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Demographic considerations in analyzing decedents by usual occupation

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Abstract

Background: Public health research uses decedents' usual industry and occupation (I&O) from US death certificates to assess mortality incidence and risk factors. Of necessity, such research may exclude decedents with insufficient I&O information, and assume death certificates reflect current (at time of death) I&O. This study explored the demographic implications of such research conditions by describing usual occupation and current employment status among decedents by demographic characteristics in a large multistate data set.

Methods: Death certificate occupations classified by Standard Occupational Classification (SOC) (ie, compensated occupation) and other categories (eg, student) for 36 507 decedents (suicide, homicide, other, undetermined intent) age 22+ years from the 2016 National Violent Death Reporting System's (NVDRS) 32 US states were analyzed. Decedents not employed at the time of death (eg, laid off) were identified through nondeath certificate NVDRS data sources (eg, law enforcement reports).

Results: Female decedents, younger (age < 30 years) male decedents, some non-White racial group decedents, less educated decedents, and undetermined intent death decedents were statistically less likely to be classified by SOC based on death certificates—primarily due to insufficient information. Decedents classified by SOC from death certificates but whose non-death certificate data indicated no employment at the time of death were more often 30+ years old, White, less educated, died by suicide, or had nonmanagement occupations.

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AUTHOR CONTRIBUTIONS

CP conceived of the study, led the study design and interpretation of results, and drafted the manuscript. CP and PKS analyzed data. PKS and ALS assisted with the study design and interpretation of results. All authors edited the manuscript and approved the final manuscript as submitted.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

Conclusions: Whether decedents have classifiable occupations from death certificates may vary by demographic characteristics. Research studies that assess decedents by usual I&O can identify and describe how any such demographic trends may affect research results on particular public health topics.

Keywords

death certificates; homicide/statistics & numerical data; occupations/statistics & numerical data; suicide/statistics & numerical data; United States

1 | INTRODUCTION

Decedents' usual industry and occupation (I&O) reported on US death certificates can be used in epidemiological research to inform public health decision-making and create safer and healthier work environments.[1–8] Such research is important for several reasons, including identifying mortality risk factors and engaging industry and professional groups and employers to implement public health interventions.

However, some death certificates do not contain sufficient information to classify decedents by usual I&O and there is limited investigation into whether decedents with particular demographic characteristics lack classifiable death certificate I&O more often.[9,10] To be formally classified by I&O, a decedent would need one recognized usual I&O (sometimes different from most recent I&O[11]) and next of kin who accurately describe that I&O to recording officials in a way that software algorithms and expert reviewers are able to translate to formal I&O classifications—typically, codes indicating compensated occupation, such as the Standard Occupational Classification (SOC) (eg, SOC 13-2053: *Insurance underwriter*, or SOC 41-2011: *Cashier*).[6,12] Specifically, it is possible that age, sex, race, and socioeconomic status—factors associated with labor market participation[13]—are associated with whether a decedent can be classified by I&O code from death certificate information. This topic was recently examined using cancer registry data, which can include patient I&O from electronic medical records sources.[14] That study reported a low overall rate of patients classified by industry (37%) from registry sources and, notably, lower rates among women (apparently due to a higher prevalence of unpaid work compared to men) and non-White patients (apparently due to a higher prevalence of both unpaid work and blank or uncodable industry information compared to White patients).

It is relevant to understand whether some decedent demographic groups are more likely to be classified by I&O from death certificates and how any such identified demographic patterns could influence research results on particular public health topics. For example, if some demographic groups are more likely to have classifiable death certificate I&O data, it is important to directly address this when interpreting research results based on such data. This study aimed to describe death certificate civilian occupational classifications and recent employment status among violent-death decedents by demographic characteristics in a large US multistate data set.

2 | METHODS

2.1 | Data

Authors used data on 36 507 male and female decedents age ≥22 years old from 32 US states[1] that participated in the Center for Disease Control and Prevention's 2016 National Violent Death Reporting System (NVDRS) (www.cdc.gov/violenceprevention/nvdrs) (most recent available data year). NVDRS collects data on suicide, homicide, and legal intervention deaths, as well as deaths from unintentional firearm injuries and deaths of undetermined intent [see Table notes for definitions],) primarily from death certificates, coroner/medical examiner reports, and law enforcement reports. Age 22 years was used as a cut-off in this study so results were less likely to be influenced by full-time students. Analysis of violent death decedent I&O, in particular, is important for public health research that aims to reduce injuries and violence, but NVDRS was used for this analysis primarily because it is a publicly-available and population-based source of death certificate information that includes decedent I&O.

NVDRS data abstractors record decedents' usual industry and occupation (NVDRS data set variables, *IndustryText* and *OccupationText*) as it appears in the death certificate occupation text field.[15] Decedents' industry is sometimes used to classify occupation. The National Center for Health Statistics' instructions for recording officials (eg, funeral directors) who fill in the occupation item of the death certificate is as follows[16]:

> Item 54. Enter the usual occupation of the decedent. This is not necessarily the last occupation of the decedent. Never enter "retired". Give kind of work decedent did during most of his or her working life, such as claim adjuster, farmhand, coal miner, janitor, store manager, college professor, or civil engineer. If the decedent was a homemaker at the time of death but had worked outside the household during his or her working life, enter that occupation. If the decedent was a homemaker during most of his or her working life, and never worked outside the household, enter "homemaker". Enter "student" if the decedent was a student at the time of death and was never regularly employed or employed full time during his or her working life.

