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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 two or three decades. There is no single explanation seeming to work well for the increase. 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, by cohort, primarily only at the ages when they experienced the Recession. However, the jump is difficult to explain, for while there was a temporary decline in employment during the Recession, it is unclear why there it should be followed by a permanent increase in pain. We assess a number of explanations related to family structure, the deterioration of family life, hysteresis, and biopsychosocial channels. While some factors have potential explanatory power, the rise in pain continues to be mysterious and deserves further research in light of our new findings.

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I. Introduction

The rise in pain among Americans over the last two of three decades has been well documented (Grol-Prokopczyk, 2017; Nahin et al., 2019; Stokes et al., 2020; Zimmer and Zajacova, 2020; Zajacova et al. 2021; Glei et al., 2022). Most of these studies find the increase to have disproportionately occurred among the less educated. Some studies have found the trend increase to have occurred in some types of pain and not others (Cutler and Glaeser (2021)). In a particularly important contribution by economists, Case, Deaton, and Stone (2020) showed that today's midlife Americans report higher levels of pain throughout their adult years compared to today's American elderly, especially for those with less than a bachelor's (BA) degree. Although today's elderly have lower levels of pain than today's midlife Americans, the authors showed that the elderly themselves experienced lower levels of pain in their own midlife years, and that the upward shift across all birth cohorts has occurred for every successive cohort born after 1950, each of which reported more pain than the previous cohort at every age during their adulthood.

The work of Case et al. extends their prior examination of pain trends. In their prior work, Case and Deaton (2015) found increases in four different types of self-reported pain between 1997-1999 and 2011-2013 among non-Hispanic Whites. Case and Deaton (2017) added to those findings by showing that pain-age profiles for non-Hispanic Whites have shifted upward by cohort for those with less than a BA degree as well as that there were positive linear average cohort trends. Case and Deaton (2020) have a lengthy discussion of the causes and consequences of pain and of possible correlates of those trends. However, aside from these discussions of pain, most of the work in these studies has focused on mortality and not on pain, and the two do not demonstrate the same trends and demographic correlates (as the authors note).

In this study we use data from the National Health Interview Survey (NHIS) (employed by Case et al. and others in the literature) to show that the increase in pain has not been the result of a smooth upward trend. We report five findings. First, we find that the upward shift in the measure of pain used was primarily the result of a jump during the Great Recession 2007-2010. In fact, there

is no evidence of any trend in pain before that event and evidence for only mild trends thereafter, at least for less educated individuals. We show that this discontinuity is reflected in differential shifts after the Great Recession by age category, and that the cohort pain profiles which have shifted upward also show a Great Recession discontinuity at the ages at which each cohort experienced that Recession. Second, while we confirm that cohort profiles of pain have been shifting up for all cohorts, we also find that that those profiles have been shifting up disproportionately at certain ages—specifically, older ages— and, again, primarily at the time of the Great Recession. Thus, there was not a uniform shift upward of cohort-pain profiles at all ages. Third, we find no differences in pain trends or discontinuities by gender, or by race or ethnicity, unlike other work on mortality and morbidity. Fourth, we find downward jumps in employment during the Great Recession for both men and women, especially among the less educated, but this is expected for any economic downturn. But there was a long-term decline in employment that preceded the Recession that may be more important when considering economic factors (as noted by other authors, including Case et al.). Fifth, we examine trends in marital status and childbearing and find no discontinuous jump in the 2007-2010 period but find family structure trends resulting in a decline in the proportion of less educated men and women who are married and have children in the household, reflecting long-term declines in marriage and fertility. But this group has been mostly replaced by those unmarried and without children rather than by those unmarried with children. Thus, out-of-wedlock childbearing, most often considered the major indicator of a deterioration in family life, while having increased, is not the dominant trend. We also examine trends in pain and in employment by family structure group and find some differences in which groups experienced the discontinuity at the time of the

Great Recession, but we do not find discontinuities in family structure, marriage, or fertility itself at the time of the Recession.

We first show the details of these results and then, with the findings established, we devote our Discussion Section to speculation on possible causes of the Recession discontinuity in pain given the lack of any other measurable or observable factor that jumped at that time.

II. Data and measures

While CDS used several datasets in their paper, their primary data source for the study of U.S. pain was the National Health Interview Survey (NHIS). For comparability with the CDS analysis, we use the same years (1997-2018) and the same measure of pain (face, neck, or lower back and leg pain, which we label as "FNLBL"). In the NHIS, leg pain, defined as pain that "spreads down either leg to areas below the knees", and is often associated with sciatica, is asked as a follow-up to the question on lower back pain. We use this follow-up question combined with questions asking about facial pain and neck pain for this measure (following CDS). We show results for some other measures of pain that are used in the literature in our Discussion section as well. For complete comparability with CDS, we restrict the sample to 25–79-year-old non-Hispanic Black and White American adults born between 1935-1990.

III. Results

We use the same data as Case et al. described in the section above. We replicate the main results of Case et al. on increases in pain using the NHIS, as shown in Figures S1, S2, and S3 in our Appendix. Figure S1 shows that the elderly (over 65) report lower levels of pain than midlife Americans (40-55) for both non-Hispanic Whites and non-Hispanic Blacks, while Figure S2 displays the pattern found by Case et al. showing the effect to be stronger for less educated than more educated individuals (less than BA vs BA or more). Figure S3 shows their finding that pain uniformly rises with age once birth cohort is controlled for, and rising with birth cohort once age has been controlled for, again primarily

for those with less than a BA degree. We therefore have ensured that our data are showing the same trends and patterns of pain as did their study.

Our first new finding is shown in Figure 1, which depicts trends in the face, neck, or lower back and leg (hereafter "FNLBL") measure of pain used by Case et al., by gender, educational level, and by year. Like those authors., we find almost no trends in pain for those with a BA but see noticeable upward trends for those without a BA. However, it is clear visually that there was a major upward shift in pain for those without a BA which occurred in roughly the 2007-2010 period, which we make visually clear by inserting vertical lines at 2007 and 2010. No trend is visually apparent prior to 2007 or after 2010, although a small upward trend after 2010 may have occurred. To confirm these visual results, we present in Appendix Table S1 results from three-variable regressions which allow the estimation of the pre-2007 trend, the jump from 2007 to 2010, and the trend after 2010. For no group is there a significant trend in pain prior to 2007 but there is a significant sharp upward during 2007-2010 which occurs only for those with no BA. All groups experienced an upward trend after 2010, including those with a BA (as also noted by Case et al. (p.24788)), but the magnitudes are small—for those without a BA, for example, it took 10 years or more after 2010 for pain to rise as much as it jumped at the discontinuity point in 2007-2010.[1]

Figure 2 shows the time trends for those men and women without a BA but broken out by age. We find that the upward shifts in pain occurred at all ages but were larger in magnitude among those 45 and older. But we also find that the upward shifts for those older men and women show the same upward discontinuity in the 2007-2010 period as appeared for all age groups together. Appendix Table S2 confirms the statistical significance of the discontinuity with regression results by age (there are discontinuities for some younger men as well but smaller in magnitude than those for older age groups).

[1] The Appendix table treats 2007 as the last pre-recession year and 2011 as the first post-recession year. Appendix Tables S1A and S1B test the sensitivity of the results to the choice of beginning and ending years of the Recession, by treating one more year (2007) as part of the recession and dropping one year at the end (2010) from the recession. The finding of a discontinuity is robust to the exact choice of starting and ending year.

As Case et al. note, pain-age cohort profiles have been shifting upward for later born cohorts. However, Figure 2 implies that those upward shifts must have been concentrated at particular ages and in a particular period—namely, in the 2007-2010 period. Appendix Table S3 confirms this by showing selected narrower 3-year age groups and 3-year birth cohorts just before and after the 2007-2010. While there are some upward trends before or after 2007-2010 for some cohorts, usually there was very little trend before that period or after. But there was a noticeable jump in pain from years prior to that period to the years afterward that is typically much greater for men and women after their late 40s, sometimes up to a large 6 percentage point jump. This makes the upward shift in pain look much more like a period phenomenon than a cohort phenomenon.

