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Suicide by Firearm Among Women: An Analysis of Ecological and Individual Correlates

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of

Philosophy in Social Welfare

by

Carol Art-Win Leung

ABSTRACT OF THE DISSERTATION

Suicide by Firearm among Women: An Analysis of Ecological and Individual Correlates

by

Carol Art-Win Leung

Doctor of Philosophy in Social Welfare

University of California, Los Angeles, 2020

Professor Mark S. Kaplan, Chair

Although firearm suicide is consistently higher among men than among women, the growing number of firearm suicides in women is a cause for concern. The purpose of this study is to understand the distal and proximal risk factors associated with firearm suicides rates and the choice of methods using ecological and individual-level data. First, the ecological study obtained state-level data from the U.S. American Community Survey (2017), Social Capital Project (2018), YouGov (2015), Behavioral Risk Factor Surveillance System (2017), and Centers for Disease Control and Prevention's Web-based Injury Statics Query and Reporting System (2017). A model using multivariate and stepwise regression analyses was developed to examine the complex relationship between firearm suicide rates and state-level characteristics among women. Second, the individual study obtained data from 32 states from the National Violent Death

Reporting System Restricted Access Database, 2012–2016. A multivariate logistic regression model was used to differentiate women who used firearms to complete suicide from those who used other methods. The results of the ecological study showed that states with higher rates of divorce, veterans, gun ownership, depression, and lower rates of accessing health care had significantly higher rates of firearm suicide among women. From the individual-level data, the presence of intimate partner problems, acute alcohol use, and loss of a family member by suicide prior to the time of death were significant predictors of an increased likelihood of firearm use among women. Suicides occurring in a rural area and the South were significantly more likely to involve firearms. Future research, clinical practice, and policy changes are discussed to address suicide prevention strategies. From a micro perspective, these discussions will center on improving social work services to identify risks among those who are suicidal for further assessment in health care and gender-specific mental health interventions. From a macro perspective, research using both population-level and individual-level data would help policymakers identify updated policies to prevent gun suicide.

The dissertation of Carol Art-Win Leung is accepted.

Todd Franke

Augustine Kposowa

Laura Wray-Lake

Mark S. Kaplan, Committee Chair

University of California, Los Angeles
2020

DEDICATION

This work is dedicated to those who lost their lives to suicide, those grieving the loss of a loved one by suicide, and those who have been or will be tempted to make premature exits from life.

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CURRICULUM VITA

EDUCATION

- 2011 M.S.S.W. Social Work, The University of Texas at Austin
- **B.A.** Psychology, Certificate in Business Foundation, The University of Texas at Austin

PUBLICATIONS

- **Leung, C. A.** (2020). Concerns about suicide among Asian Americans: The need for outreach? *Social Work*, 65(2), 114–122. https://doi.org/10.1093/sw/swaa006
- **Leung, C. A.**, Kaplan, M. S., & Xuan, Z. (2019). The association between firearm control policies and firearm suicide among men: A state-level age-stratified analysis. *Health and Social Work*, 44(4), 249–258. https://doi.org/10.1093/hsw/hlz028
- Cheung, M., & Leung, C. A. (2019). Social-cultural and ecological perspective. In R. Ow & A. Poon (Eds.), *Mental health and social work*. New York, NY: Springer.
- Kaskie, B., **Leung, C. A.**, & Kaplan, M. (2016). Deploying an ecological model to stem the rising tide of firearm suicide in older age. *Journal of Aging & Social Policy*, 28(4), 233–245. https://doi.org/1080/08959420.2016.1167512
- **Leung, C. A.** (2016). Translinguistic practice with Chinese immigrants in New York City: My social work experience in mental health. *Reflections: Narratives of Professional Helping*, 22(2), 9–16.
- **Leung, C. A.** (2015). Hakka cultural root: Metalinguistic awareness and practice principles. *International Social Work*, *58*(6), 802–812. https://doi.org/10.1177/0020872813503858

RESEARCH EXPERIENCE

2013-2014

2015-2016	Graduate Research Associate, UCLA Department of Social welfare
	Grant Title: Homicide Followed by Suicide (PI: Mark Kaplan, PhD)
2014-2016	Graduate Research Associate, UCLA Department of Social Welfare
	Grant Title: Economic Contraction and Alcohol-Related Suicides: A Multi-Level
	Analysis (PI: Mark Kaplan, PhD)
	Funded by: National Institutes of Health (NIH) and National Institute on Alcohol
	Abuse and Alcoholism (NIAAA) R01 AA021791
	Responsibilities: Performed data analysis using the National Violent
	Death Reporting System; produced GIS spatial analysis maps; assisted
	in NIAAA/NIH grant submission; reviewed and edited peer-reviewed journal
	articles prior to submission; assisted with annual report and final oral
	presentations
2014-2015	Graduate Research Associate, UCLA Department of Social Welfare
	Grant Title: Acute Alcohol Use in Youth Suicidal Behavior (PI: Mark Kaplan,
	PhD)

Graduate Student Researcher, UCLA Department of Social Welfare

Grant Title: Willingness of Parents to Medicate Their Child (PI: David Cohen, PhD)

SELECTED PROFESSIONAL PRESENTATIONS

- **Leung, C. A.,** & Kaplan, M. S. (2019, January). *Alcohol Involvement in Firearm-Related Suicides Among Young, Middle-Aged and Older Men.* Poster presentation at the 23rd annual conference of the Society for Social Work and Research (SSWR), San Francisco, CA
- **Leung, C. A., &** Kaplan, M. S. (2018, November). *Suicide in Late Life: Identifying and Addressing Risk Factors*. Oral paper presentation at the 70th annual scientific meeting of The Gerontological Society of America (GSA), Boston, MA.
- **Leung, C. A.**, Kaplan, M. S., & Xuan, Z. (2018, April). *The Impact of Firearm Control Measures on the Use of Guns Among Young, Middle-Aged and Older Suicidal Men.* Oral paper presentation at the 51st annual conference of the American Association of Suicidology (AAS), Washington, DC.
- **Leung, C. A.**, Boyd, D., & Kaplan, M. S. (2017, January). *Social Mistrust and Gun Ownership in the Obama Era: A Gender-Stratified Analysis of the General Social Survey.* Poster presentation at the 21st annual conference of the Society for Social Work and Research (SSWR), New Orleans, LA.
- **Leung, C. A.,** & Kaplan, M. S. (2016, April). *Firearm Suicides Among Older Adults: Why Do Gun Laws Matter?* Poster presentation at the 49th annual conference of the American Association of Suicidology (AAS), Chicago, IL.

PRACTICE EXPERIENCE

2011–2013	Psychotherapist (Post-MSSW, full-time), Flushing Hospital Medical Center-
	Psychiatry and Addiction Services, Flushing, New York
2010-2011	Social Work Intern, Austin Lakes Hospital, Austin, Texas
2009-2010	Social Work Intern. Asian Family Support Service of Austin. Austin. Texas

TEACHING EXPERIENCE

IEACIIIIIO	EXI EXIENCE	
Fall 2019	Lead Teaching Fellow, UCLA, Luskin School of Public Affairs	
	How Environments Shape Human Development	
Summer 2019 Instructor, UCLA, Luskin School of Public Affairs		
	How Environments Shape Human Development	
Spring 2018	Teaching Assistant, UCLA, Luskin School of Public Affairs	
	Adult Psychopathology	
Winter 2018	Teaching Assistant, UCLA, Luskin School of Public Affairs	
	Social Work Research Methods	

- Winter 2017 **Teaching Assistant**, UCLA, Luskin School of Public Affairs Diversity in Aging: Roles of Gender and Ethnicity
- Fall 2016 **Teaching Assistant**, UCLA, Luskin School of Public Affairs Foundations in Social Welfare Policy

CHAPTER 1: INTRODUCTION

Significance of the Study

Suicide is the 10th leading cause of death in the United States, and more than half (51%) of these suicides involve the use of firearms (Centers for Disease Control and Prevention [CDC], 2017). Although there is a growing divergence in firearm suicide rates between men and women across the lifespan, the increasing suicide rate among women, particularly those who complete suicide by firearm, is a cause for concern (Kaplan, Adamek, Geling, & Calderon, 1997; Kaplan, McFarland, & Huguet, 2009a). As the urgency to reduce firearm suicide rates has grown (Maa & Darzi, 2018), more research has focused on the high rate of firearm suicide among men (Scourfield, Fincham, Langer, & Shiner, 2012), while there has been relative silence on the study of suicide among women (Chaudron & Caine, 2004), specifically the use of firearms to complete suicide.

Although there are studies on gender differences in firearm suicide trends (Siegel & Rothman, 2016), the literature tends to overlook themes about suicidal women or develop hypotheses about women's suicidal behavior based on the experiences and behavior of men (Vijayakumar & Lamech, 2000). Thus, the field could benefit by not depicting suicide as predominantly a problem among men but also recognizing that suicide is also common among women. This research focuses on the complexity of gun violence in the United States and the rising suicide rates among women. Chapter 1 explores suicide as a preventable cause and explains the significance of firearm suicides and the choice of method to complete suicide among women across the lifespan.

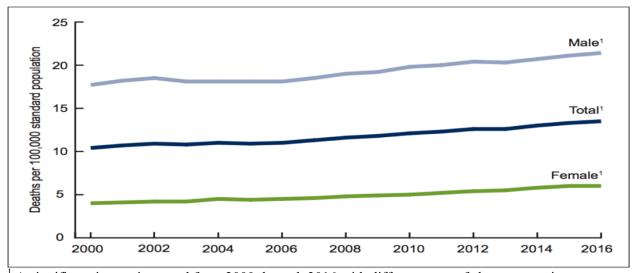
Suicide among Women

Suicide is a significant public health problem in the United States (Curtin, Warner, & Hedegaard, 2016; Goldsmith, Pellmar, Kleinman, & Bunney, 2002). The U.S. Surgeon General (U.S. Department of Health and Human Services, 2012) and the National Action Alliance for Suicide Prevention (2014) acknowledged suicide as a preventable cause of death and prioritized a research agenda to address the burden of suicide (National Research Council, 2005; Institute of Medicine, 2013; Stone et al., 2018). Although, suicide rates in the United States declined by 18% between 1986 and 1999 (Curtin et al., 2016; Hu, Wilcox, Wissow, & Baker, 2008), the suicide rate steadily rose across gender and age from 2000 to 2016 (see Figure 1) (Hedegaard, Curtin, & Warner, 2018). While suicide rates for women remained much lower than those for men, the pattern shows that the incidence of suicide has been rising among women in nearly all age groups (Steele, Thrower, Noroian, & Saleh, 2018) (Figure 2).

Before (2005 to 2006), during (2007 to 2009), and after (2010 to 2013) the economic contraction in the United States, the age-adjusted suicide rates among women increased by 2%, 1%, and 5%, respectively. This trend may reflect that women might have a delayed effect during financial strain and hardships (Kaplan et al., 2015). Moreover, between 2013 to 2018, the age-adjusted suicide rates among women continued to increase by 13% while among men, it only increased by 11%. This reflects an imminent need to reduce this preventable cause of death, especially when the increase in suicide is growing among women.

Furthermore, in 2014, suicide was the second, third, fourth, and seventh leading cause of death among women ages 20 to 24, 25 to 34, 35 to 44, and 45 to 54, respectively (CDC, 2017a; Curtin et al., 2016). In addition to the enormous emotional burden endured by people who have lost a loved one to suicide, the increase in suicides among women of working age also

contributes to an economic cost and lifetime cost (medical and work loss cost), which is estimated to be more than \$9 million and \$7 billion annually in the United States, respectively (CDC, 2016a; Shepard, Gurewich, Lwin, Reed, & Silverman, 2016). Because the burden of suicide falls most heavily on women of working age, the cost to the economy results almost entirely from lost wages and productivity (Shepard et al., 2016).



¹ A significant increasing trend from 2000 through 2016 with different rates of change over time, p < .001.

Source: Hedegaard, Curtin, & Warner (2018).

Figure 1. Age-Adjusted Suicide Rate, by Gender: United States, 2000–2016

Why Focus on Firearm Suicide Among Women?

The first reason to focus on women is that the rate of firearm suicide among women steadily increased from 1999 to 2016 by 23% and reached its highest level in 2016 since 1992 (CDC, 2017a). Nearly a third of women will use a firearm to complete suicide, and over 3,000 women will die by a firearm each year (CDC, 2017a). Unfortunately, firearm suicide among women remains a hidden problem, with few studies focusing specifically on the growing use of firearms among women (Adamek & Kaplan, 1996; Kaplan & Mueller-Williams, 2019).

Second, the most frequently used method to complete suicide among women is the use of firearms. It is important to note that, for women, the fraction of firearm suicide use (32.7%) is

similar to the fraction of poisoning (30.3%; CDC, 2017a). However, the lethality of firearms as a suicide method plays a more critical role in determining the chance of survival in a suicidal attempt (Shenassa, Catlin, & Buka, 2003; Spicer & Miller, 2000). In a recent study, Wang and colleagues (2020) highlight the growing risk of using highly lethal means among women. While the most common perception for women is that they are less likely to kill themselves with a firearm (Canetto & Sakinofsky, 1998), Miller, Azrael, and Hemenway (2004) found that the case fatality rate for firearms among women was as high as 85%, which is comparable to the case fatality rate for firearms among men (91%). In nearly all these documented cases, females who used a firearm to attempt suicide typically die (Cibis et al., 2012; Shenassa et al., 2003). Due to the high lethality of firearms, firearms provide fewer opportunities for intervention between the suicidal act and the time of death, resulting in a significantly decreased chance for seeking potential help (Cantor & Baume, 1998; Choi, DiNitto, Marti, Kaplan, & Conwell, 2017). Ultimately, examining firearm suicide among women will dispel the myth that women are less likely to use firearms to complete suicide.

Third, the presence of a firearm in a home is frequent in the United States, with more than one-third of households owning a firearm (Miller & Hemenway, 2008). Numerous research studies have shown that firearm accessibility and availability is associated with an elevated risk of suicide in the United States. In a case-control study design, those who had access to purchase a handgun in the past three years were more likely to die by suicide compared to the control group who died by a noninjury method. In one study, women who purchased a firearm in the past three years were notably more likely (odds ratio [OR] = 33.9) to die by suicide (Grassel, Wintemute, Wrights, & Romero, 2003). According to Siegel and Rothman (2016), suicide rates are higher among states with a higher prevalence of household firearm ownership. They also

found that the increased firearm ownership rate is associated with an increased firearm suicide rate among men and women. While risk varies by storage practice, type of gun and the number of guns in the home, individuals with firearms in their homes have a significantly higher risk for suicide than those without firearms (Dahlberg, Ikeda, & Kresnow, 2004).

Fourth, women represent a growing segment of firearm owners compared to two decades ago (Wolfson, Azrael, & Miller, 2018). Although men consistently have higher gun ownership rates, Wolfson et al. (2018) reported that women who own a firearm represent 27% of all gun owners in the United States. The gun ownership rate among men has been declining and that the gender gap in gun ownership is changing. Furthermore, Azrael, Hepburn, Hemenway, and Miller (2017) found that gun ownership among women increased from 9% to 14% from 1994 to 2015, a 36% increase within 21 years. In general, higher prevalence rates of firearm ownership may explain a higher risk of fatal suicide attempts.

Fifth, researchers must find effective means to reduce preventable deaths, particularly among women (Yip et al., 2012). Studies have found that reducing access to the most lethal methods such as firearms can reduce the high rate of suicide (Mann et al., 2005; Mann & Michel, 2016). Thus, policy-based strategies for preventing firearm suicides in the United States may reduce suicide rates among women. For example, the use of more restrictive firearm laws was strongly associated with a lower suicide rate among women and men (Fleegler, Lee, Monuteaux, Hemenway, & Mannix, 2013; Kposowa, Hamilton, & Wang, 2016). While population-level studies have shown that limiting access is the most effective way to reduce suicide, Baumert, Erazo, Ruf, and Ladwig (2008) suggested that future studies should focus on the individuals' correlates and circumstances by sex and age to develop suicide prevention campaigns aimed to reduce suicide rates. A study examining risk factors associated with suicide found that suicidal

individuals have faced a variety of life stressors and crises before completing suicide. However, firearm suicide decedents did not seek help for a mental health or substance abuse problem than those who used other methods (Kaplan et al., 2009a).

The Choice of Methods Matters

The method used in a suicide attempt is a critical element that may provide cues for understanding the pathway to suicides among women. The choice of method is a complex interaction of social (Callanan & Davis, 2012), cultural (Canetto, 1992, 2008), psychological (Boggs et al., 2018; Sher, Oquendo, & Mann, 2001), environmental (Hirsch & Cukrowicz, 2014), and physical/biological (Matthews et al., 2013; Van Heeringen, 2012) factors that precede individuals' decisions to complete suicide (Cantor & Baume, 1998; Kanchan, Menon, & Menezes, 2009). The choice of method depends largely on social acceptability (cultural norms and environmental influences) (Canetto & Sakinofsky, 1998), availability and accessibility, and lethality (Elnour & Harrison, 2008). It is also linked with the individual's intent of dying, disfigurement, and the impulsivity of the suicidal individual (Lester, 1998). Most research predominantly has focused on gender differences in the choice of a method (Callan & Davis, 2010; Denning, Conwell, King, & Cox, 2010; Kanchan et al., 2009) but not on issues exclusively associated with women. Further discussions on gendered behaviors can provide a more in-depth analysis of targeted prevention and intervention strategies for women (McKay, Milner, & Maple, 2014).

Lethality of Firearms

The increase in the suicide rate among women across the age span in the past decade suggests that a fraction of these deaths may be attributable to an increase in access to certain lethal methods such as firearms (Fowler, Dahlberg, Haileyesus, & Annest, 2015; Sullivan,

Annest, Luo, Simon, &, Dahlberg, 2013). While the most frequently used method among women switches between poisoning and firearms, the lethality of method plays a central role in whether an individual survives an attempt. Numerous researchers have found that the lethality of method plays a critical role in whether an individual survives a suicidal attempt (Shenassa et al., 2003; Spicer & Miller, 2000). Spicer and Miller (2000) found that the most lethal and effective method of suicide was firearms (82.5%), followed by drowning (65.9%) and then suffocation and hanging (61.4%), while the least lethal methods were drug overdose and poison ingestion (1.5%), followed by cutting and piercing (1.2%). More violent and lethal methods of suicide provide fewer opportunities for intervention between the suicidal act and the time of death, resulting in a significantly decreased chance for individuals to reconsider their decision or seek potential help (Cantor & Baume, 1998; Choi et al., 2017). Consequently, since 2016, the most lethal method, such as firearms, has become the most frequently used method among women (CDC, 2017a). Thus, studying the choice of a firearm as a suicide method and comparing it to other methods can help researchers find ways to reduce suicide among women.

Gendered Behaviors and the Socialization of Cultural Norms

Gendered behaviors and the socialization of cultural norms are significant factors affecting women and men differently in determining their choice of suicide methods (Canetto, 2008). A study examining the perceptions of gender differences found that suicide methods are stereotypically "male" if they are lethal (firearms, hanging, and jumping from a bridge), whereas stereotypically "female" methods are less lethal (drowning, overdosing, and poisoning) (McAndrew & Garrison, 2007). Furthermore, Canetto (2015) found gendered patterns and meanings in suicide in traditional gender roles and cultural norms that discouraged women from suicide. Women are more likely to have adaptive coping skills, including seeking social and

emotional support, and to seek help from a physician related to their mental health (Hawton, 2000). In terms of cultural norms, women who die by suicide are judged more negatively and are less culturally accepted because suicide is viewed as a masculine act (Canetto, 2008).

The findings on the increasing use of firearms among women contradict the cultural assumptions and norms that women would not exhibit masculine behaviors of using lethal methods (Canetto, 1992). Recently, Moore, Taylor, Beaumont, Gibson, and Starkey (2018) discovered that the suicide rates among women and men converged when working-class women participated in the workforce and became breadwinners during the industrialization period in the 19th and early 20th centuries. Their findings suggested that women who had taken on traditionally masculine roles, such as being the breadwinner of the family, would have suffered from a heightened level of stress that could be linked to suicide. Nevertheless, their research also supported the notion that "gender differences in suicide rates are the product of complex interactions between traditional and prevailing norms and expectations around gender" (Moore et al., 2018, p. 8). In other words, the interaction between traditional gender roles and cultural shifts may play a salient role in the patterns of suicide. The exploration into the changing culture and reasons women choose a specific method to complete suicide is critical for reducing the rising suicide rates among women.

Impulsivity and Related Factors

Impulsivity is one factor that can have a crucial impact on completed suicides (Clarke, 2017; Simon et al., 2001). Impulsivity can be broadly defined as a "predisposition toward rapid, unplanned reaction to internal or external stimuli without regard to the negative consequences of these reactions" (Dvorak, Lamis & Malone, 2013, pp. 327; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). However, there are inconsistencies in how impulsivity is defined and

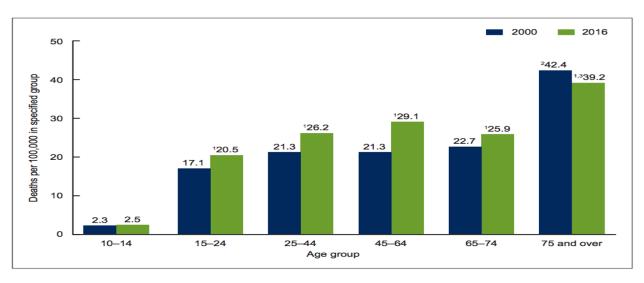
operationalized (Dick et al., 2010). To resolve this ambiguity, researchers have proposed a conceptualization of impulsivity which includes "situational impulsivity" (Kattimani, Sarkar, Rajkumar, & Menon, 2015) and impulsivity based on personalities (Whiteside & Lynam, 2001).

