Original Research

Epidemiology of suicide in an Iowa cohort

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ABSTRACT

Objectives: Suicide is an ongoing public health problem in the United States. The purpose of this epidemiologic investigation was to characterize and identify populations at risk of suicide, which in turn may lead to targeted intervention and improvements in suicide prevention.

Study design: This is a descriptive analysis of 657 suicide decedents autopsied by the University of Iowa Hospitals and Clinics between 7/1/2003 and 6/30/2018 (180 months, 15 years).

Methods: Data were obtained via autopsy report abstraction. Chi-squared tests were used for categorical variables and Wilcoxon rank–sum tests were used for continuous variables. Statistical analyses were conducted using SAS 9.3.

Results: Decedents were primarily white (88.2%) and male (75.7%). Average age was 43 years. Suicides were more likely to occur at a residence (69.3%), earlier in the week, and in the late night to early morning hours. Suicides were most likely to occur in spring and least likely to occur in winter. The most common method was a firearm (44.6%), most often a handgun (61.3% of firearm suicides). Less than one-half (42.8%) of decedents communicated intent to end their life. Approximately one-quarter (22.1%) of suicides were without a known identified life stressor or a known inciting event, a phenomenon that was markedly more common among men.

Conclusions: More than one-half of decedents left no communication of intent to commit suicide, and one-quarter—more commonly men—had no known life stressor or other specifically identified motivating factor. While women were more likely to have a known mental health condition, prior contact with mental health care, or prior suicidal behavior, we found that, statistically speaking, the typical profile of a completed suicide is a white male who used a firearm in his place of residence. Future studies should seek to further elucidate factors leading to suicide in this at-risk population.

Introduction

Suicide is an ongoing public health problem in the United States. The suicide rate is on the rise, representing 1.6% of all US deaths in 2016—a total of 44,965 suicide deaths at an annual rate of 13.42 per 100,000.[1–3] There is differential risk among population subgroups, with marked differences in suicide rates by age, sex, and race/ethnicity. Among men, the age-

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adjusted suicide rate is 21.31 per 100,000, more than three times higher than the rate among women. Suicide rates among Caucasians and American Indians are more than twice that among Asians and African Americans. In addition, there is a bimodal increase in suicide risk associated with age, with rates as high as 19 per 100,000 in middle age and among individuals aged 80 years of age or older.[3] Because of this differential risk among sex, age, and racial groups, epidemiologic evaluation of suicide is important for identification and characterization of at-risk populations. The suicide rate in Iowa is somewhat higher than the national rate at 14.5 per 100,000, which is comparable to other Midwest states' rates.[3] This study describes an Iowa cohort of suicide decedents autopsied at the University of Iowa Hospitals and Clinics between July 1st, 2003 and June 30th, 2018. The purpose of this investigation is to provide information that in turn may lead to targeted intervention and improvements in suicide prevention.

Methods

This study consists of 657 suicide decedents who had an autopsy examination at the University of Iowa Hospitals and Clinics, Iowa City, Iowa between July 1, 2003 and June 30, 2018.

Since mid-2003, forensic pathologists at the University of Iowa Hospitals and Clinics have conducted autopsies for Johnson County and surrounding counties in Southeastern Iowa. As forensic pathologist staffing has increased, the autopsy service has in turn increased its capacity to serve surrounding counties. As of 2016 and to date, there are eight referring counties, including Johnson County. In Iowa, medical examiner jurisdiction is determined by location of death rather than location of incident. By virtue of the University of Iowa Hospitals and Clinics' designation as a tertiary care center, the Johnson County Medical Examiner jurisdiction also encompasses autopsies for which an incident occurred in an outside county, and the patient was subsequently admitted to the University of Iowa Hospitals and Clinics before death. For this reason, in addition to these eight counties, cases included in this report span an additional 21 counties across Southeastern Iowa and surrounding areas.

All study data were obtained via abstraction of University of Iowa autopsy reports, which contain historical, scene, and investigative information. Of note, data from some Iowa suicides are not included in this study: suicide autopsies conducted in other Iowa locations and suicide deaths that did not have an autopsy examination. Population characteristics evaluated in this study were age, race/ethnicity, sex, and psychiatric comorbidities, as well as suicide date, location, and method. For the purposes of this report, 'county' refers to the county in which the self-inflicted fatal injury occurred rather than the county in which death occurred. Likewise, date and location are considered to be the date and location of incident, as these can differ from date and location of death if there is a period of survival and/or transport to a medical center before death. Suicide methods were grouped into the categories of poisoning, drowning, hanging/suffocation, thermal/corrosive injuries (flame, explosives, caustic materials, and hypo/hyperthermia), firearms, blunt injuries (traffic, jumping from height, and other blunt injuries), and sharp

injuries, according to 2018 ICD-10 (International Classification of Diseases 10th Revision) classifications for intentional self-harm.

