Research Report

Sociodemographic predictors of suicide means in a population-based surveillance system: Findings from the National Violent Death Reporting System

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ABSTRACT

Background: Multivariate studies of specific suicide means are relatively rare, given the logistical challenges associated with the low base rate of suicide in the general population. Thus, information on individual characteristics associated with specific suicide means remains relatively wanting. The current study provided the largest examination to date of sociodemographic characteristics associated with different means of lethality among suicide decedents, using data from a multi-state population-based surveillance system.

Methods: Multivariate logistic regression was used with data for 20,577 suicide decedents in the National Violent Death Reporting System from 2003 to 2005.

Results: Firearm decedents were more likely male, elderly, non-Hispanic white, married, veterans, and born in the U.S. Hanging and suffocation decedents were more likely male, young, racial/ethnic minorities, never married, non-veterans, and foreign-born. Decedents that jumped from heights were more likely female, older, non-Hispanic black, never married, non-veterans, and foreign-born. Decedents who used sharp instruments were more likely older, never married, and foreign-born. Self-poisoned decedents were more likely female, middle-age, non-Hispanic white, and not married. Regarding specific poisons, alcohol was more likely to be used by middle-age decedents; gas by males, elderly, and married individuals; over-the-counter drugs by females, adolescents, and foreign-born decedents; prescription drugs by females, middle-aged, and U.S. born individuals; and street drugs by males and racial/ethnic minorities.

Limitations: The data were drawn from 18 states and so cannot be regarded as nationally representative.

Conclusions: Substantial sociodemographic variability exists across different suicide means. Recognition of this variability may help to tailor prevention efforts involving means restriction.

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1. Introduction

Violence-related injuries have been consistently identified as among the leading causes of death in the United States (Centers for Disease Control and Prevention, 2011). Insofar as violent deaths are behavior-dependent, and to the extent that the factors that influence such behaviors are modifiable, the occurrence of these deaths should be preventable. The most common form of violent death is suicide (Karch et al., 2008). Indeed, suicide is one of the top 10 causes of death across all age groups, and the third leading cause of death from the ages of 10 to 24 (Centers for Disease Control and Prevention, 2011). What is more, while a notable decline has been observed in recent years in the mortality rates for several leading causes of death, including heart disease (Lloyd-Jones et al., 2010), HIV (Kochanek et al., 2011), and motor vehicular accidents (Rockett et al., 2012), deaths by suicide have increased over much the same time period, and are now the leading cause of injury-related death (Hu et al., 2008; Rockett et al., 2012). Given the consistently high rates of suicide found in the general population, there remains a pressing need for effective prevention programs.

Given that the proportion of suicide attempts resulting in death (i.e., case fatality ratio) is tied to ease of access to lethal means (Miller et al., 2012a), one relatively effective strategy for preventing suicidal behavior is to limit the availability of means for

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attempting suicide, or means restriction (Mann et al., 2005; Yip et al., 2012). This approach may result in the use of less lethal alternative means and fewer suicide attempts overall. Empirical support for the effectiveness of means restriction as a suicide prevention strategy has been found (for a recent review, see Yip et al., 2012). For example, one of the most recent studies in this area, utilizing a naturalistic epidemiological design, examined the effects of a policy change by the Israeli Defense Forces requiring its soldiers to leave their firearms on base when they return home on the weekends (Lubin et al., 2010). The implementation of this policy was followed by a 40% decrease in suicide rates. That this decline was accounted for by a 70% decrease in suicides on weekends, and no significant change in suicide rates on weekdays, is strongly suggestive of the effectiveness of limiting firearms access in preventing suicide in at-risk individuals. Also worth noting is that this study found no observable increase in suicide by other methods, indicating that, in many cases, limited access to firearms did not lead to the adoption of the next available alternative means (i.e., means substitution).

