

Association Between State Minimum Wages and Suicide Rates in the U.S.



Alex K. Gertner, BA, Jason S. Rotter, MHS, Paul R. Shafer, MA

Introduction: The suicide rate in the U.S. has been increasing in recent years. Previous studies have consistently identified financial stress as a contributing factor in suicides. Nevertheless, there has been little research on the effect of economic policies that can alleviate financial stress on suicide rates. The purpose of this study is to determine whether increases in state minimum wages have been associated with changes in state suicide rates.

Methods: A retrospective panel data study was conducted. In 2018, linear regression models with state fixed effects were used to estimate the relationship between changes in state minimum wages and suicide rates for all 50 U.S. states between 2006 and 2016. Models controlled for time-varying state characteristics that could be associated with changes in minimum wages and suicide rates.

Results: There were approximately 432,000 deaths by suicide in the study period. A one-dollar increase in the real minimum wage was associated on average with a 1.9% decrease in the annual state suicide rate in adjusted analyses. This negative association was most consistent in years since 2011. An annual decrease of 1.9% in the suicide rate during the study period would have resulted in roughly 8,000 fewer deaths by suicide. Analyses by race and sex did not reveal substantial variation in the association between minimum wages and suicides.

Conclusions: Increases in real minimum wages have been associated with slower growth in state suicide rates in recent years. Increasing the minimum wage could represent a strategy for addressing increases in suicide rates.

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INTRODUCTION

The suicide rate in the U.S. has been steadily increasing in recent years.^{1,2} The age-adjusted suicide rate in 2016 was 13.4 per 100,000 people, compared with 10.5 per 100,000 in 1999. Between 1999 and 2016, the suicide rate increased significantly in 44 states, with 25 states experiencing increases of more than 30%.¹ The increases in suicides are contributing to reversals in decades-long trends of decreasing overall mortality rates.³ Though there has been particular attention paid to increasing mortality among non-Hispanic whites,^{3,4} the suicide rate has also been increasing within other racial and ethnic groups.⁵

Worsening economic conditions that strain individuals have long been proposed as contributing to suicide deaths.⁶ Studies using interview and survey data in diverse settings and populations have consistently

identified financial stress as a contributing factor in suicides.^{7–10} The proportion of suicides with circumstances related to job or financial issues increased among middle-aged individuals in the U.S. between 2005 and 2010.¹¹ A recent report found that approximately one in six people who died by suicide in several U.S. states experienced a job or financial problem before death.¹

Increasing minimum wages may reduce financial stress on groups that are at higher risk of suicide. Prior studies have found increases in minimum wages increase income for low-income groups,^{12,13} potentially relieving

From the Department of Health Policy and Management, Gillings School of Global Public Health, University of North Carolina, Chapel Hill, North Carolina

Address correspondence to: Alex K. Gertner, BA, McGavran-Greenberg Hall, CB #7411, Chapel Hill NC 27516. E-mail: alex_gertner@med.unc.edu. 0749-3797/\$36.00

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financial stress. Although a small portion of the population works for the minimum wage, this population is also at higher risk of suicide. Being in a low-income household is associated with an increased probability of suicide even after controlling for demographic characteristics.¹⁴ Positive economic effects of minimum wage increases may also extend beyond minimum wage workers. There is evidence that increases in the minimum wage could increase wages for workers who earn more than the minimum wage.¹³

Increasing minimum wages may also have benefits for population health. Prior studies found that increases in state minimum wages in the U.S. were associated with improved life satisfaction among workers without a high school diploma¹⁵ and reduced odds of reporting unmet medical needs.¹⁶ A study of the United Kingdom found that the introduction of a minimum wage was associated with a decrease in the probability of having poor mental health among those affected by the change.¹⁷ In a recent analysis, half of people who died by suicide in several U.S. states had a known mental health condition and more than one fifth had a physical health stressor.¹ These results suggest a possible role for increasing minimum wages in reducing suicide rates.

Despite prior findings of the benefits of minimum wage increases, the authors are unaware of any studies examining the effect of minimum wage increases on suicide rates. The aim of this study is to assess the relationship between increases in minimum wages and suicide rates using variation in the minimum wage within states across time between 2006 and 2016. Though the U.S. suicide rate has been increasing since at least 1999, the pace of the increase accelerated after 2006. This period coincides with a period of higher variation in minimum wages compared with previous years. The Fair Minimum Wage Act of 2007 changed the federal minimum wage between 2007 and 2009, and several states also made changes to their minimum wages during this period.

