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CIRCUMSTANCES CONTRIBUTING TO SUICIDES AMONG PREGNANT, POSTPARTUM AND NON-PREGNANT WOMEN (15 - 54 YEARS) IN RURAL AND URBAN COUNTIES IN THE U.S., NVDRS 2003-2012

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ABSTRACT OF CAPSTONE

Akosua Korantema Adu

The College of Public Health

University of Kentucky

2016

CIRCUMSTANCES CONTRIBUTING TO SUICIDES AMONG
PREGNANT, POSTPARTUM AND NON-PREGNANT WOMEN (15 -
54 YEARS) IN RURAL AND URBAN COUNTIES IN THE U.S.,
NVDRS 2003-2012.

ABSTRACT OF CAPSTONE

A Capstone project submitted in partial fulfillment of the
requirements for the degree of Doctor of Public Health in the
College of Public Health
at the University of Kentucky

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ABSTRACT OF CAPSTONE

CIRCUMSTANCES CONTRIBUTING TO SUICIDES AMONG PREGNANT, POSTPARTUM AND NON-PREGNANT WOMEN (15 - 54 YEARS) IN RURAL AND URBAN COUNTIES IN THE U.S., NVDRS 2003-2012.

Background: Although maternal deaths due to direct causes (those caused by complications during pregnancy), such as bleeding or infection, have declined over the years, maternal deaths due to indirect causes (those caused by pre-existing physical and mental health conditions), such as suicides, have not seen a corresponding decline. Suicide has become one of the leading causes of death in pregnant and post-partum women. Suicides are the fourth leading cause of death among women between the ages of 15-54 years in the United States (U.S.). The total lifetime medical and work loss costs of suicides among women of reproductive age (15-54 years), were \$108,130,000 and \$38,986,498,000 respectively in 2010. Residence status, specifically, residence in rural areas is reported as a significant risk factor for suicides. There is, however, a paucity of research examining how suicide risk factors differ among women from rural or urban counties in the U.S.

Aim: To examine whether rural-urban county status modifies measures of association between suicide risk factors and pregnancy status among pregnant, post-partum and non-pregnant female suicide decedents aged 15-54 years for the years 2003 to 2012.

Methods: This study used data from the National Violent Death Reporting System, Restricted Access Dataset. Multivariable polytomous logistic regression analyses

were used to examine if residence county status modified the association between suicide risk factors and pregnancy status. These included, stratification by county and two-way interactions between model predictors and county type.

Results: Chi-squared analysis indicated that rural suicide decedents were much older, married, less likely to have had a mental health diagnosis and more likely to use a firearm. Multivariable polytomous logistic regression analyses confirmed that there are some variations in suicide risk factors among pregnant, post-partum and non-pregnant decedents from rural and urban counties.

Conclusion: This data suggests that there is the need for differences in strategies for suicide prevention in rural and urban counties in the U.S.

KEYWORDS: (SUICIDE, RURAL, URBAN, PREGNANT, POSTPARTUM)

(Student's Signature)_____

(Date)_____

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2016

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College of Public Health

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CHAPTER 1

INTRODUCTION

Background of the project

Suicides during pregnancy and the postpartum period are a major public health problem worldwide and in the United States (U.S.).¹ Such fatal events are tragic not only to the victim, but also profoundly impact the baby, the family and the community.¹ In the U.S., suicides were the fourth leading cause of death among women between the ages of 15-54 years in 2012.² During that same year, suicides were the second leading cause of death among girls 15–19 and 20-24 years, the third leading cause of death among women 25-29 years, the fourth leading cause of death among women 30-39 years, and the fifth leading cause of death among women 40-54 years.² Although women have lower rates of mortality from suicides compared to men, the female suicide fatality rates have not decreased in recent years.² Between 2010 and 2012, the age adjusted rates of suicides among women of reproductive ages 15-54 years (whether pregnant or non-pregnant) have increased from 6.72 per 100,000 population to 7.38 per 100,000 population.³

Studies examining suicides among pregnant and postpartum women report lower risk of suicide and suicide attempts among this group compared to non-pregnant women.⁴⁻
⁶ Self-harm ideation, i.e. “thoughts of self-harm”, however, is reported to be more common than suicide attempts or deaths among this group and has been estimated to be as high as 15% in pregnant, and 14% in postpartum women.⁵ Furthermore, studies report that although suicide deaths and attempts are lower among pregnant and postpartum

than in non-pregnant/non-postpartum women, suicides, when they do occur, account for 1–20% of total deaths of pregnant or postpartum women.^{4,6,7}

Pregnancy, and the postpartum period, make women more vulnerable to mental health problems. Studies attribute the risk of suicide among pregnant and postpartum women to the higher rate of psychiatric disorders^{8,9} and higher levels of depressive symptoms¹⁰⁻¹² during the perinatal period. Estimates of the prevalence of depression and anxiety disorders among pregnant and postpartum women vary widely affecting 13–20%^{13,14} and 10–12%¹⁵ of pregnant and postpartum women respectively. Suicide, however, is a complex behavior associated with various contributing factors. Several research studies have therefore examined and identified social, demographic and clinical factors such as unemployment, race and ethnicity, age, gender, marital status, lower education, substance abuse and intimate partner problems as risks factors for suicides.¹⁶⁻¹⁹ Residence status, specifically, residence in rural areas have also been reported as a significant known risk factor for suicides.²⁰⁻²² The aforementioned studies pointed out higher rates of suicides in rural areas particularly among men and children²⁰ with barriers to treatment, socioeconomic disparities, social isolation, substance abuse and access to firearms as reasons for the higher rates of suicides in these areas.^{21,22}

Presently, there is a dearth of research on the determinants of suicides among pregnant, postpartum and non-pregnant women from rural and urban counties in the U.S. Very little is therefore known about how suicide risk factors differ among these women from rural or urban counties in the U.S. Previous studies of suicides among women have been limited by, (1) studies restricted to localized samples, such as single state or city data, or data restricted to either urban or rural locations; (2) little information regarding

precipitating circumstances to these deaths; and (3) likely underreporting of maternal violent deaths, especially due to reliance on death certificates alone (which may vary by state and contain missing information in the cause-of-death section).²³

Purpose of the Study

To address these gaps in the literature, we conducted secondary data analysis on women of reproductive age who died by suicide using data from the Center for Disease Control and Prevention's (CDC) National Violent Death Reporting System (NVDRS). The NVDRS is a multi-state database that collects data on violent deaths, using multiple, complementary data sources, including police reports, death certificates, and coroner/medical examiner reports. For this study, we obtained an individual-level Restricted Access Dataset (RAD), which contains more detailed information, such as the county of residence of the decedent.

The overarching purpose of the current project therefore was to examine whether rural-urban county status modifies measures of association between suicide risk factors and pregnancy status among pregnant, post-partum and non-pregnant female suicide decedents aged 15-54 years for the years 2003 to 2012.

There were two specific aims for this study:

1. Aim 1 was to characterize the socio-demographic, mental health issues, substance/alcohol abuse, precipitating circumstances, other suicide characteristics (including weapons used and suicide event location) and intimate partner problem (IPP) characteristics of suicide decedents by county of residence.

2. Aim 2 was to investigate whether residence county status modifies the association between suicide risk factors and pregnancy status after adjusting for confounding factors.

Statement of the Problem

Suicides are serious but largely preventable public health problem. Suicides during pregnancy and the postpartum period also have profound impacts on the baby, the family, and the community. Suicides among women of childbearing age can also have enormous direct and indirect costs on a country's social and economic development.²⁴ According to the CDC, in 2010, the total lifetime medical and work loss costs of suicides among women of reproductive age (15-54 years), were \$28,835,000 and \$6,322,688,000 respectively (lifetime medical and work loss costs refers to the medical and work loss costs associated with the fatal injury event).²⁵

A number of studies have shown that suicide mortality rates tend to be higher in rural areas than in urban areas.²¹⁻²² Societal factors such as socioeconomic disparities, social and physical isolation, substance abuse, access to firearms and barriers to treatment have been cited as possible theories for the comparatively higher suicide rates in rural areas.^{20-22,26} Only one U.S. study has examined rural–urban patterns in suicide risks among both males and females, characterizing the demographic, socioeconomic, and mental health features of individual suicide decedents by urban–rural residence status.²⁰

To date, there is no known study that has compared the individual characteristics of suicides among women of reproductive age 15-54 in terms of their county of residence. The National Violent Death Reporting System (NVDRS), RAD allows such a research gap

to be addressed because it provides detailed data on all completed suicides in participating states.

Overview of Project Processes

Descriptive statistics were used to compare the socio-demographic and suicide risk factors (including type of weapon and suicide event location) of the suicide decedents in urban and rural counties using chi-square analysis to test for significance of categorical variables. Multivariable polytomous logistic regression analyses were used to examine if residence county status modified the association between suicide risk factors and pregnancy status. These included, stratification by county type, and two-way interactions between model predictors and county type. All analyses were conducted using SAS 9.4® (Institute, Inc.; Cary, NC, USA).

Scope and Importance of the Study

This study will add to the extant literature by examining the relationship between risk factors for suicides and pregnancy status, in urban and rural counties in the U.S to inform comprehensive prevention programs in these different populations. Women of reproductive age are more likely to have frequent contacts with the health care system, hence, providers can rely on the results of this study to ask their patients about the suicide risk factors that may be unique to their geographic area. Finally, the results of this study will also be useful for informing future suicide research and effective interventions for the prevention of suicides in clinical care settings and communities in rural and urban counties in the U.S.

CHAPTER 2

LITERATURE REVIEW

Suicides in women of reproductive age

Suicide in women of reproductive age is recognized globally as a serious public health problem. Studies on suicidality (suicide deaths, attempts, and ideation including thoughts of self-harm), show that women, unlike men, are less likely to actually die by suicide, but are more likely to attempt suicide.^{27,28} The majority of research attention, therefore, has leaned toward the etiology of suicide among men and much less about the etiology of suicide in women.²⁹ As a result, there are very few studies on death from intentional injuries³⁰ and suicidal behavior³¹ among women of reproductive age.

According to the American Foundation for Suicide Prevention (AFSP), a woman attempts suicide every 78 seconds and dies by suicide every 90 minutes in the U.S.³² Studies vary in the reported prevalence of suicides among women, yet, all have reported increasing numbers over the years.² In the U.S., suicide rates among women aged 15–54 years increased from 6.72 per 100,000 population in 2010 to 7.38 per 100,000 population in 2012.² In 2012, suicide was the fourth leading cause of death among women aged 15–54 years in the United States (U.S.).² Worldwide, suicide is the fourth cause of maternal deaths,⁴ the leading cause of death in first-year post-partum women in the United Kingdom,³³ the leading cause of death in young women in China,³⁴ and the world leading cause of death in women aged 15–24 years, mainly in low-income and middle-income countries.³⁵

International rates of completed suicides among women just as in the U.S., tend to be much lower than male completed suicide rates, and is commonly referred to as the

gender paradox.³⁶⁻³⁹ There are, however, exceptions in countries such as India and China, where this paradox is absent with comparable suicide rates among women and men due to the high rates of completed suicide among rural young women.⁴⁰⁻⁴³

Suicides in Pregnant and Post-partum Women

Several studies report low suicide deaths and attempts among pregnant and postpartum women than in the general population of women.^{4,12,44,45} Although suicides and suicidal attempts occur at a lower rate during pregnancy and the postpartum period, suicide deaths, when they do occur, account for up to 1-20% of the total deaths of pregnant and postpartum women.^{4-6,23} Perinatal suicides are still a major concern despite the reported low suicide mortality rates during this period.²⁷ This is because of the profound impact suicide has on the risk to the woman's life, the growth and development of the baby, the function of the family, and possibly the burden on the community as a whole.²⁷

Recently studies find, perinatal suicidality one of the leading causes of maternal mortality in the first 12 months postpartum.^{4,5,23,46-48} Furthermore, the risk of suicide death is significantly higher among pregnant and postpartum women with depression and psychiatric disorders and has been found to be the second or leading cause of death in this depressed population.¹² Studies report that 10–25% of pregnant and postpartum women experience depressive disorders^{12,15,48-51} or anxiety disorders.¹⁵ Other studies also report a higher rate of psychotic disorder and neurotic depression in women during the perinatal period, which are known to increase suicide risk.^{12,20,51}

Very few U.S. based research studies have compared the risk of completed suicide deaths among pregnant, postpartum and non-pregnant/non-postpartum women.^{1,7,35} These studies reported lower rates of suicide among pregnant/postpartum women when compared to non-pregnant/non-postpartum women. Using data from medical examiner records, a New York City study from 1990–1993, reported the rate of suicides among pregnant women to be approximately 1/3 of the rate among non-pregnant women aged 15–44.¹

Another study compared the rates of violent death among pregnant and/or postpartum women to non-pregnant/non-postpartum women ages 14–44 using the North Carolina surveillance and vital statistics data from 2004 to 2006.⁷ In this study, the suicide rate for pregnant women was 27% of the rate for non-pregnant/non-postpartum women (rate ratio = 0.27, 95% CI = 0.11–0.66), and that for postpartum women was 54% of the rate for non-pregnant/non-postpartum women (rate ratio = 0.54, 95% CI = 0.31–0.95).⁷

Just recently, Wallace et al., compared the rates of violent death among pregnant, postpartum (divided into early and late post-partum) and non-pregnant women ages 10–54 years. This study obtained death records from all 50 US states and the District of Columbia, from 2005 through 2010 from the National Center for Health Statistics.⁵² In this study, risk of suicide among pregnant/postpartum women was 0.62 times less (95% confidence interval, 0.57–0.68) that of non-pregnant/non-postpartum women.⁵² Pregnancy-associated suicide risk in this study ranged from 1.6–4.5 per 100,000 live births after adjustments compared with 5.3–5.5 per 100,000 women among non-pregnant/non-postpartum women.⁵²

Rural-Urban Status

To date, there are no U.S. based studies that have compared the characteristics of suicides among pregnant, post-partum and non-pregnant decedents from rural and urban counties, hence, it is not known to what degree rural or urban status is an actual suicide risk factor during pregnancy and the post-partum period. Prior studies have reported either higher suicide mortality rates in urban areas than in rural areas⁵³⁻⁶⁰ or higher suicide mortality rates in rural areas than in urban areas.^{20-22,58-61} In the studies reporting high rural suicide rates, rural suicide rates were particularly higher among men and children.^{54,60} Barriers to treatment, socioeconomic disparities, social isolation, substance abuse and access to firearms were explained as reasons for the higher rates of suicides in these areas.⁶¹⁻⁶⁴

Several socio-economic, cultural and demographic factors are known to modify the effect of rurality.⁶⁵ Furthermore, compared to urban areas, rural areas are usually less developed in terms of social, cultural and economic aspects.⁶⁵ For instance, physical and mental health services are less available in rural areas.⁶⁶ In addition, women often have less access to health services and mental health professionals in these areas due to geographic distance and location.^{66,67} Women living in rural regions may, therefore, be especially at risk of suicide because of geographical isolation.⁶² Women in rural areas also tend to differ from women in non-rural or urban areas.⁵¹ For example, women in rural areas tend to have lower levels of education and income.⁵¹ Suicides in rural areas in both developing and western countries are highly stigmatized, therefore, rural women may be especially reluctant to disclose suicidal ideation due to lack of anonymity (since they are

more likely to encounter someone they know when reporting or receiving services), and hence, may be less likely to seek the needed help.⁶⁰

Rural-urban definitions

There is no universal definition of “rural” or “urban” status in suicide research. The term rural often suggests isolation, small towns, and low population density.⁶⁷ Rural areas, however, are not all uniform in character.⁶⁸ For instance, large rural areas that are adjacent to urban areas often have more in common with urban areas than they do with remote and isolated rural areas.⁶⁷ There are many different ways to define and measure rural and urban status. The five most common terminologies for rural and urban locations and measurements in the United States come from the U.S. Census Bureau (UCB), the Office of Management and Budget (OMB), and the U.S. Department of Agriculture (USDA).⁶⁸

The OMB’s definition of metropolitan and nonmetropolitan populations and the Census Bureau’s definition of rural and urban fail to identify the same populations as rural.⁶⁷ For instance, the UCB uses population density information and categorizes urban areas into urbanized areas and urban clusters.^{68,70} The urbanized areas have cores with populations of 50,000 or more, and the urban clusters have cores with populations that range from 2,500 to 49,999.^{62,64} All other territory, persons and housing units not located in an urbanized area or urban cluster are then classified as rural areas.⁶⁸⁻⁷⁰

In contrast, the OMB classifies geographic areas into metropolitan, micropolitan and nonmetropolitan areas.⁷⁰ Metropolitan areas as defined in 2003 are Core-Based Statistical Areas (CBSAs) with 1 or more urbanized areas (cities with a population greater than or equal to 50,000), and outlying counties that are economically tied to the core

(measured by commuting to work).^{68,70} Micropolitan areas are CBSAs associated with at least one urban cluster and central county or counties containing the core (cities with population of at least 10,000 but less than 50,000), and adjacent outlying counties having a high degree of social and economic integration with the central county as measured through commuting.^{67,69} All other areas not in metropolitan or micropolitan areas are classified as non-metropolitan or non-CBSA.^{68,70}

The USDA Economic Research Service developed the Rural-Urban Continuum Codes (RUCCs) and the Urban Influence Codes (UICs). The RUCCs distinguishes metropolitan counties by size (codes 1 - 3) and non-metropolitan counties (codes 4 - 9) by their degree of urbanization or proximity to metro areas but does not consider the large or small size of the adjacent area in their definition for non-core areas (i.e. areas outside metropolitan and micropolitan areas). The UICs also distinguishes metropolitan counties by size (codes 1-2) and non-metropolitan counties (codes 2 - 12) by their degree of urbanization or proximity to metro areas, but further subdivides the non-core areas based on adjacency and the presence of a town of at least 2,500 in size.^{68,70}

Another measurement of urbanization available in both ZIP code and census tract formats, is the Rural-Urban Commuting Areas (RUCA) coding system created by the USDA Economic Research Service in collaboration with Health Resources Service Administration Office of Rural Health Policy and WWAMI Rural Health Research Center.⁶⁹ RUCA incorporates the density of population, urbanization and daily commuting information into 10 primary (whole numbers) and 30 secondary (decimal levels) codes. RUCA codes are similar to the UICs and RUCCs but are especially useful within non-core

areas that may have some pockets of urbanization otherwise lost in the non-core designation.⁶⁹

There is no perfect rural definition that meets all purposes.^{68,70} Rural and urban definitions vary and are not applied uniformly across all suicide studies. Deciding which rural definition to apply to an area depends on the purpose of the study, the availability of data, and the appropriateness and availability of the definition.⁶⁹ Hence, when using rural statistics, it is important to understand which definitions were used to ensure that comparisons made are fair and appropriate.⁶⁹ This is the first study to examine whether rural-urban county status modifies measures of association between suicide risk factors and pregnancy status using the RUCC codes to define rural and urban status.

