

# Unemployment Insurance and Opioid Overdose Mortality in the United States

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**ABSTRACT** Over the past two decades, opioid overdose deaths contributed to the dramatic rise in all-cause mortality among non-Hispanic Whites. To date, efforts among scholars to understand the role of local area labor market conditions on opioid overdose mortality have led to mixed results. We argue the reason for these disparate findings is scholars have not considered the moderating effects of income support policies such as unemployment insurance. The present study leverages two sources of variation—county mass layoffs and changes in the generosity of state unemployment insurance benefits—to investigate if unemployment benefits moderate the relationship between job loss and county opioid overdose death rates. Our difference-in-differences estimation strategy reveals that the harmful effects of job loss on opioid overdose mortality decline with increasing state unemployment insurance benefit levels. These findings suggest that social policy in the form of income transfers played a crucial role in disrupting the link between job loss and opioid overdose mortality.

**KEYWORDS** Unemployment insurance • Opioid overdose • Mortality • Unemployment

## Introduction

Over the past century, mortality and life expectancy in the United States have improved because of public health interventions and advances in the treatment of infectious diseases and chronic conditions (Cutler et al. 2006; Cutler and Miller 2005; Riley 2001). However, mortality improvements slowed in recent decades in the United States and even reversed course for less educated, middle-aged Whites (Crimmins and Zhang 2019; Ho and Hendi 2018). Over the past 20 years, the pronounced loss of life among Whites was largely attributable to opioid overdose deaths, particularly among men and less educated adults (Acciai and Firebaugh 2017; Case and Deaton 2015, 2017; Geronimus et al. 2019; Masters et al. 2017; Muennig et al. 2018; Novosad et al. 2020; Ruhm 2018; Sasson and Hayward 2019).

Like many social problems, the opioid epidemic is rooted in complex interactions between economic and social conditions, including economic stagnation and opioid

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prescribing patterns (Dasgupta et al. 2017). One point of contention in the literature is the extent to which changes in local labor market conditions contribute to opioid overdose mortality. Several studies leveraging exogenous changes in manufacturing employment and exposure to international trade have found evidence that economic shocks are associated with an increase in county opioid overdose deaths (Charles et al. 2019; Pierce and Schott 2020; Venkataramani et al. 2020). Others argue that opioid supply factors are behind the rise in opioid overdose deaths and declining labor force participation (Aliprantis et al. 2019; Harris et al. 2019; Ruhm 2019).

What these explanations share is a concern for structural causes preceding the biological or behavioral factors that once dominated substance abuse research. These explanations are consistent with contemporary understandings of population health and health disparities emphasizing the importance of social determinants or “causes of the causes” like unemployment and working conditions (Dahlgren and Whitehead 1991; Marmot and Wilkinson 2006). More recently, health scholars have broadened this perspective to consider the potential for social policy to condition the effects of social determinants by structuring the distribution of resources throughout society (Beckfield et al. 2015; Bergqvist et al. 2013; Montez et al. 2017).

Despite broad interest in understanding the effect of labor market conditions on health, little research has investigated the role of social policy in moderating the relationship between economic hardship and opioid overdose mortality. The neglect of social policy in earlier work could explain why some studies have found modest or weak connections between unemployment and opioid deaths. Indeed, the social determinants of health perspective suggests that income support offered through unemployment insurance (UI) benefits would mitigate the harmful effects of job loss on opioid overdose mortality.

We investigate this hypothesis by leveraging mass layoff data and changes in state policy to examine if the generosity of UI moderates the relationship between involuntary job loss and county opioid overdose mortality for prime-age (25–54 years) U.S. adults. As seen in earlier studies, we find that worsening local area labor market conditions are associated with greater opioid overdose mortality. However, we also find that the harm associated with job loss increased with a decline in state UI benefit generosity. Specifically, the positive association between job loss and opioid overdose mortality more than doubles with a one standard deviation decline in the maximum state UI benefit. In stratified analyses, the moderating effect was strongest for men and non-Hispanic Whites but was consistently observed across demographic groups.

## Background

### The Opioid Epidemic and Mortality

In 2017, the U.S. government declared the opioid epidemic to be a national public health emergency (Department of Health and Human Services 2017). The number of people dying from opioid overdoses increased from 8,050 to 46,802 between 1999 and 2018 (Hedegaard et al. 2020). Today, opioids account for more deaths each year than traffic accidents or firearms and are the leading cause of injury deaths. Public health scholars now widely acknowledge that the opioid epidemic consists of three distinct phases

marked by different types of opioids, the use of which has spread unevenly across socio-demographic groups (Kiang et al. 2019). Our study overlaps with the first phase of the epidemic, which began with the introduction of the prescription pain reliever OxyContin in the mid-1990s and lasted through 2010 with the reformulation of OxyContin to deter abuse (Dasgupta et al. 2017; Kiang et al. 2019; Ruhm 2019). During this phase, the number of opioid prescriptions more than quadrupled, reaching a peak of 250 million in 2010 (Guy et al. 2017). Opioid overdose deaths were driven by prescription opioids and mostly affected White individuals, who had better access to health care than Black and Hispanic individuals and who were more likely to be treated for pain and prescribed pain medication (Green et al. 2003; Pletcher et al. 2008; Shavers et al. 2010).

Yet like other indicators of population health, mortality is highly stratified by socioeconomic status, even among relatively advantaged Whites. A rise in all-cause mortality since the 1990s and more recent decline in life expectancy for Whites have been limited to less educated adults, as health and mortality have continued to improve for college-educated Whites (Case and Deaton 2015, 2017; Geronimus et al. 2019; Ho 2017; Sasson 2016). Opioid overdose deaths were the most important factor contributing to the widening educational gradient among Whites (Geronimus et al. 2019). Since 2010, the educational gradient for life expectancy has similarly widened for Black men and women, also because of an increase in opioid overdose deaths among the least educated (Sasson and Hayward 2019) as the opioid epidemic transitioned to heroin and fentanyl in its later stages (Alexander et al. 2018; Shiels et al. 2017). These patterns suggest that in addition to contributing to educational inequalities among Whites, opioid overdose deaths may also widen existing racial disparities in mortality and life expectancy.

### Job Loss and Opioid Overdose Mortality

The profound effect of the opioid epidemic on population health and inequality has generated interest among social scientists and public health scholars in understanding possible economic and social causes. Case and Deaton (2015, 2017) attributed the opioid epidemic and rise in other “deaths of despair” to a sense of loss and hopelessness brought on by the intergenerational decline in the economic and social lives of working-class Whites. Others have blamed pharmaceutical companies and doctors for aggressively marketing and prescribing opioid pain relievers while downplaying the potential for addiction (Guy et al. 2017; Van Zee 2009). Several studies have investigated the relationship between local labor market conditions and opioid usage and overdose mortality. This work contributes to an extensive literature connecting job loss to negative health outcomes (Brand 2015; Burgard and Kalousova 2015; Catalano et al. 2011), including increased risk of mortality (Eliason and Storrie 2009; Sullivan and von Wachter 2009), depression (Brand et al. 2008; Burgard et al. 2007), suicide (Phillips and Nugent 2014), and alcohol abuse (Dávalos et al. 2012; Dee 2001). Moreover, even workers who maintain employment during economic downturns suffer negative health consequences as a result of job-related stress (Burgard and Seelye 2017; Modrek and Cullen 2013a, 2013b; Modrek et al. 2014).