Insofar as the effectiveness of means restriction is dependent on anticipating potential methods through which at-risk individuals may attempt suicide, identifying individual characteristics associated with specific means may prove to be particularly critical. Such differences in individual tendencies have been previously observed. In particular, suicide rates have been found to be higher among males than females in the U.S. in large part because males tend to adopt more potentially lethal means of attempting suicide (Callanan and Davis, 2012; Hee Ahn et al., 2012). More specifically, men are more likely than women to kill themselves through the use of firearms or hanging, whereas female suicides are more likely than male ones to involve poisoning (Callanan and Davis, 2012). In the U.S., the former two suicide means have the highest case fatality ratios among all means of attempted suicide (85 for firearms, and 69 for hanging and suffocation), whereas the latter, in contrast, has a substantially lower case fatality ratio of two (Miller et al., 2012a).

Beyond these basic findings, however, relatively little is known about what individual characteristics may be associated with greater likelihood of engaging in different specific means of suicide. In some measure, the paucity of research in this area reflects the not inconsiderable challenges associated with the study of suicide. That is, although it remains one of the leading causes of death across all age groups, suicide occurs at a relatively low base rate in the general population. Consequently, quite sizeable samples are usually required to yield a sufficient number of cases for analysis (Mościcki, 2001; Prinstein, 2008). For example, in a study with 6891 psychiatric outpatients, only 49 cases of suicide were observed over a 20-year longitudinal period (Brown et al., 2000). This issue is especially pertinent when moving beyond documenting suicide-related risk factors to more fine-grained analyses of aspects of suicide mortality, as in the case of determining individual characteristics associated with specific suicide means.

The National Violent Death Reporting System (NVDRS) is uniquely suited to address this issue. It is a population-based surveillance system established by the Centers for Disease Control and Prevention (CDC) in 2002 to collect data on all violent deaths, including suicides, and associated risk factors, with the eventual goal of guiding future public health interventions aimed at reducing their occurrence (Paulozzi et al., 2004). The NVDRS provides in-depth information from multiple sources regarding the characteristics and circumstances surrounding each violent death captured within its population-based surveillance system, and thus presents the level of detail and sample size required to conduct multivariate assessments of patterns associated with different suicide means. The primary purpose of the current study was to examine sociodemographic characteristics associated with

different means of lethality (i.e., firearms, hanging and suffocation, jumping from heights, poisoning, and sharp instruments) among suicide decedents in the NVDRS. Additionally, given that, relative to other suicide means, suicide by poisoning is a rather heterogeneous category, the current study also assessed sociodemographic characteristics associated with different methods of poisoning (i.e., alcohol, gas, over-the-counter drugs, prescription drugs, and street drugs).

2. Methods

2.1. Data source

Data in the current study were drawn from the NVDRS for the years 2003 to 2005. The NVDRS is an incident-based surveillance system which provides detailed information about violent deaths in the United States. The NVDRS defines violent deaths as deaths "resulting from either the intentional use of physical force or power against oneself, another person, or a group or community, or the unintentional use of a firearm" (Karch et al., 2008). Only deaths resulting from suicide ($n=20,577$) were included in the current study. Data from 2003 were collected from seven states (Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia). In 2004, the NVDRS was expanded to include six additional states (Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin), and, in 2005, four more states were included (California, Kentucky, New Mexico, and Utah), for a total of 17 states. Data were collected state-wide, except in the case of California, for which data were drawn from the following counties: Los Angeles, Riverside, San Francisco, and Santa Clara.

The NVDRS compiled detailed information on each decedent, including personal characteristics, the manner of death, weapons involved, as well as the context in which the death occurred (Azrael et al., 2001; Paulozzi et al., 2004). Data were linked and drawn from multiple and complementary sources, including death certificates, coroner or medical examiner reports, crime lab data, toxicology reports, hospital data, and law enforcement records (Mercy et al., 2006). Each state collected monthly data through state health departments or subcontracted entities (e.g. medical examiner's office), where data were assembled and coded by trained abstractors. Abstractors observed the NVDRS coding manual in reviewing the data to ensure consistency and accuracy of the codes (Centers for Disease Control and Prevention, 2003). Suicide cases were determined by the data abstractors based on all available information. Additional details regarding the NVDRS have been previously reported (Centers for Disease Control and Prevention, 2003; Paulozzi et al., 2004).