Review of suicides in women of reproductive age from rural and urban areas

There are very few studies on suicides and suicidal behavior among women of reproductive age. The vast majority of studies that have examined suicides in rural and urban areas have been conducted outside the United States and have focused mainly on answering the question as to whether more suicides occur in rural or urban areas and less on individual suicide behavior among victims. Research in countries such as China, Australia, England and Wales, Scotland and Austria have all demonstrated the gender heterogeneity of suicide rates in both rural and urban regions with little or no information on suicidal behavior and characteristics among these groups.

A study by Phillips et al., determined the current pattern of suicides by sex, 5-year age-group and region (urban or rural) in China.⁷¹ In this study, suicide rates as well as rural and urban populations were obtained from mortality data for 1995-99 from the

Chinese Ministry of Health and were adjusted according to an estimated rate of unreported deaths and projected to the corresponding population. Results from this study showed a 25% higher rate of suicides among women than in men and this was mainly attributed to the large number of suicides in young rural women which were 66% higher than the rates among young rural men. The results also showed a three times higher suicide rate in rural areas than in urban areas and this difference remained true for both sexes, for all age-groups, and over time.⁷¹

Another study in Australia by Dudley et al., investigated the differences in suicide rates between metropolitan and rural areas among young women and men aged 15-24 years.⁷² Female suicide rates did not increase over the time period of this study (1964-1993). The findings of this study were similar to another study conducted among Australian women over a 15 year period from 1986 to 2000.⁷³ The second study, however, further investigated the changes in the pattern of female suicides by alteration in the methods of suicide utilized. In this study, although the overall suicide rates remained unchanged for all age groups, there were significant increases in hanging and carbon monoxide (CO) toxicity deaths over all age groups ($p < 0.05$), with significant falls in drug overdose deaths in the 10–25 year age group ($p < 0.01$), and significant overall falls in suicides due to gunshot wounds ($p < 0.05$).⁷³

Middleton et al., used population-based indices of rurality to measure rural and urban areas to examine and assess the extent to which suicide patterns between 1981 and 1998 were associated with the changing social and economic characteristics of rural and urban areas in England and Wales.⁷⁴ Results from this study showed that females aged 15-24 years from areas remote from the main centers of population had the most

unfavorable trends in suicides, where suicide rates increased by 0.04 [95% CI (0.02,0.07)] per 100,000 per year between 1981 and 1998 but decreased by 0.01 [95%CI (-0.02,0.0)] per 100,000 per year (P (difference in trends) <0.001) in urban areas. Results from this study also showed that only around 1% of all 15–44-year-old female suicides were firearm related compared to 3–5% of all 15–44-year-old male suicides.⁷⁴

In Scotland, Levine and Leyland used a rurality indicator created from the Scottish House-hold Survey rurality classification. The purpose of their study was to describe the pattern, magnitude and trend of urban/rural variation in suicide in Scotland, and to examine methods of suicide within differing geographies.⁷⁵ They found that there were increases in suicide rates for both sexes over time up to age 40 but decreases in suicide rates for both sexes over time at the older age groups with the largest increase for suicides amongst men occurring in the 20–24-year age group, and in the 15–19 age group for women. They also found that women experienced highest suicide rates in urban areas and remote towns and although most suicides in women were by poisoning with solids or liquids, they were significantly less likely to poison themselves using solids or liquids in accessible and remote rural areas, less likely to jump from high places in accessible rural areas, more likely to drown themselves in remote towns and more likely to use firearms and explosives in accessible rural areas and remote towns.⁷⁵

In a longitudinal trend study of rural and urban suicides from 1970 to 2005, Kapusta et al., classified all 99 districts in Austria into five categories of rurality/urbanicity. They utilized a Poisson regression model to determine trends in suicide rates according to gender in rural and urban regions as well as the ratios of rural- to urban-suicide rates. Findings from this study included a decreased suicide rate among men but not women

with increasing urbanicity (despite a continuous increase in suicide rates over the past 35 years in both genders), and a lack of significant correlation between age groups and suicide rates with increasing population density among women. Hanging and jumping from heights were the most common suicide method of women in 'most rural' (4.3 per 100.000), and 'most urban' (4.1) areas respectively, and high suicide rates were among widowers (123.7–156.1 per 100.000).⁷⁶

In the U.S., Singh and Siahpush used both multiple regression and Poisson regression models to estimate rural-urban differentials in suicide mortality over time using a 10-category rural-urban continuum measure and 1970-1997 county mortality data. The purpose of this study was to examine rural-urban gradients in US suicide mortality and the extent to which such gradients varied across time, sex, and age. Findings from this study showed higher female suicide rates for the first 4 time periods in more urban areas than in more rural areas. The female suicide rate for the most rural county group were 52%, 30%, 24%, and 16% lower than the rate for the most urban county group for the periods 1970 to 1974, 1975 to 1979, 1980 to 1984, and 1985 to 1989 respectively. In the 1995 to 1997 period, no significant association between rural–urban continuum and female suicide mortality was observed, although this pattern was reversed when divorce rates and ethnic composition were controlled for such that suicide rates for women, especially for young women, appeared to be significantly higher in the most rural than the most urban areas.²²

As mentioned previously, only one U.S. study has examined rural–urban patterns in suicide risks among both males and females, characterizing the demographic, socioeconomic, and mental health features of individual suicide decedents by urban–rural

residence status.²⁰ Data from the National Violent Death Reporting System (NVDRS) was analyzed in this study to examine the associations between decedent residence type and suicide variables with separate logistic regressions adjusted for age, sex, race, and ethnicity. Rurality was defined using the Federal Information Processing Standards (FIPS) codes and the 2003 Urban Influence Codes (UICs). Results from this study showed that rural decedents were less likely than urban decedents to have a mental health diagnosis or mental health care, although the prevalence of depressed moods appeared similar. Most suicides were by firearm, and rural decedents were more likely than urban decedents to have used a firearm.²⁰

Risk factors

There are multiple and interrelated risk factors for suicide.⁷⁷ Social, demographic and clinical factors such as race and ethnicity, age, gender, marital status, lower education, substance or alcohol abuse, and mental health problems have been identified and examined as risks factors for suicides.

Age. Suicide rates in women have been reported to increase with age.⁷⁸⁻⁸² Using data from the new World Health Organization Statistical Information Services Mortality Database, White and Holmes conducted a study to explore patterns of mortality in young men and women (aged 15–44 years) across 44 countries.⁸⁰ Findings from the study indicated an increase in suicide rates in women with age reaching its peak at 35–44 years. The study also reported suicide rates of 14.1, 21.7 and 23.8 per 100,000 population among women of age groups 15–24 years, 25–34 years, and 35–44 years respectively.⁸⁰ Data from the NVDRS also show that in the U.S., female suicide is concentrated in the

35–64 years age group (64.8%), with a 9.1/100000 peak between those aged 45–54 years.⁸¹ Two other studies also reported similar findings of increased risk of suicide among women aged 35-64 years.^{83,84} The increased suicide risk in this age-group was attributed to societal changes that lead many women in this age group to become economically active. Results from these studies were, however, mixed and not straightforward, hence they stated the need for more research, especially on the relationship between the relative status of the unemployed and their psychological wellbeing to better understand the mechanism that links unemployment to suicides in females.^{82,83}

Marital status. Findings in the existing literature report lower suicide risk among married women and report that married women are less prone to suicide than single, divorced, and widowed women.⁸⁴⁻⁸⁶ Using the U.S. Vital Statistics data, three different studies, conducted at different time periods (1939–42 and 1949–51;⁸⁴ the U.S. White population for 1959–61 and 1979⁸⁵ and 1992–94 for the US white population)⁸⁶ all documented that marriage is a protective factor against suicide for women. Similarly, using the 2009 NVDRS data, Karch et al., reported that never-married, divorced, or widowed women died by suicide most often (60.4%) in the U.S.⁸¹ Two other studies reported that the greater risk of completed suicides among widowed, divorced, and never married women was among older women, which might be explained by the death of a partner.^{87,88} This was similar to another study that reported a 15-fold higher risk of suicide among old persons after the loss of their partner than middle-aged persons.⁸⁹

Mental health problems. Mental health disorders have been described as the strongest risk factor for suicides.⁹⁰⁻⁹⁵ Depression has been identified in approximately

60% of all suicides in psychological autopsy studies (studies that gather information on suicides through interviews with relatives and friends and by inspection of medical records).⁹⁶ In other psychological autopsy studies, 90–95% of the people who die by suicide had a diagnosable psychiatric disorder at the time of the suicide.⁹⁷ Presence of a psychiatric disorder has also been reported in prior studies to be more likely to increase suicide risk in female than in male subjects.^{98,99-101} The risk for suicidality is significantly elevated among depressed women during the perinatal period because they have been found to have high levels of depressive symptoms.⁸ In a case-control study using data from the 1993 National Mortality Followback Survey in the United States, depressive symptoms were related to suicide in all age groups among female decedents, and the use of mental health services was more frequent in suicides in 15–29 and 45–64 age groups.¹⁰²

Method of suicide. There are gender difference in the methods of suicides. Previous studies have found that women are less likely to die by violent means.^{103,104} A recent surveillance report of the National Violent Death Reporting System (NVDRS) showed that among females, poisoning was the most common method used (34.6%), followed by a firearm (32.4%).¹⁰³ This is similar to a study conducted by Kposowa et al., where women were over 73% less likely to use firearms than men (OR = 0.267, CI = 0.172, 0.413) and 4 times more likely to die from drug poisoning than male victims (OR = 4.828, CI = 3.047, 7.650).¹⁰⁴

Substance and alcohol use. Alcohol/substance use is a risk factor for suicide and suicidal behavior. In a case-control study using data from the 1993 National Mortality Followback Survey in the United States, marijuana use, and excessive alcohol

consumption, increased the odds of suicide for both genders.¹⁰² Alcohol is also frequently found in suicide victims.^{104,105} A review of 102,401 deaths investigated by North Carolina medical examiners in the period 1973-1983, found alcohol present in 35.3% of suicides.¹⁰⁶ Similarly, Haberman and Baden found blood alcohol levels in 32 percent of suicide victims in New York City.¹⁰⁷ Prior studies, however, report that male suicide victims are more likely than females to have a history of alcohol misuse¹⁰⁸ or to have detectable levels of alcohol at autopsy.¹⁰⁹ Another study, however, found that female alcohol abusers died by suicide more often compared with women in general than did male abusers in comparison with men in general.¹¹⁰ The relationship between alcohol misuse and suicide is very complex. Studies report various effects of the role of alcohol in suicides. Some studies report that the effects of alcohol on suicidal behavior are mediated through depression.¹¹¹⁻¹¹⁷ Two other studies also proposed that alcohol abuse leads to lowered self-esteem, and ultimately increased risk of suicide, through a process of negative life events (such as marital separation and work problems), loss of social networks and social isolation.^{118,119}

Precipitating circumstances/Life stressors. Suicidal behaviors are often preceded by stressful events. This is the case because stressful life events such as loss events,^{120,121} disrupted interpersonal relationships,¹²¹⁻¹²³ job problems and financial difficulties,¹²¹ and events related to adverse physical health,¹²² often interact with psychiatric, psychological, and biologic factors to increase suicide risk. Recent crisis was among the primary precipitating factors of suicides in a recent surveillance report of the NVDRS.¹²⁴ In this report, circumstances noted most often among suicide decedents were intimate partner problems (31.2%), a crisis of some kind in the preceding or impending 2

weeks (26.9%), physical health problems (22.4%), and job (15.4%) or financial problems (13.6%).¹²⁴ Slightly more than one fifth of female (24.5%) suicide decedents experienced physical health problems in the period before their deaths whereas less than a third of female suicide decedents experienced job problems (11.5%), financial problems (11.2%) and criminal legal problems (4.1%).¹²⁴

Intimate partner problems/violence (IPP/V). Cross-sectional studies of women in both high and lower income settings have reported a strong and consistent association between IPV experience and suicide.¹²⁵⁻¹²⁹ Physical and sexual partner violence against women is very common and widespread.¹³⁰ In multi-country studies, about 15%–71% of women report experiencing physical or sexual partner violence over their lifetime.¹¹⁵ IPV has also been shown to be associated with incident suicide attempts and incident depressive symptoms among women.¹³¹ Prior studies have identified depressive symptoms as the link between IPV and suicidal ideation.¹³²⁻¹³⁸ A systematic review and meta-analysis of observational studies conducted in the United States showed a two to three-fold increased risk of major depressive disorder and 1.5–2-fold increased risk of elevated depressive symptoms and postpartum depression among women exposed to intimate partner violence relative to non-exposed women.¹³⁹ IPV has also been shown to increase the risk of suicide among pregnant and post-partum women. According to a 2011 surveillance report of the NVDRS, 54.3% of pregnancy-associated suicides involved intimate partner conflict that appeared to contribute to the suicide.¹ This was similar to another study where Pregnancy associated suicides had significantly higher odds of being positive for intimate partner problems.²³

CHAPTER 3

METHODOLOGY

Data Source Description

Data from the National Violent Death Reporting System (NVDRS) Restricted Access Data set (RAD), were used for this study. The NVDRS is a population based, active surveillance system established by the Centers for Disease Control and Prevention (CDC) in 2002, to collect detailed and timely information on all violent deaths from participating US states.^{140,141} In 2003, the NVDRS collected data from seven participating states (Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia); six additional states (Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin) joined in 2004; four (California, Kentucky, New Mexico, and Utah) in 2005; and two in 2010 (Ohio and Michigan), for a total of 19 states.¹⁴²

Each participating state is responsible for collecting information on its own violent deaths from multiple complementary data sources such as death certificates, law enforcement reports and coroner/medical examiner (CME) records.^{140,141} Data collection practices must be consistent across states and over time to produce valid interstate comparisons and time trends. Therefore, uniform protocols for defining different manners of death are used. All recommended data elements and response options are defined in a users' manual, and the CDC organizes an annual coding training for staff from funded states.^{140,141} The types of violent deaths recorded include suicides, homicides, homicides followed by suicides, and deaths resulting from child maltreatment or intimate partner violence, as well as "deaths where individuals are killed by law enforcement in the line of duty, unintentional firearm injury deaths, and deaths of undetermined intent".¹⁴²

The NVDRS is unique in that it is the first surveillance system to provide detailed information on: 1) precipitating circumstances of violent deaths; 2) victim and suspect characteristics such as relationship between victim and suspect; 3) weapon type; 4) toxicology reports; 5) historical mental health diagnoses; and 6) law enforcement and/or coroner/medical examiner narratives.^{140,141} The CDC makes some of these data available in aggregate (so that individuals cannot be identified) via its interactive web-based system - Web-based Injury Statistics Query and Reporting System (WISQARS).¹⁴¹ For this study, we obtained an individual-level Restricted Access Dataset (RAD), which includes data from 18 states (California concluded its participation in 2009) from 2003 to 2012. The RAD also contains more detailed information such as the county of residence of the decedent.¹⁴³

The purpose of this study was to investigate whether urban-rural county status modified measures of association for suicide risk factors among pregnant, post-partum and non-pregnant female suicide decedents aged 15-54 years for the years 2003 to 2012.

