ADULT SUICIDE MORTALITY IN THE UNITED STATES:

INDIVIDUAL AND CONTEXTUAL COVARIATES[*]

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ABSTRACT

We examine individual and contextual risk factors for adult suicide mortality, a major social problem and a central cause of preventable death in the United States. We link nine consecutive years of the National Health Interview Survey (1986-1994) to the Multiple Cause of Death file through the National Death Index (1986-1997), and use Cox proportional hazard models to examine how demographic, social, and health factors are related to the risk of suicide mortality in the United States. We find that individual level characteristics – age, sex, marital status, family size, education, employment status, existing medical conditions, and veteran status – as well as contextual factors – as measures of social disorganization – are related to suicide mortality risks. These results reveal important mechanisms that contribute to suicide mortality risk, a central preventable cause of death in the United States.

Social scientists have long endeavored to uncover the causes of suicide mortality. The risk of suicide is high, but the reasons for this have not been fully articulated. Whereas much of the literature focuses on causes of suicide rates at the aggregate level, we contribute to the literature by employing a recent and innovative national data set to identify individual level factors that affect differences in suicide. The study of suicide mortality is crucial because of the large number of potentially preventable deaths that result from suicides each year; it was the eleventh leading cause of all deaths and the second leading cause of preventable mortality, contributing to 29,423 deaths in the United States in 2001.[1] Furthermore, among persons aged 15-24, it is the third leading cause of death, and among persons aged 25-44, it is the fourth leading cause of death (Aris and Smith 2003). Below, we review various perspectives regarding suicide mortality and then examine them with individual level data.

SOCIAL INTEGRATION

Beginning with Durkheim's (1897 [1951]) germinal work, there is extensive literature on the effects of social integration on mortality, especially suicide. Durkheim classified four different forms of suicide – anomic, altruistic, fatalistic, and egoistic. Egoistic suicide occurs through the absence of social integration; altruistic suicide, on the other hand, occurs through exceptionally high rates of social integration. Indeed, several studies have examined the effects of social malaise on poor health and ultimately, on mortality. Anomic suicide can be contrasted with fatalistic suicide. Most studies have focused on egoistic suicide, or suicides due to lack of social integration.

Sex Differences in Suicide

Suicide mortality exhibits the largest sex difference for any of the major causes of death. Indeed, compared to female rates, male suicide mortality rates are 4.5 times greater (Miniño et al. 2002). Differential socialization plays a key role in sex differences in suicide mortality. Scant research has examined the U.S. suicide mortality patterns between males and females at the individual level, particularly while using a large set of covariates. This paper has three aims. First, we expect that individuals' sociodemographic characteristics – marital status, sex, age, and socioeconomic status – will substantially attenuate the male-female suicide mortality gap. It is important to control for income, education, and unemployment. Second, we expect that social relationships, at both the individual and contextual level, exert a strong influence on suicide. And last, we expect that veteran status has a large influence on suicide mortality, especially among males.

Theoretically, suicide rates increase as family integration decreases. For example, Breault (1986) examined the effects of family integration on reduced rates of suicide. He used the divorce rate as a proxy for family integration. He found that higher rates of divorce were associated with higher rates of suicide. Individuals kill themselves for selfish reasons; if integration is absent, there is no reason to live.

Accordingly, at the individual level, marital status should be an important predictor of suicide. Spouses can provide social support in stressful situations and can inhibit risky behaviors and encourage healthy ones by giving individuals a sense of meaning in their lives and a sense of obligation to others (Waite, 1995). The ability to talk about problems with a spouse, as well as the sense of responsibility to another person

should lower the incidence of suicide mortality for those who are married.

Further, some research suggests that marriage confers greater benefits to men than to women. For example, women may spend more time caring for the physical and emotional health of other family members, which may contribute to their stress while lowering the stress of their husbands and any children (Hochscheild, *The Second Shift*). Further, women who forego career advancement or high paying jobs to care for the domestic life of their partners may have fewer extra-marital resources such as friendships or independent sources of income. Thus, marriage may lower the risks of suicide for men farther than for women.

