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The Prevalence of Work-Related Suicides Varies by Reporting Source from the National Violent Death Reporting System

Corinne Peek-Asa, PhD[1], **Ling Zhang, MS**[2], **Cara Hamann, PhD**[3], **Jonathon Davis, PhD**[1], **Carri Casteel, PhD**[1]

[1]University of Iowa, College of Public Health, Department of Occupational and Environmental Health

[2]University of Iowa, College of Public Health, Department of Biostatistics

[3]University of Iowa, College of Public Health, Department of Epidemiology

Abstract

Introduction: Both suicides overall and work-related suicides are increasing in the United States, and efforts to reduce suicide risk will require understanding of the frequency and role of work in suicides. This study examines the incidence of occupational suicides using the National Violent Death Reporting System (NVDRS), which identified the role of work in suicides using the traditional death certificate as well as from death investigations.

Methods: NVDRS suicides among those aged 16 through 65 from 2013 through 2017 were examined to identify if the death certificate identified the death as work-related, if the death investigation identified a job problem as a suicide circumstance, and if the death investigation identified that the job problem was a crisis at the time of the suicide.

Results: Overall, 1.13% of death certificates identified the suicide as work-related, 2.34% of suicides included a job crisis, and 11.2% a job problem, and proportions did not vary over the years of the study. Overlap between the death certificate and death investigation was very low, with only 0.21% of suicides identified as related to work by both sources. Identification of work-relatedness varied by source for demographic characteristics, mechanism of suicide, and occupation. For example, the death certificate identified 2.1% of suicides among those working in protective services as work-related, but death investigations identified 15.2% as having a job problem.

Corresponding Author: Corinne Peek-Asa, 145 N. Riverside Drive, S143 CPHB, Iowa City, IA 52241, Corinne-peek-asa@uiowa.edu.

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Disclaimer: The National Violent Death Reporting System (NVDRS) is administered by the Centers for Disease Control and Prevention (CDC) by participating NVDRS states. The findings and conclusions of this study are those of the authors alone and do not necessarily represent the official position of the CDC or of participating NVDRS states.

Institution and Ethics approval and informed consent: This study was approved as an expedited study through the University of Iowa Human Subject Office because it is a secondary data analysis of de-identified data. Data were obtained through a Data Use Agreement with the CDC/National Center for Injury Prevention and Control, National Violent Death Reporting System.

Conclusion: Work-related factors may be associated with a far higher proportion of suicides than previously documented.

Keywords

suicide; occupational health; surveillance

INTRODUCTION

Occupational injuries in the US increased 11.9% between 2011 and 2018, from 4,693 in 2011 to 5,250 in 2018.[1] The number of occupational suicides during this period increased 21.6%, far outpacing the increase in overall occupational injuries and staying abreast with the increase of 22.3% for overall suicides in the US.[2,3] Understanding the impact of the workplace in addressing the rising burden of occupational suicide requires accurate surveillance, including accurate estimates of the incidence of occupational suicide, methods to tie a suicide to work, and the work-related circumstances that contributed to the suicide.

Historically, the death certificate has been the only surveillance system for identifying, enumerating, and describing work-related fatal injuries, including suicides, at the state or national level.[1–4] Deaths are identified as work-related using the “injury-at-work” tick-box on the death certificate, and these are defined as deaths that occur during paid work, training, or volunteering in any area of a work premises, including while on a break, and including travel for business. Based on the wording of the item, the focus is strongly tied to the location of the suicide rather than circumstances of work underlying the suicidal behavior. Research has shown that the death certificate may significantly undercount work-related suicides.[4–6] While the death certificate has high specificity for work-related suicides (few false positive), it lacks sensitivity (has high false negatives). Based on documented variance in the injury-at-work tick-box on the death certificate, national surveillance systems such as the Bureau of Labor Statistic’s Census of Fatal Occupational Injuries (CFOI) identifies and validates work-related deaths using multiple sources, including media reports and medical examiner reports. CFOI data do not capture systematic and detailed information about the underlying work factors.

