

The Home Foreclosure Crisis and Rising Suicide Rates, 2005 to 2010

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In 2009, the number of suicides in the United States surpassed motor vehicle deaths for the first time in modern history.^{1,2} Between 2005 and 2010, the suicide rate increased nearly 13%, from 11.0 to 12.4 per 100 000 people.^{1,3,4} The recent rise in suicides has been especially pronounced among adults aged 35 to 64 years.² Suicide rates among the middle-aged increased nearly 30%, from 13.7 in 1999 to 17.6 in 2010.² Middle-aged suicide recently has become more prevalent than suicide among the elderly, who have historically had higher suicide rates than all other age groups.² The rise in suicide, especially among the middle-aged, has become a puzzling and troubling public health concern.

The recent increase in suicides has coincided with the deepest economic recession since the Great Depression, raising questions about whether aspects of the recession may be partially responsible for rising suicide rates (Figure 1). Although considerable research has examined economic cycles and suicide,⁵⁻⁹ little research has considered the consequences of widespread home foreclosures. In this study, we offered a systematic examination of the association between state-level foreclosures and suicide rates during the Great Recession.

Unlike other economic downturns, the Great Recession was distinct in that it was the most severe housing market recession in US history. In 2007, following decades of increasingly risky borrowing practices, defaults in the subprime mortgage market resulted in the worst housing market collapse in the United States since the Great Depression. The housing market crash led to a historically unprecedented rise in home foreclosures—from 650 000 in 2007 to a record 2.9 million homes in 2010, when more than 2% of all US homes received a foreclosure notice.¹⁰ During this time, US households lost a great deal of their wealth, as housing values and home equity declined sharply.¹¹ The recent recession thus provides a unique opportunity to examine the role of an

Objectives. We examined the association between state-level foreclosure and suicide rates from 2005 to 2010 and considered variation in the effect of foreclosure on suicide by age.

Methods. We used hybrid random- and fixed-effects models to examine the relation between state foreclosure rates and total and age-specific suicide rates from 2005 to 2010 (n = 306 state-years).

Results. Net of other factors, an increase in the within-state total foreclosure rate was associated with a within-state increase in the crude suicide rates (b = 0.04; $P < .1$), and effects were stronger for the real-estate-owned foreclosure rate (b = 0.16; $P < .05$). Analysis of age-specific suicide rates indicated that the effects were strongest among the middle-aged (46–64 years: total foreclosure rate, b = 0.21; $P < .001$; real-estate-owned foreclosure rate, b = 0.83; $P < .001$). Rising home foreclosure rates explained 18% of the variance in the middle-aged suicide rate between 2005 and 2010.

Conclusions. The foreclosure crisis has likely contributed to increased suicides, independent of other economic factors associated with the recession. Rising foreclosure rates may be partially responsible for the recent uptick in suicide among middle-aged adults. (*Am J Public Health*. Published online ahead of print April 17, 2014: e1–e7. doi:10.2105/AJPH.2013.301774)

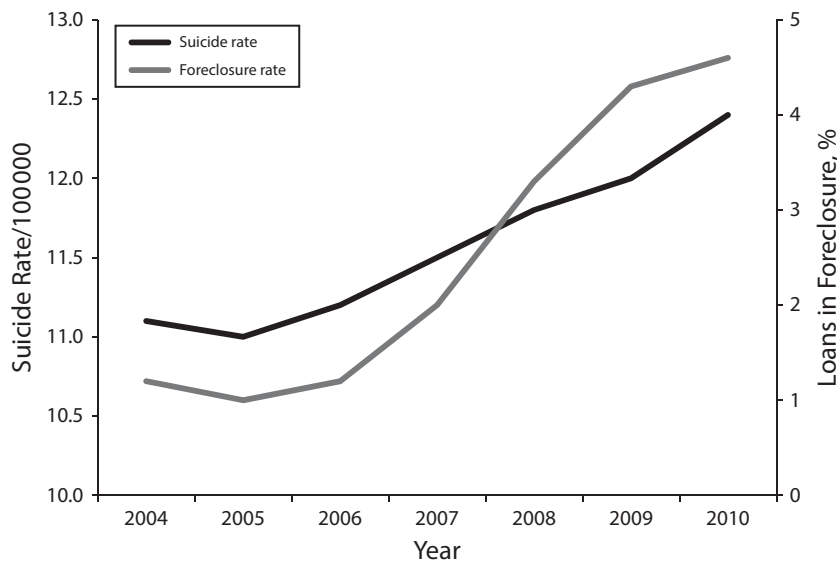
understudied aspect of economic strain on suicidal behavior—home foreclosures.