However, there is still debate over the extent to which unemployment and local area labor market conditions have contributed to the opioid epidemic. Drawing on the observation that mortality rates continued to worsen even as the labor market improved

following the Great Recession, Case and Deaton (2017) argued against a connection between job loss and recent mortality trends. Meanwhile, Ruhm (2019) found that within-county changes in unemployment explained variation in opioid overdose mortality rates but that the relationship was almost entirely accounted for by confounding factors. Ruhm argued instead that opioid supply is the major driver of the opioid epidemic. Similarly, others attributed declining employment and labor force participation to opioid prescribing patterns (Aliprantis et al. 2019; Harris et al. 2019; Krueger 2017).

Nonetheless, several studies examining local labor market conditions have found that opioid overdose mortality increased with rising unemployment. For example, Hollingsworth et al. (2017) estimated that the opioid overdose death rate increased 3.6% for every percentage-point increase in county unemployment rates from 1999 to 2014, but the effect was specific to Whites. One potential criticism is that county unemployment rates are endogenous in that workers more prone to opioid addiction may select into unemployment. Other studies have overcome the endogeneity problem by leveraging quasi-exogenous shocks to employment. For example, Venkataramani et al. (2020) found that the opioid overdose death rate was 85% higher in counties that experienced the closure of automotive assembly plants relative to counties that had at least one assembly plant but did not experience a closure. Meanwhile, others have found that opioid usage and overdose deaths have increased fastest in parts of the country that have experienced declines in manufacturing or that have greater exposure to international trade (Charles et al. 2019; Dean and Kimmel 2019; Pierce and Schott 2020).

### Unemployment Insurance and the Opioid Epidemic

That structural explanations for the opioid epidemic dominate public and scholarly discourse is a notable shift in tone from earlier eras when individualistic models of drug addiction and abuse prevailed. Structural explanations are consistent with the social determinants of health perspective, which emphasizes the importance of social and economic conditions in shaping health outcomes and disparities (Marmot and Wilkinson 2006). Health scholars are increasingly interested in the potential for social policy to mitigate the harmful effects of social determinants like unemployment on health outcomes (Beckfield et al. 2015; Beckfield and Krieger 2009). Yet despite interest in labor market explanations for the opioid epidemic, there has been little discussion of the role that income supports play in mitigating the harmful effects of job loss on opioid overdose mortality.

In the United States, UI is the main form of financial assistance available to working-age adults, replacing approximately half of lost wages for up to 26 weeks (von Wachter 2019). Eligibility is limited to workers who are unemployed at no fault of their own, meet minimum earnings requirements, and are able and available for work. For these reasons, the program disproportionately serves more advantaged workers, while in most states, only a fraction of unemployed workers claim benefits (Gould-Werth and Shaefer 2012). The United States is widely acknowledged to offer relatively weak labor market protections (Esping-Andersen 1990). Even so, states retain considerable discretion over setting the dollar amount and duration of benefits, resulting in considerable within- and between-state variation in UI generosity. The real value of UI fluctuates within states with legislative changes or when inflation erodes the value of benefits.

Many public health scholars would predict that generous social benefits, including a robust UI system, should have a positive effect on population health (Bambra and Beckfield 2012; Beckfield et al. 2015; Beckfield and Krieger 2009; Navarro et al. 2003; Solar and Irwin 2010). However, two contrasting theoretical perspectives, known as the effect-budgeting and stress-reduction hypotheses (Burgard and Kalousova 2015; Catalano et al. 2011), elucidate several mechanisms by which UI benefits could conversely help or harm the health of unemployed workers.

The stress-reduction hypothesis predicts that income supports will improve the physical, mental, and behavioral health of unemployed workers by reducing financial stress and related issues like marital problems (Catalano et al. 2011). Job loss is associated with downward economic mobility as unemployed workers are at increased risk of experiencing permanent earnings losses (Couch and Placzek 2010; Gangl 2006; Jacobson et al. 1993), a downgrading of job quality and prestige (Brand 2006), and future employment instability (Stevens 1997). Previous studies have found that UI protects against these risks by smoothing household consumption after job loss and reducing poverty (Bitler and Hoynes 2016; Browning and Crossley 2001; Chetty 2008; Rothstein and Valletta 2017). More concretely, UI saved an estimated 1.3 million households from foreclosure during the Great Recession (Hsu et al. 2018). By mitigating the economic cost of job loss, UI may obviate the need for coping mechanisms like prescription and illicit opioids. These benefits are not limited to job losers; the knowledge that UI benefits are available could also reduce stress among precariously employed workers, not to mention the spouses and children of unemployed workers.

Whereas the stress hypothesis considers job loss from a social-psychological perspective, the effect-budgeting hypothesis is grounded in an economic understanding of health. From this perspective, UI benefits could affect opioid overdose mortality through several mechanisms. The most obvious is that economic insecurity leads unemployed workers to scale back on nonessential purchases of alcohol, cigarettes, and, perhaps, opioids (Burgard and Kalousova 2015; Catalano et al. 2011). The partial wage replacement provided by UI could also free up disposable income to spend on coping mechanisms like opioids. If UI increases unemployed workers' capacity to purchase opioids but does little to mitigate unemployment-related stress, these benefits could increase risk of opioid mortality. At the same time, UI allows unemployed workers to maintain health insurance coverage (Kuka 2020), which could facilitate access to prescription opioids during a period of heightened stress. Conversely, access to prescription drugs could reduce overdose mortality by preventing people from transitioning to more lethal substances like heroin and fentanyl. Finally, because unemployment is associated with increased time for leisure, including recreational drug use, UI could contribute to overdose mortality, even among jobless workers who do not experience an increase in stress or anxiety. These perspectives illustrate that the effects of UI on opioid overdose mortality are theoretically ambiguous.

Although there are no studies to date on UI and opioid overdose mortality, these benefits have been shown to mitigate the harmful effects of job loss on a range of physical, mental, and behavioral health outcomes in the United States and other countries. For example, cross-national comparisons have found that unemployed workers in countries with more generous UI benefits experience smaller reductions in subjective well-being than their counterparts in countries with less robust benefits (Sjöberg

2010). Even though UI is relatively modest in the United States compared to other countries, it has been found to offset about one quarter of the decline in subjective well-being associated with job loss (Young 2012). Likewise, Tefft (2011) found that the number of state UI claims was negatively associated with the Google depression-search index. The association was stronger in states with immediate benefit payments than in those with mandatory waiting weeks.

