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RESEARCH ARTICLE

Association Between Fatal Occupational Injuries and State Minimum-Wage Laws, 2003–2017

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Introduction: Low wages are associated with an increased risk of occupational injuries. Increasing the minimum wage is one way to increase workers' wages; however, a previous study found that higher state minimum wage was associated with an increase in nonfatal occupational injuries and illnesses. This study aims to examine the association between state minimum-wage laws and fatal occupational injuries.

Methods: Fatal occupational injury data (2003–2017) for the 50 U.S. states were obtained from the Census of Fatal Occupational Injuries. State minimum-wage law information was obtained from Temple's LawAtlas website. Linear and Poisson regression models were used to analyze the association between state minimum-wage laws and the rates of fatal occupational injury per 100,000 workers. All data were analyzed in 2020.

Results: Having a state minimum wage higher than the federal minimum had no statistically significant association with fatal occupational injury rate, (−4.0%, 95% CI= −9.1, 1.5). State minimum wage amount was also not associated with fatal occupational injuries (−4.0%, 95% CI= −9.1, 1.5).

Conclusions: Although previous research suggested that state minimum-wage laws were associated with increased rates of nonfatal occupational injuries, these findings indicate that these laws are not associated with an increased risk of fatal occupational injuries. Concerns that raising the minimum wage will lead to worse workplace safety may be unfounded.

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INTRODUCTION

The rate of fatal occupational injuries in the U.S. has been increasing since 2009.[1] In 2018, a total of 5,250 workers were killed by a workplace injury in the U.S., a rate of 3.5 fatalities per 100,000 full-time workers.[2] Fatal occupational injury risk varies by industry and occupation, with the highest rates observed in the truck and transportation (28.3 per 100,000 full-time workers) and farming, fishing, and forestry (22.8 per 100,000 full-time workers) occupations in 2018.[2]

One important risk factor for occupational injury is having a low wage.[3,4] Low-wage workers are more likely to be employed in industries with higher rates of fatal injuries and nonfatal occupational injuries and illnesses.[5] Foreign-born workers, workers of color, and individuals with lower overall health are more likely to be working in low-wage jobs, which may further magnify their risk.[4–7]

One commonly discussed strategy to raise workers' wages is minimum-wage laws. Most U.S. adults support minimum-wage laws,[8] and proposals to enact a federal minimum-wage law are gaining prominence in the national policy dialogue.[9] Minimum-wage laws set a minimum amount that must be paid on an hourly basis for eligible workers. They can be enacted at the federal,

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state, or local levels, with the federal minimum wage establishing a national floor. The current federal minimum wage is $7.25, the same amount it has been since July 2009. In addition to setting higher minimum wages, states and localities also have the option to expand worker eligibility to include those who are not currently protected under federal wage laws, such as restaurant servers.

Along with higher incomes,[10] increased minimum wage may be associated with safer workplaces and improved health outcomes. Increased minimum wage is associated with higher job satisfaction.[11−13] Higher minimum wages are associated with a reduction in the number of hours employees work, either because they do not need to work as many hours or because employers respond to wage increases by decreasing hours.[14] Higher minimum wages are also associated with reductions in the chronic disease risk factors associated with occupational injury such as obesity[15,16] and smoking status.[11] To the best of the authors' knowledge, no published work to date has examined the impact of state minimum-wage laws on fatal occupational injuries. This manuscript aims to examine the association between state minimum-wage laws and fatal occupational injuries in an exploratory study to continue looking at the association of minimum wage with workers' safety outcomes. The hypothesis is that higher state minimum-wage laws will not be associated with higher rates of occupational fatalities and indeed may be associated with lower rates.

METHODS

Study Sample

To examine the association between state minimum-wage laws and fatal occupational injuries, natural variations in state minimum-wage laws over time were used to compare fatal occupational injury rates in states that have a minimum wage higher than the federal minimum wage with those in states that do not. A panel data set was used to examine the association between 2003 and 2017. An additional analysis was conducted to examine the association between state minimum wage amount and fatal occupational injuries.