2.2. Variables

The current study examined select demographic variables as predictors of suicide means. Relevant demographic characteristics were extracted from suicide decedents' death certificates and included: gender, age at time of death, race/ethnicity, marital status, veteran status, and country of origin. Suicide means examined included firearms, hanging or suffocation, poisoning, jumping from heights, and sharp instruments. Suicides by poisoning were also further subdivided by substance used: alcohol, gas (e.g., carbon monoxide), over-the-counter drugs, prescription drugs, and street drugs.

3. Statistical analysis

To evaluate sociodemographic predictors of suicide by different means of lethality (i.e., firearms, hanging and suffocation, jumping

from heights, poisoning, and sharp instruments), we conducted a series of multivariate logistic regression analyses with each suicide means as the criterion variable, and with gender, age, race, marital status, veteran status, and country of origin as independent variables. We then conducted a second series of multivariate logistic regression analyses to examine sociodemographic predictors of suicide by different methods of poisoning (i.e., alcohol, gas, over-the-counter drugs, prescription drugs, and street drugs). Each method of poisoning was treated as the criterion variable, with the same set of sociodemographic variables retained as independent variables. Odds ratios and 95% CIs were reported for all analyses. Statistical significance at the α level of .05 is indicated by 95% CIs that do not include 1.

4. Results

4.1. Descriptive statistics

Demographic characteristics of the sample are reported in Table 1. Of the suicides in the current sample, 55.2% were due to firearms, 21.2% resulted from hanging and suffocation, 19.3% were through the use of poisons, 1.6% involved jumping from heights, 1.2% were conducted with sharp instruments, and 3.5% were carried out by other means.[1] Of the suicides through poisoning, 62.3% involved prescription drugs, 23.7% resulted from gas (e.g. carbon monoxide), 13.8% were with over-the-counter drugs, 7.9% were the consequence of alcohol poisoning, 4.7% were due to street drugs, and 4.9% were through another type of poison.[2]

4.2. Multivariate models

Table 2 summarizes the multivariate analyses of the relation between sociodemographic characteristics and suicide by different means of lethality. Suicides by firearms were less likely to be committed by females, individuals born outside the U.S., and racial/ethnic minorities, with the exception of non-Hispanic blacks. Suicide by this method was also positively associated with being elderly, married, and a veteran.

Suicides by hanging and suffocation were similarly less likely to be committed by females, but were also less prevalent in veterans and married individuals relative to those who were never married. Additionally, individuals born outside the U.S. and racial/ethnic minorities, with the exception of non-Hispanic blacks, had higher rates of suicide by this means. This method of suicide also appeared to be inversely related to age, such that younger individuals were more likely than the elderly to die by this method, with adolescents being more than five times as likely to utilize this means of suicide, and adults of the ages 20–39 being approximately three times as likely.

The likelihood of suicide by jumping from heights was higher among males, individuals born outside the U.S., those who never married relative to those who were in a marital relationship, and non-Hispanic blacks relative to non-Hispanic whites. A trend was observed for age, with prevalence of this means increasing with age. This trend only reached statistical significance, however, for individuals under the age of 40, with both age groups less likely than elderly adults to adopt this method of suicide.

Suicide by poisoning was more common among females than males, and non-Hispanic whites compared to all other ethnic/racial categories. Married individuals were also least likely to

adopt this means. A curvilinear trend was observed for age; whereas adolescent suicides were less likely than the elderly ones to result from poisoning, individuals from the ages of 30 to 69 were more likely to utilize this means, with the likelihood being highest among the middle-aged.

Suicides by sharp instruments were more likely in individuals born outside the U.S., and in those who never married compared to married individuals. A positive trend was observed between age and suicide by this means. Only individuals under the age of 40, however, were significantly less likely than those over 70 to commit suicide using a sharp object.