The advent of the National Violent Death Reporting System (NVDRS) is the first opportunity to more accurately identify work-relatedness of suicides and to describe the underlying circumstances, such as work problems prior to the suicide. The NVDRS data are abstracted from multiple sources and agencies and provide a more comprehensive summary of the decedent and circumstances of the death. One goal of the NVDRS is to identify circumstances, such as work, that contribute to the suicide behavior. The NVDRS has several sources that can be used to identify work-relatedness of a suicide. The death certificate is one of these sources. In addition, the NVDRS includes a variable called “job problem” which indicates if any of the information sources identified that a work problem or circumstance contributed to the death. To more directly identify underlying work circumstances, the NVDRS also has a variable called “job crisis,” which is defined as the job problem presenting a crisis within two weeks of the death.

The work-related criteria for these different NVDRS sources varies. For example, the death certificate identifies “injury-at-work” defined as deaths that occur during paid work, training, or volunteering in any area of a work premises, including while on a break, and including travel for business. This definition does not include underlying circumstances that are related to work but not “at-work” as defined by the death certificate. The NVDRS variables of “job problem” and “job crisis” capture these circumstances without the suicide being tied to specific work locations or activities. The NVDRS is the first opportunity to examine how work contributes to suicide as a broader circumstance, which can be important both to understand the contribution of work factors to suicide and for workplaces to implement successful suicide prevention and mental health support programming. The goal of this analysis is to identify the relative frequency with which death certificates and the NVDRS variables “job problem” and “job crisis” identify a suicide as being related to work factors.

METHODS

Data from the NVDRS were used for this analysis. Data were acquired through a signed data use agreement with the Centers for Disease Control and Prevention/National Center for Injury Prevention and Control and the University of Iowa, and the study was approved by the University of Iowa Human Subject Office. The NVDRS includes in-depth information about violent deaths, including homicide and suicide in the US. Data are collected from death certificates, autopsy reports, law enforcement investigation reports, and crime scene analysis.

Suicides for the years of 2013 through 2017 were included in this study. With the goal of becoming a national surveillance system, the NVDRS began collecting data in 2002 with six states. By 2013, 17 states were included and by 2017 this increased to 35 states, as well as Puerto Rico and the District of Columbia. Not all states report every violent death in the state and instead have a regional focus. We compared results for the study period using only the 17 states that reported each year to the results using all reporting units for each year and found similar trends. Years prior to 2013 were excluded from this analysis because the variables that indicate that a particular underlying circumstance of the death was a crisis were not included until 2013. In order to maximize the number of individuals in the sample who were likely to be working, suicides within the age group of 16 (when most states issue work permits) to 65 (the most common age of retirement) were included. A total of 114,428 suicides outside of these ages were excluded.

Three sources within the NVDRS identify the relation of working to the suicide. The death certificate has a tick-box that indicates if the death was an “injury-at-work” with a yes/no response. According to instructions from the CDC (CDC2003), an injury at work applies to any occupation, not just the “usual occupation” and includes deaths that occur during paid work, training, or volunteering in any area of a work premises, including while on a break, and including travel for business.[7] The NVDRS identifies deaths as having a “job problem” if the decedent was described in any of the NVDRS data sources as experiencing a problem related to work such as the following: tensions with a co-worker or manager, poor performance review, increased pressure at work, fear of losing the job, or recently laid

off from the job. A decedent described as being unemployed without specific identification of additional workplace problems was not sufficient for identifying a job problem. A “job crisis” was identified for a death if the job problem was current at the time of death or occurred within two weeks of the death. Thus, the “job crisis” variable is a subset of the “job problem” variable for which the job problem was proximal in time and a priority factor identified in the suicide circumstances. The variables “job problem” and “job crisis” are coded by trained abstractors for each NVDRS site.

