

## ORIGINAL ARTICLE

# Examining predictors of suicide by firearm in young, middle, and late adulthood

Meagan Docherty PhD<sup>1</sup>  | Joanna Kubik PhD, MSW<sup>2</sup>  | Grant Drawve PhD<sup>3</sup>

<sup>1</sup>Department of Psychology, Bowling Green State University, Bowling Green, Ohio, USA

<sup>2</sup>Department of Sociology, Rider University, Lawrenceville, New Jersey, USA

<sup>3</sup>CAP Index, Exton, Pennsylvania, USA

## Correspondence

Meagan Docherty, Department of Psychology, Bowling Green State University, 259 Psychology Building, 822 E. Merry Ave., Bowling Green, OH 43403, USA.

Email: [mdocher@bgsu.edu](mailto:mdocher@bgsu.edu)

## Abstract

**Introduction:** Suicide remains a leading cause of death in the U.S., and firearms are one of the most lethal methods of suicide. This study examines personal and contextual factors that predict suicide with a firearm compared to other methods across stages of adulthood.

**Methods:** Data on adult suicide decedents from 2009 to 2019 were obtained from Colorado's National Violent Death Reporting System (NVDRS) data ( $N=11,512$ ). The dataset includes incident and person characteristics collected by law enforcement and coroners. Zip code level data were integrated from the American Community Survey.

**Results:** Age, sex, race, marital status, military service, substance use, suicide attempt history, mental health, and location characteristics (population density, as well as age, education, veteran status, and household status of population) predicted suicide by firearm. Risk was particularly high for males in older adulthood. We further explored age-specific models (young, middle-aged, and older adults) to determine salient risk factors for each group.

**Conclusion:** This study highlights the need for comprehensive suicide prevention approaches that consider both individual and contextual risk factors, as well as unique risks in each stage of adulthood.

## KEYWORDS

adulthood, development, firearm, location, mortality

## INTRODUCTION

Suicide is a major public health concern in the United States. Suicide rates have steadily increased in the past couple of decades, and suicide is a leading cause of death in the U.S. (Garnett & Curtin, 2023). Use of a firearm is the most common method of suicide, accounting for about half of all suicides (Centers for Disease Control

and Prevention, 2020), and is more lethal compared to other methods of suicide such as suffocation or poisoning (Anestis, 2016; Spicer & Miller, 2000). Further, about half of firearm-related deaths in the U.S. are due to suicide (Centers for Disease Control and Prevention, 2020). Thus, understanding the personal and contextual factors that lead to suicide by firearm might help to inform prevention programs and reduce firearm-related mortality.

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2023 The Authors. *Suicide and Life-Threatening Behavior* published by Wiley Periodicals LLC on behalf of American Association of Suicidology.

## Predictors of risk for suicide

Several sociodemographic and psychosocial risk factors for suicide have been identified in previous research (Turecki et al., 2019). Although rates of suicide attempts are generally higher for females than males (Brådvik, 2018), the rate of suicide deaths is roughly four times higher in males (Seedat et al., 2009; Turecki et al., 2019). The risk of suicide also increases for those suffering from mental health disorders and substance use, including depression, alcoholism, and drug use (Brådvik, 2018), as well as for individuals experiencing loneliness or lack of connection to others (Daniel & Goldston, 2012). In fact, one of the leading contemporary theories on suicide, the three-step theory, posits that suicide is the result of a combination of pain, hopelessness, a lack of connectedness to others, and the capacity to attempt suicide (Klonsky et al., 2021). Thus, those who are feeling less connected and more isolated—such as older individuals, who may be living alone, particularly in more rural areas—could be at greater risk for attempting suicide.

The risk of suicide mortality tends to wax and wane across the lifespan. Rates of suicide are generally highest for middle-aged adults (45–64), followed by younger adults (25–44), and then by older adults and older adolescents, with the lowest rate for children and early adolescents (Garnett & Curtin, 2023). In addition to differences in overall risk for suicide by age, there may be different predictors of suicide across different stages of adulthood, or the same risk factor (e.g., lack of connectedness) may operate differently depending on one's life stage (Conner et al., 2014; Daniel & Goldston, 2012). Determining risk and protective factors at different points in adulthood is critical to tailor suicide prevention efforts to people's unique needs depending on their life stage.

## Predictors of suicide method

Importantly, few studies have examined the psychosocial predictors of suicide methods, or the means by which a person dies by suicide. Identifying such risk factors is important in reducing the suicide rate, as suicide attempts involving firearms have a 90% fatality rate (Cai et al., 2022). Understanding which factors are associated with using a firearm could aid in informing prevention strategies to reduce suicide by firearm and overall suicide mortality. Previous research has found that those who die by suicide using a firearm, relative to those using other methods, are less likely to have received mental health treatment and are less likely to have made a previous suicide attempt (Anestis et al., 2017; Bond et al., 2022). However, these predictors may differ as individuals move through

adulthood and experience changes in relationships, physical and mental health, cognitive functioning, and developmental tasks. For example, previous research has found that older White males living in rural areas (Houtsma et al., 2018; Kaplan et al., 1996) or those who are single or have not earned a high school degree (Kaplan et al., 1996) could be particularly at risk of suicide by firearm, but less is known about risk factors in younger and middle-aged adults. It is particularly important to distinguish predictors of suicide by firearm at different stages of adulthood because evidence shows that the lethality of suicide by firearm increases from about 78% in young adulthood to 94% in late adulthood (Cai et al., 2022). However, previous research has generally failed to examine predictors separately by stages of adulthood (although see Conner et al., 2014, which examined data from 2005 to 2010).

In addition to personal factors, it is possible that there are contextual factors associated with risk of suicide by firearm compared to other methods. For example, as noted above, living in a rural area is associated with suicide by firearm. However, most macro-level research tends to focus on county-level characteristics (e.g., see Rossen et al., 2018; Steelesmith et al., 2019). We extend from extant literature by focusing on a smaller spatial unit—zip code—while accounting for similar measures used in previous research. Other factors that correlate with population density, such as socioeconomic and educational disadvantage (Cairns et al., 2017), social capital (Smith & Kawachi, 2014), or age of the population, might also explain contextual influences on suicide by firearm. The current paper seeks to address this gap in the literature by including both personal and contextual predictors of suicide by firearm, including population density and other sociodemographic characteristics of the area in which someone dies by suicide. Thus, the current paper replicates and extends prior work by using statewide suicide mortality data that spans 11 years and includes incident level and zip code level predictors of suicide by firearm compared to suicide by other methods, and by examining predictors separately by period of adulthood (e.g., young, middle, and older adulthood).