I&O coding experts used CDC's National Institute for Occupational Safety and Health Industry and Occupation Computerized Coding System (NIOCCS 3.0) (https://wwwn.cdc.gov/nioccs3/) to translate NVDRS *IndustryText* and *OccupationText* data to 2010 US Census civilian occupation codes and, via crosswalk, to 2010 SOC codes. The 22 SOC major groups analyzed for this study comprise hundreds of detailed occupational groups. Military occupations were not assessed. Reasons that decedents were not assigned an SOC code are reported for this study as assigned by NIOCCS software algorithms: *Military, insufficient information to classify* (eg, a blank, "unknown," or unclassifiable entry), *student*, *did not work* (volunteers included in this category for this study), *homemaker*. In addition to

[1]Alaska, Arizona, Colorado, Connecticut, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Utah, Vermont, Virginia, Washington, Wisconsin. Note: in 2016 Illinois, Pennsylvania, and Washington collected data on more than equal to 80% of violent deaths in the state, in accordance with requirements under which the state was funded.

death certificate I&O, NVDRS includes an option for free text data on decedents' occupation at time of death (NVDRS data set variable, *OccupationCurrentText*), which NVDRS abstractors are requested to include when such information is available from non-death certificate data sources (eg, law enforcement reports).[15] Decedents assigned SOC codes based on death certificates but not employed at the time of death were identified from the NVDRS *OccupationCurrentText* variable through a keyword text search (eg, "laid off"; see Table 2 notes) using methods from a recent study.[2] Reasons that decedents were not employed are reported (classified for this study as: *Unemployed* [eg, laid off], *retired*, *disabled*, *student*, *homemaker*).

2.2 | Analysis

The analysis was conducted with Stata 14 (College Station, TX). The proportion of decedents with and without SOC codes assigned based on death certificates is demonstrated by the following decedent characteristics, using NVDRS data: *Age group* (22-29, 30-44, 45-64, and 65+ years), *sex* (male/female), *race* (White, Black or African American, American Indian or Alaska Native, Asian/Pacific Islander, other/unspecified, two or more races, unknown), *education* (not high school graduate, high school graduate, Associate's or Bachelor's degree, Master's degree or above degree, unknown), and *manner of death* (suicide, homicide, other, undetermined) (Table 1). Next, among decedents assigned SOC codes based on death certificates, the number and proportion of such decedents identified by NVDRS non-death certificate data sources (eg, law enforcement reports) as not employed at the time of death (eg, laid off) is reported by decedent characteristics, as well as SOC major group based on the decedent's usual occupation from the death certificate (Table 2).

Three multivariable logistic regression models are presented, which, in addition to aforementioned decedent characteristics, controlled for the US state where the death was reported to NVDRS (data not presented by US state due to small cell sizes). The first model assessed whether some decedents were more likely to have an SOC code assigned (ie, compensated usual occupation) from death certificates based on demographic characteristics. The second model assessed whether some decedents were more likely to have insufficient information to classify usual occupation in any way (eg, blank—that is, not classifiable by SOC or other identifier, such as "homemaker") from death certificates based on demographic characteristics. The third model assessed whether some decedents were more likely to be identified as not employed at time of death—as indicated by NVDRS non-death certificate data sources—based on demographic characteristics and usual occupation (described by SOC major group from information on the death certificate).

Directly examining demographic patterns among decedents assigned an SOC code (Model 1) is important because public health research using I&O often focuses on decedents with formal I&O classifications—for example, by calculating death rates by I&O group using the currently employed population count by I&O from administrative sources in the denominator.[2] Directly examining demographic patterns among decedents with insufficient information to classify occupation (eg, blank entry) (Model 2) is important, because death certificate recorders (eg, funeral directors) may be able to reduce the incidence of insufficient occupation information through best practices for completing death certificates.[6]

NVDRS concurrent information about decedent usual (death certificate) vs current (time of death) information is relatively unique among large US datasets, and comparing such information (Model 3) can help researchers to assess the impact of assuming death certificate I&O is a decedent's recent I&O. The primary aim of these models was to facilitate conclusions about a large decedent sample with a variety of demographic characteristics (Tables 1 and 2). However, because analyzed decedents were majority male and women and men in aggregate have different labor market experiences, model results also were examined for male and female decedents separately (Table 3 for model results, descriptive data in STable 1- STable 4 in the supplementary file).

3 | RESULTS

Nearly 80% (n = 28 714/36 507) of decedents were assigned an SOC code (ie, compensated occupation) based on death certificates (Table 1). The most common reason decedents were not assigned an SOC code was *insufficient information to classify* (n = 3828/7793 or 49% of decedents not assigned a SOC code [or n = 3828/36 507 or 10% of total decedents]), followed by *student* (8%), *did not work* (19%), *homemaker* (19%), and *military* (5%) (Table 1).

Controlling for all assessed decedent characteristics, a multivariable logistic regression model among all decedents indicated that decedents who were female, younger (age < 30 years), non-White (Black or African American, American Indian or Alaska Native, Asian/Pacific Islander, and other/unspecified), less educated (no college degree) or with unknown education level, or with undetermined intent death (compared to suicide) were statistically less likely to have a SOC code assigned—for any reason—based on death certificates (Table 1: Model 1). For example, 82% of male decedents compared to 68% of female decedents were assigned a SOC code (Table 1), and the regression model indicated that after controlling for other factors, the odds that male decedents were assigned a SOC code were 2.8 (95% CI: 2.6-3.0) times higher than for females (Table 1: Model 1).