The National Institute for Occupational Safety and Health (NIOSH) Occupation Computerized Coding System (NIOCCS) was used to assign Standard Occupational Classification (SOC) to each decedent based on occupation and industry text reported on the death certificate. A description of the program is available from NIOSH (NIOSH 2019). The NIOCCS autocoding program has been used previously with NVDRS records to describe rates of suicide across industry and occupation during 2016.[8,9]

ANALYSIS

The number and proportion of suicides that were identified as work related were described using each of the three work-related definitions (“injury-at-work”, “job problem”, or “job crisis”). The proportion of all suicides that were identified as work-related by one of the three definitions were compared by year, sex, age, suicide mechanism, and occupation using the Chi-squared test for independence with α=0.05 used as a threshold for statistical significance. All statistical analyses were conducted using SAS 9.4. All variables were categorical, some variables with dichotomous measures, such as Injury-at-work, Job crisis, and Job problem, some variables with nominal measures binned into three or more levels, such as Marriage, Race, Suicide Mechanism and Occupation, some variables with ordinal measures binned into three or more levels, such as Age group and Education. We conducted independence analyses using Chi-square test on sex, age, marriage, education, Race, suicide mechanism with each one of the Injury-at-work, Job crisis, and Job problem, for example, testing the independence of sex with Injury-at-work, the independence of sex with Job crisis, and the independence of sex with Job problem.

RESULTS

Prevalence of work-related suicide by source

Among the 84,389 suicides of 16 to 65 year olds reported by all states in the NVDRS in the US between 2013 and 2017, the death certificate identified 950 (1.13%) as work-related (Table 1). This percentage remained stable from 2013 through 2017 and ranged from a low of 1.1% in 2014 to a high of 1.2% in 2017. These percentages are similar to those comparing only the 17 states that reported NVDRS data from 2013 to 2017.

The NVDRS variable “job crisis” identified more than twice as many (n = 1,976; 2.34%) of the suicide deaths to have had an employment crisis related to the suicide, compared to the number of work-related suicides identified from the death certificate. Job crisis was also stable for the study period for all reporting states, ranging from 2.0% in 2015 to 2.8% in 2014. These percentages were similar to those among the 17 states reporting each year,

although the percentages had a slight increase from 2.3% in 2013 to 3.0% in 2017. The more general NVDRS 'job problem" identified 9,443 (11.2%) suicide deaths as having an employment problem mentioned in the death investigation, with prevalence ranging from 10.3% in 2015 in to 13% in 2013 but with no consistent time trend.

The prevalence of suicides identified as work-related by any source ranged from 11.32% in 2017 to 13.87% in 2013 for all reporting states, and ranged from 11.4% in 2017 to 13.9% in 2013 among the 17 states reporting each year. Among the suicides that were identified by the death certificate (n = 950) and by NVDRS as a job crisis (n = 1,976), only 54 overlapped (Figure 1). Thus, among the 1,976 suicides for which review of the death investigation found a job crisis, the death certificate identified only 2.7% of them as work-related. Among the 950 suicides identified as work-related on the death certificate, only 5.7% were identified by NVDRS as having a job crisis.

Characteristics of work-related suicide by source

Work-related suicides were more prevalent among males than females for all reporting sources (Table 2). Suicides identified as work-related by the death certificate had the largest difference by sex, with males nearly three times more likely to be work-related, compared with less than twice as likely for other sources. Age trends were similar for all sources. Work-related suicides were most prevalent in the age group ranging from 35 to 54 years old, followed by 55 – 64 year olds, 21–34 year olds, and lowest among 16–20 year olds. The prevalence of work-relatedness for married suicide deaths was highest among all reporting sources. The prevalence was high for those who were divorced or separated based on the job crisis and job problem sources, compared to less than 1% from the death certificate. For all reporting sources, work-related suicides were highest among those with a college education and above, and lowest for those with less than a high school education.

For the death certificate, the percentage that were work-related by race/ethnicity was highest for those of Hispanic descent, followed by Other race, non –Hispanic descent. The prevalence was highest for those of White non-Hispanic descent for both job crisis (2.46%) and job problem (11.74%) and the Other/Unknown group. Suicides by falling (1.64%) and hanging (1.51%) were the most frequently identified as work-related by the Death Certificate and least common for drowning (0.24%). For both job crisis and job problem, the highest proportions were among firearms and other weapons and for hanging.

