



# Factors contributing to homicide-suicide: differences between firearm and non-firearm deaths

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**Abstract** The primary aim of this study is to determine the relationship between situational factors, method of death, and homicide-suicide deaths, specifically comparing method of death (firearm vs. nonfirearm) across these factors. We used data from the national violence death reporting system, a reporting system for violent deaths that links data from multiple sources. We included incidents that involved at least one homicide death followed by perpetrator suicide in the 42 states from 2013 to 2016. In addition to univariate analyses, we compared proportions of incidents that included a firearm to non-firearm incidents by incident, victim, and perpetrator characteristics. By far, firearm-related injuries were the most frequent cause of death for victims (85.6%) and for perpetrators (89.5%). Women, Hispanic individuals, individuals with a current mental health issue, and individuals with recent depression symptoms had lower odds of using a firearm, as did perpetrators who killed both an intimate partner and other family member. Individuals who had recently been in a fight had increased odds of using a firearm. Despite these differences, the overwhelming majority of homicide-suicide deaths involved firearms, which supports the need for adequate, appropriate firearm control measures to prevent these tragedies.

**Keywords** Homicide-suicide · Homicide followed by suicide · Firearms · Context · Situational factors

An estimated 11–17 homicide-suicide incidents, defined as at least one homicide death followed by a subsequent suicide by the perpetrator, occur each week in the United States, which is nearly twice the global average (Large, Smith, & Nielssen, 2009). Although low in number and in proportion to other violent deaths in the United States, homicide-suicide incidents often result in substantial trauma to the effected social networks and communities, which may be compounded by media coverage and social awareness of the homicide-suicide incidents (Marzuk, Tardiff, & Hirsch, 1992; Podlogar, Gai, Schneider, Hagan, & Joiner, 2018).

Despite the social impacts of homicide-suicide, research on these incidents has been limited, in part due to difficulty in case ascertainment and small sample sizes due to the relatively low number of deaths. Case identification is difficult in death certificate data because the homicide and suicide deaths are not linked. Many state domestic violence death review teams make this linkage, but few states have a sufficient number of cases for quantitative analysis. Homicide-suicide research is further complicated by the deaths of both perpetrators and victims, meaning individuals closest to the situation are no longer available to provide insight into the circumstances so vital information is often missing. Due to these limitations, most research on homicide-suicide is descriptive or theoretical (Bossarte, Simon, & Barker, 2006; Huguet & Lewis-Laietmark, 2015; Logan et al., 2008, 2013; Smith, Fowler, & Niolon, 2014).

This research suggests that homicide/suicide incidents are distinct from homicide and from suicide (Barber et al., 2008; Liem, 2010; Panczak et al., 2013; Podlogar et al.,

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2018; Reckdenwald & Simone, 2017; Starzomski & Nussbaum, 2000). Homicide perpetrators/suicide victims are, overall, predominantly middle-aged, married men with a history of domestic violence. Firearm injuries are the most frequent cause of death for both victims and perpetrators (Panczak et al., 2013). In early work on homicide-suicide, Marzuk and colleagues (1992) theorized these incidents could be categorized by the relationship between victim and perpetrator, and by primary motivating factor (e.g., financial/social stressors, “mercy killing”, retaliation, etc.). This classification system may be used to understand different types of homicide-suicide incidents and to better understand how risk and protective factors differ for each type (Marzuk et al., 1992). Some studies have found significant differences in circumstances around the time of death and the method of death, by victim-perpetrator relationship (Barber et al., 2008; Reckdenwald & Simone, 2017). For example, deaths involving intimate partners tend to have older victims and perpetrators, more female victims, and more male perpetrators than deaths compared with other victim-perpetrator relationships (Reckdenwald & Simone, 2017). However, it is not known how Marzuk’s overall typology applies to large samples of homicide-suicide deaths or how risk and protective factors vary across the types of incidents. This limited understanding of modifiable risk and protective factors for homicide-suicide hampers our ability to develop and implement effective intervention and prevention efforts.

