American Journal of Epidemiology

Vol. 188, No. 12
DOI: 10.1093/aje/kwz103
Advance Access publication: April 24, 2019

## Original Contribution

# Economic Insecurity and Deaths of Despair in US Counties

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*Initially submitted November 5, 2018; accepted for publication April 19, 2019.*

Recent research has implicated economic insecurity in increasing midlife death rates and "deaths of despair," including suicide, chronic liver disease, and drug and alcohol poisoning. In this ecological longitudinal study, we evaluated the association between changes in economic insecurity and increases in deaths of despair and midlife all-cause mortality in US counties during 2000–2015. We extended a previously developed measure of economic insecurity using indicators from the Census and Federal Reserve Bank in US counties for the years 2000 and 2010. Linear regression models were used to estimate the association of change in economic insecurity with change in death rates through 2015. Counties experiencing elevated economic insecurity in either 2000 or 2010 had higher rates of deaths of despair and all-cause midlife mortality at baseline but similar rates of increase in deaths of despair from 2001 to 2015 compared with counties with stable low economic insecurity. Counties in the highest tertile of economic insecurity in 2000 and 2010 had 41% (95% confidence interval: 1.36, 1.47) higher midlife mortality rates at baseline and a rate of increase of 2% more per 5-year period (95% confidence interval: 1.00, 1.03) than counties with stable low economic insecurity. Economic insecurity may represent a population-level driver of US death trends.

all-cause mortality; drug and alcohol poisoning; economic insecurity; liver disease; death; suicide; United States

Abbreviation: CI, confidence interval.

After decades of steady declines in death rates in the United States (1), recent research has shown a reversal in this trend. Case and Deaton reported an increase in death of 2% per year among middle-aged non-Hispanic white persons in the United States between 1999 and 2013 (2). This increase in deaths was partially attributable to increases in fatal drug and alcohol poisonings, suicide, and deaths resulting from chronic liver disease, referred to as "deaths of despair" (2), and was also observed in American Indian and Alaska Native populations (3). Increases in poisonings have been observed among blacks (4), and overall death rates may be rising in this group (5). Smaller metropolitan and rural areas appear to be hardest hit by these increases (4). Understanding the population-level drivers of these death outcomes is key to identifying targets for intervention and reversing these trends.

One potential explanation for these observations, advanced by Case and Deaton (2) and Stein et al. (4) but not yet formally tested, is that economic conditions, particularly financial insecurity and diminishing economic opportunity, may be contributing to these increases in deaths of despair. Economic insecurity is the likelihood of a downward trajectory of income, material resources, and socioeconomic status (6, 7). The increasing precariousness of employment, rising cost of living, stagnant wages, and decline of the manufacturing sector and of economic mobility compared with earlier generations have all been implicated in concerns about the economic security of middle-class Americans (8–10). Decades of shifts in the structure of the US economy may have led to an increase in economic insecurity. In particular, the concentration of deaths of despair in smaller metropolitan areas and rural areas may be related to changes in labor markets and local economic conditions, which are more marked outside of large metropolitan areas (11).

In descriptive analyses examining the results of the 2016 presidential election, Monnat (12) showed higher rates of drug-related, alcohol-related, and suicide deaths in counties with higher proportions of working class populations and

higher economic distress. Economic insecurity in these areas may lead to unhealthy coping mechanisms, such as increased alcohol consumption and drug use (13), particularly among middle-aged adults who should be in the peak of their career earnings and may feel the effects of insecurity more acutely. According to a recent analysis, the economic stressors of the Great Recession increased blood pressure and glucose levels of US adults, particularly among middle-aged adults and homeowners (14). High-risk drinking behaviors as well as illicit drug use have been increasing nationally and are associated with elevated death rates (15–17). Simultaneously, economic insecurity reduces the material resources and other intangibles such as social capital of communities to respond to perceived threats. Reduced community expenditures on social welfare programs, for example, may lead to reductions in social services, including drug and alcohol treatment programs (18, 19).

Given the concurrent trends in increasing economic insecurity and death rates, we hypothesized that economic insecurity may be associated with increased rates of death, including total midlife mortality and deaths of despair (i.e., suicide, chronic liver disease, and fatal drug and alcohol poisoning). Our primary objective was to evaluate the association between county economic insecurity and changes in county-level rates of death due to suicide, chronic liver disease, and drug and alcohol poisoning in the United States. Secondarily, we examined the association between economic insecurity and changes in rates of all-cause mortality in midlife (ages 45–54 years).

