

JUSTIN T. DENNEY *Rice University*

Families, Resources, and Suicide: Combined Effects on Mortality

Important resources from family support systems, employment, and educational attainment inhibit the risk of death. Independently, these factors are particularly salient for suicide, but how they combine to affect mortality is less clear. Analyses of National Health Interview Survey data from 1986 to 2004 (N = 935,802), prospectively linked to mortality through 2006 (including 1,238 suicides), reveals a process of compensation in the way work status and family combine to affect adult suicide: Individuals who are not working experience more suicide defense from more protective family support systems than do working adults. But a process of reinforcement occurs in the combination of education and family: More education associates with more protection from the family than does less education. The findings demonstrate how families and resources combine to affect mortality in unique ways.

Mortality is a social process (Cockerham, 2007; Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004). Substantial bodies of research document the effects of social support and household relationships on health and mortality prospects in general (Berkman & Glass, 2000; Carr & Springer, 2010; Hughes & Waite, 2002; Umberson & Montez, 2010), showing that risks of death and some forms of ill health decrease

with increased social ties and more supportive relationships. Research focusing on domestic relationships and suicide are robust, well documented, and wide ranging. Married persons are less likely than unmarried persons to commit suicide (Kposowa, 2000; Kposowa, Breault, & Singh, 1995), as are persons in larger families than persons in smaller families (Denney, Rogers, Krueger, & Wadsworth, 2009) and persons with children than persons without children (Denney, 2010; Qin, Agerbo, & Mortensen, 2003). Indeed, although families do not always exert positive effects on health (Seeman, 2000), individual propensity to suicide is related to how households are configured, and living in households with other relatives is generally protective (Denney, 2010; Qin et al., 2003).

Other social and economic characteristics provide resources that are leveraged to lengthen life. Advantaged groups are positioned to purchase better health, have access to the latest technological advances and knowledge about healthy living, and have incentives to practice healthy habits (Glied & Lleras-Muney, 2008; Pampel, Krueger, & Denney, 2010). Specifically, employment and higher educational attainment extend life by creating additional networks of social support and integration (Berkman & Glass, 2000; House, Landis, & Umberson, 1988; Link & Phelan, 1995). Contemporary research on suicide has shown there is increased risk for the unemployed (Stack, 2000a) and for individuals who are not active in the workforce (Denney et al., 2009). Recent empirical work on education and suicide, however, is quite limited and has

Department of Sociology, MS-28, 6100 Main St., Houston, TX 77005-1892 (jtdenney@rice.edu).

Key Words: education, employment, family formation, family support, suicide.

produced inconsistent findings (Denney et al., 2009; Kposowa et al., 1995; Stack 2000b).

Despite conceptually clear links between familial and social and economic factors and suicide, research has focused on their independent effects, ignoring important ways in which they might combine to influence risk. The objective of this study was to illuminate how household formations combine with employment and educational attainment to influence suicide, a leading cause of adult mortality accounting for nearly 36,000 deaths in the United States in 2009 (Kochanek, Xu, Murphy, Miniño, & Kung, 2011).

THE COMBINED INFLUENCE OF HOUSEHOLDS WITH EMPLOYMENT AND EDUCATION: POTENTIAL MECHANISMS

Households broadly represent an individual's immediate social environment, the daily arena for social support and integration. Households can include spouses, friends, children, other relatives, and even hired caretakers; in this article, the terms *household*, *family*, and *living arrangements* are used interchangeably. The theoretical work connecting how core elements of household living arrangements, employment, and education—such as social support and integration—influence suicide suggests they may combine in unique ways. Households and employment may combine through a process of *compensation*, meaning that positive attributes from one factor override negative attributes from the other. Households and education also may combine through a process of *reinforcement*, meaning that positive attributes on both factors work together to further reduce mortality risks.

Independence: Important but Separate

First, the effects of social support and integration garnered both in the home and through work and education might be distinct enough to create important but separate effects on suicide. To date, this is the approach taken by the majority of researchers concerned with the topic (Denney, 2010; Gibbs, 2000; Gibbs & Martin, 1964). Households and the relationships built within them provide systems of support unmatched in nearly any other area of life (Berkman & Glass, 2000). And employment and education provide economic stability, self-fulfillment, and improved social relations that correspond with

reduced risks of taking one's own life (Stack, 2000a, 2000b).

Many of the explanations for the associations among employment, education, and suicide are similar. Employment increases income and decreases economic hardship. Economic hardship can erode mental and physical health. Indeed, the accumulation of stress from trying to meet the basic needs of a household not only correlates with the odds of getting a disease but also with failing to recover from it. In addition, involuntary nonemployment (as opposed to voluntary nonemployment because one is in school or retired) comes with a low sense of social control and low levels of social support (Pearlin, Lieberman, Menaghan, & Mullan, 1981; Ross & Mirowsky, 1995). Education could also improve health and reduce the odds of suicide by increasing income and enhancing prospects in the labor market. But education does more than enhance economic prospects to improve well-being (Cutler & Lleras-Muney, 2008); it increases autonomy and raises social status as well (Mirowsky & Ross, 2003). In all, the literatures on families, employment, and education provide a first hypothesis.

Hypothesis 1: Adults in households that include other persons, who work, and who have more education will have reduced suicide risks compared to adults who live alone, who do not work, and who have less education.