The rise in home foreclosures had a profound effect on individuals, families, and communities in the United States.¹² At the individual level, experiencing a home foreclosure is a stressful life event that invokes feelings of shame, loss, and regret¹³ and is associated with anxiety, depression,¹³⁻¹⁹ and physical health problems.¹⁷⁻¹⁹ The effect of the housing crisis extends well beyond those who experienced a foreclosure. At the community level, a rise in local area foreclosures is associated with declines in community resources such as home values,^{20,21} tax revenue,²² community investment,²³ social capital,²⁴ and residential stability.²⁵ Foreclosure rates are also associated with a rise in community stressors, such as abandoned properties,²² crime,^{26,27} and feelings of insecurity and mistrust.²⁸ It is therefore unsurprising that living in high-foreclosure areas is associated with adverse health, such as depression,²⁹ weight gain,³⁰ and hospital visits.³¹

Despite a growing literature on foreclosure and health, no research to our knowledge has

considered how the housing crisis is associated with rising suicide rates. Foundational work dating back to Durkheim's *Suicide*³² points to an association between macroeconomic busts and suicide. Durkheim suggested that suicides increase during economic crises as a result of weakening societal integration and lost status, meaning, and purpose in peoples' lives. Modern research confirms that suicide rates tend to increase during recessionary periods, as measured by local, state, or national unemployment rates,⁵⁻⁸ and suicide rates accelerated during the Great Recession.³ However, this research focused primarily on the aggregate unemployment rate and did not consider that the foreclosure crisis may be a unique, and potentially suicidogenic, feature of the recent recession. Rising foreclosures may be particularly salient for suicide not only because the loss of a home is a signal of status loss, shame, and stress at the individual level but also because rising foreclosure rates may undermine social support and other vital community resources at the aggregate level.

Yet the foreclosure crisis likely had varying effects depending on one's stage in the life



Source. Centers for Disease Control and Prevention and 2012 US Census Bureau Statistical Abstract on Banking, Finance, and Insurance.

FIGURE 1—Changes in suicide and foreclosure rates: all 50 US states plus Washington, DC, 2004–2010.

course. For middle-aged populations who are preparing for retirement, a home foreclosure or lost equity may be devastating to their economic and psychological well-being more than for other age groups because they are at the height of their social status and have the most to lose from a foreclosure and lost equity with little time to recover losses. This is consistent with life-course research suggesting that “off-time” events adversely affect overall health and mental well-being because they interfere with achievement and hinder age-appropriate status attainment.³³

We used state-level data and determined whether rising home foreclosures—which were a defining feature of the Great Recession—were associated with increased suicides. By focusing on the state level, we replicated and extended prior research on recessions and suicides, which often focus on unemployment as the key economic indicator.^{3,5,6} Building on this research, we examined how state variation in foreclosures over time was associated with total and age-specific suicide rates adjusted for state-level social and economic conditions.