Conversely, marriage may provide substantial benefits for both men and women. Both men and women may feel a sense of responsibility to ensure the emotional and mental health of their spouse by prompting medical care, allowing for time away from stressful circumstances, or encouraging their spouse to talk about their problems. Thus, marriage may help both men and women.

Age Differences in Suicide

Individuals' sociodemographic characteristics – especially marital status, age, sex, and socioeconomic status – are important predictors of mortality (Hummer, 1996; Keil et al., 1992; Rogers et al., 2000; Sorlie et al., 1995). High levels of education, employment, and income reduce the risk of suicide.

Both age and sex are important predictors of suicide mortality. The relationship between suicide and age is often poorly understood and incompletely described. Although suicide mortality rates slowly increase with age, from 10.4 (per 100,000) for

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ages 15-24 to 19.4 for ages 85 and over (Miniño et al. 2002), this slight increase is unlike the exponential increase in age-specific mortality for chronic and degenerative diseases, and obscures the fact that suicide deaths are clustered in the middle years of age. Indeed, over two-thirds of all suicide deaths occur within the ages 25 to 64; over one-fifth of all suicide deaths occur within the ages 35 to 44 (Miniño et al. 2002).

Indeed, the increased risk of suicide at the older ages does not imply death due to bodily wear and tear or declines in immune functioning, as might be the case for cancer, cardiovascular disease, or respiratory disease mortality. Rather, suicide is a uniquely social phenomenon that requires the individual to deliberately end his or her own life. As such, social transitions such as widowhood, exiting from the labor force, or social isolation due to the poor health or death of one's friends may account for increases in suicide at the older ages.

Suicide and Health

Much research has unsurprisingly found that poor health – in the form of many chronic conditions, functional disability, or low subjective assessments of health – is a strong predictor of prospective mortality. But health status might also affect suicide mortality, albeit for different reasons. Indeed, poor physical health can be socially and psychologically stressful. Not only are those with many health problems likely to be depressed, but those who have many health problems may begin to feel as though they are a burden on other family members who must physically, emotionally, or economically care for them.

The poor health of one individual in a household may also affect the risks of

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suicide for others in the household. Two opposite hypotheses may frame this relationship. First, the stressor hypothesis suggests that individuals living in households with others who are in poor health may face increased stress over having to care for other household members. In turn, this increased stress may dispose those individuals toward increased risks of suicide.

Second and conversely, the social need hypothesis suggests that individuals who live in households where other members are in poor health may actually have lower risks of suicide because they have an individual in the household who needs their social and emotional support. Because individuals must fill the immediate and pressing need to care for others, they may be able to cope with the stress and depression associated with caring for another by undertaking a sense of social responsibility or altruism. In turn, this social responsibility would buffer them against the risk of suicide.

Suicide among Veterans

War veterans have a unique status in society. At times, they are revered as heroes, as in the case of veterans of World War II. As such, they may have lower risks of suicide as their status may confer them certain social privileges. Conversely, veterans of other wars may be less revered, including those from Vietnam. Further, although veterans may be revered on particular days or events, such as Memorial Day or Veterans Day, they may be afflicted with higher levels of stress and depression, due to things like post-traumatic stress disorder. Additionally, veteran benefits such as health care and employment services may not fully compensate for any mental or physical health problems that veterans acquired while at war. Thus, veterans may have higher risks of

suicide than their non-veteran counterparts.

Socioeconomic Differences in Suicide

Numerous scholars have looked at aggregate levels of social disruption as predictors of suicide, such as the divorce rate, the unemployment rate (Sampson, 1987), or rates of poverty or the concentration of poverty. While aggregate measures may capture general levels of social disruption, they cannot accurately account for how marital or socioeconomic statuses influence individuals' risks of suicide mortality without risking ecological fallacy. Thus, our individual-level analyses can examine relationships that have heretofore been tested at an aggregate level.

Higher levels of education may provide reduced risks of suicide, as highly educated individuals may have more social and cultural resources to deal with stressors or social isolation. Highly educated individuals are more likely to be married and in the labor force, factors that may mark social integration. Further, they may have higher levels of income and better health insurance, which may help them cope with social or emotional stress.