Other studies leveraging within-state changes in UI generosity have shown that benefits buffer unemployed workers from a range of negative health outcomes. For example, Cylus et al. (2014) found that the suicide rate increased by 0.16 deaths per 100,000 for every percentage-point increase in the unemployment rate. However, a model interacting state unemployment rates with the dollar amount of UI revealed that the risk of suicide associated with unemployment increased at a slower rate in states with more generous benefits. Studies employing similar methods have likewise found that more generous UI benefits also increase routine health care check-ups, improve self-reported health, and encourage more physical activity among the unemployed (Cylus 2017; Cylus et al. 2015; Kuka 2020). In contrast, the evidence on whether UI reduces risky health behaviors is mixed. Overall, more generous benefits are not associated with an increase in smoking among the unemployed (Kuka 2020) and may lead to a reduction in smoking among benefit recipients (Fu and Liu 2019). However, there is evidence that more generous benefits are associated with more frequent binge drinking among the unemployed (Kuka 2020). These disparate results suggest that there may be qualitative differences among coping mechanisms, but on balance, stress-reduction benefits appear to outweigh income effects.

The present study examines whether UI moderated the relationship between involuntary job loss and opioid overdose deaths among prime-age adults for the period 1999–2012.<sup>1</sup> We hypothesize that county opioid overdose mortality increases with involuntary job losses. However, the relationship between job loss and opioid overdose deaths may weaken or strengthen with more generous UI benefits. Specifically, exploiting variation in job loss and changes in UI generosity over time and across space, we use a difference-in-differences framework to estimate the direction of the association between benefit generosity and opioid-related deaths.

## Methods

### Data

We compiled a panel of county–year observations using data from the Centers for Disease Control and Prevention, the U.S. Department of Labor (USDOL), the Bureau of Labor Statistics, and other sources. Our analytic sample consists of 43,883 county–year observations for 3,137 unique counties for 1999–2012, covering 99.8% of counties and county-equivalents for all states and the District of Columbia.

<sup>1</sup> Our study period accommodates the availability of the opioid-related mortality and the county-level mass layoffs data. The former became available in 1999 and the latter were discontinued in 2012.

## Measures

### *County Opioid Overdose Death Rate*

The outcome variable is prime-age opioid overdose mortality, defined as the number of opioid-related deaths per 100,000 adults aged 25–54 in county  $z$  in year  $t$ . We obtained county-level death records from the U.S. National Vital Statistics System restricted-use multiple causes of death mortality data set and the county-level single-year population estimates from the National Cancer Institute Surveillance, Epidemiology, and End Results program. As for previous studies (e.g., Alexander et al. 2018), we classified deaths as opioid-related if the International Classification of Diseases code was X40–X44, X60–X64, X85, or Y10–Y14, and the contributing cause of death was T40.0–T40.4 or T40.6.<sup>2</sup> In addition to reporting results for prime-age adults, we used the same data sources to stratify the opioid overdose death rate by race and ethnicity, sex, and age.

### *State Unemployment Insurance Generosity*

Following earlier work (Cylus et al. 2015), we calculated UI generosity as the product of the inflation-adjusted maximum weekly benefit amount and the maximum number of benefit weeks available in state  $s$  for year  $t$ . We obtained the maximum dollar amount and duration of benefits from USDOL (2021a). Our main results pertain to regular state UI benefits, but in periods of high unemployment, additional weeks of benefits were available through various emergency UI programs. Because of these benefit extensions, unemployed workers could qualify for up to 99 weeks of benefits during the Great Recession in some high-unemployment states. In supplementary analyses, we included a parallel measure for the generosity of extended UI programs.<sup>3</sup>

### *County Mass Layoff Rate and Unemployment Rate*

Our primary measure of UI-eligible involuntary job losses is the two-year county mass layoff rate. We constructed this variable by dividing the total number of UI initial claims associated with extended mass layoffs for county  $z$  in year  $t$  and year  $t - 1$  by the size of the labor force in the county in year  $t$ . Mass layoffs occur when a private-sector nonfarm establishment has at least 50 initial UI claims filed against it over a five-week period, where separations are at least 31 days long. We retrieved the number of initial claims and county labor force data from the Bureau of Labor Statistics' Mass Layoff Statistics and Local Area Unemployment Statistics programs,

<sup>2</sup> To address the concern that opioid-related deaths may be misclassified, we followed the imputation method detailed in Ruhm (2017) and imputed the share of opioid-related drug overdose deaths misclassified as having undifferentiated causes. The results from this supplemental analysis (not shown) yielded the same point estimates reported in our main results, but with larger standard errors.

<sup>3</sup> Rothstein (2011) produced a public data set with the maximum number of UI benefits available for all programs by state.

respectively. Because mass layoffs relate to a subset of workers who lost employment at no fault of their own and already filed for UI, the two-year mass layoff rate captures a pool of workers directly affected by changes in UI benefit levels in each year  $t$ .

Similarly, we obtained county-level unemployment rates from the Local Area Unemployment Statistics program to construct a measure of non-mass-layoff unemployment, defined as the county unemployment rate minus the two-year layoff rate. For a small subset of counties where the two-year layoff rate exceeded the county unemployment rate, we bottom-coded non-layoff unemployment as zero. Our estimates were nearly identical when the negative cases were not bottom-coded or dropped.

### State-Level Controls

The state-level controls, which include state gross domestic product (GDP), personal income, poverty rate, population, and state unemployment rate, were retrieved from the University of Kentucky Center for Poverty Research (UKCPR) National Welfare Data Series (2020). We also controlled for the average weekly wage for UI-covered workers for each state using data from USDOL (2021b). In addition to the mentioned controls for state economic conditions, we retrieved information on Supplemental Nutrition Assistance Program (SNAP) recipients, Temporary Assistance for Needy Families (TANF) recipients, Medicaid enrollees, state earned income tax credit (EITC) rate, and state effective minimum wage rates for additional robustness checks (UKCPR 2020). Apart from the poverty rate, unemployment rate, EITC rate, and minimum wage rates, all state-level controls were log-transformed.