Stratified multiple regression analyses by sex indicated some differences in terms of magnitude (ie, value of point estimate), statistical significance (ie, 95% CI does not include one), and in some cases, direction (positive or negative odds of the outcome) compared to results among all decedents (Table 3). For example, the proportion of males assigned an SOC code notably increased by age group (age 22-29: 71%; age 30-44: 82%; age 45-64: 85%, age 65+: 90%; STable 1), and in a multiple regression model among only males, older males had higher odds of having an assigned SOC code than younger males (Table 3: Model 1). In comparison, among female decedents, the proportion assigned an SOC code was only modestly higher among older age groups (age 22-29: 65%; age 30-44: 67%; age 45-64: 69%, age 65+: 68%; STable 2) and in a multiple regression model among only females, age group was not statistically associated with having a SOC code assigned (Table 3: Model 1). As also reflected in the male- and female-only descriptive data and regression model results, the proportion of White males assigned an SOC code (85%) was substantially higher than Black or African American males (71%) and males of the unknown race (68%), but similar to American Indian and Alaska Native males (84%) (STable 1), whereas the proportion of White females assigned a SOC code (69%) was similar to Black or African American

females (68%), but notably higher than American Indian and Alaska Native females (57%) (STable 2). Compared to suicide decedents, male homicide decedents were statistically *less* likely and female homicide decedents were *more* likely to have an assigned SOC code (Table 3: Model 1).

The second multivariable logistic regression model among all decedents indicated that decedents with many of the same characteristics that were associated with not having a SOC code assigned (Model 1)—that is, younger age (age < 30 years), non-White race (Black or African American, Asian/Pacific Islander, and other/unspecified), less education (no college degree) or unknown education level, and undetermined intent death—had statistically higher odds of having insufficient information to classify occupation in any way (that is, by either SOC code or other identifier [*student*, *did not work*, *homemaker*, or *military*]) (Table 1: Model 2). In addition, decedents with death due to homicide or "other" intent (compared to suicide) had higher odds of having insufficient information to classify occupation, and decedents with two or more races had lower odds of having insufficient information to classify occupation (Table 1: Model 2). Again, male- and female-only regression models (Table 3: Model 2) indicated some differences compared to results among all decedents. For example, female (but not male) American Indian or Alaska Native decedents had statistically higher odds of having insufficient information to classify usual occupation.

Among decedents with SOC codes assigned based on death certificates (n = 28 714), approximately 10% (n = 2987) were identified by NVDRS nondeath certificate data sources as not employed at the time of death (Table 2). The most common reasons were *unemployment* (n = 1634/2987 or 55% of decedents not working at the time of death), *retired* (33%), *disabled* (11%), *student* (1%), and *homemaker* (<1%) (Table 2). A multivariable logistic regression model among all decedents with assigned SOC codes based on death certificates indicated that decedents not working at the time of death were more often age 30+ years, White (compared to Black or African American or other/unspecified), less educated (no college degree), died by suicide (compared to homicide, and other intent death), or had nonmanagement occupations (multiple; eg, Protective Service) (Table 2: Model 3). Again, male- and female-only descriptive data (STable 3-STable4) and separate models (Table 3) indicated some differences by sex. For example, male (but not female) Black or African American and other/unspecified race decedents with SOC- classified usual occupation were statistically more likely than White decedents to be working at the time of death (Table 3: Model 3), and female (but not male) decedents with *Arts, Design, Entertainment, Sports, and Media* occupations were statistically more likely to be not working at the time of death.

4 | DISCUSSION

There are three implications from this study for public health research that uses death certificate I&O classifications. First, whether decedents have formal I&O classifications (ie, indicating compensated usual occupation) may be associated with decedent demographics; females, younger males, some non-White racial groups, and less educated decedents were less frequently classified by SOC code than counterparts. This conclusion is based on this study's Model 1 results and may primarily reflect trends in US labor market participation—

groups with lower labor market participation can be expected to have a lower rate of classifiable compensated occupation reported on death certificates.

Despite this likely explanation for some demographic groups lacking classifiable death certificate occupation more than others, the impact on public health research of this circumstance merits consideration and presumably varies based on the health topic under investigation. One example could include examining death rates by sex in combination with the occupation. Only 68% of female decedents were assigned a SOC code based on death certificates (compared to 82% of males) and the most common reason female decedents were not assigned a SOC code was that their usual occupation was reported as a homemaker. Because SOC and other formal occupational classifications are designed to classify *compensated* occupations, investigating mortality only by formal I&O classifications such as SOC may not directly address mortality by occupation among a large number of female decedents. Research studies using death certificate I&O data can address these issues directly by reporting demographic characteristics of decedents included vs excluded from the I&O analysis.

The second takeaway from this study's results is that some decedent demographic groups—younger males, some non-White racial groups, decedents with less education, as well as those who died due to violence perpetrated by someone else—may be more likely to have insufficient I&O information recorded on death certificates to identify a person's occupational status in any way (eg, a blank, "unknown," or unclassifiable entry). This conclusion is based on Model 2 results, and conceivably could reflect either occupational (eg, decedent's employment across multiple occupations might inhibit reporting of a single usual occupation as requested for the death certificate) or social, communications (eg, nonnative English speaker), and other challenges when next of kin complete a death certificate with a recording official or a combination of these and other issues. One example of the impact these circumstances could have on research studies could be spurious mortality rates by occupation if some occupations have relatively *higher* employment of demographic groups that are *less likely* to have classifiable occupations from death certificates. In such a situation, a disproportionately large number of workers with such occupations might be not properly classified based on death certificates, resulting in undercounting deaths for that occupation. As described in previous studies, improving the utility of I&O data for public health requires enhanced efforts in eliciting, recording, abstracting, and coding I&O.[14,17] Research has demonstrated that interviewer training can substantially improve the codability of I&O data.[18] For example, if the decedent had many different occupations and different places of business, it may be necessary to ask additional questions to determine the usual occupation and industry, such as, in which job did the decedent work the longest?[6] The results of the present study suggest that efforts to improve death certificate I&O data quality should also explicitly consider decedent demographics to ensure that I&O data quality improves across all decedent populations.