The implementation of the National Violent Death Reporting System by the Centers for Disease Control, National Center for Injury Prevention and Control (NCIPC) overcomes some of the challenges associated with homicide-suicide research by creating a pooled, multi-source standard data collection process for all violent deaths (NCIPC, 2017). This dataset allows for systematic investigation into actionable factors contributing to homicide-suicide and how these factors differ across types of homicide-suicide incidents. Understanding how factors differ across firearm and non-firearm homicide-suicide incidents may inform prevention and intervention activities and enable targeting interventions based on specific risk characteristics. The primary aim of this manuscript is to determine the relationship between contributing factors, method of death, and homicide-suicide deaths, specifically determining differences in method of death (firearm vs. nonfirearm) by Marzuk classification for relationship type and motivating circumstances.

## Methods and measures

### Data

We accessed data for this analysis through a restricted access agreement with the Centers for Disease Control and Prevention (CDC) for the National Violent Death Reporting System (NVDRS). NVDRS is the only state-based reporting system for violent deaths in the United States and links data from vital records, law enforcement, and coroner/medical examiners. In most of the participating states, information about all violent deaths occurring within the state is collected. We included the forty-two states and territories that reported data to the NVDRS between 2013 and 2016. However, some states began reporting data between 2013 and 2016 so not all states contributed data for the full time period of this analysis. Because we were not examining time trends or calculating rates, we pooled all homicide/suicide incidents regardless of state and year. As of March 2019, NVDRS data collection and access information was available on the website (NCIPC, 2017).

For this analysis, we included deaths from 2013 to 2016 that were categorized as “Single homicide followed by suicide” or “Multiple homicide followed by suicide” by NVDRS, which was 1157 events involving 2547 individuals (1388 victims; 1159 perpetrators). For this analysis, we included only deaths perpetrated by an adult that had complete records for our variables of interest, meaning victim-perpetrator relationship, circumstantial information, and cause of death must have been documented. We excluded 31 people because the victim-perpetrator were under the age of 18 at the time of the incident. Perpetrators under the age of 18 were excluded because it was suggested we do so during the review for our NVDRS data sharing agreement. We excluded 205 people due to missing circumstance information for their incident, 147 people due to missing relationship information, and an additional 181 people due to missing cause of death. Records may have been missing multiple variables so the final sample size for this analysis was 952 events (1104 victims and 954 perpetrators), or 80.8% of homicide-suicide events identified in the NVDRS between 2013 and 2016. To determine if excluded incidents and individuals were substantively different from those with full case information, we compared the available characteristics of each excluded group to the group with full case information (e.g., demographic characteristics, circumstantial information, and cause of death for cases missing victim-perpetrator relationship). We found little evidence to suggest that the excluded cases were substantively different from the other cases. However, perpetrators who were under the age of 18 at the time of the incident appeared to be motivated by different factors and

killed different people than adult perpetrators. School issues and caregiver-child issues were frequently identified as contributing to these homicide-suicide incidents. In addition, family members, rather than intimate partners, were frequently victims of young perpetrators.

## Measures

### *Dependent variable*

We categorized deaths as firearm-related or non-firearm related using the International Classification of Diseases (10th revision; ICD-10) underlying cause code (World Health Organization, 1992). This dataset included the following firearm-related ICD-10 codes: S01.5, S01.9, S21.9, W33, W34, X72, X73, X74, X94, X94, X95, and Y23, which we categorized as firearm deaths. We categorized all other known causes of death as non-firearm deaths. For analyses conducted at the individual victim or perpetrator-level, we used the individual mechanism of death. For analyses conducted at the incident-level, we aggregated the causes of death for all individuals killed in the incident. Incidents that included at least one death due to firearm were categorized as involving a firearm. Incidents that did not include any firearm-related deaths were categorized as non-firearm incidents.

### *Independent variables*

We created descriptive categories of the incidents based on a modified version of the Marzuk and colleagues (1992) classification scheme. Briefly, the Marzuk classification combined perpetrator-victim relationship and primary motive to create a single descriptive code. Although the NVDRS dataset is the largest to allow examination of homicide-suicide deaths, there were an insufficient number of incidents to create a code that combined both relationship and primary motive. As such, we created separate variables for relationship and for contributing factors. We categorized victims' relationships with the perpetrator into three main categories: intimate partner, other family, and extrafamilial. We also created incident-level victim-perpetrator relationship categorizations, which accounted for the possibility of multiple victims and perpetrators: only intimate partner, only other family, intimate partner and other family, intimate partner or other family and extrafamilial, and extrafamilial. There were multiple perpetrators in only two incidents. In both, the perpetrators were the biological parents of the victims so the incidents were categorized as "only other family" incidents because each of the perpetrators was responsible for the death of their children and themselves, not their intimate partner.