This study focuses on suicide deaths in Colorado, given its relatively higher suicide rate (Centers for Disease Control and Prevention, 2020) and higher proportion of firearm-owning households compared to other states (Schell et al., 2020). To combat this suicide risk, there are a number of active prevention programs in the state, including one focused on destigmatizing mental health among men (Man Therapy; Mocarski & Butler, 2016) and another aimed at engaging firearm retailers in suicide prevention education for their communities (Polzer et al., 2021). The Colorado Firearm Safety Coalition, founded in 2015, is also involved in this project and others, which include

providing local options to anyone seeking temporary firearm storage. These initiatives are largely in line with calls to increase means safety around the use of firearms to reduce suicide by firearm (Houtsma et al., 2018). However, despite the implementation of these evidence-based prevention measures, there remains a shortage of mental and behavioral health treatment programs in the state, particularly in rural areas (McDonough, 2023). Because of this, Colorado provides a unique but meaningful study site to better understand predictors of suicide across different developmental periods in adulthood.

## MATERIALS AND METHODS

Data came from the National Violent Death Reporting System (NVDRS), years 2009–2020, in Colorado (original  $N=19,407$ ), and were obtained from the Colorado Department of Public Health and Environment (CDPHE; [www.cdph.colorado.gov](http://www.cdph.colorado.gov)). Beyond traditional incident and individual level characteristics, this dataset is unique in what it offers for greater context surrounding the suicide incidents. Variables include measures from both the law enforcement investigation and from the coroner's or medical examiner's report. The current dataset was limited to adults 18 and older who died by suicide prior to 2020 ( $N=11,512$ ) with a focus on the method used, firearm (50%) versus non-firearm (26% suffocation; 18% poisoning; 6% other). Incidents from 2020 ( $N=1317$  suicides) were excluded given the differences in trends for that year brought about by the COVID-19 pandemic (Houry et al., 2022; Le et al., 2020), and one person whose age was unknown was excluded from analysis. To supplement the NVDRS data with contextual factors that could predict suicide by firearm, we incorporated city- and zip code level data from the American Community Survey (ACS) 5-year estimates. These variables are discussed in further detail below. This study involved secondary analysis of de-identified mortality data, and thus was not subject to IRB review or approval.

## Measures

### Personal factors

The NVDRS data contain information on relevant personal sociodemographic characteristics and risk and protective factors. For the purposes of this study, we included 11 person-level variables from the NVDRS: age, sex, race/ethnicity, marital status, education, veteran status, alcohol use, marijuana use, mental health treatment, attempt history, and family problems. Age was coded as age in years. Sex was coded as male (1), female (0), or unknown.

Because the majority of the sample (82.8%) identified as non-Hispanic White, we coded race/ethnicity as a binary variable (1 = non-Hispanic White, 0 = all other racial/ethnic groups). Marital status was coded into a three-level variable: 1 = single/unmarried, 2 = married (or in a civil union or domestic partnership), and 3 = divorced/separated/widowed. Education was coded as years of education completed. Veteran status was a binary variable (1 = ever served in armed forces, 0 = civilian). Alcohol use was a binary variable indicating if alcohol use was suspected in the hours preceding the event. Marijuana use was a binary variable for the results of marijuana testing in the toxicology report. Mental health treatment was a binary variable indicating that the decedent had been receiving treatment for a mental health problem at the time of death. Attempt history was a binary variable indicating whether the person had a history of attempting suicide. Family problems were a binary variable indicating whether the decedent had been experiencing problems with family relationships. In addition to these variables, the year of the incident was also included.

### Contextual factors

For information on contextual factors, we linked NVDRS data with ACS data. We used total population in the city in which the suicide took place, captured in 2017, and coded this into a three-category variable: 1 = urbanized area (50,000 or more people), 2 = urban cluster (2500–49,999 people), and 3 = rural (fewer than 2500 people), consistent with the U.S. Census's classification of urban and rural areas (Ratcliffe et al., 2016). In addition, we incorporated seven variables measured at the zip code level for each year from 2011 to 2019: percent of the population 65 and over; percent of the population that is White; percent of the population living alone; percent of the population with a bachelor's degree or higher; percent of the population that is a veteran; percent of the population that is unemployed; and percent of the population living below the poverty line. We matched incidents to these data based on the zip code where the decedent lived and the year in which the incident occurred. Because each of the zip code characteristics was highly stable from year to year, we used data from 2011 for incidents that occurred in 2009 and 2010. We were able to obtain and match these zip code data for 10,980 incidents (95%).

### Analysis plan

To examine how risk for suicide by firearm varies by age, we first conducted logistic regression models predicting

suicide by firearm (1 = firearm, 0 = other method) in the entire sample and included linear and quadratic age as predictors, as well as other personal and contextual factors. We then categorized the sample into the developmental stages of (1) young adulthood (18–39; 38.7%), (2) middle adulthood (40–64; 46.8%), and (3) later adulthood (65+; 14.5%), and ran separate logistic regression models for each subgroup, while also including age in years as a predictor in these models.<sup>1</sup> This was done to allow for predictors to function differently across developmental stages while also allowing for linear trends by age within developmental stages. Descriptive information for the predictors used in regression models is provided in Table 1. For models, age was centered at the sample mean (46.17) and divided by 10, and zip code level predictors were also divided by 10. Because risk factors may differ among different means for non-firearm suicide (e.g., poisoning and hanging/suffocation), we then tested two additional models in the full adult sample: one comparing firearm deaths to deaths by poisoning (which includes overdose), and one comparing firearm deaths to deaths by hanging/suffocation. For these analyses, the deaths due to other means of suicide were excluded, and the sample size for the specific analysis is provided.

Because listwise deletion would have resulted in a sample size of 2937 (26% of the original sample) and results in biased estimates unless data are missing completely at random (MCAR), we first used multiple imputation with chained equations (MICE) to impute 50 datasets, and then analyzed imputed data and pooled the results. Study variables were modeled according to their distribution for imputation equations (e.g., logistic regression for binary variables), and predictive mean matching was used for zip code level variables and education in years. Imputation equations were conducted separately by developmental stage, to allow for different associations among variables across age categories.

## RESULTS

Table 2 displays odds ratios and 95% confidence intervals from logistic regression models predicting suicide by firearm compared to suicide by another method, in the overall sample and in separate age groups. The overall model indicated that there was a quadratic trend for age, such that risk for using a firearm for suicide increased with age, and this increase became more pronounced at older ages. Most of the personal variables in the model significantly predicted suicide by firearm, including sex, race, military service, marital status, education, urbanicity, suspected alcohol use at time of death, receiving mental health treatment at time of death, and having a history

TABLE 1 Descriptive statistics for predictor variables.

