. We examined the data and found some small changes in composition by age, race-ethnicity, and marital status and numbers of children, so we constructed weights for the distribution of these covariates and reweighted the regression to hold the distribution fixed at the average composition over all years in the data. We found the results in our Tables 1–4 to be unchanged. However, these weighting adjustments are only approximate and do not account for changing composition on the basis of unobservables. Further work on this issue is recommended.

[5] "Any pain" takes the value 1 if respondents report experiencing any of face, neck, lower back pain, migraine, or joint pain.

[6] Blanchflower and Bryson (2022) found a marked difference in pain profiles by employment status, but only examined the period after 2008 and did not specifically focus on time trends as we do here.

[7] We do not put employment or family structure on the right-hand-side of Equation (2) because those variables are potentially endogenous, and causality could run the opposite direction (e.g., Piper et al. (2021, 2023) and Krueger (2017) showed that pain leads to job and labor force participation rate reductions, while Gaskin and Richard (2012) looked at the effect of pain on economic productivity). It might be possible to include them as regressors but develop instruments for them but that is beyond the scope of this maximum-3000-word Note.

[8] Women's employment had a strong historical upward trend prior to about the year 2000, but in that year women's employment stopped growing and started declining (e.g., Moffitt 2012).

[9] But this literature also emphasizes that the direction of causality can run from pain to stress as well.

[10] But Macchia et al. (2023) found that more years of unemployment leads greater pain with a very long lag, up to 20 years. This might explain why pain experienced a small rate of increase after the GR. This is a type of "scarring" effect noted below.

[11] An interesting follow-up to our paper would be to obtain access to the restricted NHIS data which have state identifiers, which would be needed to use Yagan's hysteresis variable in our regressions. We suggest such an exploration for future work.

References

Abraham, K. G., and M. S. Kearney. 2020. "Explaining the Decline in the US Employment-to-Population Ratio: A Review of the Evidence." *Journal of Economic Literature* 58, no. 3: 585–643. https://doi.org/10.1257/jel.20191480.

Ball, L. 2014. "Long-Term Damage From the Great Recession in OECD Countries." *European Journal of Economics and Economic Policies* 11, no. 2: 149–160. https://doi.org/10.4337/ejeep.2014.02.02.

Blanchard, O. J., and L. H. Summers. 1986. "Hysteresis and the European Unemployment Problem." *NBER Macroeconomics Annual* 1: 15–78. https://doi.org/10.1086/654013.

Blanchflower, D. G., and A. Bryson. 2022. "Further Decoding the Mystery of American Pain: The Importance of Work." *PLoS One* 17, no. 1: e0261891. https://doi.org/10.1371/journal.pone.0261891.

Blanchflower, D. G., and A. J. Oswald. 2019. "Unhappiness and Pain in Modern America: A Review Essay, and Further Evidence, on Carol Graham's Happiness for All?" *Journal of Economic Literature* 57, no. 2: 385–402. https://doi.org/10.1257/jel.20171492.

Burgard, S. A., and L. Kalousova. 2015. "Effects of the Great Recession: Health and Well-Being." *Annual Review of Sociology* 41, no. 1: 181–201. https://doi.org/10.1146/annurev-soc-073014-112204.

Case, A., and A. Deaton. 2015. "Rising Morbidity and Mortality in Midlife Among White Non-Hispanic Americans in the 21st Century." *Proceedings of the National Academy of Sciences* 112, no. 49: 15078–15083. https://doi.org/10.1073/pnas.1518393112.

Case, A., and A. Deaton. 2017. "Mortality and Morbidity in the 21st Century." *Brookings Papers on Economic Activity* 2017, no. 1: 397–476. https://doi.org/10.1353/eca.2017.0005.

Case, A., and A. Deaton. 2020. *Deaths of Despair and the Future of Capitalism*. Princeton University Press.

Case, A., A. Deaton, and A. A. Stone. 2020. "Decoding the Mystery of American Pain Reveals a Warning for the Future." *Proceedings of the National Academy of Sciences* 117, no. 40: 24785–24789. https://doi.org/10.1073/pnas.2012350117.

Chou, E. Y., B. L. Parmar, and A. D. Galinsky. 2016. "Economic Insecurity Increases Physical Pain." *Psychological Science* 27, no. 4: 443–454. https://doi.org/10.1177/0956797615625640.

Cutler, D. M., and E. L. Glaeser. 2021. "When Innovation Goes Wrong: Technological Regress and the Opioid Epidemic." *Journal of Economic Perspectives* 35, no. 4: 171–196. https://doi.org/10.1257/jep.35.4.171.

Davis, S. J., and T. M. Von Wachter. 2011. *Recessions and the Cost of Job Loss*. National Bureau of Economic Research.