The NVDRS dataset included many possible contributing circumstantial factors, which we conceptualized as the motives for the deaths. The Marzuk and colleagues (1992) classification included jealousy, mercy killing, stressors, extended suicide, retaliation, other, and unspecified as the primary motives. Of these, we were unable to identify an indication of retaliation in the data. For the other factors, NVDRS included, either explicitly or otherwise, at least one variable that mapped onto the classification components. In the NVDRS dataset, dichotomous indicators of jealousy, mercy killing, and multiple financial and social stressors were included as circumstantial factors. We defined jealousy-motivated deaths as those motivated by distress over a current or former intimate partner's relationship with another person. Mercy killing occurs when a victim is killed, at his/her request, to end pain or distress. Numerous stressors were included in the NVDRS dataset. We categorized eighteen types of stressors into three main dichotomous categories: fights, general stressors, and interpersonal stressors. Fights included recent arguments, brawls, or fights. Stressors included a range of experiences, such as loss of housing, a financial or job problem, legal problems, and others. Interpersonal stressors were those stressors that involved another person, such as family relationship issues, past month violence victimization or perpetration, or a death in the social network.

Extended suicide has been defined a few different ways in the literature. In some literature, any homicide-suicide is considered an extended suicide (Liem, Postulart, & Nieuwbeerta, 2009; Saleva, Putkonen, Kiriruusu, & Lönnqvist, 2007). Other authors have narrowed the definition. In some literature, extended suicide is any homicide-suicide during which the perpetrator is primarily motivated by the suicide but kills others in the process (Flynn et al., 2009; Takahashi, 2001). In other literature, extended suicide is restricted to instances where a perpetrator views the victim as an extension of himself/herself and kills the victim(s) in an attempt to save the victim from the reason for the suicide (D'Argenio, Catania, & Marchetti, 2013). Dettling, Althaus, & Haffer, 2003; Marzuk et al., 1992). Extended suicide is not explicitly captured in the NVDRS data, but historical indications of suicidal intent, thoughts, and attempts were included. As such, we conceptualized prior intent, thoughts, or attempts as an indication that the suicide was a primary motive for the homicide-suicide incident, which is most congruent with the second possible definition. For each category (jealousy, mercy killing, fights, general stressors, interpersonal stressors, extended suicide), we coded incidents and individuals with at least one experience in each category as experiencing that contributing factor.

### *Other perpetrator characteristics*

We also included biological sex (male or female), education (high school or less, some college/2-year degree, 4-year degree or greater), and race/ethnicity of the perpetrator (Non-Hispanic White, Non-Hispanic Black, Hispanic, other) in our analyses. When necessary due to small cell sizes, we combined categories (e.g., less than high school degree and high school degree combined to high school or less). Although not formally included in the Marzuk and colleague (1992) classification structure, depression and other mental health issues were hypothesized to be strongly associated with homicide-suicide perpetration and also access to firearms, so we also included dichotomous indicators of perpetrator depression and mental health issues in these analyses. In the NVDRS data, mental health issues was broadly defined as any mental health issue. Additional details of the NVDRS definitions of each variable and our categorization of each is available in “Appendix”.

### **Analytic plan**

First, we used univariate statistics to describe the demographic characteristics, mental health characteristics, cause of death for victims and perpetrators, and the Marzuk classifications, including relationship classification (i.e., intimate partner, other family, extrafamilial) and contributing factors (e.g., jealousy, mercy killing, extended suicide, and stressors). We aggregated relationship classification to the incident-level to determine the proportion of homicide-suicide incidents that included intimate partner only, other family only, intimate partner and other family, intimate partner or family and extrafamilial, and extrafamilial only deaths. Then, we conducted bivariate analyses to examine the proportion of incidents, victims, and perpetrators that included the primary contributing factors identified by Marzuk and colleagues (1992), including jealousy, mercy killing, possible extended suicide, and a variety of potential stressors. In addition to examining these factors at the individual-level, we also aggregated the contributing factors to the incident-level (e.g., incident-level: any decedent was involved in a fight; victim-level: victim was involved in a fight; perpetrator-level: perpetrator was involved in a fight). To understand differences in characteristics between incidents that involved at least one firearm death and those that involved no firearms, we used bivariate analyses to calculate the proportion of incidents that included a firearm, by perpetrator biological sex, perpetrator educational attainment, perpetrator race/ethnicity, and victim-perpetrator relationship. We used logistic regression analyses to compare the odds of an incident including a firearm by these characteristics. Finally, we