The third takeaway from this study's results is based on Model 3 results, which indicated approximately 10% of decedents with SOC-classifiable occupations from death certificates were not working at the time of death, and not working was statistically more likely among decedents who were 30+ years old, White, less educated, died by suicide, or had

nonmanagement occupations. NVDRS appears unique among large U.S. data sources in providing an opportunity to investigate this topic—that is, a comparison of usual I&O from death certificates vs current employment status from alternative administrative and other sources. However, because of the non-universal nature of current occupation data in NVDRS (variable, *CurrentOccupationText*, described above), this result should be cautiously interpreted and regarded as a conservative estimate of the proportion of decedents analyzed here that were not employed at the time of death. Nonetheless, these findings can be considered in studies that calculate mortality rates by occupation using I&O death certificate data as the numerator and the currently employed population as the denominator.

This study had notable limitations. NVDRS includes only decedents with specific manners of death, who may be different from the general population in terms of employment, type of occupation, and demographic characteristics; for example, males are 77% of these data, compared to 49% of the US population. Future analysis using all-cause mortality data can examine empirically whether trends documented here are similar or different among, for example, female decedents, younger male decedents, non-White racial group decedents, and less educated decedents with other causes of death (eg, infectious disease, unintentional injury, etc.). Results on American Indian or Alaska Natives should be interpreted with caution because death certificates under-identify those groups.[19] This analysis used keyword searches to identify and classify decedents not employed at the time of death from non-death certificate data sources (eg, law enforcement reports) included in NVDRS. The same approach was applied in a previous analysis of NVDRS data, when researchers reported a low false-positive rate based on confirmatory manual record review.[2] However, non-death certificate I&O information is included in NVDRS only as available to data abstractors and is therefore unsystematic and not analogous to administrative data sources which question respondents on both current and usual occupation, such as the National Health Interview Survey.[11] Notably, decedent data from some NVDRS states were automatically excluded from Model 3 calculations due to zero decedents identified as unemployed at the time of death through this study's methods (Table 2 notes). This could potentially indicate a different approach to this narrow topic among NVDRS contributing US states and merits further investigation. This study included a large decedent sample and presented multivariable regression analyses to address three distinct questions to identify associations between decedents' demographics and I&O classification. Model results were also investigated separately among males and females. Future analysis might examine these issues among other subgroups of interest.

5 | CONCLUSIONS

Whether decedents have classifiable occupations from US death certificates may be associated with decedent demographics. This may be in large part due to labor market conditions. However, in this study, decedent demographic characteristics—including age, race, and education level—were also statistically associated with whether decedents had insufficient information (eg, blank entry) from the death certificate to classify occupation; this suggests that uneven recording of death certificate I&O may be associated with such characteristics, independent of labor market conditions. Improving the quality of death certificate I&O data, therefore, may require a specific approach to address these observed

demographic disparities. I&O research studies using death certificate data can directly compare characteristics of decedents with and without assigned formal I&O classifications and describe how any observed demographic differences likely affect research results on particular public health topics.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

I&O	industry and occupation
NIOCCS	National Institute for Occupational Safety and Health Industry and Occupation Computerized Coding System
NVDRS	National Violent Death Reporting System
SOC	Standard Occupational Classification.

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TABLE 1

Descriptive data and logistic regression analysis of decedents by death certificate usual occupation, age ≥22 y, National Violent Death Reporting System, 32 States[a], 2016

	Descriptive data							Regression analysis	
	Decedent classified by SOC code[b] (n)(%)		Reason decedent not classified by SOC code[b]						
Characteristic	Yes	No	Insufficient information to classify	Student	Did not work	Homemaker	Military	Model 1: Decedent classified by SOC code[b] (aOR)(95% CI)	Model 2: Decedent had insufficient information to classify occupation[b] (aOR) (95% CI)
Column number	1	2	3	4	5	6	7	8	9
Total	28 714 (79)	7793 (21)	3828 (49)	648 (8)	1453 (19)	1,469 (19)	395 (5)	36 507	36 507
Age, y									
22–29	5005 (70)	2130 (30)	965 (45)	512 (24)	389 (18)	130 (6)	134 (6)	Reference	Reference
30–44	8392 (78)	2316 (22)	1171 (51)	116 (5)	477 (21)	439 (19)	113 (5)	1.6 (1.5–1.7) *	0.9 (0.8–1.0) *
45–64	10,721 (81)	2544 (19)	1289 (51)	19 (1)	529 (21)	635 (25)	72 (3)	1.8 (1.7–2.0) *	0.8 (0.7–0.9) *
65+	4596 (85)	803 (15)	403 (50)	1 (<1)	58 (7)	265 (33)	76 (9)	2.3 (2.1–2.5) *	0.7 (0.6–0.8) *
Sex									
Male	22 947 (82)	5042 (18)	3035 (60)	504 (10)	1068 (21)	63 (1)	372 (7)	2.8 (2.6–3.0) *	1.1 (1.0–1.2)
Female	5767 (68)	2751 (32)	793 (29)	144 (5)	385 (14)	1406 (51)	23 (1)	Reference	Reference
Race									
White	22 458 (81)	5205 (19)	2279 (44)	391 (8)	953 (18)	1264 (24)	318 (6)	Reference	Reference
Black or African American	4,730 (71)	1,968 (29)	1266 (64)	173 (9)	391 (20)	87 (4)	51 (3)	0.7 (0.6–0.7) *	2.0 (1.8–2.2) *
American Indian or Alaska Native	409 (77)	122 (23)	32 (26)	16 (13)	37 (30)	35 (29)	2 (2)	0.7 (0.6–0.9) *	1.2 (0.8–1.8)
Asian/Pacific Islander	492 (66)	259 (34)	123 (47)	47 (18)	32 (12)	48 (19)	9 (3)	0.5 (0.4–0.6) *	1.9 (1.5–2.4) *
Other/unspecified	314 (64)	174 (36)	113 (65)	14 (8)	19 (11)	21 (12)	7 (4)	0.7 (0.6–0.9) *	1.5 (1.2–2.1) *
Two or more races	294 (84)	58 (16)	11 (19)	7 (12)	18 (31)	14 (24)	8 (14)	1.1 (0.8–1.5)	0.5 (0.2–0.9) *
Unknown	17 (71)	7 (29)	4 (57)	0 (<1)	3 (43)	0 (<1)	0 (<1)	0.5 (0.2–1.3)	2.2 (0.7–6.6)
Education									
Not high school graduate	4288 (74)	1475 (26)	684 (46)	25 (2)	463 (31)	294 (20)	9 (1)	0.5 (0.5–0.6) *	1.6 (1.4–1.8) *

