Factors Contributing to Variation in Nonmedical Use of Prescription Pain Relievers Among U.S. Workers: 2004–2014

December 2021

Wenjia Zhu, Marisa Shenk, Yonatan Ben-Shalom (Mathematica)
William Shaw (University of Connecticut Health Center)

Submitted to:

U.S. Department of Labor
Chief Evaluation Office
200 Constitution Avenue, NW
Washington, DC 20210
Project Officer: Kuangchi Chang

Submitted by:

Mathematica
1100 First Street, NE, 12th Floor
Washington, DC 20002-4221
Phone: (202) 484-9220
Fax: (202) 863-1763

Acknowledgements

The authors are grateful for the analytic support of Adrienne Jones from the National Center for Health Statistics; for the early input on our analysis plan by Sarah Luckhaupt and Alexis Grimes Trotter from the National Institute for Occupational Safest and Health; for the helpful comments on analysis findings by Jonathan Gellar and Vincent Pohl from Mathematica and Priyanka Anand from George Mason University; for the expert review of drafts of this report by Christopher Jones from the Centers for Disease Control and Prevention and Sarah Luckhaupt; and for valuable input from staff of the Chief Evaluation Office at the U.S. Department of Labor.

This report was prepared for the U.S. Department of Labor (DOL), Chief Evaluation Office (CEO) by Mathematica, under contract number 1605DC-18-A-0020/1605DC-18-F00401. The views expressed are those of the authors and should not be attributed to DOL, nor does mention of trade names, commercial products, or organizations imply endorsement of same by the U.S. Government.

Contents

Tables

Figures

Executive Summary

Nonmedical use of prescription opioids, opioid addiction, and overdose deaths involving opioid use are a major public health concern in the United States. Drug overdose is now the leading cause of injury death, with approximately 70 percent of all drug overdose deaths involving an opioid in 2017 (Mattson et al. 2020). Although opioid prescribing rates have begun to decline since 2010, opioid fatality rates have continued to rise, largely due to increased use of synthetic opioids, such as illicitly manufactured fentanyl (Mattson et al. 2021). The dramatic increase in both prescription and illicit opioid use since 2000 (Pezalla et al. 2017) is attributed to a marked liberalization of opioid prescribing practices for the treatment of both acute and chronic pain (Mundkur et al. 2019). Previous studies have shown that rates of nonmedical use of opioids and overdose death involving opioid use vary geographically in the United States (Lipari et al. 2017) and by industry and occupation (Morano et al. 2018), although the exact mechanism by which occupational factors affect these outcomes is unclear.

To our knowledge, no studies have examined the variation in nonmedical use of opioids while accounting for both individual- and state-level factors. The U.S. Department of Labor's Chief Evaluation Office contracted with Mathematica and the University of Connecticut Health Center to generate new evidence on factors associated with opioid use among workers. This study used data on self-reported nonmedical use of prescription pain relievers from 2004 to 2014 to address three primary research questions:

Nonmedical use of prescription pain relievers

We use this term in our research questions and findings to be consistent with how the relevant survey data were collected. Survey respondents were asked to indicate if they had ever used prescription pain relievers without a doctor's prescription or simply for the feeling or experience the drug caused. The specific survey question focused on prescription opioids, but respondents were also asked about their nonmedical use of any other prescription pain relievers.

1. How does nonmedical use of prescription pain relievers among U.S. workers vary across states?
2. How does nonmedical use of prescription pain relievers among U.S. workers vary across industry, occupations, and other individual characteristics?
3. How well do individual- and state-level factors explain the overall variation in nonmedical use of prescription pain relievers?

To address these research questions, we first examined summary statistics for nonmedical use of prescription pain relievers by state, industry and occupation, and other individual characteristics. We then performed regression analyses to understand the separate contributions of individual- and state-level factors to the overall variation in nonmedical of prescription pain relievers.

The summary statistics showed that nonmedical use of prescription pain relievers varied widely across states. It also varied considerably by workers' industry, occupation, and demographic characteristics such as age, sex, and race/ethnicity. The regression analyses further demonstrate the associations between each of these individual-level factors and the nonmedical use of prescription pain relievers while taking into account other factors that might differ across individuals and states. These findings imply that policies to prevent nonmedical use of prescription pain relievers might need to consider individual risk factors beyond occupation and industry.

Several state-level factors were associated with nonmedical use of prescription pain relievers. Factors associated with increased nonmedical use included the state proportions of workers with less than high school education, in the construction industry, and in public administration. That is, states that have higher proportions of workers with less than high school education, in the construction industry, or in public administration, tend to have higher levels of nonmedical use of prescription pain relievers. Factors associated with decreased nonmedical use included the state proportions of workers ages 50 to 64 and those who are Black, non-Hispanic, or Hispanic, and the number of hospitals per capita. In particular, the number of hospitals per capita is negatively associated with nonmedical use of pain relievers, meaning that states with fewer hospitals tend to see higher levels of nonmedical use of prescription pain relievers. This implies that regional influences on health care access should be considered in policies designed to prevent nonmedical use of prescription pain relievers.

We also broke down the overall variation in nonmedical use of prescription pain relievers into parts. Overall, the factors we included in our regression model explained 17.4 percent of the overall variation in nonmedical use of prescription pain relievers in the past 12 months. Most of that 17.4 percent was driven by individual-level worker characteristics. However, workers' industry and occupation contributed very little to the explained variation. This finding suggests that differences in nonmedical use of prescription pain relievers between industries and occupations are explained, in part, by demographic differences between workers in those industries and occupations. That is, workers in different industries and occupations vary a great deal in their demographic characteristics, and differences across industries and occupations in nonmedical use of prescription pain relievers may in part reflect the demographic differences between occupational groupings.

State-level factors associated with nonmedical use of prescription pain relievers

Increased nonmedical use

- Proportion of workers with less than high school education
- Proportion of workers in the construction industry
- Proportion of workers in public administration

Decreased nonmedical use

- Proportion of workers ages 50 to 64
- Proportion of workers who are Black, non-Hispanic, or Hispanic
- Number of hospitals per capita

In comparison to individual-level worker characteristics, little of the explained variation was driven by state-level worker characteristics and other state-level factors such as population density, income inequality, and the availability of health care providers. Hence, understanding occupational influences on opioid misuse requires a more thorough understanding of worker characteristics, as they are some of the most important factors associated with nonmedical use of prescription pain relievers. These findings might help federal and state agencies, and other entities seeking to prevent nonmedical use of prescription opioids and related overdose deaths, to focus their efforts more effectively. In addition, policymakers and designers of employer-based programs might want to consider other potential risk factors for opioid misuse in their worker populations, including workplace and employer-level factors.

I. Introduction

Nonmedical use of prescription opioids, opioid addiction, and overdose deaths involving opioid use are a major public health concern in the United States. Drug overdose is now the leading cause of injury death, with approximately 70 percent of all drug overdose deaths in 2017 involving an opioid (Mattson et al. 2021).[1] Although opioid prescribing rates have been declining since 2010, opioid fatality rates have continued to rise, largely due to increased use of synthetic opioids such as illicitly manufactured fentanyl, with 49,900 lives lost in 2019 (Guy et al. 2017; Mattson et al. 2021); opioid overdose death rates rose from 2.9 to 15.5 per 100,000 persons (more than 400 percent) between 1999 and 2019 (KFF 2021). In 2016, people ages 20 to 64 accounted for more than 71,000 nonfatal hospitalizations related to opioid poisoning and a similar number of nonfatal emergency department visits (Roehler et al. 2019). The dramatic increase in both prescription and illicit opioid use since 2000 (Pezalla et al. 2017) is attributed to a marked liberalization of opioid prescribing practices for the treatment of both acute and chronic pain (Mundkur et al. 2019).

Opioid overdose death rates and nonmedical use of prescription opioids are highest among the working-age population. Injured workers are often prescribed opioids to ease pain, and adults ages 35 to 54 have some of the highest overdose death rates due to prescription opioids. In 2018, an estimated 15,000 people died from drug overdoses involving prescription opioids, with death rates highest among those ages 35 to 54 (8.1 per 100,000 for ages 35 to 44 and 8.4 per 100,000 for ages 45 to 54 [Wilson et al. 2020]). Nonmedical use of prescription opioids in 2008 to 2011 was about twice as high among adults ages 18 to 49 compared with those age 50 and older (Jones et al. 2014).

Previous studies have shown that rates of nonmedical use of opioids and overdose death involving opioid use vary geographically and by industry and occupation, although the exact mechanism by which various individual- and state-level factors affect these outcomes is unclear. Average nonmedical use in the past year by state ranged from 3.4 to 5.3 percent in 2012–2014; this variation might reflect state differences in opioid prescribing practices, opioid policy reforms, sociodemographic and system-level factors, and industry mix (Lipari et al. 2017; Shraim et al. 2019; Strickler et al. 2020; Webster et al. 2009). Opioid nonmedical use and overdose death rates are among the highest in occupations with heavy physical demands. For example, relative mortality for prescription opioid-related overdose deaths was more than double in construction workers compared with those in education in 2007–2012 (Morano et al. 2018). To our knowledge, no studies have tried to explain the variation in nonmedical use of opioids while accounting for both individual- and state-level factors.

The U.S. Department of Labor's Chief Evaluation Office contracted with Mathematica and the University of Connecticut Health Center to generate new evidence on factors associated with opioid use among workers. This study used 2004–2014 data from the National Survey on Drug Use and Health (NSDUH) to address three primary research questions:[2]

[1] For this study, nonmedical use of opioids refers to any use of prescription pain relievers when they were not prescribed for the individual using them or they were taken for the experience rather than a medical purpose.
[2] We used NSDUH data for years 2004–2014, because the data from 2015 onward do not include information on industry and occupation, which are central to our analysis. Hence, our analyses do not capture the changing patterns of opioid use in more recent years.

1. How does nonmedical use of prescription pain relievers among U.S. workers vary across states?[3]
2. How does nonmedical use of prescription pain relievers among U.S. workers vary across industry, occupation, and other individual characteristics?
3. How well do individual- and state-level factors explain the overall variation in nonmedical use of prescription pain relievers?

To address these research questions, we first examined summary statistics for nonmedical use of prescription pain relievers by state, industry and occupation, and other individual characteristics. We then performed regression analyses to understand the separate contributions of individual- and state-level factors to the overall variation in nonmedical of prescription pain relievers.

A clearer understanding of the contributions of individual-level and state-level factors might help federal and state agencies, and other entities seeking to prevent nonmedical use of prescription opioids and related overdose deaths, to focus their efforts more effectively. For example, information about state-level factors associated with higher nonmedical use of prescription opioids might help federal agencies allocate relevant program funding to states at elevated risk due to these factors. Similarly, state agencies can use information about individual-level factors to allocate relevant program funding to certain geographic areas or populations at elevated risk within the state. These data might also point toward relevant policy interventions within health care systems, employer health promotion programs, and local jurisdictions.

In the remainder of the report, we first describe the data and methods we used to conduct the analyses (Chapters II and III). We then present summary statistics and findings from our regression analyses (Chapter IV). Finally, we summarize the implications of the findings, discuss their limitations, and identify research areas of interest for future study (Chapter V). Report appendices A and B provide additional detail on analysis methods and results, respectively.

[3] As we explain further in Chapter III, we refer to "prescription pain relievers" in our research questions and findings to be consistent with how the survey data were collected; the relevant survey question focuses on prescription opioids and excludes illicit drugs such as heroin.

II. Data

Our main data source for the analysis was the NSDUH, which provides individual-level data on self-reported nonmedical use of prescription pain relievers as well as demographic information and state of residence. We supplemented NSDUH data with state-level data from the U.S. Census, the American Community Survey (ACS), and the Area Health Resources Files (AHRF). Below, we briefly describe each of these data sources.

A. National Survey of Drug Use and Health

The NSDUH) is conducted each year and is representative of the civilian noninstitutionalized population ages 12 and older.[4] The Substance Abuse and Mental Health Services Administration administers the NSDUH to collect information about tobacco, alcohol, and drug use, as well as other health-related issues. We used the restricted-use version of the data, which includes state identifiers that enable us to explore geographic variation.[5] We used data for years 2004–2014, because the data from 2015 onward do not include information on industry and occupation, which are central to our analysis. We pooled the data across years to obtain a larger sample, which improves the precision of our estimates—particularly for smaller states, industries, or occupations.[6] We limited our sample to working-age adults (ages 18 to 64) who were in the labor force during the week before their NSDUH interview and were not missing information about their industry and occupation (associated with either current work or work in the past year). Our study sample includes approximately 370,100 respondents.

B. Census, American Community Survey, and Area Health Resources Files

We obtained state-level data from other sources to supplement the state-level measures we constructed from the individual-level NSDUH data, as we explain in Chapter III. These include measures of population density and income inequality from the U.S. Census Bureau and health care characteristics from the AHRF. The census's American FactFinder tool provided state-level data on population density based on the 2010 census.[7,8] We also used the American FactFinder tool to obtain the state-level Gini index, which measures income inequality.[9] For this measure, we used ACS five-year data for 2010–2014

[4] The NSDUH has been conducted annually since 1971. In 1999, data collection shifted from personal interviews and self-enumerated answer sheets to computer-assisted personal interviews (for less sensitive questions) and audio computer-assisted self-interviews (for sensitive questions) (https://www.icpsr.umich.edu/web/ICPSR/series/00064). The survey uses an independent, multistage area probability sample for each of the 50 states and the District of Columbia. Response rates ranged from 65 percent in 2019 to 79 percent in 2002 (see NSDUH data set codebooks by year at https://www.datafiles.samhsa.gov/node/2). About 67,500 persons are interviewed annually.

