

Gender and age differences in suicide mortality in the context of violent death: Findings from a multi-state population-based surveillance system

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Abstract

Objective: Males are more likely than females to die by all forms of violent death, including suicide. The primary purpose of the present study was to explore whether the gender difference in suicide rates is largely accounted for by males' general greater tendency to experience violent deaths. The current study examined gender and age differences in suicides and other violent deaths, using data from a population-based surveillance system.

Method: Pearson's chi-square tests and logistic regression analyses were conducted with data for 32,107 decedents in the 2003–2005 National Violent Death Reporting System (NVDRS). Decedents were categorized by gender, age, and death by suicide versus other violent means.

Results: When suicides were examined in the greater context of violent death, the total proportion of violent deaths due to suicide did not differ across gender. When deaths were examined by age group, after controlling for ethnicity, marital status, and U.S. location in which the death occurred, males in early to mid childhood were significantly more likely than same-aged females to die by suicide relative to all other violent deaths. The portion of deaths due to suicide was for the most part equal across both genders in late childhood, young adulthood, and mid-adulthood. Older males were more likely than older females to die by suicide relative to other violent deaths.

Conclusion: Our findings suggest that the risk of dying by suicide relative to other violent deaths may be more pronounced at certain developmental stages for each gender. This knowledge may be valuable in tailoring prevention strategies.

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1. Gender and age differences in suicide mortality in the context of violent death

Violent deaths, such as suicide, homicide, motor vehicle accidents, and accidental firearm discharges, are among the top 10 causes of death for all age groups in the United States [1]. These deaths represent an important area of study as they are behaviorally driven, and thus, to some extent, preventable [2]. Suicide is the most common form of violent death, comprising almost half of all violent deaths in the United States [3]. It is known that whereas females attempt suicide more often than males, males are more likely to die by suicide [3–5]. More broadly, males are also more likely to die of violent deaths

[6,7]. It is unknown, however, if this gender difference in completed suicide is due simply to males' greater propensity to experience more violent deaths in general.

1.1. Gender and violent deaths

The increased rate of male suicides may be due to an overall tendency to die by more violent methods than females. Indeed, although males are three to four times *less* likely than females to engage in suicidal behavior, males who do engage in suicidal behavior are three to four times *more* likely than females to actually die in a suicidal act [3–5]. This is due in part to males adopting more lethal, and thus often more violent, means than females. Females are more likely than males to self-poison, a method which tends to be slow-acting, and is fatal in only a small percentage of cases [3,8–10]. In contrast, males more commonly utilize hanging and firearms, which have the highest case fatality ratios out of all means of suicide in the United States [3,8–10].

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Additionally, males have a greater tendency than females to engage in behaviors that are not only related to death by suicide but also violent death in general. First, males are more likely to engage in generally aggressive behavior [11,12], to carry weapons which could facilitate aggressive behavior [13,14] and to require emergency medical care from injuries due to aggressive behaviors [15]. Aggressive behavior is associated with greater propensity for both violent death in general [7] and suicide in particular [16,17]. Second, males tend to engage in more risk-taking behavior [18,19], including reckless driving [20–22]. Risk-taking behavior, like aggressive behavior, is also associated with both violence-related deaths in general [23] and suicide deaths more specifically [24]. Third, males tend to be more impulsive [25]. Impulsivity predicts both aggressive [26,27] and risk taking behavior [28]. Again, like aggressive and risk-taking behaviors, impulsive behavior is associated with violent deaths in general [29] and suicide in particular [16,30,31]. Collectively, these findings suggest that the gender disparity in suicide rates may in large part be due to the greater rate of violent deaths for men in general.

1.2. Age as a moderator

It is also worth noting that suicide and violence-related fatalities share similar developmental tendencies with the underlying processes outlined above. That is, rates of both suicide in particular and violent deaths in general increase substantially in mid-to-late adolescence and early adulthood, continue to increase in mid-adulthood, and later decline in late adulthood [1]. This mortality trend may be due to developmental changes in processes that underlie risk for both suicide and violent death. Indeed, several of these risk factors, which also separate men and women, including aggression, risk-taking, and impulsivity, tend to peak during mid-to-late adolescence as well, beginning to decline in early to mid-adulthood [11,31–35]. It has been suggested that these risk factors decline as cognitive control processes begin to solidify and emotional regulation increases with the maturation of the prefrontal cortex during adolescence and early adulthood [36]. These patterns suggest that developmental considerations may be important in the etiology of violent deaths in general and suicide in particular. Thus, a secondary aim of this study is to examine age as a moderator of gender differences in suicide.