Employed individuals may be less likely to commit suicide than their counterparts who are unemployed or not in the labor force, as they may have friendship networks and social responsibilities that derive from work that keep them integrated in social life. Further, they may have adequate health care and a regular source of income, which could ameliorate stressors associated with poor health or times of economic need. Indeed, an interaction between employment and income may exist: employment that provides high levels of income may more effectively mitigate against other social stressors than would

low paying jobs.

Data and Methods

The central national source for suicide mortality information is Vital Statistics files from the National Center for Health Statistics (NCHS). Although Vital Statistics data provide age, sex, and cause-specific mortality, it provides little detail on important social covariates. Fortunately, NCHS has linked deaths to the National Health Interview Survey, the data set we employ in this article.

Because state laws require that death certificates be completed and submitted to a vital statistics office, the NCHS data arise out of circumstances that foster complete coverage and accurate reporting. Coroners or medical examiners report the data, including cause of death, to NCHS.

The accuracy of cause of death information in death certificates rests with medical personnel who vary in medical knowledge, skills, and training, as well as access to information about the circumstances surrounding the death (Gittlesohn, 1982; Hoyert and Rosenberg, 1997). Vital statistics data may underreport suicide deaths and instead over-record accidents.

In this analysis we use the National Health Interview Survey, linked to the Multiple Cause of Death File, because of the individual level variables and the ability to follow the risk of death over time. However, linking individual suicide deaths to a sample of the population at risk requires special attention to the benefits and detriments of our data.

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NCHS recently linked the National Health Interview Survey (NHIS) and the

Multiple Cause of Death (MCD) file through the National Death Index (NDI) to create

the NHIS-MCD file, a powerful, prospective, database for suicide research (NCHS,

1997). The NHIS contains a "core" set of questions that remain virtually unchanged from

year to year on a variety of sociodemographic, socioeconomic, health, and geographic

items (NCHS various years).

This analysis pools the 1987 through 1994 NHIS core data sets and links them to

the MCD file via the NDI through the end of 1997, the most recent year of matched data

(NCHS, 2000). This nationally representative data set provides annual cross-sectional

data for the non-institutionalized U.S. civilian population and allows an examination of

the risk of death over time for adults aged 18 years old and older.[2] This provides a data

set of 733,331 subjects, a large enough sample to make detailed comparisons on the risk

of death due to suicide, a relatively rare event.[3] We drop approximately 1.4 percent of

cases due to missing values on key variables, leaving a total of 723,313 cases for

analyses. Our final models include a total of 658 suicide deaths.

NCHS devised a probabilistic matching scheme that assigns weights to each of

twelve items: social security number; first and last name; middle initial; race; sex; marital

status; day, month, and year of birth; and state of birth and residence (Horm, 1993;

NCHS, 2000). Patterson and Bilgrade (1986) have shown that the matching methodology

is highly accurate. Our data are less than perfect due to the exclusion of individuals 17

years of age or younger and the modest number of deaths. But these imperfections are

counterbalanced by the exceptionally large sample, the nationally representative nature of

the survey, the linkage to prospective mortality data, and the consistency of our findings with national suicide patterns (Reidel, 1999).

Individual-Level Risk Factors

The demographic variables include age, sex, and race/ethnicity. Age is a continuous variable, ranging from age 18 to ages 99 and over. An age-squared term is included to account for the non-linear relationship between suicide and age, identified by past research (Kposown et al. 1995; Pampel 1996; Stack 1990). We code sex categorically, with females as the referent. Race/ethnicity includes non-Hispanic whites, the referent group, and non-whites. We do not include broad race/ethnic groups, because suicide is rare among the general population and is infrequent among specific race/ethnic groups, and because there is some discussion that suicides are not accurately reported for some racial groups, particularly blacks.

Social relations include marital status and family size. Marital status is coded as currently married (referent), divorced or separated, never married, and widowed. Family size includes those living along (referent), 2 members, 3 members, and 4 or more members.