[5] We obtained access to the restricted-use version of the data through an application to the National Center for Health Statistics (NCHS) Research Data Center and remote assistance from NCHS staff.

[6] Pooling the data across years might mask some of the year-by-year trends in nonmedical use of prescription pain relievers during that time; we controlled for individual year indicators in the regressions to account for time effects, which mitigates the concern to some extent.

[7] We obtained data from the American FactFinder tool before it was decommissioned; similar data are available at http://data.census.gov.

[8] The decennial census is conducted every 10 years to provide an official count of the entire U.S. population. Approximately 74 percent of U.S. households responded to the 2010 census via mail; the remaining households were counted by census workers visiting neighborhoods throughout the United States (https://www.census.gov/newsroom/releases/archives/2010_census/cb10-cn81.html).

[9] The Gini index is a single statistic characterizing the distribution of income across the population. The index ranges from 0, indicating complete equality (where everyone has the same income), to 1, indicating complete inequality (where one person or a group of people receive all the income).

to align with the last five years of our analysis period; the Gini index was stable at the state level between 2006 and 2014, the years available from the ACS.[10,11] From the AHRF, we obtained county-level data for 2014 on the availability of physicians and hospitals using the 2015–2016 and 2016–2017 files, respectively; data suggest these measures were stable over the study period.[12,13] We aggregated county-level data and divided total counts by the state population to obtain state prevalence rates of active physicians and hospitals per 100,000 people.

[10] The Census Bureau conducts the ACS annually to collect information about the characteristics of people and housing units. The ACS sampling unit is the household, and the ACS includes all persons in a sampled household. The ACS sampled between 740,000 and 900,000 housing unit addresses annually in the United States between 2000 and 2004 and about 2.9 million housing unit addresses annually since 2005 (https://www.census.gov/programs-surveys/acs/methodology/sample-size-and-data-quality/sample-size-definitions.html). The housing unit response rates ranged from 86 percent in 2019 to 98 percent in 2009 (https://www.census.gov/acs/www/methodology/sample-size-and-data-quality/response-rates/).

[11] The correlation between state-level Gini indices based on five-year ACS data for 2006–2010 and 2010–2014 is higher than 0.98. Hence, state-level Gini indices for 2010–2014 should capture state-level income inequality for the entire analysis period.

[12] The AHRF is an annual compilation of data collected from more than 50 sources including the American Hospital Association, the American Medical Association, and the U.S. Census Bureau (https://data.hrsa.gov/topics/health-workforce/ahrf). The data are available at the county, state, and national levels. Together, they provide information on geographic codes and descriptors, health facilities and professionals, measures of resource scarcity, population health status, economic activity, health training programs, and socioeconomic and environmental characteristics.

[13] According to the Kaiser Family Foundation, the number of hospitals was stable at the state level between 2004 and 2014 (https://www.kff.org/other/state-indicator/total-hospitals). Specifically, the correlation between state-level numbers of hospitals for 2004 and 2014 is higher than 0.99. Hence, using state-level numbers of hospitals for 2014 should capture state-level availability of hospitals for the entire analysis period.

III. Methods

The main outcomes of interests for our analysis are (1) nonmedical use of prescription pain relievers in the past 30 days, and (2) nonmedical use of prescription pain relievers in the past 12 months. We constructed our outcome variables using the following question from the NSDUH questionnaire: "[Within the past 30 days/12 months,] did you use any pain relievers when they were not prescribed for you or that you took only for the experience or feeling they caused?" For each outcome, we constructed a binary measure that takes a value of 1 if the person reported any nonmedical use of prescription pain relievers and 0 otherwise. Although the question above refers to "pain relievers," it focuses on prescription opioids and excludes over-the-counter pain relievers, such as Tylenol; it also excludes illicit drugs such as heroin.[14] In addition to nonmedical use, medical use of prescription opioids is also an outcome of potential interest; however, a question regarding medical use was not asked in NSDUH until 2015.

We performed both descriptive and regression analyses, which we briefly describe below; Appendix A provides more details on the analysis methods. We first examined summary statistics for nonmedical use of prescription pain relievers by state, industry and occupation, and other individual characteristics. We also summarized how workers' characteristics differed between states with high and low prevalence of nonmedical use of prescription pain relievers. We then performed regression analyses that enabled us to break down the overall observed variation in nonmedical use of prescription pain relievers into parts.

Nonmedical use of prescription pain relievers

We use this term in our research questions and findings to be consistent with how the relevant survey data were collected. Survey respondents were asked to indicate if they had ever used prescription pain relievers without a doctor's prescription or simply for the feeling or experience the drug caused. The specific survey question focused on prescription opioids, but respondents were also asked about their nonmedical use of any other prescription pain relievers.

Table 1 summarizes the types of predictors included in our regression analysis. These include both individual- and state-level predictors as well as year indicators and state-level random effects. We standardized the individual-level predictors so they represent each individual's difference from the state average for the relevant variable, with values ranging from –1 to 1. For example, for an individual living in a state where 40 percent of workers are in the construction industry, the value for their construction predictor would equal 0.6 (= 1–0.4) if the individual works in the construction industry and -0.4 (= 0–0.4) otherwise.

We included two types of state-level predictors in the model. The first type is based on individual-level variables; these predictors are equal to the state averages for the respective individual-level variables. The second type includes state-level measures from the census, ACS and AHRF data, such as state population density, Gini index, and prevalence rates of active medical doctors. Finally, we included individual year indicators and state-level random effects in the model. The year indicators account for changes over time in nonmedical use of prescription pain relievers. The state-level random effects capture the correlation of nonmedical use of prescription pain relievers between individuals within states.

[14] As Lipari et al. (2017) explain, NSDUH respondents were shown a "pill card" displaying the names and photographs of specific pain relievers and asked to indicate which, if any, they had ever used without a doctor's prescription or simply for the feeling or experience the drug caused. Most of the drugs listed on the card were opioids. Respondents were also asked about their nonmedical use of any other pain relievers not included in the list.

After running the regressions, we used the resulting estimates to calculate the distinct contributions of the various types of predictors to the overall variation in nonmedical use of prescription pain relievers. We further separated out the contributions of industry and occupation to gauge the extent to which the variation in nonmedical use of prescription pain relievers can be attributed to individual- and state-level variations in industry and occupation compared with variations in other factors (see Appendix A for more details on the method).

Table 1. Types of predictors included in the regression model

Predictor type	Description	Variables
Individual-level predictors		
Centered individual-level predictors	Individual-level differences from state averages	Industry, occupation, sex, age group, marital status, race/ethnicity, education, poverty status, and health status
State-level predictors		
Predictors based on individual-level variables	State averages of the individual-level factors	Industry, occupation, sex, age group, marital status, race/ethnicity, education, poverty status, and health status
Other state predictors	State-level measures from the census, ACS, and AHRF	Population density, Gini index, and prevalence rates of active medical doctors and hospitals
Other predictors		
Year fixed effects	Individual year indicators	Indicators of year 2005 through year 2014 (2004 is the reference year)
State random effects	Components in the model that allow the outcome to vary by state	Not applicable

Note: Centered individual-level predictors are continuous, ranging from –1 to 1. State-level predictors based on individual-level variables are continuous, ranging from 0 to 1. Other state predictors are continuous, with varying ranges. Individual year indicators are binary variables equal to 0 or 1.

ACS = American Community Survey; AHRF = Area Health Resources Files.

IV. Results[15]

In the following chapter, we present a variety of results. In brief, we found that:

- There was substantial variation in nonmedical use of prescription pain relievers by state.
- Workers' characteristics differed between states with high and low prevalence of nonmedical use of prescription pain relievers.
- There was substantial variation in nonmedical use of prescription pain relievers by industry, occupation, and demographic characteristics.
- Most of the explained variation in nonmedical use of prescription pain relievers was driven by individual characteristics, with only a small role for workers' industry and occupation; in comparison, little of the explained variation was driven by state-level population characteristics and other state-level factors, such as population density, income inequality, and the availability of health care providers.

A. Summary statistics

1. Variation in nonmedical use of prescription pain relievers by state

Nonmedical use of prescription pain relievers varied widely by state (Figures 1a and 1b). On average, 5.3 percent of all adult workers reported nonmedical use of prescription pain relievers in the past 12 months, with state averages ranging from 2.8 percent in South Dakota to 7.7 percent in Oklahoma (Figure 1a).[16] Approximately 2.1 percent of the workers reported nonmedical use in the past 30 days, ranging from 0.8 percent in South Dakota to 3.4 percent in Oklahoma (Figure 1b). In general, nonmedical use was higher in western and southern states, and lower in northeastern and midwestern states.

[15] The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Research Data Center, the National Center for Health Statistics, or the Centers for Disease Control and Prevention.

[16] To put these numbers into context, in 2015, 38 percent of U.S. civilian, noninstitutionalized adults reported medical use of prescription pain relievers (Han et al. 2017).

Figure 1a. Percentage of sample reporting nonmedical use of prescription pain relievers in past 12 months, by state

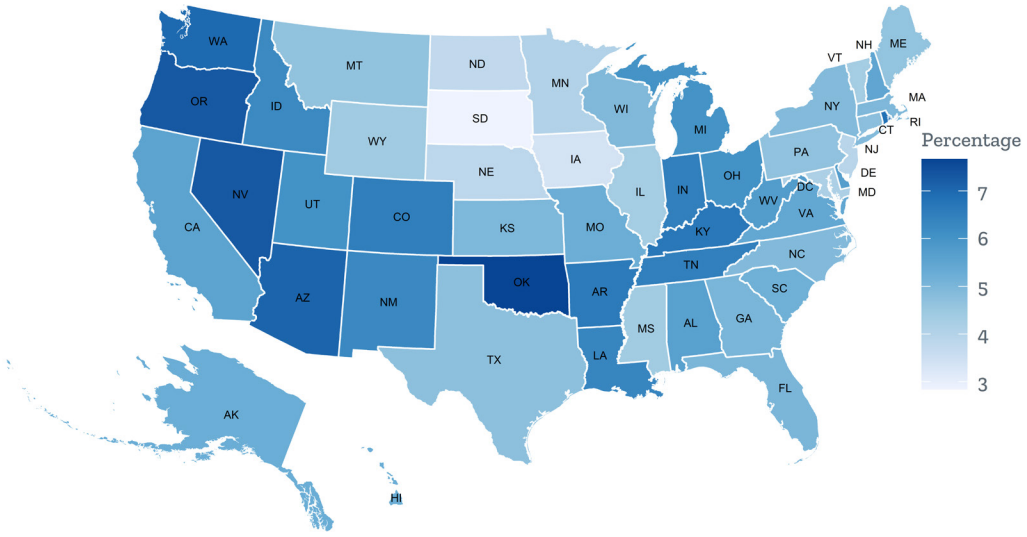
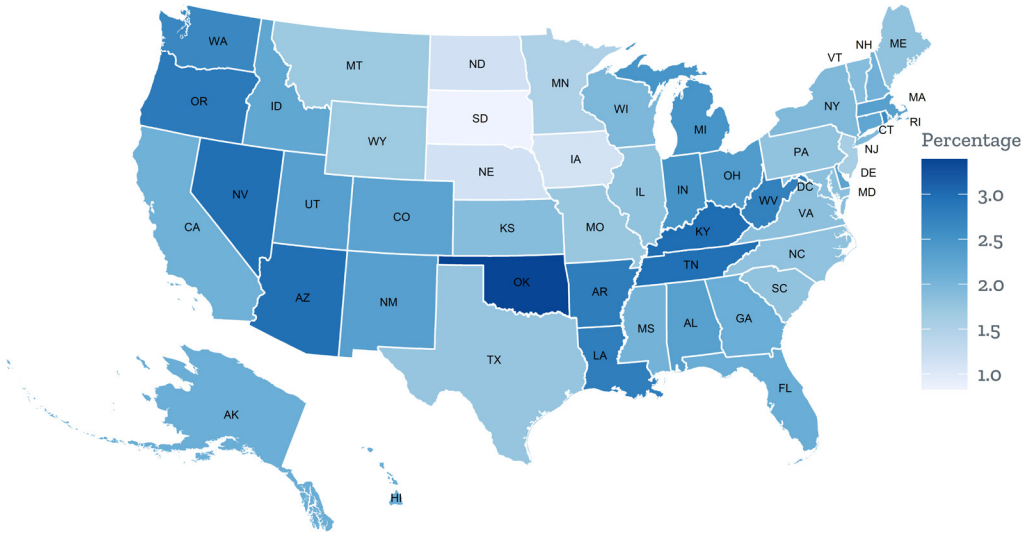


Figure 1b. Percentage of sample reporting nonmedical use of prescription pain relievers in past 30 days, by state



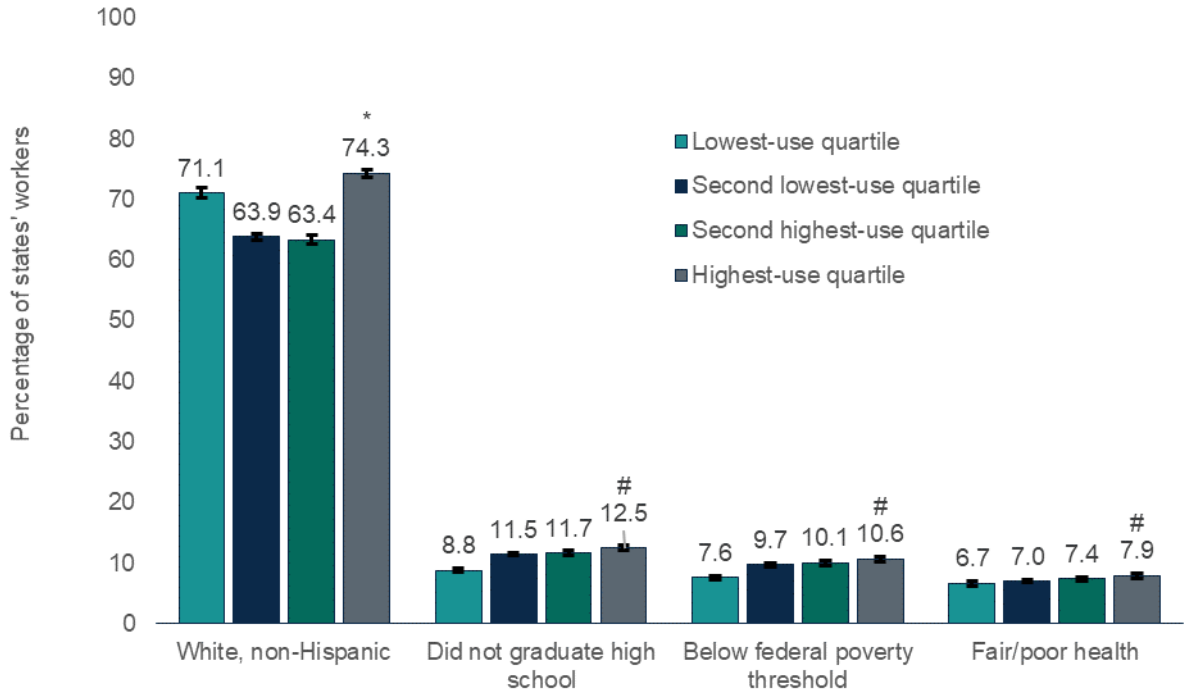
Note: See Appendix B, Table B.1 for detailed statistics underlying these figures.