There is evidence that the patterns of impulsivity may be linked to personality or stressful life events. As an example, a psychological autopsy using 164 suicide cases found that impulsive suicide completers were more likely to have a history of childhood abuse and experienced a stressful life event preceding death (Zouk, Tousignant, Seguin, Lesage, & Turecki, 2006). Additionally, Kattimani and colleagues found that impulsive suicide attempters may be more predisposed to difficult life events and interpersonal problems (Kattimani et al., 2015). Other studies have discussed the association between suicide and impulsivity in terms of personality traits. Impulsive personalities such as aggressive behaviors were associated with suicide, particularly using more violent choice of methods (Dumais et al., 2005). Together, these results suggest that the measure of impulsivity can be described as either "situational impulsivity" or impulsivity based on personalities, each of which may be a pathway to impulsive behavior.

Availability and Accessibility of Firearms

The choice of suicide methods is influenced by availability and accessibility (Kanchan et al., 2009). Numerous studies have found that restricting the availability of specific methods plays a significant role in the choice of suicide methods and is the most effective way to decrease suicide rates. Examples of these restrictions are the detoxification of domestic gas (Lester, 1990) and the placement of barriers that prevent people from jumping at popular suicide sites (Beautrais, 2001). In one particular study, Yip and colleagues (2010) examined whether the restriction of charcoal using a controlled trial could prevent suicide from carbon monoxide by

charcoal burning in Hong Kong. Indeed, they found that means restriction played a significant role in reducing rates of carbon monoxide suicide by charcoal burning, but it also reduced the overall suicide rate by 5.7%, suggesting that the population was less likely to substitute charcoal burning with another choice of method. Notably, these findings suggest restricting means of suicide does not mean removing the method entirely from the economic market but rather intervening by placing barriers to obtaining lethal quantities of the choice of method for selfdestruction (Yip et al., 2010). In another study, Crifasi, Meyers, Vernick, and Webster (2015) found that firearm legislation represents another avenue of means restriction. The effects of the permits to purchase (PTP) laws in two states showed that the presence of the PTP law in Connecticut was associated with a 15.4% reduction in firearm suicide rates. In contrast, the absence of Missouri's PTP law was associated with a 16.1% increase in firearm suicide rates. To complement this research, a study examined the independent association of 25 laws associated with the reduction of suicide and homicide by firearms (Kalesan, Mobily, Keiser, Fagan, & Galea, 2016). Their findings showed that firearm identification laws significantly decreased firearm-related suicides, implying that the enactment of such laws could be strengthened to reduce firearm suicides (Kalesan et al., 2016). Overall, when the preferred choice of method is restricted or not accessible, the suicidal individual may defer the attempt to a less lethal method. If the subsequent choice of method is less lethal, there will be a greater opportunity to intervene, which increases the chance of survival compared to those who used highly lethal methods. The first attempt by a firearm, for example, will likely result in death (Anestis, 2016).



¹ Significantly higher than 2000 rate, p < .05.

Source: Hedegaard, Curtin, and Warner (2018).

Figure 2. Suicide Rate for Females, by Age Group: United States, 2000–2016

Two-Step Study Design

The choice of suicide methods is not random (Cantor & Baume, 1998), especially the use of firearms among women. Firearms have remained the most common suicide choice of method among women in the past five years (CDC, 2017a). For understanding the impact of guns and suicide among women, two different types of tools are frequently used among researchers. Ecological studies examine the associations between aggregate variables at a higher level of analysis (e.g., the proportion of suicide by firearms by states) especially when the incident is rare (Levin, 2006); individual-level studies examine the "exposures and responses of systems with individuals" (Greenland, 2001). Both of these approaches are useful to inform policymakers and practitioners on creating strategies for suicide preventive intervention and programs. However, these approaches come from different angles, and some findings from ecological studies have been in the opposite direction from individual studies (Ramchand, 2017). Ecological bias occurs because aggregate data cannot be characterized by with-in group variability (Haneuse &

² Significantly higher than rates for all other age groups in 2000, p < .05.

³ Significantly higher than rates for all other age groups in 2000, p < .05.

Wakefield, 2008). To overcome the ecological bias problem, supplementing ecological data with individual-level using the two-step study design could provide accurate measures to uncover significant suicide patterns by firearms (Agerbo, Sterne, Gunnell, 2007; Wakefield & Haneuse, 2008).

This study will evaluate the combination of state and individual-level data to gain a more comprehensive view of suicide and firearms, explicitly investigating the associations between state and individual-level risk factors with the rate of firearm suicides and the choice of methods, respectively. First, using the 2017 CDC's Web-based Injury Statics Query and Reporting System (WISQARS), this study will evaluate the distal risk factors associated with firearm suicide rates among women across 50 states. Second, individual-level data from 2012 to 2016 are analyzed to understand the proximal risk factors associated with a firearm and nonfirearm suicides among a large sample of women drawn from 32 states using the National Violent Death Reporting System (NVDRS). Because of the high lethality associated with firearm suicide compared to nonfirearm suicide (Appleby, 2000), the individual-level data aims to compare the differences in sociodemographic, psychological, sociological, and substance misuse between firearm users and nonfirearm users among women who died by suicide.

Summary of Chapter 1

Chapter 1 provides the rationale for conducting a study on the female suicide phenomenon and how the choice of method matters, especially the use of firearms. This chapter explains that the relationship between firearm suicide and women is significant to study because of the (a) growing use of firearms among women, (b) availability and accessibility of guns, and (c) urgency to find effective means to reduce suicide rates. Based on these factors, the current study

aims to examine the complexity and importance of understanding firearm suicide among women from the results of a two-step analysis of state-level and individual-level data. This study aims to:

- assess the associations between state-level factors and firearm suicide rate across 50 states; and
- 2. examine the differences in demographic, psychological, sociological, and substance misuse factors between a firearm and nonfirearm suicides among women.

The following chapter describes the research foundations, including the development of the conceptual model and literature review.

CHAPTER 2: RESEARCH FOUNDATION

Literature Review

This chapter provides a more detailed review of the literature, including how firearm suicide is generally seen in existing research and, when possible, how it relates specifically to women. This section will discuss factors associated with firearm suicide, including socioeconomic factors, social capital, gun culture, and health-related risk factors. The chapter will also describe other variables such as demographic characteristics, mental health, suicidal event/history, relationship problem and loss, substance misuse risk factors of firearm suicide, and the choice of methods among women.

Choice of Methods

The choice of methods in suicide typically includes firearms, cutting, poisoning by carbon monoxide (Denning et al., 2000), hanging (Parks, Johnson, McDaniel, & Gladden, 2014), jumping from high places (Liu, Kraines, Puzia, Massing-Schaffer, & Kleiman, 2013; Ojima, Nakamura, & Detels, 2004) or jumping in front of moving vehicles (Lin & Gill, 2009), self-poisoning by drugs (Braden, Edlund, & Sullivan, 2017), and suffocation (Hempstead & Phillips, 2015). In particular, Hempstead and Phillips (2015) found that the choice of method matters during economic recessions and found that poisoning was the most commonly used method when personal, interpersonal, and external circumstances were present. On the other hand, the CDC (2017) reported that before 2013, drug poisoning was most frequently used; however, more women choose firearms to complete suicide. In 2017, the most commonly used method among women included firearms (31.2%), followed by suffocation (27.9%), drug poisoning (27.7%), nondrug poisoning (3.7%), fall (3.1%), drowning (1.7%), and cutting (1.6%). Despite the widespread belief that women use less lethal methods (Denning et al., 2000), patterns show that

the firearm suicide rate among women steadily increased by 21.5% from 1999 to 2017. Reducing highly lethal methods and conventional suicide methods has been associated with a reduction in suicide rates of 30% to 50% (Barber & Miller, 2014). This evidence underscores the importance of understanding method-specific trends in women, especially firearms, and finding prevention efforts to mitigate the use of highly lethal methods.

Gender Differences in Choice of Methods

In the current literature, a wide range of explanations has been proposed on why women and men choose different methods of suicide and usually are attributed to three reasons (Cantor & Baume, 1998; Denning et al., 2000). One of the primary reasons for the gender difference is the lethality of suicide methods chosen by men (Fisher, Overholser, & Dieter, 2015). Generally, compared to women, men are more likely to use lethal methods, have a higher completion rate of suicide, and attempt suicide with firearms. Women, on the other hand, are more likely to use both firearms and self-poisoning. For instance, Kposowa and McElvain (2006) found that women were 73% less likely to use firearms and were four times more likely to die from drug poisoning than men. However, Kposowa and McElvain (2006) described that a considerable number of women continue to use a firearm to complete suicide. The male-female gap in suicide mortality may partly be closing because women are using more lethal methods to complete suicide.

Second, findings on the method choice in suicidal intent differ among women and men. In an earlier psychological autopsy study, Rich and colleagues suggested that women use less lethal methods because they are less intent on dying than men (Rich, Ricketts, Fowler, & Young, 1988). Other researchers have contended that females and males reported identical intent on dying by suicide (Canetto & Sakinofksy, 1988; Denning et al., 2000; Nordentoft & Branner,

2008), even when women use less lethal methods. Similarly, Nock and Kessler (2006) found that while men are more likely to die by suicide than women because of their lethal method, the intent to die by suicide is approximately equal when women and men attempt suicide. Recently, Jordan, Samuelson, and Tiet (2019) have tested the interpersonal theory of suicide (Joiner, 2005) and found that among men and women, the repeated exposure to painful and provocative events was a significant predictor of suicide intent.

Third, cultural roles and social norms and practices impact the method choice in suicide among women and men. The traditional male gender norms are associated with power and dominance. Men typically exhibit courage, independence, rationality, and competitiveness while minimizing any vulnerability and weakness. Generally, men's emotional expressions are concealed, except for aggression and anger. These characteristics are often termed "masculine" (Canetto & Lester, 1998; Möller-Leimkühler, 2003).

In contrast, the traditional female gender role is characterized as fragile, emotional, expressive, and family-oriented. These social-cultural characteristics are frequently described as "femininity" (Möller-Leimkühler, 2003). Canetto and Lester (1998) suggest that these gender stereotypes and social characteristics play a dominant role in deciding suicide "scripts" and choosing specific methods. For example, men who use lethal suicide methods may be seen as asserting their masculinity by being strong and capable of completing the act. However, women are perceived to only "cry for help and not be motivated to die," thus using less lethal methods. Studies have suggested that suicide is thought to be triggered differently based on gender norms. As an example, females in Canada and the United States are usually triggered by interpersonal problems such as relationship losses and in response to abandonment (Canetto, 2008).

On the other hand, male suicide is seen as a reaction to problems such as financial difficulties and physical health problems (McAndrew & Garrison, 2007). In other words, females are perceived as more "feminine" and more likely to internalize crises by becoming depressed, dependent, and passive, while men usually assert their independence and physical ability in handling crises (Canetto & Lester, 1998; Jaworski, 2010; Stephens, 1995). More broadly, Canetto (2008) suggests that cultural acceptability plays a vital role in the method choice for suicide regardless of gender. When the choice of method is more acceptable and accessible in one subgroup, the suicide rate by that particular choice of method will be higher.

Another study used data from the National Violent Death Reporting System to examine significant differences between a firearm and nonfirearm suicides among women and men. Female firearm decedents were more likely to be married, White, and veterans living in the South and Pacific regions than nonfirearm suicide decedents (Kaplan et al., 2009a). Moreover, the study found that women who used a firearm were more likely than nonfirearm users to have experienced an acute crisis the week before the completed suicide, the death of a relative or a friend, relationship problems, and reported being depressed. Nevertheless, the data in Kaplan et al. (2009a) used 17 states, and without examining more recent data throughout the country, it would be hard to examine female-focused and gender-targeted intervention strategies.

Risk Factors Associated with Suicide and Firearm Suicide

The risk of women completing suicide involves a complex combination of psychological (Brockington, 2001; Seeman, Reilly, & Fogler, 2017), sociological (Mallon, Galway, Hughes, Rondón-Sulbarán, & Leavey, 2016), sociocultural, demographic, and substance misuse risk factors (Kung, Pearson, & Liu, 2003). Increasing evidence has shown that psychiatric illnesses (Crump, Sundquist, Sundquist, & Winkleby, 2014), physical health problems (Crump et al.,

2014), life stressors such as the loss of a spouse, social isolation, and functional impairment are factors associated with suicide risk among women (Chen & Roberts, 2019).

Socioeconomic Factors

Studies that focused on population risk tended to examine the relationship between county-level poverty and suicide rates. For example, epidemiological studies have shown that adult suicide deaths are associated with communities that fall in highly concentrated areas of poverty (Kerr et al., 2017; Iemmi et al., 2016; Rehkopf & Buka, 2006). This suggests that prevention programs should be targeted in geographical poverty areas to reduce high suicide risk. Kerr et al. (2017) also found that during economic downturns, poverty may play a more significant role in suicide rates than unemployment. Furthermore, Smith and Kawachi (2014) found that states with higher poverty rates had lower rates of suicide rates. On the contrary, Andres (2005) found no correlation between suicide and poverty rates. However, the association of poverty with firearm suicide among women is not well understood at the state level.

Social Capital

Social capital is generally defined as the collective value of social networks and norms of mutual aid and reciprocity (Putnam, 2000). A variety of studies have reported that an increase in the social capital of a population reduces the rate of suicide (Kushner & Sterk, 2005; Recker & Moore, 2016; Smith & Kawachi, 2014). A study (Kelly, Davoren, Mhaoláin, Breen, & Casey, 2009) from Europe found that higher levels of social capital were correlated with lower rates of suicide among 11 European countries, while another found that more social capital and higher levels of trust are associated with lower suicide rates (Helliwell, 2007). According to Smith and Kawachi (2014), White women and men in states with a higher level of social capital had significantly lower suicide rates when controlling for other confounding factors. They found that

community organizations and group membership were strongly associated with lower suicide risk when examining other dimensions of social capital.

While studies have examined the link between social capital and state-level suicide rates (Kushner & Sterk, 2005; Smith & Kawachi, 2014), only a few have shown the correlation between measures of social capital and suicide (Hemeway, Kennedy, Kawachi, & Putnam, 2001; Rosenfeld, Baumer, & Messner, 2007). Fewer studies have explicitly examined the measures of social capital and firearm suicide over large geographic areas.

Patterns of Gun Ownership and Firearm Suicide

Compared to other developed countries, the United States has been ranked the highest in its firearm ownership rate, 120.5 firearms per 100 residents (Karp, 2018). Firearms are present in approximately 38% of all households, indicating at least one firearm is owned by every adult (Hepburn, Miller, Azrael, & Hemenway, 2007; Karp, 2018). Most gun owners (67%) reported that personal protection is the primary reason for ownership (Parker, Horowitz, Igielnik, Oliphant, & Brown, 2017). Although firearms can sometimes provide safety for their owners, firearm ownership benefits are debatable (Hemenway, 2011). Hemenway (2019) states that approximately 90% of firearm suicides occur in households that own a gun, which may suggest a higher chance of dying by suicide with a firearm.

Evidence from numerous studies reported that the high rate of firearm suicides is mainly attributable to gun ownership rates in the United States (Kaplan & Geling, 1998; Miller, Lippmann, Azrael, & Hemenway, 2007). As an example, Miller, Warren, Hemenway, and Azrael (2013) reported that firearm suicide rates are higher in states where the prevalence of household firearm ownership is high. To add to this finding, Siegel and Rothman (2016) found that the increased prevalence of firearm ownership is associated with an increased rate of firearm

suicides among females and males. Similarly, using pooled cross-sectional time-series data from 10 years, women who lived in states with fewer firearms were less likely to die by firearm suicides after controlling for poverty and urbanization (Miller, Azrael, & Hemenway, 2002b). In addition, Miller et al. (2007) found that the rate of gun ownership and the firearm suicide rate was highly associated among both male and female adolescents and adults across the lifespan. Most recently, Studdert and colleagues (2020) estimated the relationship between handgun ownership and suicide deaths in California among men and women. They found that women who owned a handgun were 35 times as high to die by firearm suicide compared to women who did not own handguns (hazard ratio, 35.15; 95% CI, 29.56 to 41.79) (Studdert et al., 2020). Overall, women who lived in states with higher gun ownership rates were more likely to die from firearm-related suicides (Miller, Azrael, & Hemenway, 2002a).

Two case-control studies (Anglemyer, Horvath, & Rutherford, 2013; Dahlberg et al., 2004) have noted that the higher risk of suicide in homes involving the use of firearms applies not only to those who own a firearm but also to the spouse and children of the gun owners (Hemenway, 2019). In one study, women with firearms in the home were at an elevated risk of suicide than those without guns in the home, even though the difference was more significant for men (Dahlberg et al., 2004). Moreover, suicide decedents who lived in a home with a firearm were 30 times more likely to have used a firearm than other methods (Dahlberg et al., 2004). The presence of a gun in the home substantially increases all individuals' probability of completed suicide, regardless of urbanization, poverty, education, alcohol use, unemployment, marital status, depression, and suicide ideation and attempts, including women who live in the household of gun owners. Similarly, Stroebe (2016) found that having guns at home increases the risk of suicide involving a gun three times as much as those without guns in the home. Thus, the

availability of a firearm in the home is a critical and essential risk factor for suicide completion (Hemenway, 2014; Kellermann et al., 1992; Miller & Hemenway, 2008).

The increasing rate of firearm suicide among women could be because women represent a growing segment for gun ownership (Wolfson et al., 2018). The Pew Research Center (2013) reports that the gun ownership rate among women increased from 12% in 2013 to 22% in 2017 (Horowitz, 2017; Parker et al., 2017). A recent study by Wolfson et al. (2018) found that men and women who own guns are similar in many demographic characteristics, including age, race, U.S. region of residence, and whether they live with a child under the age of 18. In contrast to men, women are more likely to own a gun if they are not married (7.4% vs. 14.6%). In addition, household income plays a more salient factor in gun ownership among women as they are somewhat poorer than male gun owners and are more likely to live in rural areas than men. Women have reported similar reasons for owning firearms as men (e.g., self-protection and hunting). However, efforts to reduce access to firearms among women should be given more attention because the prevalence of women (28.9%) storing firearms loaded and unlocked is higher than it is for men (22.9%). While male and female gun owners vary in ways that affect firearm-related decision making and behavior, understanding gender differences can inform public policy regarding firearms.

Gun Culture

As firearm use is becoming more common among women, the symbolism and culture of firearm use among women are socially evolving across the United States. Studies have shown a strong association between social gun culture and gun ownership rates (Kalesan, Villarreal, Keyes, & Galea, 2015), which supports the examination of their indirect impact on the high rate of firearm suicide. In their study, social gun culture was measured using four questions that

ascertained whether an individual's social circle thinks less of them if they did not own a gun, the family thinks less of them for not owning a gun, social life with family involves a gun, and social life with friends involves guns (Kalesan et al., 2015). Ultimately, Stroebe (2016) suggests that there is a need for a culture change in attitudes toward guns if we want to reduce the high rate of firearm-related deaths, including firearm suicide.

The lack of interpretation in the patterns of women who use firearms to complete suicide has yet to be explored. Firearms were considered a "masculine" weapon for men, but in the past few decades, the use of firearms has been more accessible and acceptable among women (Canetto, 2008; Canetto & Lester, 1998; Canetto & Sakinofsky, 1998; Kõlves, McDonough, Crompton, & De Leo, 2018). The growing preference for firearms may be evidence of the masculinization of suicidal behaviors among women (Hamilton & Kposowa, 2015). With the increased prevalence of firearms in the home (as high as 43% of Americans own a gun) (Gallop, 2018), the risk of suicide is high. Personal values underlying firearm ownership should not impede firearm suicide prevention. By collaborating with gun owners and non–gun owners to craft mutually relevant messages that encourage ways to reduce suicide, it is possible to work toward a common goal to reduce the diseases of despair (Case & Deaton, 2017).

Although gun ownership rates are higher among men than among women, this traditional gender gap may be closing due to advances in modernization, including greater female labor force participation and greater overall gender equality (Kposowa & McElvain, 2006). Studies have suggested that women's participation in the labor force can produce benefits, including independent access to a primary source of income, social support, and opportunities for self-esteem, that are not found in unpaid domestic work (Payne, Swami, & Stanistreet, 2008; Stanistreet, Swami, Pope, Bambra, & Scott-Samuel, 2007). However, the burden of combining

"double roles" (paid and unpaid work) may lead to increased health problems (Väänänen et al., 2005). As gender roles change, with women having an increase in work responsibilities, the probability of stress related to unpaid work, such as housework, childcare, and eldercare responsibilities, contributes to them experiencing more stress than men (MacDonald, Phipps, & Lethbridge, 2005).

Because of the high gun ownership rate (Miller et al., 2007) and fewer gun control laws in the South and Mountain regions of the country (Fleegler et al., 2013), firearms are a convenient, popular, and socially acceptable means for suicide in these locations (Kaplan, Huguet, McFarland, & Mandle, 2012). More studies have addressed the strategies of reducing firearm access in the general population (Kposowa, 2013; Kposowa et al., 2016; Miller, Azrael, Hepburn, Hemenway, & Lippman, 2006). While gun control policies are practical tools to reduce firearm suicide rates (Ghiani, Hawkins, & Baum, 2019), differences in cultural acceptance and attitudes about guns within states that are more ideologically conservative may pose a challenge in enacting stricter firearm control policies. Some states have already made significant progress in reducing the rate of firearm suicide. In 2014, California enacted the Gun Violence Restraining Order (GVRO) in response to the Isla Vista mass shooting. The GRVO allows family members, significant others, and law enforcement to request that the court confiscate firearms belonging to individuals who may hurt themselves (Ward, 2015). Recent data show California has one of the strictest firearm control policies and one of the lowest firearm suicide rates in the country. Thus, the effectiveness of gun control policies in California could be a potential model for other states to follow (Kaskie, Leung, & Kaplan, 2016).