Compensation: Filling a Void

It is possible that these important factors combine to affect suicide risk. Strong family relationships benefit immune, endocrine, and cardiovascular functions (Umberson & Montez, 2010), and they reduce physiological wear and tear on the body experienced through chronic stress (McEwen, 1998; Seeman, Singer, Ryff, Love, & Levy-Storms, 2002). Persons in compromised socioeconomic states, such as the poor and unemployed, often lack such beneficial ties and resources. Adults who do not work more often experience unhealthy levels of stress (Pearlin et al., 1981) and engage more often in harmful behaviors, ultimately dying, from many causes of death, including suicide, sooner than their employed counterparts (Denney et al., 2009; Link & Phelan, 1995; Pampel et al., 2010; Phelan et al., 2004; Rogers, Hummer, & Nam, 2000). The suicide risks of not working

could plausibly be reduced via other household members who are employed or contributing to the well-being of household members in other ways.

Indeed, social ties protect against suicide by enhancing a number of beneficial social constructs that researchers have used interchangeably in the past (Berkman & Glass, 2000), including social support, social cohesion, and social capital. Perhaps most important for suicide mortality, social relationships increase an individual's level of integration by creating a collective identity through important social bonds to others, what Durkheim (1897/1951) referred to as *social integration*. Social ties, through families and the workplace, also help individuals adhere to contemporary social norms and expectations, increasing what Gibbs and Martin (1964) referred to as *status integration*. Integration is a core social element of suicide; more integration corresponds with a reduced risk of death (Wray, Colen, & Pescosolido, 2011).

Persons who lack good jobs and good pay often suffer not only economically but also socially. They lack integration and social cohesion (Phelan et al., 2004; Rogers et al., 2000). And the more one's identity deviates from established norms, the lower one's well-being (Gibbs, 2000; Gibbs & Martin, 1964). For most people, work goes a long way toward creating an identity and maintaining a script for navigating everyday life. Not working reduces involvement in collective life, increasing suicide risk while decreasing these important social and economic resources that can be leveraged toward longer lives (Kposowa, 2001; Rogers et al., 2000). People who do not work but have family ties may benefit especially from those ties. Thus, those who do not work may compensate for the corresponding social integrative deficits through family support systems. This leads to a hypothesis aimed at the combined effects of living arrangement and employment.

Hypothesis 2: Living in a family household, either with a spouse or with children, is associated with a greater reduction in suicide risk for adults who do not work than for those who do.

Reinforcement: Synergistic Reduction of Risk

Although employment and education are both positively related to better health and improved overall mortality, there are reasons

to believe that household formation and health-protecting resources from educational attainment (Mirowsky & Ross, 2003) may reinforce each other in their combined impact on suicide. Over the last several decades, more similarly educated persons have been increasingly establishing intimate relationships and starting families with other, similarly educated individuals (McPherson, Smith-Lovin, & Bra-shears, 2006). For example, college graduates are increasingly likely to marry other college graduates, and persons with low levels of education are increasingly more likely to marry other persons with low education (Schwartz & Mare, 2005). This could result in greater material and social resources that can reduce suicide risks for highly educated individuals in relationships; that is, two positive states together may be better than the sum of the two separately. Coupled with the many positive aspects of educational attainment itself (Cutler & Lleras-Muney, 2008; Mirowsky & Ross, 2003), these more resource-rich households may reinforce the benefits of individual educational attainment.

Complicating matters, historical works have documented increased suicide rates with increasing educational attainment (Durkheim, 1897/1951; Masaryk, 1881/1970; Morselli, 1882). Although contemporary research has shown that more education is positive in many respects for individuals (Mirowsky & Ross, 2003), some classic works have posited that educational attainment reflects increasing individualism and a consequent disconnect from social life. This premise suggests that the direct effects of employment and education on suicide may not be the same and runs counter to the prevailing idea that increased mortality risk is linked to disadvantage (i.e., lower education). Studies of the association between education and suicide at the individual level are quite limited (Stack, 2000a), but some recent work has suggested that educational attainment is negatively associated with suicide, at least for men (Denney et al., 2009).

In the United States and other developed nations, people with more education live longer and healthier lives (Rogers et al., 2000). They are also more likely to marry, stay married, have children, and maintain more harmonious and uninterrupted family lives—all independent contributors to better health and reduced suicide risk. But this suggests that relationships between education

and suicide are not entirely independent of domestic support systems. Benefits from more education could in some ways rely on or be enhanced by household support. If so, both family support and educational attainment together exert special positive effects on suicide. This leads to a hypothesis specific to educational attainment that runs counter to the predicted combined relationship of work status and household formation on suicide risk.

Hypothesis 3: Living in a family household, either with a spouse or with children, is associated with a greater reduction in suicide risk for adults with more education than for those with less education.

Gender and Age Considerations in the Study of Suicide

It is important to note that the rates of and contributors to suicide are very different by gender. Men die from suicide in the United States at a rate four times that of women (Kochanek et al., 2011). Research on health and mortality has found that family living, and in particular the benefits associated with marriage, may be more important for men than women (Umberson, 1992; Waite & Gallagher, 2000). This pattern holds for suicide (Stack, 2000a, 2000b) because men's, but not women's, risk is closely tied to marital status (Denney et al., 2009).

At the same time, men's notions of status center largely on areas outside the home (Shiner, Scourfield, Fincham, & Langer, 2009), for example, on educational status and employment outlook. Even in the most developed nations with large proportions of women in the workforce, female identity may slant more toward the family than toward work life (Girard, 1993). Recent analyses using individual-level data have shown that men and women who do not work have higher suicide risks than their employed counterparts (Denney et al., 2009). However, the same study showed that higher educational attainment lowered risk among men but that education was unrelated to women's risk. Research has suggested that the larger number of suicides among men than among women is a result of the importance placed by men on economic success, a primary male role (Stack, 2000a). Thus, men who do not work may rely more heavily on sources of

support in the household. And men who pursue individual achievement through higher education may mitigate any social support and integration deficits through the household. Meanwhile, families, work status, and education may independently influence women's risk. No work to date has examined the combined influence of family formation with work status and education on suicide mortality risk by gender. If family life and status outside the home are generally more important for men's than for women's mortality prospects and support is found for the processes of compensation and reinforcement, then two gender-specific hypotheses follow.