Measures

The dependent variable, fatal occupational injuries, was obtained from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries.[1] Data are available for all the 50 states beginning in 1992. The BLS collects information on workplace injury fatalities from a combination of sources, including death certificates, workers' compensation claims, and reports from other administrative agencies. The workplace fatality dependent variable was measured as both a count and a rate per 100,000 employed workers in a state. The number of employed workers in a state was obtained from the BLS, which defines *employed individuals* as those who were paid for ≥1 hour of labor in the previous week, excluding temporary absences, or as those who worked for ≥15 hours without pay in a family business.[17]

The main independent variable, state minimum-wage laws, was obtained primarily from Temple's Policy Surveillance Program (LawAtlas).[18] This resource provides information about state minimum-wage laws through 2016. When a change in a state's minimum wage was identified, the state's minimum-wage law was read to verify the amount and the date of implementation. Apparent discrepancies between the state minimum wage reported by LawAtlas and the language of the state law itself were resolved by consulting other sources. State minimum-wage laws after 2016 were obtained through the individual state's Department of Labor (or a similar website) or through additional sources such as the St. Louis Federal Reserve Bank[19] and the National Conference of State Legislatures.[20]

Separate variables were created measuring state minimum wage in a dichotomous and continuous fashion. In the dichotomous measure, states that had implemented a minimum wage greater than the federal rate were coded as 1, and states with a minimum wage at or below the federal rate were coded as 0. The proportion of the state year where the minimum wage was higher than the federal minimum amount was used if the state's minimum wage was not higher than the federal amount for the entire year. Another dichotomous variable was created to identify whether a state ever had a minimum wage higher than the federal amount, with a 1 signifying that they did, and a 0 signifying that they did not. These 2 variables were multiplied together to create an interaction term, which measured the main effect of having a state minimum wage higher than the federal amount. In the continuous measure, the effective state minimum wage amount per hour was subtracted from the federal rate per hour. If states had >1 minimum wage amount in 1 year, the weighted average for the state minimum wage amount was used.

State demographic and workforce characteristics associated with fatal occupational injury risk in the literature were included. Covariates, including the percentage of the state population aged 55−64 years and Black from the U.S. Census Bureau, were obtained through the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting System.[21] The percentage of the state population aged >25 years with a bachelor's degree[22,23] and the proportion of individuals aged >15 years living in a household earning less than the federal poverty[23] rate were also obtained from the U.S. Census Bureau. Workforce covariates, including state unemployment rates (from the BLS Local Area Unemployment Statistics[17]) and state unionization rates (from Hirsch et al.[24]), were incorporated.

Industry supersector measures—defined by BLS as an aggregation of (industry) sectors (e.g., arts, entertainment, and recreation)—were included as covariates. The number of employees working in a particular industry supersector was compiled from the Local Area Unemployment Statistics data available from the BLS.[17] Supersector data were collected beginning in 2003 given the change made that year in industry classification from Standard Industrial Classification to North American Industrial Classification System. Annual averages of workforce data were calculated from nonseasonally adjusted estimates of monthly numbers. A total of 3 supersectors with increased risk of fatal occupational injury were included in the model: (1) construction; (2) mining and logging; and (3) trade, transportation, and utilities.

Two state policy variables were included as covariates. Right-to-work laws (obtained from the National Conference of State Legislatures[25]) give states the power to determine whether workers can be compelled to join a union as a condition of employment. State Occupational Safety and Health Administration (OSHA) programs (obtained from the federal OSHA website[26]) are workplace protection plans created and operated by the state government, instead of being operated by the federal government. State OSHA plans that only covered state and government workers as having a state OSHA program were not coded. Both policy covariates were dichotomized.

Statistical Analysis

To examine the association between state minimum-wage laws and fatal occupational injuries, both comparative interrupted time series (CITS) linear regression models and Poisson regression models were utilized, each controlling for all the covariates mentioned earlier. Year was included in the models as a linear term. A spline in the year 2009 was added to account for the change in the fatal occupational injury trend. The CITS approach was used to examine the association between the dichotomous measure of having a state minimum wage higher than the federal minimum wage and the fatal occupational injury rate per 100,000 workers. For ease of interpretation, CITS model coefficients were converted to a percentage change by dividing the main effect coefficient by the mean rate of fatal occupational injury. A Poisson regression model was used to examine the association between the continuous measure of absolute state minimum wage rate and the count of fatal occupational injuries. Because the mean of the fatal occupational injuries was larger than the SD, it was determined that the Poisson regression was appropriate for this latter analysis.