	Descriptive data							Regression analysis	
	Decedent classified by SOC code[b] (n)(%)		Reason decedent not classified by SOC code[b]						
Characteristic	Yes	No	Insufficient information to classify	Student	Did not work	Homemaker	Military	Model 1: Decedent classified by SOC code[b] (aOR)(95% CI)	Model 2: Decedent had insufficient information to classify occupation[b] (aOR) (95% CI)
High school graduate	17 079 (80)	4248 (20)	1799 (42)	410 (10)	835 (20)	948 (22)	256 (6)	0.7 (0.7–0.8) *	1.1 (1.0–1.3) *
Associate's or Bachelor's degree	5,449 (85)	999 (15)	443 (44)	175 (18)	99 (10)	184 (18)	98 (10)	Reference	Reference
Master's degree or above	1623 (88)	211 (12)	120 (57)	32 (15)	7 (3)	24 (11)	28 (13)	1.4 (1.2–1.7) *	1.0 (0.8–1.2)
Unknown	275 (24)	860 (76)	782 (91)	6 (1)	49 (6)	19 (2)	4 (< 1)	0.0 (0.0–0.1) *	34.9 (29.2–41.8) *
Manner of death									
Suicide	19 255 (82)	4325 (18)	1884 (44)	414 (10)	747 (17)	943 (22)	337 (8)	Reference	Reference
Homicide	5978 (73)	2180 (27)	1285 (59)	164 (8)	461 (21)	241 (11)	29 (1)	0.9 (0.9–1.0)	1.4 (1.2–1.5) *
Other[c]	504 (79)	135 (21)	69 (51)	10 (7)	37 (27)	9 (7)	10 (7)	0.8 (0.7–1.0)	1.5 (1.1–2.0) *
Undetermined[c]	2977 (72)	1153 (28)	590 (51)	60 (5)	208 (18)	276 (24)	19 (2)	0.8 (0.7–0.8) *	1.4 (1.2–1.6) *

Note: Columns 3-7 sum to Column 2 by row.

Abbreviations: aOR, adjusted odds ratio, SOC, Standard Occupational Classification.

[a]Alaska, Arizona, Colorado, Connecticut, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Utah, Vermont, Virginia, Washington, Wisconsin.

[b]Usual occupation information was based on death certificate data (eg, from funeral directors as reported by survivors of the deceased, such as family members) and was classified by 2010 SOC for this study. Non-SOC occupational categories (eg, "student") were assigned by National Institute for Occupational Safety and Health Industry and Occupation Computerized Coding System and experts in industry and occupation coding.

[c]Other deaths are unintentional firearm injuries (self-inflicted, inflicted by other person, or unknown who inflicted) or legal intervention deaths (by police or other authority). Undetermined deaths might have been due to violence but intent cannot be determined.

*$P < .05$ for regression model that included all listed variables in this table plus US state from which the death was reported to the National Violent Death Reporting System (ie, typically where the injury occurred).

TABLE 2

Descriptive data and logistic regression analysis of decedents age ≥22 y assigned Standard Occupational Classifications from death certificates but not working at time of death, National Violent Death Reporting System, 32 States[a], 2016

	Descriptive data							
			Reason decedent not employed at time of death (n)(%)[b]					Regression analysis
Characteristic	Decedent's usual occupation classified by SOC code[b] (n)	Decedent not employed at time of death (n)(% of Column 1)[b]	Unemployed	Retired	Disabled	Student	Homemaker	Model 3: Decedent not employed at time of death[b] aOR (95% CI)
Column number	1	2	3	4	5	6	7	8
Total	28 714	2987 (10)	1634 (55)	998 (33)	327 (11)	20 (1)	8 (< 1)	25 166[c]
Age, y								
22–29	5,005	279 (6)	260 (93)	1 (<1)	7 (3)	11 (4)	0 (<1)	Reference
30–44	8,392	649 (8)	561 (86)	3 (<1)	77 (12)	7 (1)	1 (<1)	1.3 (1.1–1.5)
45–64	10 721	1,111 (10)	728 (66)	172 (15)	204 (18)	2 (< 1)	5 (<1)	1.7 (1.5–2.0) *
65+	4596	948 (21)	85 (9)	822 (87)	39 (4)	0 (<1)	2 (<1)	4.0 (3.5–4.7) *
Sex								
Male	22,947	2384 (10)	1296 (54)	834 (35)	240 (10)	14 (1)	0 (<1)	1.0 (0.9–1.1)
Female	5767	603 (10)	338 (56)	164 (27)	87 (14)	6 (1)	8 (1)	Reference
Race								
White	22 458	2646 (12)	1384 (52)	950 (36)	291 (11)	14 (1)	7 (< 1)	Reference
Black or African American	4730	205 (4)	149 (73)	25 (12)	27 (13)	4 (2)	0 (<1)	0.7 (0.6–0.8)
American Indian or Alaska Native	409	41 (10)	35 (85)	4 (10)	2 (5)	0 (<1)	0 (<1)	1.0 (0.7–1.4)
Asian/Pacific Islander	492	56 (11)	36 (64)	15 (27)	3 (5)	1 (2)	1 (2)	1.0 (0.7–1.4)
Other/unspecified	314	7 (2)	5 (71)	1 (14)	1 (14)	0 (<1)	0 (<1)	0.3 (0.1–0.7) *
Two or more races	294	30 (10)	23 (77)	3 (10)	3 (10)	1 (3)	0 (<1)	1.0 (0.6–1.5)
Unknown	17	2 (12)	2 (100)	0 (<1)	0 (<1)	0 (<1)	0 (<1)	3.7 (0.8–17.2)
Education								
Not high school graduate	4288	406 (9)	225 (55)	122 (30)	58 (14)	0 (<1)	1 (<1)	1.3 (1.1–1.5) *
High school graduate	17 079	1769 (10)	1020 (58)	551 (31)	184 (10)	10 (1)	4 (<1)	1.3 (1.1–1.4) *
Associate's or Bachelor's degree	5449	562 (10)	304 (54)	181 (32)	66 (12)	8 (1)	3 (1)	Reference