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

2. Variation in workers' characteristics between states with high and low prevalence of nonmedical use of prescription pain relievers

States that had high versus low nonmedical use of prescription pain relievers varied in their population characteristics. We classified states into four similarly sized groups (quartiles) based on the estimated prevalence of reported nonmedical use of prescription pain relievers in the past 12 months in each state. As Figure 2 shows, workers in states in the highest-use quartile—the 12 states with the highest proportion of workers reporting nonmedical use of prescription pain relievers—were disproportionally White, non-Hispanic (74.3 percent) compared with workers in states with lower prevalence of reported nonmedical use of prescription pain relievers. In addition, workers in the highest-use states were more likely to not graduate high school (12.5 percent), to live in households with incomes below the federal poverty threshold (10.6 percent), and to report being in fair or poor health (7.9 percent) than workers in states in the two lowest-use quartiles (the 26 states with the lowest and second-lowest proportion of workers reporting nonmedical use of prescription pain relievers).

Figure 2. Worker characteristics, by state quartiles of reported nonmedical use of prescription pain relievers in the past 12 months



Notes: We classified states into four similarly sized groups (quartiles) based on the estimated prevalence of reported nonmedical use of prescription pain relievers in the past 12 months in each state. There are 12 states in the highest-use quartile and 13 states in each of the other quartiles. Brackets at the top of each bar represent the 95 percent confidence interval. See Appendix B, Table B.2 for detailed statistics underlying this figure.

* Average for highest-use quartile differs from all other quartiles ($p<0.05$).

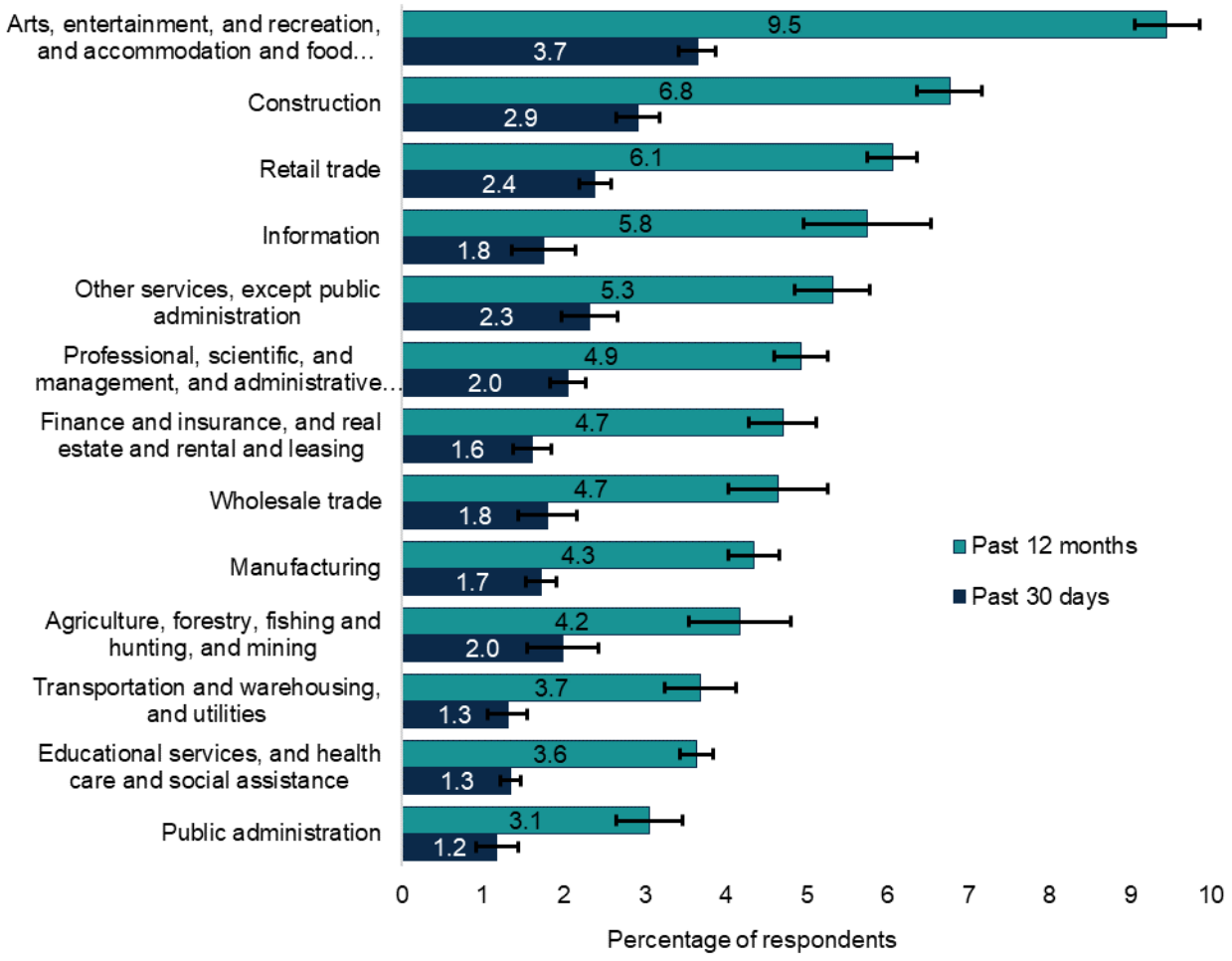
Average for highest-use quartile is above two lowest quartiles ($P<0.05$).

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

3. Variation in nonmedical use of prescription pain relievers by industry

In this section and the next two, we summarize combined data for all states and the District of Columbia. Nonmedical use of prescription pain relievers varied by industry and occupation (Figures 3 and 4). Among industries, nonmedical use of prescription pain relievers was most prevalent in the category that includes arts, entertainment, and recreation, and accommodation and food services (9.5 percent in the past 12 months and 3.7 percent in the past 30 days). The construction industry had the second most prevalent nonmedical use of prescription pain relievers (6.8 percent in the past 12 months and 2.9 percent in the past 30 days). Nonmedical use of prescription pain relievers was lowest in the public administration industry (3.1 percent in the past 12 months and 1.2 percent in the past 30 days).

Figure 3. Percentage of sample reporting nonmedical use of prescription pain relievers, by industry



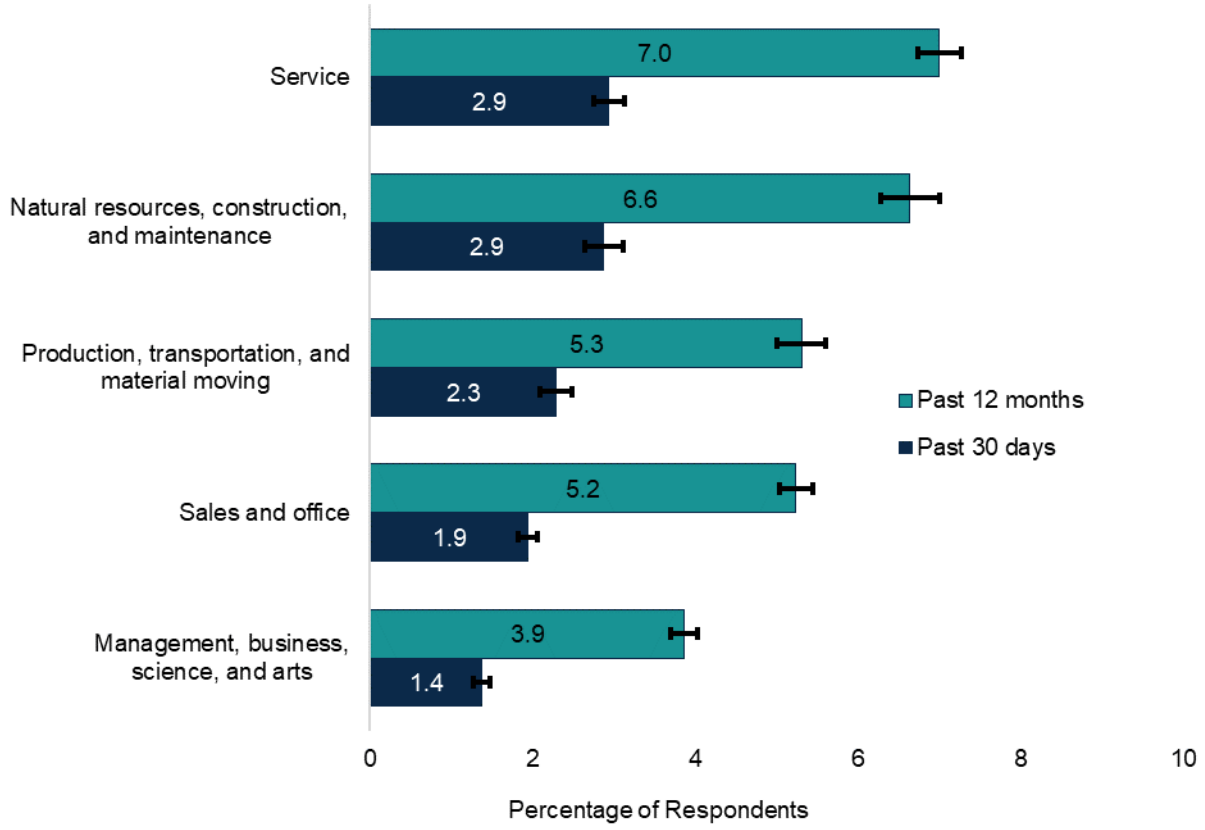
Notes: The National Survey on Drug Use and Health uses the North American Industry Classification System (NAICS) developed by the U.S. Census Bureau to identify 20 major industry groupings (see pages 16–18 of the NAICS manual for a summary of the distinguishing activities of each industry). We further combined some of the 20 major industry groupings to arrive at the 13 nonmilitary industry groupings represented in the American Community Survey. Brackets at the end of each bar represent the 95 percent confidence interval. See Appendix B, Table B.3 for detailed statistics underlying this figure.

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

4. Variation in nonmedical use of prescription pain relievers by industry and occupation

Nonmedical use of prescription pain relievers was most prevalent in the service occupations (7.0 percent in the past 12 months and 2.9 percent in the past 30 days) and least prevalent in the management, business, science, and arts occupations (3.9 percent in the past 12 months and 1.4 percent in the past 30 days). According to the Bureau of Economic Analysis (2019), workers in accommodation and food services constitute a large majority (about 85 percent) of the industry category that includes arts, entertainment, and recreation, and accommodation and food services. In comparison, few workers (approximately 15 percent) in that industry category are in arts, entertainment, and recreation. This may explain how "arts" can be included both in the highest nonmedical use industry category as well as in the lowest nonmedical use occupation group that includes management, business, science, and arts.