## METHODS

We developed a measure of economic insecurity in 2000 in the Middle-Atlantic region at the level of the US county (E. A. Knapp, unpublished data, 2018). In this article, we expand our measure of economic insecurity to include all US counties and extended it to the year 2010 so we could examine the association of change in economic insecurity across the decade 2000–2010 with subsequent changes in death rates due to suicide, chronic liver disease, and drug and alcohol poisoning.

### County economic insecurity

Briefly, in our earlier model of county economic insecurity (E. A. Knapp, unpublished data, 2018), we used confirmatory factor analysis to develop a model of economic insecurity in 2000 in the 320 counties in Pennsylvania, West Virginia, Ohio, Delaware, New York, Maryland, and New Jersey, using indicators selected from the 2000 Census and the Federal Reserve Bank. We chose to measure economic insecurity at the level of the county because counties are policy-relevant units of research and analysis. Counties are self-governing entities that administer education, law enforcement, and social and health services; maintain public roads and spaces; and enact zoning policies and economic development programs (20, 21). In addition, characterizing county-level economic insecurity and county-level health outcomes allows us to capture the net effects of economic insecurity on the entire community.

Our measure of economic insecurity includes the following county-level indicators, measured as percentages: those not in labor force, unemployed, income spent on rent, employed in service positions, and those with a subprime credit rating (FICO credit score <660) (Web Table 1, available at https://academic.oup.com/aje). We replicated this measurement model here using county-level data for the whole United States for the years 2000 and 2010. Replication was considered successful if fit statistics fell close to or within the accepted ranges, as follows: Comparative Fit Index of 0.95 or higher and standardized root mean square residual less than 0.08 (22). Factor scores were calculated as a standardized estimates of the magnitude of economic insecurity in each county. Additional detail is provided in Web Appendix 1.

### Data sources

Data for the measure of economic insecurity were in the 2000 Census, the Federal Reserve Bank/Equifax Consumer Credit Panel, and the American Community Survey (using pooled 5-year estimates centered around 2010) (23–25).

We obtained death data from the Centers for Disease Control and Prevention WONDER Compressed Mortality Files for 1999–2016 (26). First, consistent with the work done by Case and Deaton, we used age-adjusted (to the 2000 US population) death rates due to suicide (*International Classification of Diseases, Tenth Revision* codes X60-84 and Y87.0), chronic liver disease and cirrhosis (codes K70 and K73-4), and alcohol and drug poisonings (codes X40-45, Y10-15, Y45, Y47, and Y49) (2). To maximize the number of counties that would be included in our analyses, we pooled 3 5-year periods: 2001–2005, 2006–2010, and 2011–2015. For the deaths of despair outcome, we included deaths from all ages and races 1) to minimize missing data at the county level; 2) because deaths among Native Americans were also increasing during this time (3); 3) the absolute death rates of blacks are much higher than those of whites, and we did not want to exclude populations at high risk for premature death (27); and 4) deaths due to these causes are largely preventable, regardless of age at death (3). For the main analyses, deaths resulting from these 3 causes were combined, which allowed for sufficient sample size and minimized the potential for misclassification among these 3 possibly overlapping causes of death. Death rates were positively skewed, leading us to log-transform these outcomes.

Second, we analyzed all-cause mortality rates for persons aged 45–54 years, the age group Case and Deaton observed to have increasing death rates (2). Using all causes of deaths allowed us to evaluate the broader trends in premature death in this age group with data missing from fewer counties. We used the same 3 periods: 2001–2005, 2006–2010, and 2011–2015.

### Analysis

Counties were classified as metropolitan (and further divided into large central, large fringe, medium, or small) or nonmetropolitan (divided into micropolitan or noncore areas) according to the National Center for Health Statistics urban-rural classification scheme (28). Because outcomes were similar in large central and large fringe metropolitan

areas, we combined these categories into a single metropolitan category. Small and medium metropolitan areas were likewise combined into a single category ("small/medium metropolitan"), as were micropolitan and noncore areas ("nonmetropolitan").

Standardized factor scores of county economic insecurity were divided into tertiles of high, medium, and low insecurity in each period to enhance interpretability and explore nonlinear associations. Using these tertiles, we created categories of change in economic insecurity. "Stable high" counties were in the highest tertile in both 2000 and 2010, "stable medium" were in the middle category in both periods, and "stable low" counties were in the lowest tertile in both periods. Counties were included in the increasing category if they moved into a higher category in 2010 (e.g., low to medium or medium to high), and decreasing if they moved into a lower category in 2010.