Socioeconomic variables include education, employment status, and income equivalence. Education includes three categories: those with 0-11 years of schooling, high school graduates, and those with at least some college (referent). Employment status is coded as employed (referent), unemployed, and not in the labor force. Because the NHIS asks respondents about family but not individual income, we use an income equivalence scale that incorporates information about family size and income. Based on

economies of scale, equivalence coding accounts for a family of two having less purchasing power than a family of one with the same income (for detail on family equivalence coding, see Rogers, 1995). To aid in interpretation, family income equivalence is measured on a continuous scale in units of $10,000.

Contextual-Level Risk Factors

We used a methodology developed by Wells and Horm of the National Center for Health Statistics to create very small areas (VSAs), using the design features of the NHIS. VSAs are small geographic areas with unique identifiers that do not vary during the study period, allowing us to match the areas across the nine years of survey data. VSAs are based on the sampling design of the NHIS and are roughly equivalent to census blocks or block groups, although this equivalence is imperfect as the NHIS sometimes draws interviews from adjoining blocks. More detailed characteristics of VSAs, including geographic location, shape, or area, are concealed to ensure that surveyed individuals cannot be identified. We calculate the VSA level data by collapsing weighted individual characteristics by unique VSA identifiers derived from the processing quarter, random recode of PSU, week assigned to interview, and segment number fields in the NHIS. Thus, the VSA level variables derive from the aggregated individual-level characteristics of those persons living in a given geographic area.

But our estimates are potentially more accurate than those based on decennial Census data because we calculate VSA level factors for several years. Separate analyses control for the age structure within the VSA, as it may associate with suicide rates, single parent households, poverty levels, unemployment, levels of divorce and separation, and

levels of individuals living alone. The categorical cut-points for the VSA level variables are empirically derived. We tested various categorical, linear, and log transformations of the variables to ensure that they best capture their associations with mortality risk.

Coding of Suicide

Suicide, the dependent variable, is defined as death from causes coded E950-E959 in the *International Classification of Diseases* (U.S. Department of Health and Human Services, 1990). We examine suicide as an underlying cause of death, which is defined as the disease or injury that initiated the sequence of events leading directly to death (Goodman et al., 1982).[4] This conceptualization of mortality allows for straightforward tabulation, statistical analysis, and interpretation (Hoyert and Rosenberg, 1997; Manton and Stallard, 1984).[5] The NIHS-MCD data include suicides due to poisoning, strangulation, firearms, and other means.

Because this sample is based on individuals who survived from 1986 through 1997 or who died sometime within the period, we performed Cox proportional hazard analyses to examine suicide mortality differences over time (Shah et al., 1997). Cox proportional hazard modeling allows us to use 9 years of pooled, cross sectional data, to predict deaths matched up to 132 months after the year of survey.[6] Hazard models are especially well-suited to the multivariate examination of the risk of experiencing a rare event, such as suicide, over a specific follow-up period.

Because the NHIS interviewed people throughout the calendar year and because the deaths for individuals surveyed between January 1987 and December 1997 could have taken place in any of 132 follow-up months, estimates using the month of interview

allow the calculation of risk that a person will die at twelve points over the course of the

year, beginning from the actual month in which they were interviewed. This analysis

models the risk of dying by month, rather than weeks or days, because the MCD file

contains information about the month of death only, in part to protect the identity of the

decedent (NCHS, 2000). We report all coefficients in the form of hazard ratios, and we

use Stata 8.0 software to adjust the estimated hazard ratios and standard errors for the

stratified, clustered, unequal probability sampling design used by NCHS (StataCorp.,

2003).

Results

Table 1 reports the total number of suicides over the follow-up period, as well as

number of suicides, percent of the total number of suicides, and mortality rates for each

of the individual level risk factors. Although suicide is a rare event, males commit over

three-quarters of the total number of suicides. Whereas approximately 15 out of every

1,000 males commit suicide, only 4 out of every 1,000 females commit suicide.[7] Further,

most suicide victims are non-Hispanic whites. Although non-whites typically experience

higher risks of all cause mortality (NCHS 2003), suicide represents a particular cause of

death that is much more prevalent among non-Hispanic whites.