conducted, at the level of incident, victim, and perpetrator, bivariate analyses to examine differences in contributing factors between firearm and non-firearm incidents and deaths. For incident-level analyses, we used logistic regression models to determine if there were statistical differences. To account for non-independence within the perpetrator-level and victim-level analyses (e.g., multiple victims possible in one incident), we conducted clustered logistic regression analyses. For each analysis, we reported if there were significant differences in the presence of each contributing factor between firearm and non-firearm incidents and deaths.

### **Results**

Across the 952 homicide-suicide incidents, 1104 victims killed by 954 homicide perpetrators who committed suicide (hereafter called perpetrators) were included in this analytic dataset. On average, 2.17 people, including the homicide perpetrator, died per homicide-suicide incident (range: 2–10; *SD* 0.53). Approximately 90% of incidents had two associated deaths ( $n = 839$ ), indicating one victim died in the incident along with the perpetrator. A total of 727 intimate partners (65.9%), 244 family members (22.1%), and 133 unrelated people (12.1%) were killed. Most incidents ( $n = 663$ ; 69.5%) involved, in addition to the homicide death, the death of only an intimate partner, 132 (13.8%) involved only the death of another family member, 47 (4.9%) involved an intimate partner and other family member, 17 (1.8%) involved an intimate partner or family member and an extrafamilial victim; and 95 (10.0%) involved only extrafamilial victims. “Other person, known to victim” ( $n = 59$ ), strangers ( $n = 17$ ), friends ( $n = 15$ ), and acquaintances ( $n = 13$ ) were the most common extrafamilial victims. By far, firearm-related injuries were the most frequent cause of death for victims (85.6%;  $n = 945$ ) and for perpetrators (89.5%;  $n = 854$ ). Deaths due to strangling/suffocating, sharp force trauma, poisoning, and other causes were less common. In the vast majority of cases the cause of death was the same for all decedents in the event.

The average age of victims was 41.5 years (range: 0–92; *SD*: 20.4) and the average age of perpetrators was 47.8 years (range: 18–100; *SD*: 16.1). A large majority of victims were female, but most perpetrators were male (Table 1). Education and race/ethnicity were similar across victims and perpetrators. Very few victims had recently experienced a depressed mood, and few had experienced a current mental health issue. In contrast, nearly 15% of perpetrators experienced a recent depressed mood and 20% a current mental health issue.

**Table 1** Characteristics of homicide-suicide victims and perpetrators

Individual characteristic	Victim (n = 1104) n (%)	Perpetrator (n = 954) n (%)
<b>Biological sex</b>		
Male	255 (23.1%)	892 (93.5%)
Female	849 (76.9%)	62 (6.5%)
<b>Education</b>		
High school or less	580 (52.5%)	532 (55.8%)
Some college/2-year degree	219 (19.8%)	174 (18.2%)
4-year degree or greater	164 (14.9%)	103 (10.8%)
Unknown	141 (12.9%)	145 (15.2%)
<b>Race/ethnicity</b>		
Non-hispanic white	774 (70.1%)	638 (66.9%)
Non-hispanic black	152 (13.8%)	166 (17.4%)
Hispanic	102 (9.2%)	94 (9.9%)
Other	76 (6.9%)	56 (5.9%)
<b>Cause of death</b>		
Firearm	945 (85.6%)	854 (89.5%)
Strangle/suffocate	34 (3.1%)	30 (3.1%)
Sharp force trauma	45 (4.1%)	22 (2.3%)
Poison	12 (1.1%)	18 (1.9%)
Other	68 (6.2%)	30 (3.1%)

Using the Marzuk classification, we identified the proportion of incidents motivated by jealousy, mercy killing, and financial or social stress-related factors. Approximately 10% of homicide-suicide incidents were related to jealousy (n = 94) and 2.6% were a “mercy killing” (n = 25) (Table 2). Approximately 20% of incidents (n = 201) involved a perpetrator with a history of suicidal thoughts or behaviors. Financial, social, or mental health stressors were substantially more common among perpetrators. More than half of perpetrators experienced an interpersonal stressor, such as family relationship issues (n = 569). Approxi-

mately a third of perpetrators engaged in an argument or fight (n = 327) or experienced recent stressors (e.g., job or legal problem; n = 364) near the time of the incident.