Figure 4. Percentage of sample reporting nonmedical use of prescription pain relievers, by occupation



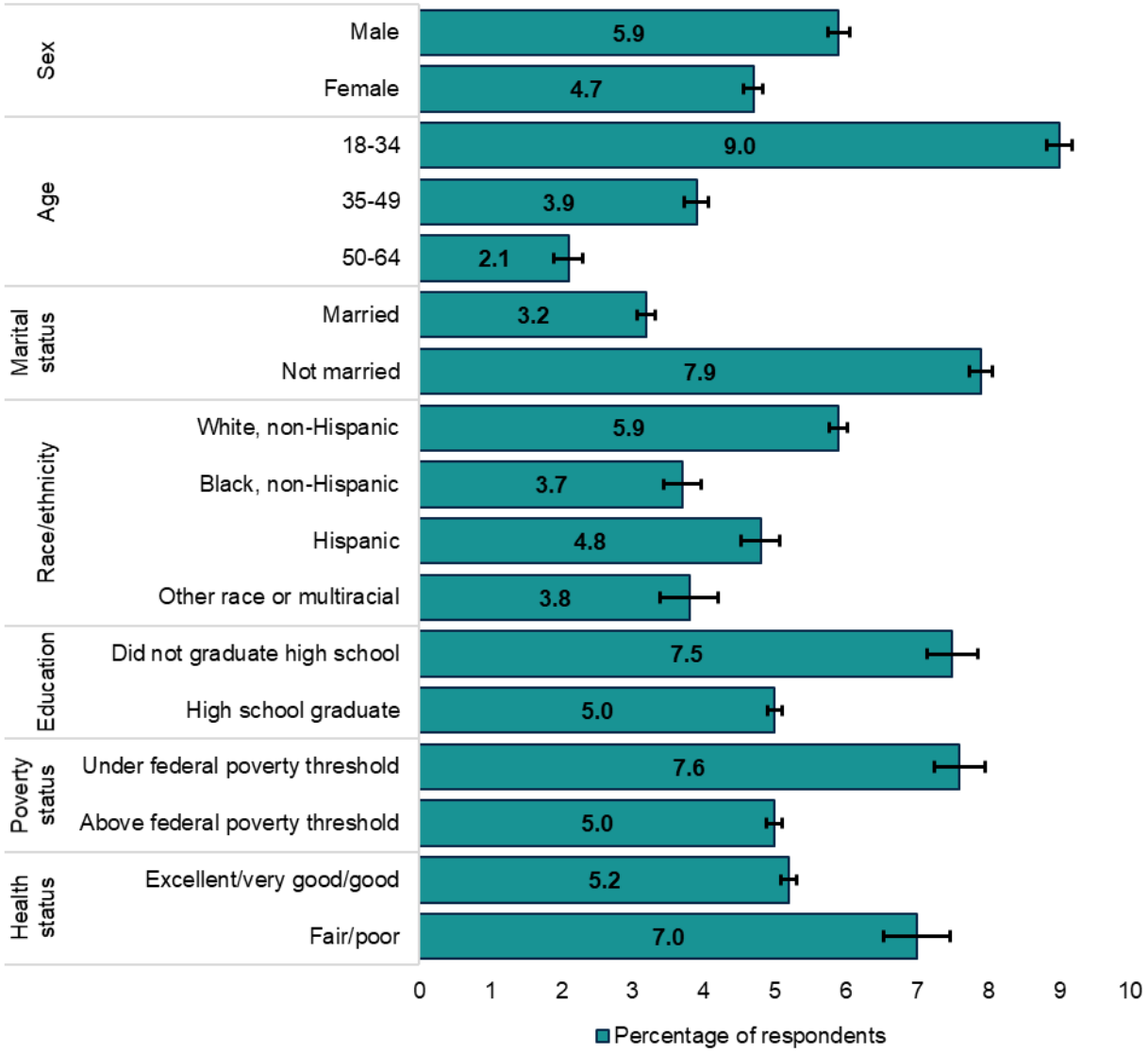
Notes: The National Survey on Drug Use and Health uses the 23 major occupation groupings derived from the U.S. Census Bureau's Standard Occupational Classification (SOC) system (see page 11 of the SOC manual for a summary of the distinguishing activities of each occupation). We further combined the occupation groupings to arrive at the 5 nonmilitary occupation groupings represented in the American Community Survey. Brackets at the top of each bar represent the 95 percent confidence interval. See Appendix B, Table B.4 for detailed statistics underlying this figure.

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

5. Variation in nonmedical use of prescription pain relievers by demographic characteristics

Nonmedical use of prescription pain relievers in the past 12 months also varied by other personal characteristics such as sex, age, and race/ethnicity (Figure 5). For example, nonmedical use of prescription pain relievers was higher for males (5.9 percent) than females (4.7 percent); higher among individuals ages 18–34 (9.0 percent) than other age groups; and higher among the White, non-Hispanic population (5.9 percent) compared with other race/ethnicity groups. Results for nonmedical use of prescription pain relievers in the past 30 days similarly varied by demographic characteristics.

Figure 5. Percentage of sample reporting nonmedical use of prescription pain relievers in the past 12 months, by demographic characteristics



Note: Brackets at the end of each bar represent the 95 percent confidence interval. See Appendix B, Table B.5 for detailed statistics underlying this figure.

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

B. Regression analysis and variance decomposition

Appendix B, Tables B.6a and B.6b include detailed results from the regression analysis.[17] The estimated coefficients for individual-level factors such as industry, occupation, sex, age, and race/ethnicity are consistent with the summary statistics shown in Figures 3, 4, and 5. That is, the regression results further demonstrate the associations between each of these individual-level factors and the nonmedical use of prescription pain relievers while taking into account other factors that might differ across individuals and states.

In addition to the individual-level factors above, several state-level factors had statistically significant ($p<0.05$) associations with nonmedical use of prescription pain relievers in either the past 12 months, the past 30 days, or both:

- **Factors associated with increased nonmedical use of prescription pain relievers**: state proportions of workers with less than high school education, in the construction industry, and in public administration.
- **Factors associated with decreased nonmedical use included:** state proportions of workers ages 50 to 64 and those who are Black, non-Hispanic or Hispanic, as well as the number of hospitals per capita in the state.

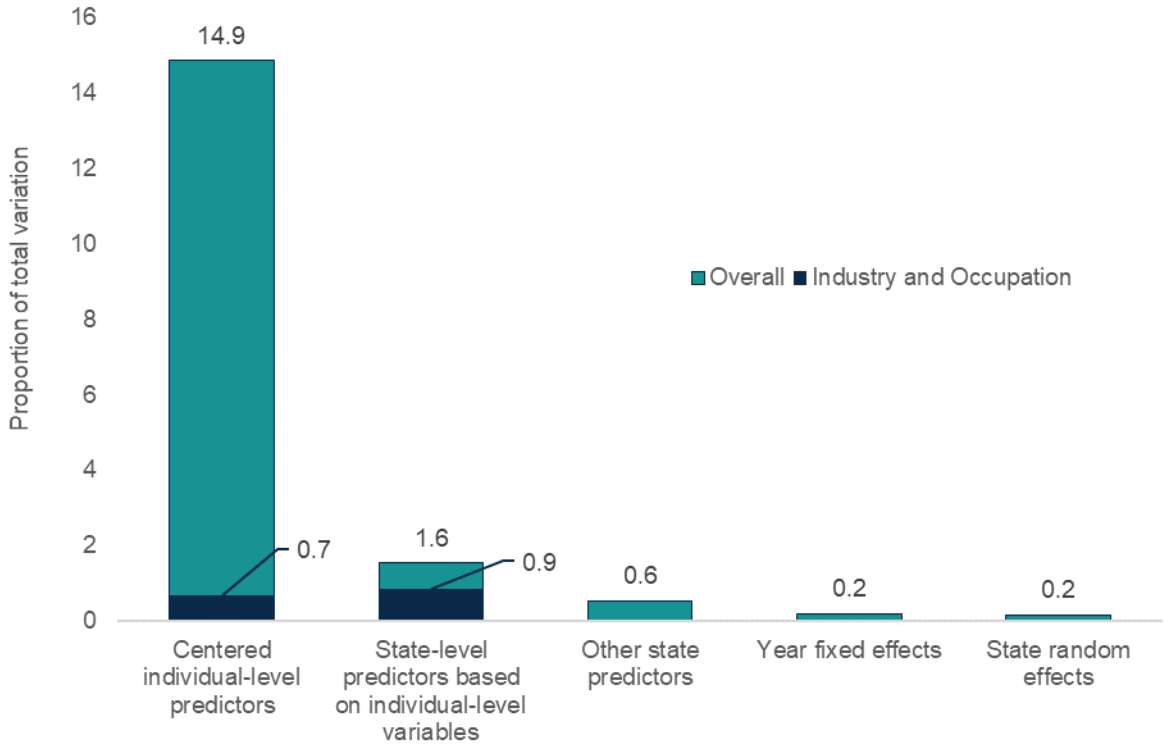
When we analyzed the separate contributions of individual- and state-level factors to the overall variation in nonmedical of prescription pain relievers (Figure 6), we found that:

- Factors included in our regression model explained 17.4 percent of the total variation in reported nonmedical use of prescription pain relievers in the past 12 months; the remaining 82.6 percent is residual variation.
- Of the 17.4 percent of variation explained by the factors we included, most (14.9 percentage points) can be attributed to differences in individual-level variables; the remainder (2.5 percentage points) is due to differences in state-level worker characteristics (the state-level predictors based on individual-level variables), other state-level factors, the state itself, and the year.
- Of the 14.9 percent and 1.6 percent of variation explained by individual-level and state-level worker characteristics, 0.7 and 0.9 percentage points, respectively, were contributed by industry and occupation.

These findings suggest that most of the explained variation in nonmedical use of prescription pain relievers was driven by differences in individual-level worker characteristics, with only a small role for workers' industry and occupation. In comparison, little of the explained variation was driven by differences in state-level worker characteristics and other state-level factors such as population density, income inequality, and the availability of health care providers.

[17] The predictors included in the regression models are summarized in Table 1. In the regressions, Model I includes information on industries but not occupations; Model II includes information on both industries and occupations.

Figure 6. Proportion of total variation in reported nonmedical use of prescription pain relievers in the past 12 months explained by each component in the regression model



Note: See Appendix B, Tables B.6b and B.7b for detailed statistics underlying this figure. The full model explains 17.4 percent of the overall variation in nonmedical use of prescription pain relievers in the past 12 months.

Source: Authors' analysis of National Survey on Drug Use and Health data for 2004–2014.

V. Conclusions[18]

The opioid epidemic in the United States is a crippling public health crisis. Opioid-related overdoses caused more than 190 deaths every day, on average, in 2019 (Mattson et al. 2021). Working-age people ages 20 to 64 are particularly vulnerable to nonmedical use of opioids and opioid-related overdose deaths, which vary geographically and by industry and occupation (Lipari et al. 2017; Morano et al. 2018). Using NSDUH data from 2004 to 2014, we analyzed nonmedical use of prescription pain relievers among adult workers to understand how individual and state-level factors contribute to the overall observed variation in nonmedical use, with a particular focus on the role of industry and occupation.

The summary statistics showed that nonmedical use of prescription pain relievers varied widely across states. It also varied considerably by workers' industry, occupation, and demographic characteristics such as age, sex, and race/ethnicity. The regression analyses further demonstrate the associations between each of these individual-level factors and nonmedical use of prescription pain relievers while taking into account other factors that might differ across individuals and states. These findings imply that policies to prevent nonmedical use of prescription pain relievers might need to consider individual risk factors beyond occupation and industry.

Several state-level factors were associated with nonmedical use of prescription pain relievers, even when controlling for individual-level characteristics. Factors associated with increased nonmedical use of prescription pain relievers included the state proportions of workers with less than high school education, in the construction industry, and in public administration. That is, states that have higher proportions of workers with less than high school education, in the construction industry, or in public administration, tend to have higher levels of nonmedical use of prescription pain relievers. Factors associated with decreased nonmedical use included the state proportions of workers ages 50 to 64 and those who are Black, non-Hispanic, or Hispanic, and the number of hospitals per capita. In particular, the number of hospitals per capita is negatively associated with nonmedical use of pain relievers, meaning that states with fewer hospitals tend to see higher levels of nonmedical use of prescription pain relievers. This implies that regional influences on health care access should be considered in policies designed to prevent nonmedical use of prescription pain relievers.

We also broke down the regression results to decompose the overall variation in nonmedical use of prescription pain relievers into parts. The factors we included in our regression model explained 17.4 percent of the overall variation in nonmedical use of prescription pain relievers in the past 12 months. Most of that 17.4 percent was driven by individual-level worker characteristics. However, workers' industry and occupation contributed very little to the explained variation. This finding suggests that differences in nonmedical use of prescription pain relievers between industries and occupations are explained, in part, by demographic differences between workers in those industries and occupations. That is, workers in different industries and occupations vary a great deal in their demographic characteristics, and differences across industries and occupations in nonmedical use of prescription pain relievers may in part reflect the demographic differences between occupational groupings.

In comparison to individual-level worker characteristics, little of the explained variation was driven by state-level worker characteristics and other state-level factors such as population density, income inequality, and the availability of health care providers. Hence, understanding occupational influences on

[18] The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Research Data Center, the National Center for Health Statistics, or the Centers for Disease Control and Prevention.

opioid misuse requires a more thorough understanding of worker characteristics, as these are some of the most important predictors of nonmedical use of prescription pain relievers. These findings might help federal and state agencies, and other entities seeking to prevent nonmedical use of prescription opioids and related overdose deaths, focus their efforts more effectively. In addition, policymakers and designers of employer-based programs might want to consider other potential risk factors for opioid misuse in their worker populations, including workplace and employer-level factors.

Our study has several limitations. First, because our analyses did not include use of heroin or illicitly manufactured synthetic opioids and stopped in 2014, they do not fully capture how the opioid crisis has shifted in the last decade. Overdose deaths involving prescription opioids have decreased since 2010, while overdose deaths involving heroin have risen rapidly (Centers for Disease Control and Prevention 2020). Starting in 2013, there have also been large increases in overdose deaths involving synthetic opioids such as fentanyl, further driving the overall growth in opioid-related overdose deaths. This limitation means that the relationships we found might no longer hold. Second, our analyses did not incorporate any contributions from opioid prescribing practices, opioid policy reforms, or workplace and employer-level factors, which may be important factors in explaining nonmedical use of prescription pain relievers. Third, because we pooled data for 2004 to 2014, our analyses might mask some of the year-by-year trends in nonmedical use of prescription pain relievers during that time. We included individual year indicators in the regressions to account for time effects, which mitigates the concern. However, our analyses do not fully account for the potential of time trends in nonmedical use of prescription opioids to vary across states, industries, or occupations, which might affect our results. Fourth, because the NSDUH is a cross-sectional survey, this study could not establish temporal or causal relationships. Fourth, NSDUH data might be subject to recall and social-desirability biases that might bias our analysis results.