Multivariate analyses for the relation between sociodemographic characteristics and specific means of poisoning are presented in Table 3. Risk of suicide by alcohol poisoning demonstrated a curvilinear trend with respect to age, such that adolescents and the elderly were less likely that those between the ages of 20 and 69 to utilize this means. Statistical significance was only observed, however, for those between the ages of 30 and 39; these individuals being between two and four times as likely as those over 70 to use this method.

Suicides by poisoning with gas were less likely to occur in females than males, and in individuals who were never married and divorced or separated compared to those who were married. This method of suicide was also more prevalent in individuals over the age of 70 relative to all other age groups except adolescents.

Gender, age, and country of origin were all related to the risk of suicide via medication overdose. The use of both over-the-counter drugs and prescription drugs as a means of suicide was more common in females than males. Suicides by individuals born outside the U.S., relative to those of those born in the country, were more likely to involve over-the-counter drugs, but less likely to include prescription drugs. Adolescents were at highest risk for suicide by over-the-counter drugs, whereas, suicide by prescription drugs was more prevalent between the ages of 30 and 69 relative to those 70 and older.

Table 1
Demographic characteristics of the sample.

Demographic	Percent of sample
Sex	
Female	21.4
Male	78.6
Age	
0–19 years	5.7
20–29 years	15.7
30–39 years	17.8
40–49 years	23.1
50–59 years	17.2
60–69 years	8.4
70+ years	12.0
Race/Ethnicity	
Hispanic	4.3
Non-Hispanic black	7.6
Other	3.0
Non-Hispanic white	85.1
Marital status	
Never Married	33.1
Widowed	7.0
Separated or divorced	21.6
Married	38.3
Veteran status	
Veteran	23.5
Non-Veteran	76.5
Country of origin	
Born outside of the U.S.	6.2
Born within the U.S.	93.8

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[1] Cumulative percentage across methods exceeded 100% because of cases involving the use of multiple means.

[2] Cumulative percentage of poison type exceeded 100% because of cases involving the use of multiple types of poison.

Table 2
Sociodemographic predictors of suicide means.

	Firearms	Hanging and suffocation	Jumping from heights	Poisoning	Sharp instruments
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Sex					
Female	0.36 (0.33–0.39)***	0.88 (0.80–0.98)**	1.70 (1.22–2.38)**	3.97 (3.62–4.36)***	0.87 (0.67–1.20)
Male	1.00	1.00	1.00	1.00	1.00
Age					
0–19 years	0.39 (0.31–0.47)***	5.64 (4.45–7.14)***	0.39 (0.18–0.87)*	0.56 (0.39–0.78)**	0.17 (0.07–0.40)***
20–29 years	0.48 (0.41–0.56)***	3.19 (2.60–3.92)***	0.37 (0.18–0.73)**	1.20 (0.96–1.51)	0.25 (0.14–0.45)***
30–39 years	0.34 (0.30–0.40)***	2.96 (2.44–3.60)***	0.53 (0.28–1.01)	2.31 (1.89–2.82)***	0.47 (0.28–0.77)**
40–49 years	0.37 (0.32–0.42)***	1.98 (1.63–2.40)***	0.77 (0.43–1.39)	2.94 (2.23–3.56)***	0.86 (0.56–1.32)
50–59 years	0.48 (0.42–0.56)***	1.45 (1.19–1.77)***	0.71 (0.38–1.31)	2.57 (2.13–3.12)***	0.89 (0.58–1.40)
60–69 years	0.86 (0.72–1.01)	0.95 (0.74–1.21)	1.21 (0.64–2.28)	1.38 (1.10–1.73)**	0.85 (0.51–1.40)
70+ years	1.00	1.00	1.00	1.00	1.00
Race/Ethnicity					
Hispanic	0.64 (0.53–0.76)***	1.89 (1.59–2.26)***	0.86 (0.40–1.85)	0.73 (0.56–0.94)*	1.06 (0.57–1.98)
Non-Hispanic black	0.99 (0.88–1.12)	1.12 (0.98–1.29)	1.61 (1.01–2.57)*	0.59 (0.49–0.71)***	1.05 (0.67–1.66)
Other	0.71 (0.58–0.88)**	1.46 (1.19–1.80)***	1.23 (0.59–2.56)	0.70 (0.53–0.94)*	1.13 (0.56–1.40)
Non-Hispanic white	1.00	1.00	1.00	1.00	1.00
Marital status					
Never married	0.71 (0.64–0.77)***	1.20 (1.08–1.33)**	3.35 (2.26–4.99)***	1.14 (1.02–1.29)*	1.98 (1.44–2.72)***
Widowed	0.72 (0.61–0.84)***	1.02 (0.82–1.26)	1.45 (0.78–2.71)	1.63 (1.35–1.97)***	1.44 (0.91–2.30)
Divorced or separated	0.75 (0.69–0.82)***	1.10 (0.98–1.23)	1.08 (0.68–1.72)	1.38 (1.24–1.53)***	1.33 (0.98–1.83)
Married	1.00	1.00	1.00	1.00	1.00
Veteran status					
Veteran	1.42 (1.30–1.55)***	0.74 (0.66–0.84)***	0.73 (0.48–1.12)	0.94 (0.84–1.06)	0.78 (0.57–1.07)
Non-veteran	1.00	1.00	1.00	1.00	1.00
Country of origin					
Born outside of the U.S.	0.45 (0.39–0.53)***	1.95 (1.67–2.29)***	2.52 (1.53–4.15)***	0.98 (0.80–1.20)	1.81 (1.16–2.82)**
Born within the U.S.	1.00	1.00	1.00	1.00	1.00