1.3. Current study

Previous research on gender and age differences in suicide has focused largely on risk factors and means of suicide. To our knowledge, however, no research to date has examined gender and age differences in suicide in the context of violent death. Thus, a question that naturally follows is to what degree are the well-documented gender differences in suicide rates a function of males' general greater propensity to experience more violent deaths. The National Violent Death Reporting System (NVDRS) is

uniquely suited for research in this area. It is a population-based surveillance system managed by the Centers for Disease Control and Prevention that collects data regarding violent deaths in the United States, most notably including the characteristics and circumstances surrounding each death [37]. The primary purpose of the present study was to explore whether the gender difference in suicide rates is largely accounted for by males' general greater tendency to experience violent deaths. Specifically, we assessed whether gender served to differentiate suicides from other violent deaths in the NVDRS. We hypothesized that the portion of violent deaths due to suicide does not differ across genders. We also considered age as a moderator in our analysis of gender as a factor differentiating suicide from other violent deaths. We hypothesized that the tendency to die violently may be more pronounced at certain developmental stages.

2. Method

2.1. Data source

The data on violent deaths used in the current study were obtained from the 2003–2005 NVDRS database ($n = 32,107$). The NVDRS is an incident-based surveillance system that provides detailed information for participating states about different types of violent deaths. Data from 2003 were comprised of seven states (Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia). Six more states were added to the NVDRS in 2004 (Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin), and four additional states were added in 2005 (California, Kentucky, New Mexico, and Utah) to the database, for a total of 17 states. With the exception of California, for which data were only collected from three counties (Los Angeles, Riverside, San Francisco, and Santa Clara), data for each state were collected state-wide.

The NVDRS collected details about each decedent, including manner and mechanism of death, demographic characteristics, and the context in which the death took place [37,38]. The NVDRS linked data from multiple information sources, including death certificates, hospital records, coroner or medical examiner's reports, toxicology laboratories, crime laboratories, and law enforcement records [39]. Data were assembled and coded monthly by trained abstractors at designated locations (e.g. state health departments or subcontracted entities, such as a medical examiner's office) throughout each state. Abstractors adhered to the NVDRS coding manual when reviewing source documents to ensure coding consistency and accuracy [40]. Additional information regarding the NVDRS has been described elsewhere [37,40].

2.2. Measures

2.2.1. Demographic characteristics

Demographic characteristics were derived from the death certificate, and included gender, age, and marital status at the

time of death, and the U.S. region in which the death occurred (i.e., North East, Midwest, South, West).

2.2.2. Manner of death

NVDRS abstractors used source documentation to classify each death into one of five categories: death by suicide, homicide, unintentional firearm discharge, legal intervention (such as when a decedent is killed by an officer of the law acting in the line of duty), or undetermined intent (assigned in cases in which the manner of death is unclear from the available data, such as when a death can be classified as either jumped or fell). For cases in which source documents were not in agreement on the nature of the death, the abstractor assigned a manner of death based on the general consensus of the source documents [40].

2.3. Data analysis

In order to determine whether the proportion of violent deaths due to suicide varied across gender, we conducted Pearson's χ^2 tests with gender as the predictor variable and death by suicide versus other violent means as the criterion variable. We then examined age as a moderator, using the thirteen groupings for age at time of death provided in the NVDRS dataset (i.e., 0–14 years, 15–19 years, 20–24 years, 25–29 years, 30–34 years, 40–44 years, 45–49 years, 50–54 years, 55–59 years, 60–64 years, 65–69 years, 70–74 years, and 75 years and older). We subsequently built on the Pearson's χ^2 tests with logistic regression analyses to examine whether our findings still held after controlling for relevant covariates in the dataset including race and ethnicity, marital status, and the U.S. region in which the death occurred. We excluded marital status from our analysis of the 0–14 and 15–19 age groups, as there was not enough variability within these particular groups for meaningful analysis.

