

Pain among US adults before, during, and after the COVID-19 pandemic: a study using the 2019 to 2023 National Health Interview Survey

Anna Zajacova^{a,*}, Hanna Grol-Prokopczyk^b, Richard L. Nahin^c

Abstract

The unprecedented disruption of the COVID-19 pandemic raises crucial questions about its impact on chronic pain levels in the US population. We present a comprehensive analysis of chronic pain (CP), high-impact chronic pain (HICP), and site-specific pain prevalence before, during, and after the pandemic, and investigate key contributing factors. We analyze a nationally representative sample of 90,769 community-dwelling adults aged 18 years and older from 3 cross-sectional waves of the National Health Interview Survey (2019, 2021, and 2023). Outcomes are CP and HICP; we also present findings for 6 site-specific pain measures. We include an extensive range of covariates (demographics, socioeconomic status, health behaviors, health conditions, mental health, and health insurance type); additional analyses also explore the role of long COVID. Chronic pain prevalence increased from 20.5% (95% confidence interval: 19.9%-21.2%) in 2019 to 20.9% (20.3%-21.6%) in 2021 and 24.3% (23.7%-25.0%) in 2023, representing an 18% increase over the study period. High-impact chronic pain prevalence, which was 7.5% (7.1%-7.8%) in 2019, declined to 6.9% (6.6%-7.3%) in 2021 before rising to 8.5% (8.1%-8.9%) in 2023, a 13% overall increase. The 2023 pain increases were widespread: they occurred for all examined body sites except tooth/jaw pain and all population subgroups. Long COVID accounted for approximately 13% of the observed 2019 to 2023 increase in both CP and HICP. In 2023, an estimated 60 million Americans experienced CP and 21 million experienced HICP, the highest prevalence ever recorded in the National Health Interview Survey. These findings suggest a significant escalation in the population burden of pain, with crucial implications for public health policy.

Keywords: Chronic pain, High-impact chronic pain, US adults, Trends, Epidemiology, COVID-19

1. Introduction

Chronic pain affects millions of US adults, constituting a public health crisis with profound economic and social consequences. The annual cost of pain was estimated at \$560–\$635 billion annually (in 2010 dollars), surpassing the costs of heart disease, cancer, or diabetes.¹³ Pain affects physical, mental, and cognitive health.^{2,27,33} It also profoundly affects all other life domains such as employment,³¹ family relationships,³⁸ sexual function,¹² and sleep,¹⁹ and contributes significantly to opioid use and misuse, which remain a major public health challenge.⁴¹ Given the pain's

role as a barometer of population health,⁴⁸ monitoring pain levels in the United States is one of the Healthy People 2030 goals.³⁰

During the early years of the 21st century, chronic pain increased steadily among US adults,^{43,47,50,51} but the upward trends slowed or even reversed by 2020 or 2021.^{22,34} This encouraging change coincided with the start of the COVID-19 pandemic, however, when pain researchers warned of potential widespread pain-related consequences of COVID-19.^{6,20} Pain might increase as a direct consequence of the viral infection^{25,36} or due to stress, anxiety, depression, and loneliness linked to social distancing^{26,45}; increases in detrimental health behaviors^{39,49}; disrupted health care³⁷; or economic hardships during the pandemic.⁴² In recent years, emerging literature has documented pain-related consequences of COVID-19 infection, especially of long COVID.^{10,21,25,35,44} Despite these concerns, little is known about chronic pain prevalence at the population level after the pandemic.

To date, only 2 brief government reports have provided pain prevalence estimates among US adults during this period—one during the pandemic³⁴ and one postpandemic.²⁴ These reports document a 2021 chronic pain prevalence comparable with that of prior years and a higher prevalence in 2023. These studies are purely descriptive, however, offering only unadjusted prevalence for selected population groups without systematic comparisons over time or examination of potential drivers, such as pandemic-linked social and economic disruptions or long COVID.

Our study provides the first comprehensive assessment of chronic pain in a nationally representative sample of US adults before (2019), during (2021), and after (2023) the COVID-19

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^a University of Western Ontario, London, ON, Canada, ^b University at Buffalo, SUNY, Buffalo, NY, United States, ^c National Center for Complementary and Integrative Health, NIH, Bethesda, MD, United States

*Corresponding author. Address: 5330 Social Science Centre, University of Western Ontario, London ON N6A 5C2, Canada. E-mail address: anna.zajacova@uwo.ca (A. Zajacova).