Appendix Figure S4 shows trends in FNLBL pain by race and gender. While there are small differences in the patterns, both race groups by gender show the same strong discontinuous jump in the 2007-2010 period for those without a BA and no comparable discontinuity for those with a BA.

One of the hypotheses for the rise in pain suggested by economists relates to long-term trends in deindustrialization and the decline of the unskilled labor market. Case et al. hypothesize, more broadly, that the rise in pain has been mostly a result of the ongoing deterioration of economic and family life among the less educated (see Case and Deaton, 2017, 2020, as well). We examine these hypotheses and whether there is evidence of discontinuities in the 2007-2010 period for economic outcomes or family structure. Figure 3 shows trends in the employment-population ratio by gender. Both men and women have experienced long-term declines in employment but there was a discontinuous jump downward at the time of the Recession (see the Figure). But recessions always cause downward jumps in employment, especially for the less educated, almost by definition, so ascribing a causal effect to employment for the jump in pain would be premature. There may be cumulative effects of the long-term decline, an interpretation we discuss further below in our Discussion section.[2]

[2] Regression results in Appendix Table S4 confirm a statistically significant downward jump in employment in the 2008-2010 period. However, it is also interesting both from Figure 3 and the

Case et al. suggest that an associated cause of the increase in pain is related to trends in family life such as an increase in social isolation, more fragile home lives, less marriage, more divorce, and more out-of-wedlock childbearing (p.24788). With the NHIS we can measure trends in marriage and childbearing, and these are shown for the less educated in Figure S7, separately for men and women with and without children in the home. The strongest trends are an increase in the fraction who are unmarried without children and a corresponding decline in the proportion who are married with children. This represents a simultaneous decline in marriage and child-bearing, and has been associated in the literature with an increasing age at first marriage and at first birth. There are small trend increases in the fraction who are unmarried with children, at least for women (the results for men are less informative because many unmarried men have children living with the mother). There is no indication that any of these groups experienced a large discontinuity at the time of the Great Recession, although in some cases there is a slight change in trend. However, an abrupt change in such family structure groups should not be expected, and it may be only the cumulative effect of long-term trends that matter (as Case et al. suggest). But the trends do not bear close resemblance to the trends in pain we have shown above. Appendix Table S5 shows regression results for the sizes of these four family structure groups and show that, while the estimates show some jumps from 2007 to 2010, there are generally also significant trends both before and after the Recession and the size of the change at the time of the Recession was not very different than that implied by those trends.

We end our exploration of the NHIS data by showing trends in pain and employment by marital status and the presence of children. Appendix Figure S5 shows levels and trends in FNLBL pain for the four family structure groups for those without a BA degree. The Figure shows a great deal of statistical noise, but it appears that there was a significant upward shift in pain for all groups after the Great Recession. Regression results, shown in Appendix Table S6, are clearer and show a large discontinuity at 2007-2010 for unmarried men and women without children and some

regressions that employment either stopped declining or declined at a much slower rate after the Recession, at the same time that pain stopped rising or rose at a slower rate.

discontinuities for other groups as well. There are occasionally significant trends before 2007 or after 2010.[3]

Appendix Figure S6 show trends in employment for the less educated, separately by gender and family structure group. While all groups experienced a decline in employment during the Great Recession, employment for women with children generally recovered in the years afterward, consequently indicating no long-term impact of the downturns. More evidence of a discontinuity occurs for unmarried women without children who, despite a decline in employment prior to 2007 (already documented by Moffitt (2012)), saw an abrupt decline after the Great Recession which then stabilized. Regression results in Appendix Table S7 confirm that there were discontinuous declines in employment during the Great Recession (as should be expected for any recession) but that employment recovered for men with children, but also that the pre-recession declines continued after the Recession for the men and women without children (with larger discontinuities for unmarried men and women). [4]

IV. Discussion

Our main finding—that the FNLBL measure of pain in the NHIS shows a discontinuous jump around the time of the Great Recession—has not been found in the general literature on trends in pain in the U.S. There have been many studies of those trends, many using the NHIS but many using other data sets as well, showing trend increases over time, usually disproportionately for the less educated population, as we noted in our references in the Introduction. There are a number of reasons that the discontinuity has not been ascertained in this work. One is that this work uses various smoothing specifications in their empirical specifications, imposing smooth parametric profiles over age, year, and/or birth cohort. Smoothing over year will not detect jumps, and

[3] We should note that the family structure shifts shown in Figure S7 should make the upward trends stronger for women because married women with children have lower levels of pain and unmarried women without children have higher levels, and hence a shift from the former to the latter should increase average pain levels.

[4] Again, shifts in the proportions of men and women in different family structure groups could have generated some additional trends in average employment, given their different levels of employment.

smoothing over age even if not smoothing over birth cohort or year (to take one example) will also not detect a discontinuity because it is only the interaction of age with cohort or year that will pick up the specific years of the Great Recession.[5]

But this work often uses other measures of pain, or subcomponents of the FNLBL measure, even when using the NHIS (many data sets do not have the same measures as the NHIS has). We explore this in Figure 4, showing trends in joint pain as well as the subcomponents of FNLBL pain, for the less educated population. We find that there was a discontinuity in joint pain in the 2007-2010 period and that almost all components of FNLBL—including lower back and leg pain (LB + Leg) by itself—show the discontinuity to varying degrees. For lower back and leg pain specifically, we see that the increase started in the Great Recession years and has stayed high after 2010 for both males and females. Neck pain shows a small jump in 2007-2010 and only for face pain and lower back pain only is there little visual appearance of a discontinuity. These visual trends are confirmed in Appendix Table S8, which shows regression-estimated discontinuous jumps in 2007-2010 for many types of 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 legs. Sciatica is also often examined in the literature, including by Case and Deaton in their papers. But our main conclusion, based on Figure 4 and Appendix Table S8, is that the discontinuity in FNLBL pain is not limited to only one location or kind of pain.

There is also a large literature on whether recessions in general have an impact on health, with part of that examining the effects on pain, and part of that literature specifically focused on the Great Recession (although perhaps with mortality the most common object of study). The literature on the Great Recession and health outcomes shows mixed evidence, with some studies showing

[5] Because the discontinuity has not been examined in other data sets, it is not known whether the discontinuity we have found for pain would appear in other data sets. The NHIS has had some changes in design, sample size, and response rates over time, we have found no evidence that those could have contributed to our main finding in the data. However, comparisons with other data sets would be useful.

improvements in outcomes and others showing deterioration (Burgard and Kalosouva, 2015).[6] Burgard and Kalosova hypothesize that the mixed pattern of results occurs because there are multiple channels through which a recession affects health, with some having positive effects and others negative. However, few of these studies examine pain in particular. But in a unique study, Althouse et al. (2014) used Google searches to calculate the types of "excess" health concerns that were so expressed during the Great Recession, finding back pain to be in the top 10 of excess searches. Nevertheless, this literature does not particularly suggest a strong causal mechanism through which the Great Recession might have affected pain in the discontinuous way we have documented.

Case et al. discuss other possible contributions to a trend rise in pain but argue against all of them as having a major contribution, and their arguments extend to explaining a discontinuous jump (see also the discussion in Case and Deaton, 2020, Chapter 7). There has been a shift from more physically demanding blue-collar jobs to less physically demanding white-collar jobs over time, not the other way around, but in a recession most individuals lose jobs, not change them. Misreporting of pain may have occurred over time, but why it would have occurred suddenly in 2007-2010 and not before or after, and not for more educated individuals, is not clear. In addition, that trend increases in pain are observed in multiple data sets makes it unlikely that misreporting is occurring simultaneously in all of them. Obesity may have some role to play in the trend—Case et al. estimate that as much as one-quarter of the trend increase in pain could have been a result of increasing weight—but this has even a less plausible explanation for a short-term, one-time permanent increase in pain.