Finkelstein, A., M. J. Notowidigdo, F. Schilbach, and J. Zhang. Forthcoming. "Lives vs. Livelihoods: The Impact of the Great Recession on Mortality and Welfare." *Quarterly Journal of Economics*.

Gaskin, D. J., and P. Richard. 2012. "The Economic Costs of Pain in the United States." *Journal of Pain* 13, no. 8: 715–724. https://doi.org/10.1016/j.jpain.2012.03.009.

Gatchel, R. J., Y. B. Peng, M. L. Peters, P. N. Fuchs, and D. C. Turk. 2007. "The Biopsychosocial Approach to Chronic Pain: Scientific Advances and Future Directions." *Psychological Bulletin* 133, no. 4: 581–624. https://doi.org/10.1037/0033-2909.133.4.581.

Glei, D. A., A. C. Stokes, and M. Weinstein. 2022. "Widening Socioeconomic Disparities in Pain and Physical Function Among Americans Are Linked With Growing Obesity." *Journal of Aging and Health* 34, no. 1: 78–87. https://doi.org/10.1177/08982643211028121.

Grol-Prokopczyk, H. 2017. "Sociodemographic Disparities in Chronic Pain, Based on 12-Year Longitudinal Data." *Pain* 158, no. 2: 313–322. https://doi.org/10.1097/j.pain.0000000000000762.

Huckfeldt, C. 2022. "Understanding the Scarring Effect of Recessions." *American Economic Review* 112, no. 4: 1273–1310. https://doi.org/10.1257/aer.20160449.

Juhn, C., K. M. Murphy, and R. H. Topel. 2002. "Current Unemployment, Historically Contemplated." *Brookings Papers on Economic Activity* 2002, no. 1: 79–116. https://doi.org/10.1353/eca.2002.0008.

Khalatbari-Soltani, S., and F. M. Blyth. 2022. "Socioeconomic Position and Pain: A Topical Review." *Pain* 163, no. 10: 1855–1861. https://doi.org/10.1097/j.pain.0000000000002634.

Krueger, A. B. 2017. "Where Have All the Workers Gone? An Inquiry Into the Decline of the US Labor Force Participation Rate." *Brookings Papers on Economic Activity* 2017, no. 2: 1–87. https://doi.org/10.1353/eca.2017.0012.

Macchia, L., M. Daly, and L. Delaney. 2023. "The Effect of Adverse Employment Circumstances on Physical Pain: Evidence From Australian Panel Data." *Preventive Medicine* 173: 107574. https://doi.org/10.1016/j.ypmed.2023.107574.

Macchia, L., and A. J. Oswald. 2021. "Physical Pain, Gender, and the State of the Economy in 146 Nations." *Social Science & Medicine* 287: 114332. https://doi.org/10.1016/j.socscimed.2021.114332.

McEwen, B. S., and T. Seeman. 1999. "Protective and Damaging Effects of Mediators of Stress: Elaborating and Testing the Concepts of Allostasis and Allostatic Load." *Annals of the New York Academy of Sciences* 896, no. 1: 30–47. https://doi.org/10.1111/j.1749-6632.1999.tb08103.x.

Moffitt, R. A. 2012. *The US Employment-Population Reversal in the 2000s: Facts and Explanations*. National Bureau of Economic Research.

Nahin, R. L., T. Feinberg, F. P. Kapos, and G. W. Terman. 2023. "Estimated Rates of Incident and Persistent Chronic Pain Among US Adults, 2019–2020." *JAMA Network Open* 6, no. 5: e2313563. https://doi.org/10.1001/jamanetworkopen.2023.13563.

NBER. 2024. "Business Cycle Dating." https://www.nber.org/research/business-cycle-dating.

Piper, A., D. G. Blanchflower, and A. Bryson. 2021. *Does Pain Lead to Job Loss? A Panel Study for Germany*. National Bureau of Economic Research.

Piper, A., D. G. Blanchflower, and A. Bryson. 2023. "Is Pain Associated With Subsequent Job Loss? A Panel Study for Germany." *Kyklos* 76, no. 1: 141–158. https://doi.org/10.1111/kykl.12319.

Slade, G. D., A. E. Sanders, and K. By. 2012. "Role of Allostatic Load in Sociodemographic Patterns of Pain Prevalence in the US Population." *Journal of Pain* 13, no. 7: 666–675. https://doi.org/10.1016/j.jpain.2012.04.003.

Smart, K. M. 2023. "The Biopsychosocial Model of Pain in Physiotherapy: Past, Present and Future." *Physical Therapy Reviews* 28, no. 2: 61–70. https://doi.org/10.1080/10833196.2023.2177792.