This study had several strengths that enabled us to examine the link between foreclosures and suicide. First, we used unique proprietary foreclosure data to longitudinally track most home

foreclosures in the United States from 2005 to 2010.¹⁰ We considered the overall foreclosure rate and the rate at which foreclosed homes were repossessed by the lenders (real-estate-owned foreclosure rates), the latter of which was indicative of severe crisis. Second, we used innovative mixed-effects or hybrid models to differentiate the within-state and between-state effects of foreclosures on suicide.³⁴ The fixed-effects portion of these models estimated the effect of within-state changes in the foreclosure rate on within-state changes in the suicide rate net of observed and unobserved stable state characteristics, whereas the random-effects portion of the model estimated the effect of between-state differences in foreclosures on between-state differences in suicide rates over the study period. Finally, in addition to considering the overall suicide rate, we examined age-specific suicide rates to determine whether the association between foreclosures and suicide varied by age.

METHODS

Data for this study came from 3 primary sources. We extracted state-level suicide data from the Centers for Disease Control and Prevention (CDC) WONDER compressed mortality

database.³⁵ Foreclosure data were from RealtyTrac. RealtyTrac collects foreclosure data from public records in more than 2200 counties and covers more than 90% of US households.¹⁰ Additional state-level data, including sociodemographic confounders and the number of home mortgages, were from the American Community Survey (ACS). The ACS is an annual nationally representative survey of approximately 3 million US households, conducted by the US Census Bureau to create estimates of social and economic characteristics of the US population. Response to the ACS is required by law, thus ensuring very high response rates (approximately 98%).³⁶ These 3 data sources were merged by using state-by-year Federal Information Processing Standards codes. Study coverage includes all 50 US states plus Washington, DC, from 2005 to 2010, yielding 306 state-years.

Suicide Rates

We constructed several measures of the suicide rate. In most analyses, we used the crude age-unadjusted suicide rate, calculated as the number of suicides in the state per 100 000 residents. Models that used the age-adjusted suicide rate yielded substantively identical results to those reported in the text. We examined age-specific effects with 4 different age-specific suicide rates: 18 to 29 years, 30 to 45 years, 46 to 64 years, and 65 years and older.

Foreclosure Rates

We constructed 2 measures of the foreclosure rate. The first included all foreclosed properties divided by the number of mortgages in the state for each year. The number of mortgages in a state was obtained from ACS data and more accurately reflects the households that are at risk for foreclosure than a simple measure of the number of households or number of residents in the state. This overall foreclosure rate captures the percentage of homes with mortgages in the state that are in any stage of the foreclosure process (e.g., the owner has received a legal notice of foreclosure, the property is up for public auction or sale, or the lender has repossessed the home). The second measure was the number of real-estate-owned foreclosures divided by the number of mortgages. This real-estate-owned

foreclosure rate captures the percentage of homes with mortgages in the state that have been repossessed by the lender. The real-estate-owned rate reflects a particularly severe measure of the foreclosure rate, because most owners are forced to leave their homes if they reach this stage of the foreclosure process, and many real-estate-owned homes during the foreclosure crisis were at risk for abandonment.³⁷

State-Level Covariates and Confounders

We also included an array of state-level sociodemographic characteristics that may confound any association between foreclosure and suicide. Particularly important are other economic features of the recession. We used principal components analysis and included a structural disadvantage measure to capture the combined influence of (1) the unemployment rate, (2) the percentage of households in poverty, (3) the percentage of female-headed households with young children, and (4) the percentage minority (eigenvalues showed that all variables load best on only 1 factor, and all factor loadings were greater than 0.65; see Sternthal et al.³⁸ and Xue et al.³⁹ for similar applications of this measure in health research). Prior mortality research suggested that measures of structural disadvantage can meaningfully be indexed with principal components methods at multiple levels of analysis, including cities, metropolitan areas, and states.⁴⁰ On the basis of previous research^{8,41} we also adjusted for several known risk and protective factors for suicide, including the percentage of the adult population that was divorced, median age, population density, and percentage of the population that was foreign-born. Summary statistics for all measures are shown in Table 1.