Because state demographics may not reflect worker demographics, a sensitivity analysis was conducted by running a model without state demographics, including only workforce and policy covariates. Robust SEs were used to account for heteroscedasticity. Following best practices from Leigh and colleagues,[16] state clustered SEs were also utilized to account for intrastate variance and differences between states. State fixed effects (to account for time-invariant differences between states) or year fixed effects (to account for state-invariant difference between years) were not used because of high collinearity. All data were analyzed in 2020 using Stata I/C, version 14.2.[27]

RESULTS

The federal minimum wage changed incrementally from $5.15/hour in July 2007 to $7.25/hour in July 2009. The number of states with a minimum wage higher than the federal minimum wage changed throughout the study period, ranging from 7 to 32. As the number of states with a minimum wage higher than the federal rate increased dramatically after 2010, the average difference in rates between effective state and federal minimum wage also increased. Over the entire study period, state minimum wage rates varied from $5.15/hour to $11.00/hour.

The number of fatal occupational injuries decreased until 2009, before trending upward (Figure 1). Similarly, the rate of fatal occupational injuries decreased annually until 2009 when it started to trend upward. The mean of

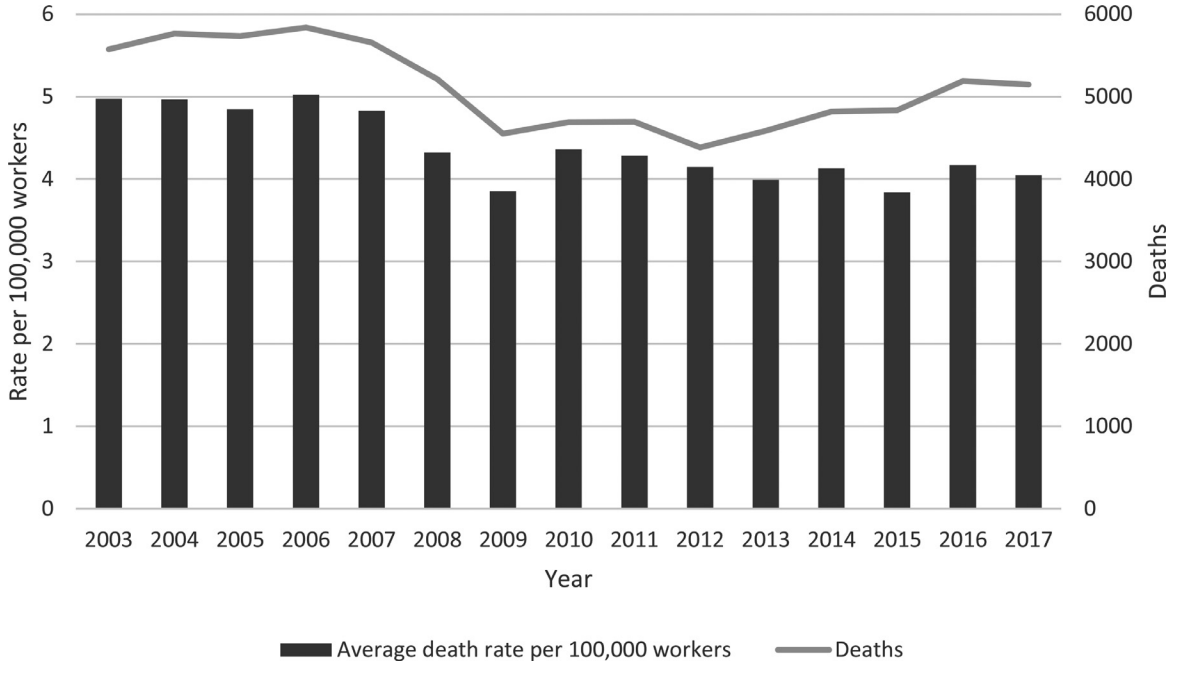

Figure 1. Fatal occupational injuries and rates, 2003–2017.

Table 1. Association Between Having a State Minimum Wage Higher Than the Federal Amount and Fatal Occupational Injury Rates, 2003–2017