Stokes, A. C., W. Xie, D. J. Lundberg, et al. 2020. "Increases in BMI and Chronic Pain for US Adults in Midlife, 1992 to 2016." *SSM-Population Health* 12: 100644. https://doi.org/10.1016/j.ssmph.2020.100644.

Turk, D. C., R. B. Fillingim, R. Ohrbach, and K. V. Patel. 2016. "Assessment of Psychosocial and Functional Impact of Chronic Pain." *Journal of Pain* 17, no. 9: T21–T49. https://doi.org/10.1016/j.jpain.2016.02.006.

Wiech, K., and I. Tracey. 2009. "The Influence of Negative Emotions on Pain: Behavioral Effects and Neural Mechanisms." *NeuroImage* 47, no. 3: 987–994. https://doi.org/10.1016/j.neuroimage.2009.05.059.

Yagan, D. 2019. "Employment Hysteresis From the Great Recession." *Journal of Political Economy* 127, no. 5: 2505–2558. https://doi.org/10.1086/701809.

Zajacova, A., H. Grol-Prokopczyk, and Z. Zimmer. 2021. "Pain Trends Among American Adults, 2002–2018: Patterns, Disparities, and Correlates." *Demography* 58, no. 2: 711–738. https://doi.org/10.1215/00703370-8977691.

Zimmer, Z., and A. Zajacova. 2020. "Persistent, Consistent, and Extensive: The Trend of Increasing Pain Prevalence in Older Americans." *Journals of Gerontology: Series B* 75, no. 2: 436–447.

Appendix A: Tables

TABLE A1 | Summary statistics.

Variable	Mean	SD	Min	Max	*N*
Employed for 9 months or more last year	0.648	0.478	0	1	516,893
Female	0.550	0.497	0	1	518,551
Completed BA	0.292	0.455	0	1	518,551
Race and ethnicity					
Non-Hispanic White	0.632	0.482	0	1	518,551
Non-Hispanic Black	0.144	0.351	0	1	518,551
Hispanic	0.167	0.373	0	1	518,551
Others	0.057	0.231	0	1	518,551
Marital status and children					
Unmarried, no Kids Below 18 (UMNK)	0.375	0.484	0	1	516,513
Married, no Kids Below 18 (MNK)	0.272	0.445	0	1	516,513
Married, Has Kids Below 18 (MK)	0.247	0.431	0	1	516,513
Unmarried, Has Kids Below 18 (UMK)	0.106	0.307	0	1	516,513
Age groups					
25–34	0.230	0.421	0	1	518,551
35–44	0.238	0.426	0	1	518,551
45–54	0.222	0.416	0	1	518,551
55–64	0.188	0.391	0	1	518,551
65–74	0.103	0.304	0	1	518,551
75–79	0.019	0.137	0	1	518,551
Pain variables					
Face, neck, or lower back and leg pain (FNLBL pain)	0.237	0.425	0	1	518,551
Any pain	0.520	0.500	0	1	403,244
Joint pain began 3+ months ago (joint)	0.300	0.458	0	1	403,254
Had pain in jaw/front of ear, past 3 months (face)	0.051	0.219	0	1	518,487
Had low back pain, past 3 months (LB)	0.299	0.458	0	1	518,525
Lower back pain (no leg pain), past 3 months (only LB)	0.189	0.391	0	1	518,525
Low back pain spread down leg/below knees (LB + leg)	0.109	0.312	0	1	518,525
Had neck pain, past 3 months (neck)	0.166	0.372	0	1	518,521
Severe headaches/migraine, past 3 months (migraine)	0.165	0.371	0	1	518,472

Note: Face, neck, or lower back and leg pain (FNLBL pain) is a binary variable that takes the value 1 for those who report either face, neck, or lower back and leg pain (LB + Leg) in the last 3 months. Any pain is a binary variable that takes the value 1 for those who report either face, neck, lower back, joint pain, or migraine in the last 3 months. Joint pain is a binary variable that combines two variables in the NHIS. It takes the value 1 for those who report joint pain ("any symptoms of pain, aching, or stiffness in or around a joint" during the past 30 days) and report that these symptoms started 3 months or more ago ("Did your joint symptoms first begin more than 3 months ago?"). Joint pain is only available for the years 2002–2019. Face pain is a binary variable that takes the value 1 for those who report "facial ache or pain in the jaw muscles or joint in front of the ear" during the past 3 months. Lower back pain is a binary variable that takes the value 1 for those who report "low back pain" during the past 3 months. Those who replied in the affirmative were asked "Did this pain spread down either leg to areas below the knees?". Only LB is a binary variable that takes the value 1 for those who report lower back pain but do not have leg pain (lower back pain that spread down to either leg or areas below the knees). Neck pain is a binary variable that takes the value 1 for those who report neck pain in the last 3 months. Migraine is a binary variable that takes the value 1 for those who report severe headache or migraine during the past 3 months.