Psychiatric history, including psychiatric diagnoses, previous suicidal behavior, and contact with mental health care—either through inpatient, outpatient, or emergency room visits—were identified at the time of autopsy via investigator reports, collateral contacts, and medical record review. Prescription medication usage was identified through correlation between substances identified in the blood at the time of death via toxicology report and medications known to be prescribed to the decedent, as identified through medical records and investigator report.

Statistical analyses were conducted using the Chi-squared test for categorical variables and Wilcoxon rank-sum test for continuous variables. SAS 9.3 was used for all analyses.

Results

This study consists of 657 suicide decedents autopsied by the University of Iowa Hospitals and Clinics, Iowa City, Iowa, between July 1, 2003 and June 30, 2018. This cohort spans 29 counties centered on Southeast Iowa, with Johnson County (37% of suicide autopsies) and Scott County (31%) most heavily represented.

The majority of decedents were white (88.2%) and male (75.7%) (Table 1). Information regarding marital status was available for 87% of decedents ($n = 572$); of these, 27% were married. Age at time of death ranged from 10 to 90 years of age, with a mean (sd) age of 43 (17) years and a median age of 43 (Fig. 1). Although women tended to be younger on average, with a mean (sd) age of 41 (15) years and a median age of 43 years versus a mean (sd) age of 44 (18) years and a median age of 43 years among men (Fig. 2), this difference was not statistically significant ($P = 0.38$).

The location of incident was most commonly a place of residence (69.3%). Self-inflicted fatal injuries were more likely to occur earlier in the week in the late night to early morning hours. Suicides were most likely to occur in the spring and least likely to occur in the winter (Figs. 3 and 4). The suicide methods most commonly utilized were firearm (44.6%), hanging/suffocation (25.2%), and poisoning (20.8%). Firearm deaths most commonly involved a handgun (61.3%) or a shotgun (20.3%) (Fig. 5). Poisoning deaths most commonly involved prescription medications (62.1%), carbon monoxide (22.9%), or over-the-counter medications (16.4%) alone or in combination with other substances. Men were more likely than women to employ firearms and less likely to employ poisoning or drowning (Table 2). Younger individuals were more likely than older individuals to employ hanging (Table 3).

Less than one-half (42.8%) of decedents communicated suicidal intent, either in the form of a paper note, an electronic communication such as a text message or social media post or a verbal message. To emphasize the converse, more than one-half of suicide decedents did not issue a 'suicide note' or similar communication (Table 1). Life stressors occurring around the time of death—as identified by contents of a suicide note, investigator report, or interview with collateral contacts at the time of autopsy—were most commonly

Table 1 – Overall characteristics of study sample.	
Characteristic	N (%) Total n = 657
White	593 (88.24%)
Male	509 (75.74%)
Psychiatric history	
Depression	257 (39.12%)
Prior psychiatric care	239 (36.38%)
Recent antidepressant/antipsychotic/mood stabilizer use	194 (29.53%)
Prior suicidal behavior	187 (28.46%)
Substance use	162 (24.66%)
Recent sedative-hypnotic use	157 (23.90%)
Anxiety	74 (11.26%)
Bipolar disorder	30 (4.57%)
Schizophrenia	16 (2.44%)
Any personality disorder	15 (2.32%)
Post-traumatic stress disorder	14 (2.13%)
Suicide note	281 (42.77%)
Surrounding circumstances	
Depression	164 (24.96%)
None or unknown	145 (22.07%)
Relationship	135 (20.55%)
Other mental health	79 (12.02%)
Criminal/Legal	55 (8.37%)
Physical health	41 (6.24%)
Finances	28 (4.26%)
Location	
Residence	455 (69.25%)
Vehicle	71 (10.81%)
Public Land	60 (9.13%)
Private Land	37 (5.63%)
Public Building	21 (3.20%)
Method	
Firearms	300 (44.64%)
Hanging	169 (25.15%)
Poisoning	140 (20.83%)
Drowning	12 (1.79%)
Sharp	12 (1.79%)
Jump from Heights	9 (1.34%)
Thermal	9 (1.34%)
Traffic	5 (0.74%)
Blunt	1 (0.15%)