**Factors associated with firearm use**

Several perpetrator and incident characteristics were associated with reduced odds of using a firearm during the incident. Female perpetrators had significantly reduced odds of using a firearm compared with male perpetrators (Table 3). Hispanic perpetrators had significantly reduced

**Table 2** Contributing factors, by incident and person level

Contributing factor	Incident aggregate (n = 952) n (%)	Victim (n = 1104) n (%)	Perpetrator (n = 954) n (%)
Jealousy	94 (9.9%)	98 (8.9%)	–
Mercy killing	25 (2.6%)	25 (2.3%)	N/A
Possible extended suicide	201 (21.1%)	N/A	201 (21.1%)
<b>Stressors</b>			
Recent fight	380 (39.9%)	365 (33.1%)	327 (34.3%)
Recent stressors	366 (38.5%)	12 (1.1%)	364 (38.2%)
Recent interpersonal stressors	589 (61.9%)	192 (17.4%)	569 (59.6%)
Recent drug/alcohol issues	204 (21.4%)	92 (8.3%)	172 (18.0%)
Recent depressed mood	138 (14.5%)	24 (2.2%)	129 (13.5%)
Recent mental health problem	247 (26.0%)	94 (8.5%)	195 (20.4%)

–Indicates cell was suppressed due to small cell size

**Table 3** Incident characteristics and use of firearm during homicide or suicide

Other factors	Firearm (n = 868) n (row %)	No firearm (n = 84) n (row %)	Crude odds ratio (95%CI)
<b>Biological sex of perpetrator<sup>a</sup></b>			
Male	818 (91.9%)	72 (8.1%)	Ref
Female	49 (81.7%)	11 (18.3%)	0.44 (0.20–0.79)
<b>Perpetrator educational attainment<sup>b</sup></b>			
High school or less	488 (91.7%)	44 (8.3%)	Ref
Some college/2-year degree	150 (87.2%)	23 (12.8%)	0.62 (0.33–1.06)
4-year degree or greater	94 (91.3%)	9 (8.7%)	0.94 (0.45–1.99)
<b>Perpetrator race/ethnicity</b>			
Non-hispanic white	588 (92.5%)	47 (7.6%)	Ref
Non-hispanic black	152 (91.6%)	14 (8.4%)	0.89 (0.48–1.65)
Hispanic	80 (85.4%)	14 (14.9%)	0.47 (0.25–0.88)
Other	48 (85.7%)	8 (14.3%)	0.49 (0.22–1.11)
<b>Victim-perpetrator relationship</b>			
Intimate partner only	607 (91.6%)	56 (8.4%)	Ref
Other family only	116 (89.2%)	14 (10.8%)	0.76 (0.41–1.42)
Intimate partner and family	39 (82.9%)	8 (17.0%)	0.45 (0.20–1.00)
Intimate partner/family and extrafamilial	17 (100%)	0 (0%)	–
Only extrafamilial	89 (93.7%)	6 (6.3%)	1.37 (0.57–3.27)

<sup>a</sup>Two incidents excluded due to multiple homicide perpetrators with different biological sex

<sup>b</sup>Forty incidents excluded due to missing perpetrator education data

–Indicates unable to calculate odds ratio due to cell size

odds of using a firearm compared with white perpetrators. Perpetrators who killed both an intimate partner and other family member had significantly lower odds of using firearm than homicide-suicides involving only an intimate partner.

At the incident-level and individually for both victims and perpetrators, the presence of jealousy, mercy killing, suicide-intent, or most stressors as a contributing factor to the deaths were, overall, not associated with odds of using a firearm during the homicide-suicide incident (Table 4; regression results not tabled). However, incidents that involved a recent fight had significantly increased odds of involving a firearm (OR: 1.98; 95%CI: 1.19–3.28). Conversely, incidents involving individuals who had experienced a depressed mood or mental health issue had significantly reduced odds of involving a firearm in the incident (OR: 0.55; 95%CI: 0.32–0.94 and OR: 0.60; 95%CI: 0.37–0.96, respectively). These relationships were also statistically significant for perpetrator-level contributing factors and use of a firearm in the suicide.