Covariates	Coefficient	% change
Treatment and policy interaction	−0.240 (−0.760, 0.280)	−5.48 (−17.34, 6.39)
Treatment state	−0.00813 (−0.694, 0.678)	−0.19 (−15.84, 15.47)
Percentage of the state population between the age of 55 and 64 years	0.195 (−0.142, 0.531)	4.44 (−3.24, 12.12)
Percentage of the state population with a bachelor's degree or higher	**−0.0555*** (−0.120, 0.00926)	**−1.27** (−2.74, 0.21)
Percentage of the state living in poverty	0.0667 (−0.0546, 0.188)	1.52 (−1.25, 4.29)
Percentage of the state population identified as Black	−0.00370 (−0.0400, 0.0326)	−0.08 (−0.91, 0.74)
Percentage of the state population unemployed	**−0.146**** (−0.267, −0.0246)	**−3.33** (−6.10, −0.56)
Percentage of workers who are covered by unions	0.00863 (−0.0593, 0.0766)	0.20 (−1.35, 1.75)
Percentage of the workforce employed in mining and logging	**0.904***** (0.647, 1.1605)	**20.61** (14.75, 26.47)
Percentage of the workforce employed in trade, transportation, and utilities	**0.305***** (0.145, 0.465)	**6.95** (3.30, 10.59)
Percentage of the workforce employed in construction	0.0825 (−0.250, 0.415)	1.88 (−5.70, 9.46)
State right-to-work policy	0.443 (−0.186, 1.072)	10.11 (−4.25, 24.46)
State OSHA policy	0.0371 (−0.454, 0.528)	0.85 (−10.36, 12.05)
Year	**−0.160***** (−0.278, −0.0421)	**−3.65** (−6.35, −0.96)
Year after 2009	0.0785 (−0.0531, 0.210)	1.79 (−1.21, 4.79)
Constant	**318.4***** (85.970, 550.803)	
Observations	720	
R-squared	0.699	

Note: Boldface indicates statistical significance (***p<0.01; **p<0.05; *p<0.1).
The 95% CIs are in parentheses.
OSHA, Occupational Safety Administration.

fatal occupational injuries for the study period per state year was 100.51 (SD=96.07) and ranged from 5 to 545.

Having a state minimum wage higher than the federal amount was associated with a nonstatistically significant 5.48% decrease (95% CI= −17.34, 6.39) in fatal occupational injury rates (Table 1). Both a 1−percentage point increase in the state workforce employed in mining (20.61%, 95% CI=14.75, 26.47) and trade, transportation, and utilities (6.95%, 95% CI=3.30, 10.59) were associated with statistically significant increases in state fatal occupational injury rates. A 1−percentage point increase in a state's unemployment rate was associated with a statistically significant 3.33% decrease (95% CI= −6.10, −0.56) in fatal occupational injury rate.

A $1 increase in state minimum wage over the federal amount was associated with a nonsignificant 4.0% decrease (95% CI= −9.1, 1.5) in fatal occupational injuries (Table 2). State unemployment rate and the percentage of workers covered by a union were both associated with statistically significant decreases in fatal occupational injuries. An increase in the percentage of the workforce employed in mining and the percentage of the workforce employed in trade, transportation, and utilities were both associated with statistically significant increases in fatal occupational injuries. In addition, a 1 −percentage point increase in the state population aged 55−64 years and the percentage of the state population with a bachelor's degree were associated with a statistically significant 5.5% increase (95% CI=1.0, 10.3) and a 2.6% decrease (95% CI= −3.8, −1.3) in fatal occupational injuries, respectively.

Additional sensitivity analyses were conducted. In models without state demographics, having a state minimum wage higher than the federal minimum wage was not associated with the rate of fatal occupational injuries (−5.24%, 95% CI= −15.1, 4.59). However, a $1 increase in state minimum wage above the federal amount was associated with a statistically significant 6.91% decrease in fatal occupational injuries (95% CI= −11.8, −1.75).

DISCUSSION

No statistically significant association between state minimum-wage laws and fatal occupational injury was found. Although there was no association between state minimum wage and fatal occupational injuries, the sensitivity analysis did find an association. However, this association was in the same direction as the effect in the main model. These findings differ from those of the only previous study of minimum wage and occupational injuries. Hradil[28] found that an increase in state minimum wage was associated with a statistically significant increase in nonfatal occupational injuries and illnesses. Study of Hradil[28] hypothesized that increasing a state's

Table 2. Association Between State Minimum Wage Amount and Fatal Occupational Injury Counts, 2003–2017