depression or other mental health issues (37.0%), problems in interpersonal or romantic relationships (20.5%), or criminal and/or legal problems (8.4%). Less common were failing physical health and/or personal independence (6.2%) or financial problems (4.3%). Approximately one-quarter (22.1%) of suicide deaths were accompanied by no known inciting event or identified life stressors, which was markedly more common among men ($P = 0.0012$) (Table 2). Recent problems in interpersonal or romantic relationships and criminal and/or legal problems were more commonly identified among younger individuals than older individuals, who were more likely than their younger counterparts to demonstrate depression or failing physical health as a possible contributory factor (Table 3).

Nearly one-third (28.5%) of decedents had a prior history of suicidal behavior, including one or more prior suicide attempts (17.7%) and/or a history of suicidal ideation or self-injurious behaviors such as cutting (15.4%) (Table 1). Slightly more than one-half (56.9%) of decedents had a known mental health condition, such as a mood, anxiety, personality, or substance use disorder. Approximately one-third (36.4%) had a history of some form of contact with mental health care (i.e. at least one psychiatric outpatient, inpatient, or emergency department visit), and 29.5% of decedents had recent use of an antidepressant, antipsychotic, or mood stabilizer around the time of death. Women were more likely than men to have a mental health condition ($P < 0.0001$) or history of suicidal behavior ($P < 0.0001$) and were also more likely to have had prior contact with mental health care ($P < 0.0001$) or current use of an antidepressant, antipsychotic, or mood stabilizer ($P < 0.0001$).

Discussion

This study characterizes an Iowa cohort of 657 suicide decedents autopsied at the University of Iowa Hospitals and Clinics over 15 years, between July 1, 2003 and June 30, 2018. Overall, our findings are similar to those of previously described cohorts, including the National Violent Death Reporting System (NVDRS), a national database established
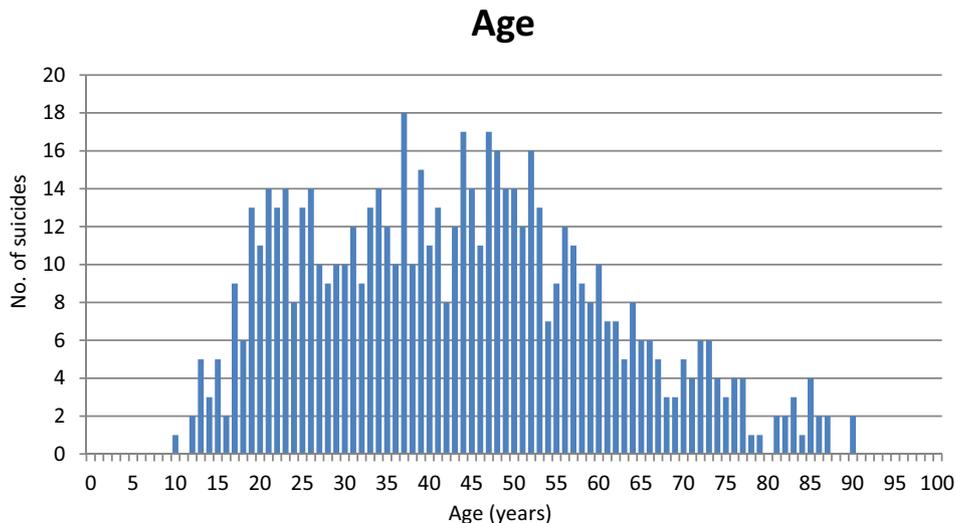
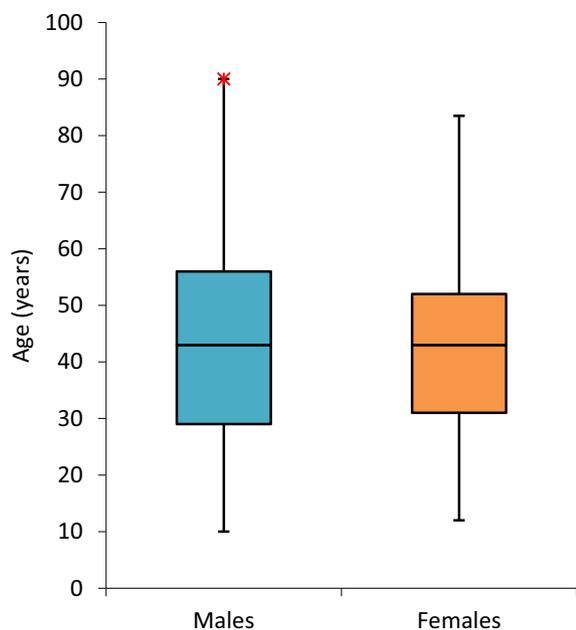**Fig. 1 – Suicide age distribution.**

Fig. 2 – Age distribution by sex.