TABLE A2 | Regressions estimating time trends.

Dependent variable: FNLBL pain				
	(1)	(2)	(3)	(4)
Variables	**All males no BA**	**All males with BA**	**All females no BA**	**All females with BA**
Survey year	0.003***	0.001***	0.002***	0.001***
Constant	−5.596***	−2.075***	−3.615***	−0.994**
Observations	163,090	70,006	204,180	81,275
R-squared	0.002	0.000	0.001	0.000
Mean of DV	0.221	0.154	0.286	0.218

Note: These results are from regressions estimated for the dependent variable FNLBL pain ("face, or neck, or lower back & leg pain") which is a binary variable. Year (linear) is included as an independent variable to estimate time trends. The coefficient for year remains significant when age, and dummies for marital status, and race/ethnicity are included as independent variables (not shown here).
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE A3 | Regressions for FNLBL pain (estimated separately for males and females without BA belonging to each 10-year age-group).

Dependent variable: FNLBL pain					
	(1)	(2)	(3)	(4)	(5)
Variables	**Ages 25–34**	**Ages 35–44**	**Ages 45–54**	**Ages 55–64**	**Ages 65–74**
Panel A: Males No BA					
Min (Year, 2007)	−0.003***	−0.001	0.000	0.001	0.004
Recession (2008–2010)	0.024***	0.014	0.038***	0.028**	0.006
Max (Year, 2010)	0.003**	0.001	0.000	0.004**	0.006***
Constant	−1.252	−0.543	−1.009	−9.886**	−19.809**
Observations	32,101	35,045	32,818	27,363	13,772
R-squared	0.001	0.000	0.002	0.003	0.003
Mean of DV	0.157	0.208	0.248	0.272	0.241
Panel B: Females No BA					
Min (Year, 2007)	−0.003***	−0.002**	−0.001	0.001	−0.005
Recession (2008–2010)	0.019**	−0.003	0.035***	0.034***	0.043***
Max (Year, 2010)	0.003*	0.005***	0.002	−0.001	0.000
Constant	−0.473	−5.194	−1.115	2.045	8.419
Observations	40,042	41,575	39,173	35,010	19,401
R-squared	0.001	0.000	0.001	0.001	0.001
Mean of DV	0.219	0.270	0.328	0.329	0.301

Note: These results are from regressions estimated for the dependent variable FNLBL pain ("face, or neck, or lower back & leg pain") which is a binary variable. There are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly. Panel A shows results for males without a BA degree belonging to each 10-year age group mentioned in the column heading. Panel B shows results for females without a BA degree belonging to each 10-year age group mentioned in the column heading.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE A4 | Regressions for FNLBL pain (estimated separately for males and females without BA belonging to family structure group).

	Dependent variable: FNLBL pain			
Variables	**(1) UMNK**	**(2) MNK**	**(3) MK**	**(4) UMK**
Panel A: Males No BA				
Min (Year, 2007)	0.001	0.001	−0.002**	−0.002
Recession (2008–2010)	0.020***	0.018**	0.023**	0.043**
Max (Year, 2010)	0.006***	0.002	0.001	−0.001
Constant	−13.375***	−6.386*	1.808	5.206
Observations	59,452	40,227	35,446	8237
R-squared	0.004	0.002	0.001	0.001
Mean of DV	0.230	0.233	0.192	0.230
Panel B: Females No BA				
Min (Year, 2007)	−0.002**	−0.002*	−0.002**	−0.001
Recession (2008–2010)	0.039***	0.014	0.009	−0.005
Max (Year, 2010)	0.001	0.001	0.003*	0.004**
Constant	2.873	1.800	−2.503	−6.916
Observations	61,394	45,176	40,158	32,334
R-squared	0.001	0.000	0.000	0.000
Mean of DV	0.325	0.292	0.232	0.275

Note: These results are for regressions estimated on the pooled sample where the dependent variable is a binary variable for FNLBL pain ("face, or neck, or lower back & leg pain") and there are three independent variables: Min (Year, 2007), Recession (a dummy for year 2010 and after), and Max (Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Recession variable to show the discontinuity more clearly. Panel A shows results for males without BA belonging to each marital status and presence of children group. Panel B shows results for females without BA belonging to each marital status and presence of children group. Each columns represents a marital status and presence of children group: Unmarried, No Kids Below 18 (UMNK), Married, No Kids Below 18 (MNK), Married, Has Kids Below 18 (MK), and Unmarried, Has Kids Below 18 (UMK).
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.