Note: Each column represents a separate multivariate logistic regression model.
*$p < .05$; **$p < .01$; ***$p < .001$; CI=confidence interval.

Table 3
Sociodemographic predictors of suicide by poison type.

	Alcohol	Gas	Over-the-counter drugs	Prescription drugs	Street drugs[a]
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Sex					
Female	0.84 (0.61–1.14)	0.24 (0.19–0.30)***	2.12 (1.66–2.72)***	3.08 (2.56–3.69)***	0.62 (0.40–0.95)*
Male	1.00	1.00	1.00	1.00	1.00
Age					
0–19 years	0.61 (0.07–5.63)	0.47 (0.20–1.09)	2.71 (1.20–6.12)*	1.33 (0.66–2.69)	
20–29 years	1.28 (0.40–4.14)	0.57 (0.35–0.95)*	1.40 (0.76–2.56)	1.35 (0.86–2.13)	1.40 (0.51–3.80)
30–39 years	3.32 (1.22–9.06)*	0.50 (0.32–0.76)**	1.01 (0.59–1.75)	2.11 (1.42–3.14)***	1.16 (0.48–2.81)
40–49 years	2.69 (1.01–7.19)*	0.48 (0.32–0.72)***	1.05 (0.63–1.73)	2.36 (1.62–3.42)***	1.03 (0.44–2.40)
50–59 years	2.49 (0.93–6.69)	0.47 (0.32–0.71)***	0.95 (0.57–1.58)	2.21 (1.52–3.22)***	0.63 (0.25–1.55)
60–69 years	2.21 (0.73–6.69)	0.43 (0.26–0.71)**	0.68 (0.35–1.34)	2.50 (1.58–3.97)***	1.00
70+ years	1.00	1.00	1.00	1.00	
Race/Ethnicity					
Hispanic	1.38 (0.58–3.29)	0.72 (0.39–1.35)	0.42 (0.17–1.09)	1.55 (0.89–2.67)	2.45 (1.00–5.99)*
Non-Hispanic black	0.95 (0.47–1.92)	0.65 (0.40–1.05)	1.12 (0.68–1.83)	0.82 (0.56–1.20)	5.12 (2.95–8.87)***
Other	1.92 (0.70–5.23)	0.39 (0.15–1.02)	1.14 (0.56–2.32)	1.21 (0.64–2.28)	1.22 (0.27–5.58)
Non-Hispanic white	1.00	1.00	1.00	1.00	1.00
Marital status					
Never married	1.04 (0.69–1.57)	0.69 (0.53–0.90)**	1.37 (1.00–1.88)	1.08 (0.86–1.37)	0.78 (0.45–1.35)
Widowed	0.75 (0.34–1.67)	0.68 (0.44–1.03)	1.54 (0.97–2.43)	1.07 (0.74–1.54)	1.32 (0.49–3.57)
Divorced or separated	1.29 (0.916–1.82)	0.76 (0.60–0.96)*	1.09 (0.82–1.45)	1.08 (0.88–1.32)	1.22 (0.76–1.95)
Married	1.00	1.00	1.00	1.00	1.00
Veteran status					
Veteran	0.84 (0.54–1.31)	0.93 (0.72–1.19)	1.17 (0.82–1.67)	1.12 (0.88–1.41)	0.54 (0.28–1.04)
Non-veteran	1.00	1.00	1.00	1.00	1.00
Country of origin					
Born outside of the U.S.	0.55 (0.23–1.35)	1.02 (0.64–1.63)	1.91 (1.19–3.08)**	0.64 (0.43–0.96)*	0.93 (0.34–2.52)
Born within the U.S.	1.00	1.00	1.00	1.00	1.00