To evaluate the association of category of change in county economic insecurity between 2000 and 2010 with change in county-level death rates between 2001 and 2005 and 2011 and 2015, we used the following log-linear mixed effects regression models with robust standard errors:

$$\begin{aligned}\ln(\text{mortality}_{ijk}) = {} & \Upsilon_{000} + \beta_1(\text{economicinsecurity}_{ijk}) \\ & + \beta_2(\text{time}_{ijk}) + \beta_3(\text{economicinsecurity}_{ijk} \times \text{time}_{ijk}) \\ & + \beta_4(\text{male}_{ijk}) + \beta_5(\text{age}_{ijk}) + \beta_6(\text{urban}_{jk}) + \beta_7(\text{rural}_{jk}) \\ & + \beta_8(\text{Black}_{ijk}) + \beta_9(\text{Hispanic}_{ijk}) + \lambda_{00k} + \mu_{0jk} + \varepsilon_{ijk}\end{aligned}$$

where $i$ represents the period (2001–2005, 2006–2010, or 2011–2015), $j$ indicates the county, and $k$ indicates state; death is the log-transformed death rate in each period; and economic insecurity is categorized into 5 categories of change from 2000 to 2010, as described previously in Methods. We included a random intercept for state and county, and a random slope for period. We adjusted for the time-varying covariates percentage of black and Hispanic residents. Urban or rural classification was included as a time-fixed covariate. In models estimating all-cause mortality in midlife, we additionally adjusted for percentage of the county population aged 45–49 and 50–54 years and percentage of the county population that was male, to account for differential distribution of age within the age group 45–54 years and patterns of death by sex (29). Models estimating deaths of despair (among all ages) were adjusted for median age and percentage of the population that was male. We present exponentiated coefficients from these models, which represent the percent change in death rate. Mixed-effects models were preferable in this analysis because this flexible modelling approach allowed us to model differences at baseline and in rate of change over time, account for correlations between counties over time and within the same state, and, unlike a fixed effects approach, estimate parameters that were fixed within counties.

Two secondary analyses were planned a priori. First, we limited our deaths of despair outcome to non-Hispanic white persons aged 45–54 years—the population previously observed to be driving increases in death in the United States (2). Second, we estimated the association between deaths of despair among all races in the subset of counties where non-Hispanic white death rates were not missing. We also present models with economic insecurity as a continuous exposure. Secondary analyses are presented in Web Appendix 2. Analyses were conducted in STATA, version 15.0 SE (StataCorp LP, College Station, Texas).

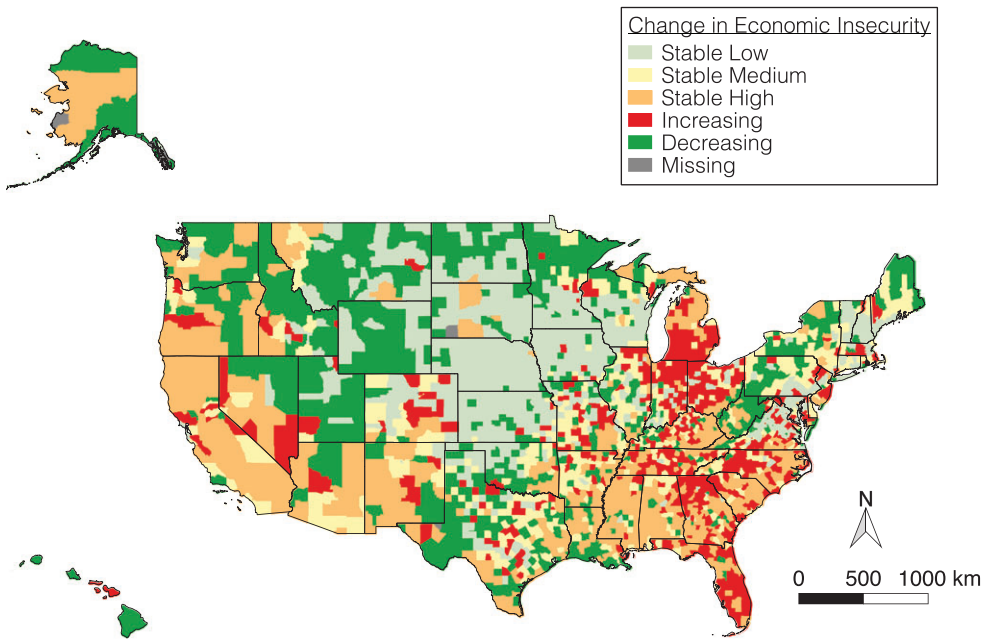


**Figure 1.** Categories of change in economic insecurity between 2000 and 2010 in US counties. Alaska and Hawaii are not drawn to size.