Health Indicators

In the United States, mental health and substance use disorders continue to be a major cause of mortality. In 2015, more than 27 million people in the United States reported that they used illicit drugs or misused prescription drugs, and more than 66 million reported binge drinking during the previous month (U.S. Department of Health and Human Services, 2016). Compared to other causes of mortality (infectious diseases), rates of suicide, drug overdose, and chronic liver disease, which is a marker for alcohol misuse, have increased during the past 15 years (Hopkins, Landen, & Toe, 2018). Furthermore, early diagnosis and appropriate access to services for individuals with suicide risk factors can play a crucial role in saving lives.

Substance Misuse Risk

It is well known that alcohol dependence is highly associated with suicide (Cavanagh, Carson, Sharpe, & Lawrie, 2003; Wilcox, Conner, & Caine, 2004). Recent studies have also identified that acute alcohol intoxication is a salient suicide risk factor (Caetano et al., 2013; Cherpitel, Borges, & Wilcox, 2004; Conner et al., 2014; Kaplan et al., 2012). Generally, men have higher rates of alcohol dependence and acute intoxication at the time of death; however, Kaplan et al. (2012) found that a sizable proportion of female suicide decedents (17%) were also intoxicated at the time of the death. Most research on alcohol use and suicide has focused on suicidal ideation or attempted suicide instead of completed suicide, precisely because of the methodological difficulties of investing completed suicides (Borges et al., 2017). Moreover, research has examined the role of substance use in completed suicides among women; however, these studies have yielded mixed results. One study by Wilcox et al. (2004) reported that substance use was more pronounced among women than men who completed suicide. On the other hand, substance use was not common among female suicides (Schneider et al., 2006). Furthermore, the CDC (2016) reported 42,000 opioid-overdose fatalities, including an unknown

number of suicides. However, in suicides with opioid overdose, it is difficult to ascertain the manner of death given the underreporting of opioid-overuse death as suicide (Oquendo & Volkow, 2018). Nevertheless, various questions about the relationship between substance use disorders and suicide remain open, indicating directions for future research.

Moreover, studies have documented the predictive role of binge drinking and firearm suicide. Individuals who die from firearm suicide commonly have consumed alcohol before death in large quantities (Branas, Han, & Wiebe, 2016; Wintemute, 2015). According to Wintemute (2015), approximately 8.9 to 11.7 million firearm owners binge drink in an average month. The evidence from Wintemute (2015) shows that alcohol misuse and firearm access increase the risk of suicide.

Similarly, Conner and Bagge (2019) found that acute use of alcohol was commonly present among those who died by suicide and is a potent proximal risk factor for suicidal behavior. The higher the amount of alcohol is consumed, the higher the risk of lowering inhibition and promoting suicidal thoughts (Conner & Bagge, 2019). Another study documented that, in comparison with abstinence, the estimated risk for suicide associated with the presence of acute use of alcohol increases up to 90 times, which is defined as the use of alcohol within 3 hours, or within 6 hours of suicidal behavior, or any blood alcohol concertation in an individual who died by suicide (Borges et al., 2017).

Another study (Conner et al., 2014) documented that alcohol use before suicide was present among those who used firearms to complete suicide (35%) compared with other choices of methods such as hanging (36.8%) and poisoning (32.7%). However, this study examined patterns of individual-level data and not statewide data. While binge drinking typically has focused on youth and young adults, binge drinkers across the age span have higher odds of completing

suicide. Moreover, alcohol consumption, including binge drinking, may make the impulsive and painful act of using a firearm to complete suicide easier for an individual. Specifically, a study using the National Survey on Drug Use and Health data examined the association between binge drinking and suicidal attempts across sex and found that binge drinking had a higher likelihood in women (OR = 1.37) with suicidal behavior compared to males (Kittel, Bishop, & Ashrafioun, 2019).

Access to Health Care

Researchers have highlighted the increased burden of suicide among vulnerable populations, such as those who have difficulty accessing health care, including the stigma, cost, and the disorganization of mental health services (Goldsmith et al., 2002; Tondo, Albert, & Baldessarini, 2006). Furthermore, the literature highlights low access to health care among those with the risk of suicidal behavior (Miller & Druss, 2001). For instance, Miller and Druss (2001) found that suicide decedents are three times more likely to have difficulties accessing health care than people who die of other causes. The barriers to accessing health care for this group are difficulty paying for medical bills, difficulty getting into a treatment facility, and problems finding a physician. A study that examined firearm suicide rates and behavioral health workforce capacity found that across all states, holding all variables constant, a 10% relative increase in behavioral health workers per state would be associated with a 1.2% reduction in the adjusted firearm suicide rate. While there is a small effect on firearm suicide, this finding is consistent with state-level suicide rates concerning difficulty accessing health care. Undoubtedly, ensuring adequate healthcare access and use is imperative to suicide prevention, especially given the number of individuals who access primary care months before suicide (Ahmedani et al., 2014; Owens, Lloyd, & Campbell, 2004). Unmet health needs, including that of mental health, are a

critical component of access to care, as further highlighted by the literature (Stene-Larsen & Reneflot, 2019), and can lead to preventable disability and mortality.

Psychological Risk Factors

From a psychological point of view, one of the key drivers of completed suicide involves factors such as mental health problems and suicidal ideation, plan, and attempts. Studies have shown that mental health problems and suicidal behaviors are associated with firearm suicide.

Mental Health Problems

Having a mental health problem is a risk factor for suicide among women (O'Connor & Nock, 2014). The presence of having a current mental health problem was the most frequently cited contributing circumstance. Furthermore, a large percentage of those with a diagnosed mental health problem were receiving some form of mental health treatment, either having a current prescription for psychiatric medication or seeing a mental health professional within two months before their death or both.

Another risk factor most consistently associated with suicide among women was depression (Brent, Perper, Moritz, Baugher, & Allman, 1993; Beautrais, 2006; Conwell & Brent, 1995; Crump et al., 2014; Kumar et al., 2012; Vijayakumar & Lamech, 2020). For example, an international study from Sweden using longitudinal national mortality data showed that women with depression are estimated to have a 19-fold increased suicide risk, and suicide risk was even higher in the first 13 weeks after diagnosis (Crump et al., 2014). Findings from this study also showed that psychiatric disorders such as schizophrenia, anxiety, personality disorders, and bipolar disorder are factors associated with suicide among women.

Research on depression among women who used a firearm to complete suicide is inconsistent. One study has indicated that women aged 50 years and older who used firearms to

complete suicide are less likely to have a mental health disorder like depression and dysthymia than overdose users (Choi, DiNitto, Sagna, & Marti, 2018). This comparison suggests that the role of firearms among older women might go hidden and undetected for prevention. Contrary to this literature, Kaplan et al. (2009a) found that among female suicide decedents, having depression was a significant factor for women to choose a firearm to complete suicide.

Suicidal Behaviors

Early research indicated that the history of suicidal ideation is one of the most important predictors of completed suicide (Beck, Kovacs, & Weissman, 1979). Recent studies have shown that other suicidal behavior, such as previous suicide attempts and disclosed intent to complete suicide, such as a plan, has been firmly established as an additional risk factor for completed suicide. Furthermore, suicide notes left by those who have attempted or completed suicide provide implications for suicide prevention (Canetto & Lester, 2002; Synnott, Ioannou, Coyne, & Hemingway, 2018).

Although most people who have depression do not die of suicide, depression is the most common psychiatric disorder in people who die by suicide (Hawton, Comabella, Haw, & Saunders, 2013). Moreover, compared to natural deaths, females with depressive symptomatology are at higher risk of suicide (Kung et al., 2003). Research has demonstrated the importance of behavioral health factors such as depression that affect the risk of suicide (Crowder & Kemmelmeier, 2014). For example, Durkheim's theory suggests that being socially integrated into one's social environment protects individuals against suicide, whereas individuals who are not integrated into their social environment have a higher risk of suicide and depression.

Few studies have discussed whether firearm suicide, in particular, has a role in depression, as many studies exclude how the choice of methods plays a role in suicide.

According to Crowder and Kemmelmeir (2014), untreated depression predicts higher suicide rates in states where independence and self-reliance are higher. In other words, states with higher suicide rates are reflective of people's unwillingness to seek professional help when psychologically distressed. Specifically, among states with high suicide rates, going to seek help may be a sign of personal weakness (Bock, Brown, & Green, 2019). If depression is left untreated, there could be a fatal consequence of suicide (Colucci & Martin, 2007). On the other hand, a study by Hemenway and Miller (2002) found that lifetime major depression and the rate of suicide across the United States are not highly correlated; however, depression is associated with higher suicide rates (Khan, Mar, Gokul & Brown, 2018). Given the differences in these findings, the role of care for depressed individuals warrants further studies (González et al., 2010), especially among those who have easy access to firearms in their home.

Sociological Risk Factors

Relationship Problems/Losses

The known risk factors used to assess the patterns of suicide include an interpersonal problem or other relationship problems and recent losses, including recent exposure to death (e.g., the recent death of a friend or family member). However, many studies have not examined the choice of methods among women across the life span of at least 32 states (Comiford, Sanderson, Chesnut, & Brown, 2016). In a study that examined the choice of methods among older adults in Queensland, Australia, women who died by drug poisoning were more likely to experience interpersonal conflict than other methods. Similarly, in a study conducted in the United States, those who used firearms had a higher likelihood of having relationship conflicts

than those who used overdose as a method of suicide (Choi et al., 2018). However, older adults who died by suffocation by plastic bags were less likely to experience interpersonal conflict (Koo, Kõlves, & De Leo, 2019). Moreover, another study found that a significant predictor of firearm suicide among female suicide decedents was having experienced the death of a relative or friend (Kaplan et al., 2009a). However, the data used in the study examined only 17 states.

Life Stressors

While previous research has explored life stressors as a predictive factor for completed suicide, the findings varied. Major life stressors, including job problems, financial problems, criminal problems, and physical health problems, are highlighted as triggering factors for completed suicide (Karch, Dahlberg, & Patel, 2010). Yet, researchers examined the differences in the choice of method among females and males and found that financial problems or economic stressors were associated with risk of firearm use for suicide among younger men, younger women, and older women. In contrast, physical health problems were associated with firearm use in suicide among older men compared to other methods (Kalesan, Sampson, Zuo, & Galea, 2018). In particular, according to Walker and Peterson (2018), physical health and illness are components in an analytic model that explains a social phenomenon. Physical health is a variable under a broader sociological approach because when individuals cope with and adapt to their physical health problems, they may face constraints linked to the social and economic structure within the health system. In other words, the interaction between the health system and physical health problems faced by patients with resource limitations is associated with inequity in healthcare access and unfair treatment choices. Additionally, Joyce and Loe (2010) provide an example of how biomedicine is moving from the medical model to a sociological definition of health. Collectively, physical health interacts with mental, physical, and emotional well-being in

combination with social capital, which is part of a sociological approach. Taken together, these findings lead to the use of life stressors as sociological predictors for suicide.

Demographic Characteristics

Research studies have examined a limited number of demographic variables, including age, educational attainment, race, marital status, the region of residence, and veteran status, about the differences in the choice of method women use to complete suicide. Most studies have focused solely on men, who make up the majority of suicides. Few studies have addressed the predictive role of age, education attainment, race, veteran status, the geography of suicide, and marital status on the differences between choosing firearms and nonfirearms among women who completed suicide.

Race and Ethnicity

Female suicide rates differ by race and ethnic groups. Compared to Black (2.70 per 100,000), Asian/Pacific Islander (3.84 per 100,000), Hispanic (2.64 per 100,000), or American Indian/Alaskan Native (6.6 per 100,000) females, non-Hispanic White women (7.90 per 100,000) have the highest suicide rate per 100,000 (CDC, 2017a). In fact, White women account for 8 of 10 female suicides across the life span.

In urban counties, non-Hispanic Whites and American Indian/Alaska Natives females had the highest suicide rates across three urbanization levels and had more significant increases in suicide than other ethnic and racial groups (Ivey-Stephenson, Kresnow-Sedacca, Crosby, Jack, Haileyesus, & Kresnow-Sedacca, 2017). In nonmetropolitan/rural counties, Ivey-Stephneson et al. (2017) found that suicide rates were higher among all ethnic and racial groups, except for non-Hispanic Blacks compared to metropolitan/urban counties (Ivey-Stephenson et al., 2017).

These patterns indicate that suicide rates among women by race/ethnicity are consistently higher in rural areas.

In an earlier study, McIntosh and Santos (1986) explained that there are distinct differences in the choice of method between White and Black women in different age groups. Among White women, there was an increase in firearm use for nearly every age group. Black women, particularly in older adulthood, consistently used firearms to complete suicide compared to other methods, while younger black women use firearms and nonfirearms equally (McIntosh & Santos, 1986). In another study, Kaplan and Geling (1998) found that the correlation between gun ownership and rates of firearm suicides was stronger among White women than among Black women. These findings need to be validated through aggregate data from the population or state-level data analysis.

Age Differences in Suicide

An examination of the epidemiology of suicide among women reveals distinct patterns related to age. According to the CDC (2017a), the suicide rate among women is 6.25 per 100,000 people. While it is extremely rare for females younger than 14 years to die by suicide, the suicide risk increases from late adolescence into young adulthood and peaks in adults ages 50 to 54 years (CDC, 2017a). Suicide risk declines steadily once females reach older adulthood. Suicide prevention efforts have traditionally focused on younger and older women, even though there has been a substantial increase in suicide rates among middle-aged women aged 40 to 64 years (Hempstead & Phillips, 2015). Since 1999, the overall suicide rates among women have risen approximately 36%. From 1999 to 2017, these rates increased in every age group except for women aged 80 years and older (CDC, 2017a).

A recent study examined suicide methods among women aged 50 years and older and found that suicide in certain age groups had higher odds of firearm use (Choi et al., 2017). Compared to women aged 50 to 54 years, women aged 65 to 74 years and 75 to 84 years had significantly higher use of firearms and lower odds of using other methods such as hanging and suffocation. Women aged 85 years and older had lower odds of firearm use compared to other methods (Choi et al., 2017). Ultimately, for women, the risk of using a firearm to complete suicide peaks in middle age and steadily declines in the oldest-old age group (CDC, 2017a; see Figure 2). Other studies found that younger females were less likely to employ lethal means due to lack of firearm access but used hanging and suffocation to complete suicide (Baca-Garcia, Perez-Rodriguez, Mann, & Oquendo, 2008; Bridge et al., 2010).

Due to the changing epidemiology of suicide and the behavioral differences in social experiences associated with age, examining age patterns and behavioral differences in suicide may reduce suicide rates (Phillips, 2014). Current data provide insight for investigation and highlight that the risk of dying by suicide relative to other violent deaths may be more pronounced at certain developmental stages (Bozzay, Liu, & Kleiman, 2014). Using age-period-cohort analyses, Phillips (2014) found that suicide rates begin to increase in cohorts among those who were born from 1915 to 1945. This cohort perspective is important for preventing suicide because if there is changing epidemiology due to new cohort patterns among younger and middle-aged women in the United States, additional planning strategies must be implemented to cease the widespread problem of female suicide. A substantial amount of literature on risk factors associated with men exists. However, few, if any, of these studies address the differential impact of demographic characteristics and precipitating circumstances on the choice of firearms

among suicidal women in different age groups. Given the limited study of these demographic variables, further study is warranted.

Veteran Status

The use of firearms among women in the military has grown in recent years because they have contributed to a substantial percentage of the armed forces (14.5%) (Kaplan, McFarland, & Huguet, 2009b; McCarten, Hoffmire, & Bossarte, 2015; Pruitt et al., 2016). Given the veterans' military history, veterans can be expected to have higher levels of firearm knowledge and understand how to use firearms compared to their nonveteran counterparts. Compared to women not in the military, those in the military were 1.6 times more likely to use firearms and had a higher proportion of suicides involving firearms (Kaplan et al., 2009b). Among women veterans aged 65 years and older, firearms were one of the most frequently used methods to complete suicide (Kaplan et al., 2009b). In another study, from 2001 to 2010, as high as 40% of female veterans aged 18 years and older used a firearm to complete suicide (McCarten et al., 2015). Furthermore, among women veterans, there have been larger increases in the percentage of suicide involving the use of firearms. This increase was 34% from 2001 to 2002; then, it was 45% from 2009 to 2010 (McCarten et al., 2015). Moreover, Hoffmire and Bossarte (2014) found that women veterans were 18% more likely to use firearms than nonveteran women. However, in this study, only nine states were used to analyze the association between firearm suicide and veteran status. Further recommendations of future research aimed to clarify the relationship between a history of military service and firearm suicide across all states are needed (McCarten et al., 2015).

Living in Rural Areas

Although suicide affects both rural and urban populations, there have been persistent and widening increases in firearm suicide in rural populations compared to the urban populations (Branas, Nance, Elliott, Richmond, & Schwab, 2004; Kegler, Scott, Stone, & Holland, 2017; Searles, Valley, Hedgaard, & Betz, 2013). For example, in Maryland, the firearm suicide rate in most rural areas was 66% higher than in the most urban counties of Maryland (Nestadt, Triplett, Fowler, & Moijabai, 2017). Similarly, the firearm rate in Texas was significantly higher among residents in rural areas. Specifically, female teenagers in rural areas had significantly higher firearm use than those 50 to 79 years of age (Choi et al., 2018). In California, firearm suicide rates also varied by rural and urban areas; in 2015, the rates ranged from 2.12 to 21.03 deaths per 100,000 residents, with rural counties having rates three times higher than urban counties like the Bay Area and L.A. County (Pear, Castillo-Carniglia, Kagawa, Cerda, & Wintemute, 2018). Across the United States, suicides involving firearms in rural and urban areas were approximately 60% and 47%, respectively (National Advisory Committee on Rural Health and Human Services, 2017). In a recent study, Steelesmith and colleagues (2020) found that between 1999 and 2016, suicide increased most rapidly in rural counties. Regarding the rural-urban suicide differential, the National Advisory Committee on Rural Health and Human Services (2017) recognized that rural residents have more access to guns and use guns more frequently than urban residents. Moreover, economic and cultural barriers in rural areas such as lack of available services, extra driving time to service providers, social isolation, and economic disparities make it difficult and undesirable for suicidal individuals to seek mental health. The consistent pattern of higher firearm suicides in rural areas reflects that urban-rural disparity is a factor that can predict firearm suicide.

Geography of Suicide

The firearm suicide rates in the United States vary significantly by geographical location. The CDC (2018a) released a geographic report showing that suicide rates across the United States have increased by 30 percent since 1999. States such as Montana, Idaho, Wyoming, Utah, Kansas, Oklahoma, South Carolina, North Dakota, and South Dakota have experienced even higher increases in the rate of suicide (ranging between 38 to 58%). In one widely cited study, Kaplan and Geling (1998) explained that the Mountain (e.g., Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming) and South regions (Arkansas, Louisiana, Oklahoma, Texas, Kentucky, Alabama, Mississippi, Tennessee) of the United States have one of the highest rates of firearm suicide due to the high gun ownership patterns. A recent study by Kposowa, Ezzat and Brault (2020) found that the mountain and southern census divisions had higher suicide risk than New England regions of the United States. Moreover, Kaplan and Mueller-Williams (2019) show that states with the most restrictive firearm regulations tend to have lower rates of firearm ownership, resulting in fewer suicides involving firearms. Westefeld, Gann, Lustgarten, and Yeates (2016) highlighted the need for further exploration of geographical differences in suicides by firearm and suggested that reducing the accessibility of firearms would help alleviate the rising suicide rates.

Education

Research has shown that a critical correlate for suicide is education (Pompili et al., 2013). Most studies show that individuals with higher educational attainment, especially college graduates, were less likely to complete suicide (Abel & Kruger, 2005; Agerbo, 2007; Bálint, Osváth, Rihmer, & Döme, 2016; Phillips & Hempstead, 2017). Phillips and Hempstead (2017) found that, between 2000 and 2008, women with some college had lower suicide rates than those without a high school diploma, suggesting that education provides significant protection against

suicide. Nevertheless, studies involving the role of education and suicide in specific groups reveal contrary results. For example, Stack (1988) found that African Americans with higher educational attainment had a higher risk of suicide based on individual-level data. In contrast, for Whites, the higher the level of education, the lower the risk for suicide. This finding suggests that higher education among Blacks may not translate into higher gains in income or economic reward due to structural and systemic barriers (Fernquist, 2004). Another study showed that low levels of education are associated with increased suicide risks among men but not among women (Denney, Rogers, Krueger, & Wadsworth, 2009). Moreover, the link between the choice of method and suicide attempts has been studied more extensively, but few studies have examined education as a predictive factor for those who completed suicides using firearms or other methods. In earlier work, Kaplan et al. (1997) found that older women who completed suicide with a firearm had lower educational attainment compared to those who used other methods.

Marital Status

Based on Durkheim's concept of social integration (Tsai, Lucas & Kawachi, 2015), marriage and social support systems protect an individual from suicide risk intersecting with other risk factors. Studies have consistently shown that higher social integration results in a lower risk of suicide (Duberstein et al., 2004; Stack, 2000). For example, those who are married are protected from suicide risk, while divorced and separated persons were over twice as likely to die by suicide (relative risk [RR] = 2.08, 95% CI [1.58, 2.72]) (Kposowa, 2000). When the data were stratified by sex, it was observed that the risk of suicide among divorced men was more than twice that of married men (RR = 2.38, 95% CI [1.77, 3.20]). However, when females were studied separately, differences in suicide risk by marital status were not statistically significant (Kposowa, 2000).