METHODS

Study Sample

The dependent variable in these analyses is the age-adjusted suicide rate obtained from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS) for all states from 2006 to 2016 reflecting underlying cause of death codes associated with intentional self-harm (X60–X84, Y87.0, and U03).⁵ The independent variable is the real, or inflation-adjusted, minimum wage, defined as the highest value of the state or federal minimum wage applicable in the state for each year. For instance, if a state had a minimum wage law but the federal minimum wage was higher for the year, the real federal minimum wage was selected as the minimum wage in the state in that year. Minimum wages were inflation-adjusted using the Consumer Price

Index for All Urban Consumers.¹⁸ State minimum wage data came from the Policy Surveillance Program, a project by the Robert Wood Johnson Foundation and the Temple University Beasley School of Law.¹⁹ The Policy Surveillance Program's minimum wage data set was constructed by searching for wage laws in legal databases (e.g., Westlaw, Lexis Nexis) using key terms, coding laws for key variables, and checking results with secondary sources (e.g., U.S. Department of Labor, state legislature websites).

Measures

Analyses included several covariates to account for potential confounding between the minimum wage and suicide rates. Previous studies of the U.S. have found that suicide rates increase as macroeconomic conditions worsen.^{20–23} These studies have used unemployment, job loss, and business cycles—defined in part as changes in gross domestic product (GDP)—as measures of economic conditions. States experiencing economic prosperity may experience lower suicide rates and also be more likely to increase their minimum wages, giving the appearance that minimum wages decrease suicide rates. To control for state economic conditions, analyses included state unemployment rates from the Bureau of Labor Statistics²⁴ and state-level real GDP from the Bureau of Economic Analysis.²⁵ States may also have increased the minimum wage at the same time as they made investments in state health resources, potentially confounding the relationship between the minimum wage and suicide rates. To control for investments in health, models include the percentage of the total state budget spent on Medicaid from the National Association of State Budget Officers²⁶ and the health uninsured rate for individuals aged 0 to 64 years from the U.S. Census Bureau's Small Area Health Insurance Estimates.²⁷ Inclusion of the uninsured rate helps to account for the implementation of the Affordable Care Act during the study period. The final combined data are a balanced panel of all 50 states over 11 years (2006–2016).

Statistical Analysis

A Box–Cox test of functional form supported the use of the logged form of suicide rate as outcome in models. Fixed effects panel regression models were used to assess the relationship between changes in the real minimum wage and the age-adjusted suicide rate at the state level. States with higher minimum wages may also possess time-invariant characteristics that result in lower suicide rates. To account for this potential confounding, the fixed effects estimator used state fixed effects to estimate the effect of changes in the minimum wage on suicide rates within states across time. Year fixed effects account for time trends in the suicide rate. Regressions were weighted by the average state population between 2006 and 2016 to ensure estimates were not skewed by observations from larger states. SEs were clustered at the state level.

Analyses separately examined the effect of minimum wage increases on age-adjusted suicide rates among women, men, non-Hispanic white, and non-Hispanic black groups. North Dakota was excluded from the model of suicide rates among women because several years of data were suppressed in WISQARS because of small cell sizes. Twenty states were similarly excluded from the analysis of suicide rates among non-Hispanic black groups. Estimating the effect of minimum wage changes on suicide rates among Hispanic groups was not possible because of the small number of states with

unsuppressed yearly estimates of suicide rates. Sensitivity analyses included using nominal minimum wage as the independent variable, running unweighted regressions, using unlogged suicide rate as the outcome, including state demographic variables in the main model, and using the suicide rate among individuals aged 16–64 years as the dependent variable to check for a differential association in the working-age population. All analyses were performed in 2018 using Stata, version 15.1.

RESULTS

There were approximately 432,000 suicide deaths in the study period. [Figure 1](#) presents the age-adjusted suicide rates from 2006 to 2016 by sex and race. Suicide rates increased among all groups, with men and non-Hispanic whites experiencing the largest absolute changes. The largest relative increases took place among women and non-Hispanic whites.