Fig. 4 – Suicides by season.

for tracking homicides, suicides, deaths by legal intervention, and unintentional firearm deaths for the purpose of providing data to aid in violence prevention efforts.[4]

It is a commonly held belief that winter is a time of high suicide risk. Among our study cohort, suicides were most common in the spring and were least likely to occur in the winter. Similarly, national data from the 2003 to 2014 NVDRS suggest that suicide rates begin increasing in March and decrease to the lowest rate in December and that suicides are more likely to occur in the first week of the month, earlier in the week, and in the morning/afternoon—except among adolescents, for which the peak time is evening.[5]

The most common suicide methods among our Iowa cohort were firearms (45%), hanging/suffocation (25%), and poisoning (21%). Likewise, the most common suicide methods nationwide are firearms (51%), hanging/suffocation (26%), and poisoning (15%).[3] It is important to note that while 45% of suicides committed by firearms is reflective of US statistics, this rate of suicide by firearms is not typical of the developed world at large and is likely a reflection of the overall high rates of firearms-related violence in the United States—in non-US high-income
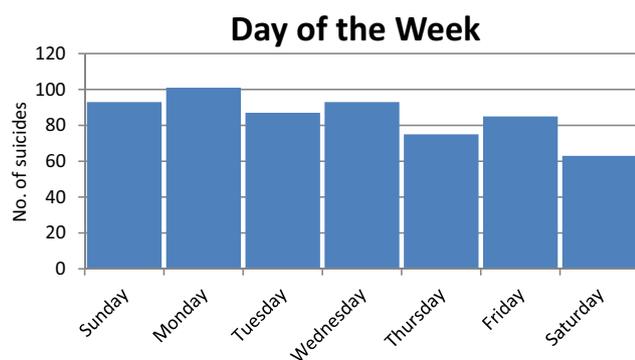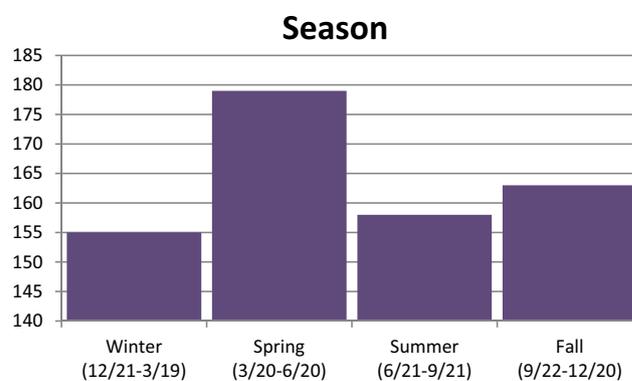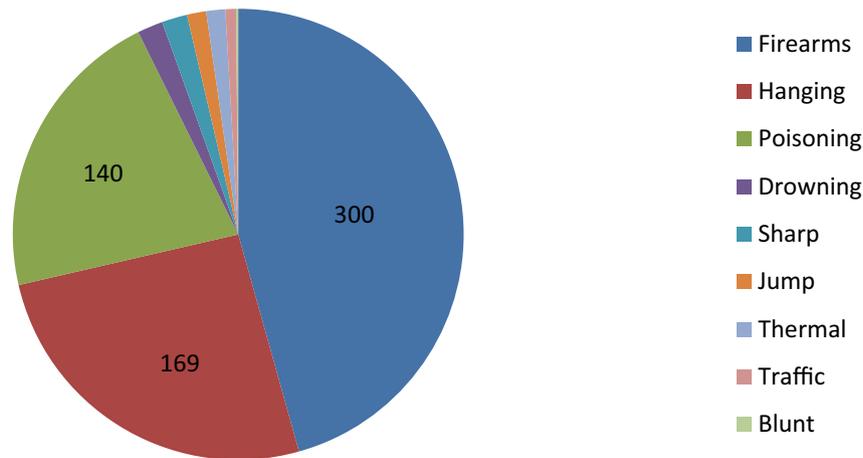
countries, only 5% of suicides are attributable to firearms, and the overall firearm death rate (including suicides, homicides, and accidents) in the United States is 11.4 times higher than that of other high-income countries.[6] Our study also demonstrates demographic differences in suicide method, which is consistent with findings from a more extensive investigation of demographic differences in suicide method conducted by Liu et al. using data from the 2003 to 2005 NVDRS.[7]