### Analysis Plan

We estimated the association between UI generosity and opioid-related deaths through the following difference-in-differences (DID) model:

$$\begin{aligned}
 \text{Opioid Death Rate}_{z,s,t} &= \beta_0 + \beta_1 \text{Max Benefit}_{s,t} + \beta_2 \text{Mass Layoff Rate}_{z,s,t} \\
 &+ \beta_3 (\text{Max Benefit}_{s,t} \times \text{Mass Layoff Rate}_{z,s,t}) \\
 &+ \beta_4 \text{Non-Layoff Unemployment Rate}_{z,s,t} + \gamma \mathbf{X}_{s,t} + \delta_t + \sigma_z + \varepsilon_{z,s,t}, \quad (1)
 \end{aligned}$$

where the outcome variable is the opioid overdose death rate per 100,000 prime-age adults in county  $z$  in year  $t$ ;  $\text{Max Benefit}_{s,t}$  measures the demeaned (with respect to the population-weighted mean across the sample) maximum regular UI benefit in state  $s$  in year  $t$ ;  $\text{Mass Layoff Rate}_{z,s,t}$  is the two-year mass layoff rate for county  $z$  in year  $t$ ;  $\text{Non-Layoff Unemployment Rate}_{z,s,t}$  is an indicator for the share of workers who are unemployed for reasons other than recent mass layoff events in county  $z$  in year  $t$  and is defined as the county unemployment rate minus  $\text{Mass Layoff Rate}_{z,s,t}$ ;  $\mathbf{X}$  is a vector of state-level economic characteristics;  $\delta_t$  and  $\sigma_z$  are year and county fixed effects; and  $\varepsilon_{z,s,t}$  is an idiosyncratic error term. Vector  $\mathbf{X}$  includes the unemployment rate, log GDP, log personal income, poverty rate, log population, and log average weekly wages for UI-covered workers.



The two-year mass layoff rate measures the intensity of UI-eligible involuntary job loss in a county. Because unemployment status is often endogenous to the outcomes of interest, mass layoff events have been widely used in past literature as a quasi-exogenous treatment to identify the consequences of job loss on individuals (Couch and Placzek 2010; Jacobson et al. 1993; Stevens 1997; Sullivan and von Wachter 2009) and communities (Ananat et al. 2013; Classen and Dunn 2012; Foote et al. 2019; Gassman-Pines et al. 2014; Venkataramani et al. 2020). Coincidentally, because workers who lose their jobs in mass layoff events are generally eligible to receive UI for up to 26 weeks after their job separation, the two-year mass layoff rate also identifies a treatment group of the UI policy in county  $z$  in year  $t$ .

Admittedly, the opioid use behavior of workers could potentially affect observed county mass layoff rates, and the two variables are also subject to other sources of influence, such as a regional decline in public health or human capital. This could upwardly bias the estimated main effect of the mass layoff rate on opioid-related mortality. Therefore, the identification of the interaction term between the mass layoff rate and UI generosity, our variable of interest, relies primarily on the quasi-exogeneity of UI generosity.<sup>4</sup> As in other recent studies (e.g., Hsu et al. 2018), we found insignificant correlations between state economic conditions and the changes in statutory maximum UI benefits. Table A1 in the online appendix reports estimated correlations between UI and state unemployment rates, GDPs, average wage levels, unionization coverage rates, UI trust fund balances, and minimum wage rates. While we do not find statistically significant correlations between UI benefits and state labor market conditions, it remains possible that state labor market environments partially conditioned UI generosity. To address the confounding effect, we included an extensive vector of state-level controls in our regression models. Still, absent a clean policy experiment, our results may fall short of strict causal evidence between UI generosity and opioid overdose deaths.

Furthermore, our hypothesis suggests that unemployment without support from UI has a different association with opioid overdose deaths. To account for this relationship, we include the *Non-Layoff Unemployment Rate* $_{z,s,t}$  to capture the share of unemployed workers in a county separated from employment for reasons other than recent mass layoff events and hence had mixed UI eligibility and lower UI receipt rate.<sup>5</sup> The variable serves as a natural within-county control group that allows us to further test if UI had a weaker effect on unemployed workers who had lower UI receipt rates. If the associations identified in our study were driven by other unobserved state policies or economic conditions that correlate with UI benefit generosity, we would expect these factors to affect UI recipients and nonrecipients alike.

<sup>4</sup> If UI generosity has an expected zero correlation with the regression error term, the interaction term, which is a product between UI generosity and mass layoff rates, would also have an expected zero correlation with the regression error term.

<sup>5</sup> We define the share of non-mass-layoff unemployed workers receiving UI as  $\frac{(Total\ Regular\ UI\ Recipients_{s,t} - Mass-laid-off\ Workers_{s,t})}{(Total\ Unemployed\ Workers_{s,t} - Mass-laid-off\ Workers_{s,t})}$ . Using this formula, we estimated that

approximately 11%–25% of non-layoff unemployed workers were receiving UI and, therefore, directly affected by changes in UI benefit levels during our study period. Readers should note that the share does not include workers who were eligible for UI but did not apply for it, and hence does not reflect the total number of UI-eligible workers.

As discussed, the variable *Max Benefit*<sub>s,t</sub> measures the inflation-adjusted maximum dollar amount and maximum duration of UI available in a state in year *t*. During the study period, all states, except Florida and Georgia in 2012, adopted a fixed maximum duration that did not vary with underlying state labor market conditions. The fixed duration guarantees that our measure of the UI generosity is not by design endogenous to the outcome variable. Nevertheless, during times of high unemployment, extended benefits were available through the permanent Extended Benefit (EB) program and the Temporary Extended Unemployment Compensation (TEUC) and Emergency Unemployment Compensation (EUC) programs.<sup>6</sup> The number of additional benefit weeks available through these extensions varied across states with state unemployment rates. To estimate whether extended UI benefits further moderate the effect of job loss on opioid overdose death risk, we followed previous studies (see Farber and Valletta 2015; Hsu et al. 2018; Rothstein 2011) by augmenting Eq. (1) with a cubic function of the state unemployment rate interacted with the layoff rate to control for the possible influence of state unemployment on opioid overdose deaths. The estimating equation for the association between the extended UI benefits and opioid-related deaths is

$$\begin{aligned}
 \text{Opioid Death Rate}_{z,s,t} &= \beta_0 + \beta_1 \text{Max Benefit}_{s,t} + \beta_2 \text{Max Extended Benefit}_{s,t} + \beta_3 \text{Mass Layoff Rate}_{z,s,t} \\
 &+ \beta_4 \text{Non-Layoff Unemployment Rate}_{z,s,t} \\
 &+ \beta_5 (\text{Max Benefit}_{s,t} \times \text{Mass Layoff Rate}_{z,s,t}) \\
 &+ \beta_6 (\text{Max Extended Benefit}_{s,t} \times \text{Mass Layoff Rate}_{z,s,t}) \\
 &+ \kappa_1 (\text{State Unemployment Rate}_{s,t} \times \text{Mass Layoff Rate}_{z,s,t}) \\
 &+ \kappa_2 (\text{State Unemployment Rate}_{s,t}^2 \times \text{Mass Layoff Rate}_{z,s,t}) \\
 &+ \kappa_3 (\text{State Unemployment Rate}_{s,t}^3 \times \text{Mass Layoff Rate}_{z,s,t}) + \gamma \mathbf{X}_{s,t} + \delta_t + \sigma_z \\
 &+ \varepsilon_{z,s,t}
 \end{aligned} \tag{2}$$

where *Max Extended Benefit*<sub>s,t</sub> is the demeaned maximum extended UI benefit in state *s* in year *t*, calculated as the product of the inflation-adjusted state maximum weekly benefit and the number of additional weeks authorized through the extended UI programs.