Social relationships are important for determining variations in suicide mortality

as well. Although married individuals comprise over half of all suicides, only 8 out of

1,000 married individuals took their own life over the follow up period. In contrast, 11

per 1,000 divorced or separated individuals and 12 per 1,000 never married individuals

committed suicide. Similarly, 14 out of 1,000 individuals living alone committed suicide

compared to only 7 out of 1,000 individuals with family sizes exceeding three persons.

Over 30 percent of all the suicides were committed by military veterans: a comparatively small group, and one that typically experiences advantages in mortality risk (Kang 1996). In fact, the suicide mortality rate for veterans, 18 per 1,000, exceeds all other groups.

Finally, suicide varies by socioeconomic and existing health factors. In fact, there are slightly lower rates of suicide for individuals who are employed and for individuals with an educational level that exceeds high school, compared to unemployed persons and those with less than a high school degree. More pronounced are the elevated rates of suicide for individuals experiencing major activity limitations and individuals with multiple existing medical conditions. But these rates do not simultaneously adjust for the other factors. For that, we turn to the multivariate results.

Table 1 about here

Table 2 presents hazard ratios of suicide mortality risk for each of the individual level covariates. Model 1 examines baseline differences and shows that males are over four times as likely as females to have experienced suicide mortality over the follow-up period. In contrast, non-whites are over 30 percent less likely to have committed suicide, compared to non-Hispanic whites. Male risk for suicide mortality actually increases as controls for social relationships are introduced (Model 2). Model 2 suggests that close social relationships have a protective effect on the risk of committing suicide. Compared to married individuals, divorced or separated, never married, and widowed persons experienced nearly 40 percent or higher risk of suicide mortality. This relationship demonstrates that the risk of committing suicide increased if close social relationships

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dissolved (divorced, separated, or widowed) or did not exist (never married).[8] In addition to being married, increased family size significantly reduced the risk of suicide mortality. Compared to individuals living alone, persons associated with a family of three or more members were approximately 35 percent less likely to have committed suicide over the follow-up period.

The effects of different marital statuses on suicide risk are attenuated when socioeconomic and individual health indicators are controlled for (Model 5). However, while the risk for divorced or separated persons is statistically explained away, widowed individuals are still 45 percent more likely to have committed suicide, compared to married individuals. Further, the protective effect associated with larger family size actually increases after controlling for other factors. Individuals with 3 or more family members are over 40 percent less likely to have committed suicide, compared to individuals living alone.

Military veterans are an interesting, unique, and arguably understudied population in the health and mortality literature. In general, veterans experience advantages in overall mortality, partly due to selection effects (Kang 1996). But controlling for sociodemographic variables, military veterans were 38 percent more likely to experience mortality from suicide, compared to non-veterans over the follow-up period (Model 3). This increased risk of suicide mortality persists even after controlling for social relationships, socioeconomic indicators, and existing health conditions (Models 4 and 5).

Finally, individuals who were unemployed or possessed less than a high school education were at significantly greater risk of suicide mortality than individuals who reported employment or greater than a high school education, respectively. Similar

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associated risk existed for persons with activity limitations or multiple existing medical conditions versus individuals with no limitations or no medical conditions.

Table 2 about here

Table 3 examines the effects of social relationships on suicide mortality risk at different contextual levels: household and VSA. Models 2, 4, and 6 control for the additional individual level covariates but, for parsimony, we present only the risk ratios for the baseline, household, and VSA level variables.

At the individual level it is impossible to determine marital status and family size simultaneously. However, the cumulative effect of marital status and family composition may be important when examining suicide mortality risk. For example, an individual who is married and with children possesses more close social relationships than an individual who is married without children and certainly more than an unmarried person with no children. In such a circumstance, based largely on the information provided in Table 2, we would expect to see a progressively larger protective effect against suicide mortality. Accordingly, we examine this scenario by looking at household family composition (Model 1). Indeed, compared to not married individuals without children, persons who are married with no children are 34 percent less likely to commit suicide and individuals who are married and have children are 54 percent less likely to commit suicide over the follow-up. Model 2 shows that these protective effects persist after controlling for the other individual level covariates.