Variable Definition and Measurement

Suicide is defined by the NVDRS as death resulting from the use of force against oneself when the preponderance of the evidence indicates that the use of force was intentional.^{141,144,145} Cases were identified using the corresponding ICD-10 codes and were then included in the NVDRS (X60-X84 and Y87.0).^{140,141,144}

Rural-Urban status

Rural-urban residence status was determined by matching each case to the degree of rurality of the decedent's county of residence using the INCITS 31-2009

(formerly the Federal Information Processing Standards (FIPS)) codes and the 2013 Rural-Urban Continuum Codes developed by the US Department of Agriculture (RUCC; USDA, 2013).¹⁴⁶

The RUCC assigns each US county one of 9 mutually exclusive classification codes, which are determined by the county's population size and proximity to metropolitan areas.¹⁴⁶ The nine categories are: 1= Counties in metro areas of 1 million population or more; 2= Counties in metro areas of 250,000 to 1 million population; 3= Counties in metro areas of fewer than 250,000 population; 4= Urban population of 20,000 or more-Adjacent to a metro area; 5= Urban population of 20,000 or more-Not adjacent to a metro area; 6= Urban population of 2,500 to 19,999-Adjacent to a metro area; 7= Urban population of 2,500 to 19,999-Not adjacent to a metro area; 8= Completely rural or less than 2,500 urban population-Adjacent to a metro area; 9= Completely rural or less than 2,500 urban population-Not adjacent to a metro area.¹⁴⁶

For this analysis, the RUCC codes were collapsed into urban (codes 1-3) and rural (codes 4-9) designations. Responses were then recoded in the data set as 0 = urban, 1 = rural.

Pregnancy status

The primary outcome variable was the pregnancy status of the suicide decedents. NVDRS information regarding pregnancy, postpartum or non-pregnant status at the time of death is obtained from death certificate and/or coroner/medical examiner records (CME).¹⁴⁰ This is because decedent's pregnancy status is often noted on the death certificate and in the CME report, however, findings are more likely to be authoritative if a full autopsy is performed.¹⁴⁰ Since this variable is based on the codes used on the new

U.S. standard death certificate, pregnancy status is documented at the time of death, not at the time of injury. The coding structure of the NVDRS pregnancy status variable allows response options for states whose death certificate either matches or does not match the U.S. standard death certificate.¹⁴⁰ Response options include: Not pregnant within last year; Pregnant at time of death; Not pregnant but pregnant within 42 days of death; Not pregnant but pregnant 43 days to 1 year before death; Not pregnant, not otherwise specified; Pregnant, not otherwise specified; Not applicable and Unknown if pregnant within past year (see supplemental Table 1 in Appendix 1).¹⁴⁰

For the purpose of this analysis, pregnant at the time of death was defined to include: “pregnant at the time of death, and “pregnant, not otherwise specified”; post-partum at the time of death was defined to include “not pregnant but pregnant within 42 days of death” and “not pregnant but pregnant 43 days to 1 year before death”; and not pregnant at time of death was defined to include “not pregnant within last year” and “not pregnant, not otherwise specified.” Responses were then recoded in the data set as 0 = non-pregnant, 1 = pregnant, and 2 = post-partum.

Risk Factors

Mental health

Two indicator variables were constructed as surrogate markers for probable mental health problems: current mental health problem and current depressed mood. The NVDRS provides data on current use of a prescription psychiatric medication, which indicates whether the decedent had an active prescription for psychiatric medication at the time of death.¹⁴⁰ Toxicology results help assess whether the decedent was taking the prescribed medication.¹⁴⁰ Below is the coding structure of the current mental health

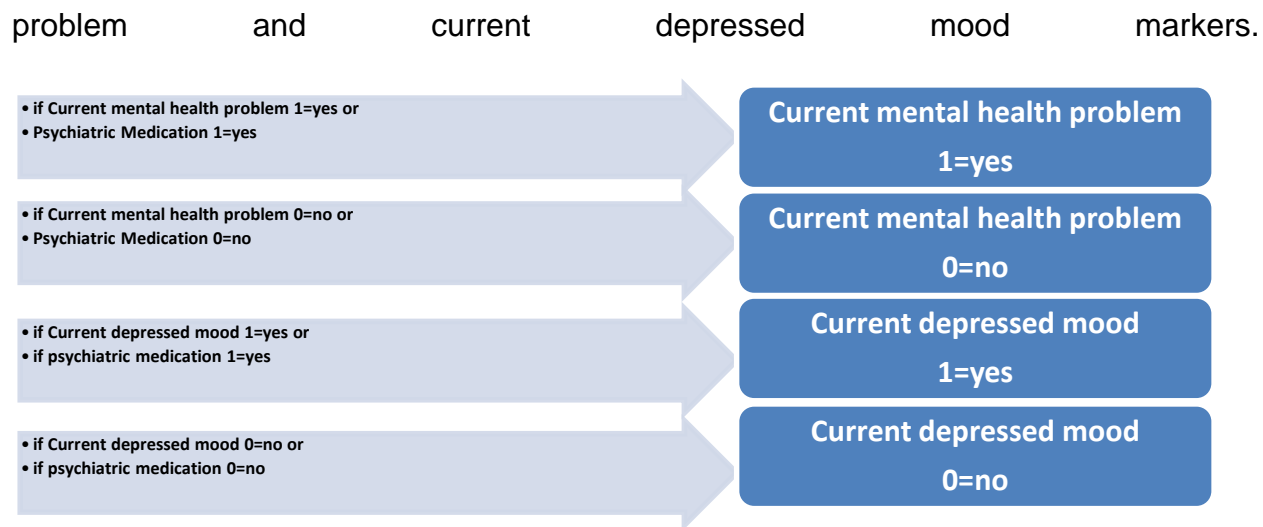


Figure 1. Coding structure of current mental health problem and current depressed mood.

Substance and alcohol use

Substance and alcohol use variables of interest included: alcohol use suspected at time of death, alcohol abuse, and other substance (non-alcohol related) abuse problem. Alcohol use suspected at time of death was coded as “Yes” based on witness or investigator reports (e.g., law enforcement note that the decedent “had been drinking heavily”), or circumstantial evidence (e.g., empty alcohol containers scattered around suicide decedent)¹⁴⁰. Alcohol problem was coded as “Yes” if the decedent was perceived by self or others to have a problem with, or to be addicted to, alcohol. Finally other substance abuse problem was coded as “Yes” if the decedent was perceived by self or others to have a problem with, or to be addicted to drugs other than alcohol.¹⁴⁰ Responses were coded in the dataset as 0 = no, 1 = yes.

Intimate partner problems (IPP)

Intimate partner problem is defined as problems with a current or former intimate partner that appeared to have contributed to the suicide or undetermined death.¹⁴⁰ It was

coded as “Yes” if at the time of the incident the decedent was experiencing problems with a current or former intimate partner, such as a divorce, break-up, argument, jealousy, conflict, or discord, and this appears to have contributed to the death.¹⁴⁰ Responses were coded in the dataset as 0 = no, 1 = yes.

Precipitating circumstances

The circumstances preceding death, referred to as precipitating circumstances in this study, are defined as the events that preceded and therefore might have contributed to the infliction of a fatal injury.^{140,141,144} For suicide decedents the presence of a crisis within the last two weeks prior to injury, problems with finances, physical health, or job problems were of particular interest.

Financial problem was coded as “Yes” if at the time of the incident the victim was experiencing a problem such as bankruptcy, overwhelming debts, or foreclosure of a home or business, and this appears to have contributed to the death. Job problem was coded as “Yes” if at the time of the incident the victim was either experiencing a problem at work (such as tensions with a co-worker, poor performance reviews, increased pressure, feared layoff) or was having a problem with joblessness (e.g., recently laid off, having difficulty finding a job), and this appears to have contributed to the death. Physical health problem is defined as the victim was experiencing physical health problems (e.g., terminal disease, debilitating condition, chronic pain) that were relevant to the event. Recent crisis is defined as victim experienced a crisis within two weeks of the incident, or a crisis was imminent within two weeks of the incident that was not associated with another circumstance variable.¹⁴⁰ All responses were coded in the data set as 0 = no, 1 = yes.

Suicide characteristics

The history of suicide attempt, and whether the victim disclosed intent to die by suicide were of particular interest. The CDC defines suicide attempt to include a non-fatal, self-directed, potentially injurious behavior with any intent to die as a result of the behavior; which may or may not result in injury.¹⁴⁷ History of suicide attempts is coded as “Yes” if the victim was known to have made previous suicide attempts before the fatal incident, regardless of the severity of those attempts or whether any resulted in injury.¹⁴⁰ Responses were coded in the data set as 0 = no, 1 = yes.

Suicide intent disclosed is defined as the victim disclosed to another person their thoughts and/or plans to die by suicide within the last month prior to injury. Disclosure of suicidal thoughts or plan can be verbal, written or electronic. It was coded as “Yes” if the victim had disclosed suicidal thoughts or plans to another person recently or within the last month, whether explicitly or indirectly.¹⁴⁰ Responses were coded in the data set as 0 = no, 1 = yes.

Type of weapon

The NVDRS abstractors code only the weapon(s) that resulted in death.¹⁴¹ For this analysis type of weapon was collapsed to four categories: 1=firearm, 2=poisoning, 3=strangulation/suffocation and 4= sharp/blunt instrument.

Suicide event location

The NVDRS abstractors collect information for injury event location from death certificates. For this analysis, injuries that occurred in the decedent’s home were of particular interest. Thus, an indicator variable was constructed such that 1 = injury occurred in decedent’s home and 0 = injury did not occur in decedent’s home.

Socio-demographic variables

Socio-demographic characteristics that were examined in this study were age, race, education level, and marital status at the time of death of the decedents. The NVDRS coding manual provides coding instructions on the following socio-demographic variables.

Age

Age is reported using the same conventions used by the National Center for Health Statistics.¹⁴⁰ The decedent's age was reported in years. For this analysis, age was categorized into two groups by splitting at the midpoint of the age range: 1= 15-34, and 2=35-54.

Race

The NVDRS abstractors follow the U.S. Department of Health and Human Services (HHS) and Office of Management and Budget (OMB) standards for race/ethnicity categorization.¹⁴⁰ The response options for race include white, black or African American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native and Unspecified race. Due to small numbers in some cells, these response options were re-coded in the current study as: 1= White, and 2=Non-White (including Black and Other/Unknown (including Asian, Native Hawaiian/Pacific Islander, American/Alaskan Native, and unspecified race)).

Education level

The decedent's education level was measured by the highest degree attained. The options for these variables are those on the 2003 death certificate and include 8th grade or less; 9th to 12th grade; no diploma, high school graduate or general equivalency

diploma (GED) completed; some college credit, but no degree, Associate's degree; Bachelor's degree; Master's degree; Doctorate or Professional degree; and Unknown. For this analysis, education level was combined into two groups: 1= less than high school or equivalent, 2= at least high school or equivalent.

Marital status

The NVDRS abstractors obtain information on marital status from death certificate and often from law enforcement or medical examiner records.¹⁴⁶ Response options include Married /Civil Union/ Domestic Partnership; Never Married; Widowed; Divorced; Married/Civil Union/Domestic Partnership but separated; Single, not otherwise specified and Unknown. Marital status was combined into two groups for analysis as: 1=Married/Divorced/Separated/Widowed and 2=Single/Never Married/Unknown.

Data Analysis

For the purposes of this study, we limited our analysis to women of reproductive age (15–54 years) from the 18 states reporting complete data to the National Violent Death Reporting System. The detailed description of the steps taken to select the cases included in the analysis is shown in Figure 2. Chi-square tests of independence were conducted to compare the socio-demographic, suicide risk factors, as well as suicide event location and type of weapon used by the suicide decedents between the two residence groups (urban vs rural). Chi-square tests of independence were also used to identify the distribution of pregnant, post-partum and non-pregnant suicide decedents in urban and rural counties in the study. Fisher's Exact Probability Test was used for

categorical variables that did not meet the minimum expected cell frequency of five or greater.

Multivariable polytomous logistic regression analyses were performed using 'PROC LOGISTIC' in SAS to estimate the adjusted odds ratio (ORs) and 95% confidence intervals (CI) of suicide risk factors among pregnant and post-partum women with non-pregnant decedents as the reference group. 'PROC SGPLOT' in SAS was used to generate Odds Ratio plots of the point estimates and 95% CIs of the pregnancy risks factors of the fully adjusted model. Statistical significance was set at $p < 0.05$. All analyses were conducted using SAS 9.4® (Institute, Inc.; Cary, NC, USA).

Two approaches were then used to assess potential effect modification of risk factor associations by rural/urban residential status. In the first approach, a stratified analysis was used. The fully adjusted model was stratified by county of residence using the by-group command in 'PROC LOGISTIC' (such that data from rural and urban counties were analyzed separately) to obtain beta coefficients and ORs for pregnancy status within each stratum (urban vs rural). 'PROC SGPLOT' in SAS was used to generate Odds Ratio plots of the point estimates and 95% CIs of the pregnancy risks factors of the fully adjusted models for urban and rural counties (Figure 4).

The fully adjusted statistical models for estimating the association between suicide risk factors and pregnancy status were specified identically for both the rural and urban strata as:

$$\text{logit (pregnant vs not pregnant)} = b_0 + b_1X_1 + \dots + b_{16}X_{16} + \text{error},$$

where X_i was specified as described in Table 1.

Table 1. Multivariable logistic regression model independent variables

X ₁	Financial problem (1 = yes, 0 = no)
X ₂	Alcohol problem (1 = yes, 0 = no)
X ₃	Alcohol use suspected (1 = yes, 0 = no)
X ₄	Current mental health problem (1 = yes, 0 = no)
X ₅	Current depressed mood (1 = yes, 0 = no)
X ₆	Recent crisis (1 = yes, 0 = no)
X ₇	Intimate partner problem (1 = yes, 0 = no)
X ₈	Job problem (1 = yes, 0 = no)
X ₉	Physical problem (1 = yes, 0 = no)
X ₁₀	Suicide intent disclosed (1 = yes, 0 = no)
X ₁₁	Suicide attempt history (1 = yes, 0 = no)
X ₁₂	Other substance problem (1 = yes, 0 = no)
X ₁₃	Age (1= 15-34 years, and 2=35-54 years)
X ₁₄	Race (1= White, 2=Non-White)
X ₁₅	Marital status (1=Married/Divorced/separated/other and 2=Single/never married/unknown)
X ₁₆	Education level (1= less than a High school grad or GED, 2=High school grad or GED or more)

In the second approach, several models were investigated by adding two-way interaction terms (between model predictors and county type) one at a time to the full adjusted model using PROC LOGISTIC in SAS. OR point estimates and confidence intervals were evaluated for rural and urban decedents for each predictor in the model.

CHAPTER 4 RESULTS

Between 2003 and 2012, of the 25,649 females between the ages of 15-54 years, 13,313 (53.8%) died as a result of suicide (Figure 2). Of the 13,313 suicide decedents, only 4,537 (34.1%) had complete data and were included in the study. The major cause of missing data, and thus excluded, was unknown pregnancy status (Table 2).

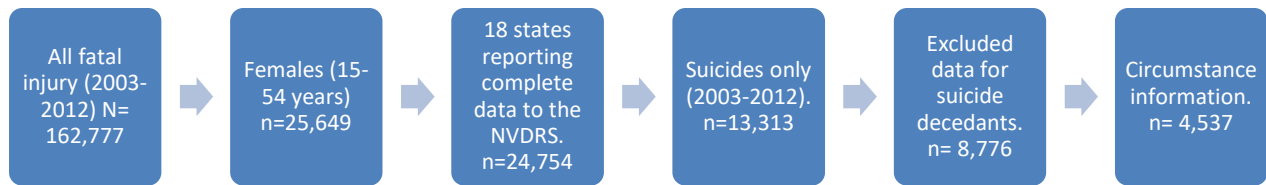


Figure 2. Description of NVDRS (2003-2012) study case selection.

Table 2. Excluded records from suicide decedents (NVDRS, 2003-2012).

Reason for exclusion	N (%)
Unknown pregnancy status	8252 (61.98)
Not applicable pregnancy status	524 (3.94)
Total	8,776

Of the 4,537 suicides that met initial inclusion criteria, there were 4,306 suicides with known suicide circumstances recorded and those cases comprised the final sample for analysis. Suicide circumstances were known in 95.49% non-pregnant, 96.88% pregnant and 98.17% post-partum suicide decedents from urban counties and in 92.91% non-pregnant, 100% pregnant and 93.33% post-partum suicide decedents from rural counties.

Demographics

The majority of the suicide decedents were from urban (80.35%) counties, were white (88.83%), had a high school grad/equivalent or more (85.30%), were between the ages of 35-54 years (68.46%), were married/divorced/separated/other (68.83%), and non-pregnant (94.57%) (Table 3).

Age of suicide decedents differed by rural-urban status. Suicide decedents from urban counties tended to be younger than suicide decedents from rural counties. The majority of the suicide decedents in urban counties were in the 15-34 age-group, whereas the majority of the suicide decedents in rural counties were in the 35-54 age-group. Education level also significantly varied among rural and urban county suicide decedents. A higher percentage of suicide decedents from rural counties had less than a high school/GED level of education whereas a higher percentage of decedents from urban counties had completed a high school or GED level or more (Table 3).