Approximately 88% of suicide decedents in our study cohort were white, which is reflective of the demographic breakdown of Johnson County, Iowa (86% white) and the state of Iowa as a whole (91% white), although it should be noted that the racial breakdown of Iowa is not representative of the United States as a whole (72% white).[8]
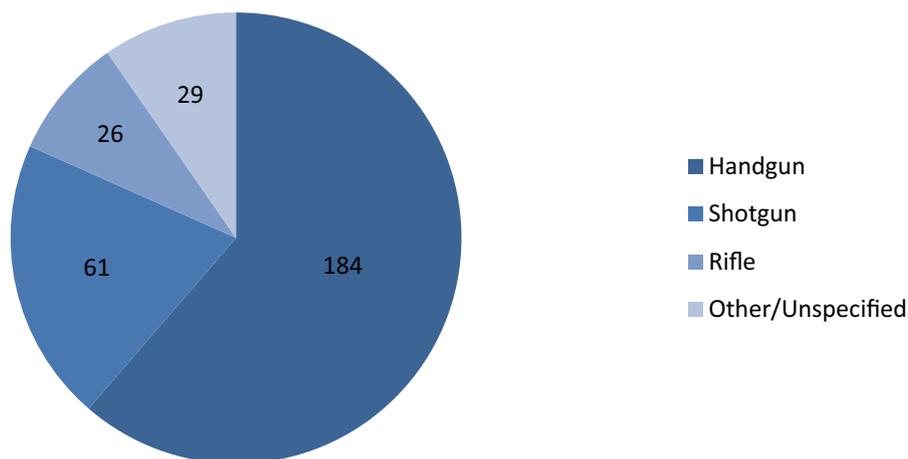
Approximately three-quarters of suicide decedents in our study cohort were male. This is consistent with the findings of larger studies estimating that approximately 77% of all suicide deaths occur among men.[1,9] Interestingly, a 2014 study by Bozzay et al. notes that the higher rate of suicide among men can be explained by a higher rate of violent death among men, such that although men demonstrate overall higher rates of both suicide and violent death in general,[9,10] there is no difference across gender in the proportion of violent deaths due to suicide.[11]

Slightly more than one-half of suicide deaths among our cohort occurred among individuals with a known mental health condition, which is consistent with previous studies demonstrating that approximately one-half of all suicide deaths occur among individuals with a known mental health condition, a majority of whom were currently receiving psychiatric treatment.[1,12] Existing literature suggests that individuals with a known mental health condition are more likely to be white and female, are more likely to test positive for any drugs, including prescription, over-the-counter, and recreational substances, and are more likely to commit suicide by hanging/suffocation or poisoning.[1] Similarly, individuals receiving psychiatric treatment are more likely to have a history of substance use and are more likely to commit suicide by poisoning, specifically by ingestion of prescription medication.[13] In contrast, those without a known mental health condition are more likely to be male, belong to a racial/ethnic minority, more likely to use firearms, more likely to test positive for alcohol at the time of death, and more likely to have interpersonal problems, life stresses, criminal legal problems, or recent/impending crisis.[1]

Fig. 3 – Suicides by day of the week.

Suicide Methods

Legend:
- Firearms
- Hanging
- Poisoning
- Drowning
- Sharp
- Jump
- Thermal
- Traffic
- Blunt

Firearms Types

Legend:
- Handgun
- Shotgun
- Rifle
- Other/Unspecified

Fig. 5 — Suicides by method.