Analytical Strategy

We used 2 regression-based modeling strategies to assess the association between state-level foreclosure and suicide rates. We first specified random-effects models to account for state-specific unobserved heterogeneity by including a unique random effect for each state. However, this approach assumes that the random term—which captures unmeasured causes of state suicide rates—is uncorrelated with the measured causes of suicide. We addressed this assumption by then separating the foreclosure measure into 2 parts—a mean

for each state across the study period (the between-state effect) and a deviation score to capture the within-state variation. The difference from the state-specific mean is uncorrelated with the time-constant state-specific part of the error term, and therefore the coefficient yields a consistent estimate of the true within-state relation between foreclosures and suicide. Thus, the model incorporates aspects of both fixed- and random-effects approaches by retaining the ability to remove unmeasured time-invariant confounders while allowing for variation across states (results were similar when separating all measures into their time-constant and time-varying effects).³⁴ The chief strength of this approach was our ability to treat each state as its own control when estimating the foreclosure–suicide association. We refer to this procedure as a reduced-form hybrid-effects model.

RESULTS

We have reported the association between the total foreclosure rate and overall and age-specific suicide rates.

Home Foreclosures and the Total Suicide Rate

Table 2 shows the association between the overall suicide rate and the total foreclosure rate. Model 1 shows the bivariate relation in a random-effects model, model 2 separates the foreclosure rate into its time-constant (between-state) and time-varying (within-state) components, and model 3 shows results adjusted for state sociodemographic characteristics. Consistent with expectations, model 1 showed a significant positive association between foreclosure and suicide ($b = 0.10$; $P < .001$). Model 2 showed that when we separated the relation into its time-constant and time-varying components, the within-state effect remained positive and significant ($b = 0.10$; $P < .001$). Interpreted substantively, this suggests that the within-state suicide rate increased by 0.10 for every 1% increase in the foreclosure rate from 2005 to 2010. However, model 3 suggested that a large proportion of the foreclosure effect is explained by state-level sociodemographic characteristics, particularly structural disadvantage. (Supplemental models show that disadvantage explains a greater

TABLE 1—Summary Statistics for State-Level Measures: United States, 2005–2010

	Mean \pm SD or Median (SD)
Dependent variable	
Total suicide rate (per 100 000)	13.1 \pm 3.6
Focal measures	
Total foreclosure rate	3.5 \pm 4.9
Real-estate-owned foreclosure rate	0.9 \pm 1.2
Structural measures	
Structural disadvantage	0.0 \pm 1.0
Poverty	13.3 \pm 3.2
Unemployment	7.1 \pm 2.3
Female-headed households	8.3 \pm 1.5
% minority	27.9 \pm 16.0
% divorced	11.0 \pm 1.4
Age, y	37.1 (2.2)
% foreign-born	8.5 \pm 6.0
Population density	377 \pm 1336

Note. The sample size was $n = 306$ state-years. *Source.* Suicide information was from the Centers for Disease Control and Prevention (CDC). Foreclosure data were provided by RealtyTrac. All other measures were obtained from the American Community Survey, 2005–2010.

amount of variance than do other sociodemographic variables.) However, net of state characteristics, the within-state foreclosure effect remained positive, although it did not reach standard cutoffs for statistical significance.

Table 2 also shows the association between the real-estate-owned foreclosure rate and the overall suicide rate. Although the pattern of results is similar, the effects of real-estate-owned foreclosures were considerably larger than those of the total foreclosure rate. For example, model 5 (analogous to model 2) showed that a 1% increase in the within-state real-estate-owned rate was associated with a 0.40 increase in the within-state suicide rate, compared with an effect of only 0.10 for the total foreclosure rate (effects are significantly different at $P < .001$ based on z tests). Consistent with results described earlier, model 6 suggested that state-level sociodemographics explain a considerable portion of the real-estate-owned foreclosure effect. Still, net of these variables, the within-state effect remained positive and significant, suggesting that the

TABLE 2—Hybrid Fixed- and Random-Effects Models Testing Association Between Foreclosure and Suicide at the State Level: United States, 2005–2010