That there was a discontinuous jump in some measures of pain after the Great Recession does not necessarily mean that underlying long-term trends could not have contributed to that jump

[6] In a unique study focusing on low income single mothers, Currie et al. (2015) find a deterioration, with the negative effects stronger the more economically disadvantaged the mother. Case and Deaton (2020) argue that short-term events like recessions are unlikely to affect mortality because long-term trends are far more important.

since a major economic downturn can act as a "trigger" which acts on those trends to move them over a threshold and have long-term impacts. In economics, macroeconomists have heavily studied such "hysteresis" effects in which what is a presumed short-term, temporary decline in national output has a permanently negative effect on output thereafter (e.g., Ball (2014)). In the labor market, 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, having triggered increases in pain associated with that sudden increase in distress.

An additional channel, although also somewhat speculative, is related to the extensive literature on biopsychosocial models of pain, which has shown that the experience of pain is filtered through personal characteristics and perceptions and is partly biological but also partly psychological and social (Gatchel et al., 2007; Turk et al., 2011). 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, it would be consistent with such a mechanism. Somewhat more directly related is the large literature on allostatic overload, which argues that cumulative stresses of life and life events and general "wear and tear" can, at some point, lead to poorer physiological health outcomes and to chronic pain (McEwen and Seeman, 1999; Slade et al., 2012; Khalatbari-Soltani and Blyth, 2022).[7] This channel would be consistent again with the argument of Case et al. that pain is the result of cumulative decline in quality of life but also with a recession inducing a particularly strong increase because of the associated increase in stress.

The role of opioids has been heavily discussed by Case and Deaton (2020) as a possible contributor to mortality, but less has been written on its possible contribution to the rise in pain.

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

Case et al. 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 such as those occurring 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 jump in that period, and the latter should have generated a stronger trend increase only in the years after 2010.

Case et al. refer to the "mystery" of pain and Case and Deaton (2020) titled their chapter on pain the "mystery" of pain, suggesting that it is difficult to explain and causes of trends in pain are particularly difficult to establish. We agree with that characterization and suggest a new and even more mysterious escalation of pain at the time of the Great Recession which deserves more research attention.

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Figures and Tables

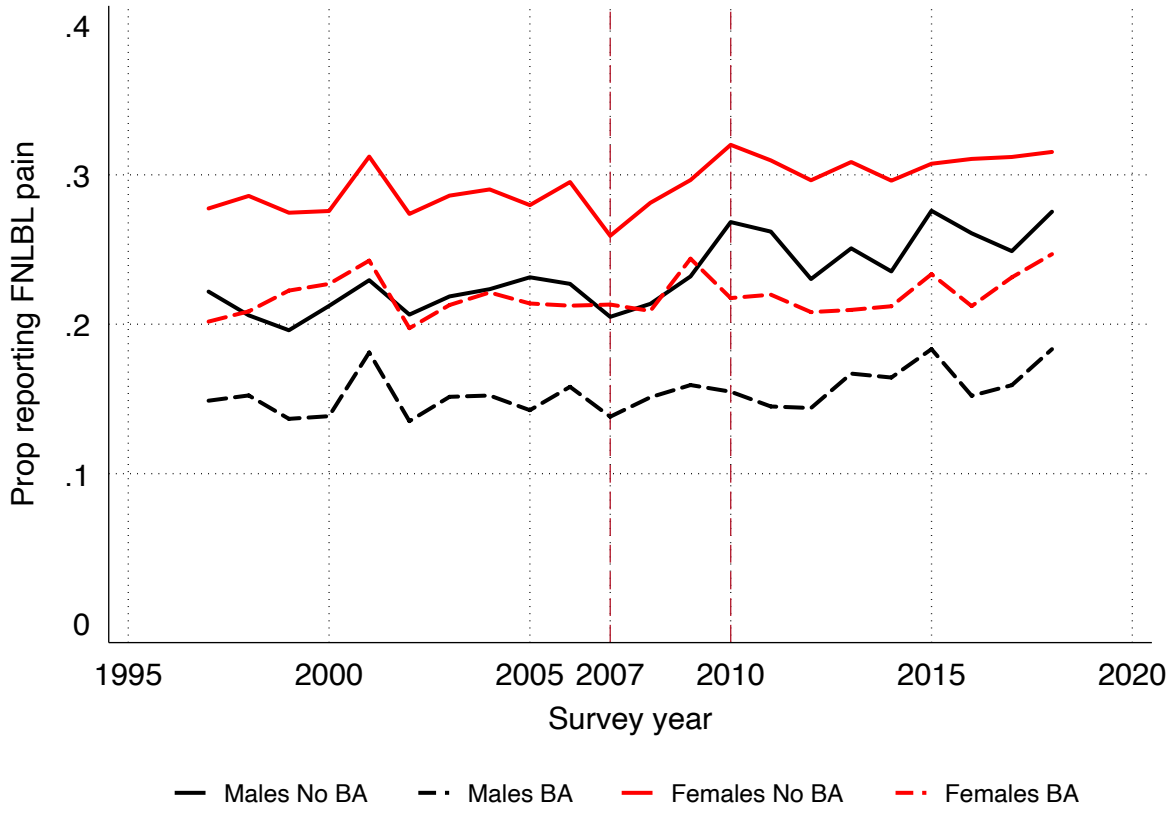

Figure 1: Trends in prevalence of pain among 25–79-year-old males and females with (BA) and without a BA degree (No BA)

Note: *We show results for "face, or neck, or lower back & leg pain" (FNLBL Pain) (n=123,326 and n= 58,016 for males without and with BA. n= 153,566 and n= 67,694 for females without and with BA). All estimates are weighted using sample weights.*

Figure 2: Trends in prevalence of pain among 25–79-year-old males and females without a BA degree by age groups

Note: *Trends in prevalence of self-reports of pain in the United States among 25-79 males and females without a BA degree by 10 year age groups (25-34, 35-44, 45-54, 55-64, and 65-74 years old). We show results for "face, or neck, or lower back & leg pain" (FNLBL Pain). The y-axis has been shrunk for expositional purposes. All estimates are weighted using sample weights.*