Predictor	N	% of total sample (N = 11,512) (or M and SD)
Incident level predictors		
Age	11,512	46.17 (17.19)
18–39	4456	38.71
40–64	5387	46.79
65 and older	1669	14.50
Race	11,507	
White	9520	82.70
Non-White	1987	17.26
Sex	11,512	
Male	8881	77.15
Female	2631	22.85
Military service	11,467	
No military service	9297	80.76
Any military service	2170	18.85
Marital status	11,439	
Single	3974	34.52
Married	3901	33.89
Divorced/widowed	3564	30.96
Education in years	5738	13.41 (2.24)
Less than 12	535	4.65
12	2179	18.93
More than 12	3024	26.27
Population density	10,056	
Urban area (>50 k)	6629	57.58
Urban cluster (>2500)	2640	22.93
Rural (<2500)	787	6.84
Suspected alcohol use	9771	
Yes	3968	34.47
No	5803	50.41
Marijuana test results	8011	
Positive	1522	13.22
Negative/NA	6489	56.37
Mental health treatment at time of death (known)	11,512	
Yes	3334	28.96
No/NA	8178	71.04
Suicide attempt history (known)	11,512	
Yes	3022	73.75
No/NA	8490	26.25
Family relationship problems (known)	11,512	
Yes	2286	19.86
No	9226	80.14

TABLE 1 (Continued)

Predictor	N	% of total sample (N = 11,512) (or M and SD)
Year	11,512	
2009	909	7.90
2010	853	7.41
2011	884	7.68
2012	1005	8.73
2013	984	8.55
2014	1056	9.17
2015	1066	9.26
2016	1117	9.70
2017	1117	9.70
2018	1242	10.79
2019	1279	11.11
Zip code level predictors		
Percent 65 and older	488	14.03 (9.00)
Percent White	488	85.37 (12.58)
Percent living alone	487	26.59 (10.54)
Percent with bachelor's degree	488	32.08 (17.64)
Percent veterans	488	10.63 (5.04)
Percent unemployed	488	6.78 (5.63)
Percent in poverty	487	12.31 (8.41)

of suicide attempts. Specifically, being male, White, having served in the armed forces, being married, living in a less densely populated area, and having suspected alcohol use at time of death were all associated with greater odds of using a firearm, while current mental health treatment and having a history of suicide attempts were associated with lower odds of using a firearm on average. In addition, a few zip code level variables predicted suicide by firearm: people who lived in zip codes with a higher percentage of older adults or veterans, or with a lower percentage of people living alone or people with bachelor's degrees, were at greater risk for suicide by firearm relative to suicide by other methods. Effect size appeared to be strongest for sex and attempt history, such that being male was associated with more than double the odds of using a firearm to die by suicide compared to being female, and people who had a previous attempt had roughly half the odds of using a firearm compared to people without an attempt history.

However, the age-specific models obtained different results from the main model and from each other, indicating that these factors differentially predict suicide by firearm across each period of adulthood. For example, the relationship between age and suicide by firearm was negative in young adulthood, positive in middle adulthood, and

non-significant in late adulthood, indicating different age trends within each stage of adulthood. Some predictors—such as sex, race, marital status, urbanicity, mental health treatment, attempt history, and living in more highly educated areas—became stronger in later stages of adulthood. For example, White people had 43% greater odds of suicide by firearm compared to people of other racial/ethnic identities in young adulthood, but this increased to almost triple the odds in late adulthood. Positive test results for marijuana use only predicted greater odds of firearm use in late adulthood. Other predictors—such as living in an area with more older adults or more veterans—became weaker in later stages of adulthood. Interestingly, alcohol use had different associations at each stage, such that young adults with suspected alcohol use at time of death were more likely to use a firearm, older adults with suspected alcohol use were less likely to use a firearm, and the association was not significant for middle-aged adults.

## Sensitivity analysis

Although it would be reasonable to expect differences in risk factors for firearm suicide across the developmental stages examined here, it is possible that the strength of risk factors changes in a more gradual and linear manner than the analyses by age category would permit. Thus, we next tested logistic regression models in the overall sample that included all predictors but added interactions between each predictor and linear and quadratic age, with separate interaction models for each predictor. We then included any significant interactions from these models in a final model, to test the interactions simultaneously (see Table 3 for results). Findings from this model largely replicated those from the models described above, with the following exceptions: suspected alcohol use at time of death was not significantly associated with decreased firearm use for older adults; marijuana use was significantly associated with lower risk for firearm use for younger adults; and living in a zip code with more White residents was a risk factor for firearm use for older adults. Thus, results were largely robust to how age was handled in the model, with some minor exceptions.

As an additional sensitivity analysis, we tested whether predictors of suicide by firearm differed when the reference group was restricted to deaths by poisoning/overdose, or deaths by hanging/suffocation, relative to the model comparing suicides by firearm to all other suicide deaths. The results of these models are provided in Table 4, as well as the results from the original model for comparison. Although the results for the two method-specific models are generally similar to the overall model, there are a few notable exceptions. When predicting suicide by firearm compared to

TABLE 2 Logistic regression models predicting suicide by firearm versus other method.