Variable	Total Foreclosure Rate			Real-Estate-Owned Foreclosure Rate		
	Model 1, b (95% CI)	Model 2, b (95% CI)	Model 3, b (95% CI)	Model 4, b (95% CI)	Model 5, b (95% CI)	Model 6, b (95% CI)
Foreclosure rate	0.10*** (0.06, 0.13)			0.41*** (0.28, 0.53)		
Time constant		0.12 (-0.14, 0.39)	0.16 (-0.07, 0.39)		0.67 (-0.50, 1.84)	0.36 (-0.55, 1.27)
Within-state variation		0.10*** (0.06, 0.13)	0.04 (-0.00, 0.08)		0.40*** (0.28, 0.53)	0.16* (0.01, 0.32)
Structural measures						
Structural disadvantage			0.45* (0.08, 0.81)			0.40* (0.03, 0.77)
% divorced			0.94*** (0.63, 1.26)			0.96*** (0.64, 1.27)
Median age			0.13 (-0.11, 0.36)			0.11 (-0.13, 0.35)
% foreign-born			-0.15* (-0.28, -0.01)			-0.11 (-0.22, 0.01)
Population density (×100)			-0.07** (-0.12, -0.03)			-0.08** (-0.13, -0.02)
Constant	12.76*** (11.78, 13.73)	12.68*** (11.35, 14.01)	-0.99 (-9.40, 7.42)	12.73*** (11.76, 13.70)	12.49*** (11.05, 13.93)	-0.62 (-9.31, 8.07)
ρ	0.93	0.92	0.85	0.93	0.93	0.86
R ² , Within	0.11	0.11	0.25	0.14	0.14	0.25
R ² , Between	0.02	0.02	0.44	0.03	0.03	0.43
R ² , Overall	0.02	0.02	0.43	0.03	0.03	0.42

Note. CI = confidence interval. SEs are corrected for clustering. The sample size was n = 306 state-years. *P < .05. **P < .01. ***P < .001.

foreclosure crisis has contributed to the uptick in suicides between 2005 and 2010 beyond other economic consequences of the recession.

Home Foreclosures and Age-Specific Suicide Rates

Table 3 shows results from hybrid models predicting the association between the total foreclosure rate or the real-estate-owned rate and age-specific suicide rates (age 18–29, 30–45,

46–64, and ≥ 65 years). All models adjusted for state-level sociodemographic characteristics.

Three notable findings emerge from Table 3. First, the within-state foreclosure effect was significant for only 2 of the 4 age groups: 30 to 45 years and 46 to 64 years. No significant association was found between the within-state foreclosure rate and suicide for younger (18–29 years) and older groups (≥ 65 years). Second, we observed the largest effects among those who

were still working but closest to retirement (46–64 years). Comparing the within-state foreclosure effect between those aged 30 to 45 years and those aged 46 to 64 years suggests that the magnitude of the foreclosure effect was about twice as large for those nearing retirement compared with those aged 30 to 45 years. Moreover, the models explain substantially more within-state variation in suicide for those aged 46 to 64 years than for every other

TABLE 3—Hybrid Fixed- and Random-Effects Models Testing Foreclosure Effects on State-Level Age-Specific Suicide Rates: United States, 2005–2010

	Total Foreclosure Rate, b (95% CI)				Real-Estate-Owned Foreclosure Rate, b (95% CI)			
	Model 1 (Aged 18–29 Years)	Model 2 (Aged 30–45 Years)	Model 3 (Aged 46–64 Years)	Model 4 (Aged ≥ 65 Years)	Model 5 (Aged 18–29 Years)	Model 6 (Aged 30–45 Years)	Model 7 (Aged 46–64 Years)	Model 8 (Aged ≥ 65 Years)
Time constant	-0.40 (-0.84, 0.04)	0.05 (-0.24, 0.34)	0.27 (-0.01, 0.55)	0.55** (0.17, 0.92)	-1.86* (-3.52, -0.20)	-0.28 (-1.38, 0.83)	0.60 (-0.49, 1.68)	1.23 (-0.25, 2.71)
Within-state variation	-0.02 (-0.11, 0.07)	0.10* (0.01, 0.19)	0.21*** (0.12, 0.30)	0.00 (-0.08, 0.09)	0.05 (-0.31, 0.40)	0.29 (-0.04, 0.62)	0.83*** (0.50, 1.16)	0.04 (-0.28, 0.36)
R ² , Within	0.06	0.02	0.23	0.00	0.05	0.02	0.24	0.00
R ² , Between	0.36	0.64	0.61	0.56	0.40	0.64	0.60	0.54
R ² , Overall	0.32	0.54	0.53	0.56	0.35	0.54	0.52	0.53
No.	283	299	300	259	283	299	300	259