Because we were unable to separately identify the opioid overdose death rate for displaced workers, the specification allowed us to test the aggregate effects of UI on all prime-age adults in a county who may or may not have been directly impacted by mass layoff events. Past studies have shown that involuntary job losses could adversely impact a community through both the direct effects on the workers and the indirect effects on other members of the community (Ananat et al. 2011; Ananat et al. 2013; Classen and Dunn 2012; Foote et al. 2019; Gassman-Pines et al. 2014; Venkataramani et al. 2020). Similarly, higher UI generosity could directly relieve financial stress on displaced workers and mitigate spillover effects by boosting

<sup>6</sup> The EB program is a permanent feature of the UI system that activates automatically by state when unemployment rates cross a certain threshold. During our study period, TEUC benefits were available from 2002 to 2004 and EUC benefits were available from 2008 to 2013.

consumption in communities of affected workers and reducing the threat of potential job loss among the employed. The results from our estimation, therefore, reflect the aggregate effect on communities instead of the treatment effect on the treated group alone.

By exploiting variations in county-level mass layoff rates and state maximum UI benefits, our DID models estimate the association between UI generosity and county-level opioid overdose death rates for the prime-age population. The estimation results shed light on how financial support following job loss moderates the risk of substance use for workers and adds new evidence to the emerging literature on the empirical relationship between job loss and opioid overdose mortality.

## Results

### Summary Statistics

Table 1 presents summary statistics for key covariates and the outcome variable in Eqs. (1) and (2). Panel A shows that the average maximum regular UI benefit was \$12,410, with a standard deviation of \$3,610. This amount is the product of the maximum weekly benefit and the maximum benefit duration. During our sample period, most of the variation in the maximum benefit was driven by differences in weekly benefit amounts, instead of differences in benefit duration, as indicated by the greater variation in weekly benefits relative to benefit duration. Conversely, because extended UI benefits are authorized only during periods of high unemployment, both the duration and the weekly values vary widely across locations and times. As a result, the maximum extended UI benefit had a larger standard deviation of \$12,400. Recall that for all regression analyses, we demeaned all the benefit measures with respect to the population-weighted mean across the sample to highlight the effect of job losses at the mean UI generosity level. Panel B shows that the two-year mass layoff rate, our measurement of involuntary job losses in a county, averaged 1.57% with a standard deviation of 1.51% over the study period. This represents a quarter of the observed unemployment rate. Lastly, in panel C, the prime-age opioid overdose mortality rate averaged 9.70 over the study period but with substantial variation across demographic groups. The rate was 97% higher for males than for females and 80% to 120% higher for White than for non-White individuals. Across age-groups, the risk of opioid overdose deaths increased slightly with age.

### State Opioid Overdose Deaths and Mass Layoffs by UI Generosity

Figure 1 presages our main results with a comparison illustrating the association between opioid overdose mortality and the layoff rate in states in the bottom and top quartiles of UI benefit generosity over the study period. The upward-sloping line of best fit in the left panel reveals a strong positive correlation between mass layoffs and opioid overdose deaths in low-benefit states. In contrast, there was no discernible relationship for high-benefit states in the right panel. Although the figure suggests that the connection between opioid overdose mortality and unemployment is

**Table 1** Summary statistics, 1999–2012

	Mean	SD
A. Unemployment Insurance Policy		
Maximum regular benefit (in \$1,000)	12.41	3.61
Maximum weekly benefit (in \$1,000)	0.48	0.13
Maximum regular duration (weeks)	26.02	0.76
Maximum extended benefit (in \$1,000)	8.71	12.40
B. County Job Loss Statistics		
Two-year mass layoff rate (%)	1.57	1.51
Non-layoff unemployment rate (%)	4.68	2.24
C. Opioid Overdose Deaths per 100,000 Population		
Prime-age, all	9.70	9.52
Prime-age, male	12.88	13.21
Prime-age, female	6.55	8.41
Prime-age, White	11.91	11.61
Prime-age, Black	6.60	14.29
Prime-age, Hispanic	5.36	9.58
Aged 25–34	8.23	11.23
Aged 35–44	10.02	12.22
Aged 45–54	10.77	12.16

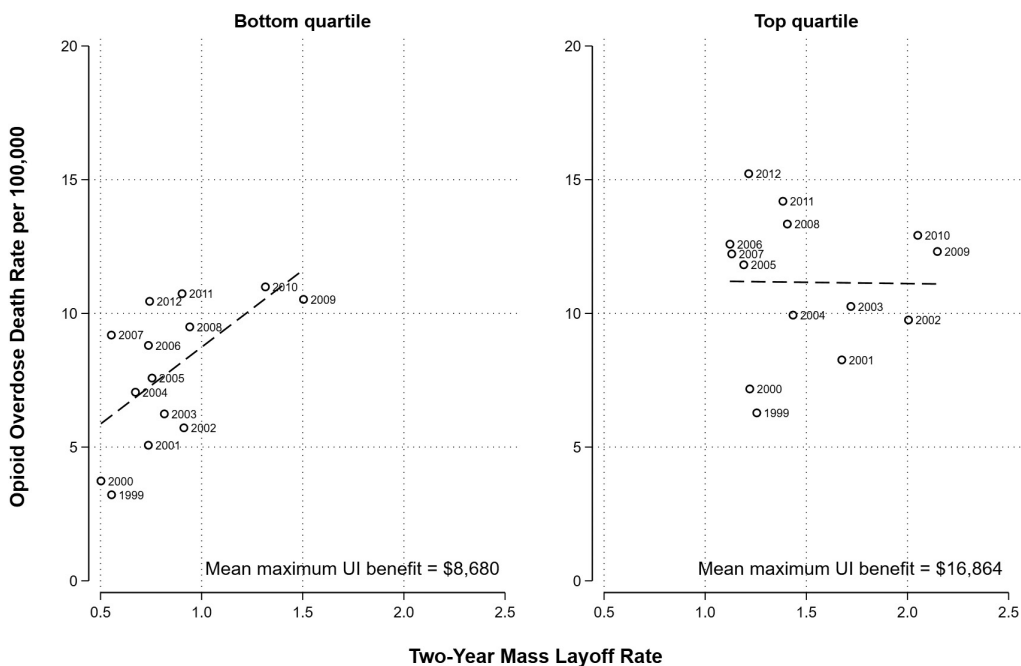
*Note:* The summary statistics are weighted by the population count in each cell.

decoupled when generous UI benefits are available, the following DID analysis leverages within-county change to account for potential confounders.