Hypothesis 4: Living in a family household, either with a spouse or with children, will reduce the risk of suicide further for men who are not working than for men who are working. The association of household living arrangement with suicide risk will not vary by women's work status.

Hypothesis 5: Living in a family household, either with a spouse or with children, will reduce the risk of suicide further for men with more education than for men with less education. The association of household living arrangement with suicide risk will not vary by women's educational attainment.

Finally, aggregate analyses of suicide rates have shown that age patterns of suicide are related to period and cohort effects, as individuals find themselves competing for good jobs, compatible mates, and general stability over the life course (Pampel, 1996; Phillips, Robin, Nugent, & Idler, 2010). In the United States, suicide generally increases with age, peaking for men at the oldest ages and in middle age for women, followed by a slight decline at the oldest ages for women (Stack, 2000b). Studies explaining age differences in suicide at the individual level are limited (Stack, 2000b), but existing literatures identifying varying mortality risks by age (Berkman, Leo-Summers, & Horwitz, 1992; Seeman, 2000) and life course theory suggest that occupying a nonnormative status can have more harmful consequences at specific ages (Gibbs, 2000). Thus, processes of compensation and reinforcement might vary importantly by age, but sample limitations prevented tests of these arguments in this study. Nonetheless, as described below, all analyses accounted for age and other important covariates.

METHOD

Data

The data for this study came from a combination of multiple years of the National Health Interview Survey (NHIS), linked to prospective mortality through the Linked Mortality Files (LMF). The Integrated Health Interview Series, an initiative through the Minnesota Population Center at the University of Minnesota, streamlines an otherwise arduous data construction process and provides the complete data set used here (Minnesota Population Center, 2010). NHIS years include 1986 through 2004, and LMF covers 1986 through 2006. Designed as a cross-sectional household survey, the NHIS annually collects information from approximately 30,000 to 40,000 households, obtaining response rates consistently at or above 90% (National Center for Health Statistics [NCHS], 1986–2004).

The NCHS recently completed its fourth mortality follow-up with NHIS respondents (NCHS, 2009). To create the LMF, the NCHS uses a probabilistic mortality matching scheme that assigns weights to multiple factors, including social security number, first and last name, and date of birth. It is important to note that, because of confidentiality concerns, public-use mortality data include deaths only for persons over age 17. Accordingly, data from respondents under age 18, who comprised 28% of the original sample and 6% of all suicides in 2009 (Kochanek et al., 2011), were included in the construction of household variables (described below) and were subsequently dropped.

An additional 3% of cases were dropped because they were missing data on the key variables used in the empirical analyses or because the NCHS designated them as ineligible to be linked to prospective mortality; ineligible cases are those whose records include insufficient identifying data, such as name and social security number, to create a mortality record (NCHS, 2009). For the years used here, fewer than 3% of cases are deemed ineligible in any single year, and NCHS (2009) provided weights that adjust for the exclusion of ineligible records. Finally, because of mortality selection at the oldest ages and because most adults complete their education and enter the workforce by early adulthood, the final data set included information on 935,802 adults ages 25 to 65 residing within 564,594 households. The individual records are linked to 1,238 suicide deaths through 2006.

Measures

The dependent variable, suicide mortality, was coded 1 for suicidal death, defined in the World Health Organization's (2007) 10th revision of the *International Statistical Classification of Diseases, Injuries, and Causes of Death* as "death from intentional self-harm" (codes X60–X84); it was coded 0 for all other respondents, who either survived the follow-up or died from other causes.

The NHIS collects a core set of sociodemographic, socioeconomic, and health measures; however, the amount of detail sometimes varies from year to year. To maintain consistency across all years, this study used some more broadly defined variables. *Age* was a continuous variable, and *gender* was coded dichotomously with women as the referent, and multivariate analyses stratified models separately for men and women. *Race* was also a dichotomous variable, with non-Hispanic White as the referent.

Separate dummy variables captured *educational attainment* and *work status*, with referents of greater than high school and employed, respectively. Only some years of the NHIS contain more detailed measures of education (NCHS, 1986–2004), so the less detailed measure was used to allow investigation over the entire study period. Although not ideal, the education dummy variable captures important differences in status. Work status separates employed individuals from those who reported that they were unemployed or not in the labor force. Compared to work and education, income has less influence on suicide mortality (Denney et al., 2009; Kposowa et al., 1995; Stack, 2000a). Thus, *income* was included primarily as a control measure. A continuous measure of income was approximated by taking the midpoint of the categories defined by the NCHS and by estimating a median value for the open-ended category (Parker & Fenwick, 1983). The value was then adjusted to account for varying purchasing power among families of differing sizes (see Van der Gaag & Smolensky, 1982), and the consumer price index was used to regulate changes in purchasing power over time. Missing data for income were estimated using a number of covariates, and stochastic variation was incorporated into the predicted values of income to better represent variability in the actual income data (see Gelman & Hill, 2007). A logged transformation of the continuous measure was included in the multivariate models to

account for its skewed distribution; models were estimated with and without the missing income data, and no discernible differences appeared.

The NHIS person files include no measures on mental health, but research suggests that subjective reports of health encapsulate many dimensions of overall health, and they vary in important ways across gender and socioeconomic status (Idler, Hudson, & Leventhal, 1999; Schnittker, 2005). Thus, self-rated health was included in models as a broad indicator of current health; it was measured continuously on a scale that ranged from 0 (*poor health*) to 4 (*excellent health*). Controlling for health status also helps with issues of selection; poor health at baseline may have an influence on family type and economic resources, increasing suicide risk.