Note. CI = confidence interval. SEs are corrected for clustering. All models include controls for structural disadvantage, % divorced, median age, % foreign-born, and population density. Number of observations varies because of data suppression protocols from the Centers for Disease Control and Prevention when too few suicides are reported for a specific age group in a given state and year. *P < .05; **P < .01; ***P < .001.

group. For example, real-estate-owned foreclosure and other predictors explain 24% of the within-state variance in suicides for those aged 46 to 64 years but only 2% of the within-state variance for those aged 30 to 45 years. Supplemental models indicate that real-estate-owned foreclosures alone explain 18% of the within-state variance in suicides among those aged 46 to 64 years and 2% of the within-state variance among those aged 30 to 45 years. Finally, although the pattern of results is similar, the real-estate-owned foreclosure rate is a stronger predictor of suicide rates than is the total foreclosure rate.

We provide a graphic display of the relation between real-estate-owned foreclosures and suicides among the middle aged in Figure 2, which is based on estimates in models 6 and 7. The figure shows that net of covariates, a 5% point increase in real-estate-owned foreclosures within a state between 2005 and 2010 was associated with a 25% increase in the suicide rate among those aged 46 to 64 years, from 18.5 to approximately 23 per 100 000 residents. Among those aged 30 to 45 years, this same change in the real-estate-owned foreclosure rate corresponded to only an 8%

increase in the suicide rate, from 17.8 to 19.2 per 100 000 residents.

DISCUSSION

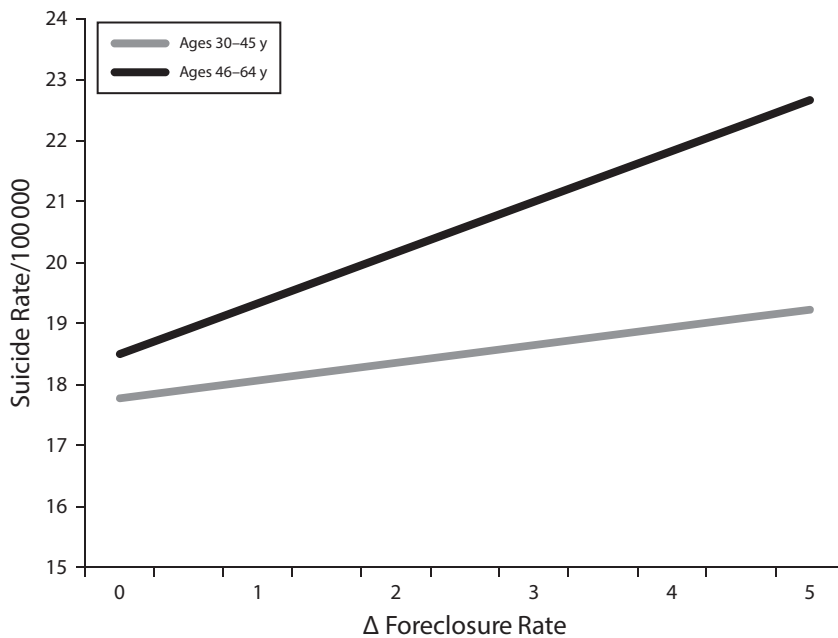
Despite considerable attention to the link between economic cycles and health, scholars have only recently begun investigating the health consequences of the foreclosure crisis. This article contributes to this growing literature by examining the role of rising foreclosures on suicidal behavior. Our results suggest that the foreclosure crisis significantly contributed to the increase in suicides in the Great Recession. Importantly, the effects of foreclosures on suicides were strongest among middle-aged adults, especially those aged 46 to 64 years, helping to explain the recent rise in middle-aged suicide.