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pandemic. Using data from the National Health Interview Survey, we examine trends in multiple chronic pain measures, including high-impact chronic pain³² and 6 location-specific pain indicators, in the total population and across key population subgroups. Importantly, we explore potential mechanisms underlying the observed changes, with particular attention to the role of long COVID in the postpandemic pain landscape.

2. Methods

2.1. Data

We analyzed trends in pain using data from the 2019, 2021, and 2023 National Health Interview Survey (NHIS) harmonized by IPUMS.⁴ The NHIS, approved by the National Center for Health Statistics Research Ethics Review Board, is an ongoing cross-sectional household-based interview survey. It is deemed to be the “best single source for pain surveillance” among US adults, including for the study of pain trends.⁹

The choice of the 3 waves—2019, 2021, and 2023—is based on NHIS’s sampling and variable collection practices: 2019 is the first year after a major study redesign¹⁷; 2023 is the most recent wave available at the time of the writing, and key variables were not collected in 2020 and 2022. In the 3 waves combined, the NHIS included 90,769 respondents aged 18 years and older.

2.2. Variables

Two widely used measures of pain were collected in 2019, 2021, and 2023. Chronic pain (CP) is defined as pain on most days or every day over the past 3 months, vs never or only on some days. High-impact chronic pain (HICP) is CP that also limits activities on most days or every day (versus no CP or CP that limits activities only on some days or never).

We also analyze all 6 available site-specific pain questions. Respondents who indicated they had pain on some days, most days, or every day were asked how much pain they experienced during the past 3 months in the following sites: back; arm, shoulder, or hand; hip, knee, or feet; headache or migraine; abdominal, pelvic, or genital; and jaw or tooth pain. Those who said they had “a lot of” pain at a given site (versus none, a little, or “somewhere between a little and a lot”) were classified as having significant pain at that site.

The main predictor is the year of interview (2019 as reference, 2021, and 2023).

Covariates include demographics (age, sex, race/ethnicity, region, and rural/urban classification), socioeconomic status, health behaviors, physical health conditions, mental health, and health insurance type. The final covariate is long COVID (ever, vs never as reference). Supplemental analyses also use a more detailed categorization that includes current long COVID and current high-impact long COVID. The long COVID variables are only available in 2023; 2019 was before the pandemic and the variables were not collected in 2021. The categories for all covariates, their distributions in the population, and tests for changes in the distribution across 2019, 2021, and 2023 are summarized in Supplemental Table S1, <http://links.lww.com/PAIN/C356>.

2.3. Approach

First, we estimated the weighted crude prevalence of CP, HICP, and the 6 site-specific pain measures in each year and tested for differences across waves using design-based F-tests (**Table 1**). We then visualized the prevalence of CP and HICP in major

population groups in each year. **Figure 1** shows the estimated prevalence for the total population, by sex, age groups, and education. Supplemental Figure S1, <http://links.lww.com/PAIN/C356> shows the prevalence also by race/ethnicity and rural/urban status. We summarize the underlying point estimates and their 95% confidence intervals in Supplemental Table S2, <http://links.lww.com/PAIN/C356>. These estimates were adjusted for changes in age distribution across the 3 waves within each population subgroup by calculating average predicted prevalences from robust Poisson models that included age and year as covariates, estimated separately for each subgroup.

In addition to the graphical representation that visualized the 2019-to-2023 pain increases in major population subgroups, we formally tested whether the degree of change differed across population subgroups. This was performed by estimating regression models of pain with interaction terms between year and each population group, net of basic demographic controls (Supplemental Table S3, <http://links.lww.com/PAIN/C356>).

Second, we examined the covariates of pain change over time using regression-based approaches. Statistical significance was defined as $P < 0.05$ for all analyses, with P -values either reported exactly or using asterisks in select tables for parsimony ($*P < 0.05$, $**P < 0.01$, $***P < 0.001$). We estimated a series of regression models of all pain outcomes as a function of year, net of the following covariate groups: Model 1 was bivariate, including only the survey year; Model 2 controlled for all covariates except long COVID; and Model 3 added long COVID (**Table 2**). We used modified Poisson models, which are appropriate for dichotomous outcomes and increasingly preferred over logistic models because their exponentiated coefficients are interpretable as prevalence ratios rather than the less intuitive odds ratios.⁴⁰

Table 2 also summarizes the percent of pain change between 2019 and 2023 that was due to long COVID, estimated using the Karlson–Breen–Holm (KHB) method⁵ for comparing coefficients across nonlinear models.