Note: Each column represents a separate multivariate logistic regression model.
*$p < .05$; **$p < .01$; ***$p < .001$; CI=confidence interval.

[a] The age categories 0–19 and 70+ years were excluded from this model because both had too few cases of suicide by street drugs for meaningful analysis.

The use of street drugs as a means of suicide was less prevalent in females than in males. This method was more prevalent, however, in Hispanics and non-Hispanic blacks relative to non-Hispanic whites.

5. Discussion

Several of the current findings are consistent with those of previous studies on individual characteristics associated with specific suicide means. Additionally, the collection of data from multiple sources and the substantial number of cases in the current study provided the level of detail and statistical power required significantly to build upon the extant literature in this area. Specifically, in terms of gender differences, our findings that male suicides are more likely than female ones to result from firearms and hanging and suffocation is concordant with previous reports (Callanan and Davis, 2012; Hee Ahn et al., 2012; Kposowa and McElvain, 2006). In contrast, but also paralleling previous findings (Callanan and Davis, 2012; Kposowa and McElvain, 2006), female suicides were more likely than male ones to occur within the context of poisoning. Although no gender differences were observed for jumping from heights in prior research (Callanan and Davis, 2012), we found male suicide decedents to be less likely than female ones to have adopted the former method, but more likely to adopt the latter one. As the odds ratio was relatively small, the absence of a significant effect in the prior study was likely due to its smaller sample size. Interestingly, when suicides by poisoning were further examined by poison type, female decedents had a higher likelihood of adopting relatively more accessible and easily implemented means (i.e., over-the-counter and prescription drugs) compared to male decedents (i.e., gas and street drugs).

Age differences in suicide means were generally consistent with prior findings (Abrams et al., 2005; Callanan and Davis, 2012; Kposowa and McElvain, 2006). That is, elderly decedents were more likely than younger ones to have died by firearms, but less likely to have died by hanging and suffocation, and middle-age decedents as well as those in their 30s were more likely to have used poisons. Adding to prior findings, we found young decedents to be less likely to have jumped from heights or used sharp instruments. Regarding specific poison types, elderly decedents were more likely to have used gas. Teenage decedents were most likely to have used over-the-counter drugs, likely a reflection of greater ease of access relative to other poisons. Young and middle-aged decedents appeared more likely to have used alcohol and prescription medication.

In general, racial/ethnic minorities were less likely than non-Hispanic whites to use firearms and poisons, but more likely to die by hanging and suffocation. The one exception to these general trends is non-Hispanic blacks, who did not differ from non-Hispanic whites in terms of suicides by firearms and hanging and suffocation, but were more likely to jump from heights. In contrast, several previous studies have failed to find any relation between race/ethnicity and suicide by firearms, hanging and poisons (Callanan and Davis, 2012; Kposowa and McElvain, 2006). These differences in findings may in some measure be due to the smaller sample sizes and thus power to detect significant effects in prior studies, and also the fact that non-Hispanic blacks and other racial/ethnic minorities were examined separately in the current study but combined into a single group in previous research. The only racial/ethnic difference detected for poison types was a greater likelihood of suicide by street drugs among Hispanic and non-Hispanic blacks relative to non-Hispanic whites.