The mean real minimum wage for the study period was \$8.00, with an SD of \$0.74. The real minimum wage changed for all states in all years because of annual inflation adjustment. [Table 1](#) presents the states that experienced changes in their nominal minimum wages by year, with 2006 excluded as the baseline year. All 50 states experienced changes in their nominal minimum wages during the study period. Of these, 16 states had minimum wages equal to the federal minimum wage for all years, meaning these states' minimum wages were equal to each other for all years. The real minimum wage in these states increased from \$6.42 in 2006 to \$8.28 in 2009 and then decreased to \$7.40 in 2016.

Among the other 34 states, the average number of years where the state minimum wage was higher than the federal minimum wage was 7.1; the average number of changes in the nominal minimum wage was 4.9, with a range of 2–10; and the average total change in the real minimum wage across the study period was \$1.10, with an SD of \$0.78. State-specific descriptive statistics are available in [Appendix Table 1](#) (available online).

A one-dollar increase in the real minimum wage was associated on average with a 1.9% decrease (95% CI= -0.031 , -0.007) in the annual age-adjusted state suicide rate in linear regression models with state fixed effects ([Table 2](#)). The estimated association between minimum wages and suicide rates among men and non-Hispanic whites were comparable with the estimate from the main analysis and statistically significant. The estimated association among women was also comparable but not statistically significant. The estimated association among non-Hispanic blacks was positive but smaller in magnitude than the main analysis and not statistically significant. However, this model was limited to 30 states, so the loss of statistical power decreased the precision of estimates for this group. A 1–percentage point increase in the uninsured rate in a state was associated with a statistically significant increase of 1.5% in the suicide rate among women, but this relationship was not found among other groups.

Sensitivity analyses produced similar estimates of the association between minimum wages and suicide rates as the main model ([Appendix Table 2](#), available online).

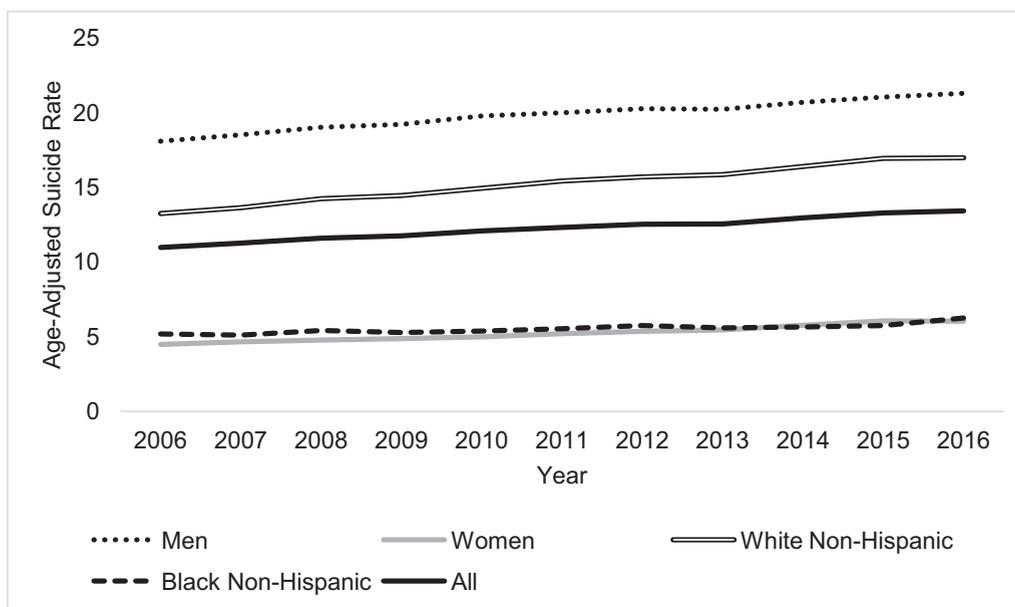


Figure 1. Age-adjusted suicide rates by sex, race, and ethnicity 2006–2016.

Note: Data from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS).