Work-related suicides by occupation

Table 3 presents the proportion of suicides identified as work-related sorted by order of frequency of suicide, including occupations with at least 1,000 suicides. Note that this is a distribution of suicides by occupation and does not represent risk of suicide by occupation because an at-risk denominator (all people employed in each occupation during the years 2013 to 2017) was not used. Construction and extraction was the most common occupation among the suicides, of which 0.75% were considered work-related by the death certificate, 1.90% as a job crisis, and 10.13% as a job problem. Transportation and material moving; sales and related occupations; production; and, management were the remaining top five

occupations listed among the suicides. Of these, management had the highest prevalence of work-relatedness for both the death certificate and as a job crisis.

Figure 2 shows the proportion of suicides identified as work-related ranked by highest prevalence for each source, including occupations with at least 1,300 suicides. Management had the highest proportion of suicides identified as work-related by the death certificate (2.5%) and as a job crisis on NVDRS (4.7%), and management was third highest as a job problem on NVDRS (17.3%). Protective services was second highest according to the death certificate (2.1%) but ranked fifth as both a job crisis (3.7%) and job problem (15.2%) on the NVDRS. Installation/maintenance and building/cleaning/maintenance ranked third and fourth, respectively, on the death certificate, but were ranked much lower based on both NVDRS sources. Transportation/materials also ranked as having a high prevalence of work-related suicides by the death certificate but not NVDRS sources.

The major SOC categories of computer/mathematical and healthcare practice/tech were ranked in the top four for NVDRS sources but were below the top five according to the death certificate. Other occupation categories that ranked higher by NVDRS than the death certificate included business and finance; sales and related occupations; and, administrative support. Rankings were fairly similar for the NVDRS sources, likely because they arise from the same base sources. However, some of the frequencies varied by occupation. For example, more than 18% of suicides in computer/mathematical and business/finance occupations were identified as related to a job problem, but fewer than 4.5% were attributed to a job crisis.

DISCUSSION

Suicidal behavior is complicated, multifactorial, and for any individual with suicidal ideation, any particular of a myriad of stressors may shift in priority. In most cases, work factors are unlikely to be the single source of stressor leading to suicide. However, understanding the prevalence of work-related factors is helpful not only for research but also to help inform workplaces in prioritizing and implementing suicide prevention and mental health support programming.

The prevalence of work issues as they relate to suicide varied considerably when comparing the injury-at-work check box on the death certificate and the NVDRS abstracted job problem and job crisis. This variance does not in itself indicate inaccuracy by reporting source, since the underlying goals of the different sources vary. The death certificate “injury at work” variable focuses on the relation of the death to work activities or locations, but does not identify underlying circumstances or motivational factors for the suicide. For example, the death certificate would not identify work stresses that might be an underlying reason for the suicide, which may have been captured from other NVDRS reporting sources such as law enforcement investigation reports. For example, an individual whose job loss led to their suicide would not likely meet criteria for coding “injury-at-work” in the death certificate but would be recognized as a job problem or job crisis within NVDRS. A suicide that occurred in the decedent’s workplace, but for which there was no known tie of work-related circumstances, would not fit into the job problem or job crisis criteria. Combining the

sources has provided a much more comprehensive estimation of the prevalence of work factors in suicide.

Regardless of the different criteria, previous research has identified that the death certificate undercounts work-relatedness of many type of deaths, and in particular suicides. Thus, the use of death certificates likely leads to an underestimate of suicides that meet the “at work” definition. Studies of occupational deaths overall have found that the death certificate is much more accurate in identifying deaths that are not work-related than those that are. Among all US deaths from 1979 to 1989, the sensitivity was estimated at only 77.6% while the specificity was over 99%.[4] A study in Michigan estimated the sensitivity from 2001 through 2016 to be 73.1% overall, although for suicides was only 61.9%. Sensitivity decreased over time and reached 63.1% in 2016.[6] In a survey of California Medical Examiners, only 38.9% reported that they would consider a suicide as work-related even if it occurred during paid work and in the decedent’s workplace.[5] Thus, the incidence of work factors as a contributor to suicide are likely to be under-recognized.