Previous research on the relationship between suicide and divorce has tended to find that divorced persons have a higher suicide rate than married people (Roškar et al., 2011). Stack and Kposowa (2016) found that those who were divorced had an increased chance of suicide even after controlling for religiosity and other sociodemographic variables. In addition, Yip and Thorburn (2004) found that women who were divorced were 2.5 times more likely to die by suicide than their married counterparts. A recent study by Kposowa, Ezzat, and Brault (2020) found that both divorced and separated person had an elevated risk of suicide compared to those who were married. Regarding sex, Kposowa et al. (2020), found that divorced and separated women were more likely to complete suicide than their married counterparts (ARR= 1.464, CI = 1.097, 1.954)

In contrast to Kposowa's (2000) findings, Kyung-Sook and others found that unmarried women younger than 65 have higher suicide risks than their married counterparts (Kyung-Sook, Sangsoo, Sanjin, & Young-Jeon, 2016). In this same study, Sook et al. (2016) identified a strong association between marital status and suicide and found that the risk of suicide in unmarried individuals was 92% higher relative to married individuals.

Combined Use of State-Level and Individual-Level Variables

This study uses a method to combine population-level and individual-level data to search for factors predicting completed suicides. Haneuse and Bartell (2011) suggest that the use of a "two-phase design" (p. 384) reduces potential ecologic biases by resembling "a stratified case-control study" with the benefits of gaining "stratified outcome totals for the population" (p. 384). In other words, in the first phase where population-level data are used, the focus is on "causes of the incidence." In the second phase, the individual-level data focus on "causes of the cases" (Keyes & Galea, 2016). This analytical framework was previously introduced in Geoffrey Rose's

(1985) paper entitled "Sick Individuals and Sick Populations," which is a landmark piece for understanding the distinction between the causes of illness at the individual-level and the population level (Rose, 2001).

According to Rose (2001), the two approaches for prevention on the individual and the population differ based on the 'high-risk strategy' and the 'population strategy'. The 'high-risk' strategy is used mainly to screen individuals who are more susceptible to the disease. Generally, this strategy is only temporary and does not deal with the source of the problem (Rose, 2001). However, the 'high-risk' approach offers a more cost-effective use of limited resources. For example, it is more cost-effective to use time and resources to concentrate on limited mental health services to individuals who need and benefit from the services. The 'population strategy' attempts to shift the whole distribution of exposure of the disease to a better direction. The advantage of this is to remove the disease's underlying causes that make the disease more common. Unfortunately, the population strategy of prevention also has disadvantages as it only offers small benefits to each individual because the majority may not have the disease. Rose (2001) identifies that both approaches to understand the causes of the disease are necessary. While researchers may focus on either the individual or the entire population because of the distinct theoretical models and techniques, the challenge is to develop a common language in suicide research to bring continuity in both methods.

To reduce suicide rates among women, it is necessary to understand the link between downstream intervention and their upstream determinants. Suicide is not a singular problem rather it has an array of upstream (distal) and downstream (proximal) elements that contribute to the burden of suicide (Caine, Reed, Hindman & Quinlan, 2018). Downstream intervention to suicide prevention focuses on mitigating the negative impacts of the individual or result in

behavior change, but cannot alter the underlying social and economic condition contributed to the individual's pathway to suicide (Gehlert et al., 2008). On the other hand, upstream determinants focus on macro-level inequities that decrease population exposure to suicide and prevent additional suicide cases (Gehlert et al., 2008).

The central theme of his paper is to show that examining ecological and individual correlates can give us a holistic picture about distal and proximal firearm suicide risk and protective factors. By introducing population data at the systems level, structural-level information can explain part of the complex problem of why and how suicides occur. At the individual-level, the data analyses are to detect the causes of the problem. Although risk identification is beneficial for clinical practice, treating each person case by case takes a more downstream approach—the downstream approach focuses on providing equitable access to care and services already. Therefore, population-level data must first be used to justify the preventive nature of the study intent.

Gaps in the Literature

Several factors may contribute to the lack of firearm-related studies on women. First, less attention has been directed to women because their firearm suicide rate is one-sixth that of men (CDC, 2017a). Second, women attempt suicide with more ambiguous methods such as poisoning and are more likely to be misclassified as an unintentional death (Huguet, McFarland, & Kaplan, 2015). Third, Canetto (2008) suggested that women's cultural attitudes toward suicide are less acceptable than men (DeRose & Page, 2009). Women's suicide is perceived as weak and attributed to interpersonal problems, while men's suicide is viewed as a masculine behavior. Because of the stigma associated with suicide among women, the facts surrounding suicide

among women are more likely to be taken less seriously than men's suicide (Mallon et al., 2016).

Previous studies have indicated that sociodemographic and psychological characteristics are associated with the rates of firearm suicide. However, there are several limitations to the existing literature regarding factors associated with psychological and sociodemographic considerations. First, there are limited studies on firearm suicide among women. Even though there is a rising rate of firearm suicide among women, indicating a need for prevention strategies, most studies have examined firearm suicide among men. Maryland's Violent Death Reporting System data suggest that there are gender differences in suicide prevention, and a higher proportion of middle-aged women than men was noted as currently being in mental health treatment (Powell et al., 2006). Early detection is critical in preventing suicide; suicidal women who enter the mental health care system allow health care providers to treat them adequately.

Another limitation is related to the measures used to examine completed suicide. Most studies have used proxy measures, such as suicide attempts, suicide ideation, and prior hospitalization rates, to identify risk and protective factors to prevent suicides. While these measures are typically considered a proxy for firearm suicide deaths, they do not provide findings on women who have completed suicide. More accurate ways to measure completed suicides entail the use of psychological autopsies, including information gathered by interviewing family and friends of the deceased. In addition, reports by coroners, medical examiners, and law enforcement illuminate further understanding on the cause of death and other valuable contexts surrounding it. These contexts include relationship problems, mental health conditions and treatment, toxicology results, and life stressors such as problems related to money, work, or physical health.

The third limitation is how other contextual explanations, including geographic factors, play a role in firearm suicide. Many studies have assessed either state-level or individual-level data on firearm suicide. However, population changes in the patterns of firearm suicide and individual data are linked by examining contextual and cultural factors. For example, state-level patterns (geographic context) can be used to inform reasons why individuals may choose firearms to complete suicide. To fully understand and identify the patterns of firearm suicide among women, demographic and socioeconomic factors associated with firearm use at both the state and individual levels should be closely examined.

According to Denning et al. (2000), in order to better tailor suicide intervention and prevention strategies, future studies should obtain larger samples among women who complete suicide to understand why women choose certain suicide methods. Only a few researchers (Adamek & Kaplan, 1996; Chaudron & Caine, 2000; Kaplan et al., 2009a; McIntosh & Jewell, 1986; Miller et al., 2002a) have considered examining the differences between suicide methods among women. However, these studies only addressed the possible differential impact of the demographics and precipitating circumstances associated with women on an individual level; they did not use population-level data. The current study aims to supplement their findings by designing preventive programs that will benefit those who are helping women patients, particularly those who have firearm access, to potentially understand the risk of this lethal weapon at the time of emotional distress.

CHAPTER 3: CONCEPTUAL FRAMEWORK

This chapter discusses the sociological, psychological, biological, sociocultural, and

multidisciplinary suicide theories that will help build a conceptual framework supporting the use

of state-level and individual-level data to analyze women suicides involving firearms. This

framework addresses how the choice of method, especially firearms, plays a significant role in

suicide among women. Adapted from the CDC, a four-level socioecological model is applied to

explain factors that lead to suicide prevention. This framework takes into consideration how the

choice of methods (firearm vs. nonfirearm suicide) interplays between the individual (personal

characteristics and precipitating circumstances), relationship (family and peer relationships),

community (rural vs. urban), and societal (gun ownership rates) factors (CDC, 2019). This

chapter starts with framing suicide as a social problem affecting women and theories used to

explain the complex phenomena of suicide among women. It will discuss how suicidal behavior

theories can guide us in a systemic-individual comparison framework to study state-level and

individual-level data on women suicides.

Suicide Theories

Every year, at least 44,000 deaths by suicide could be eliminated or prevented by

alternating the patterns of their behavior. To reduce suicides, researchers have adopted

psychological, sociological, and biological theories to find opportunities to intervene and rescue

those who reduce suicidal behaviors and evaluate harm reduction among those at risk for suicide.

Several theories in the field of suicide will guide the theoretical framework of this research

study.

Sociological: Durkheim's Suicide Theory

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The study of the primary causes of suicide can be traced to Emile Durkheim's original work, *Le Suicide*, in the 19th century (Durkheim, 1897/1951). His work has become a classic in the field of sociology and suicidology and continues to guide researchers. Durkheim's sociological theory of suicide drew theoretical conclusions that suicide mortality is linked to society's social organization. Although Durkheim described four types of suicides, including anomic, egoistic, altruistic, and fatalistic, he elaborated more on the first three. First, Durkheim described how anomic suicide occurs in a crisis, and the person is not capable of dealing with the crisis in a rational manner. He introduced the concepts of "anomie" and "normlessness" to describe how various social conditions and pressures lead to a fragmentation in regulatory norms (Cloward, 1959). In other words, as society evolves and changes abruptly (e.g., industrial revolution and immigration migration and settlement), individuals cannot adjust to the previously held norms that people valued (Cloward, 1959).

Another type of suicide, called egoistic suicide, stems from a lack of integration of the individual into society. However, when a group is highly integrated and unified, society develops a set of norms to regulate behavior and interpersonal relationships, often described as "social integration." Thus, Durkheim hypothesized that low levels of social integration within a society lead to anomie, which is linked to a high rate of suicide. For example, Durkheim argued that an organized labor force was a protective factor from suicide because staying employed integrated a person into society and reduced suicide. According to Durkheim (1897/1951), the loss of a job would decrease a person's social status and social roles and increase social isolation, resulting in an elevated risk of suicide. However, if the suicide is characterized by very high social cohesion, and the individuals are overly integrated into a group, they may use their lives to sacrifice for the benefit of the group. This is known as altruistic suicide.

Durkheim provides a structure of patterns of suicide based on socialization. Among women, Durkheim attributes the lower suicide rate to their high levels of socialization. He assumed that traditional family life protected against self-destruction. The traditional roles of caring for a family demonstrated the most significant protective factor to suicide. However, this perspective may shift due to the increase in women's suicides, the changes in the family structure, and the higher integration of women entering the labor force, reducing the protection from suicide (Kushner, 1994).

Based on Durkheimian arguments, many studies link a variety of social factors to suicide rates. For example, high unemployment levels, economic recession cycles, and high suicide rates are highly associated with one another. Luo and colleagues (2011) found that suicide rates in the United States tend to rise during economic recessions and drop during economic expansions, predominantly among adults aged 25 to 64 years. In another study, Kaplan and colleagues (2015) found that alcohol-link suicides are more prevalent during economic contractions. Specifically, there was evidence of a lag effect in financial strain among women who were acutely intoxicated at the time of death (Kaplan et al., 2015). In addition, researchers have also found that married individuals generally have lower suicide rates than those who are divorced, never married, and widowed (Lester, 1994; Smith, Mercy, & Conn, 1988). These patterns are generally valid for men, but recent findings contrary to many gender assumptions show that unemployed women in the United States have higher deaths from suicide than unemployed men (Kposowa, Ezzat, & Breault, 2019). Furthermore, in a well-known piece by Canetto and Lester (1998), suicidal women and men are often thought to be opposite in terms of rate, types, methods, and precipitants of suicidal behavior but may not differ in motives. In the past decade, the rising suicide rate among women raises an important question: Why do individuals from groups with

low suicide rates still exhibit suicidal behaviors? Durkheim's theory leads researchers to think of the influential factors reflected in multilevel data of suicide decedents.

Psychological Theories

In recent decades, strong trends in suicide research and prevention have been primarily and largely influenced by psychological theories (Barzilay & Apter, 2014). The pioneering work of Sigmund Freud (1920) has influenced studies on suicide and suicidal behavior. Freud, in his classic piece, *Beyond the Pleasure Principle* (reprinted in 2015), postulates that every human struggles between two opposing psyche drives. Eros (life instinct) is ego, which is primarily governed by the reality of an individual's pursuit of pleasure; Thanos (death instinct) is its opposite, which brings about self-destruction, extinction, or, in the extreme, suicide. Using these bipolar concepts, he believes that the drive to kill oneself is derived from an earlier repressed desire. In other words, by reliving the presence of conflict or trauma over and over again but not highlighting one's pleasure in life, suffering would gain control.

Other psychological theories of suicide are extensions of Freud's theory of suicide (Beck, Brown, Berchick, Steward, & Steer, 1990; Joiner, 2005; Van Orden et al., 2010), which generally focuses on the individual as the unit of analysis. The significant contributions of these psychological theories are their attempt to explain the suffering and pain of individuals who are suicidal, including inner feelings and psyche, stages of psychological development; traumatic experiences such as life losses, depression, hopelessness; and interpersonal problems; and other life stressors. Specifically, the interpersonal psychological theory of suicidal behavior attempts to explain why individuals die by suicide (Joiner, 2005). This theory postulates that individuals will choose to die by suicide if they desire to die and can carry out the self-inflicted harm. Individuals develop the ability to die by having two psychological states in their minds simultaneously.

These two psychological states include perceived burdensomeness and a sense of low belongingness. Perceived burdensomeness is when an individual has the perspective that their existence is more of a burden to family, friends, and society. A sense of low belongingness is defined as having the experience of isolation and not being an integral part of a family, circle, friend, or valued group. In addition, the interpersonal psychological theory of suicidal behavior proposes that suicide behavior emerges after being repeatedly exposed to "physically painful and fear-inducing experiences" (Van Orden et al., 2010). This theory suggests that specific circumstances or life stressors in which a person engages may lead to suicidal behaviors.

Biology of Suicidal Behavior

There is growing evidence that genetic and neurobiological risk factors are related to suicidal behaviors (DiBlasi et al., 2020). Studies examining genetic factors suggest that genetic predisposition to suicide or suicidal behavior may be independent of the genetic risk for mood or other psychiatric disorders (Baldessarini & Hennen, 2004; Pandey, 2013). Evidence from family, twin, and adoption studies show that suicidal behaviors in the family pose an elevated risk for suicide (Brent & Mann, 2005). Twin case and register studies report that the estimates of heritability for suicide range from 21% to 50% (Vorack & Loibl, 2007). The exact genetic system that influences suicide behaviors still warrants further exploration, but several candidate genes, such as the serotonergic system (Antypa, Serretti, & Rujescu, 2013), have been explored past decade. However, it is well documented that the biological and genetic paths leading to suicide only explain a proportion of why an individual may complete suicide. Increasing evidence shows that genetics, distal and proximal environmental factors, and other stressors play a role in influencing suicidal risk (Currier & Mann, 2008; Mandelli & Serretti, 2013; Roy, Sarchiopone, & Carli, 2009; Zai et al., 2019).

Sociocultural Matrix of Suicide

One theory that may explain the gender paradox and complexity of women's suicidal behaviors is the theory of *cultural scripts of suicidal behavior* (Canetto, 1997a, 1997b, 2008, 2009; Canetto & Sakinofsky, 1998; Stice & Canetto, 2008). This theory postulates that the pathways to suicide vary across cultures. The conceptualization of this theory is based on the observations that suicidal behaviors are culturally patterned and regulated. In other words, individuals tend to engage in appropriate behaviors based on cultural norms, which are shared expectations and rules that guide the behavior of people within social groups. For example, when the preference to use guns is more acceptable and convenient, more individuals will gravitate toward that specific choice of method (Canetto, 2008).

Furthermore, the theory of cultural scripts of suicidal behavior explains that certain conditions frame the response to suicidal behaviors. This includes the choice of methods, events leading to suicidal behaviors, the emotions and motives expressed by or attributed to the suicidal person, and other individuals associated with the person. These cultural scripts of suicidal behavior are commonly recognized as triggers of suicidal behaviors in particular communities and subgroups.

According to Canetto and Sakinofsky (1998), understanding cultural scripts of suicidal behavior is crucial given the variability in personal characteristics (e.g., by gender and age) and situations triggering suicidal behaviors (e.g., life events and history of mental illness). For example, completed suicides among Native Americans were most common among young people, while for European Americans, they were most common with older adults (CDC, 2017a). In China, suicide is common for those facing oppressive life circumstances such as young rural married women experiencing abuse from their in-laws (Cheng & Lee, 2000). In countries such as

the United States, suicide is most common in groups with the most favorable socioeconomic conditions (i.e., European American women and men) and least common among those with the least favorable socioeconomic conditions (i.e., African American women) (Canetto, 1997a). However, during periods of high unemployment, those with the least favorable socioeconomic conditions are more likely to die of suicide (Lemmi et al., 2016). Furthermore, in the United States, these cultural scripts of suicidal behaviors can explain why some individuals will have preferences for specific suicide methods.

The theoretical perspective developed by the cultural scripts theory is loosely connected to Durkheimian principles; however, it differs from the classical Durkheimian perspective in several ways. Durkheim did not postulate a theory based on sociocultural norms, which refer to informal rules and shared social expectations that distinguish expected behavior based on gender. In addition, he did not believe that suicide acceptability played a role in suicide. He wrote that both Catholics and Protestants disapproved of suicide, but their suicide rates differ based on social and religious networks. The cultural script theory adds a key element to Durkheim's sociological explanation of suicide by describing how culture can have independent effects on suicide.

In order to supplement Durkheim's theory that mainly focuses on cohesiveness, the socialization theory explains a definition of individual actions. This social value theory postulates that gender differences in suicidal behaviors are based on sociocultural norms and related to gender differences in socialization. This theory suggests that women and men tend to adopt behaviors similar to the gender norms of their cultures. Canetto (2008) suggests that cultural acceptability plays a vital role in the choice of method. This means that when the choice

of firearms is more acceptable in a person's social group, the probability of using that particular method for suicide will likely be higher.

In addition, Jaworski (2010) found that women have different help-seeking behaviors from men, partially explaining the gender disparities in their suicide rates. The patterns of suicide among women differ because of gender-based socialization (Jaworski, 2016). For example, interpersonal relationship skills among women and men are distinct because they were raised with certain expectations of masculine or feminine characteristics. In terms of masculine expectations, men's suicides are portrayed as signs of courage, pride, and resistance against circumstances such as financial hardship, physical health problems, and social isolation (Canetto, 1992, 1995, 1997b; Lieberman, 2003; Range & Leach, 1998). In contrast, feminine expectations in suicide among women are seen as an interpersonal crisis (e.g., a recent romantic breakup, divorce, or emotional turmoil). Thus their suicidal thoughts are seen as a cry for help.

Social-Ecological Model (SEM)

To help reduce suicide rates, researchers have adopted psychological, sociological, and biological theories to understand the pathway of suicide. Through these evaluations, they hope to find opportunities to intervene, reduce suicidal behaviors, and examine harm reduction methods for suicide. Yet, many of these theories seem to present limited information on why women choose lethal suicide methods. Some researchers have questioned the usefulness of the theories related to the choice of suicide methods (Medoff & Magaddino, 1983). However, the CDC's public health approach to suicide prevention provides valuable guidance (See Figure 3). Their approach is based on the assumption that prevention efforts for any health or disease issue require integrated efforts within a social-ecological model (SEM). The SEM is a four-level framework used for organizing risk and protective factors. Each level represents a point in

suicide prevention, including a macro- to micro-level distal and proximal risk factors. The four-level strata to describe the multilevel framework include societal, community, relational, and individual risk and protective factors in preventing suicide by firearms. The SEM was derived from a full review of contemporary suicide risk theories (See Figure 3).

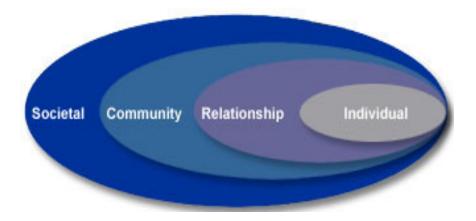


Figure 3. Social-Ecological Model (SEM)

Social-Ecological Model of Suicide Prevention

In recent years, researchers have examined how the social-ecological suicide risk approach to suicide prevention has been used to understand the distinction between individual-level and population-level factors through contextual factors (see Figure 4). This approach constitutes a powerful way to gain knowledge about the structural and cultural characteristics of suicide, which cannot be explained with examining just individual-level data (Bernburg, Thorlindsson, & Sigfusdottir, 2009; Cramer & Kapusta, 2017). Thus, this study will use individual and state-level data to explain the phenomena to address the growing rate of firearm suicide among women and why individual women use firearm versus other methods. The research would integrate the findings of both state-level factors and individual-level factors to explain the complex nature of suicide.

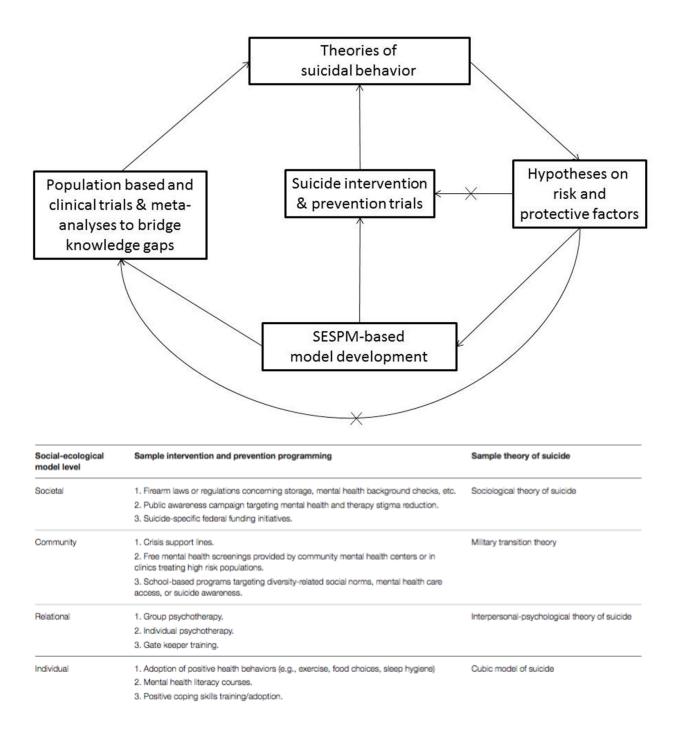


Figure 4. Conceptual Model of Social-Ecological Model of Suicide Prevention Source: Cramer and Kapusta (2011).