3. Results

3.1. Descriptive statistics

Table 1 presents the demographic characteristics of the sample categorized by suicide and other violent deaths. Suicides comprised 64% of violent deaths in the NVDRS ($n = 20,577$). Suicide decedents tended to be white, to have completed a minimum of a high school level of education, and to be between the ages of 20 and 59 at the time of death.

3.2. Gender and age differences

Male suicides outnumbered female suicides by a ratio of 4 to 1 (see Table 1). Likewise, there were 4 male decedents for every female decedent when all other violent deaths were compared. When further categorized by age at time of death, male suicides also outnumbered female suicides in every age group, as shown in Fig. 1.

However, when deaths by suicide were compared across gender as a proportion of all violent deaths, a more nuanced

Table 1
Demographic characteristics categorized by type of death.

	Suicide ($n = 20,569$)	Other violent deaths ($n = 11,538$)
Gender		
Female	21.4%	21.5%
Male	78.6%	78.5%
Race		
Black	7.6%	51.6%
Hispanic	4.3%	12.0%
White	85.1%	33.5%
Other	3.0%	3.0%
Marital status		
Never married	33.1%	63.9%
Widowed	7.0%	3.1%
Separated or divorced	21.6%	11.6%
Married	38.3%	21.4%
Educational attainment		
Some high school or lower	26.6%	48.9%
High school graduate	47.0%	41.4%
Undergraduate degree	20.7%	8.6%
Higher than undergraduate degree	5.6%	1.1%
Age category		
0–19 years	5.7%	17.5%
20–29 years	15.7%	33.2%
30–39 years	17.8%	19.8%
40–49 years	23.1%	15.0%
50–59 years	17.2%	7.7%
60–69 years	8.4%	3.5%
70+ years	12.0%	3.3%

pattern of results emerged. Overall, the proportion of violent deaths due to suicide did not differ for males and females (64% vs. 64%, $\chi^2 = 0.84$, $p > .05$). Yet, when these proportions were categorized by age groups, there were several significant differences. Fig. 2 depicts male and female suicides as a proportion of violent deaths, and Table 2 presents the χ^2 analyses for each age group. Male violent deaths were more likely than female ones to be due to suicide in childhood, from the ages of 0 to 14. In contrast, in late childhood to young adulthood (i.e., between the ages of 15 and 29), female violent deaths were more likely than male ones to be due to suicide. There were no significant gender differences in middle age (i.e., from age 30 to 59). However, the percentage of male violent deaths due to suicide was significantly greater than female ones in late adulthood (i.e., from age 60 and older). When these age differences were examined with logistic regression analyses controlling for race and ethnicity, marital status, results across age groups remained the same with one exception (Table 3). The proportion of violent deaths due to suicide from late childhood to young adulthood (i.e. between the ages of 15 and 29) no longer significantly differed across gender.

4. Discussion

In terms of raw numbers, males are markedly more likely than females to die by suicide [3] and by violent means in general [6]. We explored whether the gender difference in

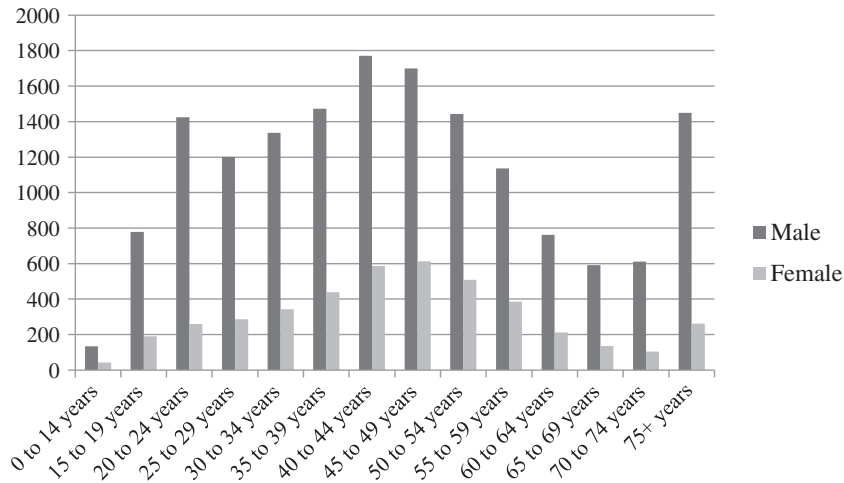


Fig. 1. Gender differences in number of suicides across the lifespan.