The very low overlap among these sources is further indication that occupational suicides have been undercounted. For example, for this study period of 2013 – 2017, the death certificate identified 1.13% of suicides as work-related, but when all three sources were considered, the proportion was 12.11%. Prior studies found that under-reporting of occupational injury occurred by sex, age, and mechanism of injury.[4–6] These studies have found that work-relatedness is undercounted in death certification overall, and that this undercount is disproportional for suicides. For example, Peek-Asa et al., surveyed coroners and medical examiners about their likelihood of checking the ‘injury-at-work’ tickbox in a number of different death scenarios, and only 38.9% indicated that they would check the box in the suicide death of a janitor found at the decedent’s usual place of work.[5] We also found differential reporting by source within NVDRS by sex, age, marital status, educational status, race, and suicide mechanism.

Using the broader definition of work-related that is enabled through the NVDRS, the association between occupation and occupational suicide may be very different. Among 14 occupations that accounted for at least 1,300 suicides over the study period, occupations in management, protective services, and business/finance were in the top five for all three sources. Based on the death certificate, the occupations of installation and maintenance, building services, and transportation had a high proportion of work-related suicides, but these occupations had far below the average proportion reporting a job crisis or job problem. Job crises and job problems were more common among those in occupations involve computer/mathematics, healthcare, or administrative support.

This study has several limitations. As the NVDRS expands into a national surveillance effort, reporting varies by state. NVDRS is not yet a population-based surveillance system, and during the study years 15 states were not yet providing data and not all states were state-wide. During this study period, 17 states reported for all five study years, and the number of reporting states grew from 17 to 37 over this time. Sensitivity analysis indicates that results of this study do not vary substantially when using the 17 recurring states or all reporting states. Death investigations focus on the factors that are a priority for each individual case,

and despite having clear definitions of work-related variables, not every investigation is going to include work factors, especially if they are not the main circumstances. Since death investigations and certifications are conducted by a large number of teams across each state, and these teams have various areas of expertise, there is considerable variance in how investigation information is collected. Variation likely also exists in state collection of NVDRS data.

Despite these limitations, this study identifies that work-related factors may be associated with a far higher proportion of suicides than previously documented. Surveillance efforts aimed at identifying broad associations of work circumstances with suicide, and that seek to overcome potential under-reporting of suicide at work on the death certificate, can increasingly use the NVDRS for incidence estimates. This potential will be greatly enhanced as the NVDRS grows to cover all deaths in all US states and territories. A more accurate estimate of work-related suicides can support prioritization of suicide prevention and mental health support programming in workplaces. The NVDRS will also be helpful in identifying the prevalence and combinations of specific work factors, which can assist in focusing suicide prevention programming. This information is helpful to support workplace efforts to address suicide risk factors, and will be essential to track trends in occupational suicide over time.

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Data Availability:

The National Violent Death Reporting System (NVDRS) is available for analysis through a request to and approved agreement with the CDC/National Center for Injury Prevention and Control (https://www.cdc.gov/violenceprevention/datasources/nvdrs/dataaccess.html).