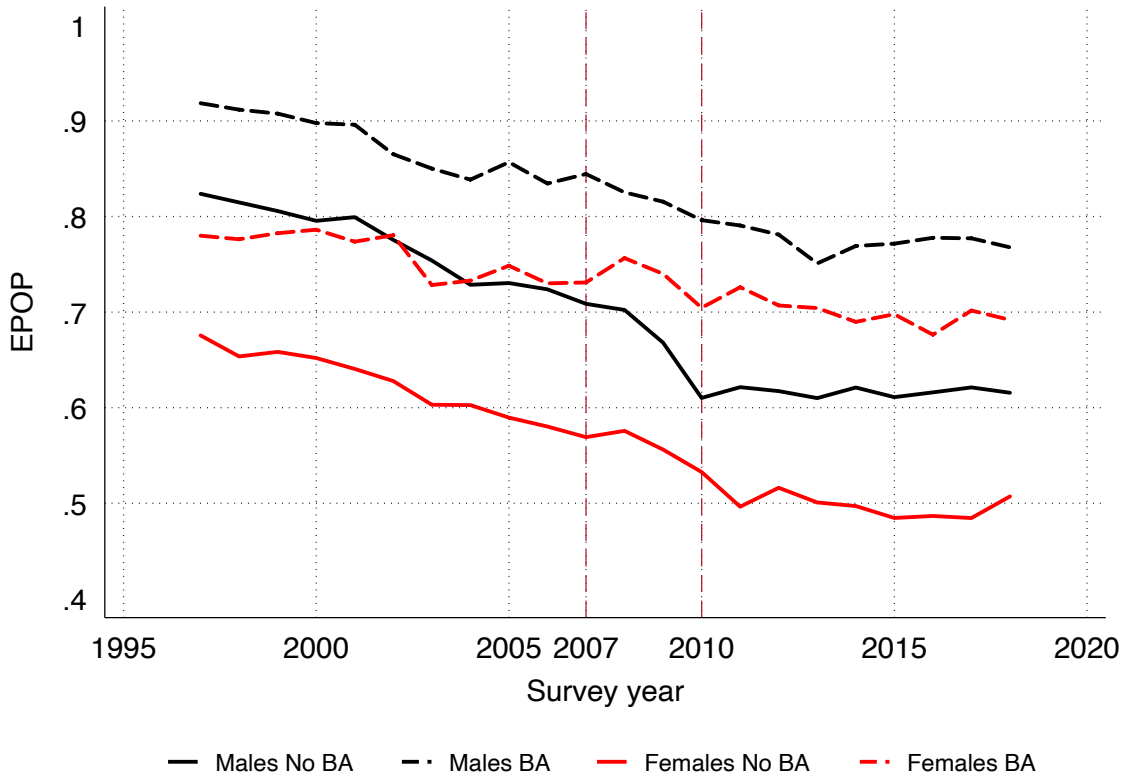

Figure 3: Trends in employment population ratio among 25–79-year-old males and females with (BA) and without a BA degree (No BA)

Note: *n=122,937and n= 57,970 for males without and with BA. n= 153,201and n= 67,615 for females without and with BA. EPOP is based on MONTHWRK for which respondents are asked the question "How many months [in the last calendar year] did [you] have at least one job or business?" MONTHWRK is only available in NHIS from the year 1997 onwards. The variable EPOP takes the value 1 if months worked last year are greater than or equal to 9 (0 otherwise). All estimates are weighted using sample weights.*

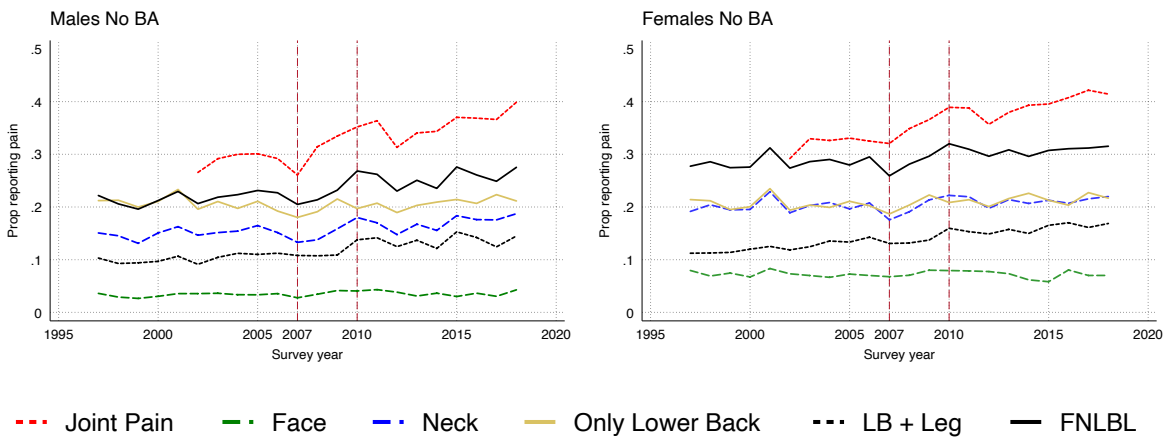

Figure 4: Trends in prevalence of pain among 25–79-year-old males and females without a BA degree by location of pain

Note: *Trends in reports of pain in the United States among 25-79 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) and its constituents including face pain, neck pain, and leg pain (LB+Leg). We also show results for only lower back pain which is asked before the question on leg pain. For joint pain the NHIS asks "DURING THE PAST 30 DAYS, have you had any symptoms of pain, aching, or stiffness in or around a joint?" and then "Did your joint symptoms FIRST begin more than 3 months ago?". These two questions were combined to create the measure of joint pain so that the recall period is 3 months for all measures of pain shown here. All estimates are weighted using sample weights.*

Appendix Figures and Tables

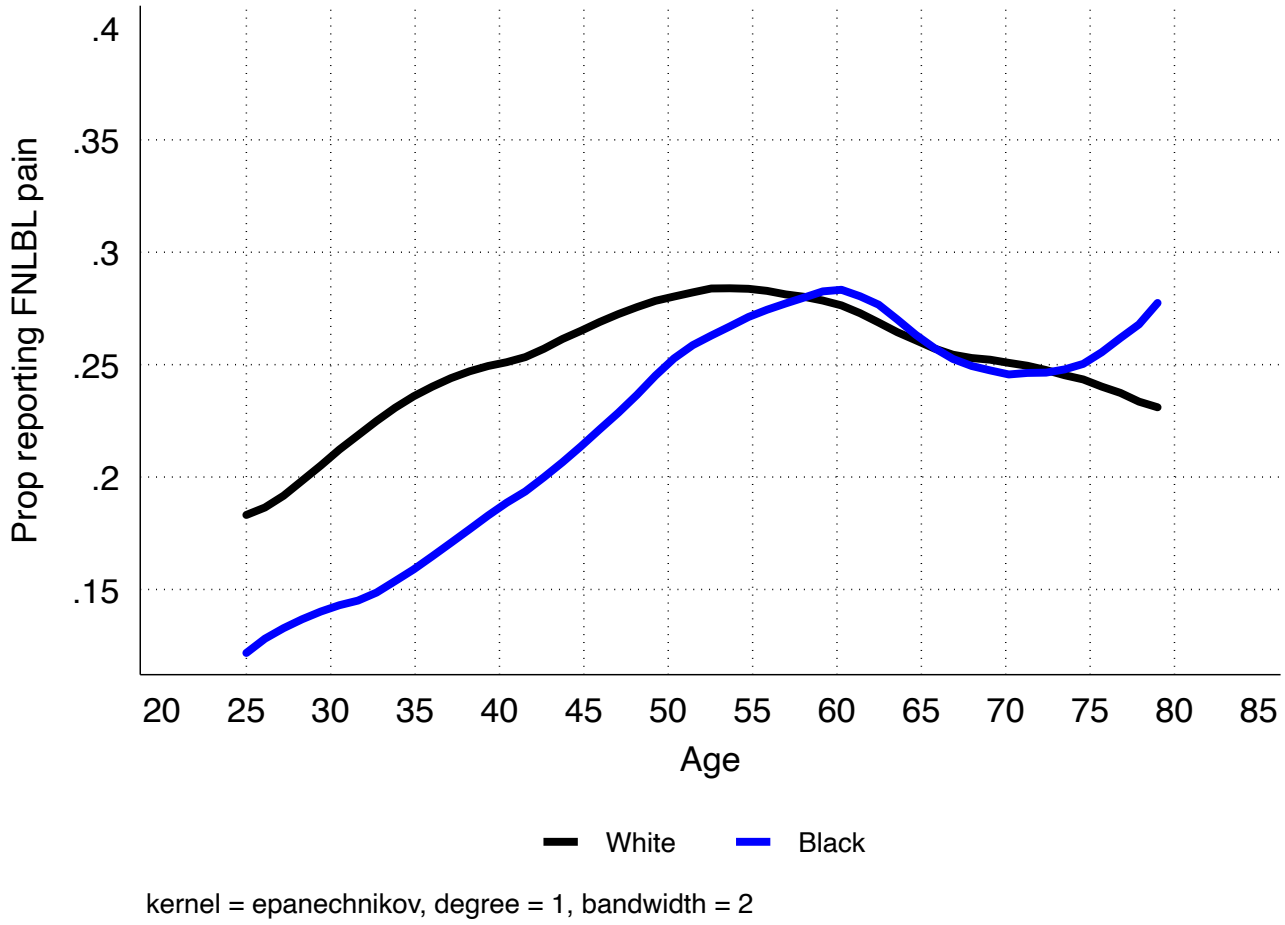

Figure S1: Proportion reporting Face, or Neck, or Lower Back and Leg (FNLBL) Pain over Ages by Race (Replication of Case et al. 2020)