	Descriptive data							
			Reason decedent not employed at time of death (n)(%)[b]					Regression analysis
Characteristic	Decedent's usual occupation classified by SOC code[b] (n)	Decedent not employed at time of death (n)(% of Column 1)[b]	Unemployed	Retired	Disabled	Student	Homemaker	Model 3: Decedent not employed at time of death[b] aOR (95% CI)
Master's degree or above	1623	222 (14)	71 (32)	135 (61)	14 (6)	2 (1)	0 (<1)	1.1 (0.9–1.4)
Unknown	275	28 (10)	14 (50)	9 (32)	5 (18)	0 (<1)	0 (<1)	1.0 (0.6–1.6)
Manner of death								
Suicide	19 255	2,375 (12)	1241 (52)	887 (37)	226 (10)	15 (1)	6 (< 1)	Reference
Homicide	5978	245 (4)	141 (58)	62 (25)	38 (16)	3 (1)	1 (<1)	0.5 (0.4–0.5) *
Other[d]	504	30 (6)	21 (70)	6 (20)	3 (10)	0 (<1)	0 (<1)	0.6 (0.4–0.8) *
Undetermined[d]	2977	337 (11)	231 (69)	43 (13)	60 (18)	2 (1)	1 (<1)	1.1 (0.9–1.3)
Usual occupation[b]								
Management	2227	233 (10)	107 (46)	110 (47)	16 (7)	0 (<1)	0 (<1)	Reference
Business and financial operations	656	77 (12)	39 (51)	29 (38)	8 (10)	1 (1)	0 (<1)	1.2 (0.9–1.6)
Computer and mathematical	563	72 (13)	46 (64)	14 (19)	10 (14)	2 (3)	0 (<1)	1.5 (1.1–2.0) *
Architecture and engineering	671	117 (17)	44 (38)	64 (55)	8 (7)	1 (1)	0 (<1)	1.6 (1.2–2.1) *
Life, physical, and social science	224	27 (12)	8 (30)	15 (56)	3 (11)	0 (<1)	1 (4)	1.2 (0.8–1.9)
Community and social service	308	33 (11)	15 (45)	13 (39)	4 (12)	1 (3)	0 (<1)	1.3 (0.8–2.0)
Legal	191	19 (10)	3 (16)	12 (63)	4 (21)	0 (<1)	0 (<1)	0.9 (0.5–1.5)
Education, training, and library	615	71 (12)	25 (35)	39 (55)	4 (6)	2 (3)	1 (1)	1.2 (0.9–1.7)
Arts, design, entertainment, sports, and media	717	93 (13)	54 (58)	24 (26)	14 (15)	1 (1)	0 (<1)	1.4 (1.1–1.8) *
Healthcare practitioners and technical	1113	152 (14)	74 (49)	59 (39)	16 (11)	2 (1)	1 (1)	1.5 (1.2–1.9) *
Health care support	538	40 (7)	30 (75)	2 (5)	7 (18)	1 (3)	0 (<1)	1.1 (0.7–1.6)
Protective service	849	121 (14)	24 (20)	87 (72)	9 (7)	1 (1)	0 (<1)	1.9 (1.4–2.4) *
Food preparation and serving related	1542	142 (9)	109 (77)	13 (9)	17 (12)	3 (2)	0 (<1)	1.4 (1.1–1.8) *
Building and grounds cleaning and maintenance	1292	94 (7)	61 (65)	17 (18)	15 (16)	0 (<1)	1 (1)	1.0 (0.7–1.2)
Personal care and service	791	65 (8)	45 (69)	10 (15)	9 (14)	1 (2)	0 (<1)	1.0 (0.7–1.4)
Sales and related	2385	263 (11)	155 (59)	83 (32)	24 (9)	0 (<1)	1 (<1)	1.2 (1.0–1.4)

	Descriptive data							Regression analysis
			Reason decedent not employed at time of death (n)(%)[b]					
Characteristic	Decedent's usual occupation classified by SOC code[b] (n)	Decedent not employed at time of death (n)(% of Column 1)[b]	Unemployed	Retired	Disabled	Student	Homemaker	Model 3: Decedent not employed at time of death[b] aOR (95% CI)
Office and administrative support	1728	177 (10)	91 (51)	61 (34)	23 (13)	2 (1)	0 (<1)	1.1 (0.9–1.4)
Farming, fishing, and forestry	252	24 (10)	15 (63)	6 (25)	2 (8)	0 (<1)	1 (4)	1.1 (0.7–1.8)
Construction and extraction	4371	405 (9)	267 (66)	92 (23)	45 (11)	1 (<1)	0 (<1)	1.1 (0.9–1.3)
Installation, maintenance, and repair	1769	194 (11)	108 (56)	59 (30)	27 (14)	0 (<1)	0 (<1)	1.2 (1.0–1.5)
Production	2462	264 (11)	124 (47)	108 (41)	31 (12)	0 (<1)	1 (<1)	1.2 (1.0–1.5)
Transportation and material moving	3450	304 (9)	190 (63)	81 (27)	31 (10)	1 (<1)	1 (<1)	1.2 (1.0–1.5)*

Note: Column 1 data in this table is the same as Table 1 Column 1 data. Column 2 in this table is a subset of Column 1 in this table. Columns 3-7 sum to Column 2 by row.