Marital status was also significantly different among suicide decedents from rural and urban counties. In urban counties, the majority of the suicide decedents were single or never married whereas rural county suicide decedents were married, divorced, separated or other. Urban suicide decedents did not vary significantly from rural decedents in terms of race. The majority of suicide decedents in both county types were white. However, more suicide decedents in urban counties were non-white compared to decedents from rural counties. Finally among included cases, the distribution of suicides by pregnancy status was similar between rural and urban counties (Table 3).

Table 3: Demographic characteristics of suicide decedents in rural and urban counties.

Characteristic	All suicides n = 4306		Urban n = 3460		Rural n = 846		p-value ^a
	n	%	n	%	n	%	
Age,y							
15-34	1358	31.54	1120	32.37	238	28.13	0.0174
35-54	2948	68.46	2340	67.63	608	71.87	
Race[†]							
White	3825	88.83	3058	88.38	767	90.66	0.0591
Non-White	481	11.17	402	11.62	79	9.34	
Educational Level							
< HS [‡] /equivalent	633	14.70	458	13.24	175	20.69	<.0001
> HS/equivalent	3673	85.30	3002	86.76	671	79.31	
Marital status*							
M*/Divorced/Sep./Wid.	2964	68.83	2343	67.72	621	73.40	0.0014
Single/NM**/Unknown	1342	31.17	1117	32.28	225	26.60	
Pregnancy status							
Non-pregnant	4072	94.57	3260	94.22	812	95.98	0.0641
Pregnant	113	2.62	93	2.69	20	2.36	
Post-partum	121	2.81	107	3.09	14	1.65	

^ap-values derived from chi-square or Fishers exact tests for categorical variables. Numbers may not add to a total of 100% due to rounding. [†]Cells suppressed for black/other/unknown races due to small number of individuals. Statistically significant association are represented in bold font. [‡]HS=High school, *M=married, **NM=never married

Mental health characteristics

Among the 4306 decedents, 2716 (63.07%) were reported to have had a current mental health problem, and 2644 (61.40%) were noted to have had a current depressed mood. Current depressed mood and current mental health problem differed significantly among suicide decedents in rural and urban counties, with a higher percentage for each occurring among decedents from urban counties (Table 4).

Substance use problems

Overall, less than half of the suicide decedents were reported to have an alcohol problem, other substance abuse problem or were suspected to have used alcohol at time of death with no significant difference by urban–rural residence status (Table 4).

Precipitating circumstances

Report of financial problems, recent crisis within the last two weeks and job problems among suicide decedents all differed significantly by rural-urban residence status (Table 4). Physical health problems, however, did not significantly differ by rural-urban residence status. Financial problems, job problems and recent crisis within the last two weeks were more commonly cited as contributing to suicide among urban decedents (Table 4).

Suicide characteristics

Having a history of a suicide attempt(s) or whether the decedent disclosed intent to die by suicide was significantly different between rural and urban suicide decedents and were both more commonly reported among decedents in urban counties (Table 4).

Intimate partner problems

Intimate partner problems differed significantly by rural-urban county status. Problems with a current or former intimate partner appeared to have contributed to more suicides among suicide decedents in urban counties compared to rural counties. (Table 4).

Location of injury

Whether the suicide incident occurred in the decedents' home did not significantly differ by rural and urban counties; in both settings, more than half of the suicides occurred in the homes of the decedents (Table 4).

Method of suicide/weapon used

The most common method of suicide was poisoning, followed by firearms, strangulation/suffocation and sharp/blunt trauma or other (Table 4). The method/type of

weapon used for suicides differed significantly by rural-urban county of residence. Compared to urban county suicide decedents, rural suicide decedents were more likely to use firearms. Urban county suicide decedents, on the other hand were more likely to die by poisoning compared to rural decedents (Table 4).

Prior to stratification by rural and urban counties, although not significant, the presence of job problems and report of history of suicide attempts were both associated with decreased odds that the suicide decedent was pregnant or post-partum compared to non-pregnant (Figure 3). Recent crisis and intimate partner problems on the other hand, were both associated with increased odds that the suicide decedent was pregnant or post-partum compared to non-pregnant albeit not significant (Figure 3). In the stratified analyses, recent crisis and intimate partner problems still increased the odds that the suicide decedent was pregnant or post-partum compared to non-pregnant in both urban and rural residence counties whereas presence of job problems and report of history of suicide attempt still decreased the odd that the suicide decedent was pregnant or post-partum compared to non-pregnant in both urban and rural residence counties, although not significant (Figure 4).

Having a current depressed mood significantly decreased the odds that the suicide decedent was pregnant by 39% (adjusted odds ratio [AOR] = 0.61; 95% confidence interval [CI] 0.41-0.91, $p=0.0158$) but significantly increased the odds that the suicide decedent was post-partum by 57% (AOR = 1.57; 95% CI 1.04-2.37, $p=0.0321$) compared to non-pregnant prior to stratification (Figure 3). In the stratified analyses, current depressed mood was still more likely to be associated with suicide decedents who were

post-partum and less likely associated with suicide decedents who were pregnant (vs. non-pregnant) in both rural and urban counties, although only the association with pregnant status in urban county was significant. Current depressed mood non-significantly increased the odds that the suicide decedent was post-partum (vs. non-pregnant) by 55% (AOR = 1.55; 95% CI 1.00–2.40, $p= 0.0523$) in urban counties and by 42% (AOR = 1.42; 95% CI 0.42–4.80, $p= 0.5743$) in rural counties. On the other hand, current depressed mood, significantly decreased the odds that the suicide decedent was pregnant (vs. non-pregnant) by 42% in urban counties (AOR = 0.58; 95% CI 0.37–0.89, $p= 0.0141$) but non-significantly by 8% (AOR = 0.92; 95% CI 0.34–2.50, $p= 0.8625$) in rural counties (Figure 4).

Prior to stratification, having current mental health problems was also associated with decreased odds that the suicide decedent was pregnant and increased odds that the suicide decedent was post-partum compared to non-pregnant, albeit not statistically significant (Figure 3). When stratified, having a current mental health problem however, decreased the odds (AOR = 0.92; 95% CI 0.59–1.41, $p=0.6919$) that the suicide decedent was post-partum (vs. non-pregnant) in urban counties but increased the odds (AOR = 2.28; 95% CI 0.59–8.87, $p=0.2352$) that the suicide decedent was post-partum (vs. non-pregnant) in rural counties. Having a current mental health problem decreased the odds that the suicide decedent was pregnant compared to non-pregnant by 13% (AOR = 0.87; 95% CI 0.55–1.37, $p=0.5338$), in urban counties and decreased the odds by over two-fold in rural counties (AOR = 0.40; 95% CI 0.14–1.19, $p=0.1006$). (Figure 4).

Table 4: Circumstances contributing to suicides in rural and urban counties.

Circumstances	All suicides n = 4306		Urban n = 3460		Rural n = 846		p-value ^a
	n	%	n	%	n	%	
Mental health characteristics							
Current mental health problem ^b	2716	63.07	2212	63.93	504	59.57	0.0186
Current depressed mood ^b	2644	61.40	2162	62.49	482	56.97	0.0032
Substance use problems							
Alcohol problem	805	18.69	659	19.05	146	17.26	0.2317
Alcohol use suspected when injured	1189	27.61	954	27.57	235	27.78	0.9046
Other substance problem	906	21.04	736	21.27	170	20.09	0.4515
Precipitating circumstances							
Recent crisis	1033	23.99	863	24.94	170	20.09	0.0031
Financial problem	547	12.70	462	13.35	85	10.05	0.0097
Physical problem	900	20.90	741	21.42	159	18.79	0.0927
Job problem	445	10.33	376	10.87	69	8.16	0.0202
Suicide characteristics							
History of suicide attempt	1613	37.46	1353	39.10	260	30.73	<.0001
Disclosed intent to commit suicide	1410	32.75	1160	33.53	250	29.55	0.0272
Intimate partner problem	1443	33.51	1181	34.13	262	30.97	0.0806
Injury occurred at victim's home	3383	78.56	2728	78.84	655	77.42	0.3667
Method of injury							
Firearm	1204	27.96	899	25.98	305	36.05	<.0001
Poisoning	1793	41.64	1458	42.14	335	39.60	
Strangulation/suffocation	999	23.20	839	24.25	160	18.91	
Sharp/blunt instrument/Other	310	7.20	264	7.63	46	5.44	

^bMedication prescription used as proxy for current mental health problem and depressed mood. ^ap-values derived from chi-square or fishers exact tests for categorical variables. Statistically significant association are represented in bold font.

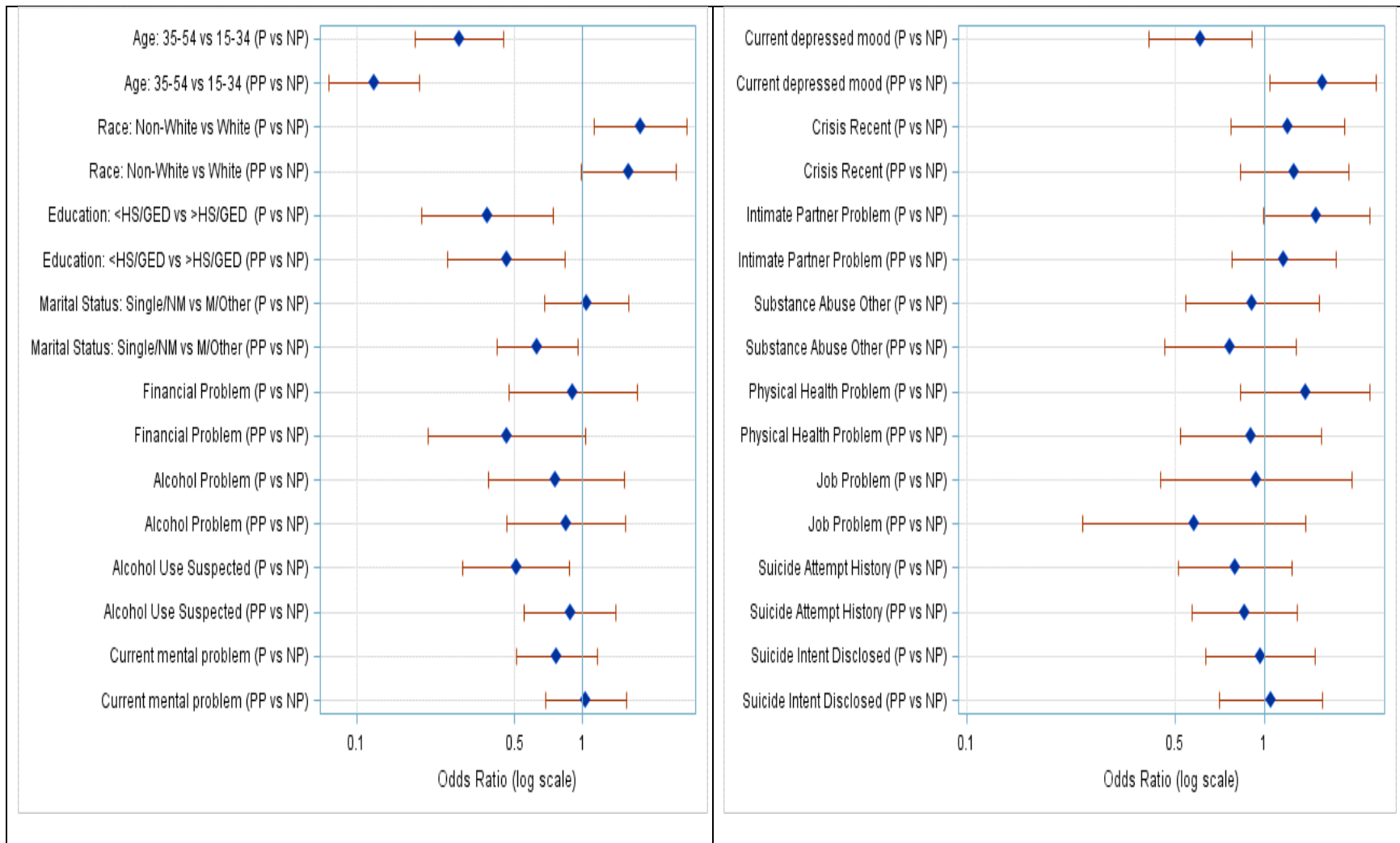


Figure 3. Odds Ratio point estimates with 95%CI from the polytomous logistic regression analysis: pregnant (P) and postpartum (PP) decedents compared with non-pregnant (NP). Rural-Urban status is not considered in this model.

The presence of physical health problem increased the odds that the suicide decedent was pregnant by 37% (AOR = 1.37; 95% CI 0.83-2.26, $p=0.2189$) but decreased the odds that the suicide decedent was post-partum by 10% (AOR = 0.90; 95% CI 0.52-1.55, $p=0.7002$) (vs non-pregnant) prior to stratification (Figure 3). Presence of physical health problems increased the odds that the suicide decedent was pregnant (AOR = 1.50; 95% CI 0.88-2.56, $p=0.1387$) in urban and also increased post-partum (vs non-pregnant) (AOR = 1.04; 95% CI 0.21-5.25, $p=0.9612$) odds in rural counties. Physical health problems however, decreased the odds that the suicide decedent was pregnant (AOR = 0.73; 95% CI 0.15-3.52, $p=0.6896$) in rural and post-partum (vs non-pregnant) (AOR = 0.89; 95% CI 0.50-1.59, $p=0.6917$) in urban counties (Figure 4).

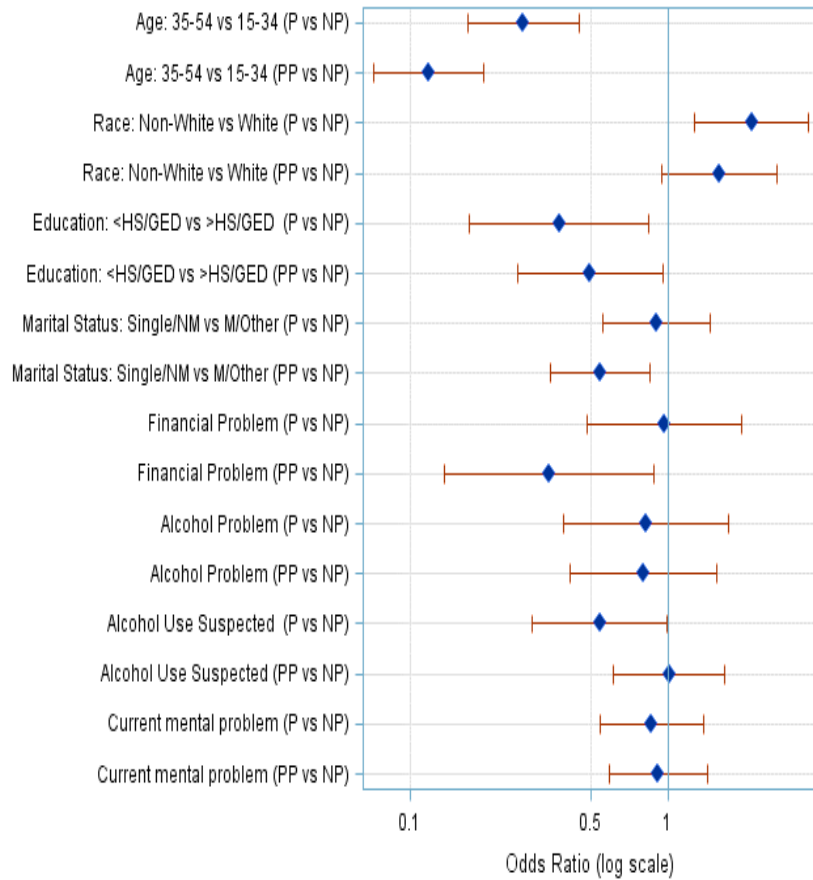
Although not significant, the presence of financial problems, report of other substance abuse problems, alcohol problems, and whether alcohol use was suspected at time of injury, were all associated with decreased odds that the suicide decedent was both pregnant and post-partum (vs non-pregnant) (Figure 3). Alcohol use suspected at time of injury and other substance abuse problems decreased the odds that the suicide decedent was both pregnant (AOR = 0.39; 95% CI 0.10-1.50, $p=0.1698$) and post-partum (AOR = 0.40; 95% CI 0.08-2.01, $p=0.2670$) (vs non-pregnant) in rural counties. In urban residence however, alcohol use suspected at time of injury did not change the odds that the suicide decedent was post-partum (AOR = 1.01; 95% CI 0.616-1.658, $p=0.9671$) but significantly decreased the odds that the suicide decedent was pregnant (vs non-pregnant) (AOR = 0.54; 95% CI 0.297-0.994, $p=0.0476$). Other substance abuse problem on the other hand, increased the odds that the suicide decedent was pregnant by 13% (AOR = 1.13; 95% CI 0.66-1.94, $p=0.6596$) but decreased the odds that the suicide

decedent was post-partum (vs non-pregnant) by 17% (AOR = 0.83; 95% CI 0.48-1.41, p=0.4829) in urban counties (Figure 4).