Future research might consider several directions. Further decomposing some of the industry categories could reveal important within-category differences (for example, separating education and health care services because those sectors are likely to differ in nonmedical use of prescription pain relievers). To better understand the contributions of industry and occupation to the overall variation in opioid use, future research could also extend the analysis to incorporate broader types of opioids, such as heroin and fentanyl. Stratified analyses assessing the effects of occupation or industry for demographically similar groupings would be another analytic strategy to help disentangle the effects of occupation from other demographic factors. Finally, future research could examine changes over time both in these factors and their associations with the nonmedical use of prescription pain relievers.

References

Bureau of Economic Analysis (BEA). "Employment by Industry." Suitland, MD: BEA, 2019. Available at https://www.bea.gov/data/employment/employment-by-industry.

Centers for Disease Control and Prevention (CDC). "National Vital Statistics System, Mortality." Atlanta, GA: CDC, 2020. Available at https://wonder.cdc.gov/.

Ene, Mihaela, Elizabeth A. Leighton, Genine L. Blue, and Bethany A. Bell. "Multilevel Models for Categorical Data Using SAS® PROC GLIMMIX: The Basics." Proceedings of the SAS Global Forum 2015 Conference. Cary, NC: SAS Institute Inc., 2015. Available at https://support.sas.com/resources/papers/proceedings15/3430-2015.pdf.

Guy, Gery P. Jr., Kun Zhang, Michele K. Bohm, Jan Losby, Brian Lewis, Randall Young, Louise B. Murphy, and Deborah Dowell. "Vital Signs: Changes in Opioid Prescribing in the United States, 2006–2015." *Morbidity and Mortality Weekly Report,* vol. 66, no. 26, 2017, pp. 697–704.

Han, Beth, Wilson M. Compton, Carlos Blanco, Elizabeth Crane, Jinhee Lee, and Christopher M. Jones. "Prescription Opioid Use, Misuse, and Use Disorders in U.S. Adults: 2015 National Survey on Drug Use and Health." *Annals of Internal Medicine*, vol. 167, no. 5, 2017, pp. 293–301.

Jones, Christopher M., Leonard J. Paulozzi, and Karin A. Mack. "Sources of Prescription Opioid Pain Relievers by Frequency of Past-Year Nonmedical Use: United States, 2008–2011." *JAMA Internal Medicine,* vol. 174, no. 5, 2014, pp. 802–803.

KFF. "State Health Facts: Opioid Overdose Death Rates and All Drug Overdose Death Rates per 100,000 Population (Age-Adjusted)." San Francisco, CA: KFF, 2021.

Lipari, Rachel N., Struther L. Van Horn, Arthur Hughes, and Matthew Williams. "State and Substate Estimates of Nonmedical Use of Prescription Pain Relievers." The CBHSQ Report. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2017.

Mattson, Christine L., Lauren J. Tanz, Kelly Quinn, Mbabazi Kariisa, Priyam Patel, and Nicole L. Davis. "Trends and Geographic Patterns in Drug and Synthetic Opioid Overdose Deaths—United States, 2013–2019." *Morbidity and Mortality Weekly Report*, vol. 70, no. 6, 2021, pp. 202–207.

Morano, Laurel Harduar, Andrea L. Steege, and Sara E. Luckhaupt. "Occupational Patterns in Unintentional and Undetermined Drug-Involved and Opioid-Involved Overdose Deaths—United States, 2007–2012." *Morbidity and Mortality Weekly Report,* vol. 67, no. 33, 2018, pp. 925–930.

Mundkur, Mallika L., Jessica M. Franklin, Younathan Abdia, Krista F. Huybrechts, Elisabetta Patorno, Joshua J. Gagne, Tamra E. Meyer, Judy Staffa, and Brian T. Bateman. "Days' Supply of Initial Opioid Analgesic Prescriptions and Additional Fills for Acute Pain Conditions Treated in the Primary Care Setting—United States, 2014." *Morbidity and Mortality Weekly Report,* vol. 68, no. 6, 2019, p. 140.

Nakagawa, S., and Holger Schielzeth. "A General and Simple Method for Obtaining R^2 from Generalized Linear Mixed-Effects Models." *Methods in Ecology and Evolution*, vol. 4, no. 2, 2013, pp. 133–142. Available at https://doi.org/10.1111/j.2041-210x.2012.00261.x.

Pezalla, Edmund J., David Rosen, Jennifer G. Erensen, J. David Haddox, and Tracy J. Mayne. "Secular Trends in Opioid Prescribing in the USA." *Journal of Pain Research,* vol. 10, 2017, p. 383.

Roehler, Douglas R., Brooke E. Hoots, Emily M. Olsen, Mbabazi Kariisa, Nana Otoo Wilson, Rose A. Rudd, Desiree Mustaquim, Likang Xu, and Lyna Schieber. "2019 Annual Surveillance Report of Drug-Related Risks and Outcomes—United States." Surveillance Special Report. Atlanta, GA: Centers for Disease Control and Prevention, 2019.

Shraim, Mujahed, Manuel Cifuentes, Joanna L. Willetts, Helen R. Marucci-Wellman, and Glenn Pransky. "Why Does the Adverse Effect of Inappropriate MRI for LBP Vary by Geographic Location? An Exploratory Analysis." *BMC Musculoskeletal Disorders,* vol. 20, no. 1, 2019, pp. 1–11.

Strickler, Gail K., Peter W. Kreiner, John F. Halpin, Erin Doyle, and Leonard J. Paulozzi. "Opioid Prescribing Behaviors—Prescription Behavior Surveillance System, 11 States, 2010–2016." *MMWR Surveillance Summaries*, vol. 69, no. 1, 2020, pp. 1–14.

Webster, Barbara S., Manuel Cifuentes, Santosh Verma, and Glenn Pransky. "Geographic Variation in Opioid Prescribing for Acute, Work-Related, Low Back Pain and Associated Factors: A Multilevel Analysis." *American Journal of Industrial Medicine*, vol. 52, no. 2, 2009, pp. 162–171.

Wilson, Nana, Mbabazi Kariisa, Puja Seth, Herschel Smith IV, and Nicole L. Davis. "Drug and Opioid-Involved Overdose Deaths—United States, 2017–2018." *Morbidity and Mortality Weekly Report,* vol. 69, no. 11, 2020, pp. 290–297.

Appendix A: Analysis Methods

The sections below provide additional details on the methods we used to address each of the three primary research questions (RQs). We conducted all the analyses using SAS, using survey procedures to account for the complex design of the National Survey on Drug Use and Health (NSDUH). For these procedures, we used the individual-level weight variable ANALWT (divided by 11 for analysis of combined data from 11 years), the strata variable VESTR, and the cluster variable VEREP. We used the GLIMMIX procedure to run the multilevel mixed-effects model for RQ3 (Ene et al. 2015).

RQ1. How does nonmedical use of prescription pain relievers among U.S. workers vary across states?

For RQ1, we used summary statistics describing the variation in nonmedical use of pain relievers across states. For each state, we computed the following statistics: number of observations, means (both unweighted and weighted) of nonmedical use in the past 30 days and past 12 months, and respective standard errors. In addition, we grouped states into four quartiles based on the weighted prevalence of nonmedical use of prescription pain relievers in the state, separately for nonmedical use in the past 30 days and past 12 months. We ordered the states from the lowest quartile of nonmedical use to the highest quartile. Within each quartile, we summarized the means and standard errors of workers' characteristics including industries, occupations, and demographic characteristics.

RQ2. How does nonmedical use of prescription pain relievers among U.S. workers vary across industries and occupations?

For RQ2, we used summary statistics describing variation in nonmedical use of prescription pain relievers across industries, occupations, and demographic characteristics. For each industry, occupation, and demographic characteristic, we computed the following statistics: number of observations, means (both unweighted and weighted) of nonmedical use in the past 30 days and past 12 months, and respective standard errors.

RQ3. How well do individual- and state-level factors explain the overall variation in nonmedical use of prescription pain relievers?

For RQ3, we implemented a multilevel mixed-effects logit model to assess the extent to which differences in nonmedical use of prescription pain relievers can be explained by differences in individual- versus state-level factors. Specifically, we used the estimation model below:

- $Y_{ij} = \beta_0 + \beta_1(X_{ij} - \overline{X}_j) + \beta_2 \overline{X}_j + \beta_3 W_j + \sum_{s=2005}^{2014} \beta_s I(year = s) + u_j$

In the equation above:

- i denotes individual and j denotes state.
- Y_{ij} denotes log odds of the outcomes of interest.
- X_{ij} denotes individual-level factors, which include industry, occupation, and demographic characteristics; the included variables are all binary, equal to either 0 or 1.

- $\overline{X_j}$ denotes the state averages corresponding to the individual-level factors (state-level predictors based on individual-level variables); the possible values for these averages range from 0 to 1.
- $(X_{ij} - \overline{X}_j)$ denotes the deviations from the state averages corresponding to the individual-level factors ("centered individual-level predictors"); the possible values for these predictors range from -1 to 1.
- W_j denotes other state-level factors ("other state predictors") that include population density, income inequality, and availability of physicians and hospitals; these state predictors are continuous, with varying ranges.
- $\sum_{s=2005}^{2014} \beta_s I\left(year = s\right)$ represents the year fixed effects; $I\left(year = s\right)$ equals 1 if year = *s* and 0 otherwise; *s* ranges from 2005 to 2014; *s* = 2004 is the reference year and therefore is omitted from the equation.
- u_j represents the state random effects.
- β_1, β_2, and β_3 are sets of coefficients indicating the relationships between the centered individual-level predictors, state averages of individual-level variables, and other state predictors and the log odds of the outcome, respectively. Estimates of these coefficients are capturing associations observed in the data, not causal effects.

To incorporate individual-level weights into the model that nests individuals into states, we scaled individual-level weights (that is, ANALWT divided by 11) by their state averages, so that the weights sum to the sample size of each corresponding state. Using the regressions results, we decomposed the total variation in nonmedical use into contributions by individual- and state-level factors by calculating pseudo-R^2 estimates (Nakagawa and Schielzeth 2013). Specifically, we used the equation below to calculate the contribution by individual-level factors:

$$
\begin{aligned}
R^2_{\textit{centered indiv-level industry}} &= \sigma^2_{\textit{centered indiv-level industry}} / (\sigma^2_{\textit{centered indiv-level industry}} \\
&+ \sigma^2_{\textit{centered indiv-level occupation}} + \sigma^2_{\textit{other centered indiv-level predictors}} \\
&+ \sigma^2_{\textit{state-level industry based on indiv-level industry}} \\
&+ \sigma^2_{\textit{state-level occupation based on indiv-level occupation}} \\
&+ \sigma^2_{\textit{other state-level predictors based on indiv-level va rs}} + \sigma^2_{\textit{other state predictors}} \\
&+ \sigma^2_{\textit{year fixed-effects}} + \sigma^2_{\textit{state random-effects}} + \sigma^2_{\textit{resid}})
\end{aligned}
$$

In the equation above:

- $\sigma^2_{\textit{centered indiv-level industry}} = \text{var}(\sum_{h \in \textit{centered indiv-level industry}} \beta_h x_{hij})$ is the variance of the centered individual-level industry.
- $\sigma^2_{\textit{centered indiv-level occupation}} = \text{var}(\sum_{h \in \textit{centered indiv-level occupation}} \beta_h x_{hij})$ is the variance of the centered individual-level occupation.

- $\sigma^2_{othercentered\ indiv-level\ predictors} = \text{var}(\sum_{h \in other\ centered\ indiv-level\ predictors} \beta_h x_{hij})$ is the variance of the other centered individual-level predictors.
- $\sigma^2_{state-level\ industry\ based\ on\ indiv-level\ industry} = \text{var}(\sum_{h \in state-level\ industry\ based\ on\ indiv-level\ industry} \beta_h x_{hij})$ is the variance of the state-level industry based on individual-level industry.
- $\sigma^2_{state-level\ occupation\ based\ on\ indiv-level\ occupation} = \text{var}(\sum_{h \in state-level\ occupation\ based\ on\ indiv-level\ occupation} \beta_h x_{hij})$ is the variance of the state-level occupation based on individual-level occupation.
- $\sigma^2_{other\ state-level\ predictors\ based\ on\ indiv-level\ va\ rs} = \text{var}(\sum_{h \in other\ state-level\ predictors\ based\ on\ indiv-level\ va\ rs} \beta_h x_{hij})$ is the variance of the other state-level predictors based on individual-level variables.
- $\sigma^2_{other\ state\ predictors} = \text{var}(\sum_{h \in other\ state\ predictors} \beta_h x_{hij})$ is the variance of the other state predictors.
- $\sigma^2_{year\ fixed-effects} = \text{var}(\sum_{h \in year\ fixed-effects} \beta_h x_{hij})$ is the variance of the year fixed effects.
- $\sigma^2_{state\ random-effects}$ is the variance of the state random effects.
- $\sigma^2_{resid} = \pi^2 / 3$
- *i* denotes individual, and *j* denotes state.
- Similarly, we can calculate $R^2_{centered\ indiv-level\ occupation}$, $R^2_{other\ centered\ indiv-level\ predictors}$, $R^2_{state-level\ industry\ based\ on\ indiv-level\ industry}$, $R^2_{state-level\ occupation\ based\ on\ indiv-level\ occupation}$, $R^2_{other\ state-level\ predictors\ based\ on\ indiv-level\ vars}$, $R^2_{other\ state\ predictors}$, $R^2_{year\ fixed-effects}$, and $R^2_{state\ random-effects}$.