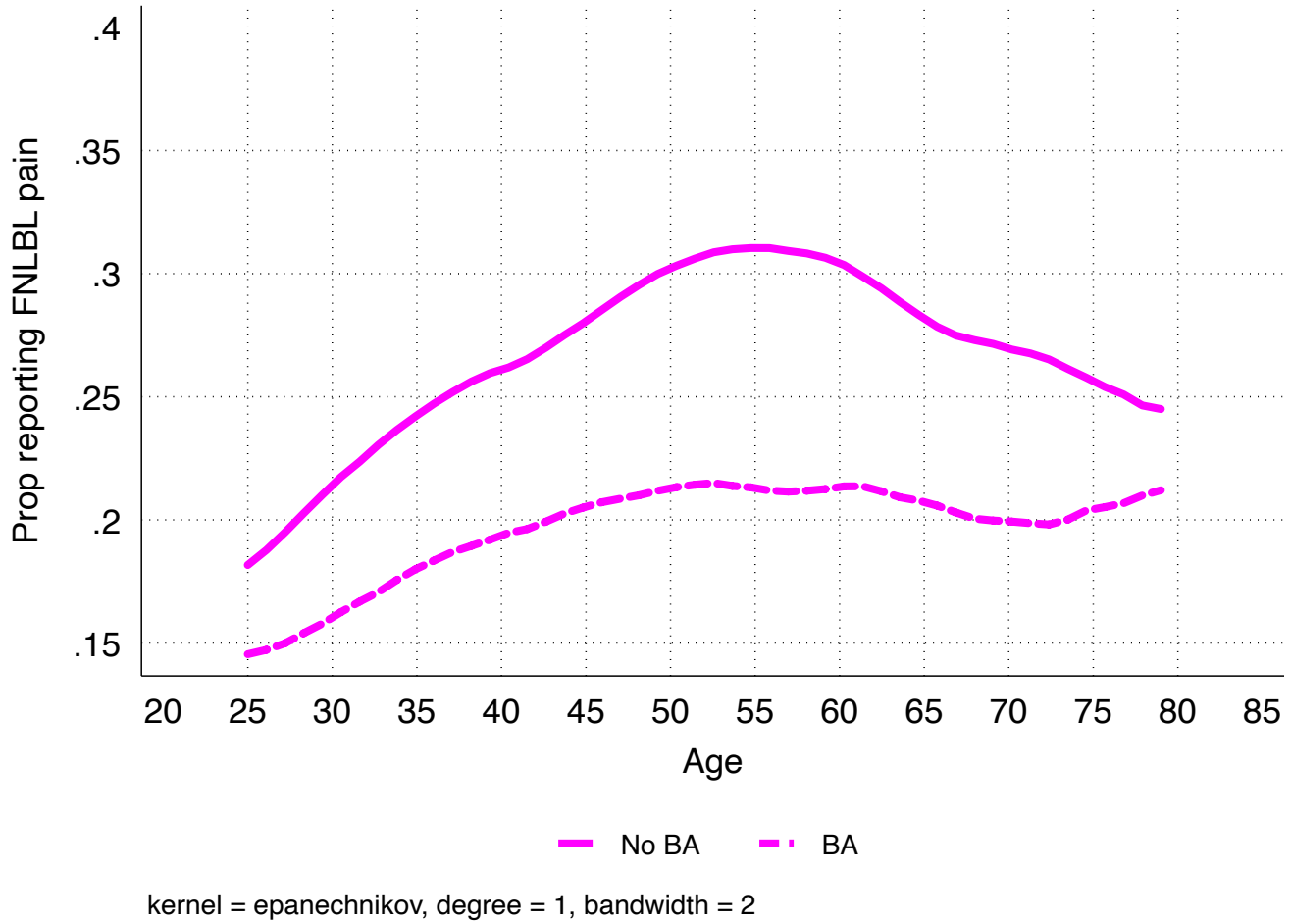

Figure S2: Proportion reporting Face, or Neck, or Lower Back and Leg (FNLBL) Pain over Ages by BA degree (Replication of Case et al. 2020)

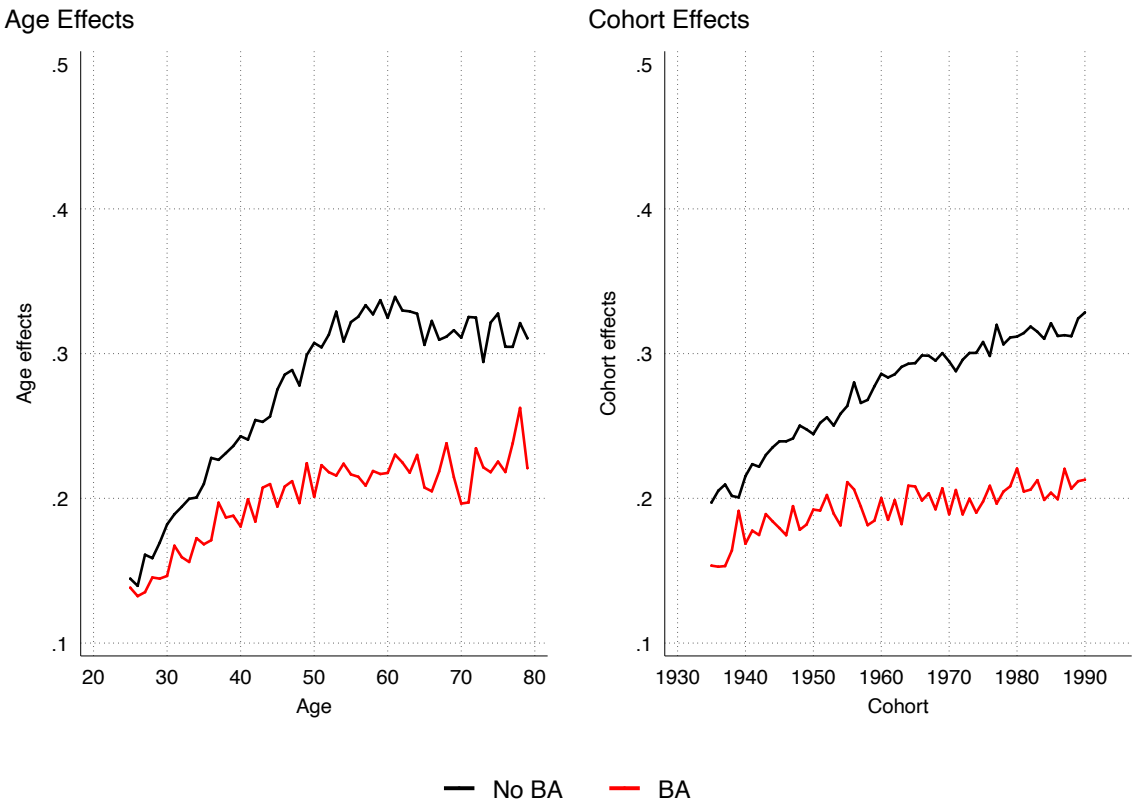

Figure S3: Age Effects and Cohort Effects (Replication of Case et al. 2020)