## RESULTS

### County economic insecurity

Replication of the county economic insecurity measurement model produced scales of county economic insecurity in both 2000 and 2010 with acceptable fit (see details in Web Table 2). Correlation between economic insecurity in 2000 and 2010 was $r = 0.69$. The mean change in county economic insecurity from 2000 to 2010 was 0.00 (standard deviation, 0.74), with a range of −3.57 to 2.467. Of 3,147 counties, 671 (21%) were in the highest tertile of insecurity in both years (stable high), 485 (15%) were stable medium, 736 (23%) were stable low, 634 (20%) increased categories of economic insecurity, and 621 (20%) decreased. Figure 1 maps these categories for each US county. Clusters of increasing economic insecurity are seen in the south and midwest. The south and California also had large clusters of counties with stable high insecurity in both 2000 and 2010.

Table 1 presents characteristics of US counties by tertile of economic insecurity in 2000. Compared with counties with medium or low economic insecurity, counties with high economic insecurity in 2000 were more likely to have higher proportions of Hispanic and black residents, less likely to be large metropolitan or suburban areas, and much more likely to be nonmetropolitan (i.e., rural) counties. All-cause mortality among all persons, all-cause mortality among those 45–54 years old, and deaths of despair were higher at each increasing level of economic insecurity.

### Deaths of despair

Figure 2 shows unadjusted trends in deaths of despair and the breakdown of each specific component cause of death by category of change in economic insecurity, for all ages. Although rates of change in suicide were similar across categories of economic insecurity, increases in deaths due to drug and alcohol poisoning and chronic liver disease were higher in categories with elevated economic insecurity in either or both periods.

Results of regression models testing the association in category of change in economic insecurity between 2000 and 2010 and change in death due to diseases of despair between

**Table 1.** Characteristics of US Counties by Tertile of Economic Insecurity in 2000

| County Characteristic | All Counties ($n$ = 3,147) | | Low Insecurity ($n$ = 1,050) | | Medium Insecurity ($n$ = 1,048) | | High Insecurity ($n$ = 1,049) | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | Median (SD) | % | Median (SD) | % | Median (SD) | % | Median (SD) |
| *County Economic Insecurity Change, 2000–2010* | | | | | | | | |
| Remained in same tertile | | 60.1 | | 70.1 | | 46.3 | | 64.0 | |
| Increased economic insecurity | | 20.1 | | 29.9 | | 30.5 | | N/A | |
| Decreased economic insecurity | | 19.7 | | N/A | | 23.2 | | 36.0 | |
| *Demographic Characteristics, 2000* | | | | | | | | |
| Percent Hispanic | | | 6.2 (12.0) | | 4.3 (6.5) | | 6.0 (10.0) | | 8.3 (16.8) |
| Percent black | | | 8.7 (14.4) | | 3.0 (5.7) | | 7.3 (10.4) | | 15.8 (20.1) |
| Population | | | 24,663 (292,717) | | 21,460 (182,961) | | 30,663 (264,500) | | 23,388 (392,776) |
| Population density per square mile | | | 243 (1,668) | | 211 (759) | | 189 (500) | | 330 (275) |
| Large metropolitan and suburban counties | | 13.3 | | 21.1 | | 12.9 | | 5.7 | |
| Medium and small metropolitan counties | | 21.4 | | 20.9 | | 25.5 | | 17.8 | |
| Nonmetropolitan/rural counties | | 65.4 | | 58.0 | | 61.6 | | 76.5 | |
| *Death Outcomes, 2001–2005, Age Adjusted per 100,000*[a] | | | | | | | | |
| All-cause mortality, all ages | 3,138 | | 889.2 (230.1) | | 799.9 (109.5) | | 894.3 (111.4) | | 973.7 (346.2) |
| All-cause mortality, ages 45–54 years | 2,906 | | 466.6 (147.8) | | 352.8 (64.8) | | 418.0 (65.7) | | 476.1 (123.6) |
| Deaths of despair, all ages | 2,636 | | 30.3 (11.8) | | 24.8 (7.7) | | 30.5 (14.7) | | 34.7 (14.7) |
| Drug and alcohol poisoning | 1,328 | | 9.4 (5.6) | | 6.8 (3.3) | | 9.5 (4.8) | | 11.5 (7.0) |
| Liver disease | 1,787 | | 10.3 (5.6) | | 7.9 (2.4) | | 9.9 (3.6) | | 12.6 (7.7) |
| Suicide | 2,128 | | 14.1 (5.8) | | 12.5 (4.3) | | 14.2 (4.7) | | 15.4 (7.5) |

Abbreviations: N/A, not applicable; SD, standard deviation.