Predictor	Overall sample (18+) N= 11,512		Young adults (18–39) N= 4456		Middle adults (40–64) N= 5387		Older adults (65+) N= 1669	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Incident level predictors								
Age	1.06***	[1.03, 1.09]	0.84**	[0.74, 0.94]	1.24***	[1.14, 1.36]	1.05	[0.89, 1.25]
Age <sup>2</sup>	1.05***	[1.04, 1.06]	—	—	—	—	—	—
Male	2.53***	[2.28, 2.81]	2.11***	[1.78, 2.49]	2.57***	[2.22, 2.97]	5.12***	[3.66, 7.15]
White	1.65***	[1.47, 1.85]	1.43***	[1.22, 1.67]	1.79***	[1.49, 2.16]	2.97***	[1.89, 4.65]
Military service	1.58***	[1.42, 1.77]	2.11***	[1.70, 2.63]	1.29**	[1.10, 1.52]	1.29	[0.97, 1.72]
Marital status								
Married (ref= single)	1.38***	[1.24, 1.54]	1.29**	[1.09, 1.53]	1.39***	[1.18, 1.64]	2.03**	[1.24, 3.32]
Divorced (ref= single)	0.95	[0.85, 1.07]	1.07	[0.87, 1.31]	0.94	[0.80, 1.11]	1.14	[0.70, 1.84]
Divorced (ref= married)	0.69***	[0.62, 0.76]	0.83	[0.67, 1.03]	0.68	[0.59, 0.77]	0.56***	[0.43, 0.73]
Education	1.03*	[1.00, 1.05]	1.09**	[1.04, 1.14]	1.01	[0.98, 1.05]	0.95	[0.89, 1.02]
Population density								
Urban cluster (ref= urban area)	1.10	[0.99, 1.22]	0.95	[0.80, 1.13]	1.21*	[1.05, 1.41]	1.07	[0.77, 1.49]
Rural (ref= urban area)	1.30**	[1.11, 1.53]	0.94	[0.71, 1.24]	1.51**	[1.18, 1.93]	1.78*	[1.01, 3.11]
Rural (ref= urban cluster)	1.18*	[1.00, 1.40]	0.99	[0.74, 1.31]	1.25	[0.97, 1.59]	1.66	[0.93, 2.94]
Alcohol use	1.16**	[1.06, 1.27]	1.48***	[1.29, 1.70]	1.06	[0.93, 1.21]	0.69*	[0.48, 0.99]
Marijuana result	0.99	[0.88, 1.12]	0.93	[0.78, 1.10]	1.03	[0.85, 1.25]	2.59**	[1.35, 4.98]
Mental health treatment	0.76***	[0.70, 0.84]	0.76***	[0.65, 0.88]	0.81**	[0.71, 0.92]	0.51***	[0.38, 0.61]
Attempt history	0.51***	[0.46, 0.56]	0.56***	[0.49, 0.65]	0.49***	[0.43, 0.57]	0.44***	[0.31, 0.61]
Family problems	1.06	[0.96, 1.17]	1.09	[0.94, 1.27]	1.06	[0.91, 1.22]	1.00	[0.69, 1.44]
Year	1.01	[0.99, 1.02]	1.01	[0.99, 1.03]	0.99	[0.97, 1.01]	1.03	[0.98, 1.08]
Zip code level predictors								
Percent 65 and older	1.15**	[1.04, 1.28]	1.20*	[1.01, 1.43]	1.20*	[1.04, 1.39]	1.04	[0.78, 1.38]
Percent White	1.02	[0.97, 1.07]	0.98	[0.90, 1.05]	1.05	[0.97, 1.14]	1.15	[0.97, 1.38]
Percent living alone	0.89***	[0.84, 0.95]	0.88**	[0.80, 0.97]	0.90*	[0.82, 0.98]	0.89	[0.75, 1.04]
Percent with bachelor's degree	0.94***	[0.91, 0.97]	1.00	[0.95, 1.05]	0.91***	[0.87, 0.96]	0.81***	[0.73, 0.89]
Percent veterans	1.14*	[1.02, 1.28]	1.31**	[1.08, 1.58]	1.00	[0.84, 1.18]	1.01	[0.70, 1.44]
Percent unemployed	0.91	[0.75, 1.10]	0.92	[0.66, 1.27]	0.88	[0.69, 1.13]	0.76	[0.43, 1.34]
Percent in poverty	0.92	[0.84, 1.00]	0.97	[0.85, 1.11]	0.89	[0.78, 1.00]	0.96	[0.76, 1.23]
Intercept	0.24***	[0.13, 0.43]	0.10***	[0.04, 0.27]	0.23**	[0.09, 0.55]	0.37	[0.05, 2.60]

Note: Logistic regression models were conducted using multiple imputed data in the overall sample and in separate age categories, with robust standard errors. Intercept represents predicted odds of suicide by firearm for a hypothetical decedent who is age 46.17, female, non-White, single, in an urban area, who was not suspected of alcohol use at time of death, had a negative marijuana result at time of death, was not in mental health treatment at time of death, did not have an attempt history, and did not have family problems, in the year 2019, in a zip code with 0% on all of the included predictors (percent aged 65 and over, percent White, percent living alone, percent with bachelor's degree, percent veterans, percent unemployed, and percent living in poverty). Age and zip code level predictors were divided by 10 before being included in the model.

Abbreviations: OR, odds ratio; CI, confidence interval.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

hanging/suffocation, gender appears to be a weaker predictor, and urbanicity, mental health treatment, and living in a zip code with more older adults are no longer significant predictors. In addition, living in a zip code with a higher

poverty rate was associated with lower odds for death by firearm compared to death by hanging/suffocation. When predicting suicide by firearm compared to poisoning/overdose, gender had a stronger effect size compared to the

TABLE 3 Interactions with age predicting suicide by firearm vs. other method.

Predictor	Separate models				Combined model			
	Interaction with linear age		Interaction with quadratic age		Interaction with linear age		Interaction with quadratic age	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Incident level predictors								
Age								
Age <sup>2</sup>								
Male	1.14***	[1.07, 1.22]	1.05**	[1.02, 1.09]	1.18***	[1.10, 1.26]	1.07***	[1.04, 1.11]
White	1.07	[1.00, 1.15]	1.00	[0.97, 1.04]	—		—	
Military service	0.90**	[0.84, 0.97]	1.03	[1.00, 1.07]	0.87***	[0.80, 0.94]	1.00	[0.97, 1.04]
Marital status								
Married (ref= single)	1.07	[0.99, 1.15]	1.00	[0.96, 1.04]	—		—	
Divorced (ref= single)	0.99	[0.90, 1.08]	0.99	[0.95, 1.03]	—		—	
Divorced (ref= married)	0.93	[0.85, 1.01]	0.98	[0.95, 1.02]	—		—	
Education	0.97**	[0.96, 0.99]	1.00	[0.99, 1.01]	0.98*	[0.96, 0.99]	1.00	[1.00, 1.01]
Population density								
Urban cluster (ref= urban area)	1.11**	[1.04, 1.17]	0.98	[0.95, 1.01]	1.06	[0.99, 1.13]	0.97	[0.94, 1.01]
Rural (ref= urban area)	1.23***	[1.11, 1.36]	1.03	[0.97, 1.09]	1.15*	[1.03, 1.29]	1.02	[0.96, 1.09]
Rural (ref= urban cluster)	1.11	[0.99, 1.25]	1.05	[0.98, 1.12]	—		—	
Alcohol use	0.86***	[0.81, 0.91]	1.02	[0.98, 1.05]	0.86***	[0.80, 0.91]	1.01	[0.97, 1.05]
Marijuana result	1.15**	[1.05, 1.27]	1.07*	[1.01, 1.13]	1.14**	[1.04, 1.26]	1.08**	[1.02, 1.15]
Mental health treatment	0.95	[0.90, 1.01]	0.97*	[0.94, 1.00]	0.99	[0.93, 1.05]	0.97	[0.94, 1.00]
Attempt history	0.91**	[0.86, 0.97]	1.01	[0.98, 1.04]	0.94	[0.88, 1.00]	1.02	[0.98, 1.06]
Family problems	0.96	[0.90, 1.03]	1.00	[0.97, 1.04]	—		—	
Year	1.00	[0.99, 1.00]	1.00	[1.00, 1.01]	—		—	
Zip code level predictors								
Percent 65 and older	1.02	[0.97, 1.07]	1.00	[0.97, 1.02]	—		—	
Percent White	1.04**	[1.01, 1.06]	1.00	[0.98, 1.01]	1.04*	[1.00, 1.07]	1.01	[1.00, 1.03]
Percent living alone	0.97*	[0.94, 0.99]	0.99	[0.98, 1.01]	0.98	[0.95, 1.02]	0.99	[0.98, 1.01]
Percent with bachelor's degree	0.97***	[0.96, 0.99]	0.99*	[0.99, 1.00]	0.98*	[0.96, 0.99]	0.99	[0.98, 1.00]
Percent veterans	1.00	[0.94, 1.07]	1.01	[0.98, 1.05]	—		—	
Percent unemployed	1.02	[0.95, 1.11]	1.03	[0.99, 1.07]	—		—	
Percent in poverty	0.99	[0.96, 1.02]	1.02*	[1.00, 1.04]	1.00	[1.00, 1.00]	1.00	[1.00, 1.00]
Intercept	—				0.34**	[0.16, 0.72]		