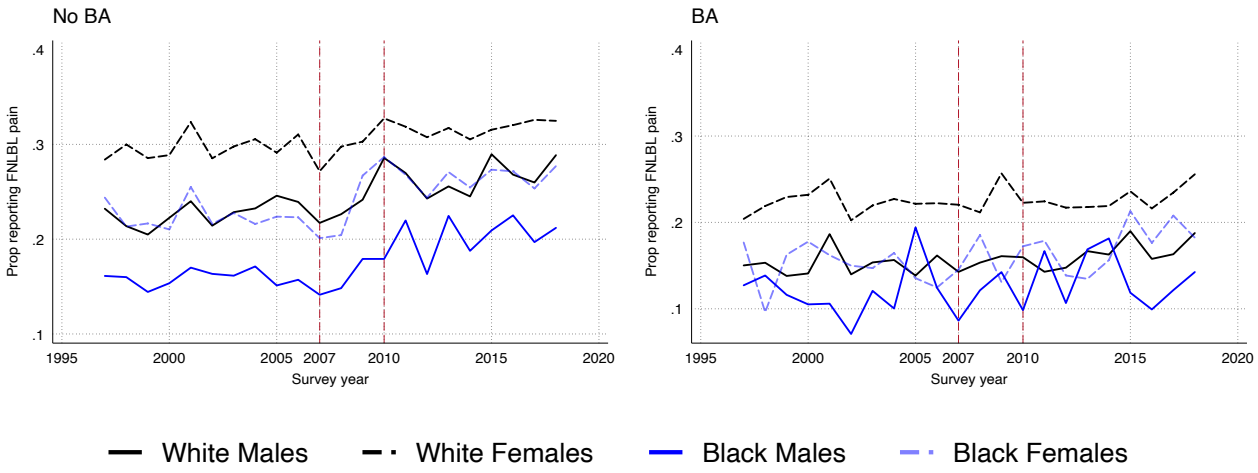

Figure S4: Trends in prevalence of pain among 25–79-year-olds with and without a BA degree by race

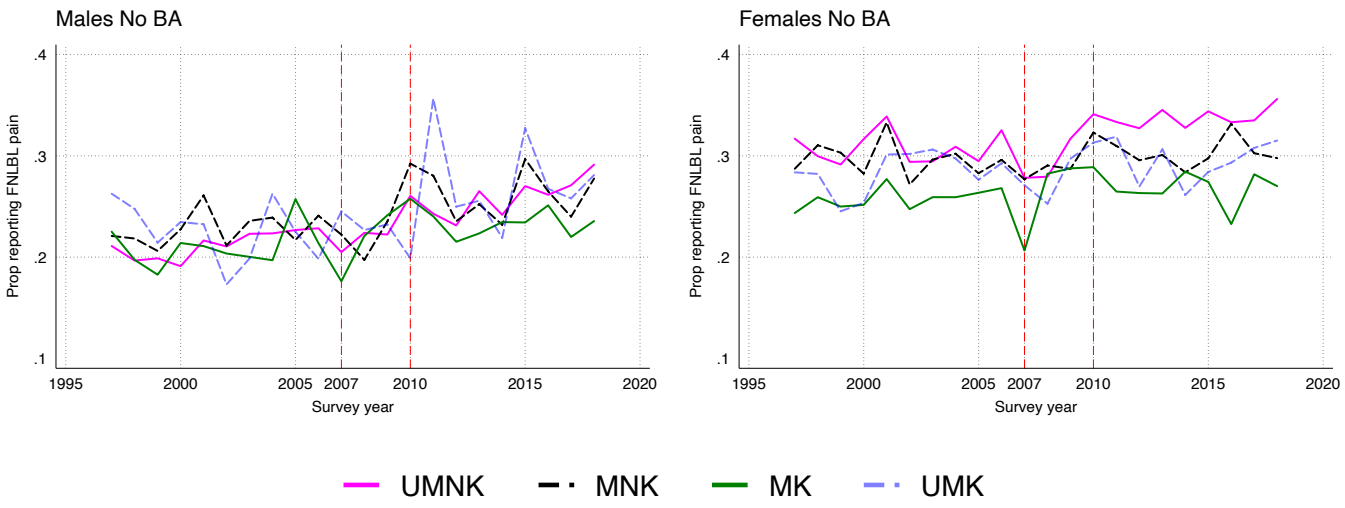

Figure S5: Trends in prevalence of pain among 25–79-year-old adults without a BA degree by family structure categories

Note: *Trends in reports of pain in the United States among 25-79 males and females without a BA degree by marital status and presence of children. UMNK- Unmarried with no children; MNK – Married with no children; MK – Married with children; UMK – Unmarried with children. The y-axis has been shrunk for expositional purposes. All estimates are weighted using sample weights.*

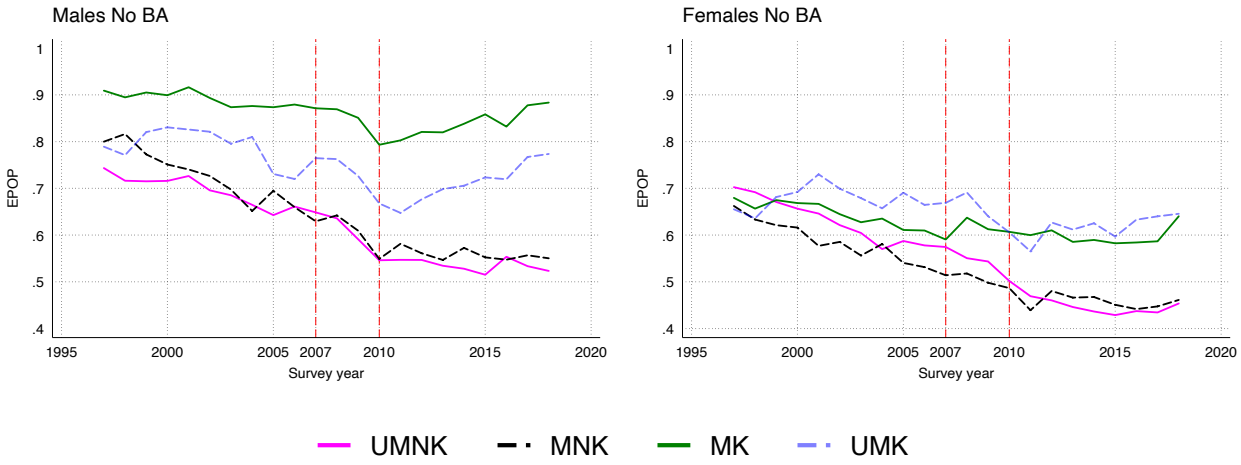

Figure S6: Trends in Employment Population Ratio among 25–79-year-old males and females without a BA degree by marital status and presence of children

Note: *Trends in reports of employed as a proportion of the population (Employment Population Ratio) in the United States among 25-79 males and females without a BA degree by marital status and children. UMNK- Unmarried with no children; MNK – Married with no children; MK – Married with children; UMK – Unmarried with children. All estimates are weighted using sample weights.*

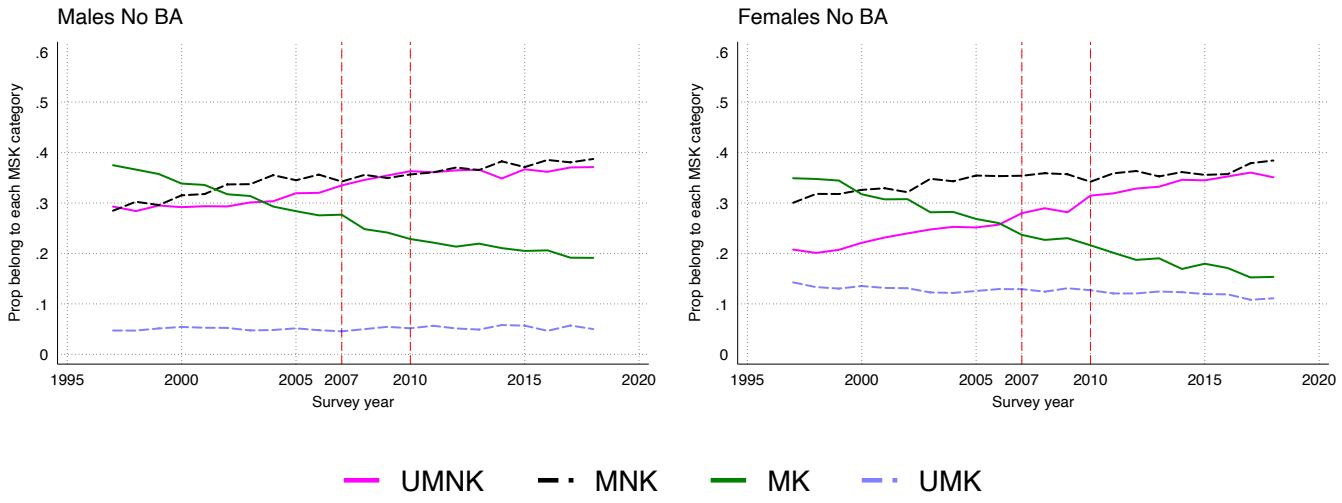

Figure S7: Trends in the proportion of 25–79-year-old males and females belonging to each family structure (MSK) category