It may be that areas characterized by unconventional social relationships, such as divorce or separation, or areas characterized by a lack of close social relationships, such as persons living alone, provide less social integration for individuals living in these

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areas. Consequently, these areas may support higher levels of unconventional behaviors, such as taking one's life. To examine this possibility we constructed two separate VSA level variables on concentration of divorce and separation and concentration of persons living alone. Model 3 shows that the risk of suicide mortality in the most highly concentrated divorce and separation VSAs is 32 percent greater than the risk in the least concentrated areas. However, Model 4 suggests that the individual level covariates are more important in determining risk of suicide mortality. Contrary to this, Models 5 and 6 demonstrate that the most concentrated areas of persons living alone are characterized by significantly greater risk of suicide mortality, over and above individual level covariates. Areas containing high concentrations of persons living alone may definitely lack any sense of social integration among members of the community.

Conclusion

Both contextual and individual sociodemographic factors help to explain sex differences in suicide mortality. With basic controls for age, compared to females, males are four times more likely to experience suicidal death (see also Farley, 1980; Griffith and Bell, 1989; Rogers, 1992; Rogers et al., 1996). This sex gap increases with controls for social relationships, and then attenuates with controls for social, economic, and health factors. Much of the sex gap in suicide mortality is due to lower rates of marriage and to lower socioeconomic status – especially lower levels of education and employment – among females. However, income equivalence is not significantly related to the risk of suicide mortality, implying that while poverty or poverty concentration may be important in predicting aggregate rates of suicide, it may be less useful for predicting individuals'

risks of suicide mortality.

Future research into sex differences in suicide could further explore cultural, structural, and behavioral characteristics. For example, differences in drug and alcohol abuse by sex may partially account for the gap in suicide risk. Concomitantly, beginning with Shaw and McKay's (1942) classic study of neighborhoods and crime, and continuing with Wilson's examination of urban poverty, researchers have been interested in neighborhood effects on the health and behavior of residents. Thus, incorporating the contextual and individual level characteristics is a very promising avenue in this area of research and might further close the remaining sex gap in suicide mortality.

There are clear sex differences in suicide due in part to the way that suicide was attempted. This paradox can be partly explained by the lethality of the weapon used. Compared to females, proportionately more males die from firearms, but proportionately fewer from drowning or jumping from high places (see Appendix A and derived from NCHS 1996). Compared to firearms, other forms of attempted suicide may not cause as much damage to an organ, may not damage as many organs, and therefore may be less likely to prove fatal. Thus, a better understanding of sex differences in suicide may require more detailed information on the method of suicide attempted. Over time, there has been an increase in the use of semiautomatic pistols rather than revolvers, in larger caliber handguns, and in emergency room patients admitted for treatment of multiple rather than single gunshot wounds, all of which increase the case-fatality rate (Wintermute, 1996).

The NHIS-MCD prospective data set contributes to the suicide literature by ascertaining responses from respondents on a variety of issues, and then following these

respondent records over time to determine whether the person later dies due to suicide. The NHIS-MCD provides accurate estimates of suicides, based on respondent's answers to interviews and on subsequent data abstracted from death certificates. Moreover, the data provide individual-level detail on social, economic, and geographic factors that affect mortality. In sum, we find it important not only to consider structural predictors of aggregate rates of suicide as prior studies have done, but also to examine the factors that put some individuals at higher risks of mortality than others.

Suicide research is an important sociological study. Suicide mortality is important because of its emphasis on firearms. Indeed, 57.9 percent of all firearm injury deaths in the year 2000 were suicides (Miniño et al. 2002). Research articulating specific factors that can reduce suicides and close the sex gap in suicide mortality has far-reaching implications for preventing premature deaths.

Endnotes

[1] Note that four terrorist deaths in the September 11, 2001 attacks were classified as suicides (Arias and Smith 2003).