The recent surge in middle-aged suicide has puzzled public health officials and researchers alike. Our results shed light on this question by confirming that foreclosures are a unique suicide risk among the middle-aged. Middle-aged adults have the highest proportion of homeowners relative to other age groups and have

a higher risk of home foreclosure than do other age groups. In addition to facing a greater risk of home foreclosure, this group also has the most to lose—losing key assets and wealth close to retirement age is likely to have a profound effect on the mental health and well-being of middle-aged individuals. In this light, it is perhaps unsurprising that we found no association between foreclosures and suicide among the elderly or younger individuals—who are unlikely to have mortgages and to be affected by the foreclosure crisis in the same way that middle-aged adults would be affected.

To our knowledge, this was the first study to examine the link between foreclosures and suicides and makes several contributions to the literature. First, we built on prior research on suicides during recessionary periods and showed that extensive foreclosures—a unique and historically unprecedented aspect of the Great Recession—were associated with a rise in suicides, net of a range of state-level factors, including the unemployment rate. Second, our hybrid-effects modeling strategy provided greater confidence that the association between foreclosures and suicides was real and substantively meaningful. Indeed, a key strength of the fixed-effects (within-state) portion of the model was that it allowed us to use each state as its own control and assess the effect of foreclosures net of observed and unobserved stable between-state characteristics. Moreover, supplemental models indicated that the results were consistent with other explanatory factors that could render the association spurious, such as the population of military veterans in the states⁴² and gun availability,^{43,44} the latter measured by the fraction of gun-related suicides relative to total suicides.⁴⁵ Third, by disaggregating suicides into age-specific rates, we gained insight into which populations were most vulnerable to suicide during the foreclosure crisis.

However, several issues remain for future research. Future work should examine the specific mechanisms linking foreclosures and suicide. We view the combination of individual-level data on suicide attempts and ideation with macrolevel information on community social and economic resources as a particularly fruitful avenue for understanding the foreclosure–suicide link, as well as work that examines the links between foreclosure, shame, self-worth, and mental health. Such a strategy would be well positioned to



Note. Estimates adjusted for structural disadvantage, percentage divorced, median age, percentage foreign-born, and population density.

FIGURE 2—Predicted suicide rates for ages 30–45 and 46–64 years by within-state changes in real-estate-owned foreclosure rates: all 50 US states plus Washington, DC, 2005–2010.

address the ecological fallacy⁴⁶ by examining the relative importance of individual-level factors (e.g., suicide resulting from experiencing a home foreclosure) and contextual-level effects (e.g., suicide resulting from living in a high-foreclosure area).

Reductions in suicide mortality are paramount to maintaining public health and have been subject to a long research agenda. Our findings add to this work by confirming that suicide risk is one of the public health consequences of extensive home foreclosures, especially among middle-aged people. Our findings underscore the potential public health benefits of policies aimed at reducing foreclosures and keeping property owners in their homes—such as the US Department of Housing and Urban Development Neighborhood Stabilization Program, real-estate-owned to rental programs, and loan modification programs such as the Home Affordable Modification Program. Future research should consider how such policies may have helped minimize the costs of the recession for public health. Examining the benefits of these policies is important for minimizing suicides and other health consequences of future recessions and housing market failures. ■

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Contributors

Both authors originated the study, interpreted the findings, and edited multiple drafts of the article. J. N. Houle drafted the introduction and conclusion of the article and conducted the early analyses. M. T. Light completed the analyses and was responsible for data and methods.

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Human Participant Protection

This study used administrative records and not human subjects. However, this study was approved by the University of Wisconsin institutional review board

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