### Regular UI Benefits and Opioid-Related Mortality

**Table 2** summarizes the results for Eq. (1) by regressing the county-level prime-age opioid overdose death rate on maximum state UI benefits, county-level two-year mass layoff rates, county-level non-layoff unemployment rates, and county and year fixed effects. In the first column, we start with a model excluding the *Max Benefit*  $\times$  *Mass Layoff Rate* interaction term and state–year economic controls in Eq. (1). At the mean UI benefit level, a percentage-point increase in the layoff rate had a near-zero correlation with the opioid overdose death rate. On the contrary, a percentage-point increase in the non-layoff unemployment rate was associated with a 0.30-point increase in the opioid overdose death rate, but the correlation was statistically insignificant. These results may lead us to believe mass layoffs did not increase the short-term risk of opioid overdose.

However, the layoff effect estimated at the mean UI amount obscures the range of worker response along the benefit generosity spectrum. Column 2 reports the estimation results for a modified version of Eq. (1), allowing the effect of the layoff rate to vary by the max UI amount in a state while leaving out the state–year economic controls. Contrary to the conclusion that layoffs have a weak effect on opioid overdose mortality, the negative coefficient for the interaction term shows that layoffs posed a higher risk of opioid-related deaths when workers receive limited support from UI following their job separation. Column 3 adds state economic controls to



**Fig. 1** Opioid overdose death rate per 100,000 for the U.S. prime-age population relative to the two-year mass layoff rate for 1999–2012, by unemployment insurance benefit generosity. Mean maximum unemployment insurance benefit amounts over the study period were estimated for each state before dividing the states into quartiles. The plotted points indicate the opioid overdose death rate and two-year mass layoff averaged across states for the top and bottom quartiles of unemployment insurance benefit generosity in each year of the study period.

reflect the full model specified by Eq. (1). The coefficient for the interaction term was substantively unchanged, suggesting that the variation in the effect of the layoff rate was not driven by parallel changes in the UI benefit amount and state economic characteristics.

Specifically, the coefficient of the interaction term indicates that for every \$1,000 increase in the maximum UI benefit, the number of opioid overdose deaths per 100,000 associated with a percentage-point increase in the layoff rate decreased by 0.13. At one standard deviation (\$3,610) below the mean UI benefit level, a percentage-point increase in the layoff rate was associated with a 0.64-base-point increase in the opioid overdose death rate (6.5% above the mean level), which was slightly higher than the 0.41-base-point increase associated with the non-layoff unemployment rate. Conversely, at one standard deviation above the mean UI benefit level, a percentage-point increase in the layoff rate had a negative but statistically insignificant association with the opioid overdose death rate.<sup>7</sup> The finding suggests that UI-eligible and

<sup>7</sup> While the point estimate is not statistically significant, the negative association suggests that, conditional on sufficient income support, unemployed workers may reduce their overall opioid use instead of increasing it. This finding is consistent with the evidence in the existing literature between recessions and improved health behaviors (Ruhm 2005, 2015).

**Table 2** Unemployment insurance generosity and opioid-related deaths among the U.S. prime-age population, 1999–2012

	Opioid-Related Death Rate			
	(1)	(2)	(3)	(4)
Maximum Benefits (in \$1,000)	-0.45** (0.15)	-0.24 (0.13)	-0.12 (0.14)	-0.05 (0.13)
Two-Year Layoff Rate	0.02 (0.30)	0.02 (0.28)	0.16 (0.18)	0.15 (0.18)
Maximum Benefits × Two-Year Layoff Rate		-0.12* (0.05)	-0.13** (0.05)	-0.14** (0.05)
Non-Layoff Unemployment Rate	0.30 (0.21)	0.29 (0.20)	0.41 (0.24)	0.40 (0.24)
Maximum Benefits × Non-Layoff Unemployment Rate				-0.01 (0.02)
State-Year Controls	No	No	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
<i>N</i>	43,883	43,883	43,883	43,883
<i>R</i> <sup>2</sup>	.58	.58	.59	.59

*Notes:* The results are weighted by the population count in each cell. Standard errors are clustered at the state level and shown in parentheses. The unemployment insurance benefit measures are demeaned with respect to the population-weighted mean across the sample.

\* $p < .05$ ; \*\* $p < .01$

UI-ineligible unemployment had a similar association with opioid-related deaths when UI offers limited support for workers, but there was no significant association between job loss and opioid-related deaths when generous UI support prevailed. It is worth noting that the estimated unemployment effect was significantly larger than previous studies have suggested (Hollingsworth et al. 2017). By distinguishing between layoff and non-layoff unemployment and the moderating role of UI, we avoided conflating the UI effect and the unemployment effect, which would bias the estimated effect of job losses on opioid-related deaths toward zero.

Additionally, our hypothesis predicts that UI generosity should affect opioid overdose death rates primarily through UI-eligible unemployment. As a robustness test, we augmented Eq. (1) with an additional interaction term between the maximum UI benefit level and the non-layoff unemployment rate, which estimates the share of workers unemployed but with a lower probability of receiving UI benefits. Column 4 reports the estimation result for this modified regression model. As predicted, we find that the interaction between the non-layoff unemployment rate and UI generosity was much smaller (-0.01) and statistically insignificant. This solidifies our previous result by showing that UI generosity was linked to opioid-related mortality predominantly through UI-eligible workers.

In sum, our results suggest that UI plays a crucial role in reducing the risk of opioid overdose deaths following involuntary job losses. At the mean UI generosity level, we do not observe a strong relationship between involuntary job losses and opioid overdose deaths, indicating that the short-run effect of job losses was not a

**Table 3** Unemployment insurance extensions and opioid-related deaths among the U.S. prime-age population, 1999–2012

	Opioid-Related Death Rate	
	(1)	(2)
Maximum Benefits	-0.15 (0.14)	-0.17 (0.14)
Two-Year Layoff Rate	0.23 (0.13)	-1.69 (1.32)
Maximum Benefits × Two-Year Layoff Rate	-0.11* (0.05)	-0.10* (0.04)
Maximum Extended Benefits	-0.00 (0.05)	0.01 (0.05)
Maximum Extended Benefits × Two-Year Layoff Rate	-0.01 (0.01)	-0.01 (0.02)
Non-Layoff Unemployment Rate	Yes	Yes
Layoff Rate × State Unemployment Cubic Function	No	Yes
State-Year Controls	Yes	Yes
County Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
<i>N</i>	43,883	43,883
<i>R</i> <sup>2</sup>	.59	.59

*Notes:* The results are weighted by the population count in each cell. Standard errors are clustered at the state level and shown in parentheses. The unemployment insurance benefit measures are demeaned with respect to the population-weighted mean across the sample.