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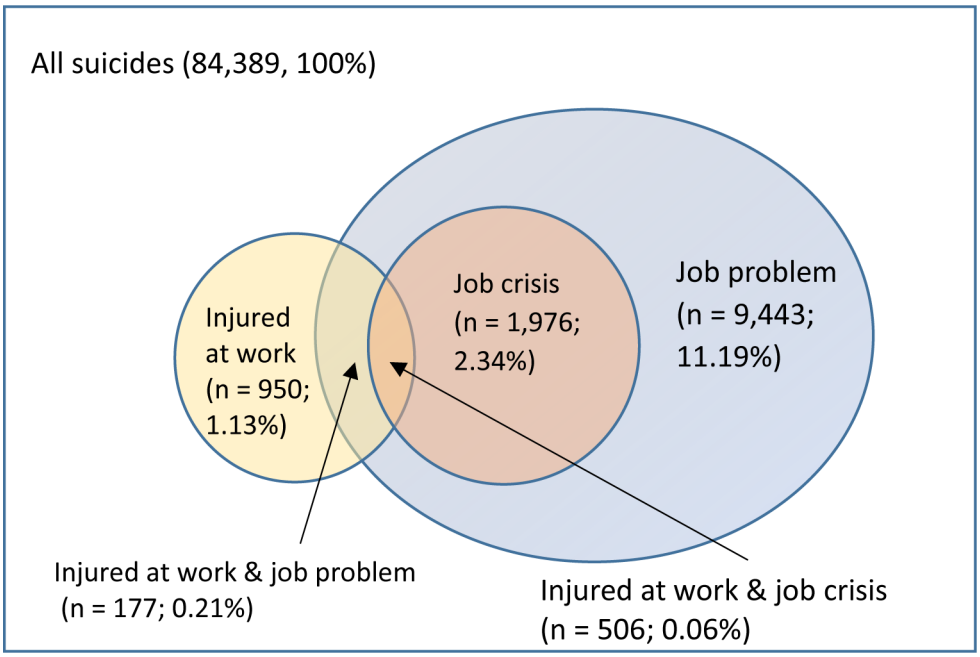

Figure 1:
Overlap in work-related suicides by source among 16 – 65 year olds, National Violent Death Reporting System, 2013 – 2017