Modified Social-Ecological Model of Suicide Prevention

To better merge the macro- and micro-level concepts, the study will adopt a modified version of the social-ecological model and the social-ecological model of suicide prevention, which will be called the modified social-ecological model of suicide prevention. The four-level model will be described as they relate to the following theories: societal (Durkheim, 1897/1951), community (cultural scripts of suicidal behavior, the ecological theory of suicide), relational (e.g., interpersonal-psychological theory of suicide), and individual (Shneidman, 1987) level perspectives.

Compounded with environmental complexities, rather than choosing one specific theory to explain the choice of methods among suicide decedents, this dissertation will examine how existing theories produce insights into explaining the various types of suicidal behavior (Fuse, 1997). Combining elements from Durkheim's theories of social integration, Freud's and other recent psychological theories, and Canetto's sociocultural matrix of suicide, the modified socioecological model was created using population- and individual-level data. In this model, depicted in Figure 5, the modified social-ecological model of suicide prevention integrated Cramer and Kapusta's (2017) social-ecological framework, including four-levels—societal, community, relational, and individual. Cramer and Kapusta (2017) describe that the four-level framework potentially provides a "comprehensive framework for organizing risk and protective factor knowledge, as well as integrating levels to examine how upper-level factors may moderate the influence of lower-level factors, and vice versa" (p. 2). The first-level, "individual," identifies personal history factors that increase the likelihood of suicide. The second-level, "relational," examines close relationships that may increase the risk of dying by suicide. For example, suicide decedent's most intimate partners and family members may influence their suicidal behavior. The third-level, "community," explores settings in which social relationships occur and seeks to identify these characteristics associated with suicide (e.g., barriers to health care access and mental health access). The fourth-level, "societal," looks at the broad societal factors that help create an environment in which suicide is accepted (e.g., social and cultural norms, gun control laws, and region of the United States with higher rates of suicide).

In this modified conceptual model, the study will include variables based on theories of sociological (i.e., social capital, relationship problems/loss, life stressors), psychological (health indicators, mental health problems, suicidal behaviors), and sociocultural matrix of suicide (gun culture) theories. In addition, a separate measure of individual-level risk and protective factors, called demographic factors (i.e., age, race, the geography of suicide, education, marital status), was included in the model. As seen in Figure 5, each of these factors described is related to either the upper-level or lower-level framework. Many of these measures align with Cramer and Kapusta's model, using similar theories such as the sociological theory of suicide and the interpersonal-psychological theory of suicide derived from Freud and Durkheim's work. However, in this model, two separate outcome measures of suicide, firearm suicide rate, and the choice of method (firearm vs. nonfirearm suicide) were included in this study. As shown in the model, firearm suicide among women may be affected by micro and macro facets and is needed to inform best practices for suicide prevention.

Both psychological and sociological theories complement each other in explaining the dynamic phenomenon of suicide among women. With additional emphasis on women's demographic characteristics, this study aims to identify both risk factors to prevent women's suicidal behaviors. Few studies addressed whether micro and macro perspective to suicide prevention can be used for a comprehensive framework for understanding risk factors for firearm

suicide, especially among women. The use of state and individual-level firearm suicide correlates potentially can add additional knowledge about firearm suicide. Together, these risk factors may inform mental health clinicians and healthcare providers about possible prevention efforts specific to women.

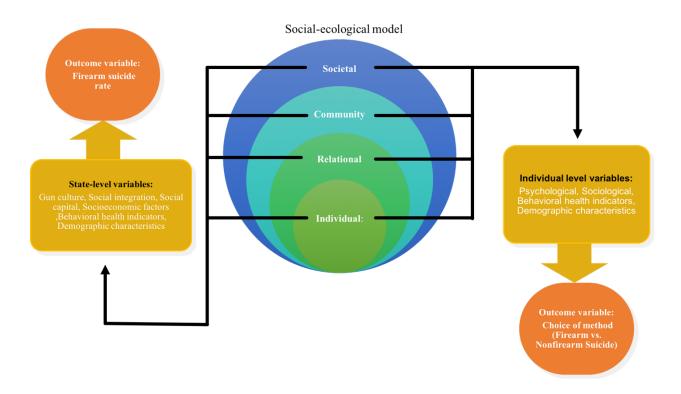


Figure 5. Modified Conceptual Model of Social-Ecological Model of Suicide Prevention

Purpose of the Study

This study examines how state-level and individual-level data can be analyzed to detect factors associated with firearm suicide among women. The major limitation inherited in ecological studies is the potential of assuming that the association between two group-level variables equates to the corresponding variables at the individual-level (Neumark, 2017). Thus,

examining state-level factors at an additional level of analysis provides the possibility to predict the dependent variable (firearm use as a choice of suicide method) in a more holistic picture of the complexity of the suicide problem. This study aims to understand the complexity of suicidal behavior in an environmental context, explicitly understanding how the context affects the outcome of those who completed suicide.

The purpose of this study is to evaluate both the population-level data (including ageadjusted female firearm suicide rates by state-level demographics, socioeconomic, gun culture,
social capital, and health indicators) and the individual-level data of the demographic
characteristics and precipitating circumstances (demographics, sociological, psychological, and
health indicators) associated with firearm suicide rates and the choice of methods, respectively.

The study aims to obtain insights into factors that will reduce firearm suicide among women by
exploring "the suicide female" phenomenon with data sources that capture both state-level
(population) data and individual-level data with two questions:

Research Question 1 (Q1):

Q1: At the state level, which distal (state-level demographic, socioeconomic, social capital, gun culture, and health indicators) factors are associated with the firearm suicide rate among women who complete suicide?

Hypothesis for Q1:

Hypothesis 1 (H1): Demographics (White, non–college-educated, veteran, living in rural areas, and divorced), socioeconomic (living below poverty levels), gun culture, social capital, and health indicator factors are significantly associated with firearm suicide rates among women across the 50 states.

H1a: States with a higher proportion of white, non-college-educated, veterans, rural residence, and divorced women will have significantly higher rates of state-level firearm suicide among women.

H1b: States with a higher proportion of women living with poverty will have significantly higher rates of state-level firearm suicide among women.

H1c: States with higher levels of social capital will have significantly lower rates of firearm Suicide among women.

H1d: States with a higher proportion of gun ownership rates will have significantly higher rates of state-level firearm suicide among women.

H1e: States with a higher proportion of women binge drinking, a higher proportion of depression and lower rates of accessing health care will have significantly higher rates of state-level firearm suicide among women.

Research Question 2 (Q2):

Q2: Which proximal risk factors (psychological factors, demographic factors, and substance misuse risk) are associated with women who complete suicide with a firearm compared to women who complete suicide without a firearm?

Hypotheses for Q2

<u>H2</u>: The relative odds of using a firearm versus nonfirearm to complete suicide differ in demographic characteristics, psychological factors, sociological factors, and substance misuse risk among women.

H2a: Women with demographic characteristics such as being older than 60 years, White, divorced, living in regions other than the Northeast, veteran status, and living in rural areas will

have significantly higher odds of using a firearm to complete suicide compared to using a nonfirearm method.

H2b: The odds of using a firearm method among women will be significantly lower if they had psychological factors, including depressed mood, the current treatment of a mental health problem, and previous suicide attempts compared to those who used firearms.

H2c: The odds of using a firearm to complete suicide among women will be significantly higher if they had any relationship problems compared to those who used nonfirearm methods.

H2d: The odds of using a firearm to complete suicide among women will be significantly higher if they had a substance misuse problem compared to those who used nonfirearm methods.

Summary of Chapter 3

Chapter 3 describes the conceptual framework used in this study and identifies firearm suicide as a social problem among women. A socio-ecological perspective has been adopted from the CDC's social-ecological model, a four-tier framework for understanding individual, relational, community, and societal risk factors. In this study, an updated conceptual framework (see Figure 5) has been used that includes an ecological and individual-level analysis. The framework outlines the link between risk factors associated with firearm suicide and choice of method among women. Using the modified conceptual Model of the Social-Ecological Model of Suicide Prevention conceptual framework, this study aims to explore how the choice of method may play a role in identifying unknown risk factors associated with suicidal women. These factors represent both internal (psychological) and external (ecological) causes, including age, demographic characteristics, life stressor(s) in psychological and sociological circumstances precipitating suicide, and drug and alcohol use. With this framework, two research questions are set with their corresponding hypotheses to represent an essential part of this research study.

CHAPTER 4: METHODOLOGY

This chapter describes the methods of using state-level and individual-level data to examine the demographic, sociological, and psychological factors related to women who used a firearm to complete suicide. The goal is to conduct both an ecological and individual study to understand the distal and proximal risk factors associated with firearm suicides in order to find accurate inferences for strategies to reduce the number of suicides among women. The individual-level study focuses on firearms as the choice of suicide method, while the ecological study examines how state-level factors are associated with state-level firearm suicide rates. This chapter will begin with defining firearms, discussing the data collection, and providing details of the two-step analysis method.

Firearms Defined

According to the Gun Control Act of 1968, 18 U.S.C., §921(a) (3), the word *firearm* is defined as "(a) any weapon (including a starter gun) which will or is designed to or may readily be converted to expel a projectile by the action of an explosive; (b) the frame or receiver of any such weapon; (c) any firearm muffler or firearm silencer; or (d) any destructive device." Such term does not include antique firearms. In this study, the words *gun* and *firearms* are used interchangeably with this definition.

Two-Step Data Collection

This study involves a two-step analysis. First, this study used state-level data obtained from the U.S. American Community Survey, 2017; Social Capital Project, 2018; YouGov, 2015; and the Behavioral Risk Factor Surveillance System. Firearm suicide rates across 50 states were obtained using the 2017 CDC's WISQARS. Second, individual-level data from 2012 to 2016 are analyzed to establish factors associated with a firearm and nonfirearm suicides among women

using a large sample of suicide decedents drawn from 32 states using the National Violent Death Reporting System (NVDRS).

Step 1: Analyzing State-Level Data

The objectives of using the state-level data are to:

- 1) evaluate the association between state-level demographic characteristics and firearm suicide rates across the United States,
- 2) examine the complex relationship between state-level firearm suicide rates and state-level factors, including state-level demographics, social capital, socioeconomic, gun culture, and health indicators among women in the United States.

Data Source: State Level

Dependent Variable

The dependent variable in the state-level data is the firearm suicide rate among women in each state from 2013 to 2017. The mortality data were collected from the CDC's WISQARS mortality reports. WISQARS provides the numbers and rates per 100,000 of injury-related deaths that occur in the United States (CDC, 2017a). WISQARS mortality data are based on the CDC annual data files from the National Center for Health Statistics. This data set includes the number of intentional self-injury-related deaths by state, year, sex, age, and race/ethnicity. This study obtained mortality data on female suicide decedents aged 18 years and older in each state from 2013 to 2017. As an inclusion criterion, data of suicide decedents who were assigned with *International Classification of Diseases, 10th Revision (ICD-10)* codes of X72 (intentional self-harm by handgun discharge), X73 (intentional self-harm by rifle, shotgun, and larger firearm discharge), and X74 (intentional self-harm by other and unspecified firearm discharge) are selected. The ICD-10 codes are a medical classification listed by the World Health Organization

that describes causes of injury or disease. These yearly mortality data were age adjusted using the year 2000.

Independent Variables

1. Demographic Characteristics.

State-level demographic characteristics, including race/ethnicity (percentage of White people), percentage of veterans, percentage of people living in rural areas, percent divorced, and percentage of non-college-educated women, were included from the U.S. Census American Community Survey Population Estimates, 2013–2017 (U.S. Census Bureau, 2017). The selection of variables of interest was based on previous findings of their significant association with firearm-related suicides (Fleegler et al., 2013; Kalesan et al., 2015).

2. Socioeconomic Factors.

Based on Durkheim's idea of social regulation, suicide rates tend to rise during economic recessions and downturns and decrease after expansions. Socioeconomic factors were measured by economic indicators, including those living below the federal poverty level based on the U.S. Census American Community Survey Population Estimates, 2013–2017 (U.S. Census Bureau, 2017). The variable, living below the poverty level, is determined by income divided by the poverty threshold by size of family and number of related children under the age of 18 (US Census Bureau, 2017). Income is a composite score based on the following variables, including (a) wage, salary, commission, and bonuses; (b) self-employment income from nonfarm businesses or farm businesses, including proprietorship and partnerships; (c) interest, dividends, net rental income, royalty income, or income from estates and trusts; (d) Social Security or railroad retirement; (e) supplemental security income; (f) any public assistance or welfare payment from state or local welfare office; (g) retirement, survivor, or disability pensions; and

(h) any other sources of income received, such as veteran's payment, unemployment compensation, child support, or alimony. For this study, the percentage of women living below the poverty level in the United States was used in the analysis.

3. Social Capital.

State-level social capital data were collected by the Social Capital Project Vice
Chairman's Staff of the Joint Economic Committee (U.S. Congress, Joint Economic Committee,
2018) to elaborate on Robert Putnam's work from 1975 and 1998 (Putnam, 2000). The data were
collected from various sources by state, including (a) Civic Engagement Supplement to the
November 2008 Current Population Survey; (b) Behavioral Risk Factor Surveillance System; (c)
National Survey of Children's Health, 2016; (d) American Community Survey, 2012–2016, 5year estimates; (e) Volunteer Supplement Population Survey, 2013 and 2015; (f) County
Business Patterns, 2015; (g) IRS, Business Master File, 2015; (h) Volunteer Supplement
Population Survey, 2013 and 2015; (i) County Business Patterns, 2015; (j) IRS, Business Master
File, 2015; (k) Election Administration and Voting Survey, 2010; and (l) FBI Uniform Crime
Reporting Statistics, 2014.

The social capital data provide a general Social Capital score based on seven dimensions. Figure 6 defines each of these dimensions. The various dimensions of the social capital variable were merged into a composite score. The composite score was standardized and put on a universal scale, ranging from –2.2 to 2.1. If a score is 1.5, this means that a state lies one and a half standard deviations above the mean index score across the United States. In other words, the social capital levels are 1.5 times higher than the average (U.S. Congress, Joint Economic Committee, 2018).

Indicator	Data Source	Notes
Family Unity Subindex		
Share of births in past year to women who were unmarried	American Community Survey, 2012-2016, 5-year estimates; 2007-2011, 5-year estimates for 27 counties in eight states	American FactFinder Table S1301
Share of women ages 35-44 who are currently married (and not separated) $ \label{eq:control}$	American Community Survey, 2012-2016, 5-year estimates	American FactFinder Table B12002
Share of own children living in a single-parent family	American Community Survey, 2012-2016, 5-year estimates	American FactFinder Table B09002
Family Interaction Subindex		
Share who report child spends at least 4 hours per weekday in front of a \ensuremath{TV}	National Survey of Children's Health, 2016	includes watching TV, videos, or video games
Share who report child spends at least 4 hours per weekday on electronic device, excluding homework	National Survey of Children's Health, 2016	includes computers, cell phones, handheld video games, and other electronic devices
Share who report someone in the family read to child every day in past week $% \left\{ 1,2,\ldots ,n\right\}$	National Survey of Children's Health, 2016	restricted to parents with child 0-5 years old
Social Support Subindex		
Share saying they get the emotional support they need only sometimes, rarely, or never	Behavioral Risk Factor Surveillance System	analysis of BFRSS microdata, 2006 & 2010 estimates averaged to get pre- and post-recession estimates
Average number of close friends reported by adults	Civic Engagement Supplement to the November 2008 Current Population Survey	
Share of adults reporting they and their neighbors do favors for each other at least $1 \kappa / month$	Volunteer Supplement to the November 2013 Current Population Survey	
Share of adults reporting they can trust all or most of their neighbors	Volunteer Supplement to the November 2013 Current Population Survey	
Community Health Subindex		
Share of adults who report having volunteered for a group in the past year	Volunteer Supplement to the September 2015 Current Population Survey	
Share who report having attended a public meeting re. community affairs in past year	Volunteer Supplement to the September 2015 Current Population Survey	
Share who report having worked with neighbors to fix/ improve something in past year $$	Volunteer Supplement to the September 2015 Current Population Survey	
Share of adults who served on a committee or as an officer of a group $% \left\{ \mathbf{r}_{i}^{\mathbf{r}_{i}}\right\} =\mathbf{r}_{i}^{\mathbf{r}_{i}}$	Volunteer Supplement to the November 2013 Current Population Survey	
Share who attended a meeting where political issues were discussed in past year	Civic Engagement Supplement to the November 2008 Current Population Survey	
Share who took part in march/rally/protest/demonstration in past year	Civic Engagement Supplement to the November 2008 Current Population Survey	
Membership organizations per 1,000	County Business Patterns, 2015; ACS population estimates, 7/2015 (2015 vintage)	
Registered non-religious non-profits plus religious congregations per 1,000	IRS, Business Master File, 12/2015; ACS population estimates, 7/2015 (2015 vintage); U.S. Religion Census: Religious Congregations and Membership Study, 2010	IRS data via National Center for Charitable Statistics & American FactFinder Table PEPANNRES; congregation data obtained via Association of Religious Data Archives, census conducted 2009-11
Institutional Health Subindex		
Average (over 2012 and 2016) of votes in the presidential election per citizen age 18+	Election Administration and Voting Survey	U.S. Election Assistance Commission; rates based on citizen estimates from 2010 decennial census and ACS
Mail-back response rates for 2010 census	Census Bureau	
Share of adults reporting some or great confidence in corporations to do what is right	Volunteer Supplement to the November 2013 Current Population Survey	
Share of adults reporting some or great confidence in the media to do what is right $% \begin{center} \end{center} \begin{center} center$	Volunteer Supplement to the November 2013 Current Population Survey	
Share of adults reporting some or great confidence in public schools to do what is right	Volunteer Supplement to the November 2013 Current Population Survey	
Collective Efficacy		
Violent crimes per 100,000	FBI, Uniform Crime Reporting Statistics, 2014	
Philanthropic Health		
Share who report having made a donation of >\$25 to a charitable group in past year	Volunteer Supplement to the September 2015 Current Population Survey	
Γ' ($\Omega_{i,j}$ 1 1 1 1	. 1 . 1 . 1	

Figure 6. State-level social capital index indicators.

Source: U.S. Congress, Joint Economic Committee, 2018

4. Gun Culture.

State firearm ownership rates and the gun law environment are macro-level variables designed to measure social gun culture. The state firearm ownership rates in 2013 were obtained from a recent study that used survey data from YouGov, a nonpartisan research firm that recruits

its participants online through a polling website that collects nationally representative data (Kalesan et al., 2015). Gun ownership culture was measured by asking six questions about gun ownership, including (1) was the gun a gift, (2) was the gun bought before or after the year 2000, (3) was the gun used for hunting, (4) did the gun owner attend gun safety classes, and (5) did the owner advocate responsible gun ownership. Kalesan et al. (2015) categorized the individual as a gun owner if they responded 'yes' to any of the six questions.

5. Health Indicators.

Health indicator measures, including healthcare coverage, depression, and binge drinking among women, were obtained through the Behavioral Risk Factor Surveillance System, 2017 (BRFSS). Health indicator measures included the percentage of 400,000 adult nationally representative interviews who reported "yes" to the following questions: (a) Do you have any kind of health care coverage? (b) Has a doctor, nurse, or other health professionals ever told you that you have a form of depression? (c) Considering all types of alcoholic beverages, how many times during the past 30 days did you have four or more drinks on any occasion? Health care coverage does not include mental health coverage; therefore, this study examined depression as a proxy for mental health.

Data Analysis for Answering Q1

A multivariate model was constructed, which was adapted from Katz's multivariable analysis (Katz, 2011, pp. 134–139). First, the association of each independent variable with the outcome variable, firearm suicide rate, was assessed with a nonparametric measure of association. A correlation matrix was examined to check for multicollinearity among independent variables. Distal factors that were included to predict state-level firearm suicide rates are state-level demographics, including white, non-college educated, veteran status, living

in rural areas, divorced, socioeconomic, social capital, gun culture, and behavioral health (see Table 3). The distal factors were measured based on U.S. Census American Community Survey 5-year estimates (2013–2107); CDC WISQARS (2013–2017); Behavioral Risk Factor Surveillance System, 2017; U.S. Congress Joint Economic Committee, 2018; and Yougov.com. These factors are defined as "distal" because of the societal and ecological context as well as the underlying risk of dying by firearm suicide.

Second, the independent variables that had significant relationships with the dependent variable were included in the multiple regression analysis using the SPSS program. Finally, the SPSS stepwise regression analysis program was used to develop the most parsimonious model for predicting the firearm suicide rate among women. The stepwise procedure would eliminate all statistically nonsignificant independent variables from the model. In the stepwise procedure selection, each of the independent variables were added one at a time. In each forward step, the variables that give the best improvement to the model are less likely to be excluded from the model. The objective of the model was to select the combination of variables that best predicted the variance in firearm suicide rates. Using the F test, this study assessed whether the fit of the model (by calculating the adjusted R^2) could correct the number of predictors in the model.

Step 2: Examining Individual-Level Suicide Risk

Data Source: Individual-level

The NVDRS is a state-based surveillance system that provides a detailed account of violent deaths that occur in the participating states. The NVDRS includes all suicides, homicides, legal intervention deaths, unintentional firearm deaths, and undetermined deaths. The data were collected from coroner or medical examiner records, police reports, death certificates, toxicology laboratories, crime laboratories, and Alcohol, Tobacco,

Firearms, and Explosives (ATF) firearm trace reports. In some cases, information was obtained from family members and friends (proxies) of the decedents (Fowler, Jack, Lyons, Betz, & Petrosky, 2018). This study used NVDRS's restricted access database from the 2012 to 2016 period. The individual data are not from the same time period as the state-wide data because the latest suicide data available are from 2012-2016.