\* $p < .05$

key driver in the national increase in opioid overdose deaths during this period. This, however, reflects the average treatment effect of UI benefits on workers and communities. As UI generosity declines, the probability of workers resorting to opioid use as a coping mechanism for job losses rises. This finding suggests that financial stress from income loss is the critical link between recent job losses and opioid-related mortality. Consistent with the stress-reduction hypothesis, when income loss is sufficiently replaced by UI benefits, job losses do not appear to worsen opioid overdose mortality. The evidence presented here does not lend support to the effect-budgeting hypothesis predicting heavier opioid use with more generous UI benefits.

### Extended UI Benefits and Opioid-Related Mortality

During times of high unemployment, states may offer additional weeks of UI benefits through emergency UI programs. To estimate whether extended UI benefits further weaken the association between job loss and opioid overdose death risk, we began with a modified version of Eq. (2) excluding the interaction terms between the layoff rate and the state unemployment rate cubic function. As reported in column 1 of Table 3, while the maximum regular benefit significantly reduced the elevated risk of opioid overdose death from layoffs, the maximum extended benefit had a minimal role in moderating

**Table 4** Unemployment insurance generosity and opioid-related deaths, by demographic characteristics, among the U.S. prime-age population, 1999–2012

	Opioid-Related Death Rate							
	(1) Male	(2) Female	(3) White	(4) Black	(5) Hispanic	(6) 25–34	(7) 35–44	(8) 45–54
Maximum Benefits	-0.17 (0.20)	-0.07 (0.10)	-0.23 (0.18)	-0.33 (0.40)	-0.06 (0.12)	-0.06 (0.15)	-0.21 (0.17)	-0.06 (0.15)
Two-Year Layoff Rate	0.23 (0.23)	0.09 (0.13)	0.29 (0.19)	-0.27 (0.14)	-0.10 (0.07)	0.16 (0.18)	0.12 (0.17)	0.19 (0.23)
Maximum Benefits × Two-Year Layoff Rate	-0.18** (0.07)	-0.08* (0.03)	-0.12* (0.05)	-0.08 (0.06)	-0.04 (0.04)	-0.18** (0.06)	-0.10 (0.05)	-0.14** (0.04)
Non-Layoff Unemployment Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State–Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	43,883	43,883	43,883	42,591	43,760	43,883	43,883	43,883
<i>R</i> <sup>2</sup>	.54	.43	.57	.41	.35	.39	.44	.48

*Notes:* The results are weighted by the population count in each cell. Standard errors are clustered at the state level and shown in parentheses. The unemployment insurance benefit measures are demeaned with respect to the population-weighted mean across the sample.

\**p* < .05; \*\**p* < .01

this harmful relationship. For every \$1,000 increase in the maximum extended benefit from the mean level, the number of opioid overdose deaths per 100,000 associated with a percentage-point increase in the layoff rate declined by only 0.01.

Because extended benefits become available only when labor market conditions deteriorate, the estimates in column 1 may be subject to bias if the association between job losses and substance use changes during times of high unemployment. In column 2, we address this concern by augmenting the equation with the interaction terms between the layoff rate and the state unemployment rate cubic function. The coefficient of the interaction term between the maximum extended benefit and the layoff rate remained -0.01 in this specification, indicating that changes in state economic condition did not drive the insignificant result in column 1. These findings suggest that income support immediately following job loss has the most substantial effect in preventing opioid overdose mortality associated with the loss of employment. Extending benefits over the standard 26-week maximum does not appear to further protect workers from harmful substance use after the job loss.

### Estimation Results by Demographics

In [Table 4](#), we stratified the main analysis by gender, race, and age by substituting the outcome variable with the gender-, race-, and age-specific opioid overdose death



rates. These results show that UI was consistently associated with lower opioid overdose mortality rates across demographic groups. However, the effects were largest for Whites and men. These patterns are consistent with earlier studies finding that the link between unemployment and opioid overdose mortality is strongest for White men.

Columns 1 and 2 show that the association between the layoff rate and the opioid overdose death rate was more than twice as great for men as for women. Proportional to the size of these main effects, UI generosity had a greater moderating effect in reducing opioid overdose deaths for men than for women. However, the stronger effect for men was not a result of men being disproportionately more exposed to mass layoffs. To measure the level of direct exposure to layoff events, we computed the annual layoff-to-population ratio by gender, defined as the number of male (female) workers laid off in mass layoff events as a share of the total prime-age male (female) population. During our sample period, the average layoff-to-population ratio was 1.1% for men and 0.8% for women, suggesting that women were only slightly less affected by mass layoffs. The slight difference in exposure cannot fully account for the large gap in the behavioral response to job losses indicated by the coefficient estimates. This implies that income loss provokes more opioid use among men, and as a result, income support through the UI has a stronger effect in reducing opioid overdose deaths.

The effect of job losses for Whites stood out relative to the effect for other racial and ethnic groups. At the mean UI generosity level, a percentage-point increase in the layoff rate was associated with an increase in the opioid overdose death rate for Whites but a decrease in the opioid overdose death rate for Blacks and Hispanics. As discussed earlier, during our study period, opioid overdose deaths were driven by prescription opioids and mostly affected Whites who had better access to health care and were more likely to be treated for pain. The contrast here suggests that job loss could potentially further widen this racial gap in health care access. Despite the contrasting behavioral response, UI generosity was consistently associated with lower opioid overdose death rates, with the largest effect observed among Whites. This implies that income support serves a similar role in reducing opioid use following employment separations across racial and ethnic groups.

In terms of age, job loss posed a slightly lower risk of overdose for adults aged 35–44. Consequentially, the moderating effect of UI was modestly smaller for this age-group. A possible explanation for the weaker behavioral response to job loss is that workers aged 35–44 had stronger ties to the labor market than the other two age-groups, indicated by their higher labor force participation rate and employment-to-population ratio. The differences in the interaction terms between the age-groups, nevertheless, were not statistically significant, and we do not find clear evidence suggesting there is a meaningful difference across age-groups.

In sum, while job losses evoked a range of different responses, the findings here show that UI was consistently associated with lower opioid overdose mortality rates across demographic groups.

## Robustness Checks

The results reported in [Table 5](#) show that the association between UI and the opioid overdose death rate was robust to several alternative specifications. In column 1, we

**Table 5** Robustness checks: Unemployment insurance and opioid-related deaths among the U.S. prime-age population, 1999–2012

	Opioid-Related Death Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Maximum Benefits × Two-Year Layoff Rate	-0.08* (0.04)	-0.13** (0.05)	-0.13* (0.05)		-0.24* (0.10)	
Maximum Benefits <sub>t-2</sub> × Two-Year Layoff Rate <sub>t-2,t-3</sub>		-0.01 (0.05)				
In Maximum Benefits × Two-Year Layoff Rate				-1.68** (0.57)		
Maximum Benefits × One-Year Layoff Rate						-0.18* (0.07)
Layoff Rate Measures Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Unemployment Insurance Benefit Measures Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
Non-Layoff Unemployment Rate	Yes	Yes	Yes	Yes	Yes	Yes
State-Year Controls	Yes	Yes	Yes	Yes	Yes	Yes
County/State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
State Time Trend	Yes	No	No	No	No	No
Layoff Rate × State Welfare Policies Full Interaction Terms	No	No	Yes	No	No	No
Unit of Observation	Counties	Counties	Counties	Counties	States	Counties
N	43,883	43,849	43,883	43,883	712	43,883
R <sup>2</sup>	.63	.59	.59	.59	.78	.59

Notes: The results are weighted by the population count in each cell. Standard errors are clustered at the state level and shown in parentheses. The unemployment insurance benefit measures are demeaned with respect to the population-weighted mean across the sample.