To take advantage of the household nature of the NHIS data, multiple variables—including marital status and household size—are used to identify household types. Each household in the NHIS is assigned a unique numeric identifier, as is each person; in combination, these numbers enable the analyst to ascertain who lives in which household. Then, a series of steps identifies the configuration of the household. First, a variable identifies households that include children under age 18. Second, a variable indicates whether a marriage exists within the household. A third variable records whether households include other nonchild relatives, and a fourth indicates whether unrelated persons reside in the dwelling. Because suicide is a relatively rare cause of death, the types of households included in the analyses are limited to those that capture critical aspects of domestic integration. Married-couple families without children, married-couple families with children under age 18, unmarried families with children under age 18, and unmarried families without children are included. Unmarried families include adults who are not currently married but may have been divorced or widowed as well as those who never married. Family types with and without children can include other nonchild relatives and unrelated adults. Separate analyses of the more intricate family types do not alter interpretations. For example, separating married-couple-only households from married-couple households with other relatives or unrelated persons produces much the same results. Some household configurations are more common than others, but all household configurations used in the present analysis

represent the living situation of at least 4.0% of the sample. The reference category in all multivariate analyses is an adult living alone.

Estimation

Multivariate analyses investigating the relationships among individual characteristics, household living arrangements, and suicide employ a Cox proportional hazard framework (Allison, 1984). The Cox models are particularly useful because they do not impose a distribution of death across age; neither do they require the analyst to choose a particular form for the times of survival specified (Allison, 1984). The model declares the hazard rate for the j th respondent as

$$h(t|x_j) = h_0(t) \exp(x_j \beta_x),$$

where the coefficients β_x are estimated from the data using a partial likelihood approach (Hoffman, 2004).

A key assumption of the Cox model is proportional hazards. Tests of the proportionality assumption following a generalization formulated by Grambsch and Therneau (1994) revealed that the assumption is violated for the full model but not for models stratified by gender. These results, together with evidence suggesting that Cox estimates are sturdy despite proportionality assumptions when based on large, nationally representative samples (Therneau & Grambsch, 2000), provide some confidence in the techniques used here.

Further robustness checks included examining only those suicides that occurred within 5 years of interview and testing for differences between an early period (1986–1994) and a late period (1996–2004). The results from these models are available on request and are much the same as those presented here. All results from the Cox proportional hazard analyses are reported as hazard ratios (HRs). Stata 12 incorporates sample weights and estimates robust standard errors that account for the NHIS stratified and clustered sampling design (NCHS, 1986–2004).

Finally, the hypotheses required that the models be stratified by work status and educational level and by gender. To evaluate effects across groups, interaction models were estimated, and Wald tests were calculated using the results from those models, a procedure referred to as the *generalized linear model solution to compare model results* (Hoffman,

2004). The Wald test is distributed chi-square and provides the analyst with some important flexibility, including the ability to evaluate differences across all household types and differences across specific types of household configuration. Degrees of freedom are equal to the total number of household types for the former (4) and equal to 1 for the latter.

The multivariate analyses proceeded by first establishing the relationship between household living arrangement and suicide for the full sample and separately by gender (see Table 2). Then, models were estimated to assess the effects of household living arrangement by work status and educational attainment on suicide risk (see Table 3). The Wald test information from these models represent tests of two-way interactions (i.e., living arrangement \times work status). Finally, models with three-way interactions (i.e., living arrangement \times education \times gender) were estimated to further delineate household living arrangement by work status and educational achievement for men and women. The three-way interaction models also included all one-way (i.e., education) and two-way terms (i.e., living arrangement \times education). The Wald test information for significant three-way interaction models is presented in Table 4. The Wald test information provided in Tables 3 and 4 was used to assess the proposed processes of combined influence. If a process of compensation occurs, supportive household formations will reduce suicide risk more for individuals with fewer resources (i.e., those who are not working). If reinforcement occurs, the opposite will be observed: Persons with more resources will benefit more from supportive household types (i.e., those that are more highly educated). Finally, if living arrangements, work status, and educational attainment exert independent effects on mortality risk, no significant differences across groups will be observed in the Wald tests.

RESULTS

Weighted means of the individual- and household-level covariates for the full sample and for those who committed suicide over the follow-up period are provided in Table 1. The average age for respondents who committed suicide is similar to the average age of the sample. There are large disparities between the full sample and those who committed suicide by gender

Table 1. *Weighted Means of Individual Characteristics and Living Arrangements for the Full Sample and for Those Who Died of Suicide Over the Follow-up Period, U.S. Adults Age 25–65, 1986–2006*

Variable	Full sample (<i>N</i> = 935, <i>n</i> = 1,802)	Suicide deaths (<i>n</i> = 1,238)
Individual characteristics		
Age	42.4	41.9
Gender (male = 1)	.49	.78
Race (non-Hispanic White = 1)	.75	.88
Education		
High school or less	.50	.56
More than high school	.50	.44
Work status		
Unemployed or not in the labor force	.24	.29
Working	.76	.71
Household income		
≤ \$20,000	.21	.30
Self-rated health	2.87	2.59
Family/household living arrangement		
Single living alone	.12	.22
Married couple without children	.26	.28
Married couple with children	.48	.39
Unmarried with children	.10	.09
Unmarried without children	.04	.02

Note: Table values are based on data from the National Health Interview Surveys Linked Mortality Files, 1986–2006.

and race. Of note is that, as in national trends (Kochanek et al., 2011), the overwhelming majority of those in the sample who committed suicide were White, making detailed analyses by racial group difficult. Other individual-level differences between the full sample and those who committed suicide are more modest but are also consistent with current knowledge (Denney et al., 2009; Stack, 2000a; Stack, 2000b).