National Violent Death Reporting System Restricted Access Database (NVDRS **RAD).** The current study provides new evidence for understanding firearm suicides among women by using data from a unique surveillance system, the National Violent Death Reporting System Restricted Access Database (CDC, 2016b; NVDRS RAD), which contains rich circumstance data at the individual level. The CDC granted permission for the researcher to use individual-level suicide mortality data from 2012 to 2016 (CDC, 2016a) to measure demographic characteristics and precipitating circumstances associated with firearm and nonfirearm suicides. As of August 2016, mortality data for 32 states from 2012 to 2016 were available from the NVDRS to use for analysis (see Figure 7). This data set is an extensive and demographically wellcharacterized database with toxicology reports, coroner, and medical examiner reports documenting more information about the suicide. Although limited to completed suicides, these data allow the analysis of how suicide circumstances may have changed in ways that reflect the growing importance of method-specific circumstances and demographic factors.

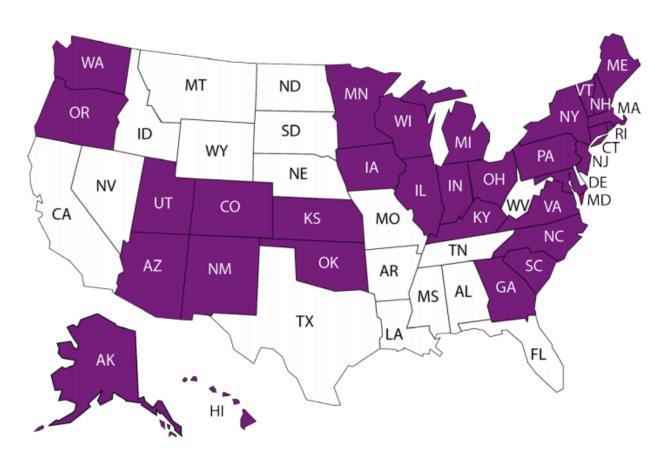


Figure 7. The 32 States Participating in the 2012–2016 NVDRS *Purple=Participating states

Sample of the Individual-Level Data

Inclusion Criteria

Between 2012 and 2016, 18,831 women died by suicide in the 32 participating states. The individual-level data show that 31% of these women used firearms, and 69% used other methods. Suicide decedents included in this study were women aged 18 years and older who were living in the United States. Considering the age range (Ivey-Stephenson et al., 2017), rates of suicide among women generally increase substantially in emerging and early adulthood (18–25 and 26–39 years) and continue to increase in the middle-age period (40–59). Suicide decedents aged 60 and older were included in the study because those who completed suicide with a firearm were more likely to be in the older age group (Kaplan et al., 1997). Other studies, such as Phillips (2014), found that the suicide rates increase at each point of the life course after the previous generation, suggesting that as the young and middle-aged cohort age into older adulthood, the rate of suicide among older women may increase. Recent studies have used similar age categories to understand suicide patterns and behaviors (Kaplan et al., 2015; Kerr et al., 2017).

Missing Data

At the individual-level data, there were 18,831 suicide decedents. There were 7,804 cases that did not have toxicology reports to identify whether the suicide decedents had blood alcohol concentration greater than or equal to .08 mg/dl. After running a chi-square, there were no significant differences between suicide decedents who did have toxicology reports and those who did not have toxicology reports. Thus, 7,804 cases were removed, retaining 59 percent of the suicide decedents. Thus, the final analysis includes 11,027 suicide decedents, with 2,915 suicide decedents who used firearms and 8,112 who used nonfirearms.

It should also be noted that the data collected for the precipitating circumstances, including mental health, suicidal event/history, relationship problem/loss, life stressors, and substance risk, had only two response options. Either "no, not available, unknown" and "yes" were choices for the coder to choose from. Thus, missing data was included in the response option as "no, not available, unknown."

Dependent Variable in the Individual-Level Data

Firearm Versus Nonfirearm (All Other Methods) Suicides

Mortality data on suicides have been coded using the *ICD-10* to classify the manner (intent) of the death or injury and the mechanism (cause) of the event from death certificates. Suicide (manner of death) is defined in the *ICD-10* as "purposely self-inflicted poisoning or injury" (World Health Organization, 2003). Suicide deaths are categorized by method of injury using the following *ICD-10* codes: firearm (X72–X74), suffocation (X70), poisoning (X60–X69), and other methods (U03, X71, X75–X84, and Y87.0). The following *ICD-10* codes for firearm-related suicides are defined as X72 (intentional self-harm by handgun discharge), X73 (intentional self-harm by rifle, shotgun, and larger firearm discharge), and X74 (intentional self-harm by other and unspecified firearm discharge). Based on previous findings (Anestis, Khazem, & Anestis, 2017; Birckmayer & Hemenway, 2001), two groups of measures are applied to this study. First, the main outcome variable is method of suicide: (a) suicide by firearm (*ICD-10* codes X72–X74) and (b) suicide by all other methods, including death from a sharp or blunt instrument (*ICD-10* codes X78–X79), poison (X60–X69), hanging (X70), fall (X80–X81), drowning (X71), fire or burns (X76–X77), motor vehicle (X82), or other (X75, X83–X84).

Covariates

In this study, different independent and control variables are used to test the hypotheses. The independent variables analyzed included (a) suicide decedents' demographic characteristics, including urbanicity; (b) psychological factors, including mental health status and suicidal behaviors; (c) sociological factors, including specific details of individual suicide circumstances preceding the event; and (d) dependence on alcohol, blood alcohol levels at the time of death, and substance abuse history. Variable definitions were adopted from the NVDRS codebook (CDC, 2016a).

Demographic characteristics are derived from death certificates. In this study, marital status (married or not married), age (18–25, 26–39, 40–59, and 60 and older), veteran status, education (less than or equal to high school vs. greater than high school), the region of residence at the time of death (Northeast, Midwest, West, or South), and urbanicity/rurality (metropolitan, nonmetropolitan) were used. Since most of the suicides were among White women, all other racial and ethnic groups were combined into one group. Figure 8 shows the four divisions and nine regions with the corresponding states (U.S. Census Bureau, 2010).

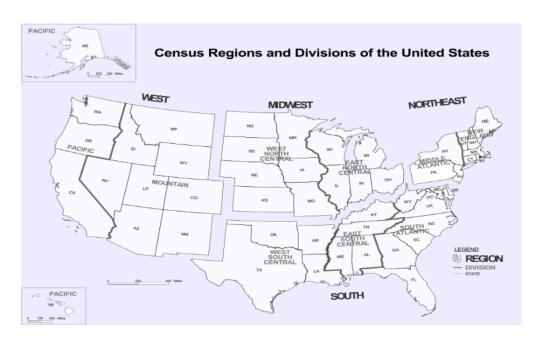


Figure 8. Census Regions and Divisions of the United States

Source: U.S. Census Bureau (2010).

Metropolitan and nonmetropolitan residence status was established by matching each suicide case to the rurality of the decedent's county of residence using the 2013 National Center for Health Statistic urban-rural classification scheme for counties (Ingram & Franco, 2013). The urban-rural classification scheme for counties classifies each U.S. county into six categories and characterizes metropolitan counties by population and nonmetropolitan counties by level of urbanization to metropolitan areas. The categories range from "1" (counties in metropolitan areas of 1 million population or more) to "6 (completely rural or less than 49,000 population) (Ingram & Franco, 2014, pp. 2–3). The 6 categories were recoded into two categories, metropolitan (codes 1 through 4) and nonmetropolitan (code 5 through 6) residence status.

Precipitating circumstances. Three major variables that address the differences between firearm and nonfirearm suicide are (a) psychological factors, (b) sociological factors, and (c) substance misuse risk. These factors are defined in the NVDRS as "precipitating circumstances" and life events.

Data were collected from proxy information (friends or family) and the scene investigator. The following precipitating circumstances are coded "yes" or "no" in the analysis: (1) ever treated for a mental health problem, (2) current mental health problem, (3) current treatment for a mental health problem, (4) current depressed mood, (5) disclosed intent to die of suicide, (6) previous suicide attempt, (7) left a suicide note, (8) recent suicide of a family member or a friend, (9) physical health problem, (10) dependence on alcohol, (11) blood alcohol levels at the time of death, (12) intimate partner/relationship problem, (13) financial problem, (14) job problem, (15) criminal or legal problems, (16) argument over money/property, and (17) crisis in the past 2 weeks (CDC, 2016a). A fuller description of the NVDRS RAD variables

appears in Appendix A (CDC, 2016a). In this study, precipitating circumstances are broken down into three categories, including (a) psychological, (b) sociological, and (c) substance misuse risk.

Psychological Factors

Mental health status was defined with four items, including (a) ever treated for a mental health problem, (b) current mental health problem, (c) current treatment for a mental health problem, and (d) current depressed mood. Family members or friends reported if the suicide decedent had a perceived mental health diagnosis or a mental health problem.

History of suicidal behavior was defined as whether the suicide decedent disclosed an intention to complete suicide or any history of nonfatal suicide attempts or behavior based on reports by family members or friends.

Sociological Factors

Life events/crises are defined as decedent experiencing a crisis within 2 weeks before the suicide or if a crisis had appeared imminent based on reports by family members or friends. Family members were also asked if the decedent experienced any of the following: financial problems, physical health problems, job problems, or criminal legal problems.

Any relationship problem/loss is defined as the decedent experiencing relationship problems with a friend, intimate partner, family member, and associate before the suicide. In addition, any loss includes the death of a loved one by suicide or nonsuicide death. Arguments or conflicts are defined as decedents having a specific argument that was perceived as related to the death (e.g., an argument over money, a relationship problem, or an insult).

Substance Misuse Risk

Substance use other than alcohol was measured from reports by proxies (family

members or friends) on whether the decedent was perceived by self or others to have had a substance abuse problem shortly before death.

Alcohol dependence was measured from reports by proxies on whether the decedent was perceived by self or others to have had an alcohol problem shortly before death.

Blood alcohol concentration (BAC) was measured to explore the relationship between alcohol intoxication and suicide with data on time of injury, time of death, and time at which body specimens were drown. The BAC was first coded as a continuous measure in terms of weight by volume and then categorized as 0.08 g/dL or ≥ 0.08 g/dl. In this analysis, the BAC ≥ 0.08 g/dl was chosen to represent alcohol intoxication as noted by the US Department of Transportation. Of note, only 62.4 percent of all suicide decedents in this sample was tested for alcohol across 32 states. Eleven states (Georgia, Indiana, Kansa, Kentucky, Maine, Michigan, New Hampshire, New York, Ohio, Oregon, South Carolina, and Washington) had testing rates lower than 60 percent. The percent of women who died by suicide in 32 states who underwent autopsy for alcohol testing appears in Table 1.

Table 1. Prevalence (%) of suicide decedents tested for alcohol

Alaska	97.7	New Hampshire	35.9
Arizona	71.5	New Jersey	88.7
Colorado	78.9	New Mexico	89.2
Connecticut	97.1	New York	44.4
Georgia	29.4	North Carolina	95.8
Hawaii	94.2	Ohio	26.6
Illinois	75.5	Oklahoma	86.8
Indiana	24.7	Oregon	44.0
Iowa	85.5	Pennsylvania	60.8
Kansas	50.5	Rhode Island	97.9
Kentucky	51.5	South Carolina	30.1
Maine	57.4	Utah	94.9
Maryland	91.6	Vermont	77.8
Massachusetts	79.9	Virginia	70.1
Michigan	40.5	Washington	26.0
Minnesota	88.5	Wisconsin	71.7

Data Analysis for Answering Q2

First, descriptive statistics include frequencies, percentages, means, and standard deviations of variables contributed to suicides by firearms and nonfirearms among women from 2006 to 2015. Descriptive statistics are also presented to show the frequencies and percentages by the five regions, decedents' demographic characteristics, psychological factors, sociological factors, and substance misuse risk.

Second, Pearson's chi-square tests were used to examine the associations between demographic characteristics, psychological, sociological, and substance misuse risk factors and women who completed suicide with a firearm as compared with women who used other suicide methods. The purpose of conducting the chi-square test was to eliminate non-significant variables because there were over 25 potential variables, which could result in predictors. Thus, only statistically significant independent variables from the chi-square tests

were included in the multiple logistic regression to build a robust model. The logistic regression was used to assess the relative odds of using a firearm for each precipitating circumstance (psychological, sociological, and substance misuse) and demographic characteristics (Conner et al., 2014; Kaplan et al., 2009a; Siegel & Rothman, 2016). The youngest age group is used as the reference category. Age groups include 18 to 25 years, 26-39 years, 40-59 years, and 60 and older. Tables are constructed to compare differences between suicide decedents with firearm use and nonfirearm use among women. To aid the interpretation of the results, the odds ratios were used with their 95% confidence intervals. For this model, the dependent variable was set to 0 or 1, depending on if the suicide decedent used a firearm (coded "1") or not (coded "0"). Finally, a multiple logistic regression using Wald forward selection is used to identify the variables that had a statistically significant contribution to explain the dependent variable (firearm use vs. nonfirearm use). All statistical analyses are conducted using the Statistical Package for the Social Sciences (SPSS) Version 27.0.

Summary of Chapter 4

Chapter 4 describes a social-ecological approach to understanding the proximal and distal firearm suicide risk factors among women using both state-level and individual-level data (see Table 2). The chapter begins with the definition of firearms and women's choice of method using firearms and describes a two-step data collection process starting with the state-level data from WISQARS (2017). It then summarizes the historical context of the NVDRS as a way to support the use of the individual-level data collection method in the second step. Main variables were extracted from these two databases. Due to the nature of secondary data analysis, specifically in the NVDRS, limitations include not having data from all states and the possible exclusion of major determinants in the analysis due to unavailability.

Table 2. State-Level Variables

Variable	Question Wording ^c	Source
Demographic charac		
White	What is Person 1's race?	U.S. Census American Community Survey, 2017
College educated	What is the highest degree of level of school this person has completed?	U.S. Census American Community Survey, 2017
Veteran	Has this person ever served on active duty in the U.S. Armed Forces, Reserves, or National Guard?	U.S. Census American Community Survey, 2017
Living in rural area	What is your area code?	U.S. Census American Community Survey, 2017
Divorced	What is this person's marital status?	U.S. Census American Community Survey, 2017
Socioeconomic factor	·s	
Living below poverty level	What was this person's total income during the past 12 months?	U.S. Census American Community Survey, 2017
Social capital		
Social capital index	25 state-level indicators related to social, economic, health, and other indicators	Social Capital Project, 2018 ^a
Gun culture		
Gun ownership b	Status of gun ownership ascertained using six questions ^b	Kalesan, Villarreal, Keyes, & Galea, 2015
Health indicators		
Binge drinking	How many times during the past 30 days did you have four or more drinks on any occasion?	Behavioral Risk Factor Surveillance System, 2017
Accessing health care	Do you have any kind of health care coverage?	Behavioral Risk Factor Surveillance System, 2017
Depression	Has a doctor, nurse, or other health professional ever told you that you have a form of depression?	Behavioral Risk Factor Surveillance System, 2017

^a Social Capital Project measures include data from (a) Civic Engagement Supplement to the November 2008 Current Population Survey; (b) Behavioral Risk Factor Surveillance System; (c) National Survey of Children's Health, 2016; (d) American Community Survey, 2012–2016, 5-year estimates; (e) Volunteer Supplement Population Survey, 2013 and 2015; (f) County Business Patterns, 2015; (g) IRS, Business Master File, 2015; (h) Election Administration and Voting Survey, 2010; and (i) FBI Uniform Crime Reporting Statistics, 2014.

^b The gun ownership rate was ascertained using six questions that asked about the status of firearm ownership, including whether they "were a gun owner," "were given a firearm as a gift," "bought a firearm before year 2000," "brought a firearm after 2000," "used the firearm for hunting," "attended firearm safety classes," and "advocated responsible gun ownership."

^C The person level variables have been aggregated to the state level.

CHAPTER 5: RESULTS

This chapter describes the data and statistical analysis results from two data sources: the state-level data from WISQARS mortality reports and the individual-level data from the NVDRS RAD data set. From the state-level data describing the population who died by firearm suicide, results were reported based on the findings on the relationship between the dependent variable (firearm suicide rate) and the selected independent variables, including demographics, gun culture, social capital, and socioeconomic and health factors. From the individual-level data describing correlates with each type of suicide, results were reported to support the findings on the relationship between the dependent variable (firearm vs. nonfirearm suicide) and the selected independent variables based on the conceptual framework in this study.

State-Level Data

Descriptive Statistics

The population-level data consist of information about women suicides collected in 50 states based on the 2017 CDC WISQARS mortality reports (see Table 3). Across the United States, the majority of women in this sample were White (69.46%). On average, 10.40% of these women had fewer than 12 years of education. More than a quarter (26.22%) of suicide decedents had resided in rural areas. In addition, on average, less than 9% had served in the U.S. Armed Forces, Reserves, or the National Guard.

In this CDC sample, on average, 12.49% of women had reported being divorced, and less than 16% struggled financially below the state-level poverty line. Based on a social capital index scale (–2.2 to 2.1), the average score for both women and men was .034. In other words, states leaned more toward higher social capital, suggesting that the collective value of social networks, as well as norms of mutual aid and reciprocity, was closer to zero. The average gun ownership

rate for both women and men was 33.09%. This shows that at least a third of individuals owned a firearm across all states.

The health indicator includes three measures: binge drinking, accessing health care, and depression. The percentage of binge drinkers among women was found to be 12.12%. About a quarter (25.54%) of women in the state reported depression. However, the average percentage of women who did not have health care coverage was 9.48%.

Table 3. State-Level Descriptive Statistics

Variable	Mean	SD	N	
Demographic characteristics (%)				
White	69.46	15.94	50	
Less than high school education	10.40	2.81	50	
Veteran	8.45	1.51	50	
Living in rural areas	26.22	14.40	50	
Divorced	12.49	1.38	50	
Socioeconomic factors (%)				
Living below poverty level	15.21	3.24	50	
Social capital ^a				
Social capital index (-2.2 to 2.1)	0.034	0.99	50	
Gun culture (%) ^a				
Gun ownership (%)	33.09	13.53	50	
Health indicators (%)				
Binge drinking	12.12	2.20	50	
Accessing health care	90.62	3.65	50	
Depression	25.54	4.06	50	

^a Data for gun ownership and social capital were not available by gender. Data collected included the demographics of both women and men.

Assumptions

Before conducting the multiple regression analysis, several statistical procedures were implemented to examine whether the assumptions were met, including normality of distribution, linear relationships between firearm suicide rates and factors, homoscedasticity, and multicollinearity. Measures of skewness and kurtosis, histogram, and Q-Q plots show that the shapes of the distributions of firearm suicide rate approach that of a normal curve. Pearson's

correlations and partial scatterplots show a linear relationship between firearm suicide and all factors. The inspection of the scatterplot of predicted scores against the residual confirms that the assumption of homoscedasticity was met. Finally, the evaluation of the correlation matrix and both VIF and tolerance values show no multicollinearity among the factors.

Association between Firearm Suicide Rate and State-level Predictors

When examining the bivariate association between the firearm suicide rate and the state-level predictors, the results indicated multiple significant positive associations (see Table 4). The results show that states with more women veterans had higher rates of firearm suicide among women (r = .65, $p \le .001$). In states with more women living in rural areas, there were higher rates of firearm suicide among women (r = .46, $p \le .001$). Results suggest that states with higher divorce rates among women also had higher rates of firearm suicide among women (r = .60, $p \le .001$). In addition, states with more women living in poverty had higher rates of firearm suicide among women (r = .48, $p \le .001$).

State gun ownership patterns revealed that states with more people owning guns, the higher the firearm suicide rate among women (r = .76, $p \le .001$). State health indicators also appear significant. The results show that states with more women with depression had higher rates of firearm suicide (r = .65, $p \le .002$). Also, states where access of health care services are difficult for more women, there is a higher rate of firearm suicide among women (r = -.40, $p \le .004$). States with a higher proportion of women binge drinking had lower rates of firearm suicide rates among women (r = -.41, $p \le .003$).

Table 4. Bivariate Associations with the State Firearm Suicide Rate among Women, 2013–2017

Variable	r	N	р
Demographic characteristics (%)			-
White	0.13	50	.388
Less than high school education	0.15	50	.314
Veteran	0.65	50	.001
Living in rural areas	0.46	50	.001
Divorced	0.60	50	.001
Socioeconomic factors (%)			
Living below poverty level	0.48	50	.001
Social capital			
Social capital index (-2.2 to 2.1)	-0.24	50	.102
Gun culture (%)			
Gun ownership	0.76	50	.001
Health indicators (%)			
Binge drinking	-0.41	50	.003
Accessing health care	-0.40	50	.004
Depression	0.43	50	.002

Multivariate Analysis

Table 5 shows the multiple linear regression analyses and stepwise regression analyses of the independent variables (demographics, socioeconomic, gun culture, and health indicators) on the statewide firearm suicide rate among women. Results showed that firearm suicide rates among women were correlated with the proportion of the state populated to report depression. Likewise, states with a higher percentage of veterans and divorced women were correlated to firearm suicide rates among women across states. Also, states with a higher proportion of depression were significantly associated with higher firearm suicide rates among women. States with a lower proportion of women accessing health care were significantly associated with the higher rates of firearm suicide rates for women. In sum, states with more veterans, higher divorce rates, higher depression rates, and lower rates of accessing health care needs are all associated with firearm suicide rates among women.

Because significance testing can be misleading, the effect size using Cohen's f^2 was used to emphasize which finding was most important. Effect size for multiple linear regression is Cohen's f^2 and the effect size measure for f^2 are .02, .15, and .35, indicating small, medium and large effect. It is important to note that the effect size for gun ownership rates had a medium effect (f^2 =.197). In contrast, the effect size for other variables, including the percentages of divorce, veteran status, accessing healthcare coverage, and depression among women was quite small. The most salient finding show that states with more firearm availability have higher rates of women dying by firearm suicide.