\**p* < .05; \*\**p* < .01

included an additional state-level time trend in the regression model to test if our finding holds after removing UI policy variations parallel to unobserved time trends in a state. The result shows that the inclusion of state-level time trends reduced the point estimate of the UI interaction effect by 40%. According to this estimate, at one standard deviation (\$3,610) below the mean UI benefit level, a percentage-point increase in the layoff rate resulted in a 0.50-base-point increase in the opioid-related mortality rate compared to a 0.63-base-point increase based on the estimates from Eq. (1). While the two estimates were not statistically different, we want to highlight the range of moderating effects. In column 2, we tested if our main result was biased by the lagged effect of UI benefits. If layoff rates were correlated across years and UI had a lagged effect in reducing late-onset opioid overdose deaths, the lagged effect may create a bias for the estimated contemporary effect of UI. The results presented here do not support this alternative proposition.

In column 3, we augmented Eq. (1) with the full set of interaction terms between the layoff rates and state-level social welfare and labor-policy characteristics, including the log number of SNAP recipients, log number of TANF recipients, log number of Medicaid enrollees, state EITC rate, and state minimum wage rates. The coefficient of the main interaction term remained identical to the previous estimates, suggesting that the estimated UI effect was not driven by the correlation between UI policy and other state-level policy changes.<sup>8</sup> In column 4, we logged the maximum regular UI benefits as an alternative measure to test whether opioid death rates declined with a proportional increase in UI generosity. The estimated effect of UI was numerically consistent with our main result. In column 5, we aggregated the opioid death rates, layoff rate, and the non-layoff unemployment rate to the state level to test how the model performs at a less disaggregated geographic level. While the coefficient for the interaction term increased under this alternative aggregation, the difference with the county-level interaction term was not statistically significant. In column 6, we replaced the two-year layoff rate in the original data with the one-year layoff rate and adjusted the non-layoff unemployment rate accordingly. The result indicates that UI generosity had a larger effect through newly unemployed workers, but the difference with the two-year layoff rate interaction term was not statistically significant.

## Discussion

Opioid overdose deaths have been the primary contributor to the rise in all-cause mortality over the past 20 years among Whites in the United States. The disproportionate impact of the opioid epidemic on disadvantaged Whites has widened the educational gradient in life expectancy. Moreover, as the opioid epidemic gains a foothold in Black communities, it threatens to exacerbate existing racial inequalities in mortality and life expectancy. In contrast to earlier work on drug addiction emphasizing individual behavior, scholarship on the opioid epidemic has investigated the role of structural factors such as economic conditions on overdose mortality. The focus on structural factors is consistent with the social determinants perspective emphasizing the importance of income, working conditions, and unemployment to population health and health inequalities (Beckfield et al. 2015). However, studies on unemployment and opioid overdose deaths have yielded somewhat mixed results (Case and Deaton 2017; Ruhm 2019).

One possible reason for the apparent weak connection between unemployment and opioid overdose mortality is that previous work neglected social policy context. Scholarship on social determinants has primarily focused on what Solar and Irwin (2010) referred to as intermediary factors such as unemployment, neighborhood and housing quality, and employment conditions (Raphael 2006). However, more recent theoretical perspectives underscore the importance of socioeconomic and policy contexts in explaining cross-national differences in population health and health inequalities within countries (Bambra and Beckfield 2012; Beckfield et al. 2015; Beckfield and Krieger 2009; Montez et al. 2017; Solar and Irwin 2010; Whitehead et al. 2000). First, these theoretical frameworks predict that social policy and socioeconomic context will

<sup>8</sup> Table A2 in the online appendix shows the full set of coefficient estimates for the policy interaction terms.

influence the distribution of social determinants in society. For example, free trade policies could expose manufacturing workers to unemployment risk. Second, as we demonstrate here, social policy can also moderate the relationship between social determinants such as unemployment and health outcomes by influencing other determinants such as income. Some have argued that life expectancy and mortality in the United States lag behind these indicators in other developed nations because social welfare policies provide little protection against unemployment, poverty, and sickness (Beckfield and Bambra 2016). Nonetheless, it is important to consider within-regime policy heterogeneity (Beckfield and Krieger 2009; Montez et al. 2017), particularly in the United States, where institutional arrangements (Brady et al. 2013; Soss et al. 2001) and opportunity are highly stratified by geography (Chetty et al. 2014).

In leveraging employment shocks (i.e., mass layoffs) and policy change (i.e., within-state variation in UI generosity), the present study provides support for theoretical frameworks emphasizing the importance of income support policies to population health. We found that although there was a positive relationship between the mass layoff rate and overdose mortality, this effect was not statistically significant. Taken alone, this result would only add to what is already an inconclusive body of evidence. However, by interacting the mass layoff rate with the generosity of UI benefits, we showed that the relationship between unemployment and opioid overdose deaths is conditioned by the level of income support available to unemployed workers. Specifically, we found that at one standard deviation (\$3,610) below the mean UI benefit level, a percentage-point increase in the layoff rate raised the opioid overdose death rate by 0.50–0.63 base-points, or 5.0%–6.5% from its mean level. Moreover, these results persisted after stratifying the results by gender, race, and age, indicating that the positive benefits of UI are widely shared.

The present study adds to a growing body of evidence that UI may mitigate the harmful effects of job loss on physical, mental, and behavioral health outcomes (Cylus 2017; Cylus et al. 2014, 2015; Kuka 2020). The consistency of these findings is even more surprising given the fact that the United States is often characterized as a welfare state laggard in international comparisons. Although the United States has historically provided less generous social welfare benefits and protection against unemployment than other wealthy nations (Esping-Andersen 1990), there is also evidence that these benefits have become less generous over time, particularly in the context of UI in states that made dramatic programmatic cuts since the Great Recession (von Wachter 2019). In 2019, less than 30% of unemployed workers nationwide received UI benefits, while the dollar amount of lost wages replaced continues to decline (O'Leary 2020). The results presented here suggest that cuts to social welfare benefits such as UI have second-order effects on outcomes such as health that extend well beyond basic financial needs. ■

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