Note: Logistic regression models were conducted using multiple imputed data in the overall sample and in separate age categories, with robust standard errors. Intercept represents predicted odds of suicide by firearm for a hypothetical decedent who is age 46.17, female, non-White, single, in an urban area, who did not use alcohol, had a negative marijuana result, did not receive mental health treatment, did not have an attempt history, and did not have family problems, in the year 2019, in a zip code with 0% on all of the included predictors (percent aged 65 and over, percent White, percent living alone, percent with bachelor's degree, percent veterans, percent unemployed, and percent living in poverty). Age and zip code level predictors were divided by 10 before being included in the model. Abbreviations: OR, odds ratio; CI, confidence interval.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

TABLE 4 Logistic regression models predicting suicide by firearm vs. hanging/suffocation, poisoning/overdose, and all other methods.

Predictor	Firearm vs. hanging/ suffocation (N = 8760)		Firearm vs. poisoning/ overdose (N = 7833)		Firearm vs. all other methods (N = 11,512)	
	OR	95% CI	OR	95% CI	OR	95% CI
Incident level predictors						
Age	1.20***	[1.15, 1.24]	0.86***	[0.82, 0.90]	1.06***	[1.03, 1.09]
Age <sup>2</sup>	1.06***	[1.04, 1.08]	1.07***	[1.05, 1.09]	1.05***	[1.04, 1.06]
Male	1.50***	[1.32, 1.71]	4.88***	[4.30, 5.55]	2.53***	[2.28, 2.81]
White	1.90***	[1.67, 2.16]	1.12	[0.93, 1.33]	1.65***	[1.47, 1.85]
Military service	1.82***	[1.57, 2.11]	1.19*	[1.02, 1.40]	1.58***	[1.42, 1.77]
Marital status						
Married (ref = single)	1.19**	[1.05, 1.35]	1.60***	[1.35, 1.89]	1.38***	[1.24, 1.54]
Divorced (ref = single)	0.98	[0.85, 1.13]	0.91	[0.77, 1.07]	0.95	[0.85, 1.07]
Divorced (ref = married)	0.82**	[0.73, 0.93]	0.57***	[0.50, 0.65]	0.69***	[0.62, 0.76]
Education	1.04**	[1.01, 1.07]	1.01	[0.98, 1.04]	1.03*	[1.00, 1.05]
Population density						
Urban cluster (ref = urban area)	1.06	[0.94, 1.20]	1.20*	[1.03, 1.40]	1.10	[0.99, 1.22]
Rural (ref = urban area)	1.21	[0.99, 1.48]	1.42**	[1.10, 1.82]	1.30**	[1.11, 1.53]
Rural (ref = urban cluster)	1.14	[0.93, 1.40]	1.18	[0.91, 1.52]	1.18*	[1.00, 1.40]
Alcohol use	1.25***	[1.12, 1.40]	1.03	[0.91, 1.18]	1.16**	[1.06, 1.27]
Marijuana result	1.00	[0.86, 1.15]	1.15	[0.96, 1.38]	0.99	[0.88, 1.12]
Mental health treatment	0.93	[0.83, 1.04]	0.60***	[0.53, 0.68]	0.76***	[0.70, 0.84]
Attempt history	0.53***	[0.48, 0.59]	0.49***	[0.43, 0.56]	0.51***	[0.46, 0.56]
Family problems	0.95	[0.85, 1.07]	1.23**	[1.07, 1.43]	1.06	[0.96, 1.17]
Year	0.99	[0.98, 1.01]	1.04**	[1.02, 1.06]	1.01	[0.99, 1.02]
Zip code level predictors						
Percent 65 and older	1.07	[1.95, 1.21]	1.25**	[1.08, 1.45]	1.15**	[1.04, 1.28]
Percent White	1.04	[0.98, 1.10]	0.98	[0.91, 1.06]	1.02	[0.97, 1.07]
Percent living alone	0.92*	[0.86, 0.98]	0.90*	[0.83, 0.98]	0.89***	[0.84, 0.95]
Percent with bachelor's degree	0.94**	[0.90, 0.97]	0.95*	[0.91, 1.00]	0.94***	[0.91, 0.97]
Percent veterans	1.27**	[1.09, 1.47]	1.02	[0.86, 1.20]	1.14*	[1.02, 1.28]
Percent unemployed	0.99	[0.79, 1.25]	0.78	[0.61, 1.01]	0.91	[0.75, 1.10]
Percent in poverty	0.89*	[0.80, 0.98]	0.97	[0.86, 1.09]	0.92	[0.84, 1.00]
Intercept	0.38**	[0.19, 0.75]	1.25	[0.55, 2.86]	0.24***	[0.13, 0.43]

Note: Logistic regression models were conducted using multiple imputed data in the overall sample and in subsamples focusing on suicide by firearm compared to hanging/suffocation or poisoning/overdose, with robust standard errors. Intercept represents predicted odds of suicide by firearm compared to the other method for a hypothetical decedent who is age 46.17, female, non-White, single, in an urban area, who was not suspected of alcohol use at time of death, had a negative marijuana result at time of death, was not in mental health treatment at time of death, did not have an attempt history, and did not have family problems, in the year 2019, in a zip code with 0% on all of the included predictors (percent aged 65 and over, percent White, percent living alone, percent with bachelor's degree, percent veterans, percent unemployed, and percent living in poverty). Age and zip code level predictors were divided by 10 before being included in the model.