[a] Because of privacy concerns, the Centers for Disease Control and Prevention suppresses death counts when there are fewer than 10 deaths per county. Therefore, the number of counties varies by period and death outcome.

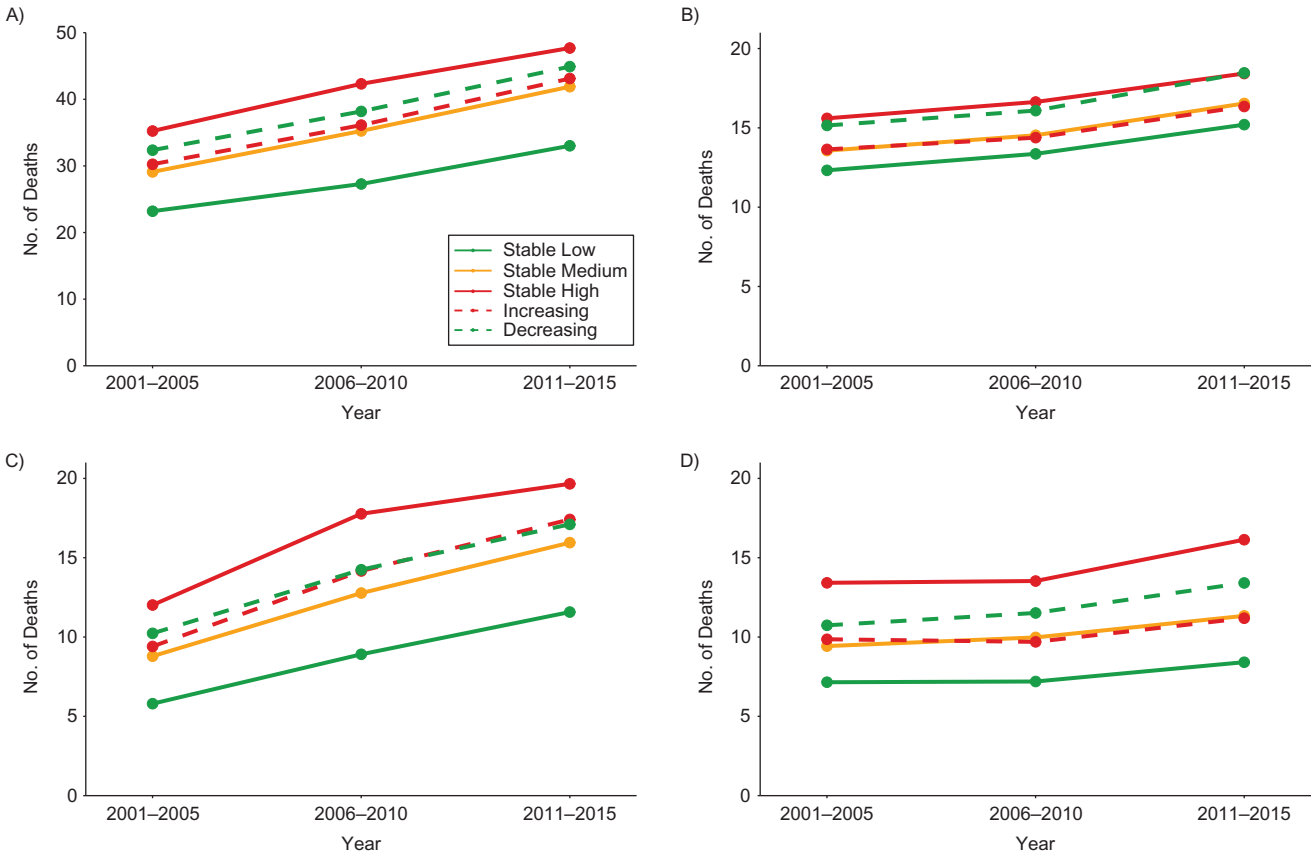


**Figure 2.** Age-adjusted death rates per 100,000 in 2001–2005, 2006–2010, and 2011–15 are shown by category of change in economic insecurity for A) all deaths of despair and each individual component cause of death: B) suicide, C) drug and alcohol poisoning, and D) chronic liver disease.

2001 and 2005 to 2011 and 2015 are shown in Table 2. Controlling for place type (i.e., urban or rural), age and sex distribution, and racial composition (model 4), counties with elevated economic insecurity in either 2000 or 2010 (i.e., increasing, decreasing, stable medium, and stable high categories) had more deaths of despair in 2001–2005 than counties with stable low economic insecurity. Death rates were highest in 2001–2005 among counties with stable high economic insecurity (60% higher death rate than stable low counties; 95% confidence interval (CI): 1.47, 1.74). The rate of change in deaths of despair per 5 years was very similar across all categories of change in economic insecurity. Counties with stable medium economic insecurity had a 1% higher rate of increase in death than counties with stable low economic insecurity (95% CI: 1.00, 1.03). When accounting for economic insecurity, racial and sex composition, and median age, rural counties did not have statistically significantly higher rates of deaths of despair than medium or small metropolitan areas.