Table 1. State-level Changes in Nominal Minimum Wage 2007–2016

Year	States changing minimum wage	n
2007	AZ, CA, CO, CT, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, ME, MI, MO, MS, MT, NC, ND, NE, NH, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WV, WY	44
2008	AL, AR, AZ, CA, CO, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NM, NV, OH, OK, OR, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY	43
2009	AK, AL, AR, AZ, CO, CT, DE, FL, GA, ID, IL, IN, KS, KY, LA, MD, ME, MN, MO, MS, MT, NC, ND, NE, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, VT, WA, WI, WY	42
2010	AK, CO, CT, IL, NV	5
2011	MT, OH, OR, VT, WA	8
2012	AZ, CO, FL, MT, OH, OR, VT, WA	8
2013	AZ, CO, FL, MO, MT, NY, OH, OR, RI, VT, WA	11
2014	AZ, CA, CO, CT, DE, FL, MI, MN, MO, MT, NJ, NY, OH, OR, RI, VT, WA	17
2015	AK, AR, AZ, CO, CT, DE, FL, HI, MA, MD, MN, MO, MT, NE, NJ, NY, OH, OR, RI, SD, VT, WA	23
2016	AK, AR, CA, CO, CT, HI, MA, MI, NE, RI, VT, WV	12

Note: Authors' analysis of data from the Temple University Beasley School of Law's Policy Surveillance Program.

AK, Alaska; AL, Alabama; AR, Arkansas; AZ, Arizona; CA, California; CO, Colorado; CT, Connecticut; DE, Delaware; FL, Florida; GA, Georgia; HI, Hawaii; IA, Iowa; ID, Idaho; IL, Illinois; IN, Indiana; KS, Kansas; KY, Kentucky; LA, Louisiana; MA, Massachusetts; MD, Maryland; ME, Maine; MI, Michigan; MN, Minnesota; MO, Missouri; MS, Mississippi; MT, Montana; NC, North Carolina; ND, North Dakota; NE, Nebraska; NH, New Hampshire; NJ, New Jersey; NM, New Mexico; NV, Nevada; NY, New York; OH, Ohio; OK, Oklahoma; OR, Oregon; PA, Pennsylvania; RI, Rhode Island; SC, South Carolina; SD, South Dakota; TN, Tennessee; TX, Texas; UT, Utah; VA, Virginia; VT, Vermont; WA, Washington; WI, Wisconsin; WV, West Virginia; WY, Wyoming.

Including demographic characteristics reduced the magnitude of the estimated association compared with the main model to a 1.5% decrease (95% CI= -0.027 , -0.0035), but the CIs for this estimate and the main model estimate overlapped. The model with demographic characteristics also found an association between increases in the percentage of women and Hispanics in a state and decreases in suicide rates.

Figure 2 presents year-specific estimates of the adjusted association between minimum wages and suicide rates. These year-specific estimates were obtained by following the same general approach as the main model but interacting year fixed effects with the state real minimum wage. The figure reveals some heterogeneity in the association between minimum wages and suicide rates. Between 2007 and 2010, the association between minimum wages and suicide rates was zero or slightly positive. By contrast, since 2011, the association has been negative and larger in most years than the average estimate across all years of -1.9% .

DISCUSSION

A one-dollar increase in state minimum wage was associated on average with a 1.9% decrease in the annual age-adjusted suicide rate. Such a decrease in the suicide rate during the study period would have resulted in roughly 8,000 fewer suicide deaths. The estimated association was consistent across multiple model specifications and assumptions. The models controlled for economic conditions in states, state investments in

health care, and improvements in health insurance coverage. As such, the analyses provide support for the potential role of increases in minimum wages in addressing increasing suicides rates in the U.S.

Case and Deaton⁴ reported that the association between income and mortality since 1980 is more pronounced among non-Hispanic whites as compared with other groups, though they question whether these changes are major drivers of increases in mortality. This study did not find substantial evidence that the association of minimum wage and suicide rates was different by race or sex, but the ability to precisely estimate these associations was limited for non-Hispanic black individuals. In a model controlling for demographic characteristics, increases in the percentage of women and Hispanic individuals in states were associated with decreases in suicide rates. This association may be easily explained by the fact that women and Hispanics have among the lowest suicide rates of the groups considered in these analyses. What is more interesting is that controlling for demographic changes in states led to a decreased point estimate for the association between minimum wages and suicide rates, suggesting that changes in demographic composition in states may explain a portion of the association between minimum wages and suicide rates. It is possible that increases in minimum wages attract more women and Hispanic individuals to states, or that minimum wages are increased during times of relative prosperity that attract these groups. Alternatively, it is possible that states with increasing numbers of women and Hispanic individuals are more