Abbreviations: aOR, adjusted odds ratio, NVDRS, National Violent Death Reporting System; SOC, Standard Occupational Classification.

[a]Alaska, Arizona, Colorado, Connecticut, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Utah, Vermont, Virginia, Washington, Wisconsin.

[b]Usual occupation information was based on death certificate data (eg, from funeral directors as reported by survivors of the deceased, such as family members) and was classified by 2010 SOC for this study. Decedents' current occupation (ie, at time of death) was based on information as reported by survivors of the deceased by coroners/medical examiners and law enforcement officials or other sources; both occupational types (usual occupation from death certificates and current occupation from non-death certificate sources) are reported in the National Violent Death Reporting System (NVDRS). Decedents not working at time of death were identified through a text search of NVDRS current occupation data: unemployed ("unemp", "not empl," "laid off", "never worked", "never employed", "not working", "not in workforce", "incarcer", "inmate", "prisoner"), retired ("retir"), disabled ("disab"), student ("student"), homemaker ("homemaker", "home maker", "housewife", "house wife"). When decedents' current occupation information indicated more than one reason for not working at time of death (eg, "unemployed/retired"), decedents were classified by the more specific reason for no employment—that is, "retired", "disabled", "student", or "homemaker" were each prioritized above "unemployed", and "disabled" was prioritized above "retired.".

[c]Four states had zero decedents identified as not in the labor force at time of death based on this study's methods; decedents from those states were automatically dropped from the model due to no variation in the dependent variable, reducing the number of analyzed observations.

[d]Other deaths are unintentional firearm injuries (self-inflicted, inflicted by other person, or unknown who inflicted) or legal intervention deaths (by police or other authority). Undetermined deaths might have been due to violence but intent cannot be determined.

*$P < .05$ for regression model that included all listed variables in this table plus US state from which the death was reported to NVDRS (ie, typically where the injury occurred).

TABLE 3

Separate logistic regression analysis among male and female decedents age ≥22 y, National Violent Death Reporting System, 32 states[a], 2016

	Model 1: Decedent classified by SOC code[b] aOR (95% CI)		Model 2: Decedent had insufficient information to classify occupation[b] aOR (95% CI)		Model 3: Decedent not employed at time of death aOR (95% CI)	
Characteristic	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Total n	27 989	8516	27 989	8516	20 061	4974
Age, y						
22–29	Reference	Reference	Reference	Reference	Reference	Reference
30–44	1.8 (1.7–2.0)*	1.0 (0.8–1.1)	0.9 (0.8–1.0)*	0.9 (0.7–1.1)	1.2 (1.0–1.5)*	1.5 (1.1–2.2)*
45–64	2.2 (2.0–2.4)*	1.1 (0.9–1.3)	0.8 (0.7–0.9)*	0.8 (0.6–1.0)	1.7 (1.5–2.0)*	1.7 (1.2–2.4)*
65+	3.2 (2.8–3.6)*	1.0 (0.9–1.3)	0.7 (0.6–0.8)*	0.7 (0.5–1.0)	3.9 (3.3–4.6)*	4.5 (3.1–6.5)*
Race						
White	Reference	Reference	Reference	Reference	Reference	Reference
Black or African American	0.6 (0.5–0.7)*	1.1 (0.9–1.3)	1.9 (1.7–2.1)*	2.2 (1.7–2.8)*	0.7 (0.6–0.9)*	0.8 (0.5–1.1)
American Indian or Alaska Native	0.8 (0.6–1.1)	0.5 (0.4–0.8)*	0.9 (0.5–1.5)	2.2 (1.1–4.5)*	1.1 (0.7–1.5)	0.7 (0.3–1.9)
Asian/Pacific Islander	0.5 (0.4–0.6)*	0.5 (0.4–0.6)*	1.6 (1.2–2.2)*	2.3 (1.6–3.5)*	1.0 (0.7–1.5)	0.9 (0.5–1.6)
Other/Unspecified	0.7 (0.6–1.0)*	0.5 (0.3–0.8)*	1.4 (1.0–1.9)*	2.2 (1.2–4.2)*	0.4 (0.2–0.9)*	1.0 (1.0–1.0)
Two or more races	1.0 (0.7–1.5)	1.4 (0.8–2.3)	0.5 (0.3–1.0)	0.2 (0.0–1.4)	1.0 (0.6–1.6)	1.0 (0.4–2.2)
Unknown	0.4 (0.1–0.9)*	1.0 (1.0–1.0)	2.2 (0.7–6.9)	1.0 (1.0–1.0)	3.9 (0.8–18.5)	1.0 (1.0–1.0)
Education						
Not high school graduate	0.7 (0.6–0.8)*	0.3 (0.2–0.3)*	1.5 (1.3–1.8)*	1.9 (1.4–2.5)*	1.4 (1.2–1.7)*	1.0 (0.7–1.5)
High school graduate	0.9 (0.8–1.0)*	0.5 (0.5–0.6)*	1.2 (1.0–1.3)*	1.0 (0.8–1.3)	1.3 (1.1–1.5)*	1.2 (0.9–1.5)
Associate’s or Bachelor’s degree	Reference	Reference	Reference	Reference	Reference	Reference
Master’s degree or above Degree	1.1 (0.9–1.4)	1.7 (1.3–2.3)*	0.9 (0.7–1.2)	1.0 (0.7–1.4)	1.2 (1.0–1.6)	0.9 (0.6–1.3)
Unknown	0.1 (0.0–0.1)*	0.1 (0.0–0.1)*	33.7 (27.4–41.5)*	42.3 (28.9–61.9)*	1.0 (0.6–1.6)	0.9 (0.3–2.9)
Manner of death						
Suicide	Reference	Reference	Reference	Reference	Reference	Reference
Homicide	0.9 (0.8–0.9)*	1.2 (1.1–1.4)*	1.5 (1.3–1.7)*	1.0 (0.8–1.3)	0.4 (0.3–0.5)*	0.6 (0.5–0.9)*