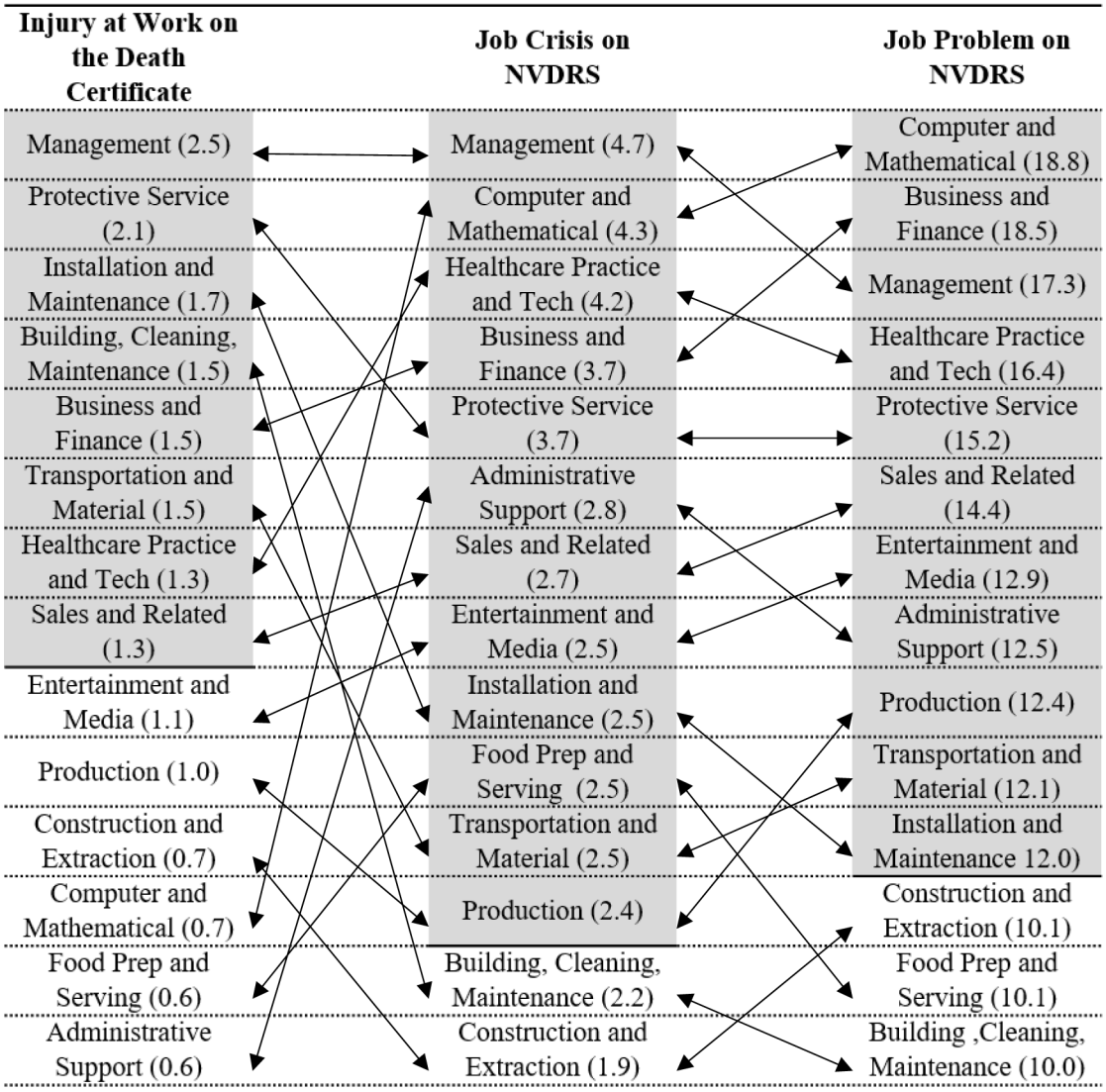

Figure 2:

Percent of suicides identified as work-related by source, ranked by percentage, age 16–65, National Violent Death Reporting System, 2013–2017.*

*Major SOC occupation codes with at least 1,300 suicides were included. **Occupations in the shaded areas have above the average proportion identified as work-related by that source.

Table 1:

Prevalence of work-related suicide by source, ages 16 – 65, National Violent Death Reporting System, 2013 – 2017

Year	Number of States	Injury-at-work on the death certificate N (%)	Job crisis indicated on NVDRS N (%)	Job problem indicated on NVDRS N (%)	Suicides identified as work-related by any source N(%)	Total Number of Suicides N
All NVDRS Reporting States						
2013	17	120 (1.11)	250 (2.32)	1400 (12.99)	1494 (13.87)	10775
2014	18	126 (1.05)	331 (2.75)	1440 (11.95)	1541 (12.79)	12046
2015	27	187 (1.12)	342 (2.04)	1801 (10.75)	1953 (11.66)	16746
2016	32	238 (1.14)	475 (2.27)	2332 (11.14)	2522 (12.05)	20925
2017	37	279 (1.17)	578 (2.42)	2470 (10.34)	2706 (11.32)	23897
Total	37	950 (1.13)	1976 (2.34)	9443 (11.19)	10216 (12.11)	84389
States Reporting For All Study Years						
2013	17	120 (1.11)	250 (2.32)	1400 (12.99)	1494 (13.87)	10775
2014	17	121 (1.11)	324 (2.96)	1335 (12.20)	1431 (13.08)	10940
2015	17	111 (0.97)	296 (2.60)	1234 (10.83)	1322 (11.60)	11397
2016	17	133 (1.15)	314 (2.71)	1326 (11.46)	1432 (12.37)	11574
2017	17	124 (1.03)	360 (2.99)	1273 (10.58)	1377 (11.44)	12037
Total	17	609 (1.07)	1544 (2.72)	6568 (11.58)	7056 (12.44)	56723

Table 2:

Percent of suicides identified as work-related by source, age 16 – 65, by decedent characteristics, National Violent Death Reporting System, 2013 – 2017