Table 1 reveals important differences in living arrangements between the full sample and those who committed suicide. Although 12% of the sample was composed of single persons living alone, 22% of individuals who died from suicide lived alone. Along the same lines, but less striking, 26% of the sample lived in married households without children, and those persons accounted for 28% of all suicides. In contrast, 48% of the full sample lived in households that included a marriage and children, and those persons accounted for only 39% of suicides.

Finally, multiperson households without a marriage, both with and without children, accounted for smaller proportions of both the full sample and the suicide deaths.

Table 2 provides hazard ratios of the individual and household covariates, first for the full sample and then separately for men and women. For the full sample, compared to a single adult living alone, living in households that included other members was associated with suicide risks less than 1.0. The key individual-level variables, work status and education, showed that not working was associated with a 65% higher risk of suicide over the follow-up period, but having less education, compared to having more, was not significantly associated with suicide risk. Other individual-level controls in the full model showed that men were at over four times the risk of suicide compared to women, non-Whites experienced 60% the risk of Whites, income had no effect, and more positive health ratings were associated with lower suicide risks.

The models by gender in Table 2 generally show that the risk of suicide was lower for respondents living in households with other adults and children compared to living alone. Men in unmarried households without children

had a lower risk of suicide than men who lived alone, but the same comparison among women showed that unmarried women who live with others face similar risks of suicide compared to women who live alone. The difference between men and women in that household type was marginally significant ($p = .08$; results available on request). Men and women who were not working were more likely to commit suicide over the follow-up period compared to their working counterparts. But although men with less education showed a higher risk of suicide than more highly educated men, the education association was reversed among women (and significantly different from men, $p \leq .05$; results available on request). The other control variables had similar and expected relationships for both men and women. In all, Table 2 suggests that family living, work status, and education have important relationships with suicide mortality.

Table 3 presents results from Cox analysis testing the combined associations of household formation with work status (top panel) and education (bottom panel). The top panel of the table provide some support for the compensation perspective; it shows that respondents who were not working experienced more risk reduction

Table 2. Cox Proportional Hazard Ratios for the Risk of Suicide Mortality, U.S. Adults Age 25–65

Variable	Full model	Men	Women
Family/household living arrangement			
Single living alone (ref.)			
Married couple without children	0.64**	0.61**	0.69 [†]
Married couple with children	0.45**	0.47**	0.35**
Unmarried with children	0.73**	0.82	0.54*
Unmarried without children	0.40**	0.31**	0.71
Individual characteristics			
Work status (ref.: Working)			
Unemployed or not in the labor force	1.65**	1.59**	1.91**
Education (ref.: More than high school)			
High school or less	1.06	1.18*	0.75[†]
Logged household income	1.00	1.01	0.97
Age (continuous)	0.99**	0.99*	0.97**
Gender (ref.: Female)			
Male	4.40**		
Race (ref.: Non-Hispanic White)			
Non-White	0.40**	0.43**	0.30**
Self-rated health	0.76**	0.78**	0.69**
Log likelihood	−15,542.9	−11,343.3	−3,307.0

Note: Table values are based on data from the National Health Interview Surveys Linked Mortality Files, 1986–2006. Boldface type indicates values that are significantly different ($p \leq .10$) from men. ref. = reference category.

[†] $p \leq .10$. * $p \leq .05$. ** $p \leq .01$.

Table 3. Cox Proportional Hazard Ratios and Wald Tests of Interactions for the Risk of Suicide Mortality by Work Status and Education

	Work status		Test: Working vs. not working (χ^2)
Variable	Working	Not working	
Family/household living arrangement			
Single living alone (ref.)			7.8 [†]
Married couple without children	0.62**	0.67*	0.1
Married couple with children	0.48**	0.35**	2.7 [†]
Unmarried with children	0.86	0.51**	4.5*
Unmarried without children	0.42**	0.34**	0.2
Log likelihood	−10,745.6	−4,078.3	
	Education		
	More than high school	High school or less	Test: More vs. less educated
Family/household living arrangement			
Single living alone (ref.)			11.6*
Married couple without children	0.49**	0.84	6.2**
Married couple with children	0.35**	0.58**	10.7**
Unmarried with children	0.63*	0.88	0.7
Unmarried without children	0.34**	0.48*	0.5
Log likelihood	−6,096.4	−8,694.9	

Note: Table values are based on data from the National Health Interview Surveys Linked Mortality Files, 1986–2006. All models include adults age 25 and older and control for all individual-level sociodemographic, socioeconomic, and self-rated health covariates. Tests across work status and education come from models that pool individuals from the demographic subgroup presented. These tests are provided for the living arrangements as a whole with $df = 4$ and for the individual living arrangements with $df = 1$. ref. = reference category.

[†] $p \leq .10$. * $p \leq .05$. ** $p \leq .01$.

from living in family households over the follow-up period than did those who were working ($\chi^2 = 7.8, p \leq .10$). This was most evident in households that included children. For adults who were not working, compared to living alone, those living in married-couple-with-children households had a 65% lower risk of suicide, and those living with children but without marriage had a 49% lower suicide risk. By comparison, for working adults, those in married-couple households with children had a 52% lower suicide risk, and the risk for working individuals in unmarried households with children was statistically indistinguishable from the risk for adults living alone.

With regard to education, the bottom panel of Table 3 shows that education and family combine synergistically to influence risk. In accord with the reinforcement perspective, this bottom panel shows that more educated persons had lower suicide risks in family

households than did less educated persons ($\chi^2 = 11.6, p \leq .05$). These lower risks were concentrated in households that included a marriage. More educated persons experienced a significantly lower suicide risk in married-couple households with (HR = 0.35) and without children (HR = 0.49) than did less educated persons (HRs = 0.58 and 0.84, respectively).