Statistically speaking, the typical profile of a suicide is a white male with a firearm in his place of residence.[14] Men who attempt suicide are at the same time least likely to have had contact with mental health care or carry a formal mental health diagnosis[1,15] and are most likely to in retrospect endorse feelings of defeat and powerlessness before the suicide attempt.[16] Alessi et al. argue that this sense of defeat, such as that occurring as a result of loss of function or autonomy, social problems, loss of status, or debilitation, creates the motivation to attempt suicide by inflicting a narcissistic injury with which the individual is unable to cope. This argument hinges on the stress-diathesis framework—that the decision to attempt suicide arises from an interaction between life stressors and individual disposition.[16] This suggests that there is an unmet need for mental health support among this group of individuals, whether in terms of limited access to mental health care or an unmitigated sense of stigma surrounding the acceptance of services. While this current analysis is limited in its ability to evaluate the potential converging influences of coping with feelings of powerlessness and stigma surrounding receipt of mental health support on the decision to commit suicide, it is worth noting that more than half of decedents left no communication of intent to commit suicide, and one-quarter—more commonly men—had no known life stressor or other specifically identified motivating factor. Future studies should seek

Table 2 – Study sample characteristics by sex.			
Characteristic	Total[a] (n = 657)	Male (n = 509)	Female (n = 146) P-value
	N	N	N
White	593	463	130	0.21
Psychiatric history			
Depression	257	170	86	<0.0001
Prior psychiatric care	239	148	91	<0.0001
Recent antidepressant/ antipsychotic/mood stabilizer use	194	107	87	<0.0001
Prior suicidal behavior	187	112	75	<0.0001
Substance use	162	126	36	0.98
Recent sedative-hypnotic use	157	100	57	<0.0001
Anxiety	74	48	26	**0.0019**
Bipolar disorder	30	13	17	<0.0001
Schizophrenia	16	10	6	0.11
Any personality disorder	15	8	7	**0.012**
Post-traumatic stress disorder	14	13	1	0.19
Suicide note	281	214	67	0.47
Surrounding circumstances			
Depression	164	103	61	<0.0001
None or unknown	145	127	18	**0.0012**
Relationship	135	105	30	0.98
Other mental health	79	53	26	**0.016**
Criminal/legal	55	51	4	**0.0052**
Physical health	41	36	5	0.11
Finances	28	27	1	**0.015**
Location			
Residence	455	346	109	0.12
Vehicle	71	57	14	0.58
Public land	60	46	14	0.84
Private land	37	33	4	0.084
Public building	21	18	3	0.37
Method			
Firearms	300	268	31	<0.0001
Hanging	169	131	38	0.94
Poisoning	140	75	64	<0.0001
Drowning	12	5	7	**0.0025**
Sharp	12	10	2	0.64
Jump from heights	9	7	2	0.99
Thermal	9	8	1	0.42
Traffic	5	4	1	0.90
Blunt	1	1	0	0.59

Bolded values are statistically significant at p < 0.05.
[a] Note: Missing data for 2 individuals when separated by age.

Table 3 – Study sample characteristics by age.			
Characteristic	Total[a] (n = 657)	Aged <43 years (n = 327)	Aged 43+ years (n = 328) P-value
	N	N	N
White	593	280	313	**0.0003**
Male	509	256	253	0.72
Psychiatric history			
Depression	257	110	147	**0.0055**
Prior psychiatric care	239	97	142	**0.0002**
Recent antidepressant/ antipsychotic/ mood stabilizer use	194	82	112	**0.019**
Prior suicidal behavior	187	98	89	0.45
Substance use	162	84	78	0.60
Recent sedative-hypnotic use	157	62	95	**0.0047**
Anxiety	74	33	41	0.37
Bipolar disorder	30	12	18	0.29
Schizophrenia	16	9	7	0.58
Any personality disorder	15	9	6	0.59
Post-traumatic stress disorder	14	6	8	0.62
Suicide note	281	137	144	0.75
Surrounding circumstances			
Depression	164	71	93	**0.045**
None or unknown	145	71	74	0.76
Relationship	135	82	53	**0.0054**
Other mental health	79	45	34	0.19
Criminal/legal	55	35	20	**0.036**
Physical health	41	2	39	<0.0001
Finances	28	13	15	0.69
Location			
Residence	455	227	228	0.89
Vehicle	71	37	34	0.72
Public land	60	33	27	0.42
Private land	37	14	23	0.13
Public building	21	7	14	0.12
Method			
Firearms	300	141	159	0.15
Hanging	169	109	60	<0.0001
Poisoning	140	62	78	0.12
Drowning	12	3	9	0.079
Sharp	12	3	9	0.079
Jump from heights	9	4	5	0.73
Thermal	9	4	5	0.73
Traffic	5	3	2	0.66
Blunt	1	0	1	0.32

Bolded values are statistically significant at p < 0.05.
[a] Note: Missing data for 2 individuals when separated by age.

to further elucidate the influence of life stressors and overall mental health on suicide completion, as well as other factors leading to suicide in this at-risk population.

Author statements

Ethical approval

Funding

Competing interest

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