	Total Number	Percent identified as work-related by source					
		Injury At Work on the Death Certificate	Chi-Square test	Job Crisis indicated on NVDRS	Chi-Square test	Job Problem indicated on NVDRS	Chi-Square test
Overall percent		1.13		2.34		11.29	
Sex *			<.0001		<.0001		<.0001
Male	64466	1.33		2.57		12.34	
Female	19922	0.48		1.60		7.47	
Age			<.0001		<.0001		<.0001
16–20	5775	0.40		1.02		4.33	
21–34	23884	0.94		2.14		9.99	
35–54	36763	1.32		2.68		12.78	
55–64	17967	1.20		2.33		11.75	
Marriage			<.0001		<.0001		<.0001
Married/civil union/ widowed	26606	1.77		2.88		12.65	
Never married/single	35665	0.71		2.02		9.89	
Divorced/ married but separated	21030	0.98		2.26		11.76	
Other/unknown	1088	1.75		1.38		7.08	
Education			0.0001		<.0001		<.0001
Less than high school	11292	0.84		1.16		6.37	
High school diploma/ Some college credit, but no degree	45091	1.08		2.17		10.29	
College and above	19066	1.38		3.40		15.45	
Unknown	8940	1.20		2.46		12.76	
Race			0.0013		<.0001		<.0001
White, non-Hispanic	68502	1.11		2.46		11.74	
Black or African American, non-Hispanic	5669	0.78		2.15		9.00	
Hispanic	5564	1.56		1.62		8.23	
Other race, non-Hispanic	3370	1.36		1.87		9.58	
Other/Unknown	1284	1.01		1.40		8.72	
Mechanism**			<.0001		<.0001		<.0001
Fall	2129	1.64		2.30		8.17	
Hanging/strangulation/ suffocation	26126	1.51		2.46		11.90	
Firearms	38386	1.07		2.53		12.30	
Other Weapon	1699	1.35		2.59		10.30	

	Total Number	Percent identified as work-related by source					
		Injury At Work on the Death Certificate	Chi-Square test	Job Crisis indicated on NVDRS	Chi-Square test	Job Problem indicated on NVDRS	Chi-Square test
Poisoning	12779	0.55		1.71		8.26	
Fire/burn	371	0.81		1.62		7.28	
Transportation	1547	0.39		1.49		6.33	
Drowning	819	0.24		2.20		8.42	
Other/unknown/missing	533	1.13		0.38		2.63	

* One suicide was missing Sex

* Mechanism categories: Firearm = firearm, non-powder gun; Other weapon = sharp instrument, blunt instrument, personal weapon, explosive, biological; Transportation= MVA, other

Table 3:

Percent of occupational suicides identified as work-related by source ages 16–65, by occupation, National Violent Death Reporting System

	Total Number	Percent identified as work-related by source		
Occupation[1]		**Injury At Work on the Death Certificate**	**Job Crisis indicated on NVDRS (percent of all suicides)**	**Job Problem indicated on NVDRS**
Construction and Extraction	8440	0.73	1.90	10.13
Transportation and Material Moving	5119	1.50	2.46	12.09
Sales and Related	4484	1.29	2.74	14.41
Production	4655	0.99	2.38	12.40
Management	3940	2.54	4.70	17.34
Installation, Maintenance and Repair	3404	1.73	2.50	12.02
Office and Administrative Support	2903	0.55	2.82	12.54
Food Preparation and Serving Related	2867	0.63	2.48	10.12
Healthcare Practitioners and Technical	2597	1.31	4.16	16.40
Building and Grounds Cleaning and Maintenance	2182	1.51	2.15	9.99
Protective Service	1589	2.08	3.71	15.23
Arts, Design, Entertainment, Sports, and Media	1501	1.07	2.53	12.92
Business and Financial Operations	1391	1.51	3.74	18.48
Computer and Mathematical	1380	0.65	4.28	18.77
Architecture and Engineering	1217	1.73	4.27	16.93
Personal Care and Service	1199	1.17	1.67	8.26
Education Instruction and Library	1110	0.72	2.88	11.17
Healthcare Support	1023	0.39	1.47	8.80

Major SOC codes that had at least 1,000 suicides are included. 33,388 suicides (39.6% were in other occupations, did not have an identified occupation, had an unknown occupation, or their occupation did not match to an SOC code.