Abbreviations: OR, odds ratio; CI, confidence interval.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

original model, and race and living in an area with more veterans were no longer significant; however, experiencing family problems predicted greater odds of death by firearm compared to poisoning/overdose, and odds of suicide by

firearm increased slightly in each year. Interestingly, odds of firearm suicide were decreasing with age in this model, such that they decreased from ages 18 to 56 and then increased through later adulthood.



## DISCUSSION

The current study examined mortality data from 11,512 suicide deaths in Colorado from years 2009 to 2019 and revealed that suicide by firearm, compared to suicide by other methods, becomes more common with age, particularly in late adulthood. In terms of predictors, we found that being older, male, White, a veteran, married, or more highly educated was associated with greater odds of suicide by firearm compared to suicide by other methods. Additionally, suspected alcohol use in the hours preceding death, living in an area with more older adults, and living in a community with more veterans were each associated with greater risk of firearm use. Being divorced, receiving mental health treatment at time of death, having a history of attempting suicide, or living in an area with more people living alone or more people with a college degree was associated with lower odds of firearm use compared to other methods. However, some of these main effects were qualified by interactions with age.

We found that for older adults, being male, White, married, living in a rural area, and using marijuana prior to death were particularly strong risk factors for firearm use, while receiving mental health treatment was associated with lower odds of firearm use for all ages but particularly for older adults. For younger adults, sex and race still predicted firearm use, only to a lesser extent, and military service and suspected alcohol use before death also predicted greater odds of firearm use. Having a history of attempting suicide was associated with similarly reduced odds of firearm use across all ages. These findings are notable because previous research examining differences between suicide by firearm and suicide by other methods have generally not distinguished young, middle, and older adults. Doing so reveals key differences, such that for young adults, having served in the military or using alcohol may increase risk of firearm suicide, while for older adults, living in rural or isolated areas and using marijuana may be more potent risk factors. The implications of these findings are discussed in more detail below.

Several contextual factors measured at the zip code level significantly predicted suicide by firearm compared to other methods in the current study. Living in an area with more older adults was associated with greater odds of firearm use for younger and middle-aged adults, while living in an area with more people living alone was associated with lower firearm use for these groups. For middle-aged and older adults, living in an area with more college-educated people was associated with lower odds of firearm use. For young adults, living in an area with more veterans was associated with greater odds of firearm use. These findings for age interactions with contextual

factors indicate that community factors matter in predicting risk for suicide by firearm, and that they may operate differentially depending on developmental stage. Younger adults, for example, may feel isolated or out of place in areas with more older adults, or they may be more exposed to guns and gun-related injuries when they live in areas with greater veteran populations. While prior research has shown higher rates of suicide by firearm among veteran populations, these results are novel—young adults who live in areas with higher rates of veterans may also be more prone to suicide by firearm compared to other methods. It is possible that in communities with larger veteran populations, there is greater availability and acceptability of guns that might increase risk for suicide by firearm (Ellison et al., 2022; Kaplan et al., 2009). For middle-aged and older adults, living in an area with more college-educated people might be associated with greater social capital and other resources, which may reduce the risk of suicide by firearm relative to other methods. Based on these findings, interventions targeted at reducing risk for firearm suicide might focus on communities where there are more older adults or more veterans, or fewer people living alone or with college education.

Two models comparing suicide deaths by firearm to deaths by hanging/suffocation and deaths by poisoning/overdose, respectively, resulted in similar findings to the original model, with some minor exceptions. For example, gender differences in firearm suicide were greater when compared to poisoning/overdose but weaker when compared to hanging/suffocation. The age trend was also different for comparison with poisoning/overdose, such that odds of firearm death decreased in early and middle adulthood, then increased through late adulthood. However, overall, results were largely similar, suggesting that many risk and protective factors (e.g., attempt history, marital status, and military service) are associated with suicide death by firearm, regardless of the comparison.

The findings from this study corroborate those from previous research. Previous studies have indicated that older individuals, males, and those living in rural areas are at heightened risk for suicide by firearm (Houtsma et al., 2018). Greater gun availability and more positive attitudes regarding guns in rural areas and those with a greater veteran population may contribute to greater risk for suicide by firearm in these areas (Anestis & Capron, 2016; Celinska, 2007; Westefeld et al., 2016; although see Miller, 2019). The findings for suspected alcohol use are also in line with previous research using NVDRS data from 2005 to 2010, which found that alcohol use predicts suicide by firearm for younger adults but not older adults (Conner et al., 2014). However, the results for marijuana were novel and unexpected; previous

research on suicide decedents in Colorado found that positive marijuana test results did not differ for those who died by firearm compared to those who died by hanging, but did not examine other methods or test for different associations by age (Sheehan et al., 2015). It is possible that for younger adults, alcohol contributes to capacity for suicide (e.g., by lowering inhibitions and increasing depressive symptoms or suicidal ideation), while older adults who use marijuana may be using it to cope with pain or other stressors, and thus may be at greater risk for suicide by firearm. Future research should further examine substance use and the method of suicide by age to replicate results.

Consistent with previous research, the current study found that people who were receiving mental health treatment at the time of death were less likely to use a firearm compared to other suicide methods (Bond et al., 2022). In fact, the odds ratio for mental health treatment in this study ( $OR = 0.76$ ) is slightly stronger than the one found in a previous study ( $OR = 0.85$ ; Bond et al., 2022), and became even stronger for older adults ( $OR = 0.51$ ). In the current study, 29% of decedents were receiving mental health treatment at their time of death, but this rate was lower for older adults (22%) and for those living in rural areas (24%). Given that firearm suicide decedents were less likely to receive mental health treatment, it is important to integrate prevention solutions outside of the healthcare spectrum. A growing initiative is to partner with gun shops as a means to reach potentially at-risk people at places they visit (see Barber et al., 2017; Barnard et al., 2023; Polzer et al., 2021; Vriniotis et al., 2015). This work is also being done in Colorado; as an example, Barnard et al. (2023) discuss the need to leverage community resources and collaborations to address firearm-involved suicides in El Paso county, which has the highest number of suicides and firearm-related suicide deaths in the state. Given the stronger effect size and lower rate of treatment for older adults, it may be particularly important to focus on interventions outside of the healthcare system for this age group, while also increasing access to mental health care (Price & Khubchandani, 2021). In short, there needs to be a spectrum of prevention solutions to meet at-risk individuals directly, rather than expecting people to seek out prevention on their own. Future research should continue to examine what types of prevention programs are able to reach at-risk individuals outside of only healthcare.