2.3.1. Sensitivity checks

We conducted extensive supplemental analyses to assess the robustness of our conclusions to different variable and model specifications. The regression models were reestimated with logit and probit links, and as linear probability models. The findings were comparable with those shown. We incorporated long COVID in regression models in 3 different ways because of its collinearity with 2019 and absence in 2021 (Supplemental Table S4, <http://links.lww.com/PAIN/C356>). Specifically, we used the composite year/COVID-19 set of dummies, added long COVID as a covariate (2021 dropped out of these models because long COVID was not ascertained that year), and estimated the models after excluding adults with long COVID. The goal was to ascertain that these 3 different approaches to incorporating long COVID yielded nearly identical results. We also estimated the KHB models with probit rather than logit link functions. Moreover, in addition to using the KHB decomposition to obtain an unbiased estimate of the proportion of the 2023 (vs 2019) difference due to long COVID, we also estimated the nested models with and without long COVID using linear probability models, as feasible for dichotomous outcomes,¹⁶ where it is possible to directly calculate percent of effect (for the 2023 year) that was due to the inclusion of COVID-19. These checks also obtained estimates similar to those shown in the article.

We examined missingness on dependent and independent variables closely. Of the 90,769 respondents, 2300 (2.5%) were missing the lead chronic pain question; an additional 23 (0.02%)

Table 1**Prevalence of pain in 2019, 2021, and 2023.**

	2019		2021		2023		P from pairwise tests		
	N	Prevalence, (95% CI)	N	Prevalence, (95% CI)	N	Prevalence, (95% CI)	2021 vs 2019	2023 vs 2021	2023 vs 2019
Sample size	31,916		29,396		29,457				
Population represented	250,334,186		252,461,316		257,760,200				
Global pain									
Chronic pain	50,154,951	20.5 (19.9-21.2)	51,490,798	20.9 (20.3-21.6)	60,713,114	24.3 (23.7-25.0)	0.358	<0.001	<0.001
HICP	18,218,925	7.5 (7.1-7.8)	17,076,145	6.9 (6.6-7.3)	21,114,932	8.5 (8.1-8.9)	0.033	<0.001	<0.001
Site-specific pain									
Back/neck	27,369,896	11.2 (10.8-11.7)	26,555,370	10.8 (10.4-11.2)	30,992,275	12.4 (11.9-12.9)	0.132	<0.001	<0.001
Shoulder/arm	20,774,218	8.5 (8.1-9.0)	19,389,110	7.9 (7.5-8.3)	22,807,394	9.2 (8.7-9.6)	0.015	<0.001	0.029
Hip/knee/leg	29,652,413	12.2 (11.7-12.7)	28,200,773	11.5 (11.0-12.0)	32,575,447	13.1 (12.6-13.6)	0.026	<0.001	0.006
Head/migraine	11,623,361	4.8 (4.5-5.1)	10,478,580	4.3 (4.0-4.6)	13,832,320	5.6 (5.2-5.9)	0.010	<0.001	<0.001
Abdominal	6,162,424	2.5 (2.3-2.8)	5,887,226	2.4 (2.2-2.6)	7,730,317	3.1 (2.9-3.4)	0.343	<0.001	<0.001
Tooth/jaw	5,349,077	2.2 (2.0-2.4)	5,277,190	2.2 (1.9-2.4)	5,534,036	2.2 (2.0-2.4)	0.736	0.602	0.871

Prevalence estimates for 2023 vis-à-vis 2019 for CP and HICP are bolded for ease of observation.

All contents adjusted for complex sampling design. The last 3 columns show *P*-values from survey-adjusted Wald tests for differences across pairs of year. F-tests for equality across all 3 years, not shown for parsimony, yielded *P*-values *P* < .001 for all pain measures except tooth/jaw where *P* = 0.873.

Site-specific pain is defined as "a lot" of pain, vs none, a little, or "somewhere in between a little and a lot" in each site.

HICP, high-impact chronic pain. Source: National Health Interview Survey, Adults 18 years and older, *n* = 90,769.

were missing HICP; and site-specific pain was missing for an additional 98 to 144 (0.1% to 0.2%). There was no missingness on age, region, rurality, race/ethnicity, and income (imputed by NCHS), and only 10 respondents were missing sex. Other covariates had low to moderate missingness such that the fully adjusted complete-case models with all covariates lost only 5.8% of the analytic sample. Nonetheless, we compared complete-case and multiply imputed models (Supplemental Table S5, <http://links.lww.com/PAIN/C356>); findings were nearly identical between both approaches.