[2] NCHS interviews non-institutionalized individuals, although they may become institutionalized over the course of the follow-up. Therefore, we may capture some institutionalized suicide deaths, but these deaths will be few and will be underrepresented from the entire population. Further, because of confidentiality and consent restrictions, NCHS does not link records of individuals under the age of 18 to subsequent death records (NCHS, 2000). This produces a left censoring issue – some individuals die from suicide before the age of 18 and are therefore not included in the data. The reader should be mindful, therefore, that we base our results and interpretations on the risk of death among adults.

[3] About 2% of the NHIS records termed "ineligible" contain insufficient information to be matched to any death record. NCHS identifies these records so that they may be dropped from the analysis. If these records were retained, it would give the mistaken impression that these individuals would live forever.

[4] Researchers have noted that some causes of death, such as diabetes, frequently contribute to mortality, even if they are not listed as the underlying cause (Hoyert and Rosenberg, 1997; Manton and Stallard, 1984; Wrigley and Nam, 1987). Among suicide attempts, a person mat unsuccessfully use a firearm, be taken to the hospital for surgery, recover from the gunshot, but then later die of, say, an infection. We examined all causes of death and found only 1 death that was classified as a suicide arising from "Late Effects" of a suicide attempt. There is no evidence in our data that the suicide attempt

exclusively contributed to the death. Thus, all suicides examined in this analysis are classified as the underlying cause of death.

[5] Two forms of right censoring may occur. First, individuals may not die from suicide by 1997, but may die of suicide in subsequent years. Second, individuals may die of other causes, thus no longer risking death from suicide. We account for the latter by calculating a person's risk of death until they die of any cause, so that they will contribute the appropriate number of "at risk" months.

[6] The cross-sectional nature of the data set precludes the examination of time-varying covariates for such variables as marital or employment status. Thus, one area for future research would be the examination of the effects of covariate changes over time on suicide. In the present analysis, age and vital status are the only variables that change with time.

[7] Whereas males commit suicide disproportionately more often than females, the most common specific cause of death for male and female suicides involves firearms and explosives. For more information on specific cause of death among the suicide victims, see Appendix A.

[8] The importance of marital status in reducing suicide rates also differs by gender. Between Models 1 and 2, the sex hazard ratio increases, indicating that after controlling for marriage, the sex gap in suicide increases slightly.

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Table 1. Descriptives for Suicide Mortality, US Adults, 1986-1997.

	Suicides[a]	% of suicides	Suicide mortality rate[b]
	658		9.0
Sociodemographic			
Age (mean)	45.2	--	--
Sex			
Male	511	77.66%	15.0
Female	147	22.34	4.0
Race/Ethnicity			
non-Hispanic white	545	82.83	10.0
non-white	113	17.17	6.0
Social Relationships			
Marital Status			
Married	369	56.08	8.0
Divorced or seperated	79	12.01	11.0
Never married	162	24.62	12.0
Widowed	48	7.29	9.0
Family Size			
Living alone	163	24.77	14.0
2 members	239	36.32	11.0
3 members	99	15.05	7.0
4 or more members	157	23.86	7.0
Veteran status			
not a veteran	464	69.76	7.0
veteran	199	30.24	18.0
Socioeconomic			
Family Income (mean in 1995 dollars)	36,546	--	--
Employment			
Employed	383	58.21	8.0
Unemployed	27	4.10	11.0
Not in labor force	248	37.69	10.0
Education			
less than HS	174	26.44	11.0
HS	260	39.51	9.0
more than HS	224	34.04	8.0
Health			
Activity Limitation			
No limitations	481	73.10	8.0
Some limitations	107	16.26	12.0
Major limitations	70	10.64	17.0
Medical Conditions			
Zero	314	47.72	8.0
1 condition	138	20.97	8.0
2 to 3 conditions	144	21.88	12.0
4 or more conditions	62	9.42	15.0

[a] Number of suicides unless otherwise noted.

[b] Suicides per 1,000.

Source: 1986-1997 NHIS-NDI linked file

Table 2. Hazard Ratios of Suicide Mortality Risks, Individual level, US Adults, 1986 to 1997.