Though this study had several strengths, including the use of statewide mortality data and Census zip code level data spanning a decade, this study is not without limitations. The sample was restricted to suicide deaths among adults in Colorado using 2009–2019 data, thus limiting

generalizability to suicide attempts and to suicide deaths in other states or during other time periods. In addition, this study solely focused on adults, and thus, it cannot be generalized to children and adolescents under age 18. There were also limited data on risk and protective factors prior to death. Subsequent studies should include a wider range of concurrent and historical risk and protective factors obtained from various sources.

## CONCLUSION

Given the findings that older men in Colorado are at greater risk for suicide by firearm, public health initiatives serving isolated men in rural areas in the state, as well as expanding mental health options to those areas, may be especially impactful to target those at highest risk. These interventions may also have ripple effects for younger and middle-aged adults living in communities with a larger older adult population, given the findings for zip code level predictors. Based on the findings for mental health treatment, increasing the availability of follow-up services may be critical, especially for individuals with previous mental health disruptions who may have received services. Previous research found that for patients who were discharged from emergency departments following suicide attempts or ideations, those who also received follow-up telephone calls had fewer subsequent suicide attempts in the following year (Catanach et al., 2019). Thus, public health initiatives that include follow-up services, such as phone calls to those individuals currently in or discharged from treatment, could have the potential to reduce suicide risk overall. While these findings are particularly informative to the specific context of suicide by firearm in Colorado, they may provide useful information for public health and suicide prevention initiatives in other regions with similar characteristics. More research at both the state and national levels is needed to determine how to best intervene and prevent suicide by firearm depending on person-, incident-, and context-specific factors.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data used for the project described in this article cannot be shared publicly due to the data agreement in place with CDPHE.

## DISCLAIMER

The opinions, findings, conclusions, and recommendations expressed in this publication are those of the authors

and do not reflect the official position or policies of CAP Index.

## ORCID

Meagan Docherty  <https://orcid.org/0000-0002-5995-5122>

Joanna Kubik  <https://orcid.org/0000-0003-1850-2722>

## ENDNOTE

<sup>1</sup>We only included linear age in these models because (1) dividing the sample into three age categories allowed us to observe non-linear trends with respect to age, (2) there was multicollinearity between the linear and quadratic age terms in the age group models, and (3) the quadratic term was not significant in these models.

## REFERENCES

- Anestis, M. D. (2016). Prior suicide attempts are less common in suicide decedents who died by firearms relative to those who died by other means. *Journal of Affective Disorders, 189*, 106–109. <https://doi.org/10.1016/j.jad.2015.09.007>
- Anestis, M. D., & Capron, D. W. (2016). The associations between state veteran population rates, handgun legislation, and statewide suicide rates. *Journal of Psychiatric Research, 74*, 30–34. <https://doi.org/10.1016/j.jpsychires.2015.12.014>
- Anestis, M. D., Khazem, L. R., & Anestis, J. C. (2017). Differentiating suicide decedents who died using firearms from those who died using other methods. *Psychiatry Research, 252*, 23–28. <https://doi.org/10.1016/j.psychres.2017.02.048>
- Barber, C., Frank, E., & Demicco, R. (2017). Reducing suicides through partnerships between health professionals and gun owner groups—Beyond docs vs locks. *JAMA Internal Medicine, 177*(1), 5–6. <https://doi.org/10.1001/jamainternmed.2016.6712>
- Barnard, L. M., Spark, T. L., Leavitt, C., Leary, J., Lehmkuhl, L. J., Johnston, N., & Wallace, E. A. (2023). Leveraging community context, data, and resources to inform suicide prevention strategies. *The Journal of Law, Medicine & Ethics, 51*(1), 83–92. <https://doi.org/10.1017/jme.2023.43>
- Beseran, E., Pericàs, J. M., Cash-Gibson, L., Ventura-Cots, M., Porter, K. M. P., & Benach, J. (2022). Deaths of despair: A scoping review on the social determinants of drug overdose, alcohol-related liver disease and suicide. *International Journal of Environmental Research and Public Health, 19*(19), 12395. <https://doi.org/10.3390/ijerph191912395>
- Bond, A. E., Bandel, S. L., Rodriguez, T. R., Anestis, J. C., & Anestis, M. D. (2022). Mental health treatment seeking and history of suicidal thoughts among suicide decedents by mechanism, 2003–2018. *JAMA Network Open, 5*(3), e222101. <https://doi.org/10.1001/jamanetworkopen.2022.2101>
- Brådvik, L. (2018). Suicide risk and mental disorders. *International Journal of Environmental Research and Public Health, 15*(9), 2028. <https://doi.org/10.3390/ijerph15092028>
- Cai, Z., Junus, A., Chang, Q., & Yip, P. S. F. (2022). The lethality of suicide methods: A systematic review and meta-analysis. *Journal of Affective Disorders, 300*, 121–129. <https://doi.org/10.1016/j.jad.2021.12.054>
- Cairns, J.-M., Graham, E., & Bambra, C. (2017). Area-level socioeconomic disadvantage and suicidal behaviour in Europe: A systematic review. *Social Science & Medicine, 192*, 102–111. <https://doi.org/10.1016/j.socscimed.2017.09.034>
- Catanach, B., Betz, M. E., Tvrdy, C., Skelding, C., Brummett, S., & Allen, M. H. (2019). Implementing an emergency department telephone follow-up program for suicidal patients: Successes and challenges. *The Joint Commission Journal on Quality and Patient Safety, 45*(11), 725–732. <https://doi.org/10.1016/j.jcjq.2019.07.009>
- Celinska, K. (2007). Individualism and collectivism in America: The case of gun ownership and attitudes toward gun control. *Sociological Perspectives, 50*(2), 229–247. <https://doi.org/10.1525/sop.2007.50.2.229>
- Centers for Disease Control and Prevention. (2020). *Underlying cause of death 1999–2019 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999–2019, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program.*
- Conner, K. R., Huguet, N., Caetano, R., Giesbrecht, N., McFarland, B. H., Nolte, K. B., & Kaplan, M. S. (2014). Acute use of alcohol and methods of suicide in a US national sample. *American Journal of Public Health, 104*(1), 171–178. <https://doi.org/10.2105/AJPH.2013.301352>
- Daniel, S. S., & Goldston, D. B. (2012). Hopelessness and lack of connectedness to others as risk factors for suicidal behavior across the lifespan: Implications for cognitive-behavioral treatment. *Cognitive and Behavioral Practice, 19*(2), 288–300. <https://doi.org/10.1016/j.cbpra.2011.05.003>
- Ellison, C. G., Kelley, M. S., Leal, D., & Gonzalez, P. E. (2022). How do veterans view gun policies? Evidence from the guns in American life survey. *Social Science Quarterly, 103*(3), 752–768. <https://doi.org/10.1111/ssqu.13145>
- Garnett, M. F., & Curtin, S. C. (2023). Suicide mortality in the United States, 2001–2021. *NCHS Data Brief, 464*, 1–8. <https://doi.org/10.15620/cdc:125705>
- Houry, D. E., Simon, T. R., & Crosby, A. E. (2022). Firearm homicide and suicide during the COVID-19 pandemic: Implications for clinicians and health care systems. *JAMA, 327*(19), 1867. <https://doi.org/10.1001/jama.2022.6924>
- Houtsma, C., Butterworth, S. E., & Anestis, M. D. (2018). Firearm suicide: Pathways to risk and methods of prevention. *Current Opinion in Psychology, 22*, 7–11. <https://doi.org/10.1016/j.copsyc.2017.07.002>
- Kaplan, M. S., Adamek, M. E., & Geling, O. (1996). Sociodemographic predictors of firearm suicide among older white males. *The Gerontologist, 36*(4), 530–533. <https://doi.org/10.1093/geront/36.4.530>
- Kaplan, M. S., McFarland, B. H., & Huguet, N. (2009). Firearm suicide among veterans in the general population: Findings from the National Violent Death Reporting System. *Journal of Trauma: Injury, Infection & Critical Care, 67*(3), 503–507. <https://doi.org/10.1097/TA.0b013e3181b36521>
- Klonsky, E. D., Pachkowski, M. C., Shahnaz, A., & May, A. M. (2021). The three-step theory of suicide: Description, evidence, and some useful points of clarification. *Preventive Medicine, 152*, 106549. <https://doi.org/10.1016/j.ypmed.2021.106549>
- Le, H., Khan, B. A., Murtaza, S., & Shah, A. A. (2020). The increase in suicide during the COVID-19 pandemic. *Psychiatric Annals, 50*(12), 526–530. <https://doi.org/10.3928/00485713-20201105-01>
- McDonough, J. (2023). Colorado's mental health crisis: Innovative services poised to improve health equity & access. *ColoradoBiz*