Table 5. Stepwise Regression of Statewide Variables on Firearm Suicide Rates Among Women

Variable	Stepwise Regression					
	В	β	SE	p	Lower CI	Upper CI
Constant	4.37		2.81	0.127	-1.29	10.02
Demographic characteristics (%)						
Veteran	0.18	0.18	0.08	0.037	0.01	0.35
Divorced	0.25	0.23	0.08	0.010	0.06	0.44
Gun culture (%)						
Gun ownership	0.06	0.5	0.5	0.001	0.04	0.07
Health indicators (%)						
Accessing health care	-0.11	-0.26	0.03	0.001	-0.17	-0.05
Depression	0.08	0.2	0.03	0.011	0.02	0.13
F statistic (df)	41.49 (5,	44)**				
Adjusted R ²	0.81					

^{}***p* ≤ .001.

Individual-Level Data:

Associations between the Use of Firearm and Other Nonfirearm Suicide Methods

Chi-square (χ^2) tests were conducted with each of the independent variables to determine their association with the dependent variable (firearm suicide decedents vs. nonfirearm suicide decedents) (see Table 6). There were several significant differences between firearm and nonfirearm suicide decedents. The results using the chi-square test showing the differences between demographic characteristics, psychological factors, sociological factors, and substance misuse among firearm and nonfirearm suicide decedents will be presented.

Demographic Characteristics

Women who died by suicide using a firearm show unique demographic characteristics compared to women who used other methods. The chi-square test shows that among older adults,

a higher proportion of older adults used a firearm (19.8%) to complete suicide compared to nonfirearm methods (18.1%) (χ^2 (1, N = 11,027) = 13.1, df = 3, p = .004). However, among women aged 40 to 59 and 26 to 39, a higher proportion of middle-aged and younger women used nonfirearm to complete suicide compared to women who used firearms (χ^2 (1, N = 11,027) = 13.1, df = 3, p = .004. Compared to nonfirearm suicides, women who used firearms to complete suicide were proportionally more likely to be White (91.4% vs. 87.3%) (χ^2 (1, N = 11,027) = 35.2, df = 1, p = .001, married (42.7% vs. 29.4%) (χ^2 (1, N = 11,027) = 171.8, df = 1, p = .001), residing in the South (46.7% vs. 30.5%) (χ^2 (1, N = 11,027) = 533.5, df = 3, p = .001), living in a nonmetropolitan area (22.4% vs. 13.9%) (χ^2 (1, N = 11,027) = 115.6, df = 1, p = .001, and a veteran (4.3% vs. 2.4%) (χ^2 (1, N = 11,027) = 90.2, df = 1, p = .001).

Psychological Factors

Mental Health

Women who used a firearm to complete suicide were proportionally less likely to have a history of being treated for a mental health problem (45.5%) compared to women who used nonfirearm methods (58.9%) (χ^2 (1, N = 11,027) = 157.2, df = 1, p = .001). The suicide decedent using a firearm (36.1%) were proportionally less likely to be in current mental health treatment (e.g. had a current prescription for psychiatric medication, saw a mental health professional or participated in an outpatient treatment within the past two months) than those who used nonfirearm methods 50.1%) (χ^2 (1, N = 11,027) = 169.5, df = 1, p = .001).

Suicidal Event/History

The profile of women who died by suicide with a firearm shows three characteristics associated with suicidal event and history. First, firearm suicide decedents were proportionally more likely disclose intent to complete suicide (25.0%) compared to nonfirearm suicide

decedents (23.1%) (χ^2 (1, N = 11,027) = 4.4, df = 1, p = .035). Second, firearm suicide decedents were proportionally less likely to have previous suicide attempts (23.8%) than the nonfirearm suicide decedents (36.5%) (χ^2 (1, N = 11,027) = 157.6, df = 1, p = .001). Third, firearm suicide decedents (37.1%) were proportionally less likely to leave a suicide note compared to nonfirearm suicide decedents (39.9%) (χ^2 (1, N = 11,027) = 7.2, df = 1, p = .007).

Sociological Factors

Relationship Problems

This study found that firearm suicides among women were often preceded by relationship problems. Women who died by firearm were proportionally more likely to experience intimate partner problems (33.3%) compared to nonfirearm suicide decedents (24.3%) (χ^2 (1, N = 11,027) = 89.7, df = 1, p = .001). Similarly, firearm suicide decedents (20.8%) were proportionally more likely to have argument and conflicts compared to nonfirearm suicide decedents (14.2%) (χ^2 = (1, N = 11,027) 55.8, df = 1, p = .001). Compared to women who died by nonfirearms (6.9%), women who used a firearm were more likely to experience a death of a family member or relative by suicide (7.4%) (χ^2 (1, N = 11,027) = 5.2, df = 1, p = .001).

Life Stressors

Financial problems, physical health problems, job problems, and criminal problems were not significantly different between nonfirearm and firearm suicide decedents.

Substance Misuse Risk

Toxicology reports showed that a higher proportion of women who used a firearm to complete suicide were intoxicated with alcohol prior to death (31.9%) (χ^2 (1, N = 11,270) = 30.9, df = 1, p = .001) compared to nonfirearm suicide decedents (26.4%). In addition, nonfirearm

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users (23.4%) had a higher proportion of a substance abuse problems other than alcohol compared to firearm suicide decedents (16.1%) (χ^2 (1, N = 11,027) = 67.5, df = 1, p = .001).

Table 6. Characteristics of Firearm and Nonfirearm Suicide among Women, National Violent Death Reporting System, 2012–2016

Variable	Deced	Firearm Suicide Decedents $(n = 2,915)$		arm cedents 12)	χ^2	
	n	%	n	%		
Demographic characteristics						
Age						
18–25	309	10.6	802	9.9	13.1**	
26–39	695	23.8	1,815	22.4		
40–59	1,334	45.6	4,027	49.6		
60+	577	19.8	1,468	18.1		
Race						
White (vs. non-White)	2,661	91.4	7,063	87.3	35.2***	
Married (vs. unmarried)						
Married	1,244	42.7	2,838	29.4	171.8***	
Nonmarried	1,671	57.3	5,729	70.6		
Education	ŕ		ŕ			
<12 years	211	9.2	623	9.7	0.5	
≥12 years	2,094	90.8	5,823	90.3		
Region of residence						
Northeast	163	5.6	1,915	23.6	533.5***	
Midwest	629	21.6	1,619	20.0		
South	1,361	46.7	2,374	30.5		
West	761	26.1	2,091	25.8		
Nonmetropolitan area (vs.	653	22.4	6,928	13.9	115.6***	
metropolitan)						
Veteran status (vs. nonveteran)	126	4.3	196	2.4	90.2***	
Mental health						
Ever treated for a mental	1,325	45.5	4,779	58.9	157.2***	
health problem	Ź		,			
Diagnosed with a mental	42	1.4	137	1.7	.8	
health problem						
Current treatment of a mental	1,052	36.1	4,065	50.1	169.5***	
health problem	Ź		,			
Current depressed mood	1,163	39.9	3,131	38.6	1.5	
Suicidal event/history			•			
Disclosed intent to complete	729	25.0	1,872	23.1	4.4*	
suicide			•			
History of ideation	983	33.7	2,841	35.0	1.6	
Previous suicide attempts	693	23.8	2,964	36.5	157.6***	

1,081	37.1	3,238	39.9	7.2**
972	33.3	1,972	24.3	89.7***
104	3.6	254	3.1	1.3
95	3.3	230	2.8	1.3
607	20.8	1,153	14.2	69.8***
235	8.1	589	7.3	1.9
891	7.4	429	6.9	1.6***
268	9.2	686	8.5	1.5
599	20.5	1,792	22.1	3.0
248	8.5	614	7.6	2.6
120	3.7	386	4.3	2.0
469	16.1	1,896	23.4	67.5***
518	17.8	1,524	18.8	1.5
900	31.9	2,044	26.4	30.9***
	104 95 607 235 891 268 599 248 120 469 518	972 33.3 104 3.6 95 3.3 607 20.8 235 8.1 891 7.4 268 9.2 599 20.5 248 8.5 120 3.7 469 16.1 518 17.8	972 33.3 1,972 104 3.6 254 95 3.3 230 607 20.8 1,153 235 8.1 589 891 7.4 429 268 9.2 686 599 20.5 1,792 248 8.5 614 120 3.7 386 469 16.1 1,896 518 17.8 1,524	972 33.3 1,972 24.3 104 3.6 254 3.1 95 3.3 230 2.8 607 20.8 1,153 14.2 235 8.1 589 7.3 891 7.4 429 6.9 268 9.2 686 8.5 599 20.5 1,792 22.1 248 8.5 614 7.6 120 3.7 386 4.3 469 16.1 1,896 23.4 518 17.8 1,524 18.8

^{*}*p* < .05 ***p* < .01. ****p* < .001.

Logistic Regression

Standard logistic regression was conducted to compare the differences among women who used a firearm or nonfirearm suicide. There were 16 predictors that were found to be statistically significant in the chi-square analysis, as presented in Table 6. A stepwise (forward Wald) logistic regression analysis was conducted using the statistically significant factors associated with the choice of method. In each forward step, each variable that is added to the model gives the single best improvement to the model. The updated model as a whole explained 17% (Nagelkerke R^2) of the variances in firearm use. The updated model was statically significant ($\chi^2(15, N=11,132)=1,288.25, p=.001$; see Table 7). Type 1 error was eliminated, given that the p-value in the overall model is less than .001.

Table 7 presents the adjusted odds with 95% confidence intervals for the use of firearms versus other means of suicide. First, all 16 independent variables were entered simultaneously into a multivariate logistic model. A stepwise logistic regression model was used to understand the differences between firearm and nonfirearm suicide among women. As shown in Table 7, 13 of the independent variables made unique statistical contributions to the model that predicts the use of firearms among women.

H2a: Women with demographic characteristics such as being older than 60 years, White, unmarried, living in regions other than the Northeast, veteran status, and living in rural areas will have significantly higher odds of using a firearm to complete suicide compared to using a nonfirearm method.

In the chi-square results, similar results from the logistic regression was observed. Compared to nonfirearm suicides, women who used firearms to complete suicide were proportionally more likely to be white, married, residing in the South, living in a rural area and a veteran. In the logistic regression results, this study evaluated the relationship between the choice of suicide method and demographic characteristics. Women who died by firearms were more likely to be White (adjusted odds ratio [AOR] = 1.73, p = .001). In addition, women who died by firearm were more likely to live in the Midwest, South, and West (compared to Northeast). Results suggest that the likelihood of firearm suicide among women is greater among those who were married (AOR = 1.74, p = .001). Moreover, those who resided in the nonmetropolitan (compared to metropolitan) areas had a greater likelihood of firearm use (AOR = 1.39, p = .001).

The findings show that compared to the youngest age group, women age 40 to 59 years were 18% less likely to use firearms (AOR = .82, p = .001) compared to those who used nonfirearms. Additionally, compared to women aged 26-39 years, women aged 40 to 59 years

were less likely to use firearms compared to nonfirearms to complete suicide by 11% (AOR = .81, p = .001). Further, compared to women aged 40 to 59 years, women aged 18 to 25 years, 26 to 39 years, and 60 years and older were more likely to use firearms compared to nonfirearms to complete suicide by 46%, 25%, and 21%, respectively (AOR = 1.46, p = .001; AOR = 1.25, p = .001; AOR = 1.21, p = .004).

H2b: The odds of using a firearm method among women will be significantly lower if they had psychological factors, including depressed mood, the current treatment of a mental health problem, left a suicide note, and previous suicide attempts, compared to those who used firearms.

In the logistic regression results, this study evaluated the relationship between the choice of suicide method and psychological factors. Women who died by firearms were less likely to be in treatment for mental health problem (AOR = .57, p = .001). Likewise, suicide among women who used firearms were less likely to experience previous suicide attempts (AOR = .59, p = .001). Based on the chi-square test, there was not a significant difference in depressed mood among nonfirearm and firearm users. Further, suicide decedents who used a firearm were less likely to leave a suicide note (AOR = .87, p = .003).

H2c: The odds of using a firearm to complete suicide among women will be significantly higher if they had any relationship problems compared to those who used nonfirearm methods.

In the logistic regression results, this study evaluated the relationship between the choice of suicide method and relationship problems. Results suggest that women who died by firearms were more likely to experience intimate partner problems compared to women who used other methods (AOR = 1.27, p = .001). In addition, those who experienced the death of a family member or relative by suicide were more likely to use firearms (AOR = 1.46, p = .003). Further,

there is evidence those who had an argument that preceded the suicide attempt were more likely to use firearms (AOR = 1.20, p = .009).

H2d: The odds of using a firearm to complete suicide among women will be significantly higher if they had a substance or alcohol misuse problem compared to those who used nonfirearm methods.

In the logistic regression results, this study evaluated the relationship between the choice of suicide method and substance or alcohol misuse problem. Women who died by suicide using a firearm were less likely to have had substance problems other than alcohol (AOR = .60, p = .001) than women who used other methods. On the other hand, women who used a firearm to complete suicide were more likely be intoxicated with alcohol (BAC \geq .08 mg/dl) prior to death (AOR = 1.24, p = .003).

Overall, the logistic regression analysis (Table 7) shows that compared to nonfirearm suicide decedents, firearm suicide decedents were significantly more likely to be White, living in a state other than the Northeast regions, and residing in rural areas. Psychological, sociological, and substance misuse problems also appear to have had an impact on the choice of suicide methods. Specifically, firearm suicide decedents were more likely to have experienced intimate partner problems, arguments or conflict, and the suicide of a family member or relative. Also, firearm suicide decedents were significantly less likely to have had a substance abuse problem shortly before death but more likely to have a BAC greater than .08 mg/dl. Furthermore, women who died of suicide using firearms were significantly less likely to have been treated for a mental health problem.

Additionally, given the large sample size in this sample, the calculations of odd ratios were converted into Cohen's d (Cohen & Chen, 2009). Each odd ratio was computed from the

Cohen's D effect size measure. As a reference point, a "weak association", "moderate association", and a "strong association" odds ratio was 1.68, 3.47 and 6.71, respectively (Cohen & Chen, 2009). It is important to note that the effect size for residing in the Midwest (AOR = 4.25), South (AOR = 6.64) and West (AOR = 4.16) had a strong and moderate effect while the effect size for other variables were quite small. As such, the most salient finding shows that individual who live in regions other than the Northeast have a higher chance of dying by suicide with a firearm compared to nonfirearms.

Table 7. Factors Associated with Firearm Use among Women Who Completed Suicide, National Violent Death Reporting System, 2012–2016

Variable		Stepwi	se (Forward V	Wald) ^a	
	В	AOR	Lower CI	Upper CI	p value
Demographic characteristics					
Age					
18–25 ^b					
26–39	-0.16	0.86	0.72	1.02	.083
40–59	-0.36	0.69	0.59	0.82	.001
60+	-0.18	0.84	0.69	1.01	.064
Race					
White (vs. non-White)	0.55	1.73	1.47	2.03	.001
Married (vs. unmarried)	0.55	1.74	1.58	1.92	.001
Region of residence					
Northeast ^b					
Midwest	1.45	4.25	3.49	5.17	.001
South	1.89	6.64	5.52	7.99	.001
West	1.42	4.16	3.43	5.03	.001
Nonmetropolitan area (vs.	0.33	1.39	1.24	1.56	.001
metropolitan)					
Mental health					
Current treatment of a	-0.55	0.57	0.52	0.63	.001
mental health problem					
Suicidal event/history					
Previous suicide attempts	-0.53	0.59	0.53	0.66	.001
Left a suicide note	-0.14	0.87	0.79	0.95	.003
Any relationship					
problem/loss					
Intimate partner problem	0.24	1.27	1.14	1.43	.001
Argument or conflict (not	0.18	1.20	1.05	1.37	.009
specified)	33		50	5 /	,
1/					

Suicide of family member or relative	0.38	1.46	1.14	1.88	.003
Substance risk					
Substance problem other	-0.51	0.60	0.53	0.68	.001
than alcohol					
$BAC \ge .08 \text{ mg/dl}$	0.21	1.24	1.11	1.37	.001

Note. B = unstandardized beta; AOR = adjusted odds ratio; BAC = blood alcohol concentration.

Summary of Chapter 5: Findings by Hypothesis

In sum, the ecological and individual findings are presented below.

1. State-level:

H1: States with more women who were veterans, divorced, gun owners, and depressed have higher rates of firearm suicide among women.

H1a: States with a higher proportion of veterans, rural residence, and divorced women will have significantly higher rates of state-level firearm suicide among women.

H1b: States with a higher proportion of women living with poverty will have significantly higher rates of state-level firearm suicide among women.

H1c: There is no association between states with higher levels of social capital and rates of firearm suicide among women.

H1d: States with a higher proportion of gun ownership rates will have significantly higher rates of state-level firearm suicide among women.

H1e: States with a lower proportion of women binge drinking, a higher proportion of depression, and lower proportion of accessing health care will have significantly higher rates of state-level firearm suicide among women.

2. Individual-level:

H2: Compared to women who used nonfirearm methods to complete suicide, women

^a The model was statistically significant ($\chi^2(15, N=11,132)=1,288.25, p=.001$).

^b Reference group.

who used firearms to complete suicide were significantly more likely to be white, unmarried, from the Midwest, South and West (compared to Northeast). Additionally, firearm suicide decedents were more likely to experience intimate partner problems, arguments and/or conflict, death of a loved one by suicide, and BAC greater than or equal to .08 mg/dl. On the other hand, women who used nonfirearm methods were more likely to experience substance problem other than alcohol, to experience previous suicide attempts, to receive mental health treatment, and to write a suicide note.

H2a: The likelihood of using a firearm to complete suicide decreased for suicide decedents who were older, particularly from ages 40 to 59, but the likelihood of using a firearm to complete suicide increased if the suicide decedents were White, married, residing in the regions other than the Northeast part of the United States, and living in rural areas

H2b: The likelihood of using a firearm to complete suicide decreased if suicide decedent received mental health treatment and have had previous suicide attempts.

H2c: The likelihood of using a firearm to complete suicide decreased if the suicide decedent left a suicide note, but the likelihood of firearm suicide increased if the suicide decedent experienced intimate partner violence, the burden of losing someone by suicide, and interpersonal conflicts.

H2d: Women who used firearms to complete suicide were significantly less likely to have had a history of nonalcoholic substance use, but significantly more likely to have had a BAC \geq .08 mg/dl before death.

Summary of Findings across Studies

Based on Hypothesis 1, only demographic factors, gun culture, and health indicators are significantly associated with firearm suicide. However, Hypothesis 2 is supported by the evidence from the finding that the relative odds of using a firearm compared to a nonfirearm among women differ in demographic characteristics, psychological factors, sociological factors, and substance and alcohol misuse risk factors.

Based on the ecological study, the results showed that states with higher rates of gun ownership (57.50%) and more women being divorced (16.90%) explain the majority of the variance in the model. The relationship between divorce and firearm suicide among women suggests that relationship breakups are inherently stressful, which could produce feelings of loneliness. On the contrary, based on the individual-level data, being married could increase the likelihood of using a firearm compared to other methods of suicide.

The study's individual-level data are important because the results show that firearm suicides could result from many factors other than mental health problems. A critical highlight shows that women who died by firearms compared to other methods have a higher likelihood of acute alcohol consumption prior to their death, suggesting that this may be regarded as an impulsive act. Even though firearm suicide seems to be unpredictable and could be impulsive, there are predictive factors that families, friends, and helping professionals can detect for prevention. For example, the connection of sociological factors could predict the likelihood of firearm use among women. A noteworthy finding in this study is that relationship problems, such as having a conflict with one's intimate partner and other types of interpersonal issues, appear to contribute to a higher likelihood of firearm use to complete suicide. Moreover, suicide decedents having experienced the death by suicide of a relative or friend were more likely to use firearms

to complete suicide. In sum, women who have a challenging time coping with multiple losses, including deaths, violence, and conflicts, may use more fatal means to end their own life.

CHAPTER 6: DISCUSSION

The purpose of the current study was to identify predictive factors of firearm suicide among women across the lifespan. Evidence from findings of the state-level and individual-level variables among women of complete suicides provided a better understanding of how psychological, sociological, and demographic patterns could be related to firearm suicide among women. Further, the findings highlight the importance of the complex interaction among contextual (state-level) and personal factors (individual-level). Chapter 6 will highlight significant findings, explain the strengths and limitations of this study method, discuss social work practice and policy implications, and suggest future research directions that aim to address firearm suicide.

Highlights of State-Level Data Analyses

As demonstrated in the analysis, the variables in the modified social-ecological suicide prevention conceptual model for women are potential factors associated with firearm suicide rates. The findings from the multivariate model suggest a possible range of psychological, cultural, and social contributing factors that might be linked to firearm suicide among women. Specifically, based on state-level data, this analysis shows that states with more veterans, higher divorce rates, higher gun ownership rates, lower rates of health care access, and higher rates of depression have higher rates of firearm suicide among women. These findings are important for targeted firearm suicide prevention and intervention, especially for states with more of these risk factors.

While high gun ownership rates, depression, divorce, veterans, and lower rates of accessing health care carry a higher firearm suicide risk among women, this study shows that higher gun ownership rates were the most salient predictor for higher rates of firearm suicide.

Although this study does not confirm causality to the findings that firearm suicide rates are driven by gun ownership, the findings in this study indicate that firearm suicide rates among women are partly driven by firearm gun ownership. Other studies (Siegel & Rothman, 2018; Studdert et al., 2020) have also found similar results to this study's findings. Equally important, evidence from previous research shows that while women are less likely to own firearm in comparison to men, they are more likely to live in a household with firearm that they do no personally own (Wolfson et al., 2018). Although women own firearms at a lower rate compared to men, women may have the accessibility of firearms from their spouse or partner to complete suicide. Thus, the findings in this study highlight the need to lower gun ownership rates and accessibility of firearms among women.