	Model 1	Model 2	Model 3	Model 4	Model 5
Sociodemographic					
Age	0.95**	0.96	0.93**	0.95†	0.96
Age^2	1.00**	1.00†	1.00**	1.00*	1.00
Sex					
female	ref	ref	ref	ref	ref
male	4.03**	4.26**	3.60**	3.80**	3.98**
Race/Ethnicity					
non-Hispanic white	ref	ref	ref	ref	ref
non-white	0.67**	0.67**	0.68**	0.69**	0.65**
Social Relationships					
Marital Status					
Married		ref		ref	ref
Divorced or seperated		1.59*		1.57*	1.41
Never married		1.39*		1.39*	1.26†
Widowed		1.55**		1.60**	1.45**
Family Size					
Living alone		ref		ref	ref
2 members		0.95		0.94	0.84
3 members		0.65**		0.65**	0.58**
4 or more members		0.64**		0.64**	0.56**
Veteran status					
not a veteran			ref	ref	ref
veteran			1.38**	1.39**	1.38**
Socioeconomic					
Logged family income (in 1995 dollars)					1.07
Employment					
Employed					ref
Unemployed					1.57**
Not in labor force					1.34*
Education					
less than HS					1.40**
HS					1.28**
more than HS					ref
Health					
Activity Limitation					
No limitations					ref
Some limitations					1.24**
Major limitations					1.44*
Medical Conditions					
Zero					ref
1 condition					0.92
2 to 3 conditions					1.36*
4 or more conditions					1.63**
Log Likelihood	-6064	-6034	-6059	-6029	-5991

Source: 1986-1997 NHIS-NDI linked file

†p≤.10; *p≤.05; **p≤.01

Table 3. Hazard Ratios of Suicide Mortality Risks, Household and VSA level, US Adults, 1986 to 1997.

	Model 1	Model 2[a]	Model 3	Model 4[a]	Model 5	Model 6[a]
Sociodemographic						
Age	0.96[†]	0.95[†]	0.95**	0.95*	0.95**	0.95*
Age sq	1.00*	1.00	1.00**	1.00*	1.00**	1.00*
Sex						
female	ref	ref	ref	ref	ref	ref
male	4.31**	4.04**	4.05**	3.89**	4.04**	3.87**
Race/Ethnicity						
non-Hispanic white	ref	ref	ref	ref	ref	ref
non-white	0.65**	0.62**	0.63**	0.60**	0.67**	0.62**
Household Family Composition						
Not married, no children	ref	ref				
Not married with children	1.17	1.07				
Married, no children	0.66**	0.65**				
Married with children	0.46**	0.47**				
VSA Level Variables						
Divorce and Seperation						
33% least concentrated			ref	ref		
34% to 65% concentrated			0.98	0.95		
33% most concentrated			1.32*	1.23		
Living alone						
33% least concentrated					ref	ref
34% to 65% concentrated					1.31**	1.27**
33% most concentrated					1.35**	1.29**
Log-Likelihood	-6036	-5993	-6058	-6012	-6059	-6012

Source: 1986-1997 NHIS-NDI linked file

[a] These models control for individual socioeconomic and health covariates.

[†]p≤.10; *p≤.05; **p≤.01

Appendix A. Suicide Mortality Specific Cause of Death, by Sex, U.S. Adults, 1986-1997.

	Total	%	**Males**	%	**Females**	%
Poisoning	131	19.91%	77	15.07%	54	36.73%
Hanging, Strangulation, suffocation	81	12.31	61	11.94	20	13.61
Drowning	11	1.67	6	1.17	5	3.40
Firearms and Explosives	398	60.49	344	67.32	54	36.73
non-white	5	0.76	5	0.98	0	0.00
Jumping from high place	17	2.58	9	1.76	8	5.44
Self-inflicted other	14	2.13	9	1.76	5	3.40
Late effects	1	0.15	0	0.00	1	0.68
Totals	658		511		147	

Source: 1986-1997 NHIS-NDI linked file