## Discussion

Firearms were the mechanism of death in over 85% of victim deaths and nearly 90% of perpetrator suicides. These firearm usage rates for combined homicide and suicide events far exceed those of homicide or suicide only. Between 2013 and 2016, a total of 69,148 homicides were reported in the US, of which 49,610 (71.7%) were by firearm (NCIPC, 2019). A total of 173,133 suicides occurred in the US during this period, of which 87,517 (50.5%) were by firearm (NCIPC, 2019).

In this analysis, men perpetrated and women were victims of the vast majority of homicide-suicides, most of which involved an intimate partner relationship. Although Non-Hispanic White individuals represented nearly 70% of perpetrators and victims in this study, prior research on rates of perpetration among different racial/ethnic groups suggested this is likely consistent with population demographic characteristics, rather than an overrepresentation of Non-Hispanic White individuals as perpetrators (Huguet & Lewis-Laietmark, 2015). While the proportion of perpetrators with a depressed mood was only slightly higher than prior estimates (13.5% vs. 9–12%), the proportion with a current mental health issue was substantially higher (Bosarte et al., 2006; Logan et al., 2008). More than 20% of

**Table 4** Contributing factors and causes of death, by incident and person level

Contributing factor	Incident aggregate		Victim		Perpetrator	
	Firearm (n = 868) n (%)	Non-firearm (n = 84) n (%)	Firearm (n = 945) n (%)	Non-firearm (n = 159) n (%)	Firearm (n = 854) n (%)	Non-firearm (n = 100) n (%)
Jealousy	87 (10.0%)	7 (8.2%)	87 (9.2%)	11 (6.9%)	–	–
Mercy killing	–	–	–	–	N/A	N/A
Possible extended suicide	182 (21.0%)	20 (23.8%)	N/A	N/A	177 (20.7%)	24 (24.0%)
Financial or social stressors						
Recent fight	<b>358 (41.2%)</b>	<b>22 (25.9%)</b>	320 (33.9%)	45 (28.3%)	<b>305 (35.7%)</b>	<b>22 (22.0%)</b>
Recent stressors	335 (38.6%)	31 (36.9%)	–	–	326 (38.2%)	38 (38.0%)
Recent interpersonal stressors	535 (61.6%)	54 (64.3%)	165 (17.5%)	27 (17.0%)	508 (59.5%)	61 (61.0%)
Recent drug/alcohol issues	181 (20.9%)	23 (27.4%)	76 (8.0%)	16 (10.1%)	149 (17.5%)	23 (23.0%)
Recent depressed mood	<b>119 (13.7%)</b>	<b>19 (22.6%)</b>	–	–	<b>109 (12.8%)</b>	<b>20 (20.0%)</b>
Recent mental health issues	<b>217 (25.0%)</b>	<b>30 (35.7%)</b>	86 (9.1%)	8 (5.0%)	<b>165 (19.3%)</b>	<b>30 (30.0%)</b>

–Indicates cell was suppressed due to small cell size

N/A indicates contributing factor was not possible for that person type

Bold indicates significant differences at  $p < 0.05$

perpetrators had a current mental health issue, compared with prior estimates of approximately 10–12% (Bossarte et al., 2006; Logan et al., 2008). It is not clear what factors may be driving these differences, although the prior studies were in much smaller geographic areas with data collected several years prior to this study. A recent study found the proportion of US adults seeking mental health care grew consistently between 2004 and 2015 so it is possible that the higher rates of mental health issues were related to increased detection of mental health issues or to an increase in willingness of individuals to share or seek help related to mental health (Olfson et al., 2019). In 2018, the NVDRS expanded data collection to include all 50 states, Puerto Rico, and the District of Columbia. As data from the entire US becomes available, it may be possible to better assess the influence of geographic area on perpetrator mental health status.