suicide rates was largely accounted for by gender disparities in the broader construct of violent death. Our results, using data drawn from the NVDRS, demonstrated that, when suicides were examined in the greater context of violent death, the total proportion of violent deaths due to suicide did not differ across gender. When deaths were further examined by age group, there were a greater proportion of violent deaths due to suicide in females from childhood to young adulthood. This gender difference disappeared during mid-adulthood, and then reversed in late adulthood, with the proportion of deaths due to suicide being significantly greater in males. Our findings suggest that the gender disparity in suicide rates is not accounted for by gender differences alone, and that the tendency to die by certain violent means may be more pronounced at certain developmental stages for each gender.

Consistent with prior research, we found that the sheer number of male suicides outnumbered female suicides overall and across the lifespan [3]. This gender disparity likely reflects the greater tendency of males to use more immediately lethal, and often generally more violent, means when engaging in suicidal acts than females. In the United States, males are more likely to attempt [41] and complete [3] suicide using hanging or firearms. These methods tend to be more violent or quicker acting in nature, resulting in fatalities in 69% and 85% of cases, respectively [42]. In contrast, females are more likely to use less violent methods such as self-poisoning [3,41], which may be high in toxicity, but results in fatalities in only 2% of cases [42]. This low case fatality ratio may be reflective of the slow-acting nature of self-poisoning, which likely allows more time for potential medical intervention. Consequently, this discrepancy in

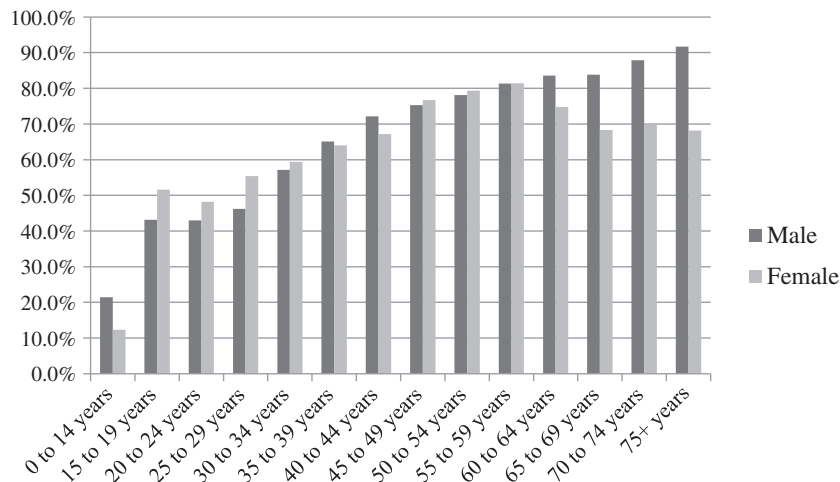


Fig. 2. Suicide as a percentage of violent deaths across the lifespan.

Table 2
Bivariate gender differences in proportion of suicides across the lifespan.

Age group	χ^2	OR	95% CI	<i>p</i>
All years	0.037	0.995	(0.941–1.052)	.847
0–14 years	12.394	1.938	(1.334–2.808)	<.001
15–19 years	8.829	0.712	(0.569–0.891)	.003
20–24 years	5.195	0.891	(0.810–0.981)	.023
25–29 years	14.754	0.690	(0.571–0.835)	<.001
30–34 years	0.922	0.913	(0.759–1.099)	.337
35–39 years	0.263	1.048	(0.877–1.252)	.608
40–44 years	7.687	1.265	(1.071–1.494)	.006
45–49 years	0.668	0.924	(0.764–1.117)	.414
50–54 years	0.438	0.928	(0.744–1.158)	.508
55–59 years	0.001	0.996	(0.762–1.302)	.977
60–64 years	10.883	1.709	(1.240–2.356)	.001
65–69 years	23.740	2.406	(1.679–3.447)	<.001
70–74 years	31.095	3.147	(2.073–4.778)	<.001
75+ years	151.269	5.131	(3.881–6.784)	<.001

OR = odds ratio for males relative to females; CI = confidence interval.

lethality of means chosen may largely account for the gender disparity in overall number of suicides.