Highlights of Individual-Level Data Analyses

The rising trend in suicide rates among women and their growing use of firearms as a method is a cause for concern. In contrast to the general stereotype that women use only poisoning to complete suicide, the results indicate that at least 30% of women will use a firearm to complete suicide. The debate regarding the gender stereotype that women's suicidal behavior is a plea for help or attention should warrant more scrutiny since women who use firearms have a higher rate of fatal attempts (Payne et al., 2008; Wang et al., 2020).

The modified social-ecological model of suicide prevention framework indicates that the choice of methods is associated with a broad range of demographic, psychological, sociological, and substance misuse risk factors. Specifically, suicide by firearms varies significantly by geographic location and levels of rurality. In particular, women who used a firearm to complete suicide were more likely to live in states other than the Northeast and reside in nonmetropolitan areas (rural areas) compared to those who used a nonfirearm method. This finding is consistent

with previous research showing that those living in nonmetropolitan areas and states other than the Northeast states are more likely to use a firearm to complete suicide (Branas et al., 2004; Kaplan et al., 2012). These risk factors can be a proxy for gun ownership rates and indicate that areas with more gun ownership significantly have an increased risk of firearm suicide among women (Siegel & Rothman, 2018).

In regards to age, the results show that women aged 18 to 25 years, 26 to 39 years, and those aged 60 years and older were more likely to use firearms than nonfirearms to complete suicide compared to those aged 40 to 59 years. Given that past research had established that older women (Kaplan et al., 2012) were more likely to use firearms to complete suicide compared to younger women, the implications of women in the emerging and young adult age group who use firearms remain unclear. It is less certain whether the younger cohort is less likely to speak about their distress and may turn to more impulsive and effective methods to complete suicide. Perhaps, more women of the emerging and young adult age groups are experiencing untreated depression in recent years, a risk factor for firearm suicide. Such a finding would suggest a cohort or generation effect on suicide among women. Moreover, the present study's finding of age shows that women 60 years and older are less likely to use a firearm compared to women aged 18 to 25 years old. This finding further validates that younger adults are turning to more drastic and effective means of suicide. This finding suggests that the use of a firearm to complete suicide shifted from 2012 through 2016 toward younger women.

It has been widely reported that the majority of suicide decedents had major depressive symptomatology (Overholser, Braden, & Dieter, 2012; Perez, Beale, Overholser, Athey, & Stockmeier, 2020). Unlike suicide in general, women who used firearms are less likely to have known or reported mental health problems. The logistic regression model findings show that

firearm suicide decedents were less likely to have had a current treatment of a mental health problem or previous suicide attempt compared to nonfirearm users. Like other studies, women who used firearms to complete suicide are less likely to report depression symptoms or seek mental health treatment (Choi et al, 2018; Kaplan et al., 2009). Thus, this subpopulation of suicide decedents is often hidden, and their mental health problems often go undetected.

This study also demonstrated that two sociological factors preceding suicide played a role in firearm suicides in the logistic regression model. Reports of intimate partner problems and arguments or conflicts among suicidal women who used a firearm underscored the need for more extensive resources to assist women who have interpersonal concerns. Those who work with suicidal women may consider addressing how a life crisis may cause triggering suicidal thoughts, plans, and attempts. Intervention should focus on developing coping skills to deal with these triggers, mainly practicing practical interpersonal skills that could divert these conflicts. On the other hand, this may not be possible because many of the firearm suicides tend to be more impulsive and hard to prevent.

Furthermore, the results also pointed to the burden of losing a family member or relative to suicide among firearm users. While this find is uncommon in the sample, the odds of using a firearm were more likely when there was a death by suicide of a family member or relative compared to those who used other methods. Numerous empirical studies show that suicidal behavior often is precipitated by the experience of loss, including bereavement, death, and threats to essential relationships (Krysinska, 2003; Pitman, 2018; Pitman, Osborn, King, & Erlangsen, 2014). Of note, those who used suicide bereavement services were significantly less likely to be at risk for suicidality, experience a loss of social support, and encounter social loneliness compared to those who did not receive services (Gehrmann, Dixon, Visser, & Griffin,

2020). The loss by suicide of a family member or relative is an extremely traumatic experience regardless of the suicide method; however, diminishing the presence of a lethal method such as firearms could help to eliminate the risk of suicide.

Many suicide decedents have elevated BACs at the time of death (Wilcox et al., 2004). Therefore, the BAC level has been used as a risk measure of alcohol misuse. The findings show that more than one third of women who used a firearm to complete suicide had a BAC greater than or equal to .08 mg/dl level. It is well accepted that acute alcohol use is associated with suicidal behavior (Amiri & Behnezhad, 2020). Moreover, the logistic regression model shows that firearm suicide decedents are more likely to have a BAC greater than .08 mg/dl compared to their nonfirearm suicide counterparts. This finding is similar to other research studies showing that consuming alcohol prior to suicide increases the risk of attempting suicide with a gun (Branas, Richmond, Ten Have, & Wiebe; Kaplan, McFarland, et al., 2013). These data emphasized that in clinical practice addressing and assessing the risk associated with acute alcohol use may be a way to prevent firearm suicides. While acute alcohol use is associated with firearm suicide, a substance problem other than alcohol is more likely to be present among nonfirearm suicide users. A question of some importance was whether substance abuse prevention and treatment programs that focus on individuals with suicidal behavior could reduce suicide. It should be noted that suicide prevention such as a patient-centered taper of opioid dosage, medication-assisted treatment, overdose education, and naloxone distribution and motivational interviewing were evidence-based treatments recommended for this population to reduce suicide (Bohnert & Ilgen, 2019).

Highlights from combining both State-level and Individual-level data

The modified social-ecological suicide prevention conceptual model was applied to understand how state-level factors and individual-level characteristics were used to draw conclusions about the phenomena of firearm suicide among women. Because the population-level findings alone could generate inaccurate conclusions about suicidal behaviors, the findings from both the state-level and individual-level data would be useful to draw a holistic interpretation of firearm suicides among women. Several key conclusions can be drawn from the data analysis.

The findings at the individual-level data showed that firearm users responded differently to crises compared to nonfirearm users. In this study, there is evidence that shows that women who used firearms compared to those who used nonfirearms to complete suicide were more likely to experience an immediate crisis such as an argument or conflict, death by suicide of a family, and intimate partner problems. Furthermore, women who used firearms are more likely to have used alcohol prior to suicide compared to nonfirearms users. It is possible that the use of alcohol could reflect impaired attention response time. These short-term risk factors such as relational problems, instability, and conflict suggest that firearms suicides tend to be more impulsive and harder to prevent compared to nonfirearm users. Furthermore, impulsivity is linked to suicide risk because it is more likely that individuals will take on behaviors that increase the capability for lethal self-harm, such as using firearms to complete suicide.

Second, although mental health is considered one of the most critical risk factors or "standard" warning signs associated with suicide (Nock, Hwang, Sampson, Kessler, 2010), in this study, firearm users were less likely to report mental health problems or previous suicide attempts compared to nonfirearm users. This finding suggests that mental health indicators, including depression, may not be a consistent indicator of among women who attempt suicide

with a firearm (Canetto, 2015). Contrary to individual-level findings, the state-level findings showed that states with more women with depression had higher rates of firearm suicide rates among women. In other words, state depression rates were a factor associated higher firearm suicide rates. The inconsistencies could mean that the proxy did not suspect any mental health indicators even though the suicide decedent may have had depression. Ultimately, women with greater exposure to impulsivity are likely to be overlooked because they do not exhibit the traditional suicide warning signs.

Third, identifying women at risk for using firearms to complete suicide for an impulsive suicide attempt is difficult because of the lack of warning given prior to an attempt. Even though firearm suicides are common among women, these suicide decedents do not have the "standard" trajectory of suicidality such as patterns of established risk factors include longstanding symptoms, such as depression or history of multiple hospitalizations. For example, in this study, observable warning signs such as leaving suicide notes were less likely to left behind among women who complete suicide. As a result, the impulsive act of suicide provides little opportunity to intervene and rescue

To prevent these impulsive suicides, population-level prevention strategies provide intervention that reduce the risk of exposure in the whole population (Rose, 2001). Applied to the population as a whole, population-level prevention strategies typically affect people whose suicide risk is otherwise undetected. In other words, more people were benefiting from the intervention, which "shift the curve of exposure" of suicide (Kaplan & Mueller-Williams, 2020).

A successful population-wide approach to suicide is the "coal gas story" (Kaplan & Mueller-Williams, 2020; Kreitman, 1976). In the United Kingdom, coal gas was the most commonly used method of suicide. With the intervention of the removal of access to coal gas to

natural gas, the trends in gas-related suicide rates drastically decreased (Kreitman, 1976). Thus, population-level firearm suicide prevention may be one way of reducing impulsive suicides among women.

The state-level data shows that states with higher gun ownership rates had higher firearm ownership rates. One of the best ways to reduce gun ownership rates at a population-level is to implement federal policies. Recent evidence in the United States shows that stricter firearm legislation is protective against firearm suicides (Alban et al., 2018; Saadi, Choi, Takada, & Zimmerman, 2020). In particular, Anestis and Anestis (2015) theorize that these laws, waiting periods, safe storage, universal background checks and open carry regulations, might lower gun ownership rates (Anestis & Aneestis, 2015). Yet, gun control's political climate makes it difficult to implement targeted legislation to reduce gun ownership rates (Sperlich, Logan-Greene, Slovak & Kaplan, 2020). Nevertheless, social workers are well-positioned to engage stakeholders to lobby or work with policymakers to reduce the high gun ownership rate in the United States. Evans (2019) calls for social workers to pursue elected office to improve public decision making. In turn, social workers would be able to influence federal firearm legislation and educate others about the link between gun ownership rates and firearm suicide rates. Overall, the findings from the individual-level findings and the state-level findings help advance the interplay of individual and environment influences on suicidal behaviors.

Of note, this study found inconsistencies between marital status on the state-level and the induvial level data. At the individual level, the finding showed that married women were more likely to use firearms to complete suicide than nonfirearm users. On the other hand, at the population-level, this study found that states with higher divorce rates among women had higher rates of firearm suicides. Studies have generally shown that marriage was a protective factor,

while divorce was a risk factor for women who used a firearm to complete suicide (Kposowa 2000; Kposowa & McElvain, 2006). Similarly, the effect of marriage on suicide risk was generally attributable to social integration or social support networks (Kposowa 2000; Hemenway, 2001). However, the individual-level finding of marital status in this study had contradictory results. It coincided with Kaplan et al. (2009a), which showed that women who used firearms to complete suicide were significantly more likely to be married than women who used other means. Johnson (2010) responds to Kaplan et al. (2009a) findings. Johnson (2010) notes that a possible reason for this finding was that women are unlikely to own firearms personally and that women's primary exposure to firearms maybe through their husbands, thereby making a marriage a "risk factor" for firearm suicide. In other words, being married may be a proxy measure for women's increased exposure to firearms in the home. Thus, being married at the individual is not an accurate depiction of marital status at the individual-level; however, divorce rates appear to be a precise measure of marital status.

Another inconsistency between state-level and individual-level data was veterans' status. States with more veterans had higher rates of firearm suicide rates, whereas veteran status was not a significant predictor of using a firearm to complete suicide among women. Other contributing factors in this study, such as immediate crisis, played a more significant role in explaining the phenomena of firearm suicide among women.

Limitations and Implications for Future Research: State-Level Data

Studies based on secondary state-level data could be limited by several factors, including issues common to most ecological studies. First, ecological studies research groups of individuals in the same way, and specifically, this study cannot differential between contextual and compositional effects. This is often referred to as ecological fallacy (Schwartz, 1994). For

example, although the state-level firearm suicide rate is disproportionately high, that does not prove that the actual individual in the particular state is dying by firearm suicide. Thus, the ecological fallacy is a limitation in this study.

Second, two variables, including social capital and gun ownership rates, were not stratified by gender. This could be a potential problem because this study focuses exclusively on the experiences of women's suicidal behavior. Thus, social capital and gun ownership rates do not reflect accurate information specifically for women. However, the data for state-level social capital and gun ownership rates among women were not available. In particular, this study uses an aggregate gun ownership rate for both men and women. The accuracy of the gun ownership rate may pose a challenge to the assumption in the findings because the aggregate gun ownership rate may represent a higher state gun ownership rate for women. However, the gun ownership rate among men and women may allow for estimates of gun ownership rates among women because there may be joint gun ownership in one household. For example, while women are less likely to own firearms, a woman might use a firearm registered under another person in the same household, suggesting that this proxy may be the most useful for gun ownership rates among women.

Third, the state-level data measure firearm suicide rate data, whereas the individual-level data measure the choice of suicide method. The data cannot be compared, given that the variables are not measuring the same independent variables. Furthermore, since there are only 50 states in the United States, the number of independent variables included is restricted. It may be harder to achieve statistical significance due to the small "n" size. Fourth, given that the data are cross-sectional through the years, the same subject may be measured twice through the years of data collection (e.g., 2013–2017).

Fifth, some of the intervening variables might not be available based on secondary data. The researcher cannot control for these intervening variables such as social norms about suicide, and recent mental health policies in the analysis. Last, the data might not represent the current situation as the data were collected in the past. Some variables, such as firearm suicide rates may have changed by 2020. In addition, the independent variables were collected from multiple sources and may have different sampling methods for data collection.

Limitations and Implications for Future Research: Individual-Level Data

Specifically, although the NVDRS RAD data set has limitations, it also led to five significant suggestions for researchers to consider. First, the NVDRS RAD data used in this study were not collected across all states. From 2006 to 2015, only 32 participating states collected data on the circumstances preceding suicide. It is suggested that researchers need to design a national data set that could provide information to generalize results with a comprehensive examination across all states, not only for comparison purposes but also for geographical generalizability when findings on rural residence were used.

Second, the lack of standardization on reporting precipitating circumstances from proxies across states and county jurisdictions may decrease the accuracy and completeness of the information collected. Data abstractors are limited to the information collected and may not include all the necessary information about suicide, which may lead to misclassification or underreporting. It is suggested that studies must report data that are reliable and valid for analytical purposes (Kaplan et al., 2009a). In addition, the precipitating circumstance collected by the proxy should be used with caution. The data collected are conservative estimates because the researchers do not know if "no" means "missing" or the precipitating circumstance was not present. Because the original data did not separate "no" from "not available", the missing data

included in the variable "not available" may lead to misinterpretation of the data results. For example, a suicide decedent could potentially have depression but was lumped into a category for not having depression. This could be a misclassification of characteristics for these suicide decedents, and the information about depression may likely be underestimated. Because only 32 states participated during the study period, the findings may not be generalizable to all U.S. suicide decedents.

Third, the data obtained from coroners and medical examiners have different levels of expertise. It is suggested that across states, uniformity in the investigation of the causes of deaths and other health and mental health coexisting concerns of the decedents could help with accurately reporting the information. Recently, the National Association of Medical Examiners (NAME) has developed and promulgated forensic autopsy standards to improve death investigations (National Association of Medical Examiners, 2020).

Fourth, the CDC does not provide funding for toxicology testing in certain states. While some states still rely on local resources to fund toxicology testing, advocacy efforts could help the CDC to require states to be tested routinely. With this suggested uniform testing across states, the toxicology results would not be affected by the differences in the testing process or its frequency among coroner and medical examiners. In this analysis, there is state variations between toxicology testing. For example, Rhode Island and Alaska had more than 97% of suicide decedents being tested for alcohol while Georgia and Indiana had less than 30% of suicide decedents being tested for alcohol. Standardizing toxicology testing throughout all states could provide further evidence for researchers to learn more about the suicide decedents, specifically measuring whether the alcohol concentration was of a lethal dosage.

Fifth, although the CDC provides training and monitoring, there might be variations in coding among different data abstractors. This is an important lesson in researcher training.

Sixth, the factors associated with firearm suicide on a social-ecological approach, using state-level data, are based on one conceptual block. The number of factors included in the full model based on their significance is relatively high. Thus, the findings should be applied cautiously. For future studies, data from all 50 states could have been collected to increase the target samples.

Finally, the large number of suicide cases may have increased the analysis power. This implies an exaggerated tendency to reject the null hypothesis. As a consequence, what is insignificant becomes significant. Consequently, the effect size estimates were reported to identify the most important findings, to avoid type 2 error.

Strengths and Implications for Policy and Social Work Practice

The use of the state-level database to study suicide raises important social work practice and policy implications. Social workers are in the position to address gun violence as a complex issue (Logan-Green, Sperlich, & Finucane, 2018) and need to contribute more knowledge about suicide prevention (Levine & Sher, 2020) with population-wide approaches. From this study, social workers can understand the most salient risk factors associated with firearm suicide rates to plan prevention services for women who own a firearm. The state-level data provide the best available proxy variables to understand the risk factors associated with firearm suicide. These variables that were found to be salient risk factors can be useful for studying the effect of firearm suicide and investigating how gun laws can reduce the high rate of suicide among women.

For the individual-level data, the NVDRS RAD has numerous strengths due to its uniqueness as a surveillance system contained with data of relevant and innovative

characteristics on suicide mortality. These strengths, at the same time, provide implications for policy and practice planning use.

First, in contrast to standard suicide mortality data obtained from death certificates, the NVDRS has much broader data elements in its comprehensive surveillance data set. In policy, it is important to provide additional funding to plan preventive measures after learning about the suicide risks among women.

Second, the NVDRS includes 250 data elements, including demographics, mental health diagnoses and treatment, substance abuse, method-specific details, and toxicology reports. It is important to educate social workers in the field to learn about all of these correlates that are associated with the feminization of firearm suicides at both local and state levels. Based on the findings in the study, social workers can bring awareness through campaigns by collaborating with gun owners to provide resources for those with untreated depression. Additionally, the NVDRS indicates that behavioral measures of impulsivity may be one potential way to identify whether an individual is at risk for suicide. In policy, this type of training must be provided for health care providers. In practice, additional training that focuses on risk assessment must be provided for incoming practitioners, particularly those with a specialization working with women clients. Health care providers may consider probing for gun availability among women who are at risk for suicide.

Third, NVDRS RAD provides geographic indicators (i.e., geocoding is possible through FIPS county codes) that can be used to link decedents to regional factors. In policy, it is important to mandate data collection in all states so that these types of indicators can be comprehensively collected. In practice, social workers must commit to working with clients

representing diversity not only by gender but also in different locations and regions to reach the most hidden populations at risk of gun suicide.

Fourth, the NVDRS includes a large number of female suicide decedents. This data set allows for comparison among different demographic subgroups, especially age groups by suicide method. This is a progressive way to prove to legislators that educational programs that target women should receive funding. In practice, more age- and gender-specific programming should focus on service designs and delivery methods, particularly among women aged 18 to 25 years old. Women aged 18 to 25 years are often categorized as the emerging adulthood age group where role transitions are deemed central to this developmental stage. Social workers could work with this age group by providing tools for recognizing an immediate crisis and learning coping skills to alleviate impulsive behavior.

Last, the NVDRS data have been used to develop prevention programs for groups that have high suicide rates. For example, by using data from NVDRS, Virginia has recently released a life span approach to prevent youth suicide (Virginia Department of Behavioral Health and Developmental Services, 2016). Specific to using the NVDRS to study women who use firearms to complete suicide, social workers and advocates could collaborate with leaders in the firearm community to work on preventive efforts. These leaders would take action to normalize the inclusion of suicide prevention in gun safety education while protecting the rights and protections of being a gun owner. In addition, the development of prevention programs to store firearms in temporary storage, especially when women are coping with a recent death, relational problem, or conflict, could be made available in the community of gun owners.

CONCLUSION

The present study investigated a wide variety of predictive factors of firearm suicide rate and choice of method by either firearm or nonfirearm suicide. To date, only a few studies have examined suicide by firearm among women. Most firearm suicide studies show the high rate of male suicides, and the opportunity to understand the growing rate of firearm suicides among women is understudied. Fewer studies have looked at both population- and individual-level risk factors among women who use firearms to complete suicide, using a social-ecological suicide prevention model. Therefore, this study's findings add to the literature and illuminate how population-level data and individual-level risk factors could provide risk indicators with combined research efforts. The association between firearm use among women and suicide can provide significant implications in crafting the gender-specific needs for those who show problematic behaviors or thoughts. These problems could be measured and predicted by suicidal indicators derived from the risk factors.

The results from the present study open the door for future research along several lines. First, population-level data would help identify significant factors that policymakers can utilize to improve the legislature around gun suicide. There is a substantial opportunity for further firearm suicide prevention research, given that the U.S. Congress lifted the federal ban on gun violence research. These factors could be further examined in both smaller geographic regions such as counties or cities. Second, there is a tremendous opportunity to use population data to plan prevention services for gun users among women. The data show that the rising firearm suicide rates among women play a role specifically where gun availability is much higher. It is imperative to deliver community-based services in these locations through information dissemination about gun safety and means restriction (Logan-Greene et al., 2018). Third, this

study could explore mediating effects on how gun ownership and geographical location can play a role in firearm suicide.

The individual-level analysis supports that firearm suicide among women is more closely associated with the tested sociological factors in this study. These factors could include intimate partner problems and the repeated pattern of suicide deaths within the family system. Although sociological factors are compared to other psychological factors, mental health problems and depressed moods could be reviewed based on family history and intergenerational connections to suicide and other family problems. Consistent with Kazan, Calear, and Batterham (2016), relationship problems and poor quality in interpersonal relationships are important risk factors for suicide behaviors and often trigger a suicide attempt. While the results underscore that women who use a firearm may not exhibit classic suicidality markers such as depression, social workers could be more aware of suicidal individuals' reports on their relationship problems and its association with an increased risk of suicide. Last, this study raises broader questions regarding how social workers can accurately identify risks among those who are suicidal and should be further examined and assessed in health care and mental health practices. To stem the tide of suicide among women, effective prevention requires collaborative interventions at both the state and individual levels. Social workers must alleviate policy, psychological, and sociological barriers to find solutions to reduce the rising rate of firearm suicide among women.

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