Finally, we closely examined the role of long COVID in influencing pain prevalence in 2023. We first estimated the association between long COVID and pain net of covariates; this set of models yielded estimates of the long COVID–pain association at the individual level (Supplemental Table S6, <http://links.lww.com/PAIN/C356>). Then, we analyzed the role of long COVID at the population level. We calculated the counterfactual (hypothetical) prevalence of pain under 2 scenarios: if no one had long COVID and if everyone in the population had long COVID. These were obtained by calculating the predicted probabilities of the outcome (pain) for each individual using their actual covariate values, but assigning the values of 0 or 1, respectively, for long COVID. We then averaged these probabilities over all observations. The comparison of the first scenario and actual observed prevalence was also used to calculate the population-attributable fraction¹⁴ of CP and HICP due to long COVID (Supplemental Table S7, <http://links.lww.com/PAIN/C356>).

3. Results

Table 1 summarizes the weighted crude prevalence of pain in each year. The prevalence of CP was 20.5% (95% confidence interval [CI] 19.9%-21.2%) in 2019 and remained statistically comparable at 20.9% (95% CI 20.3%-21.6%) in 2021 but increased significantly to 24.3% (95% CI 23.7%-25.0%) in 2023. High-impact chronic pain prevalence was 7.5% (95% CI 7.1%-7.9%) in 2019. It declined to 6.9% (95% CI 6.6%-7.3%) in 2021 but increased significantly to 8.5% (95% CI 8.1%-8.9%) in 2023.

Table 1 also summarizes the prevalence of the 6 site-specific pain measures. Tooth/jaw pain remained stable across the 3 waves. All other sites remained stable or declined significantly in 2021 vs 2019 but then increased significantly by 2023, so that 5 of the 6 sites (back/neck, shoulder/arm, hip/knee/leg, headache/migraine, and abdominal/pelvic) had a higher prevalence in 2023 than in both 2021 and 2019. For example, the most prevalent pain site—hip/knee/leg pain—declined from 12.2% (95% CI 11.7%-12.7%) in 2019 to 11.5% (95% CI 11.0%-12.0%) in 2021, then increased to 13.1% (95% CI 12.6%-13.6%) in 2023.

Figure 1 visualizes the patterns in CP (Plot A) and HICP (Plot B) in the full sample in 2019, 2021, and 2023, and also shows prevalence by sex, age, and educational attainment. The results by race/ethnicity and rural/urban classification are in Supplemental Figure S1, <http://links.lww.com/PAIN/C356>. The figures show that the 2023 increase was universal across population groups: CP and HICP stayed relatively stable in 2021 compared with 2019 but increased sharply in 2023 for everyone. The underlying estimates are summarized in Supplemental Table S2, <http://links.lww.com/PAIN/C356>.

In addition, we also tested formally whether the 2023 increase relative to 2019 was comparable by sex, age, educational attainment, race/ethnicity, and rural/urban classification, using regression models with interaction terms. The findings are in Supplemental Table S3, <http://links.lww.com/PAIN/C356>. The HICP increases were statistically equivalent across all population groups. Chronic pain increases were also comparable for men and women, as well as for Black and Hispanic, as compared with White, adults. However, CP increased significantly more for younger people, Asian Americans, college graduates, and urban residents, as compared with older adults, Whites, those without a college degree, and rural residents, respectively. Thus, the increases in CP tended toward convergence because groups with lower baseline prevalence experienced significantly greater increases through 2023 than groups with higher baseline prevalence.

The second part of the analysis explored explanations for the changes in pain prevalence. Supplemental Table S1, <http://links.lww.com/PAIN/C356> summarizes the distribution of population characteristics relevant to pain prevalence in each year.

Table 2

Prevalence ratios from robust Poisson models for chronic pain, high-impact chronic pain, and site-specific pain in 2021 and 2023 relative to 2019 under different model specifications.