Note: *Figure above shows the proportion of males and females without BA degree in each of the four family structure categories: UMNK- Unmarried with no children; MNK – Married with no children; MK – Married with children; UMK – Unmarried with children. All estimates are weighted using sample weights.*

Table S1: Regressions for FNLBL pain (estimated separately for males and females with and without BA) (Recession = 2008-2010)

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
Min(Year, 2007)	0.001	-0.000	-0.001	-0.001
Dummy for After 2010	0.024***	0.002	0.025***	-0.002
Max(Year, 2010)	0.003***	0.004***	0.002***	0.003***
Constant	-7.823***	-6.618***	-2.809	-4.421*
Observations	109,379	51,508	135,855	60,113
R-squared	0.003	0.001	0.001	0.000

**** p<0.01, ** p<0.05, * p<0.1*

Note: These results are for regressions estimated on the pooled sample (see Figure 1 footnote for sample sizes) 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), Dummy for years 2010 and after, and Max(Year, 2010). Observations in 2008, 2009, and 2010 are omitted from the regression to allow the Dummy variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2007to 2010, and the post-2010 trend. All regressions in the rest of the tables have the same specification.

Table S1A: Regressions for FNLBL pain (estimated separately for males and females with and without BA) (Recession = 2007-2010)

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
Min(Year, 2007)	0.002***	-0.000	0.000	-0.001
Dummy for After 2010	0.018***	-0.001	0.017***	-0.003
Max(Year, 2010)	0.003***	0.004***	0.002***	0.003***
Constant	-9.626***	-7.295***	-5.065**	-4.605
Observations	105,209	49,488	130,609	57,850
R-squared	0.003	0.001	0.001	0.000

**** p<0.01, ** p<0.05, * p<0.1*

Note: These results are for regressions estimated on the pooled sample (see Figure 1 footnote for sample sizes) 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), Dummy for years 2010 and after, and Max(Year, 2010). Observations in 2007, 2008, 2009, and 2010 are omitted from the regression to allow the Dummy variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2007to 2010, and the post-2010 trend. All regressions in the rest of the tables have the same specification.

Table S1B: Regressions for FNLBL pain (estimated separately for males and females with and without BA) (Recession = 2007-2009)

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
Min(Year, 2007)	0.002***	-0.000	0.000	-0.001
Dummy for After 2010	0.025***	0.001	0.022***	0.000
Max(Year, 2010)	0.002***	0.003***	0.001*	0.003***
Constant	-7.200***	-6.587***	-3.190*	-3.370
Observations	110,115	51,819	136,797	60,514
R-squared	0.003	0.001	0.001	0.000

**** p<0.01, ** p<0.05, * p<0.1*

Note: These results are for regressions estimated on the pooled sample (see Figure 1 footnote for sample sizes) 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), Dummy for years 2010 and after, and Max(Year, 2010). Observations in 2007, 2008, and 2009 are omitted from the regression to allow the Dummy variable to show the discontinuity more clearly. The three estimated coefficients therefore pick up the pre-2007 trend, the jump from 2007to 2010, and the post-2010 trend. All regressions in the rest of the tables have the same specification.

Table S2: Regressions for FNLBL pain (estimated separately for males and females without BA belonging to each 10-year age group) (Recession = 2008-2010)

	Dependent Variable: FNLBL Pain				
	Males No BA				
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Ages 25-34	Ages 35-44	Ages 45-54	Ages 55-64	Ages 65-74
Min(Year, 2007)	-0.002*	0.000	0.001	0.001	0.004
Dummy for After 2010	0.020*	0.020	0.043***	0.025**	0.016
Max(Year, 2010)	0.003	0.001	0.001	0.005**	0.005**
Constant	-1.531	-2.495	-4.284	-11.824**	-17.839**
Observations	21,581	25,089	25,781	22,910	11,578
R-squared	0.001	0.001	0.004	0.004	0.003
	Females No BA				
	(1)	(2)	(3)	(4)	(5)
	Ages 25-34	Ages 35-44	Ages 45-54	Ages 55-64	Ages 65-74
Min(Year, 2007)	-0.002*	-0.001	-0.001	-0.000	-0.002
Dummy for After 2010	0.017	0.003	0.046***	0.042***	0.030**
Max(Year, 2010)	0.003	0.006***	0.002	-0.001	0.002
Constant	-2.479	-9.326*	-1.957	3.095	0.356
Observations	26,631	29,439	30,573	28,978	16,211
R-squared	0.001	0.001	0.003	0.001	0.001

**** p<0.01, ** p<0.05, * p<0.1*

Table S3 Cohort shifts by age in pain for 25–78-year-old males and females without BA by 3-year cohorts and 3-year age groups

Proportion reporting Face, OR Neck, OR Lower Back & Leg (FNLBL) Pain

Males No BA																		
Age																		
Cohort	**25-27**	**28-30**	**31-33**	**34-36**	**37-39**	**40-42**	**43-45**	**46-48**	**49-51**	**52-54**	**55-57**	**58-60**	**61-63**	**64-66**	**67-69**	**70-72**	**73-75**	**76-78**
1921/1923																		0.172
1924/1926																	0.184	0.179
1927/1929																0.212	0.196	0.231
1930/1932															0.198	0.198	0.188	
1933/1935														0.223	0.186	0.224		
1936/1938													0.241	0.206	0.180			0.235
1939/1941												0.214	0.247	0.253			0.220	0.213
1942/1944											0.248	0.236	0.275			0.241	0.240	
1945/1947										0.223	0.264	0.235			0.248	0.275		
1948/1950									0.224	0.249	0.252			0.275	0.259			
1951/1953								0.227	0.257	0.235			0.281	0.251				
1954/1956							0.213	0.247	0.251			0.307	0.312					
1957/1959						0.211	0.241	0.236			0.270	0.371						
1960/1962					0.190	0.213	0.252			0.297	0.350							
1963/1965				0.212	0.235	0.229			0.286	0.311								
1966/1968			0.186	0.199	0.241			0.289	0.288									
1969/1971		0.139	0.190	0.194			0.250	0.280										
1972/1974	0.153	0.159	0.184			0.238	0.275											
1975/1977	0.149	0.157			0.227	0.221												
1978/1980	0.163			0.215	0.252													
1981/1983			0.213	0.237														
1984/1986		0.212	0.205															
1987/1989	0.145	0.188																
1990/1992	0.189																	