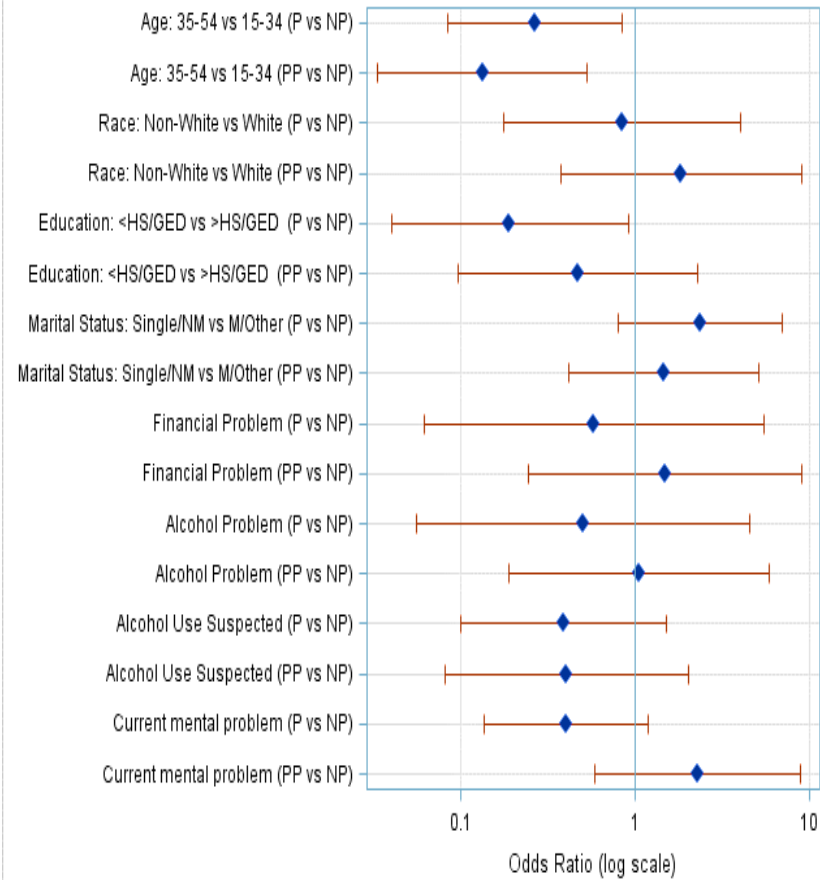
Alcohol problem also did not change the odds that the suicide decedent was post-partum (AOR = 1.05; 95% CI 0.19 - 5.85, p=0.9522) but decreased the odds that the suicide decedent was pregnant (vs non-pregnant) by 49% (AOR = 0.51; 95% CI 0.06-4.56, p= 0.5435) in rural counties. For urban residence, alcohol problem decreased the odds that the suicide decedent was pregnant (AOR = 0.82; 0.39-1.72, p= 0.6033) and post-partum (AOR = 0.80; 95% CI 0.42-1.54, p= 0.5018) (vs non-pregnant). Financial problems decreased the odds that the suicide decedent was pregnant (AOR = 0.97; 95% CI 0.49-1.93, p= 0.9283) and post-partum (AOR = 0.35; 95%CI 0.14-0.88, p= 0.0251) in urban counties, and pregnant (vs non-pregnant) (AOR = 0.58; 95% CI 0.06-5.44, p 0.6329) in rural counties. Financial problems however increased the odds that the suicide decedent was post-partum (AOR = 1.49; 95% CI 0.24-8.99, p= 0.6663) compared to non-pregnant in rural counties (Figure 4).

Finally, whether the decedent disclosed intent to commit suicide, decreased the odds that the suicide decedent was pregnant and increased the odds that the suicide decedent was post-partum (vs non-pregnant), albeit not statistically significant (Figure 3). Whether the suicide decedent disclosed intent to commit suicide was associated with decreased odds that the suicide decedent was pregnant in urban counties and post-partum in rural counties. Disclosure of suicide intent however, increased the odds that the suicide decedent was post-partum (AOR = 1.11; 95% CI 0.73-1.69, p= 0.6275) in urban and pregnant (vs non-pregnant) (AOR = 2.33; 95% CI 0.82-6.58, p= 0.1112) in rural counties (Figure 4).

Urban suicide decedents



Rural suicide decedents



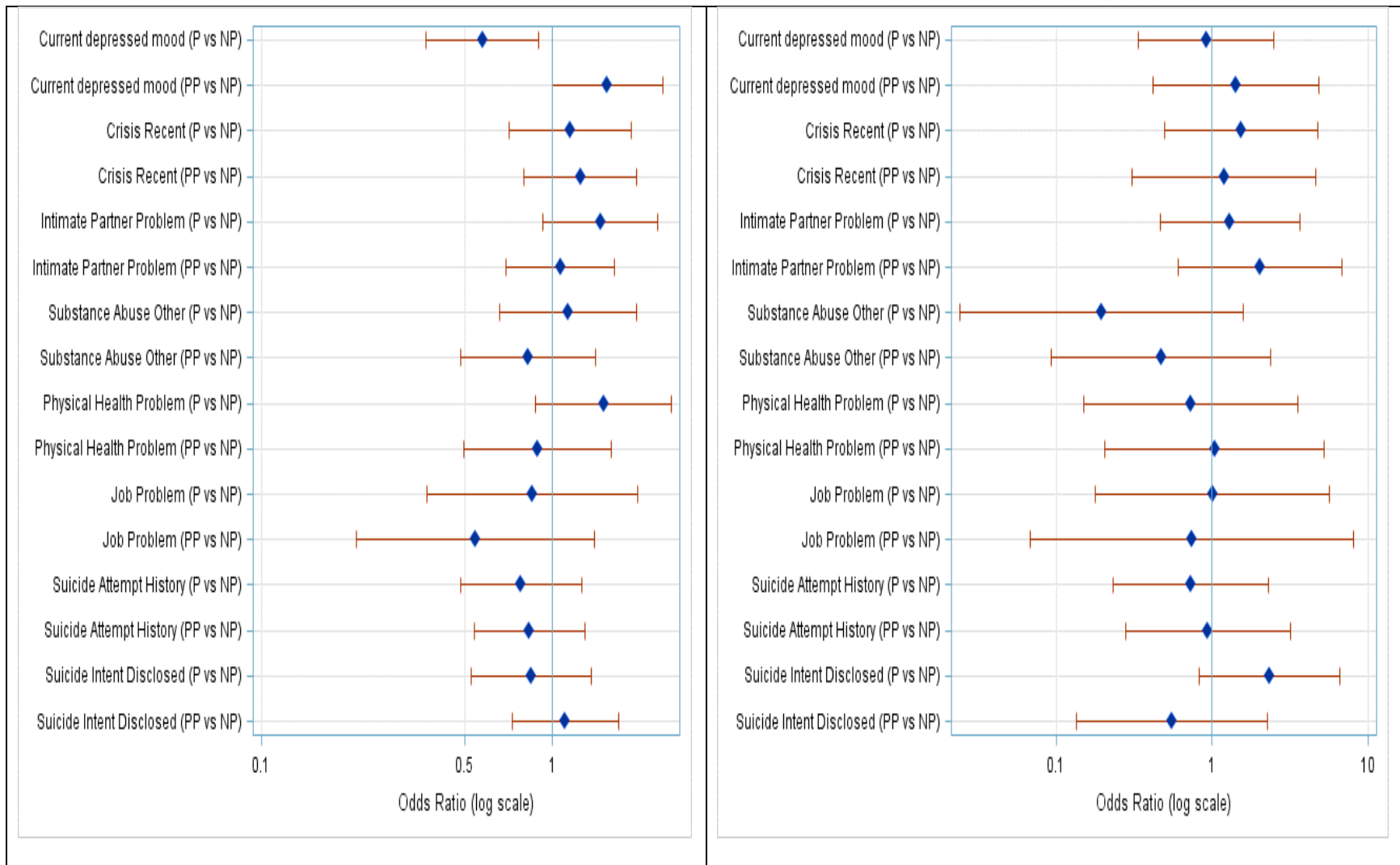


Figure 4. Odds Ratio point estimates with 95%CI from the polytomous logistic regression analysis: pregnant (P) and postpartum (PP) decedents compared with non-pregnant (NP) decedents and stratified by rural-urban status of the county of residence.

Although the point estimates in Figure 4 suggest that certain independent predictor variables differ by urban or rural county status, when the data were analyzed by refitting the model multiple times, and adding a different interaction term to the fully adjusted model with the main effects, until all the possible county-main effects terms were assessed, given the small number of pregnant and post-partum suicide decedents in rural counties (see Table 2), there was not enough power to detect the interactions, hence, none of the interaction terms were statistically significant at the $p < 0.05$ level (Table 4).

The interaction effect of having current depressed mood and alcohol use suspected at time of injury, for pregnant (vs non-pregnant) status was significantly different between urban and rural residence status whereas the interaction effect of presence of financial problems for post-partum (vs non-pregnant) status was significantly different between urban and rural residence county.

Having current depressed mood significantly decreased the odds that the suicide decedent was pregnant (vs non-pregnant) by 41% (95% CI 0.38 - 0.91) in urban counties compared to rural counties. Report of alcohol use suspected at time of injury also decreased the odds that the suicide decedent was pregnant (vs non-pregnant) by 47% (95% CI 0.30 - 0.94) in urban counties compared to rural counties. The presence of financial problems significantly decreased the odds that the suicide decedent was post-partum (vs non-pregnant) by 62% (95% CI 0.15 - 0.95) in urban counties compared with rural counties (Table 4).

Finally, all of the other odds ratios in the final model were statistically not significant as evidenced by the inclusion of the null value (OR=1) in all 95% confidence intervals.

Table 5: Stratum-specific odds ratio point estimates with 95%CI from the polytomous logistic regression analysis: pregnant and postpartum victims compared with non-pregnant victims with county interaction terms.

Effects	Pregnant vs. Non-pregnant	Post-partum vs. Non-pregnant
	Adjusted OR ^a (95%CI) ^b	Adjusted OR ^a (95%CI) ^b
Current depressed mood		
at county = Rural	0.77 (0.31 - 1.94)	1.52 (0.61 - 3.76)
at county = Urban	0.59 (0.38 - 0.91)	1.58 (1.01 - 2.46)
Current mental problem		
at county = Rural	0.51 (0.20 - 1.28)	1.52 (0.62 - 3.75)
at county = Urban	0.85 (0.54 - 1.34)	0.95 (0.61 - 1.49)
Alcohol use suspected		
at county = Rural	0.46 (0.18 - 1.23)	0.82 (0.33 - 2.07)
at county = Urban	0.53 (0.30 - 0.94)	0.80 (0.54 - 1.48)
Alcohol problem		
at county = Rural	0.35 (0.05 - 2.62)	0.56 (0.13 - 2.41)
at county = Urban	0.86 (0.42 - 1.78)	0.91 (0.48 - 1.72)
Substance abuse other		
at county = Rural	0.23 (0.03 - 1.71)	0.37 (0.09 - 1.56)
at county = Urban	1.08 (0.64 - 1.84)	0.86 (0.51 - 1.47)
Financial problem		
at county = Rural	0.63 (0.08 - 4.77)	1.12 (0.26 - 4.89)
at county = Urban	0.94 (0.48 - 1.86)	0.38 (0.15 - 0.95)
Job problem		
at county = Rural	1.31 (0.30 - 5.78)	0.74 (0.10 - 5.64)
at county = Urban	0.86 (0.38 - 1.96)	0.55 (0.22 - 1.41)
Physical health problem		
at county = Rural	0.81 (0.20 - 3.39)	0.60 (0.14 - 2.54)
at county = Urban	1.49 (0.89 - 2.51)	0.96 (0.54 - 1.71)
Recent crisis		
at county = Rural	1.50 (0.63 - 3.59)	0.95 (0.33 - 2.69)
at county = Urban	1.16 (0.73 - 1.86)	1.31 (0.85 - 2.04)
Intimate partner problem		
at county = Rural	1.54 (0.73 - 3.24)	0.96 (0.42 - 2.17)
at county = Urban	1.43 (0.93 - 2.21)	1.20 (0.79 - 1.82)
Suicide attempt history		
at county = Rural	0.76 (0.30 - 1.94)	0.67 (0.26 - 1.69)
at county = Urban	0.81 (0.51 - 1.28)	0.89 (0.59 - 1.36)
Suicide intent disclosed		
at county = Rural	1.50 (0.70 - 3.22)	0.52 (0.16 - 1.67)
at county = Urban	0.89 (0.56 - 1.41)	1.15 (0.76 - 1.73)

^aOR:Odds Ratio ^bCI:Confidence Interval. Potential confounders were factors that altered the unadjusted measure of association between the exposure and the outcome from the measure, adjusted for that variable, by 10% to 20%. The final model was adjusted for demographics - age, race, and education level. Statistically significant association are represented in bold font.

CHAPTER 5

IMPLICATIONS FOR PUBLIC HEALTH

The current study is an investigation of suicide risk factors among pregnant, post-partum and non-pregnant decedents from the 18 states reporting full data to the NVDRS from 2003-2012. Specifically, this study examined whether rural-urban county status modified the relationship between suicide risk factors and pregnancy status (i.e., pregnant, post-partum and non-pregnant) at the time of death.

In this study, the majority of the suicide decedents were from urban counties (80.35%) and were non-pregnant (94.57%). Despite the fact that prior studies have found the rates of self-harm to be lower among pregnant/postpartum women when compared to non-pregnant/non-postpartum women,^{2,6,7} suicide risk among pregnant and postpartum women is still of great concern because these women have been found to have high levels of depressive symptoms, which may increase suicide risk.¹⁴⁸⁻¹⁵¹

Rurality is a fluid definition made up of multiple components and can also be seen as a continuum since there are several degrees of rurality.¹⁵² Rural and urban definitions therefore vary and have not been uniformly applied across various studies examining rural-urban differences.^{20,22,71,75,155,157,158} By applying the 2013 Rural-Urban Continuum Codes as described (RUCC) in the methodology, only a small percentage of the pregnant and post-partum decedents in this study were coded as rural (2.36% and 1.65% respectively). This small percentage of rural pregnant/post-partum decedents, in addition to the low percentages of those who had experienced suicide risk factors within rural and urban status reduced the power of the statistical analyses.

Also in this study, county status modified the association between suicide risk factors and pregnancy status of the decedents. The results however, did not indicate a significant difference in rural-urban status and association of risk factors by pregnancy status although, suicide risk factors appeared to be more prevalent in urban counties. Furthermore, by analyzing only decedents, we cannot estimate the magnitude of such risk factors in the general population of pregnant, post-partum, and non-pregnant women who did not die by suicide in each area.

Although maternal deaths due to direct causes (those caused by complications during pregnancy), such as bleeding or infection, have declined over the years, maternal deaths due to indirect causes (those caused by pre-existing physical and mental health conditions), such as suicides, have not seen a corresponding decline. Suicide has become one of the leading causes of death in pregnant and post-partum women.⁴ Suicides however, are preventable, hence, providers should be alert to these risk factors despite the lack of significant difference.

Demographic factors

The demographic patterns in this study were similar to those found in the NVDRS reports from the general population. In this study, suicide decedents were predominantly older (in the 35-54 age group), married, and white. Data from the NVDRS also show that in the U.S., female suicide is concentrated in the 35–64 years age group (64.8%), with a 9.1/100,000 peak between those aged 45–54 years,¹⁵⁹ female suicide rates were highest among Whites and women of American Indian descent, and of suicide decedents aged

≥18 years, 34.5% were married, 29.7% had never married, and 21.6% were divorced at the time of death.¹⁵⁹

This study also presented the demographic pattern of female decedents of reproductive age residing in urban and rural counties. Suicide decedents from urban counties were significantly younger, had completed at least a high school or GED level of education, and were single or never married. Suicide decedents from rural counties were older, had less than a high school/GED level of education and were less likely to be single or never married. The distribution of race was similar between rural and urban counties, with the majority being white.

Only one U.S. study has examined rural–urban patterns in suicide risks among both males and females, characterizing the demographic, socioeconomic, and mental health features of individual suicide decedents by urban–rural residence status.²⁰ The demographic findings in this study are similar to the demographic characteristics of this present study. White women accounted for the majority of suicide decedents in urban, rural adjacent and rural not adjacent areas and decedents in both rural categories were less likely to have had a relationship status of never married.²⁰

Mental health characteristics

In this study, rural county decedents were less likely than urban decedents to have had a current mental health problem or current depressed mood. Similarly, in the study conducted by Searles et al., current mental health problems differed significantly by urban–rural status, with each being more likely with increasing urban status of decedents.²⁰ The possible explanations for the lower rates of mental health diagnosis

among rural decedents has been explored in several studies. According to one study, rural individuals are less likely to be diagnosed with and receive treatment for mental health problems because of the scarcity of health and mental health treatment providers in rural areas.⁶³ Another study attributed the lower rates of mental health diagnosis among rural decedents to the stigma attached to mental illness in rural communities, such that those suffering from mental illness may isolate themselves rather than seek help from their community.¹⁶⁰ The theory of greater social isolation in rural communities was also explained in yet another study.¹⁶¹ Physical isolation from social networks and support services in rural areas makes it less likely that an at-risk individual will be identified.¹⁶¹

Furthermore, in this study, we found that having a current mental health problem or current depressed mood significantly decreased the odds of observing pregnant status but significantly increased the odds that the suicide decedent was post-partum compared to non-pregnant. These results are consistent with another study where compared to other women, postpartum women were more likely to have been identified as having depressed mood in the two weeks prior to suicide.¹ Several predictors have been evaluated in literature to explain why depressed mood might pose a higher risk in postpartum women compared to other women. In these studies, the strongest predictors of postpartum depression included poor marital relationship, low social support, stressful life events, depression and anxiety during pregnancy and previous history of depression.¹⁶²⁻¹⁶⁵

When stratified by rural-urban status, having a current depressed mood was still more likely to be associated with suicide decedents who were post-partum and less likely associated with suicide decedents who were pregnant (vs. non-pregnant) in both rural

and urban counties, however, the association was only significant among pregnant status in urban counties. Having a current mental health problem however, decreased the odds that the suicide decedent was post-partum (vs. non-pregnant) in urban counties but increased the odds that the suicide decedent was post-partum (vs. non-pregnant) in rural counties. It is not known why current mental health problems increased the odds of post-partum (vs. non-pregnant) status in rural counties. It is possible however, that post-partum decedents from the rural counties under study may have had comparable rates of current mental health problems to post-partum decedents from urban counties but were somehow less able to cope with them.