	Model 1		Model 2		Model 3		% of 2023 effect due to long COVID
Chronic pain							
2021	1.02	(0.98, 1.06)	1.07***	(1.04, 1.11)	1.07***	(1.04, 1.11)	
2023	1.18***	(1.14, 1.23)	1.22***	(1.18, 1.26)	1.19***	(1.15, 1.23)	12.9%
2023 with long COVID					1.48***	(1.39, 1.57)	
High-impact chronic pain							
2021	0.93*	(0.87, 0.99)	1.03	(0.97, 1.10)	1.03	(0.97, 1.10)	
2023	1.13***	(1.06, 1.21)	1.19***	(1.12, 1.27)	1.16***	(1.09, 1.24)	12.4%
2023 with long COVID					1.39***	(1.24, 1.57)	
Back/neck pain							
2021	0.96	(0.91, 1.01)	1.03	(0.99, 1.09)	1.03	(0.98, 1.09)	
2023	1.11***	(1.05, 1.17)	1.15***	(1.09, 1.21)	1.11***	(1.05, 1.17)	23.6%
2023 with long COVID					1.44***	(1.31, 1.58)	
Arm/shoulder pain							
2021	0.92*	(0.87, 0.98)	1.01	(0.95, 1.07)	1.01	(0.95, 1.07)	
2023	1.07*	(1.01, 1.14)	1.13***	(1.07, 1.20)	1.07*	(1.00, 1.14)	40.1%
2023 with long COVID					1.58***	(1.42, 1.75)	
Knee/hip/leg pain							
2021	0.94*	(0.89, 0.99)	1.01	(0.96, 1.06)	1.01	(0.96, 1.06)	
2023	1.07**	(1.02, 1.13)	1.12***	(1.07, 1.17)	1.08***	(1.03, 1.14)	26.1%
2023 with long COVID					1.35***	(1.23, 1.47)	
Head/migraine							
2021	0.89*	(0.82, 0.97)	0.97	(0.89, 1.06)	0.97	(0.89, 1.05)	
2023	1.16***	(1.07, 1.27)	1.18***	(1.09, 1.29)	1.08	(0.99, 1.18)	41.5%
2023 with long COVID					1.79***	(1.56, 2.06)	
Abdominal/pelvic pain							
2021	0.95	(0.84, 1.06)	1.03	(0.91, 1.16)	1.02	(0.91, 1.16)	
2023	1.23***	(1.10, 1.37)	1.25***	(1.12, 1.40)	1.20**	(1.06, 1.35)	13.6%
2023 with long COVID					1.58***	(1.29, 1.95)	
Tooth/jaw pain							
2021	0.98	(0.85, 1.12)	1.14	(1.00, 1.30)	1.14	(1.00, 1.30)	
2023	1.01	(0.89, 1.15)	1.12	(0.98, 1.28)	1.06	(0.92, 1.22)	31.4%
2023 with long COVID					1.51***	(1.19, 1.92)	

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table summarizes prevalence ratios from robust (modified) Poisson models of each pain outcome. Only coefficients for the year 2021 and 2023 relative to 2019 are shown for parsimony and the estimates for 2023 vs 2019 are bolded for ease of observation. Complete results for Model 3 for CP and HICP are summarized in Supplemental Table S4, <http://links.lww.com/PAIN/C356>.

Analyses take into account NHIS complex sampling design.

Model 1 has no covariates, only year (2019 as reference).

Model 2 controls for all covariates (age, sex, region, rurality, race, immigrant and marital status, education, food insecurity, difficulty paying medical bills, family income, BMI, smoking, 7 physical chronic conditions, high anxiety and depression symptoms, and health insurance type) except long COVID.

Model 3 adds long COVID. Because long COVID variable is not available in 2021 and it is zero for all respondents in 2019, it is included in the models by creating a composite variable that combines year and long COVID: 2019 (reference), 2021, 2023 for those without long COVID, and 2023 for those with long COVID. This composite variable is equivalent to controlling for long COVID but allows us to retain the 2021 survey wave. The coefficient for 2023 without long COVID is equivalent to the main effect of 2023 in models adjusting for long COVID, as shown in Supplemental Table S4, <http://links.lww.com/PAIN/C356>.

The last column shows the percent of the 2023 increase that was due to long COVID, estimated with the Karlson–Breen–Holm (KHB) method⁵ for comparing coefficient effects across nonlinear models. Please note the approach is not available with full complex survey adjustment and for robust Poisson models; we therefore estimated it with sampling weights only and using the logit link. Probit KHB models yielded closely comparable findings. HICP, high-impact chronic pain; NHIS, National Health Interview Survey.

Demographics (age, sex, region, race/ethnicity, and foreign-born) did not change significantly and neither did the prevalence of physical chronic conditions (angina, arthritis, cancer, congestive heart disease, diabetes, myocardial infarction, or hypertension). However, the distributions of socioeconomic factors, mental health, health behaviors, and health insurance changed significantly between 2019 and 2023: Education and family income increased, and a smaller proportion were uninsured or had difficulty paying medical bills. Smoking prevalence decreased but the prevalence of obesity increased significantly from 31.2% in 2019 to 33.3% in 2023. The prevalence of elevated depressive symptoms and anxiety increased significantly as well. The final covariate is long COVID. In 2023, 8.3% of the population reported having had long COVID. This includes those who had long COVID previously but recovered before the interview (4.8%), those with

current long COVID (3.5%), and those with current high-impact long COVID (0.7%).