Proportion reporting Face, OR Neck, OR Lower Back & Leg (FNLBL) Pain

Females No BA																		
	Age																	
Cohort	**25-27**	**28-30**	**31-33**	**34-36**	**37-39**	**40-42**	**43-45**	**46-48**	**49-51**	**52-54**	**55-57**	**58-60**	**61-63**	**64-66**	**67-69**	**70-72**	**73-75**	**76-78**
1921/1923																		0.266
1924/1926																	0.261	0.277
1927/1929																0.244	0.255	0.250
1930/1932															0.231	0.249	0.276	
1933/1935														0.257	0.244	0.268		
1936/1938													0.286	0.274	0.258			0.278
1939/1941												0.289	0.308	0.289			0.282	0.226
1942/1944											0.312	0.300	0.303			0.298	0.317	
1945/1947										0.319	0.326	0.324			0.320	0.287		
1948/1950									0.347	0.342	0.306			0.303	0.316			
1951/1953								0.293	0.313	0.293			0.327	0.290				
1954/1956							0.297	0.329	0.298			0.324	0.311					
1957/1959						0.268	0.304	0.305			0.335	0.299						
1960/1962					0.277	0.295	0.284			0.353	0.323							
1963/1965				0.281	0.283	0.299			0.356	0.406								
1966/1968			0.250	0.256	0.285			0.347	0.381									
1969/1971		0.240	0.239	0.260			0.312	0.352										
1972/1974	0.220	0.228	0.221			0.293	0.306											
1975/1977	0.208	0.245			0.291	0.253												
1978/1980	0.205			0.287	0.336													
1981/1983			0.297	0.254														
1984/1986		0.238	0.288															
1987/1989	0.212	0.240																
1990/1992	0.204																	

Note: The table above shows the proportion of adults reporting face, or neck, or lower and leg pain for 3-year cohorts and 3-year age groups. The top three cells in each column shows proportions before the Great Recession of 2007-2010. The bottom two cells in each column shows proportions after the Great Recession of 2007-2010. The youngest cohort for each 3-year age group considered is an average over 2 cohort years instead of 3 cohort years. For example, 25–27-year-olds who were born between 1990-1992 are those who were born between 1990-1991. This is because we keep the cohorts considered constant within each age group considered

Appendix Table S4: Regressions for employment (estimated separately for males and females with and without BA) (Recession = 2008-2010)

Dependent Variable: Employment Population Ratio Last Year

VARIABLES	(1) All Males No BA	(2) All Males With BA	(3) All Females No BA	(4) All Females With BA
Min(Year, 2007)	-0.014***	-0.010***	-0.011***	-0.007***
Dummy for After 2010	-0.097***	-0.046***	-0.072***	-0.012
Max(Year, 2010)	-0.001	-0.005***	-0.004***	-0.008***
Constant	30.935***	30.500***	30.543***	31.351***
Observations	109,025	51,464	135,519	60,047
R-squared	0.039	0.026	0.024	0.011

**** p<0.01, ** p<0.05, * p<0.1*

Table S5: Regressions for proportion belonging to each family structure category (estimated separately for males without BA and females without BA) (Recession = 2008-2010)

Dependent Variable: Dummy for unmarried with no children present (UMNK)

	(1)	(2)
VARIABLES	All Males No BA	All Females No BA
Min(Year, 2007)	0.003***	0.009***
Dummy for After 2010	0.049***	0.050***
Max(Year, 2010)	0	0.007***
Constant	-6.498***	-31.464***
Observations	108,993	135,344
R-squared	0.005	0.019

Dependent Variable: Dummy for married with no children present (MNK)

	(1)	(2)
VARIABLES	All Males No BA	All Females No BA
Min(Year, 2007)	0.007***	0.003***
Dummy for After 2010	-0.019***	-0.016***
Max(Year, 2010)	0.006***	0.006***
Constant	-24.397***	-18.009***
Observations	108,993	135,344
R-squared	0.003	0.002

Dependent Variable: Dummy for married with children present (MK)

	(1)	(2)
VARIABLES	All Males No BA	All Females No BA
Min(Year, 2007)	-0.010***	-0.010***
Dummy for After 2010	-0.035***	-0.038***
Max(Year, 2010)	-0.004***	-0.005***
Constant	28.584***	28.939***
Observations	108,993	135,344
R-squared	0.019	0.022

Dependent Variable: Dummy for unmarried with children present (UMK)

	(1)	(2)
VARIABLES	All Males No BA	All Females No BA
Min(Year, 2007)	0	-0.003***
Dummy for After 2010	0.004	0.004
Max(Year, 2010)	-0.001***	-0.008***
Constant	3.311***	21.534***
Observations	108,993	135,344
R-squared	0	0.005

**** p<0.01, ** p<0.05, * p<0.1*

Table S6: Regressions for FNLBL pain (estimated separately for males and females without BA belonging to each family structure category) (Recession = 2008-2010)

Dependent Variable: FNLBL Pain

	Males No BA				**Females No BA**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	UMNK	MNK	MK	UMK	UMNK	MNK	MK	UMK
Min(Year, 2007)	0.001	0.001	-0.000	-0.001	-0.002**	-0.002*	-0.001	0.000
Dummy for After 2010	0.023***	0.019*	0.015	0.065***	0.042***	0.014	0.017	-0.006
Max(Year, 2010)	0.005***	0.002	0.002	-0.002	0.001	0.002	0.002	0.006**
Constant	-11.898***	-5.484	-3.779	6.594	3.105	0.903	-1.823	-11.373**
Observations	47,773	32,233	23,084	5,842	50,081	37,111	25,864	22,180
R-squared	0.004	0.002	0.001	0.003	0.001	0.000	0.000	0.001

**** p<0.01, ** p<0.05, * p<0.1*

UMNK- Unmarried with no children; MNK – Married with no children; MK – Married with children; UMK – Unmarried with children

Table S7: Regressions for employment (estimated separately for males and females without BA belonging to each family structure category) (Recession = 2008-2010)

Dependent Variable: Employment Population Ratio Last Year

	Males No BA				**Females No BA**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	UMNK	MNK	MK	UMK	UMNK	MNK	MK	UMK
Min(Year, 2007)	-0.013***	-0.019***	-0.004***	-0.004	-0.016***	-0.013***	-0.007***	0.001
Dummy for After 2010	-0.098***	-0.068***	-0.081***	-0.149***	-0.088***	-0.048***	-0.018	-0.115***
Max(Year, 2010)	-0.003**	-0.004**	0.012***	0.019***	-0.006***	-0.004**	0.002	0.012***
Constant	32.530***	46.369***	-14.995***	-30.563***	45.343***	35.277***	11.625**	-26.035***
Observations	47,565	32,167	23,043	5,815	49,991	37,057	25,785	22,081
R-squared	0.036	0.042	0.008	0.015	0.043	0.022	0.004	0.005

**** p<0.01, ** p<0.05, * p<0.1*

UMNK- Unmarried with no children; MNK – Married with no children; MK – Married with children; UMK – Unmarried with children

Appendix Table S8: Regressions for all measures of pain (estimated separately for males and females without BA) (Recession = 2008-2010)

	Males No BA					***Females No BA***				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	Joint	Face	Neck	Only Lower Back	LB+Leg	Joint	Face	Neck	Only Lower Back	LB+Leg
Min(Year, 2007)	0.001	0.000	-0.000	-0.002***	0.002***	0.004***	-0.001**	-0.001*	-0.001***	0.002***
Dummy for After 2010	0.042***	0.007***	0.009*	0.004	0.023***	0.034***	0.009***	0.013***	0.009*	0.017***
Max(Year, 2010)	0.009***	-0.001	0.004***	0.004***	0.000	0.009***	-0.001**	0.002**	0.002**	0.002***
Constant	-19.646***	1.153	- 6.967***	-2.457	- 4.245***	- 25.755***	3.541***	-1.774	-0.781	- 9.061***
Observations	80,684	109,330	109,340	109,337	109,371	98,789	135,822	135,831	135,821	135,850
R-squared	0.008	0.000	0.001	0.000	0.003	0.008	0.000	0.000	0.000	0.003

**** p<0.01, ** p<0.05, * p<0.1*

Note: Sample sizes are smaller for joint pain compared to the other pain measures because this measure is available in NHIS starting in 2002.