Substance use problems

In this study, alcohol problem, other substance abuse problem or whether decedents were suspected to have used alcohol at time of death were equally prevalent in rural and urban decedents. These results are in contrast to previous studies that report increased alcohol and substance abuse problems as factors that increase suicides rates in rural areas.¹⁶⁶⁻¹⁶⁸ Also in this study, substance abuse problems, alcohol problems, and whether alcohol use was suspected at time of injury, were all associated with decreased odds that the suicide decedent was pregnant and post-partum compared to non-pregnant.

Furthermore, the interaction effect of alcohol use suspected at time of injury, for pregnant (vs non-pregnant) status was significantly different between urban and rural residence status whereby report of alcohol use suspected at time of injury decreased the odds that the suicide decedent was pregnant (vs non-pregnant) in urban counties compared to rural counties. Alcohol is reported as a major factor in suicides,^{105,169} hence,

although overall, alcohol and other substance abuse problems were associated with decreased odds of observing pregnant and post-partum status in both urban and rural counties, comprehensive and culturally appropriate suicide-prevention strategies are still needed in both rural and urban counties that include efforts to reduce alcohol consumption.

Precipitating circumstances

Factors that were more prevalent among urban decedents than rural decedents included financial problems, job problems and recent crisis within the last two weeks. Contradictory to these findings are studies that report rural socioeconomic decline as factors that increase rates of suicides in rural areas.^{74,170} In this study, the presence of recent crisis, referred to as life events in other studies, increased the odds that the suicide decedent was pregnant and post-partum compared to non-pregnant. The relation between suicide and life events is complex.¹⁷¹ Prior studies have shown an association between suicides and life events in the previous 3 months, and particularly in the previous week.¹⁷² These life events were specifically associated principally with interpersonal, job, financial, and legal problems,¹⁷³⁻¹⁷⁵ and therefore indicates the need for multiple adverse life events to be taken into account in suicide risk assessment and treatment.

Suicide characteristics

In this study, having a history of suicide attempt or whether the decedent disclosed intent to die by suicide was more prevalent among urban decedents. History of suicide attempts were both associated with decreased odds that the suicide decedent was

pregnant and post-partum compared to non-pregnant and even after stratification by rural-urban residence county. These findings are similar to a study that reported lower suicide attempts during pregnancy and postpartum than in the general population of women.²

The decedent having disclosed intent to die by suicide, decreased the odds that the suicide decedent was pregnant and increased the odds that the suicide decedent was post-partum compared to non-pregnant. Although it is unclear what the implication of this difference is, disclosure of suicide intent is an important warning sign of suicidal intentions and persons in close contact with potential victims of suicide need to be educated on the significance of these warnings and how to act on them.

Intimate partner problems

In this study, intimate partner problems were also cited as a precipitating factor with a higher percentage among urban decedents than rural decedents. Intimate partner problems was also associated with increased odds that the suicide decedent was pregnant and post-partum compared to non-pregnant and still increased the odds that the suicide decedent was pregnant and post-partum compared to non-pregnant in both urban and rural residence. These results are similar to prior studies where both pregnant and postpartum women were more frequently reported as having problems with a current or former intimate partner.^{21,23} The perinatal period is a time when health care providers have recurrent encounters with pregnant and post-partum women, therefore, screening for partner violence during and after pregnancy can help lower or prevent violent deaths among potentially at-risk women.²³

Method of suicide/weapon used

In this study, the most common method of suicide was poisoning, followed by firearms, strangulation/suffocation and sharp/blunt trauma or other. Data from the NVDRS also show that in the U.S., among females, poisons were used most often (40.7%) followed by firearms (31.3%).¹⁵⁹ Furthermore, rural suicide decedents were more likely to use firearms whereas urban county suicide decedents were more likely to die by poisoning. This is also consistent with prior studies where rural decedents were more likely to use a firearm as the method of suicide.^{20,22,167,170,175}

Strengths

Few studies have examined the association between suicide risk factors and pregnancy status of suicide decedents from rural and urban counties in the U.S. Our study is therefore the first to evaluate if county residence status modifies the association between suicide risk factors and pregnancy status. Furthermore, the use of the multivariable polytomous logistic regression modeling in this study made it possible to estimate the odds ratios while adjusting for potential confounders.

Limitations

This study has several limitations. First, the NVDRS currently collects data from 18 states, and hence it is not fully nationally representative. This analysis includes data from these 18 states, therefore, the results might not be generalizable to other populations in other states. Secondly, all study subjects in the NVDRS are deceased and cannot be

interviewed after death so it is impossible to assess for all current mental health disorders, thoughts about suicide intent, or precipitating factors.^{7,20} Information regarding mental health, substance use, intimate partner problems or other precipitating circumstances are obtained from the reports of families and friends of the deceased without independent verification, and hence may be subject to lack of relevant knowledge, response bias, and recall bias^{7,177,178} In addition, the accuracy of reporting of suicide risk factors may vary by urban–rural status and the structure of the NVDRS does not allow for control of such variability.⁷

The third major limitation is that approximately 62% of the pregnancy status field was coded as “unknown” pregnancy status and were excluded from the study. As a result, some women who would have been classified as either pregnant or post-partum may have been misclassified into the unknown pregnancy group rather than correctly assigned to the right pregnancy group. Thus, this may have underestimated the number of pregnancy-associated suicide deaths and resulted in non-differential bias, which may have reduced the estimate towards the null. Possible explanations for this is the fact that although NVDRS abstractors code pregnant and postpartum status from multiple data sources, pregnancies may still be underreported because, even if identified, they may not be reported on death certificates, autopsies (if there is an autopsy) might not include examination for pregnancy and may miss early-gestation or late-postpartum status and finally, family members and friends may have been unaware of early or unwanted pregnancies.¹

As previously discussed, there is a great deal of variation in how the terms rural and urban are defined. Thus, the fourth limitation is that by using the 2013 RUCC, county

of residence was dichotomized into rural (six categories of rural (codes 4-9)) and urban (three categories of urban (codes 1-3)) in this study. Instead, a three category level of residency status could have been used and classified as rural not adjacent to urban (codes 5,7 & 9), rural adjacent to urban (codes 4,6 & 8), and urban (codes 1-3). This is because proximity to urban centers might mitigate the potential risk factors that exist in the rural setting (such as limited access to treatment), and therefore, differences also exist in risk factors for suicide among women living in completely rural or rural adjacent areas.¹⁷⁸ Using a dichotomous category for residence status as in the case of this study makes it difficult to distinguish such differences and may also give a pooled estimate of risk factors for suicide which might be similar to those of urban women and will lead to failure to reject the null hypothesis (type 1 error). Future research should include alternative measures of rural status that takes into account duration of residence and proximity to urban centers.

Lastly, only information on suicide decedents is reported in the NVDRS. This analysis does not include information on other pregnant, post-partum and non-pregnant individuals in the rural and urban counties under study. Thus by analyzing only decedents, a possible bias exists. Decedent characteristics may differ between pregnant, post-partum and non-pregnant suicide decedents and their counterparts who consider or attempt suicide or without any suicidal thoughts or attempts. Thus, the current study is only a descriptive study and the results cannot be used to infer causality when looking at factors associated with suicides among pregnant, post-partum and non-pregnant decedents from rural and urban counties. To help identify individuals at risk and prevent future mortality, future studies should also compare decedents with living controls.

Generalizability

As discussed earlier, rural areas are not homogeneous and definitions of rural and urban areas vary and are not applied uniformly across other studies. Some determinants of rurality within the United States vary from one rural area to another and may be more prevalent in one community compared to others.^{179,180} Health, demographic and socio-economic disparities are different in different parts of America and different parts of the world.¹⁷⁹ Since it is impossible to control for all the fluid factors that make up the definition of rurality, such differences affect the generalizability and external validity of this study and makes it difficult to generalize the present results to other rural and urban communities.

Conclusions

The findings from this secondary data analysis are useful for providing relevant information to public-health officials and healthcare providers and for guiding research and suicide prevention efforts in the 18 states that contribute data to the NVDRS. The current project also confirmed there are some variations in socio-demographic and suicide risk factors among pregnant, post-partum and non-pregnant decedents from rural and urban counties. In particular, compared to urban suicide decedents, rural suicide decedents were older, married, less likely to have had a mental health diagnosis and more likely to use a firearm to die by suicide. Furthermore, recent crisis and intimate partner problems were both associated with increased odds that the suicide decedent was pregnant and post-partum compared to non-pregnant, albeit not significant. These

variations may imply the need for differences in strategies for suicide prevention in rural and urban counties in the U.S.

Recommendations

Based on the results of this study, we recommend the following interventions in both urban and rural counties for all women of reproductive age that aim to: increase access to and utilization of mental health care and substance abuse treatment centers, engage and train perinatal healthcare providers in delivering mental health care, standardize screening of intimate partner violence and adverse life events, and reduce firearm access to potentially at risk women. We also recommend accurate data collection and reporting of pregnancy status to minimize data misclassification. Finally to prevent future incidents, we recommend developing culturally appropriate prevention programs and policies that target the specific demographically unique characteristics of suicides decedents in rural and urban counties in the U.S.

REFERENCES

1. Gold, K. J., et al. "Mental health, substance use and intimate partner problems among pregnant and postpartum suicide victims in the National Violent Death Reporting System." *General hospital psychiatry* 34.2 (2012): 139-145.
2. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS). National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 2009. Available at www.cdc.gov=ncipc=, accessed May 12, 2009.
3. Centers for Disease Control. (2009). Web-based injury statistics query and reporting system. Retrieved from: <http://www.cdc.gov/injury/wisqars/index.html>. Accessed on-line April 23, 2009.
4. Lindahl, V., Jane, L. P., and Colpe, L. "Prevalence of suicidality during pregnancy and the postpartum." *Archives of Women's Mental Health* 8.2 (2005): 77-87.
5. Ghazaleh, S., Sandra, L. M., Lawrence, L. K., Sharon, S., Tammy, N. and Matt, A. Are Pregnant and Postpartum Women: At Increased Risk for Violent Death? Suicide and Homicide Findings from North Carolina. *Matern Child Health J* (2011) 15:660–669
6. Marzuk, P. M., et al. "Lower risk of suicide during pregnancy." *American Journal of Psychiatry* 154.1 (1997): 122-123.
7. Samandari, G. & Schiro, S. (2009). Suicide risk among pregnant and postpartum women: A critical review of the literature. Under review for publication by the *Archives of Women's Mental Health*.
8. Appleby, L. "Suicidal behaviour in childbearing women." *International Review of Psychiatry* 8.1 (1996): 107-115.
9. Anderson, L., Sundstrom-Poromaa, I., Wulff, M., Astrom, M., & Bixo, M. (2003). Point prevalence of psychiatric disorders during the second trimester of pregnancy: A population-based study. *American Journal of Obstetrics and Gynecology*, 189, 148–154.
10. Hobfoll, S. E., et al. "Depression prevalence and incidence among inner-city pregnant and postpartum women." *Journal of consulting and clinical psychology* 63.3 (1995): 445.

11. Marcus, S. M., et al. "Depressive symptoms among pregnant women screened in obstetrics settings." *Journal of Women's Health* 12.4 (2003): 373-380.
12. Noble, R. E. "Depression in women." *Metabolism* 54.5 (2005): 49-52.
13. Gold, K. J., Marcus, S. M. The Effect of Maternal Mental Illness on Pregnancy Outcomes. *Expert Rev Obstet Gynecol*. 2008; 3(3):391–401.
14. Gjerdingen, D. K., and Barbara, P. Y. "Postpartum depression screening: importance, methods, barriers, and recommendations for practice." *The Journal of the American Board of Family Medicine* 20.3 (2007): 280-288.
15. Ross, L. E., Linda, M. M., and C. Psych. "Anxiety disorders during pregnancy and the postpartum period: a systematic review." *depression* 6.9 (2006): 1-14.
16. DeLeo, D., Bertolote, J., Lester, D. Self-directed violence. 2002. Chapter 7. In: Krug EG., Dahlberg LL., Mercy JA, Zwi A, Lozano R, eds. *World report on violence and health*[PDF 239 KB]. Geneva: World Health Organization.
17. McLean, J., Maxwell, M., Platt, S., Harris, F., and Jepson, R. Risk and Protective Factors for Suicide and Suicidal Behaviour: a Literature Review. Scottish Government Social Research. Edinburgh. 2008.
18. Platt, S., Hawton, K. Suicidal behaviour and the labour market. In: Hawton K, van Heeringen K, eds. *The international handbook of suicide and attempted suicide*. New York: Wiley, 2000:310–84.
19. LaVonne, A.G., Ortega and Debra, K. Precipitating Circumstances of Suicide among Women of Reproductive Age in 16 U.S. States, 2003–2007. *Journal of Women's Health*. January 2010, 19(1): 5-7. doi:10.1089/jwh.2009.1788.
20. Searles, V. B., Valley, Morgan A., Hedegaard, Holly, Betz, Marian E. Suicides in urban and rural counties in the United States, 2006–2008. *Crisis: The Journal of Crisis Intervention and Suicide Prevention*, Vol 35(1), 2014, 18-26. <http://dx.doi.org/10.1027/0227-5910/a000224>.
21. Gamm, L., Stone, S., & Pittman, S. (2010). Mental health and mental disorders – a rural challenge: A literature review. *Rural Health People*, 97–114.
22. Singh, G. K., & Siahpush, M. (2002). Increasing rural-urban gradients in US suicide mortality, 1970–1997. *American Journal of Public Health*, 92, 1161–1167.

23. Palladino, C. L., et al. "Homicide and suicide during the perinatal period: findings from the National Violent Death Reporting System." *Obstetrics and gynecology* 118.5 (2011): 1056.
24. Enval, E. and A. Erikssen. 2004. *Costs of Violence against Women*. National Board of Health and Welfare, Stockholm.
25. Centers for Disease Control and Prevention. *Cost of Injury Reports 2010*. Available online at <http://wisqars.cdc.gov:8080/costT/>. Last updated September 2014.
26. Wilkinson, K. P., Israel, G. D. Suicide and rurality in urban society. *Suicide Life Threat Behav.* 1984 Fall;14(3):187-200.
27. Cooperman , N. A. and Simoni , J. M. 2005. Suicidal ideation and attempted suicide among women living with HIV/AIDS. *Journal of Behavioral Medicine*, 28: 149–156.
28. Oquendo , M. A. , Bongiovi–Garcia , M. E. , Galfalvy , H. , Goldberg , P. H. , Grunebaum , M. F. Burke , A. K. 2007. Sex differences in clinical predictors of suicidal acts after major depression: A prospective study. *American Journal of Psychiatry*, 164: 134–141.
29. Chaudron , L. H. and Caine , E. D. 2004. Suicide among women: A critical review. *Journal of the American Medical Women's Association*, 59(2): 125–134.
30. Ahmed , M. K. , Ginneken , J. , Razzaque , A. and Alan , N. 2004. Violent deaths among women of reproductive age in rural Bangladesh. *Social Science & Medicine*, 54: 311–319.
31. Annette L. Beautrais. *Women and Suicidal Behavior*. *Crisis* (2006), 27, pp. 153-156.
32. American Foundation for Suicide Prevention (AFSP), "Facts and Figures about Suicide," 1998, <http://www.afsp.org/>.
33. C. Henshaw, "Maternal suicide," in *Psychological Challenges in Obstetrics and Gynecology: The Clinical Management*, J. Cockburn and M. Pawson, Eds., pp. 157–164, Springer, New York, NY, USA, 2007.
34. "Women and Suicide in Rural China." *Bulletin of the World Health Organization* 87.12 (2009): 888–889. PMC. Web. 25 Jan. 2016.