When suicides were examined within the greater context of violent death, we found that, as hypothesized, males were no more likely than females to die by suicide relative to all other violent deaths. This result suggests that the well-documented finding that males are more likely than females to die by suicide may to some degree be a function of the more general tendency of males to die by violent means relative to females. Males exhibit an increased propensity for experiencing violence, being two to three times more likely than females to incur unintentional or violence-related injuries in the United States [6], and perhaps consequently dying more frequently as a result of unintentional injury, suicide, and homicide [43–45]. It may be that, while similar proportions of males and females are more prone to suicide deaths relative to all violence-related deaths, the overall

Table 3
Multivariate gender differences in proportion of suicides across the lifespan.

Age group	OR	95% CI	<i>p</i>
0–14 years	1.944	(1.329–2.844)	.001
15–19 years	1.065	(0.815–1.390)	.645
20–24 years	1.102	(0.887–1.370)	.379
25–29 years	0.989	(0.788–1.240)	.921
30–34 years	1.177	(0.945–1.467)	.145
35–39 years	1.287	(1.047–1.583)	.017
40–44 years	1.517	(1.254–1.837)	<.001
45–49 years	1.069	(.0860–1.328)	.547
50–54 years	0.947	(0.736–1.218)	.673
55–59 years	1.197	(0.895–1.602)	.226
60–64 years	1.577	(1.099–2.265)	.014
65–69 years	3.101	(2.046–4.701)	<.001
70–74 years	2.996	(1.867–4.807)	<.001
75+ years	5.268	(3.811–7.282)	<.001

OR = odds ratio for males relative to females; CI = confidence interval. Odds ratios are adjusted for race/ethnicity, marital status, and the U.S. region in which the death occurred. Adjustment for marital status was excluded for ages 0–19 due to too few cases for meaningful analysis.

number of males likely to experience any form of violent death is simply more sizeable.

The interesting pattern of gender differences across the lifespan merits discussion. These findings suggest that gender differences in suicide are not simply a reflection of gender differences in violent deaths more generally, but that there are certain ages where gender differences in suicide relative to other violent deaths do exist. We explain and interpret these findings more fully below.

In childhood, males were more likely than females to die by suicide relative to other violent means. One explanation for this disparity may be that, in contrast to older males, males in this age range are less likely to be victims of homicide and less likely to die as the result of accidents [6]. This reduced tendency to die by other violent means during childhood may be the consequence of behavioral risk factors that tend to increase the chance of violent deaths among males such as aggression, risk-taking, and impulsivity, peaking later, during mid-to-late adolescence [11,31–35]. Given that males at an early age are less likely to die by these means compared to older counterparts, suicides likely make up a higher proportion of male violent deaths during this age range.

In adolescence and young adulthood, females represented a greater proportion of suicides relative to other forms of violent death. One possible explanation of this finding is that some of the risk factors underlying both suicides and other violent deaths such as aggression, impulsivity, and risk taking, may be more pronounced in males than females at this stage of life [32,34]. These behaviors may more directly contribute to violent deaths than to suicides. Suicide risk is theorized to be complex, resulting from a confluence of risk factors [46]. It may be that aggressive, impulsive, and risky behaviors directly contribute to violent deaths, whereas, in the case of suicide deaths, these behaviors may exert their influence indirectly, through the presence of mediating or moderating constructs. These traits may explain the gender difference in suicide relative to other violent deaths during this developmental period. However, after including marital status, race and ethnicity, and U.S. location at the time of death as covariates, the proportion of suicides relative to other forms of violent death no longer differed between genders. However, it is still worth noting that, in contrast to the trends observed in early to mid adolescence and in late adulthood, males in these age groups are still no more likely than females to die by suicide relative to other violent deaths.