Finally, models were estimated with three-way interactions for living arrangement \times gender \times work status and for living arrangement \times gender \times education (also including all other control measures and the corresponding two-way and one-way terms; results available on request). No significant Living Arrangement \times Gender \times Work Status interaction was found, suggesting that the process of compensation witnessed in the full sample does not vary by gender. A three-way Living Arrangement \times Gender \times Education interaction provides limited evidence that the reinforcement of family

Table 4. Cox Proportional Hazard Ratios and Wald Tests of Interactions for the Risk of Suicide Mortality by Education and Gender

	More than high school	High school or less	Test: More vs. less educated (χ^2)
Variable	Men		
Family/household living arrangement			
Single living alone (ref.)			10.5*
Married couple without children	0.46**	0.80	6.4**
Married couple with children	0.38**	0.58**	7.5**
Unmarried with children	0.76	0.94	0.3
Unmarried without children	0.36**	0.28**	0.2
Log likelihood	-5,073.9	-8,690.5	
	Women		
Family/household living arrangement			
Single living alone (ref.)			6.6
Married couple without children	0.60 [†]	0.87	0.8
Married couple with children	0.28**	0.44**	3.9*
Unmarried with children	0.46*	0.64	1.2
Unmarried without children	0.99	1.47	3.8 [†]
Log likelihood	-1,594.2	-2,138.9	

Note: Table values are based on data from the National Health Interview Surveys Linked Mortality Files, 1986–2006. All models control for all individual-level sociodemographic, socioeconomic, and self-rated health covariates. Tests across education were estimated after finding a significant three-way interaction ($p \leq .10$) between living arrangement, gender, and education in a model that included all one-way terms as well as two-way terms and the three-way term. The tests presented come from models that pool individuals from the demographic subgroup presented. These tests are provided for the living arrangements as a whole with $df = 4$ and for the individual living arrangements with $df = 1$. ref. = reference category.

† $p \leq .10$. * $p \leq .05$. ** $p \leq .01$.

and education may vary by gender ($p \leq .10$). Accordingly, Table 4 provides Wald tests for the interaction between living arrangement and education separately for men and women. The process of reinforcement identified in Table 3 can most clearly be seen among men ($\chi^2 = 10.5$, $p \leq .05$). Specifically, the risk of suicide for men living in married-couple households with and without children varied by education in ways that are consistent with the reinforcement perspective. The bottom panel of Table 4 shows that, overall, women’s risks of suicide did not significantly differ by education ($\chi^2 = 6.6$, $p = .16$); however, similar to men, the risk for suicide for women in married-couple families with children did vary by educational attainment.

DISCUSSION

As a leader of premature mortality in the United States over the last 50 years, suicide has aroused continued concern from policymakers, researchers, and public health officials alike. Indeed, the seemingly individual act of suicide

possesses a social character. Sources of social support and integration, including those found in the home, at work, and through educational attainment, have documented relationships with health. Results on 20 years of U.S. data linked to prospective mortality suggest that household support systems and individual employment and education are important contributors of suicide risk and that they also combine in unique ways to influence suicide.

A process of compensation was revealed, suggesting that adults who are not working may rely more heavily on households that include other adults and children to lower risks of suicide. The combination of education and household formation, however, revealed a process of reinforcement, suggesting that more educated adults may experience more protection from the household than do less educated adults.

Support through household relationships and responsibilities may be an essential consideration of suicide risk for adults who are out of the labor force: It could serve as a last line of

protection against the potential loss of meaning and social ties through work. This protection may be particularly salient for people in households that include children. Marriage and family life, especially the rearing of children, may replace the structure and meaning that persons typically rely on employment to provide. Family life may also encourage the avoidance of risky behavior associated with criminal activity and substance abuse (especially for men) that place people at increased risk for a number of poor health and mortality outcomes. This process of compensation follows the logic and findings of the relationships between disadvantage and health. Social support and greater resources are better for long-term health and mortality prospects. It is reasonable to deduce that a deficiency in one area may lead a person to depend more heavily on another. Doing so explicitly recognizes the importance of considering both employment status and family type in tandem rather than separately.

Perhaps more elusive, from a disadvantage perspective, is an explanation of why more educated persons might experience more protection via support from the home than less educated persons. Whereas the interaction between work status and household living arrangement appeared strongest in households that included children, the interactive relationship between living arrangement and education was exemplified in households where a marriage was present. Both classical sociological theory and contemporary research on the benefits of educational attainment provide places to begin to understand this finding. Durkheim (1897/1951) contended that education may be accompanied by a general loss of social connectedness, making domestic relationships all the more essential for more educated individuals. More contemporary works suggest not only that education is itself a powerful resource but also that the benefits of marriage are greater, for example, for more highly educated persons because, over time, educational heterogeneity has declined such that more highly educated persons tend to marry and stay married to other highly educated persons (McPherson et al., 2006; Schwartz & Mare, 2005). This might result in greater material and social resources that are leveraged toward better health and improved longevity for highly educated individuals in relationships. In turn, those who are less educated benefit less from marriage because they typically are married to someone who also has low

levels of education. The combined association of household composition and education may be more clearly related to men's risk, but the association between living in a married couple household with children and suicide varied by educational attainment for both men and women. Therefore, more educated men and women may synergistically experience the benefits that come with educational attainment and more resourceful marital relationships to reduce the risk of suicidal death.

Additional insights might be gained from age-specific models. Indeed, suicide research has identified middle-aged adults as a group with stability and comfort in personal and professional life (Stack, 2000b), leading to high social integration, good jobs, and positions of power. Education, for example, can protect health, and it may exert special positive effects for adults who have maintained domestic and achieved economic stability in middle age. Variations in combined associations across the life course represent a fruitful area of future research with larger samples of adults living in various household types.