The baseline all-cause mortality among persons 45–54 years old was higher in all categories representing elevated economic insecurity than in counties with stable low economic insecurity (Table 3). These counties also had higher rates of increase in death than counties with stable low economic insecurity. Counties with stable high economic insecurity had an increase of 2% (95% CI: 1.00, 1.03) more than counties with stable low economic insecurity over each 5-year period. Rural counties had 5% (95% CI: 1.03, 1.06) higher death rates and large metropolitan counties had 5% lower (95% CI: 0.93, 0.97) death rates than did medium metropolitan areas, after adjustment for economic insecurity.

## Secondary analyses

In secondary analyses, we assessed the robustness of our findings to our analytical assumptions. Web Table 3 shows the association between change in economic insecurity and change in death rates due to deaths of despair among middle-aged, non-Hispanic white persons only. Similar patterns as the main analysis in Table 2 were observed. Data on deaths in this age and race category were missing for 26% of counties and could not be included in this model. Among this subset of counties with nonmissing data on rates of deaths of despair, we ran the models listed in Table 2 (deaths of despair among all races) to check if patterns were similar (Web Table 4). Again, coefficients are similar.

Web Table 5 presents results from models in which economic insecurity was included as a continuous variable. For

**Table 2.** Association Between Categories of Change in County Economic Insecurity From 2000 to 2010 and Change in Deaths of Despair Between 2001 and 2015 in 2,856 US Counties

| Variable | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| | RR[a] | 95% CI | RR[a] | 95% CI | RR[a] | 95% CI | RR[a] | 95% CI |
| Relative rate of deaths of despair in baseline period (2001–2005) | | | | | | | | |
| Stable low | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent |
| Stable medium | 1.24 | 1.18, 1.31 | 1.23 | 1.17, 1.30 | 1.27 | 1.21, 1.34 | 1.27 | 1.21, 1.34 |
| Stable high | 1.43 | 1.30, 1.57 | 1.42 | 1.30, 1.56 | 1.60 | 1.47, 1.74 | 1.60 | 1.47, 1.74 |
| Increasing | 1.29 | 1.20, 1.39 | 1.29 | 1.20, 1.38 | 1.31 | 1.23, 1.40 | 1.31 | 1.23, 1.40 |
| Decreasing | 1.29 | 1.24, 1.35 | 1.29 | 1.23, 1.35 | 1.34 | 1.27, 1.41 | 1.34 | 1.27, 1.41 |
| Relative rate of change in deaths of despair per 5-year period | | | | | | | | |
| Stable low | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent |
| Stable medium | 1.02 | 1.00, 1.04 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 |
| Stable high | 0.97 | 0.95, 1.00 | 0.97 | 0.95, 1.00 | 0.97 | 0.95, 1.00 | 0.97 | 0.95, 1.00 |
| Increasing | 1.01 | 0.98, 1.04 | 1.01 | 0.97, 1.04 | 1.01 | 0.98, 1.04 | 1.01 | 0.98, 1.04 |
| Decreasing | 1.00 | 0.98, 1.01 | 1.00 | 0.98, 1.01 | 0.99 | 0.98, 1.01 | 0.99 | 0.98, 1.01 |
| Place type | | | | | | | | |
| Large metropolitan | | | 0.97 | 0.93, 1.01 | | | 1.00 | 0.97, 1.03 |
| Medium/small metropolitan | | | 1.00 | Referent | | | 1.00 | Referent |
| Rural | | | 1.00 | 0.97, 1.02 | | | 0.99 | 0.97, 1.02 |
| Racial composition | | | | | | | | |
| Black, % | | | | | 0.99 | 0.99, 0.99 | 0.99 | 0.99, 0.99 |
| Hispanic, % | | | | | 1.00 | 0.99, 1.00 | 1.00 | 0.99, 1.00 |

Abbreviations: CI, confidence interval; RR, relative risk.