Table 2 summarizes these characteristics in regression models of CP, HICP, and the 6 site-specific pain measures. Model 1 is unadjusted, with only year as a predictor; Model 2 includes all covariates except long COVID; and Model 3 adds long COVID. Regarding CP, the unadjusted prevalence was unchanged in 2021 vs 2019 but increased 18% in 2023 (PR = 1.18, 95% CI 1.14, 1.23). Net of the covariates added in Model 2, the 2023 prevalence remained significantly higher (PR = 1.22, 95% CI 1.18, 1.26). In Model 3, we added a composite year/long COVID variable with 4 categories: 2019 (reference), 2021, 2023 *without* long COVID (yielding year effect estimates identical to those in models controlling for long COVID), and 2023 *with* long COVID. In this model, the 2023 prevalence of CP net of all

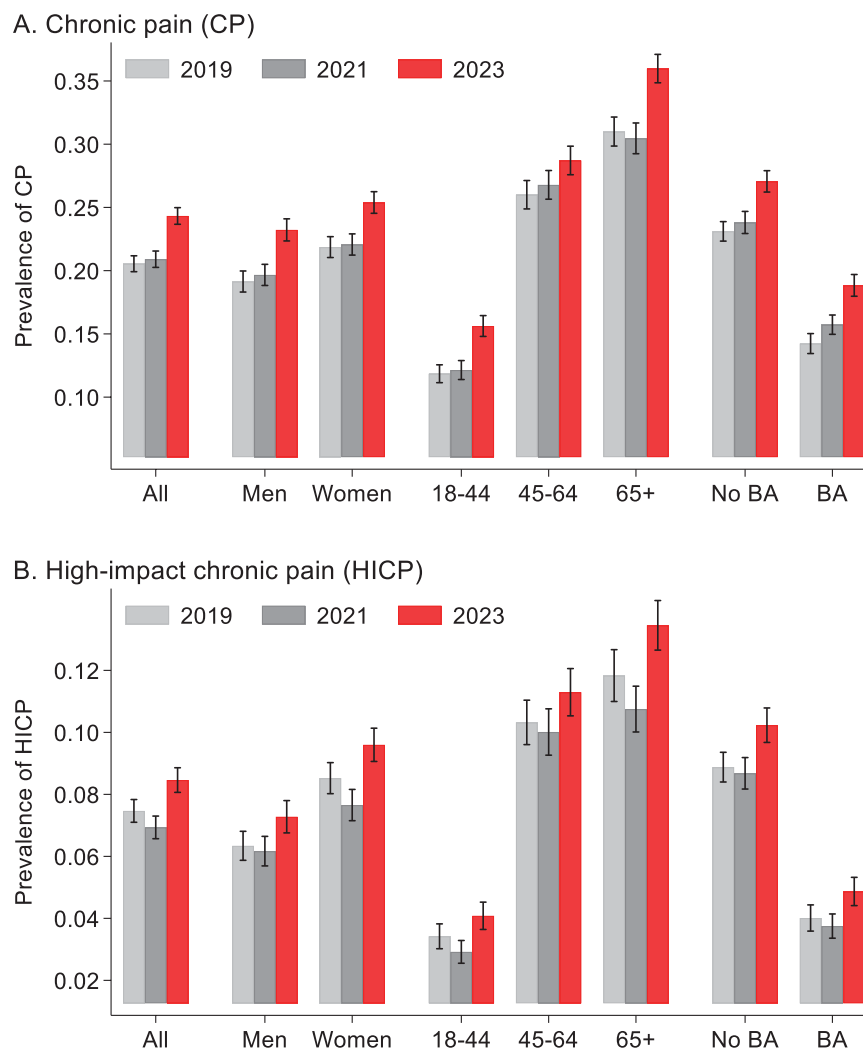


Figure 1. Chronic pain and high-impact chronic pain in 2019, 2021, and 2023, US adults 18 years and older, total and by sex, age, and education. Note: Weighted prevalence estimates and 95% confidence intervals adjusted for complex sampling design. Population in aggregate (all), by sex (men and women), by age (18-44, 45-64, and 65+), and by education (no college degree [no BA] and has college degree [BA]). See Supplemental Figure S1, <http://links.lww.com/PAIN/C356> for results by race/ethnicity and rural/urban classification and Supplemental Table S2, <http://links.lww.com/PAIN/C356> for the underlying estimates.

covariates including long COVID was 19% higher compared with 2019 (PR = 1.19, 95% CI 1.15, 1.23). The table also summarizes 2 perspectives on the role of long COVID in CP trends. First, we show the coefficient for 2023 with long COVID: Among adults who reported in 2023 that they ever had long COVID, pain was 48% higher than in the 2019 population (PR = 1.48, 95% CI 1.39, 1.57). Second, the proportion of the population-level increase in chronic pain attributable to long COVID, obtained through the KHB decomposition of estimates in Models 2 and 3, was 12.9%. That is, long COVID explained approximately 13% of the 2019 to 2023 increase in chronic pain.