- Magazine. <https://www.cobizmag.com/colorados-mental-health-crisis-innovative-services-poised-to-improve-health-equity-access/>
- Miller, S. V. (2019). What Americans think about gun control: Evidence from the general social survey, 1972–2016. *Social Science Quarterly*, 100(1), 272–288. <https://doi.org/10.1111/ssqu.12555>
- Mocarski, R., & Butler, S. (2016). A critical, rhetorical analysis of man therapy: The use of humor to frame mental health as masculine. *Journal of Communication Inquiry*, 40(2), 128–144. <https://doi.org/10.1177/0196859915606974>
- Polzer, E., Brandspigel, S., Kelly, T., & Betz, M. (2021). ‘Gun shop projects’ for suicide prevention in the USA: Current state and future directions. *Injury Prevention*, 27(2), 150–154. <https://doi.org/10.1136/injuryprev-2020-043648>
- Price, J. H., & Khubchandani, J. (2021). Firearm suicides in the elderly: A narrative review and call for action. *Journal of Community Health*, 46, 1050–1058. <https://doi.org/10.1007/s10900-021-00964-7>
- Ratcliffe, M., Burd, C., Holder, K., & Fields, A. (2016). *Defining rural at the U.S. Census Bureau: American community survey and geography brief*. U.S. Census Bureau.
- Rossen, L. M., Hedegaard, H., Khan, D., & Warner, M. (2018). County-level trends in suicide rates in the U.S., 2005–2015. *American Journal of Preventive Medicine*, 55(1), 72–79. <https://doi.org/10.1016/j.amepre.2018.03.020>
- Schell, T. L., Peterson, S., Vegetabile, B. G., Scherling, A., Smart, R., & Morral, A. R. (2020). *State-level estimates of household firearm ownership*. RAND Corporation. <https://doi.org/10.7249/TL354>
- Seedat, S., Scott, K. M., Angermeyer, M. C., Berglund, P., Bromet, E. J., Brugha, T. S., Demyttenaere, K., de Girolamo, G., Haro, J. M., Jin, R., Karam, E. G., Kovess-Masfety, V., Levinson, D., Medina Mora, M. E., Ono, Y., Ormel, J., Pennell, B.-E., Posada-Villa, J., Sampson, N. A., ... Kessler, R. C. (2009). Cross-national associations between gender and mental disorders in the World Health Organization world mental health surveys. *Archives of General Psychiatry*, 66(7), 785–795. <https://doi.org/10.1001/archgenpsychiatry.2009.36>
- Sheehan, C. M., Rogers, R. G., & Boardman, J. D. (2015). Postmortem presence of drugs and method of violent suicide. *Journal of Drug Issues*, 45(3), 249–262. <https://doi.org/10.1177/0022042615580988>
- Smith, N. D. L., & Kawachi, I. (2014). State-level social capital and suicide mortality in the 50 U.S. states. *Social Science & Medicine*, 120, 269–277. <https://doi.org/10.1016/j.socscimed.2014.09.007>
- Spicer, R. S., & Miller, T. R. (2000). Suicide acts in 8 states: Incidence and case fatality rates by demographics and method. *American Journal of Public Health*, 90(12), 1885–1891. <https://doi.org/10.2105/AJPH.90.12.1885>
- Steelesmith, D. L., Fontanella, C. A., Campo, J. V., Bridge, J. A., Warren, K. L., & Root, E. D. (2019). Contextual factors associated with county-level suicide rates in the United States, 1999 to 2016. *JAMA Network Open*, 2(9), e1910936. <https://doi.org/10.1001/jamanetworkopen.2019.10936>
- Turecki, G., Brent, D. A., Gunnell, D., O’Connor, R. C., Oquendo, M. A., Pirkis, J., & Stanley, B. H. (2019). Suicide and suicide risk. *Nature Reviews Disease Primers*, 5(1), 74. <https://doi.org/10.1038/s41572-019-0121-0>
- Vriniotis, M., Barber, C., Frank, E., Demicco, R., & the New Hampshire Firearm Safety Coalition. (2015). A suicide prevention campaign for firearm dealers in New Hampshire. *Suicide and Life-threatening Behavior*, 45(2), 157–163. <https://doi.org/10.1111/sltb.12123>
- Westefeld, J. S., Gann, L. C., Lustgarten, S. D., & Yeates, K. J. (2016). Relationships between firearm availability and suicide: The role of psychology. *Professional Psychology: Research and Practice*, 47(4), 271–277. <https://doi.org/10.1037/pro0000089>

**How to cite this article:** Docherty, M., Kubik, J., & Drawve, G. (2023). Examining predictors of suicide by firearm in young, middle, and late adulthood. *Suicide and Life-Threatening Behavior*, 00, 1–12. <https://doi.org/10.1111/sltb.13035>