Covariates	IRR[a]
Difference between state and federal minimum wage	0.960 (0.909, 1.015)
Treatment state	0.938 (0.844, 1.043)
Percentage of the state population between the age of 55 and 64 years	**1.055**** (1.010, 1.103)
Percentage of the state population with a bachelor's degree or higher	**0.974***** (0.962, 0.987)
Percentage of the state population living in poverty	1.000 (0.985, 1.015)
Percentage of the state population identified as Black	1.000 (0.994, 1.006)
Percentage of the state population unemployed	**0.967***** (0.950, 0.984)
Percentage of workers who are covered by unions	**0.991**** (0.982, 1.000)
Percentage of the workforce employed in mining and logging	**1.120***** (1.072, 1.170)
Percentage of the workforce employed in trade, transportation, and utilities	**1.038**** (1.009, 1.067)
Percentage of the workforce employed in construction	1.019 (0.984, 1.055)
State right-to-work policy	1.004 (0.902, 1.118)
State OSHA policy	1.026 (0.943, 1.117)
Year	**0.965***** (0.948, 0.982)
Year after 2009	**1.021**** (1.002, 1.042)
Constant	4.25E+26 (2.27e+11, 7.96e+41)
Observations	720

Note: Boldface indicates statistical significance (***$p<0.01$; **$p<0.05$; *$p<0.1$). The 95% CIs are in parentheses.
[a]*IRR* is defined as the incidence rate in an exposed group divided by the incidence rate in the unexposed group. IRRs are converted to percentages in the text for ease of interpretation.
IRR, incidence rate ratio; OSHA, Occupational Safety Administration.

minimum wage may cause employers to cut funding to their safety programs and increase hazards for workers. If state minimum-wage laws were associated with an increased risk of worker injury, policymakers would need to consider stronger worker protections to enact when considering raising the minimum wage. However, this paper found no evidence to suggest that these policies were associated with fatal injury in the workplace.

These findings may be helpful for employers, employees, and insurers. Employers can be confident that raising the minimum wage for their employees—even if not required by law—will not risk higher occupational injury rates. Insurers may be able to lower the rates for those employers, particularly in recognition of the overall health benefits of increased minimum wages among the general population, including lower rates of obesity.[15,16] Finally, employees are better able to advocate for higher minimum-wage laws while being able to counter at least one of the arguments sometimes made to oppose those laws.

The difference in these findings from those of Hradil[28] may be the result of differing occupational safety outcome measures in the 2 studies; state minimum-wage laws may have various associations with fatal from those with nonfatal occupational injuries. However, there are significant challenges to reporting nonfatal occupational injuries and illnesses, which rely on employers' reports of incidents on their OSHA logs.[29] Fatal occupational injury reporting comes from death certificates and is not as vulnerable to differential reporting bias.[29,30] This paper expands on analysis of Hradil[28] by accounting for several state-level factors that could operate as confounders, including state unionization. Union membership may facilitate the reporting of occupational hazards and injuries by making workers feel protected from employment repercussions.[29,31] In addition, the analyses period was truncated starting in 2003 to account for changes to OSHA reporting requirements in 1995 and 2001 and changes to industry classification from the Standard Industrial Classification to the North American Industrial Classification System in 2003. Study of Hradil[28] used data from 1996 to 2013.

Limitations

This study has some limitations. As with all quasi-experimental studies, there are threats to internal validity. States with higher minimum-wage laws may be different from states with lower rates in ways that impact fatal occupational injury risks for the state such as state workforce conditions or the extent to which policy regulates the workplace. To account for this possibility, a CITS model was used, and analyses included a treatment variable to account for differences in the states that raised their minimum wage higher than the federal rate during

the study period. Nevertheless, unmeasured differences may remain.

This study uses Census of Fatal Occupational Injuries data, which measure a relatively rare outcome (fatalities). The lack of statistical significance could be the result of a relatively rare outcome. Threats to study validity owing to endogeneity should be limited because states concerned about injury fatalities likely examine OSHA regulations or consider legislation to limit a specific type of injury, instead of raising their state minimum wage. Furthermore, fatal occupational injury rates were created from BLS data. However, there are a number of limitations to these rates; for example, military members, volunteers, and workers who worked without pay in a family business are included in the numerator but not in the denominator. It is unlikely that these would systematically bias these findings given their low number of fatalities and their exclusion from benefiting from minimum wage or receiving above minimum wage.

Finally, the CITS model relies on assumptions about the consistency of the impacts of the policy change. However, state minimum-wage laws turn on and off in different years throughout the study period, so making an understanding of the extent to which this assumption is met challenging. Thus, care should be taken with the interpretation of these results, and further studies should continue to examine the associations between state minimum wage and occupational fatalities.

CONCLUSIONS

This study found no evidence to suggest that raising state minimum wages would increase workers' risk of fatal occupational injury. Concerns that raising the state minimum wage may result in decreased worker safety may not be warranted. Future studies should continue to examine the association between minimum wage and other occupational outcomes, including using a variety of methods and outcomes.

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