Table 2 also summarizes the same series of models for HICP and site-specific pain. Except tooth/jaw pain, which showed no change over time, the data show (1) no significant increase in prevalence in 2021 compared with 2019, whether in unadjusted or adjusted models; (2) significant increases in 2023 compared with 2019 in the unadjusted Model 1 across all pain measures; (3) significant increases in 2023 compared with 2019 in the adjusted Model 2—in fact, the prevalence ratios (PRs) for 2023 are even larger than in Model 1, indicating that all the considered covariates jointly do not explain the pain increase postpandemic; and (4) long COVID explains a part of the increase between 2019

and 2023 as observed in Model 3 and the decomposition results in the last column. Specifically, the percent increase in pain prevalence due to long COVID ranges from approximately 13% for CP, HICP, and abdominal pain to approximately 40% for headache/migraine and arm/shoulder pain.

Table 2 only summarizes the coefficients for the key predictors (year 2021 and 2023) for parsimony; full results of Model 3 for CP and HICP are summarized in Supplemental Table S4, <http://links.lww.com/PAIN/C356>. This table also summarizes the equivalence of 3 ways of including long COVID in the models: using the composite variable as in **Table 2**; including long COVID as a covariate (2021 is dropped from that analysis because long COVID was not ascertained), and excluding adults with long COVID from analysis. These different specifications all show comparable results.

Finally, we offer 2 additional perspectives on the role of long COVID in pain prevalence by analyzing only 2023 data. Supplemental Table S6, <http://links.lww.com/PAIN/C356> summarizes the results of regression models of CP and HICP as a function of long COVID, disaggregating this variable into long COVID in the past, current long COVID, and current high-impact long COVID. The results show a dose-response relationship between these

COVID-19 variables and pain, confirming the strong association between long COVID and pain at the individual level.

Supplemental Table S7, <http://links.lww.com/PAIN/C356> returns to the population level and calculates the population-attributable fraction of CP and HICP due to long COVID in 2023. Adjusting only for age and sex, approximately 5% to 7% of pain in the population is due to long COVID, a nontrivial but not decisive proportion. The proportion-attributable fraction is below 3% in fully adjusted models. Counterfactual simulations (hypothetical estimates) show that if nobody in the population had long COVID, CP and HICP in 2023 would have been 23.0% (95% CI 22.4, 23.6) and 7.8% (95% CI 7.5, 8.2)—still higher than in 2019 but slightly less than the observed prevalence levels.

4. Discussion

Pain surged dramatically among US adults after the COVID-19 pandemic. Between 2019 and 2023, prevalence of chronic pain and high-impact chronic pain increased by 18% and 13%, respectively. The widely cited 20% population prevalence of CP^{8,34,46} seems outdated; our estimate from 2023 is 24.3%. This increase represents more than 10 million additional individuals experiencing chronic pain in 2023 compared with just 5 years prior, bringing the total to more than 60 million adults. Similarly, high-impact chronic pain, the most debilitating form of pain,³² affected 8.5% of adults in 2023, up from 7.5% in 2019 (and only 6.9% during the pandemic in 2021). This new estimate represents more than 21 million Americans experiencing high-impact pain in 2023.

The increase is not restricted to specific demographics or pain sites: It is evident in most population subgroups and in all examined pain sites except tooth/jaw pain. We found similar relative increases in HICP for younger and older adults, men and women, college graduates and people without college diplomas, and across all race/ethnic groups and rural/urban classification. The increases in CP were often similar across groups as well, but groups with lower prevalences before the pandemic (younger adults, Asian Americans, college graduates, and people in large metropolitan areas) experienced significantly steeper increases than older adults, Whites, people without college diplomas, and rural residents, suggesting some convergence in age-related, racial/ethnic, educational, and geographic disparities in pain.

The increases in CP and HICP were not explained by changes in the population distribution of important sociodemographic and health covariates including age, education, economic well-being, smoking and obesity, physical conditions, or depressive and anxiety symptoms. In fact, if the population distribution of these characteristics had remained at 2019 levels, the increase in pain might have been even greater. However, this interpretation warrants caution given the cross-sectional and observational nature of our data.