35. G. C. Patton, C. Coffey, S. M. Sawyer et al., "Global patterns of mortality in young people: a systematic analysis of population health data," *The Lancet*, vol. 374, no. 9693, pp. 881–892, 2009.
36. Pablo Mendez-Bustos, Jorge Lopez-Castroman, Enrique Baca-García, and Antonio Ceverino. *Life Cycle and Suicidal Behavior among Women*. *The ScientificWorld Journal* Volume 2013, Article ID 485851, 9 pages.
37. Canetto, Silvia Sara, and Isaac Sakinofsky. "The gender paradox in suicide." *Suicide and Life-Threatening Behavior* 28.1 (1998): 1-23.
38. Murphy, George E. "Why women are less likely than men to commit suicide." *Comprehensive psychiatry* 39.4 (1998): 165-175.
39. Spicer, Rebecca S., and Ted R. Miller. "Suicide acts in 8 states: incidence and case fatality rates by demographics and method." *American Journal of Public Health* 90.12 (2000): 1885.
40. M. R. Phillips and H. G. Cheng, "The changing global face of suicide," *The Lancet*, vol. 379, no. 9834, pp. 2318–2319, 2012.
41. C. R. Soman, S. Safraj, V. Kutty, K. Vijayakumar, and K. Ajayan, "Suicide in South India: a community-based study in Kerala, *Indian Journal of Psychiatry*, vol. 51, no. 4, pp. 261–264, 2009.
42. C. T. Sudhir Kumar, R. Mohan, G. Ranjith, and R. Chandrasekaran, "Gender differences in medically serious suicide attempts: a study from South India," *Psychiatry Research*, vol. 144, no. 1, pp. 79–86, 2006.
43. P. S. F. Yip and K. Y. Liu, "The ecological fallacy and the gender ratio of suicide in China," *The British Journal of Psychiatry*, vol. 189, pp. 465–466, 2006.
44. Healey C, Morriss R, Henshaw C, Wadoo O, Sajjad A, Scholefield H, et al. Self-harm in postpartum depression and referrals to a perinatal mental health team: an audit study. *Arch Womens Ment Health* (2013) 16(3):237–45.10.1007/s00737-013-0335-1
45. Orsolini, Laura, et al. "Suicide during Perinatal Period: Epidemiology, Risk Factors, and Clinical Correlates." *Frontiers in Psychiatry* 7 (2016).

46. Thornton C, Schmied V, Dennis CL, Barnett B, Dahlen HG.. Maternal deaths in NSW (2000-2006) from nonmedical causes (suicide and trauma) in the first year following birth. *Biomed Res Int* (2013) 2013:623743.10.1155/2013/623743
47. Fuhr DC, Calvert C, Ronsmans C, Chandra PS, Sikander S, De Silva MJ, et al. Contribution of suicide and injuries to pregnancy-related mortality in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet Psychiatry* (2014) 1(3):213–25.10.1016/S2215-0366(14)70282-2
48. Vesga-Lopez, Oriana, et al. "Psychiatric disorders in pregnant and postpartum women in the United States." *Archives of general psychiatry* 65.7 (2008): 805-815.
49. Watson, J. P., et al. "Psychiatric disorder in pregnancy and the first postnatal year." *The British Journal of Psychiatry* 144.5 (1984): 453-462.
50. Robertson, Emma, et al. "Antenatal risk factors for postpartum depression: a synthesis of recent literature." *General hospital psychiatry* 26.4 (2004): 289-295.
51. Appleby, Louis. "Suicide during pregnancy and in the first postnatal year." *Bmj* 302.6769 (1991): 137-140.
52. Wallace, Maeve E., et al. "Pregnancy-associated homicide and suicide in 37 US states with enhanced pregnancy surveillance." *American journal of obstetrics and gynecology* (2016).
53. World Health Organization. *World Health Statistics Annual*. Geneva: WHO, 1989.
54. Heikkinen M, Aro H, Lonnqvist J. Recent life events, social support and suicide. *Acta Psychiatr Scand Suppl* 1994;377:65–72.
55. Mortensen PB, Agerbo E, Erikson T, Qin P, Westergaard-Nielsen N. Psychiatric illness and risk factors for suicide in Denmark. *Lancet* 2000;355:9–12.
56. Johansson LM, Sundquist J, Johansson SE, Bergman B. Ethnicity, social factors, illness and suicide: a follow-up study of a random sample of the Swedish population. *Acta Psychiatr Scand* 1997;95:125–31.
57. Isometsa E, Heikkinen M, Henriksson M, Marttunen M, Aro H, Lonnqvist J. Differences between urban and rural suicides. *Acta Psychiatr Scand* 1997;95:297–305.
58. Wilkinson KP, Israel GD. Suicide and rurality in urban society. *Suicide Life Threat Behav.* 1984;14: 187–200.

59. Eberhardt, Mark S., and Elsie R. Pamuk. "The importance of place of residence: examining health in rural and nonrural areas." *American Journal of Public Health* 94.10 (2004): 1682-1686.
60. Rost, Kathryn, et al. "Rural-urban differences in depression treatment and suicidality." *Medical Care* 36.7 (1998): 1098-1107.
61. Hirsch, Jameson K. "A review of the literature on rural suicide." *Crisis* 27.4 (2006): 189-199.
62. Branas, Charles C., et al. "Urban-rural shifts in intentional firearm death: different causes, same results." *American Journal of Public Health* 94.10 (2004): 1750-1755.
63. Fiske, Amy, Margaret Gatz, and Eric Hannell. "Rural suicide rates and availability of health care providers." *Journal of Community Psychology* 33.5 (2005): 537-543.
64. Lantz, Paula M., Margaret E. Weigers, and James S. House. "Education and income differentials in breast and cervical cancer screening: policy implications for rural women." *Medical care* 35.3 (1997): 219-236.
65. Caldwell, Tanya M., Anthony F. Jorm, and Keith BG Dear. "Suicide and mental health in rural, remote and metropolitan areas in Australia." *Medical Journal of Australia* 181.7 (2004): S10.
66. Bull, C. Neil, et al. "Access and issues of equity in remote/rural areas." *The Journal of Rural Health* 17.4 (2001): 356-359.
67. Hart, L. Gary, Eric H. Larson, and Denise M. Lishner. "Rural definitions for health policy and research." *American Journal of Public Health* 95.7 (2005): 1149-1155.
68. US Department of Health and Human Services. "Health resources and services administration." *Critical Care Workforce Report*. Requested by Senate Report (2008): 108-91.
69. Hall, Susan A., Jay S. Kaufman, and Thomas C. Ricketts. "Defining urban and rural areas in US epidemiologic studies." *Journal of Urban Health* 83.2 (2006): 162-175.
70. Crosby, Richard A., et al. *Rural populations and health: Determinants, disparities, and solutions*. John Wiley & Sons, 2012.

71. Dr Michael R Phillips, Xianyun Li, Yanping Zhang. Suicide rates in China, 1995–99. *The Lancet* Volume 359, Issue 9309, 9 March 2002, Pages 835–840.
72. Dudley MJ, Kelk NJ, Florio TM, Howard JP, Waters BG. Suicide among young Australians, 1964-1993: an interstate comparison of metropolitan and rural trends. *The Medical Journal of Australia* [1998, 169(2):77-80].
73. Yip, Paul SF, Chris Callanan, and Hok Pan Yuen. "Urban/rural and gender differentials in suicide rates: east and west." *Journal of affective disorders* 57.1 (2000): 99-106.
74. Middleton, Nicos, et al. "Urban–rural differences in suicide trends in young adults: England and Wales, 1981–1998." *Social science & medicine* 57.7 (2003): 1183-1194.
75. Levin, Kate A., and Alastair H. Leyland. "Urban/rural inequalities in suicide in Scotland, 1981–1999." *Social science & medicine* 60.12 (2005): 2877-2890.
76. Kapusta, Nestor D., et al. "Rural– urban differences in Austrian suicides." *Social psychiatry and psychiatric epidemiology* 43.4 (2008): 311-318.
77. Mościcki, Eve K. "Identification of suicide risk factors using epidemiologic studies." *Psychiatric Clinics of North America* 20.3 (1997): 499-517.
78. A. Shah, "The relationship between suicide rates and age: an analysis of multinational data from the World Health Organization," *International Psychogeriatrics*, vol. 19, no. 6, pp. 1141–1152, 2007.
79. P. Cutright, S. Stack, and R. Fernquist, "Marital status integration, suicide disapproval, and societal integration as explanations of marital status differences in female age-specific suicide rates," *Suicide & Life-Threatening Behavior*, vol. 37, no. 6, pp. 715–724, 2007.
80. A. White and M. Holmes, "Patterns of mortality across 44 countries among men and women aged 15–44 years," *Journal of Men's Health and Gender*, vol. 3, no. 2, pp. 139–151, 2006.
81. D. L. Karch, J. Logan, D. McDaniel, S. Parks, and N. Patel, "Surveillance for violent deaths—National Violent Death Reporting System, 16 states, 2009," *Morbidity and Mortality Weekly Report. Surveillance Summaries*, vol. 61, no. 6, pp. 1–43, 2008.

82. D. Gunnell, N. Middleton, E. Whitley, D. Dorling, and S. Frankel, "Why are suicide rates rising in young men but falling in the elderly? A time-series analysis of trends in England and Wales 1950–1998," *Social Science & Medicine*, vol. 57, no. 4, pp. 595–611, 2003.
83. M. Kuroki, "Suicide and unemployment in Japan: evidence from municipal level suicide rates and age-specific suicide rates," *The Journal of Socio-Economics*, vol. 39, no. 6, pp. 683–691, 2010.
84. Gibbs, J. P. (1969). Marital status and suicide in the United States: A special test of the status integration theory. *American Journal of Sociology*, 74, 521–553.
85. Stack, S. (1990). New micro-level data on the impact of divorce on suicide, 1959–1980: A test of two theories. *Journal of Marriage and the Family*, 52, 119–127.
86. Cutright, P., & Fernquist, R. M. (2005). Marital status integration, psychological well-being, and suicide acceptability as predictors of marital status differences in suicide rates. *Social Science Research*, 34, 570–590.
87. B. T. Wanta, A. E. Schlotthauer, C. E. Guse, and S. W. Hargarten, "The burden of suicide in Wisconsin's older adult population," *Wisconsin Medical Journal*, vol. 108, no. 2, pp. 87–93, 2009.
88. P. Zeppegno, E. Manzetti, R. Valsesia et al., "Differences in suicide behaviour in the elderly: a study in two provinces of Northern Italy," *International Journal of Geriatric Psychiatry*, vol. 20, no. 8, pp. 769–775, 2005.
89. A. Erlangsen, B. Jeune, U. Bille-Brahe, and J. W. Vaupel, "Loss of partner and suicide risks among oldest old: a population-based register study," *Age and Ageing*, vol. 33, no. 4, pp. 378–383, 2004.
90. Moscicki EK. Epidemiology of suicidal behaviour. *Suicide Life Threat Behav* 1995; 25: 22-35.
91. Cavanagh JT, Carson AJ, Sharpe M, et al. Psychological autopsy studies of suicide: a systematic review. *Psychol Med*. 2003;33:395–405.
92. Vijayakumar L. Suicide and mental disorders in Asia. *Int Rev Psychiatry*. 2005;17:109–14.
93. Linehan MM, Rizvi SL, Welch SS, et al. Psychiatric aspects of suicidal behaviour: personality disorders. In: Hawton K, van Heeringen K, editors. *International*

- handbook of suicide and attempted suicide. 1st. Chichester, United Kingdom: John Wiley & Sons; 2000. pp. 147–78.
94. Isometsa ET. Psychological autopsy studies—a review. *Eur Psychiatry*. 2001;16(7):379–385.
 95. Bramness, Jørgen G., et al. "Self-reported mental health and its gender differences as a predictor of suicide in the middle-aged." *American journal of epidemiology* 172.2 (2010): 160-166.
 96. Cavanagh JT, Carson AJ, Sharpe M, et al. Psychological autopsy studies of suicide: a systematic review. *Psychol Med*. 2003;33:395–405.
 97. Qin, Ping, Esben Agerbo, and Preben Bo Mortensen. "Suicide risk in relation to socioeconomic, demographic, psychiatric, and familial factors: a national register-based study of all suicides in Denmark, 1981-1997." *American Journal of Psychiatry* 160.4 (2003): 765-772.
 98. Baxter D, Appleby L: Case register study of suicide risk in mental disorders. *Br J Psychiatry* 1999; 175:322–326
 99. Qin, P., Mortensen, P. B., Agerbo, E., et al (2000) Gender differences in risk factors for suicide in Denmark. *British Journal of Psychiatry*, 177, 546– 550.
 100. Hawton, K. (2000) Sex and suicide: gender differences in suicidal behaviour. *British Journal of Psychiatry*, 177, 484– 485.
 101. Kung, Hsiang-Ching, Jane L. Pearson, and Xinhua Liu. "Risk factors for male and female suicide decedents ages 15–64 in the United States." *Social psychiatry and psychiatric epidemiology* 38.8 (2003): 419-426.
 102. Schapira, K., Linsley, K. R., Linsley, A., et al (2001) Relationship of suicide rates to social factors and availability of lethal methods. Comparison of suicide in Newcastle upon Tyne 1961–1965 and 1985–1994. *British Journal of Psychiatry*, 178, 458– 464.
 103. Lyons BH, Fowler KA, Jack SP, Betz CJ, Blair JM. Surveillance for Violent Deaths — National Violent Death Reporting System, 17 States, 2013. *MMWR Surveill Summ* 2016;65(No. SS-10):1–42. DOI: <http://dx.doi.org/10.15585/mmwr.ss6510a1>

104. Kposowa, Augustine J., and James P. McElvain. "Gender, place, and method of suicide." *Social psychiatry and psychiatric epidemiology* 41.6 (2006): 435-443.
105. Goodwin, Donald W. "Alcohol in Suicides and Homicides." (1971).
106. Welte, John W., Ernest L. Abel, and William Wieczorek. "The role of alcohol in suicides in Erie County, NY, 1972-84." *Public Health Reports* 103.6 (1988): 648.
107. Smith SM, Goodman RA, Thacker SB, Burton AH, Parsons JE, Hudson P. Alcohol and fatal injuries: temporal patterns. *Am J Prev Med.* 1989 Sep-Oct;5(5):296-302.
108. Haberman, P. W., and Baden, M. W.: Alcohol, other drugs and violent death. Oxford University Press, New York, NY, 1978.
109. Pirkola, S. P., Marttunen, M. J., Henriksson, M. M. et al. (1999) Alcohol-related problems among adolescent suicides in Finland. *Alcohol and Alcoholism* 34, 320–329.
110. Ohberg, A., Vuori, E., Ojanpera, I. et al. (1996) Alcohol and drugs in suicides. *British Journal of Psychiatry* 169, 75–80.
111. Ramstedt, M. (2001) Alcohol and suicide in 14 European countries. *Addiction* 96 (Suppl. 1), S59–S75.
112. Henriksson, M. M., Aro, H. M., Marttunen, M. J. et al. (1993) Mental disorders and comorbidity in suicide. *American Journal of Psychiatry* 150, 935–940.
113. Chignon, J. M., Cortes, M. J., Martin, P. et al. (1998) Attempted suicide and alcohol dependence: results of an epidemiologic survey. *Encephale* 24, 347–354.
114. Cornelius, J. R., Salloum, I. M., Mezzich, J. et al. (1995) Disproportionate suicidality in patients with comorbid major depression and alcoholism. *American Journal of Psychiatry* 152, 358–364.
115. Cornelius, J. R., Salloum, I. M., Day, N. L. et al. (1996) Patterns of suicidality and alcohol use in alcoholics with major depression. *Alcoholism, Clinical and Experimental Research* 20, 1451–1455.
116. Driessen, M., Veltrup, C., Weber, J. et al. (1998) Psychiatric comorbidity, suicidal behaviour and suicidal ideation in alcoholics seeking treatment. *Addiction* 93, 889–894.

117. Kendall, R. (1983) Alcohol and suicide. *Substance and Alcohol Actions/Misuse* 4, 121–127.
118. Lester, D. (1992) *Why people kill themselves*. Springfield IL: Charles Thomas.
119. Cheng ATA, Chen THH, Chen CC, Jenkins R. Psychosocial and psychiatric risk factors for suicide: Case-control psychological autopsy study. *British Journal of Psychiatry*. 2000; 177:360–365.
120. Heikkinen ME, Henrikson MM, Isometsa ET, Marttunen MJ, Aro HM, Lonnqvist JK. Recent life events and suicide in personality disorders. *Journal of Nervous and Mental Disease*. 1997.
121. Cavanagh JTO, Owens DGC, Johnstone EC. Life events in suicide and undetermined death in southeast Scotland: A case-control study using the method of psychological autopsy. *Social Psychiatry and Psychiatric Epidemiology*. 1999; 34:645–650.
122. Weyrauch KF, Roy-Byrne P, Katon W, Wilson L. Stressful life events and impulsiveness in failed suicide. *Suicide and Life Threatening Behavior*. 2001; 31:311–319.
123. Parks, S. E., Johnson, L. L., McDaniel, D. D., & Gladden, M. (2014). Surveillance for violent deaths - National Violent Death Reporting System, 16 states, 2010. *MMWR: Surveillance Summaries*, 63(1), 1-33.
124. Devries KM, Kiss L, Watts C, Yoshihama M, Deyessa N, et al. (2011) Violence against women is strongly associated with suicide attempts: evidence from the WHO multi-country study on women's health and domestic violence against women. *Soc Sci Med* 73: 79–86.
125. Ellsberg M, Jansen HAFM, Heise L, Watts CH, Garcia-Moreno C, et al. (2008) Intimate partner violence and women's physical and mental health in the WHO multi-country study on women's health and domestic violence: an observational study. *Lancet* 371: 1165–1172.
126. Beydoun HA, Beydoun M, Kaufman JS, Lo B, Zonderman AB (2012) Intimate partner violence against adult women and its association with major depressive disorder, depressive symptoms and postpartum depression: a systematic review and meta-analysis. *Soc Sci Med* 75: 959–975.