Decedents who were never married were consistently more likely than married decedents to adopt every mean of suicide with the exception of firearms. In fact, married decedents were more likely than others to have died by this means. Although not directly addressed in the current study, this finding may in part be due to the greater likelihood of firearm availability among married relative to non-married individuals (Betz et al., 2011; Johnson, 2010; Oslin et al., 2004).

In the case of veteran suicides, two findings emerged in our multivariate models. Consistent with several past studies with this group (Kaplan et al., 2007; Miller et al., 2012b), we found them to be more likely than non-veterans to die by firearms, possibly in part a consequence of living in households where they are easily accessible (Miller et al., 2012b). Additionally, veteran suicides were less likely to have resulted from hanging and suffocation.

Finally, suicide decedents born outside the U.S. were generally more likely than those born within the country to die by hanging and suffocation, poisoning, and sharp instruments, but were also less likely to adopt firearms as a suicide means. In terms of poison types, they were more likely to die through the use of over-the-counter drugs, but less likely to do so via prescription drugs. These patterns in poison types may be partly due to lower rates of health insurance coverage among individuals born outside the U.S. resulting in reduced access to prescription drugs (Dallo et al., in press; Ku and Matani, 2001).

To our knowledge, the current study provides the first population-based, multi-state examination to date of patterns of risk differentiating between specific suicide means in a sample of suicide decedents. It is also the most comprehensive study thus far in assessing different means of suicide. Nonetheless, several limitations should be noted. In particular, despite the scale of the current study, the NVDRS data from the years 2003 to 2005 were drawn from only seven to 17 states. Although these states generally do not differ substantially from the national composition in terms of age, gender, race/ethnicity and suicide rates (Kaplan et al., 2012), the study sample is not nationally representative, and a degree of caution should be exercised in generalizing the present findings, especially insofar as important regional variability exists in access and tendencies to adopt different suicide means. The development of a comprehensive nationwide surveillance system, as in a recent proposal by President Obama to expand the NVDRS to all 50 states, is critically important for addressing this limitation, and enhancing our knowledge base for suicide risk and potential means of preventing its occurrence.

A second limitation is that it is possible that some cases may have been miscategorized when distinguishing between suicides, undetermined deaths, and unintentional injuries resulting in death. Related to this issue, it is also possible that rates of misclassification are higher for certain means (e.g., poisoning) than for others generally associated with less ambiguous intent (e.g., firearms; Huguet et al., 2012). Estimates in prior studies of suicides miscategorized as deaths due to other causes (i.e., false negatives) have ranged from 2% to 45%, whereas cases of deaths misclassified as suicides (i.e., false positives) were quite rare, with estimates ranging from 0% to 1% (Goldsmith et al., 2002). The likelihood of these issues occurring in the present study, however, was substantially reduced, as the NVDRS collects and links information from multiple sources for each decedent at a level of detail rarely available in studies of suicide.

Finally, the present study focused specifically on sociodemographic predictors of suicide means. Future research examining associations between traditional clinical risk factors for suicide (e.g., depression, substance use disorders, and impulsivity; Brown et al., 2000; Dumais et al., 2005; Mościcki, 1997; Zouk et al., 2006) and specific suicide means is warranted. Nonetheless, the current findings regarding sociodemographic characteristics may be of

especially practical value to prevention efforts. Assessments of other potential suicide risk factors are usually dependent upon the at-risk individual completing diagnostic interviews or batteries of questionnaires. Although such assessments are necessary for acquiring a more complete understanding of an individual's risk profile, they are also reliant on the individual's compliance, and such individuals, especially when acutely suicidal, may be less agreeable to interventions and related risk assessments. These obstacles are less of a concern in the case of sociodemographic characteristics, which are relatively quick and easy to ascertain. Consequently, such information may serve meaningfully to inform means restriction strategies.

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