Characteristic	Model 1: Decedent classified by SOC code[b] aOR (95% CI)		Model 2: Decedent had insufficient information to classify occupation[b] aOR (95% CI)		Model 3: Decedent not employed at time of death aOR (95% CI)	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**
Other	0.8 (0.6–1.0)	0.7 (0.4–1.3)	1.5 (1.1–2.0) *	1.6 (0.5–4.7)	0.6 (0.4–0.9) *	0.3 (0.0–2.6)
Undetermined	0.7 (0.6–0.8) *	0.9 (0.7–1.0) *	1.5 (1.3–1.7) *	1.1 (0.9–1.4)	1.0 (0.9–1.2)	1.2 (0.9–1.6)
Usual occupation						
Management	NA	NA	NA	NA	Reference	Reference
Business and financial operations	NA	NA	NA	NA	1.1 (0.8–1.6)	1.2 (0.7–2.2)
Computer and mathematical	NA	NA	NA	NA	1.5 (1.1–2.1) *	1.1 (0.4–2.8)
Architecture and Engineering	NA	NA	NA	NA	1.7 (1.3–2.2) *	0.9 (0.3–2.8)
Life, physical, and social Science	NA	NA	NA	NA	1.1 (0.7–1.8)	1.8 (0.7–4.8)
Community and social Service	NA	NA	NA	NA	1.3 (0.7–2.3)	1.1 (0.6–2.3)
Legal	NA	NA	NA	NA	0.9 (0.5–1.8)	0.7 (0.3–1.9)
Education, training, and Library	NA	NA	NA	NA	1.2 (0.8–1.9)	1.1 (0.6–1.9)
Arts, design, entertainment, sports, and media	NA	NA	NA	NA	1.2 (0.9–1.7)	1.8 (1.0–3.3) *
Healthcare practitioners and technical	NA	NA	NA	NA	1.4 (1.0–2.0) *	1.4 (0.9–2.2)
Health care support	NA	NA	NA	NA	0.7 (0.3–1.7)	1.1 (0.6–1.8)
Protective service	NA	NA	NA	NA	2.0 (1.5–2.6) *	0.9 (0.4–2.3)
Food preparation and serving related	NA	NA	NA	NA	1.4 (1.1–1.9) *	1.3 (0.8–2.2)
Building and grounds cleaning and maintenance	NA	NA	NA	NA	1.0 (0.8–1.4)	0.6 (0.3–1.2)
Personal care and service	NA	NA	NA	NA	1.4 (0.9–2.1)	0.7 (0.4–1.2)
Sales and related	NA	NA	NA	NA	1.2 (1.0–1.5)	1.1 (0.7–1.7)
Office and administrative support	NA	NA	NA	NA	1.2 (0.9–1.6)	1.0 (0.6–1.6)
Farming, fishing, and forestry	NA	NA	NA	NA	1.1 (0.7–1.8)	0.6 (0.1–5.0)
Construction and extraction	NA	NA	NA	NA	1.1 (0.9–1.4)	1.1 (0.3–3.4)
Installation, maintenance, and repair	NA	NA	NA	NA	1.2 (1.0–1.5)	2.4 (0.8–6.8)
Production	NA	NA	NA	NA	1.2 (1.0–1.5)	1.2 (0.7–2.2)
Transportation and material moving	NA	NA	NA	NA	1.2 (1.0–1.5)	1.2 (0.6–2.2)

Abbreviations: aOR, adjusted odds ratio; NA, not applicable (Model 1 and Model 2 did not address decedent occupation); SOC, Standard Occupational Classification.

[a]Alaska, Arizona, Colorado, Connecticut, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Utah, Vermont, Virginia, Washington, Wisconsin.

[b]Usual occupation information was based on death certificate data (eg, from funeral directors as reported by survivors of the deceased, such as family members) and was classified by 2010 Standard Occupational Classification for this study. Decedents' *current occupation* (ie, at time of death) was based on information as reported by survivors of the deceased by coroners/medical examiners and law enforcement officials or other sources; both occupational types (usual occupation from death certificates and current occupation from non-death certificate sources) are reported in the National Violent Death Reporting System (NVDRS). Decedents not working at time of death were identified through a text search of NVDRS current occupation data: unemployed ("unemp", "not empl," "laid off", "never worked", "never employed", "not working", "not in workforce", "incarcer", "inmate", "prisoner"), retired ("retir"), disabled ("disab"), student ("student"), homemaker ("homemaker", "home maker", "housewife", "house wife"). When decedents' current occupation information indicated more than one reason for not working at time of death (eg, "unemployed/retired"), decedents were classified by the more specific reason for no employment—i.e., "retired", "disabled", "student", or "homemaker" were each prioritized above "unemployed", and "disabled" was prioritized above "retired.".

[c]Four states had zero decedents identified as not in the labor force at time of death based on this study's methods; decedents from those states were therefore dropped from the model (ie, automatically dropped due to no variation in the dependent variable), reducing the number of observations.

[d]Other deaths are unintentional firearm injuries (self-inflicted, inflicted by other person, or unknown who inflicted) or legal intervention deaths (by police or other authority). Undetermined deaths might have been due to violence but intent cannot be determined.

[*]$P < .05$ for regression model that included all listed variables in this table plus US state from which the death was reported to National Violent Death Reporting System (ie, typically where the injury occurred).