Our primary purpose for these analyses was to determine if victim-perpetrator characteristics and factors contributing to the incident differed between firearm and non-firearm deaths. To structure this analysis, we used the Marzuk and colleagues (1992) classification, which hypothesized there were five main motivating factors for homicide-suicide incidents: jealousy, mercy killing, extended suicides, stressors, and retaliation. Some motivating factors were relatively uncommon in this population. Less than 10% of homicide-suicide incidents were jealousy-related and only 25 (2.3%) involved a mercy killing. Although extended suicide was not clearly defined in the data, we created a proxy measure that included any incident perpetrated by an individual who had prior suicidal ideation or attempts. Using this definition, more than

20% of incidents could be considered extended suicides, but it is difficult to determine how these results compare to other studies of homicide-suicide deaths. A recent review of intimate partner homicide-suicide deaths (2012–2018) found three studies that examined history of self-harm or suicide ideation/attempt by perpetrators (Zeppegno et al., 2019). In the first, approximately 23% of homicide-suicide perpetrators in England and Wales had a history of self-harm or attempted suicide (n = 14/60; Flynn, Gask, Appleby, & Shaw, 2016). In another study in the United Kingdom, 14% of perpetrators had made previous suicide attempts (n = 3/22; Gregory, 2012). In a German study, only 5% of perpetrators had a history of suicide attempts (n = 2/58; Siems, Flaig, Ackermann, & Parzeller, 2017). Since we included suicidal thoughts and attempts in our conceptualization, our results are most similar in measurement and estimates to those found in England and Wales and suggest that a sizeable minority of homicide-suicide incidents are perpetrated by individuals who have a history of suicide ideation and attempts.

While the demographic and individual characteristics of victims and perpetrators were consistent with prior findings, our analysis extended prior research to examine how characteristics differ among firearm and non-firearm homicide-suicide deaths. Several factors were associated with differing odds of firearm use. Women and Hispanic perpetrators had reduced odds of using a firearm. Although there were few significant differences in firearm use across victim-perpetrator relationship, there were some indications there may be underlying differences. Perpetrators who killed both an intimate partner and other family member had reduced odds of using a firearm, compared

with incidents involving only an intimate partner. Events involving only a family member were less likely, although not significantly so, to involve a firearm. Incidents involving extrafamilial victims tended to involve firearms more than those with just intimate partner or family deaths. Nearly 95% of incidents involving only extrafamilial victims and 100% of incidents involving intimate partner/family and extrafamilial victims involved a firearm.

Some contributing factors were also associated with firearm use. Perpetrators with depression or a current mental health issue had significantly lower odds of using a firearm, while perpetrators who were involved in a recent fight had significant higher odds of using a firearm. These relationships were, overall, difficult to measure with precision, resulting in wide confidence intervals and standard errors because so few events did not involve firearms. The analysis may have been underpowered to detect less substantial differences between firearm and nonfirearm incidents due to the relative rarity of non-firearm deaths for some stressors, such as recent alcohol or drug issues. The proportions of incidents involving other stressors were, overall, very consistent between firearm and non-firearm deaths. For example, 38.2% of perpetrators who used a firearm experienced recent stressors, as did 38.0% of non-firearm perpetrators. These findings suggest that firearm and non-firearm homicide-suicide incidents likely have several similar underlying contributing factors.

The high proportion of firearms as a mechanism of death in homicide-suicide deaths suggests that firearm means restriction is a potential prevention strategy, both for the homicide deaths and the resultant suicide. Programs to encourage storage of firearms locked and unloaded may help reduce events that occur due to an acute crisis, such as a fight. Studies have found that safe firearm storage practices are related to reductions in firearm suicides (Grossman et al., 2005; Morgan et al., 2018), but no studies have examined the relation to homicide-suicide. Firearm restrictions for violent offenders is another potential strategy, although the evidence for this approach is mixed. Several studies have found that restricting access to firearms for those under domestic violence restraining orders (Vigdor & Mercy, 2006) or for general violent offenses was associated with reduced intimate partner homicides (Zeoli et al., 2018). These reductions did not persist when limited to domestic violence offenses (Zeoli & Webster, 2010). Again, none of these studies examined homicide-suicide as an outcome so it is not clear if these policies would impact homicide-suicide deaths.