The NHIS LMF is large and nationally representative, but not without other limitations. The public-use release of mortality data limits the amount of information on the deceased; more detail at time of death would allow examination of respondents' changing status from interview to death. This may be relevant for the differences in the ways employment and education combine with living arrangement to influence mortality risk. Educational attainment is relatively stable over time, but employment status at the time of the interview is more likely to change by time of death, especially if the respondent encounters a medical issue that requires that he or she stop working or if the length of time between interview and death is long. Although the results presented here partially address these concerns by accounting for health status at time of interview and exploring shortened follow-up periods, these limitations should be considered when interpreting the results.

Furthermore, the cross-sectionality of the NHIS limits the investigation of issues of selection. For example, measures of health before and after a change in work status might better capture relationships, because people who are not working are also likely in poorer mental health (Platt, 1984). In addition, health status and other factors select adults into and out

of certain living arrangements. Finally, core NHIS data do not include measures for other established predictors of mortality. Some of the more important considerations in the study of suicide specifically include religiosity (Ellison, Burr, & McCall, 1997), genetic propensities (Brent & Mann, 2005), and cultural norms relating to suicide acceptability (Cutright & Fernquist, 2000).

Research on social contributors to health has shifted productively away from historical doctrines that first centered solely on structural and later on individual forces (Cockerham, 2007). The findings presented here support an approach that explores explanations that lie somewhere in the middle ground, acknowledging that family and individual characteristics can combine to affect mortality in unique ways.

NOTE

I am indebted to Fred Pampel and Rick Rogers for their insights throughout the development of this article, and I thank Kristi Denney, Jason Boardman, Jane Menken, Tim Wadsworth, Fernando Riosmena, Bob Hummer, Deb Umberson, and Rachel Kimbro for comments on earlier drafts.

REFERENCES

- Allison, P. D. (1984). *Event history analysis: Regression for longitudinal event data*. Beverly Hills, CA: Sage.
- Berkman, L. F., & Glass, T. (2000). Social integration, social networks, social support, and health. In L. F. Berkman & I. Kawachi (Eds.), *Social epidemiology* (pp. 137–173). Oxford, UK: Oxford University Press.
- Berkman, L. F., Leo-Summers, L., & Horwitz, R. I. (1992). Emotional support and survival after myocardial infarction: A prospective, population-based study of the elderly. *Annals of Internal Medicine*, 117, 1003–1009.
- Brent, D. A., & Mann, J. J. (2005). Family genetic studies, suicide, and suicidal behavior. *American Journal of Medical Genetics Part C: Seminars in Medical Genetics*, 133C, 13–24.
- Carr, D., & Springer, K. W. (2010). Advances in families and health research in the 21st century. *Journal of Marriage and Family*, 72, 743–761.
- Cockerham, W. C. (2007). *Social causes of health and disease*. Cambridge, UK: Polity Press.
- Cutler, D. M., & Lleras-Muney, A. (2008). Education and health: Evaluating theories and evidence. In R. Schoeni, J. S. House, G. A. Kaplan, & H. Pollack (Eds.), *Making Americans healthier: Social and economic policy as health policy* (pp. 29–60). New York: Russell Sage Foundation.
- Cutright, P., & Fernquist, R. M. (2000). Effects of social integration, period, region, and culture of suicide on male age-specific suicide rates: 20 developed countries, 1955–1989. *Social Science Research*, 29, 148–172.
- Denney, J. T. (2010). Family and household formations and suicide in the United States. *Journal of Marriage and Family*, 72, 202–213.
- Denney, J. T., Rogers, R. G., Krueger, P. M., & Wadsworth, T. (2009). Adult suicide mortality in the United States: Marital status, family size, socioeconomic status, and differences by sex. *Social Science Quarterly*, 90, 1167–1185.
- Durkheim, E. (1951). *Suicide: A study in sociology*. New York: The Free Press. (Original work published 1897).
- Ellison, C. G., Burr, J. A., & McCall, P. L. (1997). Religious homogeneity and metropolitan suicide rates. *Social Forces*, 76, 273–299.
- Gelman, A., & Hill, J. (2007). *Data analysis using regression and multilevel/hierarchical models*. New York: Cambridge University Press.
- Gibbs, J. P. (2000). Status integration and suicide: Occupational, marital, or both? *Social Forces*, 78, 949–968.
- Gibbs, J. P., & Martin, W. T. (1964). *Status integration and suicide*. Eugene: University of Oregon Press.
- Girard, C. (1993). Age, gender, and suicide: A cross-national analysis. *American Sociological Review*, 58, 553–574.
- Glied, S., & Lleras-Muney, A. (2008). Technological innovation and inequality in health. *Demography*, 45, 741–761.
- Grambsch, P. M., & Therneau, T. M. (1994). Proportional hazards tests and diagnostics based on weighted residuals. *Biometrika*, 81, 515–526.
- Hoffman, J. P. (2004). *Generalized linear models: An applied approach*. Boston: Pearson Education.
- House, J. S., Landis, K. R., & Umberson, D. (1988). Social relationships and health. *Science*, 241, 540–545.
- Hughes, M. E., & Waite, L. J. (2002). Health in household context: Living arrangements and health in late middle age. *Journal of Health and Social Behavior*, 43, 1–21.
- Idler, E. L., Hudson, S. V., & Leventhal, H. (1999). The meanings of self-rated health: A qualitative and quantitative approach. *Research on Aging*, 21, 458–476.
- Kochanek, K. D., Xu, J., Murphy, S. L., Miniño, A. M., & Kung, H.-C. (2011). Deaths: Final data for 2009. *National Vital Statistics Reports*, 60(3). Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60_03.pdf
- Kposowa, A. J. (2000). Marital status and suicide in the National Longitudinal Mortality Study. *Journal of Epidemiology and Community Health*, 54, 254–261.