[a]Estimates in this table are from mixed-effects linear regression models with random effects for state, county, and period (2001–2005, 2006–2010, and 2011–2015). In addition to the variables listed in the table, all models were also adjusted for the percentage of the county population that was male in each period and the median age. The outcome, deaths of despair (i.e., death due to suicide, chronic liver disease, and drug and alcohol poisoning) was log-transformed. Coefficients in this table are exponentiated and represent the relative rate of deaths of despair compared with the reference group.

each standard deviation increase in economic insecurity, death in 2001–2005 was 19% higher (95% CI: 1.17, 1.21). Among counties with average economic insecurity in 2000, each standard deviation increase in economic insecurity between 2000 and 2010 was associated with a 7% increase in the rate of change of deaths of despair (95% CI: 1.05, 1.09). These models also show statistically significant higher rates of death in rural counties.

## DISCUSSION

To our knowledge, this is one of the first analyses in which the hypothesis that county-level economic insecurity is associated with increased rates of deaths of despair or total midlife death was empirically tested. We found that county-level rates of death due to suicide, chronic liver disease, and drug and alcohol poisoning were higher among counties with stable medium, increasing, or decreasing economic insecurity in 2001–2005, but rates of increase in deaths of despair between 2001 and 2015 were similar among all counties. Among persons 45–54 years old, both the baseline levels and the increase in all-cause mortality were higher among counties with stable medium and high, increasing, and decreasing economic insecurity.

We found that county-level rates of death due to suicide, chronic liver disease, and drug and alcohol poisoning were higher in 2011–2015 than in 2001–2005. This finding is consistent with previous work (2–4), but we extended analyses to the level of the US county and directly explored associations with a direct measure of economic insecurity. Using our measure of county economic insecurity, we show that 20% of counties experienced an increase in economic insecurity between 2000 and 2010, with clusters of increasing economic insecurity primarily observed in the midwest and south. Prevalent socioeconomic exposures such as economic insecurity have the potential to make a large difference in health outcomes, even if the effect on individuals is small (30). Similar to findings of other work suggesting that increases in death in this time were concentrated in nonurban areas (4, 12), rural setting was a statistically significant predictor of all-cause mortality. In the sensitivity analyses restricted to non-Hispanic white persons aged 45–54 years, we demonstrated that associations between death and change in economic insecurity were similar among middle-aged, non-Hispanic whites compared with the total US population.

**Table 3.** Association Between Change in County Economic Insecurity From 2000 to 2010 and Change in All-Cause Mortality Among Persons Aged 45–54 Years Old Between 2001 and 2015, in 3,009 US Counties

| Variable | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| | RR[a] | 95% CI | RR[a] | 95% CI | RR[a] | 95% CI | RR[a] | 95% CI |
| Relative rate of deaths of despair in baseline period (2001–2005) | | | | | | | | |
| Stable low | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent |
| Stable medium | 1.25 | 1.21, 1.28 | 1.24 | 1.21, 1.27 | 1.24 | 1.21, 1.27 | 1.23 | 1.20, 1.26 |
| Stable high | 1.48 | 1.42, 1.54 | 1.45 | 1.39, 1.51 | 1.45 | 1.40, 1.51 | 1.41 | 1.36, 1.47 |
| Increasing | 1.23 | 1.19, 1.27 | 1.23 | 1.19, 1.26 | 1.23 | 1.20, 1.28 | 1.23 | 1.19, 1.27 |
| Decreasing | 1.24 | 1.20, 1.28 | 1.23 | 1.19, 1.26 | 1.24 | 1.20, 1.28 | 1.22 | 1.19, 1.25 |
| Relative rate of change in deaths of despair per 5-year period | | | | | | | | |
| Stable low | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent | 1.00 | Referent |
| Stable medium | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.04 |
| Stable high | 1.02 | 1.00, 1.04 | 1.02 | 1.00, 1.04 | 1.02 | 1.00, 1.04 | 1.02 | 1.00, 1.03 |
| Increasing | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 |
| Decreasing | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 | 1.01 | 1.00, 1.03 |
| Place type | | | | | | | | |
| Large metropolitan | | | 0.98 | 0.94, 0.98 | | | 0.95 | 0.93, 0.97 |
| Medium/small metropolitan | | | 1.00 | Referent | | | 1.00 | Referent |
| Rural | | | 1.05 | 1.03, 1.06 | | | 1.05 | 1.03, 1.06 |
| Racial composition | | | | | | | | |
| Black, % | | | | | 1.00 | 1.00, 1.00 | 1.00 | 1.00, 1.00 |
| Hispanic, % | | | | | 1.00 | 1.00, 1.00 | 1.00 | 1.00, 1.00 |

Abbreviations: CI, confidence interval; RR, relative risk.