Appendix B: Detailed Tables

Table B.1. Reported nonmedical use of prescription pain relievers among U.S. workers, overall and by state, 2004–2014

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days		Nonmedical use of prescription pain relievers in the past 12 months	
		Unweighted % (SE)	Weighted % (SE)	Unweighted % (SE)	Weighted % (SE)
Overall	370,100	3.03 (0.03)	2.10 (0.03)	7.76 (0.04)	5.31 (0.05)
State					
Alabama	4,900	3.55 (0.26)	2.32 (0.24)	8.59 (0.40)	5.62 (0.41)
Alaska	5,000	3.29 (0.25)	2.49 (0.26)	8.59 (0.40)	5.81 (0.40)
Arizona	4,800	3.34 (0.26)	2.97 (0.32)	9.02 (0.41)	7.07 (0.45)
Arkansas	4,700	4.35 (0.30)	2.81 (0.26)	10.12 (0.44)	6.62 (0.45)
California	19,900	2.82 (0.12)	2.07 (0.13)	7.58 (0.19)	5.55 (0.18)
Colorado	5,300	3.37 (0.25)	2.28 (0.24)	9.45 (0.40)	6.52 (0.50)
Connecticut	5,300	3.03 (0.23)	2.23 (0.26)	7.27 (0.36)	4.76 (0.39)
Delaware	5,100	3.56 (0.26)	2.26 (0.25)	8.69 (0.39)	5.69 (0.38)
District of Columbia	4,900	1.72 (0.19)	1.56 (0.19)	5.19 (0.32)	3.77 (0.30)
Florida	19,200	2.90 (0.12)	2.12 (0.13)	7.15 (0.19)	5.01 (0.21)
Georgia	5,100	2.70 (0.23)	2.11 (0.26)	7.21 (0.36)	5.03 (0.37)
Hawaii	5,100	2.47 (0.22)	1.94 (0.24)	6.73 (0.35)	4.86 (0.38)
Idaho	5,000	3.06 (0.24)	2.22 (0.23)	8.62 (0.40)	6.24 (0.37)
Illinois	19,200	2.55 (0.11)	1.79 (0.12)	6.48 (0.18)	4.32 (0.18)
Indiana	5,000	3.73 (0.27)	2.51 (0.28)	9.57 (0.42)	6.50 (0.41)
Iowa	5,300	1.86 (0.18)	1.12 (0.15)	5.21 (0.30)	3.37 (0.30)
Kansas	5,100	2.66 (0.22)	1.89 (0.24)	6.90 (0.35)	4.97 (0.36)
Kentucky	4,700	4.14 (0.29)	3.00 (0.29)	9.56 (0.43)	6.68 (0.51)
Louisiana	5,100	4.01 (0.27)	2.80 (0.27)	9.21 (0.40)	6.34 (0.40)
Maine	5,000	3.61 (0.26)	1.79 (0.22)	8.32 (0.39)	4.63 (0.36)

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days		Nonmedical use of prescription pain relievers in the past 12 months	
		Unweighted % (SE)	Weighted % (SE)	Unweighted % (SE)	Weighted % (SE)
Maryland	5,200	2.68 (0.22)	1.83 (0.23)	6.66 (0.35)	4.16 (0.30)
Massachusetts	5,200	3.41 (0.25)	2.32 (0.26)	8.30 (0.38)	4.95 (0.38)
Michigan	19,100	3.61 (0.14)	2.49 (0.13)	9.02 (0.21)	6.01 (0.20)
Minnesota	5,400	2.20 (0.20)	1.51 (0.20)	6.40 (0.33)	4.05 (0.34)
Mississippi	4,600	3.07 (0.25)	2.04 (0.22)	6.82 (0.37)	4.37 (0.35)
Missouri	5,100	2.99 (0.24)	1.73 (0.18)	8.35 (0.39)	5.24 (0.36)
Montana	5,000	2.54 (0.22)	1.69 (0.21)	7.05 (0.36)	4.65 (0.37)
Nebraska	5,400	2.02 (0.19)	1.14 (0.16)	5.79 (0.32)	3.83 (0.33)
Nevada	5,000	3.95 (0.27)	2.97 (0.36)	9.99 (0.42)	7.29 (0.60)
New Hampshire	5,300	3.35 (0.25)	2.06 (0.24)	8.92 (0.39)	5.47 (0.40)
New Jersey	5,400	2.62 (0.22)	1.58 (0.19)	6.18 (0.33)	3.93 (0.28)
New Mexico	4,700	3.21 (0.26)	2.33 (0.26)	8.65 (0.41)	6.26 (0.48)
New York	19,200	2.71 (0.12)	1.94 (0.14)	6.98 (0.18)	4.88 (0.21)
North Carolina	5,200	3.24 (0.25)	1.80 (0.21)	7.54 (0.37)	4.89 (0.43)
North Dakota	5,400	1.53 (0.17)	1.15 (0.17)	5.37 (0.31)	3.74 (0.32)
Ohio	18,900	3.63 (0.14)	2.39 (0.12)	9.21 (0.21)	6.02 (0.20)
Oklahoma	4,900	4.51 (0.30)	3.39 (0.38)	10.67 (0.44)	7.66 (0.49)
Oregon	4,900	3.57 (0.26)	2.85 (0.34)	9.73 (0.42)	7.29 (0.50)
Pennsylvania	17,300	2.88 (0.13)	1.79 (0.11)	7.29 (0.20)	4.66 (0.17)
Rhode Island	5,200	3.84 (0.27)	2.61 (0.24)	9.91 (0.41)	6.83 (0.47)
South Carolina	4,900	2.65 (0.23)	1.79 (0.23)	7.51 (0.37)	5.17 (0.44)
South Dakota	5,400	1.40 (0.16)	0.83 (0.12)	4.41 (0.28)	2.84 (0.28)
Tennessee	4,800	4.22 (0.29)	2.97 (0.27)	9.31 (0.42)	6.48 (0.45)
Texas	19,200	2.60 (0.11)	1.76 (0.11)	6.93 (0.18)	4.74 (0.17)
Utah	5,200	2.94 (0.23)	2.33 (0.24)	7.57 (0.37)	6.03 (0.45)
Vermont	5,100	3.21 (0.25)	1.88 (0.24)	7.44 (0.37)	4.31 (0.36)

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days		Nonmedical use of prescription pain relievers in the past 12 months	
		Unweighted % (SE)	Weighted % (SE)	Unweighted % (SE)	Weighted % (SE)
Virginia	5,300	2.43 (0.21)	1.84 (0.29)	7.01 (0.35)	5.42 (0.59)
Washington	4,900	3.55 (0.26)	2.66 (0.28)	9.42 (0.42)	6.99 (0.56)
West Virginia	4,400	4.40 (0.31)	2.76 (0.25)	9.23 (0.44)	5.75 (0.38)
Wisconsin	5,300	3.25 (0.24)	1.97 (0.23)	7.95 (0.37)	4.93 (0.38)
Wyoming	5,200	2.36 (0.21)	1.69 (0.21)	6.53 (0.34)	4.40 (0.33)

Note: Sample sizes are rounded to the nearest 100; SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.2. Worker characteristics, overall and by state quartiles of reported nonmedical use of prescription pain relievers, 2004–2014

Currently employed U.S. adults	Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 30 days					Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 12 months				
	All quartiles	Q1	Q2	Q3	Q4	All quartiles	Q1	Q2	Q3	Q4
N	370,100	95,800	107,800	108,100	58,500	370,100	81,400	121,300	108,000	59,300
Weighted N	147,394,700	33,040,700	53,922,600	36,931,300	23,500,100	147,394,700	22,669,700	57,580,400	41,862,000	25,282,600
Reported nonmedical use of prescription pain relievers	2.10 (0.03)	1.65 (0.06)	1.94 (0.06)	2.27 (0.06)	2.85 (0.09)	5.31 (0.05)	4.07 (0.10)	4.87 (0.08)	5.68 (0.11)	6.82 (0.15)
Sex										
Male	52.84 (0.13)	53.12 (0.25)	52.75 (0.23)	52.43 (0.24)	53.29 (0.32)	52.84 (0.13)	52.00 (0.30)	52.63 (0.21)	53.29 (0.25)	53.31 (0.31)
Female	47.16 (0.13)	46.88 (0.25)	47.25 (0.23)	47.57 (0.24)	46.71 (0.32)	47.16 (0.13)	48.00 (0.30)	47.37 (0.21)	46.71 (0.25)	46.69 (0.31)
Age group (years)										
18–34	37.31 (0.15)	37.76 (0.31)	37.13 (0.26)	36.95 (0.26)	37.66 (0.34)	37.31 (0.15)	36.42 (0.32)	37.18 (0.24)	37.68 (0.28)	37.79 (0.34)
35–49	35.70 (0.14)	35.51 (0.28)	35.90 (0.25)	35.78 (0.23)	35.39 (0.32)	35.70 (0.14)	35.63 (0.32)	35.84 (0.22)	35.75 (0.27)	35.38 (0.31)
50–64	26.99 (0.17)	26.73 (0.33)	26.97 (0.30)	27.27 (0.30)	26.95 (0.39)	26.99 (0.17)	27.95 (0.40)	26.99 (0.26)	26.57 (0.33)	26.83 (0.39)
Marital status										
Married	54.44 (0.16)	56.13 (0.34)	53.18 (0.29)	54.30 (0.31)	55.15 (0.37)	54.44 (0.16)	55.34 (0.36)	53.92 (0.27)	54.18 (0.31)	55.24 (0.37)
Not married	45.56 (0.16)	43.87 (0.34)	46.82 (0.29)	45.70 (0.31)	44.85 (0.37)	45.56 (0.16)	44.66 (0.36)	46.08 (0.27)	45.82 (0.31)	44.76 (0.37)
Race/ethnicity										
White, non-Hispanic	66.66 (0.18)	65.93 (0.38)	60.83 (0.33)	70.52 (0.33)	74.96 (0.37)	66.66 (0.18)	71.14 (0.43)	63.89 (0.29)	63.40 (0.35)	74.31 (0.36)
Black, non-Hispanic	11.50 (0.12)	9.90 (0.23)	12.28 (0.21)	13.29 (0.26)	9.18 (0.25)	11.50 (0.12)	13.01 (0.31)	13.74 (0.21)	9.27 (0.20)	8.76 (0.24)
Hispanic	14.97 (0.14)	18.64 (0.31)	17.13 (0.26)	11.80 (0.20)	9.85 (0.25)	14.97 (0.14)	9.93 (0.27)	16.45 (0.22)	18.10 (0.30)	10.94 (0.25)
Other race/multiracial	6.87 (0.09)	5.52 (0.17)	9.75 (0.20)	4.40 (0.12)	6.00 (0.17)	6.87 (0.09)	5.92 (0.21)	5.92 (0.12)	9.22 (0.23)	5.98 (0.16)

Currently employed U.S. adults	Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 30 days					Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 12 months				
	All quartiles	Q1	Q2	Q3	Q4	All quartiles	Q1	Q2	Q3	Q4
Education level										
Did not graduate high school	11.30 (0.10)	12.09 (0.22)	11.08 (0.18)	10.08 (0.16)	12.60 (0.24)	11.30 (0.10)	8.81 (0.20)	11.48 (0.16)	11.68 (0.20)	12.49 (0.24)
High school graduate	88.70 (0.10)	87.91 (0.22)	88.92 (0.18)	89.92 (0.16)	87.40 (0.24)	88.70 (0.10)	91.19 (0.20)	88.52 (0.16)	88.32 (0.20)	87.51 (0.24)
Poverty										
Under federal poverty threshold	9.64 (0.09)	9.45 (0.17)	9.38 (0.17)	9.43 (0.16)	10.81 (0.21)	9.64 (0.09)	7.63 (0.18)	9.70 (0.15)	10.05 (0.19)	10.59 (0.21)
Above federal poverty threshold	90.36 (0.09)	90.55 (0.17)	90.62 (0.17)	90.57 (0.16)	89.19 (0.21)	90.36 (0.09)	92.37 (0.18)	90.30 (0.15)	89.95 (0.19)	89.41 (0.21)
Reported health										
Excellent/very good/good	92.78 (0.08)	92.29 (0.17)	92.92 (0.14)	93.65 (0.12)	91.80 (0.21)	92.78 (0.08)	93.32 (0.20)	93.00 (0.12)	92.61 (0.15)	92.08 (0.20)
Fair/poor	7.22 (0.08)	7.71 (0.17)	7.08 (0.14)	6.35 (0.12)	8.20 (0.21)	7.22 (0.08)	6.68 (0.20)	7.00 (0.12)	7.39 (0.15)	7.92 (0.20)
Industry (ACS categories)										
Agriculture, Forestry, Fishing & Hunting, and Mining	1.82 (0.04)	2.30 (0.08)	1.56 (0.07)	1.45 (0.06)	2.36 (0.11)	1.82 (0.04)	1.82 (0.07)	1.55 (0.06)	1.92 (0.08)	2.30 (0.11)
Construction	8.37 (0.08)	8.42 (0.16)	8.09 (0.15)	8.48 (0.14)	8.78 (0.20)	8.37 (0.08)	7.57 (0.18)	8.59 (0.13)	8.16 (0.16)	8.96 (0.19)
Manufacturing	11.24 (0.09)	11.41 (0.19)	10.63 (0.17)	11.23 (0.16)	12.40 (0.23)	11.24 (0.09)	11.41 (0.22)	10.32 (0.15)	11.98 (0.18)	11.94 (0.22)
Wholesale Trade	2.68 (0.05)	2.65 (0.09)	2.71 (0.09)	2.72 (0.09)	2.61 (0.12)	2.68 (0.05)	2.63 (0.10)	2.71 (0.08)	2.70 (0.09)	2.63 (0.12)
Retail Trade	10.50 (0.08)	10.31 (0.16)	10.21 (0.15)	10.95 (0.15)	10.72 (0.21)	10.50 (0.08)	10.15 (0.18)	10.77 (0.13)	10.25 (0.15)	10.62 (0.21)
Transportation & Warehousing, and Utilities	4.85 (0.07)	5.22 (0.13)	4.66 (0.12)	4.72 (0.12)	4.96 (0.16)	4.85 (0.07)	4.89 (0.15)	4.99 (0.11)	4.61 (0.12)	4.89 (0.16)
Information	2.16 (0.04)	2.27 (0.10)	2.34 (0.07)	2.11 (0.08)	1.68 (0.08)	2.16 (0.04)	2.46 (0.12)	2.15 (0.07)	2.23 (0.08)	1.82 (0.09)