- Kposowa, A. J. (2001). Unemployment and suicide: A cohort analysis of social factors predicting suicide in the U.S. National Longitudinal Mortality Study. *Psychological Medicine*, 31, 127–138.
- Kposowa, A. J., Breault, K. D., & Singh, G. K. (1995). White male suicide in the United States: A multivariate individual-level analysis. *Social Forces*, 74, 315–325.
- Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*, 35(Extra Issue), 80–94.
- Masaryk, T. G. (1970). *Suicide and the meaning of civilization*. Chicago: University of Chicago Press. (Original work published 1881).
- McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine*, 338, 171–179.
- McPherson, M., Smith-Lovin, L., & Brashears, M. E. (2006). Social isolation in America: Changes in core discussion networks over two decades. *American Sociological Review*, 71, 353–375.
- Minnesota Population Center. (2010). Integrated Health Interview Series (version 3.0) [Computer database]. Minneapolis: University of Minnesota.
- Mirowsky, J., & Ross, C. E. (2003). *Education, social status, and health*. Hawthorne, NY: Aldine de Gruyter.
- Morselli, H. (1882). *Suicide: An essay on comparative moral statistics*. New York: D. Appleton and Company.
- National Center for Health Statistics. (2009). *The National Health Interview Survey (1986–2004) Linked Mortality Files, mortality follow-up through 2006*. Hyattsville, MD: U.S. Department of Health and Human Services.
- National Center for Health Statistics. (1986–2004). *National Health Interview Surveys: Core data*. Hyattsville, MD: U.S. Department of Health and Human Services.
- Pampel, F. C. (1996). Cohort size and age-specific suicide rates: A contingent relationship. *Demography*, 33, 341–355.
- Pampel, F. C., Krueger, P. M., & Denney, J. T. (2010). Socioeconomic disparities in health behaviors. *Annual Review of Sociology*, 36, 349–370.
- Parker, R. N., & Fenwick, R. (1983). The Pareto Curve and its utility for open-ended income distributions in survey research. *Social Forces*, 61, 873–885.
- Pearlin, L. I., Lieberman, M. A., Menaghan, E. G., & Mullan, J. T. (1981). The stress process. *Journal of Health and Social Behavior*, 22, 337–356.
- Phelan, J. C., Link, B. G., Diez-Roux, A., Kawachi, I., & Levin, B. (2004). “Fundamental causes” of social inequalities in mortality: A test of the theory. *Journal of Health and Social Behavior*, 45, 265–285.
- Phillips, J. A., Robin, A. V., Nugent, C. N., & Idler, E. L. (2010). Understanding recent changes in suicide rates among the middle-aged: Period or cohort effects? *Public Health Reports*, 125, 680–688.
- Platt, S. (1984). Unemployment and suicidal behavior: A review. *Social Science & Medicine*, 19, 93–115.
- Qin, P., Agerbo, E., & Mortensen, P. B. (2003). Suicide risk in relation to socioeconomic, demographic, psychiatric, and familial factors: A National Register-based study of all suicides in Denmark, 1981–1997. *American Journal of Psychiatry*, 160, 765–772.
- Rogers, R. G., Hummer, R. A., & Nam, C. B. (2000). *Living and dying in the USA: Behavioral, health, and social differentials of adult mortality*. New York: Academic Press.
- Ross, C. E., & Mirowsky, J. (1995). Does employment affect health? *Journal of Health and Social Behavior*, 36, 230–243.
- Schnittker, J. (2005). Cognitive abilities and self-rated health: Is there a relationship? Is it growing? Does it explain disparities? *Social Science Research*, 34, 821–842.
- Schwartz, C. R., & Mare, R. D. (2005). Trends in educational assortative marriage from 1940 to 2003. *Demography*, 42, 621–646.
- Seeman, T. E. (2000). Health promoting effects of friends and family on health outcomes in older adults. *American Journal of Health Promotion*, 14, 362–370.
- Seeman, T. E., Singer, B. H., Ryff, C. D., Love, G. D., & Levy-Storms, L. (2002). Social relationships, gender, and allostatic load across two age cohorts. *Psychosomatic Medicine*, 64, 395–406.
- Shiner, M., Scourfield, J., Fincham, B., & Langer, S. (2009). When things fall apart: Gender and suicide across the life-course. *Social Science & Medicine*, 69, 738–746.
- Stack, S. (2000a). Suicide: A 15-year review of the sociological literature. Part I: Cultural and economic factors. *Suicide and Life-Threatening Behavior*, 30, 145–162.
- Stack, S. (2000b). Suicide: A 15-year review of the sociological literature. Part II: Modernization and social integration perspectives. *Suicide and Life-Threatening Behavior*, 30, 163–176.
- Therneau, T. M., & Grambsch, P. M. (2000). *Modeling survival data: Extending the Cox model*. New York: Springer.
- Umberson, D. (1992). Gender, marital status, and the social control of health behavior. *Social Science & Medicine*, 34, 907–917.
- Umberson, D., & Montez, J. K. (2010). Social relationships and health: A flashpoint for health policy. *Journal of Health and Social Behavior*, 51, S54–S66.
- Van der Gaag, J., & Smolensky, E. (1982). True household equivalence scales and characteristics of the poor in the United States. *Review of Income and Wealth*, 28, 17–28.

- Waite, L. J., & Gallagher, M. (2000). *The case for marriage: Why married people are happier, healthier, and better off financially*. New York: Doubleday.
- World Health Organization. (2007). *International statistical classification of diseases and related health problems, 10th revision*. Geneva, Switzerland: Author. Retrieved from <http://www.who.int/classifications/apps/icd/icd10online>
- Wray, M., Colen, C., & Pescosolido, B. (2011). The sociology of suicide. *Annual Review of Sociology*, 37, 505–528.