## Limitations

Although the NVDRS data has substantial strengths (e.g., large sample size, surveillance of violent deaths in many states), there are also some weakness inherent to secondary data analysis. First, available variables did not fully match the Marzuk and colleagues (1992) conceptualization for primary motives for homicide-suicide deaths, specifically missing retaliation and an explicit indication of extended suicide. Future analyses of the NVDRS may take advantage of the qualitative data available in narratives from law enforcement and medical examiners/coroners to assess these factors in more detail. However, this initiative would require substantial effort, as qualitative analyses rarely involve hundreds of incidents. Although the NVDRS data were, by far, the largest repository of data on homicide-suicide deaths in the United States, some of the primary motives were too infrequent to be used in analyses. In other instances, we may have had insufficient power to detect differences in contributing factors between firearm and non-firearm related deaths. This limitation further supports the use of qualitative data analyses to examine the NVDRS narratives.

There may also be some underlying bias types of information collected through the NVDRS data. The victim-perpetrator relationship and other characteristics of the homicide-suicide death may have influenced the extent to which law enforcement, medical examiners/coroners, and other sources of NVDRS investigate the contributing factors of the deaths. For example, homicide-suicide incidents involving older adults with well-documented health issues may have received less critical consideration than a mass shooting or other types of homicide-suicide incidents that receive substantial media and public attention.

## Conclusions

The overwhelming proportion of homicide-suicide deaths involving firearms supports the need for adequate, appropriate firearm control measures and lethal means restriction to prevent these tragedies. However, homicide-suicide incidents may be distinct from homicide and from suicide deaths so careful consideration and evaluation of intervention strategies may be necessary.

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ical examiners/coroners, and crime laboratories. The analyses, results, and conclusions presented here represent those of the authors and not necessarily reflect those of CDC. Persons interested in obtaining data files from NVDRS should contact CDC’s National Center for Injury Prevention and Control, 4770 Buford Hwy, NE, MS F-64, Atlanta, GA 30341-3717, (800) CDC-INFO (232-4636).

**Compliance with ethical standards**

**Conflict of interest** Laura M. Schwab-Reese and Corinne Peek-Asa declare that they have no conflict of interest.

**Human and animal rights and Informed consent** This article does not contain any studies with human participants or animals performed by any of the authors.

**Appendix: NVDRS variable definitions**

Other factors	Description from NVDRS
Jealousy	Jealousy or distress over a current or former intimate partner’s relationship or suspected relationship with another person led to the incident
Mercy killing	Victim was killed, at the victim’s request, out of compassion in order to end his/her pain or distress
Fight: argument	An argument or conflict led to the death
Fight: brawl	A mutual physical fight between three or more people
Fight: fight between two people	Immediately prior to the death, a physical fight between two people
Fight: intervener assisting victim	Victim intervened, other than a law enforcement officer
Stressor: disaster	Exposure to a disaster contributed to death
Stressor: loss of housing	Loss of housing, or threat of it, contributed to death
Stressor: financial problem	Financial problems contributed to death
Stressor: job problem	Job problem(s) contributed to death
Stressor: civil legal problem	Non-criminal legal problems contributed to death
Stressor: criminal legal problem	Criminal legal problems contributed to death
Stressor: school problems	Problems at or related to school contributed to death
Stressor: traumatic anniversary	Incident occurred on or near the anniversary of a traumatic event and contributed to death
Stressor: physical health	Physical health problem contributed to the death
Interpersonal stressor: family relationship	Relationship problems with a non-intimate partner family member contributed to the death
Interpersonal stressor: interpersonal violence perpetrator	Perpetrator of violence within the past month other than the incident that resulted in the death
Interpersonal stressor: interpersonal violence victim	Victim of violence within the past month other than the incident that resulted in the death
Interpersonal stressor: social network suicide death	Suicide of a family member or friend contributed to death
Interpersonal stressor: social network death	Death of a family member or friend due to something other than suicide contributed to death
Suicide: thoughts	History of suicidal thoughts, plans, or attempts
Suicide: intent disclosed	Disclosed thoughts/plans to commit suicide within the past month
Suicide: attempt	History of attempting suicide
Substance use: drug involvement	Drug dealing, drug trade, or drug use is suspected to have played a role in precipitating the incident
Substance use: substance abuse	Non-alcohol related substance abuse problem
Substance use: alcohol problem	Alcohol dependence or alcohol problem
Depressed mood	Perceived by self or others to be depressed
Mental health: mental health problem	Identified as currently having a mental health problem

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