Currently employed U.S. adults	Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 30 days					Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 12 months				
	All quartiles	Q1	Q2	Q3	Q4	All quartiles	Q1	Q2	Q3	Q4
Finance, Insurance, Real Estate, Rental & Leasing	6.30 (0.07)	6.51 (0.15)	6.45 (0.13)	6.46 (0.13)	5.43 (0.16)	6.30 (0.07)	6.64 (0.17)	6.63 (0.12)	6.05 (0.14)	5.67 (0.16)
Professional/Scientific/Management/Administration/Waste Management	10.93 (0.10)	10.81 (0.20)	11.52 (0.18)	11.11 (0.17)	9.47 (0.22)	10.93 (0.10)	11.12 (0.24)	10.97 (0.15)	11.38 (0.20)	9.93 (0.22)
Education, Health & Social Services	21.95 (0.12)	21.88 (0.25)	22.36 (0.21)	21.52 (0.21)	21.77 (0.29)	21.95 (0.12)	22.98 (0.29)	22.36 (0.20)	21.16 (0.21)	21.39 (0.28)
Arts/Entertainment/Recreation/Accommodation/Food Services	8.90 (0.07)	8.59 (0.15)	8.67 (0.12)	9.23 (0.13)	9.34 (0.18)	8.90 (0.07)	8.10 (0.16)	8.95 (0.11)	8.98 (0.13)	9.37 (0.17)
Other Services (except Public Administration)	5.26 (0.06)	5.16 (0.12)	5.22 (0.11)	5.32 (0.12)	5.38 (0.17)	5.26 (0.06)	4.72 (0.13)	5.35 (0.10)	5.32 (0.12)	5.43 (0.16)
Public Administration	5.03 (0.07)	4.48 (0.13)	5.58 (0.13)	4.70 (0.12)	5.10 (0.16)	5.03 (0.07)	5.51 (0.17)	4.68 (0.10)	5.26 (0.14)	5.05 (0.16)
Occupation (ACS categories)										
Management, Business, Science, and Arts Occupations	39.72 (0.15)	39.43 (0.33)	41.21 (0.29)	39.49 (0.27)	37.07 (0.38)	39.72 (0.15)	41.93 (0.39)	39.77 (0.25)	39.54 (0.31)	37.93 (0.37)
Service Occupations	14.68 (0.10)	14.09 (0.18)	14.83 (0.18)	14.58 (0.18)	15.30 (0.23)	14.68 (0.10)	13.56 (0.21)	14.82 (0.16)	14.84 (0.20)	15.07 (0.22)
Sales and Office Occupations	23.34 (0.12)	23.46 (0.23)	23.19 (0.21)	23.70 (0.21)	22.91 (0.28)	23.34 (0.12)	23.13 (0.27)	23.75 (0.20)	23.16 (0.23)	22.86 (0.27)

Currently employed U.S. adults	Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 30 days					Weighted % (SE) by quartile of reported nonmedical use of prescription pain relievers in the past 12 months				
	All quartiles	Q1	Q2	Q3	Q4	All quartiles	Q1	Q2	Q3	Q4
Natural Resources, Construction, and Maintenance Occupations	10.48 (0.09)	10.65 (0.18)	9.91 (0.16)	10.50 (0.16)	11.54 (0.23)	10.48 (0.09)	9.54 (0.19)	10.49 (0.14)	10.46 (0.19)	11.38 (0.22)
Production, Transportation, and Material Moving Occupations	11.78 (0.09)	12.36 (0.20)	10.86 (0.16)	11.72 (0.17)	13.19 (0.25)	11.78 (0.09)	11.84 (0.24)	11.18 (0.15)	12.00 (0.18)	12.76 (0.24)

Note: We classified states into four similarly sized groups (quartiles) based on the estimated prevalence of reported nonmedical use of prescription pain relievers in the past 12 months in each state. There are 12 states in the highest-use quartile and 13 states in each of the other quartiles. Q1 is the lowest-use quartile, and Q4 is the highest-use quartile. Sample sizes are rounded to the nearest 100.

ACS = American Community Survey; SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.3. Reported nonmedical use of prescription pain relievers among U.S. workers, overall and by industry, 2004–2014

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days		Nonmedical use of prescription pain relievers in the past 12 months	
		Unweighted % (SE)	Weighted % (SE)	Unweighted % (SE)	Weighted % (SE)
Overall	370,100	3.03 (0.03)	2.10 (0.03)	7.76 (0.04)	5.31 (0.05)
Industry (ACS categories)					
Agriculture, Forestry, Fishing & Hunting, and Mining	7,400	2.56 (0.18)	1.99 (0.22)	5.70 (0.27)	4.18 (0.32)
Construction	27,600	4.13 (0.12)	2.92 (0.14)	9.74 (0.18)	6.77 (0.20)
Manufacturing	33,000	2.51 (0.09)	1.72 (0.09)	6.33 (0.13)	4.35 (0.16)
Wholesale Trade	8,200	2.70 (0.18)	1.80 (0.19)	7.30 (0.29)	4.65 (0.32)
Retail Trade	47,500	3.16 (0.08)	2.39 (0.10)	8.28 (0.13)	6.06 (0.16)
Transportation & Warehousing, and Utilities	13,100	2.13 (0.13)	1.31 (0.12)	5.51 (0.20)	3.69 (0.22)
Information	7,000	2.52 (0.19)	1.76 (0.20)	7.83 (0.32)	5.75 (0.40)
Finance, Insurance, Real Estate, Rental & Leasing	19,100	2.19 (0.11)	1.61 (0.12)	6.49 (0.18)	4.71 (0.21)
Professional/Scientific/Management/Administration/Waste Management	34,100	2.70 (0.09)	2.05 (0.11)	6.97 (0.14)	4.93 (0.17)
Education, Health & Social Services	72,500	1.81 (0.05)	1.34 (0.06)	5.07 (0.08)	3.64 (0.10)
Arts/Entertainment/Recreation/Accommodation/Food Services	48,900	4.64 (0.10)	3.65 (0.12)	11.74 (0.15)	9.45 (0.21)
Other Services (except Public Administration)	18,200	2.95 (0.13)	2.32 (0.17)	7.41 (0.19)	5.32 (0.23)
Public Administration	14,100	1.61 (0.11)	1.18 (0.13)	4.36 (0.17)	3.06 (0.21)

Note: Sample sizes are rounded to the nearest 100.

ACS = American Community Survey; SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.4. Reported nonmedical use of prescription pain relievers among U.S. workers, overall and by occupation, 2004–2014

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days		Nonmedical use of prescription pain relievers in the past 12 months	
		Unweighted % (SE)	Weighted % (SE)	Unweighted % (SE)	Weighted % (SE)
Overall	370,100	3.03 (0.03)	2.10 (0.03)	7.76 (0.04)	5.31 (0.05)
Occupation (ACS categories)					
Management, Business, Science, and Arts Occupations	115,600	1.81 (0.04)	1.37 (0.05)	5.12 (0.06)	3.86 (0.08)
Service Occupations	67,700	3.96 (0.07)	2.94 (0.10)	9.89 (0.11)	7.00 (0.14)
Sales and Office Occupations	90,300	2.79 (0.05)	1.94 (0.06)	7.56 (0.09)	5.24 (0.10)
Natural Resources, Construction, and Maintenance Occupations	36,600	3.84 (0.10)	2.87 (0.12)	9.15 (0.15)	6.64 (0.19)
Production, Transportation, and Material Moving Occupations	40,400	3.27 (0.09)	2.28 (0.10)	7.92 (0.13)	5.31 (0.15)

Note: Sample sizes are rounded to the nearest 100.

ACS = American Community Survey; SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.5. Reported nonmedical use of prescription pain relievers among U.S. workers, overall and by worker characteristics, 2004–2014

Currently employed U.S. adults	N	Nonmedical use of prescription pain relievers in the past 30 days				Nonmedical use of prescription pain relievers in the past 12 months			
		Unweighted %	SE	Weighted %	SE	Unweighted %	SE	Weighted %	SE
Overall	370,100	3.03	0.03	2.10	0.03	7.76	0.04	5.31	0.05
Sex									
Male	185,000	3.44	0.04	2.38	0.05	8.67	0.07	5.89	0.08
Female	185,100	2.63	0.04	1.80	0.04	6.86	0.06	4.67	0.07
Age group (years)									
18–34	244,600	3.89	0.04	3.49	0.06	10.06	0.06	8.95	0.09
35–49	91,000	1.57	0.04	1.60	0.05	3.77	0.06	3.92	0.09
50–64	34,500	0.87	0.05	0.85	0.06	2.04	0.08	2.12	0.10
Marital status									
Married	137,700	1.42	0.03	1.18	0.04	3.77	0.05	3.16	0.06
Not married	232,400	3.99	0.04	3.21	0.06	10.13	0.06	7.88	0.09
Race/ethnicity									
White, non-Hispanic	245,900	3.38	0.04	2.31	0.04	8.65	0.06	5.86	0.06
Black, non-Hispanic	41,400	2.16	0.07	1.56	0.09	5.23	0.11	3.70	0.13
Hispanic	55,300	2.37	0.06	1.86	0.09	6.30	0.10	4.80	0.14
Other race/multiracial	27,500	2.59	0.10	1.50	0.13	6.66	0.15	3.85	0.21
Education level									
Did not graduate high school	47,400	4.78	0.10	3.41	0.13	10.76	0.14	7.49	0.18
High school graduate	322,700	2.78	0.03	1.94	0.03	7.33	0.05	5.04	0.05
Poverty									
Under federal poverty threshold	53,200	3.82	0.08	3.25	0.12	9.54	0.13	7.64	0.18
Above federal poverty threshold	312,100	2.90	0.03	1.98	0.04	7.44	0.05	5.05	0.06
Reported health									
Excellent/very good/good	347,300	2.90	0.03	2.01	0.04	7.57	0.04	5.18	0.05
Fair/poor	22,800	5.00	0.14	3.27	0.15	10.72	0.21	7.01	0.24

Note: Sample sizes are rounded to the nearest 100.

SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.6a. Multilevel regression results, reported nonmedical use of prescription pain relievers in the past 30 days, 2004–2014

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 30 days (N = 370,100)	
	Model I (SE)	Model II (SE)
Intercept	-7.36 (3.58)*	-4.94 (4.57)
Individual-level predictors		
Female	-0.28 (0.03)*	-0.27 (0.04)*
Married	-0.73 (0.03)*	-0.72 (0.03)*
High school graduate	0.48 (0.04)*	0.45 (0.04)*
Income below federal poverty threshold	0.15 (0.04)*	0.13 (0.04)*
Fair/poor health	0.59 (0.05)*	0.58 (0.06)*
Age 35–49	-0.53 (0.04)*	-0.52 (0.04)*
Age 50–64	-1.22 (0.07)*	-1.22 (0.07)*
Black, non-Hispanic	-0.67 (0.08)*	-0.68 (0.08)*
Hispanic	-0.59 (0.07)*	-0.61 (0.07)*
Other race/multiracial	-0.41 (0.08)*	-0.41 (0.08)*
Agriculture, Forestry, Fishing & Hunting, and Mining	-0.15 (0.11)	-0.25 (0.12)*
Construction	0.20 (0.06)*	0.08 (0.07)
Manufacturing	-0.13 (0.06)	-0.27 (0.08)*
Wholesale Trade	-0.09 (0.09)	-0.19 (0.09)*
Retail Trade	-0.03 (0.06)	-0.10 (0.06)
Transportation & Warehousing, and Utilities	-0.21 (0.09)*	-0.36 (0.10)*
Information	-0.16 (0.11)	-0.19 (0.10)
Finance, Insurance, Real Estate, Rental & Leasing	-0.14 (0.07)	-0.17 (0.07)*
Professional/Scientific/Management/Administration /Waste Management	-0.02 (0.06)	-0.07 (0.06)
Arts/Entertainment/Recreation/Accommodation/Food Services	0.26 (0.05)*	0.16 (0.06)*
Other Services (except Public Administration)	0.03 (0.07)	-0.09 (0.06)
Public Administration	-0.34 (0.10)*	-0.40 (0.10)*
Service Occupations		0.22 (0.04)*
Sales and Office Occupations		0.10 (0.04)*