Table 2. Model Estimates of the Association Between Minimum Wage and Suicide Rates

Population	Full	Full	Female	Male	Black NH	White NH
Minimum wage	-0.020** (-0.031, -0.0095)	-0.019* (-0.034, -0.0068)	-0.020 (-0.041, 0.0012)	-0.020* (-0.035, -0.0053)	-0.015 (-0.062, 0.032)	-0.018* (-0.030, -0.0058)
Unemployment rate	0.0017 (-0.0078, 0.011)	0.010 (-0.0067, 0.027)	0.010 (-0.0067, 0.027)	-0.00056 (-0.011, 0.0094)	0.0031 (-0.022, 0.028)	0.0060 (-0.0030, 0.015)
Percent state budget spent on Medicaid	-0.000022 (-0.0014, 0.0014)	0.00055 (-0.0029, 0.0040)	0.00055 (-0.0029, 0.0040)	-0.000057 (-0.0015, 0.0014)	0.0072 (-0.0011, 0.015)	-0.00081 (-0.0020, 0.00036)
State GDP per 100,000	0.42 (-0.072, 0.92)	0.38 (-0.53, 1.28)	0.38 (-0.53, 1.28)	0.44 (-0.045, 0.93)	-0.19 (-1.63, 1.25)	0.32 (-0.10, 0.75)
Percent uninsured	0.0070 (-0.00024, 0.014)	0.015 (0.0031, 0.027)	0.015 (0.0031, 0.027)	0.0047 (-0.0016, 0.011)	0.0061 (-0.015, 0.027)	0.0034 (-0.0035, 0.010)
n	550	550	539	550	330	550
Adjusted R ²	0.637	0.649	0.566	0.507	0.113	0.732

Note: Boldface indicates statistical significance at $p < 0.05$ (* $p < 0.01$; ** $p < 0.001$). Results are from ordinary least squares (OLS) regressions with robust SEs; 95% CIs are presented in parentheses. Analyses included suicide rate data from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS); minimum wage data from the Temple University Beasley School of Law's Policy Surveillance Program; state unemployment rates from the Bureau of Labor Statistics; real GDP from the Bureau of Economic Analysis; the percentage of the total state budget spent on Medicaid from the National Association of State Budget Officers; and the health insurance rate from the U.S. Census Bureau's Small Area Health Insurance Estimates. GDP, gross domestic product; NH, non-Hispanic.

likely to favor political leaders that are inclined to raise the minimum wage.

The year-specific estimates of the association between minimum wages and suicide rates revealed some heterogeneity. The negative association between minimum wages and suicide rates appears to be driven by years since 2011. This variation may represent an opportunity to better understand under what conditions increases in minimum wages may affect suicide rates and other population health measures. The years in which the association between minimum wages and suicide rates is near zero or slightly positive coincide with years of the Great Recession and subsequent recovery. One possibility is that minimum wage increases had less effect on suicide rates during years when unemployment was high, because individuals who might have benefited from such increases were out of work. Alternatively, there are studies that suggest increases in minimum wages may decrease overall employment,^{28,29} producing a null or net negative effect on income overall. Minimum wage increases may have had variable effects on income in different states and years, producing variable effects on suicide rates. A systematic review of studies of the relationship of regional socioeconomic characteristics and suicide rates found that median income was not consistently associated with suicide rates,³⁰ pointing to the importance of better understanding the mechanisms by which minimum wages may affect suicide rates.

Unlike previous studies, these analyses did not find an association between measures of economic prosperity, namely, unemployment and GDP, and suicide rates. This divergence may simply result from the fact that economic prosperity was not a major driver of suicide rates during the study period. Alternatively, state-level unemployment and GDP may not adequately capture the economic conditions that affect subgroups with higher risk of suicide, particularly in a time of low labor participation, rising inequality, and stagnant wages. It is also possible that changes brought by healthcare legislation, such as the Affordable Care Act and the Mental Health Parity and Addiction Equity Act, helped cushion the effects of economic conditions on suicide rates. That said, these analyses did not reveal a consistent association between insurance rates and suicide rates, and previous research has found that Mental Health Parity and Addiction Equity Act did not increase specialty mental healthcare use in a nationally representative sample.³¹