127. Deyessa N, Berhane Y, Alem A, Ellsberg M, Emmelin M, et al. (2009) Intimate partner violence and depression among women in rural Ethiopia: a cross-sectional study. *Clin Pract Epidemiol Ment Health* 5:8.
128. Bonomi AE, Anderson ML, Reid R, Rivara FP, Carrell D, et al. (2009) Medical and psychosocial diagnoses in women with a history of intimate partner violence. *Arch Int Med* 169: 1692–1697
129. Garcia-Moreno, Claudia, et al. "Prevalence of intimate partner violence: findings from the WHO multi-country study on women's health and domestic violence." *The Lancet* 368.9543 (2006): 1260-1269.
130. Devries, K. M., Mak, J. Y., Bacchus, L. J., Child, J. C., Falder, G., Petzold, M., Watts, C. H. (2013). Intimate partner violence and incident depressive symptoms and suicide attempts: a systematic review of longitudinal studies. *PLoS Medicine*, 10(5), e1001439. doi:10.1371/journal.pmed.1001439.
131. Leiner, Amy S., et al. "Intimate partner violence, psychological distress, and suicidality: A path model using data from African American women seeking care in an urban emergency department." *Journal of Family Violence* 23.6 (2008): 473-481.
132. J. Y. H. Wong, A. Tiwari, D. Y. T. Fong, J. Humphreys, and L. Bullock, "Depression among women experiencing intimate partner violence in a Chinese community," *Nursing Research*, vol. 60, no. 1, pp. 58–65, 2011.
133. A. E. Bonomi, R. S. Compson, M. Anderson et al., "Intimate partner violence and women's physical, mental, and social functioning," *American Journal of Preventive Medicine*, vol. 30, no. 6, pp. 458–466, 2006.
134. K. Carbone-López, C. Kruttschnitt, and R. Macmillan, "Patterns of intimate partner violence and their associations with physical health, psychological distress, and substance use," *Public Health Reports*, vol. 121, no. 4, pp. 382–392, 2006.
135. M. K. Ehrensaft, T. E. Moffitt, and A. Caspi, "Is domestic violence followed by an increased risk of psychiatric disorders among women but not among men? A longitudinal cohort study," *American Journal of Psychiatry*, vol. 163, no. 5, pp. 885–892, 2006.

136. L. Eshelman and A. A. P. Levendosky, "Dating violence: mental health consequences based on type of abuse," *Violence and Victims*, vol. 27, no. 2, pp. 215–228, 2012.
137. T. K. Logan and J. Cole, "The impact of partner stalking on mental health and protective order outcomes over time," *Violence and Victims*, vol. 22, no. 5, pp. 546–562, 2007.
138. D. Loxton, M. Schofield, and R. Hussain, "Psychological health in midlife among women who have ever lived with a violent partner or spouse," *Journal of Interpersonal Violence*, vol. 21, no. 8, pp. 1092–1107, 2006.
139. Beydoun, Hind A., et al. "Intimate partner violence against adult women and its association with major depressive disorder, depressive symptoms and postpartum depression: a systematic review and meta-analysis." *Social science & medicine* 75.6 (2012): 959-975.
140. Centers for Disease Control and Prevention. National Violent Death Reporting System (NVDRS) Coding Manual Revised [Online] 2015 National Center for Injury Prevention and Control, Centers for Disease Control and Prevention (producer). Available from URL: www.cdc.gov/injury.
141. L J Paulozzi, J Mercy, L Frazier Jr, J L Annett. CDC's National Violent Death Reporting System: background and methodology. *Injury Prevention* 2004; 10:47–52. doi: 10.1136/ip.2003.003434
142. Matthew R. McNally, Christina L. Patton, and William J. Fremouw. Mining for Murder-Suicide: An Approach to Identifying Cases of Murder-Suicide in the National Violent Death Reporting System Restricted Access Database. *J Forensic Sci*, 2015.
143. Sharyn E. Parks, Linda L. Johnson, Dawn D. McDaniel and Matthew Gladden. Surveillance for Violent Deaths — National Violent Death Reporting System, 16 States, 2010. *MMWR Surveillance Summaries*. 2014;63.
144. Christie Lancaster Palladino, Vijay Singh, Jacquelyn Campbell, Heather Flynn, PhD, and Katherine J. Gold. Homicide and Suicide During the Perinatal Period. Findings From the National Violent Death Reporting System. *Obstet Gynecol* 2011;118:1056–63

145. Debra L. Karch, Joseph Logan, Dawn McDaniel, Sharyn Parks, Nimesh Patel. Surveillance for Violent Deaths — National Violent Death Reporting System, 16 States, 2009. *MMWR Surveillance Summaries*. 2012;61.
146. Polly A. Hulme and Mary A. Blegen. Residential Status and Birth Outcomes: Is the Rural/Urban Distinction Adequate? *Public Health Nursing* Vol. 16 No. 3, pp. 176–181.
147. Crosby AE, Ortega L, Melanson C. Self-directed Violence Surveillance: Uniform Definitions and Recommended Data Elements, Version 1.0. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2011
148. Gold, L. H. (2002). Postpartum disorders in primary care: Diagnosis and treatment. *Primary Care*, 29, 27–41.
149. Hoffman, S., & Hatch, M. C. (2000). Depressive symptomatology during pregnancy: Evidence for an association with decreased fetal growth in pregnancies of lower social class women. *Health Psychology*, 19(6), 535–543.
150. Miller, L. J. (2002). Postpartum depression. *Journal of the American Medical Association*, 287, 762–765.
151. Wisner, K. L., & Wheeler, S. B. (1994). Prevention of recurrent postpartum major depression. *Hospital & Community Psychiatry*, 45, 1191–1196.
152. Slama, K. (2004) Rural culture is a diversity issue. *Minnesota Psychologist* 53.1: 9-12.
153. Singh, G. K., & Siahpush, M. (2002). Increasing rural-urban gradients in US suicide mortality, 1970–1997. *American Journal of Public Health*, 92, 1161–1167.
154. Michael, R. P., Xianyun, L., Yanping, Z. (2002) Suicide rates in China, 1995–99. *The Lancet* Volume 359, Issue 9309, Pages 835–840.
155. Middleton, N., David, G., Stephen, F., Elise W., Daniel, D. (2003) Urban–rural differences in suicide trends in young adults: England and Wales, 1981–1998. *Social science & medicine* 57.7: 1183-1194.
156. Levin, K. A., and Alastair, H. Leyland. (2005) Urban/rural inequalities in suicide in Scotland, 1981–1999. *Social science & medicine* 60.12: 2877-2890.

157. Leroy, R., Robert, M. B., Joseph, H. E., Gary, D. C., Thomas, F. G., Jay, M. G., Carlos, L. R. (1989) Homicide in Alabama: An analysis of urban, suburban and rural murders in the deep south. *Forensic Science International* Volume 40, Issue 2, Pages 105–122.
158. Cubbin, C., Pickle, L. W., and Fingerhut, L. (2000) Social Context and Geographic Patterns of Homicide among US Black and White Males. *American Journal of Public Health* 90.4: 579–587. Print.
159. Karch, D.L., Lubell, K. M., Friday, J., Patel, N., Williams, D. D. Surveillance for violent deaths--National Violent Death Reporting System, 16 states, 2005. *MMWR Surveill Summ.* 2008 Apr 11;57(3):1–45.
160. Crawford, P., and Brian, B. "Like a friend going round': reducing the stigma attached to mental healthcare in rural communities." *Health & social care in the community* 10.4 (2002): 229-238.
161. Trout, D. L. (1980). The role of social isolation in suicide. *Suicide and Life-Threatening Behavior*, 10, 10–23.
162. O'hara, M. W., and Annette, M. S. "Rates and risk of postpartum depression—a meta-analysis." *International review of psychiatry* 8.1 (1996): 37-54.
163. Beck, C. T. "Predictors of postpartum depression: an update." *Nursing research* 50.5 (2001): 275-285.
164. Robertson, E., et al. "Antenatal risk factors for postpartum depression: a synthesis of recent literature." *General hospital psychiatry* 26.4 (2004): 289-295.
165. Gotlib, I. H., et al. "Prevalence rates and demographic characteristics associated with depression in pregnancy and the postpartum." *Journal of consulting and clinical psychology* 57.2 (1989): 269.
166. Clay, R. A. "Reducing rural suicide." *Monitor on Psychology* 45 (2014): 36-39.
167. Taylor, R., Page, A., Morrell, S., Harrison, J., & Carter, G. (2005). Social and psychiatric influences on urban–rural differentials in Australian suicide. *Suicide and Life-Threatening Behavior*, 35, 277–290.
168. Philip, J., et al. "Relationship of Social Network to Protective Factors in Suicide and Alcohol Use Disorder Intervention for Rural Yup'ik Alaska Native Youth." *Psychosocial Intervention* 25.1 (2016): 45-54.

169. Hakko, H., et al. "Alcohol-related suicides in victims with a history of hospital-treated depression." *American journal on addictions* 14.5 (2005): 455-463.
170. Judd, F., et al. "Rural suicide—people or place effects?." *Australian and New Zealand Journal of Psychiatry* 40.3 (2006): 208-216.
171. Heikkinen, M., Isometsa, E., Marttunen, M., Aro, H., Lonnqvist, J. Social factors in suicide. *Br J Psychiatry* 1995;167:747–53.
172. Beautrais, A. L., Peter, R. J., and Roger, T. M. "Precipitating factors and life events in serious suicide attempts among youths aged 13 through 24 years." *Journal of the American Academy of Child & Adolescent Psychiatry* 36.11 (1997): 1543-1551.
173. Heikkinen, M., Hillevi, A., and Jouko, L. "Life events and social support in suicide." *Suicide and Life-Threatening Behavior* 23.4 (1993): 343-358.
174. Shadigian, E. M., and Samuel, T. B. "Pregnancy-associated death: a qualitative systematic review of homicide and suicide." *Obstetrical & gynecological survey* 60.3 (2005): 183-190.
175. McCarthy, J. F., et al. "Suicide among patients in the Veterans Affairs health system: Rural–urban differences in rates, risks, and methods." *American journal of public health* 102.S1 (2012): S111-S117.
176. Palladino, C. L., et al. "Homicide and suicide during the perinatal period: findings from the National Violent Death Reporting System." *Obstetrics and gynecology* 118.5 (2011): 1056.
177. Basso O, O. J, Bisanti, L., Karmaus, W. The European Study Group on Infertility and Subfecundit. (1997) The performance of several indicators in detecting recall bias. *Epidemiology* 8(3):269.
178. Ortega, L. A., & Karch, D. (2010). Precipitating circumstances of suicide among women of reproductive age in 16 U.S. States, 2003-2007. *J Womens Health (Larchmt)*, 19(1), 5-7. doi: 10.1089/jwh.2009.1788
179. Freshwater, D. (2000). Three Papers on Rural Development. The University of Kentucky, Department of Agricultural Economics.
180. Hirsch, J. K. "A review of the literature on rural suicide." *Crisis* 27.4 (2006): 189-199.

APPENDIX 1

Supplemental Table 1. Variable definition and code/response options in the NVDRS manual

NVDRS Variable	Definition	Codes/Response options
Victim was pregnant	Victim was pregnant or recently pregnant at the time of death	0 Not pregnant within last year 1 Pregnant at time of death 2 Not pregnant but pregnant w/in 42 days of death 3 Not pregnant but pregnant 43 days to 1 year before death 4 Not pregnant, not otherwise specified 5 Pregnant, not otherwise specified 8 Not applicable 9 Unknown if pregnant within past year
Current mental health problem	Current mental health problem	0 No, Not Available, Unknown 1 Yes
Current depressed mood	Victim was perceived by self or others to be depressed at the time of the injury	0 No, Not Available, Unknown 1 Yes
Psychiatric Medication	Victim had a current prescription for a psychiatric medication at the time of the incident	0 No 1 Yes
Alcohol use suspected when injured	Victim's suspected alcohol use in the hours preceding the incident	0 No 1 Yes 8 Not Applicable 9 Unknown
Alcohol problem	Person has alcohol dependence or alcohol problem	0 No, Not Available, Unknown 1 Yes
Other substance problem	Person has a non-alcohol related substance abuse problem	0 No, Not Available, Unknown 1 Yes
Intimate partner problem	Problems with a current or former intimate partner appear to have contributed to the suicide or undetermined death.	0 No, Not Available, Unknown 1 Yes
Crisis Recent	Victim experienced a crisis within two weeks of the incident, or a crisis was	0 No, Not Available, Unknown 1 Yes

	imminent within two weeks of the incident that was not associated with another circumstance variable.	
Financial problem	Financial problems appear to have contributed to the death	0 No, Not Available, Unknown 1 Yes
Job problem	Job problem(s) appear to have contributed to the death	0 No, Not Available, Unknown 1 Yes
Physical Health Problem	Victim's physical health problem(s) appear to have contributed to the death	0 No, Not Available, Unknown 1 Yes
History of suicide attempts	Victim has a history of attempting suicide before the fatal incident	0 No, Not Available, Unknown 1 Yes
Suicide Intent Disclosed	Victim disclosed to another person their thoughts and/or plans to commit suicide within the last month.	0 No, Not Available, Unknown 1 Yes
Weapon Type	Type of weapon or means used to inflict the fatal injury	1 Firearm 5 Non-powder gun 6 Sharp instrument 7 Blunt instrument 8 Poisoning 9 Hanging, strangulation, suffocation 10 Personal weapons 11 Fall 12 Explosive 13 Drowning 14 Fire or burns 15 Shaking, (e.g., shaken baby syndrome) 16 Motor Vehicle, including buses, motorcycles 17 Other transport vehicle, (e.g., trains, planes, boats) 18 Intentional neglect, (e.g., starving a baby or oneself) 19 Biological weapons 66 Other (e.g., Taser, electrocution, nail gun, exposure to environment/weather) 99 Unknown

Injured at victim's home	Injury occurred at the person's residence	0 No 1 Yes 9 Unknown
Age	Age of victim	Numeric 999 Unknown
Race	Race of victim	1 White 2 Black or African American 3 Asian 4 Native Hawaiian or other Pacific Islander 5 American Indian or Alaska Native 6 Unspecified race
Education Level	Represents victim's educational level as measured by the highest degree attained.	0 8th grade or less 1 9th to 12th grade; no diploma 2 High school graduate or GED completed 3 Some college credit, but no degree 4 Associate's degree (e.g., AA, AS) 5 Bachelor's degree (e.g., BA, AB, BS) 6 Master's degree (e.g., MA, MS, Mend, Med, MSW, MBA) 7 Doctorate (e.g., PhD, EdD) or Professional degree (e.g., MD, DDS, DVM, LLB, JD) 9 Unknown
Marital status	Victim's marital status	1 Married /Civil Union/ Domestic Partnership 2 Never Married 3 Widowed 4 Divorced 5 Married/Civil Union/Domestic Partnership, but separated 6 Single, not otherwise specified 9 Unknown

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Publications

- Spencer M, Yang L, Adu A, Finlin BS, Zhu B, Shipp LR, Rasouli N, Peterson CA, Kern PA. "Pioglitazone Treatment Reduces Adipose Tissue Inflammation through Reduction of Mast Cell and Macrophage Number and by Improving Vascularity." Ed. Josep Bassaganya-Riera. PLoS ONE 9.7 (2014): e102190. PMC.
- Spencer M, Finlin BS, Unal R, Zhu B, Morris AJ, Shipp LR, Lee J, Walton RG, Adu A, Erfani R, Campbell M, McGehee RE Jr, Peterson CA, Kern PA. "Omega-3 Fatty Acids Reduce Adipose Tissue Macrophages in Human Subjects With Insulin Resistance." Diabetes 62.5 (2013): 1709–1717. PMC.

Presentations

- APHA 2016, Annual Meeting & Expo, Denver, October 31, 2016 (Abstract accepted). Akosua Adu, Ibitola Asaolu, Sabrina Brown, Erin Abner, Wayne Sanderson, and Laura Meints. Circumstances Contributing to Suicides among Pregnant, Postpartum and Non-pregnant Women (15-54 years) in Rural and Urban Counties in the U.S., NVDRS 2003-2012. (Poster Presentation).
- Barnstable Brown Obesity and Diabetes Research Day, University of Kentucky, Lexington May 14, 2012. Adu A, Spencer M, Nasser M, Peterson C, Kern PA. The effects of pioglitazone on insulin resistance in obese subjects. (Poster Presentation).
- Markey Cancer Center Research Day May, 2011. Boyechko T, Adu AK, Byers SW, and Mao CD. TCF7L2 alternative exon profiles distinguish breast cancer cell lines with stem-like versus epithelial-committed lineage characteristics and are regulated by TAp63 status. (Poster Presentation).

Awards & Honors

- Lyman T. Johnson Fellowship, University of Kentucky, 2011-2012.
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