[a] Estimates in this table are from mixed-effects linear regression models with random effects for state, county, and period (2001–2005, 2006–2010, and 2011–2015). In addition to the variables listed in the table, all models were also adjusted for the percentage of the county population that was male in each time period and the percentages of the county population in the age groups 45–49 and 50–54 years in each period. The outcome, all-cause mortality among persons 45–54 years old, was log-transformed. Coefficients in this table are exponentiated and represent the relative change in all-cause mortality compared with the reference group.

Counties are the primary division of US states and provide social and health services, economic development programs, maintenance of public spaces and roads, and zoning planning (20, 21). These administrative and governance functions give counties the potential to create and moderate levels of economic insecurity, making the county a policy-relevant unit for research and intervention. There are plausible mechanisms by which county economic insecurity may increase death rates. Counties facing reduced tax revenue may have to then reduce social services such as unemployment benefits, welfare spending, and drug and alcohol treatment programs. Before the 2014 rollout of the Affordable Care Act, large businesses leaving a county or shifting many of their workers to part-time status would have left more people without health insurance, increasing insecurity through increased medical costs to individuals and county hospitals (through increases in uncompensated care), and potentially reducing access to health care (31, 32). Alternatively, economic insecurity may alter the composition of counties, with more skilled workers leaving the county in search of employment opportunities.

This study has some limitations. First, we were limited by the suppressed death counts in smaller (primarily rural) counties. Approximately 10% of counties had missing data on our primary outcome, deaths of despair, even after pooling across 5-year periods and causes of death. However, given the importance of economic insecurity and deaths of despair in rural areas and smaller cities (4), methods that allow for a more detailed exploration of this phenomenon in rural areas should be considered in future analyses. If data are available, such methods would include disaggregating causes of death, which may provide more clarity on our finding that counties with decreasing economic insecurity have very similar outcomes to those with increasing insecurity. This finding may be due to different lag times in specific causes of death, such that heightened economic insecurity has both short- and longer-term effects. Second, our measure of economic insecurity summarizes county economic insecurity, which may mask intercounty variation, and is lacking indicators from important domains such as debt and foreclosure, due to lack of systematic data availability. As with any latent variable model, validation of our measure of economic insecurity is challenging and there is the potential for measurement error. Third, we cannot rule out that some of these changes seen may be due to changes in the coding of causes of death. It has been shown in previous research that cause-

of-death coding is imperfect and may actually have differential measurement error by social factors such as race (33). This may be especially relevant for the attribution of alcohol-related liver disease (34, 35). However, our analysis of all-cause mortality in the age group 45–54 years showed similar patterns to the analysis of deaths of despair. Last, there may be unmeasured sources of confounding or reverse causation, due to the overlap between our exposure and part of our outcome period.

This study also has several strengths. First, we developed a theory-based measurement of economic insecurity that captures several dimensions of economic insecurity at the county-level. Focus on the county level aligns our level of inference with a level of intervention relevant and feasible for policy change. Second, this is the first application, to our knowledge, of a measure of economic security to county-level death outcomes. Ecologic studies such as these more closely match the level of study to the level at which we wish to intervene. For example, if county economic insecurity is established as a driver of death, individual-level interventions are unlikely to be successful unless they address the economic context in which people work and live. Last, we used vital statistics data from all US counties during a span of 15 years.

## CONCLUSION

Trends in economic insecurity are co-occurring with increases in rates of deaths of despair among all ages and all-cause mortality among middle-aged adults in US counties, providing evidence for the health effects of economic conditions and their sequelae. Our work points to the importance of economic conditions in shaping death trends, especially in nonmetropolitan areas. Future work should continue to validate this and other measures of economic insecurity and explore the mechanisms by which such factors influence death.

## ACKNOWLEDGMENTS

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E.A.K. was supported by the Clinical Research and Epidemiology in Diabetes and Endocrinology training grant (T32DK062707). L.T.D. was supported by the National Institute of Mental Health (grant R25MH083620), the National Cancer Institute (grant K01CA184288), the Sidney Kimmel Cancer Center (grant P30CA006973), and the Johns Hopkins University Center for AIDS Research (grant P30AI094189). M.L. was supported by grants from National Institutes of Health during the conduct of the study; a grant from National Kidney Foundation, outside the submitted work; and funding from the National Institutes of Health (grant 5U10AA025286) to Johns Hopkins University. U.B. was partially supported by the Office of the Director of the National Institutes of Health (grant DP5OD26429) and by a Johns Hopkins Center for a Livable Future-Lerner Fellowship. D.D.C. was supported by the National Institutes of Health (grants 1U01DA036297, P30AI094189, R01DA012568, R01DA0430898, 1U24OD023382, R012DA041034, and 1U01DA040325) and a contract with Deloitte from the Ministry of Public Health, State of Qatar.

Conflict of interest: none declared.

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