In mid-adulthood, we found that the portions of violent death due to suicide did not differ across genders. This finding may reflect developmental changes in processes underlying both suicide and violent death. Risk factors such as aggression, risk-taking, and impulsivity, are most pronounced in adolescence, but taper off in early adulthood [32,34]. It may be that, as a result, gender differences in these behaviors become less marked by mid-adulthood because the underlying risk factors become less pronounced between genders.

In late adulthood, we found that males were more likely to die by suicide relative to other violent deaths when compared with same-age females. It may be that, with gender differences in behavioral risk factors substantially reduced at this stage of life, major life changes more directly contribute to elderly males' greater propensity for suicide deaths. Retirement occurs during this developmental period, and is more strongly related with elderly male [47]. Moreover, elderly males tend to experience more health issues associated with late adulthood (e.g. visual impairment, neurologic disease, and malignant illness) than elderly females [48]. These changes in elderly males' social roles and physical health may contribute to perceptions of burdensomeness on others, a construct theorized to contribute to the desire for suicide [46]. As these life changes occur, social isolation may have a stronger effect on males. Suggestive of this possibility, widowhood heightens the risk of suicide in elderly males, but not in females [49,50], and lack of familial belongingness in particular is also more strongly associated with elderly male suicides [47]. However, the most directly contributing factor may be the tendency of elderly males to adopt more lethal means of suicide relative to females. Males in late adulthood are more likely to utilize methods with higher case fatality ratios, such as firearms, and less likely to choose methods with lower case fatality ratios, such as poisoning [51,52].

Our study has several limitations that should be acknowledged. First, despite the sizeable nature of our sample, the data we derived from the NVDRS database are not nationally representative. Specifically, the sample we drew from the 2003-2005 NVDRS database covers approximately 17 states. Additionally, the data from participating states were not all available at each of year of the study. While these states are not substantially different in terms of age, gender, race/ethnicity, and suicide rates from the overall composition of the United States [53], a degree of caution is warranted in generalizing our findings to the whole of the United States. Recent proposals to expand the NVDRS to be nationally comprehensive [54] are crucial in addressing this limitation. Second, the determination of cause of death may have been miscategorized in some cases. That is, that some suicides may have been misclassified as other forms of violent death, and vice versa. However, the rigorous process of data collection and case coding the NVDRS uses in determining cause of death substantially reduces the likelihood of this occurrence. Third, we were unable to account for additional environmental and healthcare factors in our study that may further account for different forms of violent death. This may be a direction for future research. Our study has several strengths as well. To our knowledge, this is the first study to date to examine gender and age differences in suicides relative to other violent deaths. We used population-based, multi-state data derived from a database comprised solely of violent deaths, which allowed for a uniquely comprehensive examination of this topic.

Overall, our study makes an important and unique contribution to the literature regarding gender differences in suicide completion. It expands on previous findings that male suicides outnumber female suicides across the lifespan by examining proportional gender differences in suicide completions in the more general context of violent deaths. Our results suggest that gender differences in suicide are not simply a reflection of gender differences in violent deaths more generally. These findings have meaningful implications for understanding the nature of suicide risk, which may in turn inform treatment strategies. Our results are consistent with the possibility that the nature of suicide risk changes over the course of development and with gender. Hence, the most relevant risk factors at a given age may have a less prominent role at a different age. Suggestive of this possibility, the relationship between risk factors such as impulsivity, aggression, risk-taking, and suicide appears to weaken with age [11,31–35]. Thus, better understanding of gender- and age-specific risk factors may lead to more effectively tailored interventions. Future research focusing on delineating factors related to suicide risk across gender and age may be worthwhile in this vein.

Conflicts of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Acknowledgment

This research uses data from NVDRS, a surveillance system designed by the Centers for Disease Control and Prevention's (CDC) National Center for Injury Prevention and Control. The findings are based, in part, on the contributions of the 17 funded states that collected violent death data and the contributions of the states' partners, including personnel from law enforcement, vital records, medical examiners/coroners and crime laboratories. The analyses, results and conclusions presented here represent those of the authors and not necessarily those of CDC.

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