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 30 days (N = 370,100)	
	Model I (SE)	Model II (SE)
Natural Resources, Construction, and Maintenance Occupations		0.21 (0.07)*
Production, Transportation, and Material Moving Occupations		0.27 (0.07)*
State-level predictors		
State proportion of workers that are female	2.58 (4.91)	0.34 (5.10)
State proportion of workers that are married	-0.68 (2.00)	-0.85 (2.01)
State proportion of workers that are high school graduates	6.03 (2.98)*	5.54 (3.20)
State proportion of workers with incomes below the federal poverty threshold	0.03 (3.18)	0.98 (3.22)
State proportion of workers that are in fair/poor health	-3.34 (3.66)	-2.66 (4.30)
State proportion of workers that are ages 35–49	2.81 (4.01)	1.46 (4.08)
State proportion of workers that are ages 50–64	-4.68 (2.70)	-3.76 (2.98)
State proportion of workers that are Black, non-Hispanic	-2.56 (0.74)*	-2.08 (0.89)*
State proportion of workers that are Hispanic	-2.12 (0.51)*	-2.04 (0.66)*
State proportion of workers that are other race/multiracial	-0.11 (0.46)	-0.03 (0.47)
State proportion of workers in Agriculture, Forestry, Fishing & Hunting, and Mining	-1.33 (2.86)	-2.30 (3.75)
State proportion of workers in Construction	5.89 (3.40)	4.09 (5.98)
State proportion of workers in Manufacturing	1.98 (2.56)	2.85 (3.43)
State proportion of workers in Wholesale Trade	-0.25 (7.54)	-3.63 (10.49)
State proportion of workers in Retail Trade	2.21 (6.16)	1.67 (6.88)
State proportion of workers in Transportation & Warehousing, and Utilities	-4.31 (5.00)	-2.72 (6.27)
State proportion of workers in Information	12.26 (12.00)	11.69 (12.51)
State proportion of workers in Finance, Insurance, Real Estate, Rental & Leasing	-4.11 (4.84)	-5.92 (5.33)
State proportion of workers in Professional/Scientific/Management/Administration/Waste Management	-5.56 (4.13)	-7.09 (5.18)
State proportion of workers in Arts/Entertainment/Recreation/Accommodation/Food Services	3.96 (3.85)	8.16 (5.83)
State proportion of workers in Other Services (except Public Administration)	-5.67 (8.23)	-4.35 (9.06)
State proportion of workers in Public Administration	8.32 (4.31)	7.58 (4.86)
State proportion of workers in Service Occupations		-5.63 (5.82)
State proportion of workers in Sales and Office Occupations		0.24 (5.85)

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 30 days (N = 370,100)	
	Model I (SE)	Model II (SE)
State proportion of workers in Natural Resources, Construction, and Maintenance Occupations		0.18 (5.86)
State proportion of workers in Production, Transportation, and Material Moving Occupations		-3.12 (4.58)
State population density	0.00 (0.00)	0.00 (0.00)
State Gini index of income inequality	5.78 (3.92)	5.55 (3.70)
State rate of physicians	0.00 (0.00)	0.00 (0.02)
State rate of hospitals	-0.13 (0.05)*	-0.13 (0.05)*
Year fixed effects		
2005	-0.01 (0.06)	-0.01 (0.06)
2006	0.06 (0.06)	0.06 (0.06)
2007	0.09 (0.07)	0.09 (0.07)
2008	-0.01 (0.07)	0.00 (0.07)
2009	0.05 (0.06)	0.06 (0.06)
2010	0.01 (0.06)	0.01 (0.06)
2011	-0.06 (0.06)	-0.06 (0.06)
2012	-0.02 (0.08)	-0.02 (0.08)
2013	-0.23 (0.08)*	-0.23 (0.08)*
2014	-0.29 (0.08)*	-0.29 (0.08)*

Note: Model I = Individual-level (including industry) + state-level predictors. Model II = Individual-level (including industry and occupation) + state-level predictors. Models I and II also includes indicators for each of the calendar years 2005 to 2014. The state population density estimate is based on 2010 census data. State rates of physicians and hospitals come from the 2015–2016 and 2016–2017 Area Health Resources Files. State Gini index comes from 2010–2014 American Community Survey data. The reference categories that are omitted in the regressions are ages 18–34 (age group); White, non-Hispanic (race/ethnicity); Education, Health & Social Services (industry); Management, Business, Science, and Arts Occupations (occupation).

* Statistically significant (P<0.05)

SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.6b. Multilevel regression results, reported nonmedical use of prescription pain relievers in the past 12 months, 2004–2014

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 12 months (N = 370,100)	
	Model I (SE)	Model II (SE)
Intercept	-6.89 (2.61)*	-5.33 (3.94)
Individual-level predictors		
Female	-0.25 (0.02)*	-0.24 (0.02)*
Married	-0.67 (0.02)*	-0.66 (0.02)*
High school graduate	0.31 (0.03)*	0.28 (0.03)*
Income below federal poverty threshold	0.14 (0.03)*	0.13 (0.03)*
Fair/poor health	0.46 (0.03)*	0.45 (0.03)*
Age 35–49	-0.66 (0.03)*	-0.66 (0.03)*
Age 50–64	-1.36 (0.05)*	-1.35 (0.05)*
Black, non-Hispanic	-0.71 (0.06)*	-0.72 (0.06)*
Hispanic	-0.58 (0.05)*	-0.59 (0.05)*
Other race/multiracial	-0.49 (0.05)*	-0.49 (0.05)*
Agriculture, Forestry, Fishing & Hunting, and Mining	-0.30 (0.08)*	-0.38 (0.08)*
Construction	0.15 (0.04)*	0.04 (0.05)
Manufacturing	-0.12 (0.04)*	-0.22 (0.04)*
Wholesale Trade	-0.04 (0.06)	-0.13 (0.07)
Retail Trade	-0.01 (0.04)	-0.08 (0.04)
Transportation & Warehousing, and Utilities	-0.19 (0.06)*	-0.31 (0.07)*
Information	0.05 (0.07)	0.02 (0.07)
Finance, Insurance, Real Estate, Rental & Leasing	-0.01 (0.05)	-0.05 (0.05)
Professional/Scientific/Management/Admin/Waste Management	-0.06 (0.04)	-0.10 (0.04)*
Arts/Entertainment/Recreation/Accommodation/Food Services	0.33 (0.03)*	0.25 (0.04)
Other Services (except Public Administration)	0.01 (0.05)	-0.09 (0.05)
Public Administration	-0.31 (0.06)*	-0.36 (0.06)*
Service Occupations		0.14 (0.03)*

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 12 months (N = 370,100)	
	Model I (SE)	Model II (SE)
Sales and Office Occupations		0.12 (0.03)*
Natural Resources, Construction, and Maintenance Occupations		0.18 (0.04)*
Production, Transportation, and Material Moving Occupations		0.19 (0.04)*
State-level predictors		
State proportion of workers that are female	5.82 (3.03)	4.52 (3.22)
State proportion of workers that are married	-1.57 (1.19)	-1.63 (1.14)
State proportion of workers that are high school graduates	5.58 (1.94)*	5.27 (2.00)*
State proportion of workers with incomes below the federal poverty threshold	0.24 (1.82)	1.04 (1.97)
State proportion of workers that are in fair/poor health	-3.86 (2.77)	-2.69 (3.30)
State proportion of workers that are ages 35–49	1.97 (2.64)	0.69 (2.79)
State proportion of workers that are ages 50–64	-5.75 (1.88)*	-5.01 (2.13)*
State proportion of workers that are Black, non-Hispanic	-3.11 (0.61)*	-2.75 (0.75)*
State proportion of workers that are Hispanic	-2.05 (0.40)*	-2.07 (0.43)*
State proportion of workers that are other race/multiracial	-0.13 (0.27)	-0.16 (0.28)
State proportion of workers in Agriculture, Forestry, Fishing & Hunting, and Mining	0.32 (2.17)	0.71 (3.45)
State proportion of workers in Construction	6.38 (2.71)*	6.69 (4.56)
State proportion of workers in Manufacturing	2.41 (1.78)	3.71 (2.45)
State proportion of workers in Wholesale Trade	2.58 (5.88)	0.67 (7.49)
State proportion of workers in Retail Trade	0.82 (3.68)	1.52 (3.90)
State proportion of workers in Transportation & Warehousing, and Utilities	-1.54 (2.99)	0.74 (3.00)
State proportion of workers in Information	7.99 (7.17)	9.64 (7.42)
State proportion of workers in Finance, Insurance, Real Estate, Rental & Leasing	-2.54 (3.45)	-3.75 (3.59)
State proportion of workers in Professional/Scientific/Management/Admin/Waste Management	-2.02 (2.82)	-3.44 (3.26)
State proportion of workers in Arts/Entertainment/Recreation/Accommodation/Food Services	3.54 (2.43)	6.37 (4.30)
State proportion of workers in Other Services (except Public Administration)	-2.68 (5.52)	-1.32 (5.98)
State proportion of workers in Public Administration	8.01 (3.32)*	7.59 (3.84)*
State proportion of workers in Service Occupations		-3.27 (5.55)

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 12 months (N = 370,100)	
	Model I (SE)	Model II (SE)
State proportion of workers in Sales and Office Occupations		-0.46 (3.88)
State proportion of workers in Natural Resources, Construction, and Maintenance Occupations		-1.76 (4.07)
State proportion of workers in Production, Transportation, and Material Moving Occupations		-3.13 (2.73)
State population density	0.00 (0.00)	0.00 (0.00)
State Gini index of income inequality	5.03 (2.57)	4.77 (2.62)
State rate of physicians	0.00 (0.00)	0.00 (0.00)
State rate of hospitals	-0.11 (0.04)*	-0.11 (0.03)*
Year fixed effects		
2005	-0.04 (0.04)	-0.05 (0.04)
2006	0.03 (0.04)	0.03 (0.04)
2007	0.01 (0.04)	0.01 (0.04)
2008	-0.04 (0.04)	-0.04 (0.04)
2009	-0.02 (0.05)	-0.02 (0.05)
2010	-0.05 (0.04)	-0.05 (0.04)
2011	-0.07 (0.04)	-0.07 (0.04)
2012	-0.03 (0.05)	-0.02 (0.05)
2013	-0.22 (0.05)*	-0.21 (0.05)*
2014	-0.29 (0.05)*	-0.28 (0.05)*

Note: Model I = Individual-level (including industry) + state-level predictors. Model II = Individual-level (including industry and occupation) + state-level predictors. Models I and II also includes indicators for each of the calendar years 2005 to 2014. The state population density estimate is based on 2010 census data. State rates of physicians and hospitals come from the 2015–2016 and 2016–2017 Area Health Resources Files. State Gini index comes from 2010–2014 American Community Survey data. The reference categories that are omitted in the regressions are ages 18–34 (age group); White, non-Hispanic (race/ethnicity); Education, Health & Social Services (industry); Management, Business, Science, and Arts Occupations (occupation).

* Statistically significant (P<0.05)

SE = standard error.

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.7a. Variance estimates from multilevel regressions of individual-level reported nonmedical use of prescription pain relievers in the past 30 days on individual- and state-level factors, 2004–2014

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 30 days (N = 370,100)	
	Model I	Model II
Variance estimates of predicted values based on:		
Centered individual-level industry	2.01	2.21
Centered individual-level occupation	.	1.06
Other centered individual-level predictors	56.04	54.63
State-level industry based on individual-level industry	1.95	3.21
State-level occupation based on individual-level occupation	.	0.94
Other state-level predictors based on individual-level variables	2.75	2.51
Other state predictors	3.35	3.12
Year fixed effects	1.30	1.31
State random effects	1.43	1.26

Note: Model I = Individual-level (including industry) + state-level predictors. Model II = Individual-level (including industry and occupation) + state-level predictors. Models I and II also includes indicators for each of the calendar years 2005 to 2014. The state population density estimate is based on 2010 census data. State rates of physicians and hospitals come from the 2015–2016 and 2016–2017 Area Health Resources Files. State Gini index comes from 2010–2014 American Community Survey data. The omitted categories in the regressions are ages 18–34 (age group); White, non-Hispanic (race/ethnicity); Education, Health & Social Services (industry); Management, Business, Science, and Arts Occupations (occupation).

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Table B.7b. Variance estimates from multilevel regressions of individual-level reported nonmedical use of prescription pain relievers in the past 12 months on individual- and state-level factors, 2004–2014

Currently employed U.S. adults	Nonmedical use of prescription pain relievers in the past 12 months (N = 370,100)	
	Model I	Model II
Variance estimates of predicted values based on:		
Centered individual-level industry	2.10	2.19
Centered individual-level occupation	.	0.57
Other centered individual-level predictors	57.44	56.37
State-level industry based on individual-level industry	1.50	2.41
State-level occupation based on individual-level occupation	.	0.98
Other state-level predictors based on individual-level variables	2.94	2.78
Other state predictors	2.24	2.21
Year fixed effects	0.88	0.85
State random effects	0.80	0.72

Note: Model I = Individual-level (including industry) + state-level predictors. Model II = Individual-level (including industry and occupation) + state-level predictors. Models I and II also includes indicators for each of the calendar years 2005 to 2014. The state population density estimate is based on 2010 census data. State rates of physicians and hospitals come from the 2015–2016 and 2016–2017 Area Health Resources Files. State Gini index comes from 2010–2014 American Community Survey data. The omitted categories in the regressions are ages 18–34 (age group); White, non-Hispanic (race/ethnicity); Education, Health & Social Services (industry); Management, Business, Science, and Arts Occupations (occupation).

Source: Authors' analysis of National Survey on Drug Use and Health restricted data for 2004–2014.

Mathematica Inc.

Princeton, NJ • Ann Arbor, MI • Cambridge, MA
Chicago, IL • Oakland, CA • Seattle, WA
Tucson, AZ • Woodlawn, MD • Washington, DC

EDI Global, a Mathematica Company

Bukoba, Tanzania • High Wycombe, United Kingdom

mathematica.org