Although economic policy may have a key role to play in addressing increasing suicide rates, a more comprehensive and long-term policy response is likely necessary to address worsening trends in suicide deaths. Case and Deaton⁴ argue that changes in contemporaneous economic conditions alone cannot explain increases in

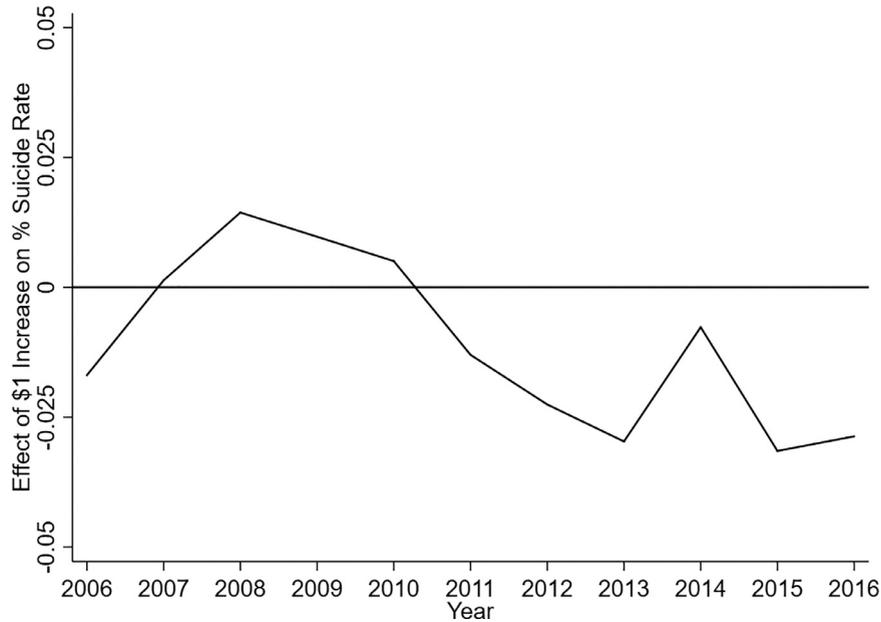


Figure 2. Year-specific association between minimum wages and suicide rates.

Note: Authors' analysis of suicide rate data from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS) and minimum wage data from the Temple University Beasley School of Law's Policy Surveillance Program.

mortality in recent years. Rather, they propose that recent increases in suicides and drug-related deaths result from an inter-generational deterioration of economic and social conditions with roots in the labor market. Addressing such a phenomenon requires a long-term policy approach with appreciation for inter-generational effects. However, that approach does not preclude the possibility that contemporaneous improvements in income and financial security can meaningfully affect population health outcomes. Minimum wage laws in the U.S. may be particularly important for providing financial security given the fewer labor protections and higher volatility U.S. workers experience compared with workers in other high-income countries.³² More studies are needed to understand the mechanisms by which increases in minimum wages may decrease suicide rates.

Limitations

Though steps were taken to reduce bias using robust model specification and covariate adjustment, the association between minimum wages and suicide rates detected in this study should not necessarily be interpreted as causal. Fixed effects models account for important differences between states that are stable over time but are unable to control for time-varying unobserved factors. The possibility that the association is confounded by unobserved factors cannot be completely discounted. The analyses do not control for health investments outside of Medicaid or how Medicaid dollars are spent. The analyses similarly do not control for

time-varying state-level social programs for which comprehensive panel data are difficult to obtain, possibly leading to an overestimate of the magnitude of the association between minimum wages and suicides. Studies of minimum wage increases that focus on specific localities may better account for such confounding. In addition, the current analysis is at a population level. Although sub-analyses focused on sex and race were conducted, the estimates may obscure heterogeneity by income, education, and other factors. Sources containing data on individuals would provide additional opportunities to examine heterogeneous effects. The inability to focus on groups most likely to be affected by minimum wage increases could mean the current study underestimates the magnitude of the association between minimum wages and suicides for affected populations.

CONCLUSIONS

This study suggests that increasing the minimum wage could represent a strategy for addressing worsening trends in suicide rates. Despite the potential role of economic factors in contributing to suicide deaths, this is the first study the authors are aware of examining the effect of minimum wage changes on suicide rates. Additional studies of specific localities and making use of individual-level data may provide greater insight into the nature of the association between suicides and minimum wages.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2018.12.008>.

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