One factor seeming to contribute to the observed trends is long COVID. At the individual level, long COVID is a powerful predictor of pain,^{11,35} a relationship we confirmed in our analyses of 2023 data: adults with long COVID are significantly more likely to report both chronic and high-impact pain. However, at the population level, long COVID explains only a part of the 2019-to-2023 increase in pain prevalence. For chronic and high-impact chronic pain, long COVID explained approximately 13% of the increase. For site-specific pain, long COVID explained between 14% of the increase in abdominal/pelvic pain, up to 40% of the increase in headache/migraine and arm/shoulder pain.

That conventional demographic, health, and socioeconomic covariates—as well as long COVID—explain only a portion of the

dramatic postpandemic pain escalation suggests that broader systemic factors are driving these trends. The counterintuitive temporal pattern—stable pain prevalence during the pandemic but substantial increases afterward—suggests complex biopsychosocial mechanisms operating across different phases.

Several factors may explain why pain did not increase during 2021 despite widespread social disruption. Pandemic-era policies provided temporary protective effects: enhanced unemployment benefits and eviction moratoriums reduced financial stress, a powerful pain correlate, for many American families. Remote work arrangements decreased commuting and workplace physical demands while allowing greater environmental control and schedule flexibility for self-care. Heightened social cohesion during the acute crisis phase may have strengthened support systems that buffer against pain, even when delivered virtually. In addition, dramatic reductions in respiratory infections due to masking and social distancing may have reduced inflammatory processes that exacerbate pain conditions.

Pandemic-linked disruptions in health care represent another potential mechanism of the observed fluctuations in pain. Healthcare visits for non-COVID-19 health issues declined dramatically in 2020 and 2021,²⁸ particularly at hospitals and emergency department,³ which are often the first site of care for acute pain management.⁷ Lack of adequate and timely management of acute pain during the pandemic might have led more individuals to transition to CP and HICP by 2023.²⁹

Beyond healthcare disruption, the postpandemic environment may have created conditions that exacerbated pain prevalence. The termination of protective pandemic-era policies coincided with, or even caused, new forms of social and economic stress. The rapid transition back to prepandemic work demands and social obligations constituted significant readjustment stress for populations that had adapted to altered routines. The return-to-work mandates may have also contributed to increased pain through increased occupational injuries and accidents, a substantial source of pain.¹⁵ In addition, the disruption of social connections, powerful correlates of chronic pain,^{1,18,23} during the pandemic may have manifested with a temporal lag, contributing to the delayed pain surge rather than immediate increases during lockdowns. Meanwhile, cumulative allostatic load from prolonged pandemic stress may have manifested in delayed psychophysiological impacts that became apparent only by 2023. The expanding population with COVID-19 infections also created a larger pool susceptible to pain-inducing immune dysregulation, compounding these social and psychological stressors.

Finally, several changes in NHIS data collection modes and response characteristics may also partially account for changing pain prevalence estimates between 2019 and 2023. For instance, during this period, the NHIS response rate declined, the proportion of interviews conducted at least in part by phone (as opposed to fully in-person) increased, and the proportion of interviews that were incomplete increased as well (Supplemental Table S8, <http://links.lww.com/PAIN/C356>). Incomplete surveys typically occur when respondents or interviewers break off the interview (eg, because they need to go somewhere or because of time considerations). Although it is not obvious how these changes in survey characteristics might affect pain prevalence estimates, they may play a role in influencing the patterns observed in this study.

In addition to these data limitations, we also note that the analysis was based on cross-sectional data. Longitudinal data could allow more causal analyses that might better identify the reasons for the observed changes in pain prevalence. We also caution that NHIS only includes noninstitutionalized adults, so changes in institutionalization might contribute to observed

patterns. Finally, all covariates were self-reported, increasing the chance of recall error. This is potentially problematic, especially regarding reports of long COVID. Given the complexity and recent emergence of this condition, over- and/or under-reporting are possible; this may lead to misestimation of its role in the rising prevalence of pain.

Despite its limitations, this analysis is the first comprehensive report on the escalation of chronic and high-impact pain after the pandemic in the US adult population. Our findings should be replicated with other nationally representative data sources, and a broader set of potential explanatory factors should be used to explain the postpandemic trends. We found that chronic pain, already a widespread health problem, reached an all-time high prevalence in the postpandemic era, necessitating urgent attention and interventions to address and alleviate this growing health crisis.

Conflict of interest statement

The authors have no conflict of interest to declare.

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