RATE AND METHOD OF SUICIDE ATTEMPTS IN THE US BETWEEN 1992 AND
2010: GEOGRAPHIC AND DEMOGRAPHIC DIFFERENCES

A Thesis
by
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Abstract

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Suicide is one of the most prevalent and burdensome conditions present in societies

globally, accounting for 71% and 50% of violent deaths in females and males, respectively.

Suicide accounts for more years of life lost than any other condition or disease except cancer

and heart disease, and it is expected to rank as the second most disabling health condition

among established market economies by 2020 (National Action Alliance for Suicide

Prevention, 2013). It is widely recognized that one of the most effective suicide prevention

strategies is to restrict access to highly lethal methods of suicide (e.g., firearms, pesticides).

However, there is a paucity of recent studies that assess the potential correlates of method

lethality, such as demographic and geographic variables. Therefore, the present study aims to

address this gap in literature by analyzing method lethality used in suicide attempts across

varying geographic and demographic variables, including region (West, Midwest, Northeast,

South), Metropolitan Statistical Area (MSA), sex, age groups, races, and ethnicities using

National Hospital Ambulatory Medical Care Survey (NHAMCS) data from 1992-2010.

Participants ($n = 1,792$; 56.4% female) were classified as engaging in high lethal (e.g.,

firearm, hanging/suffocation, jumping; $n = 115$) or low lethal (cutting/piercing, poisoning,

crashing a motor vehicle; $n = 1677$) suicide attempts. Results suggest that males are significantly more likely to use highly lethal methods when attempting suicide. Being non-Hispanic and living in a rural area was related to a higher likelihood of electing to use a highly lethal suicide attempt method, though these findings were not statistically significant. The clinical implications of these data suggest that clinical evaluation and prevention efforts should include lethal means restriction interventions for all those at risk for suicide, notably those who are especially vulnerable to electing to attempt suicide using highly lethal methods.

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Third, I would like to thank Dr. Rose Mary Webb for her involvement with creating and tweaking this study's design. I would also be completely lost on the APA formatting of my paper and references without your careful eye and astounding knowledge of all iterations of the APA formatting manual.

Finally, I would like to thank Dr. Shawn Bergman and Zach Morgan for helping me create, tweak, and execute the statistical plan for this research study. Without you guys, I would probably still be trying to make a multi-level modeling analysis work. I owe most of my ability to stay sane throughout this project to you all for letting me know when it was time to let go of the original plan.

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Rate and Method of Suicide Attempts in the US Between 1992 and 2010: Geographic and

Demographic Differences

The World Health Organization (Drapeu & McIntosh, 2015) reports that over

800,000 people die by to suicide each year. There are indications that for each individual in

the US who dies from suicide, 20-25 other individuals have attempted suicide (Drapeu &

McIntosh, 2015; Fleischmann & DeLeo, 2014). Current estimates indicate that suicide

accounts for 50% of violent deaths in males and 71% of violent deaths in females

(Fleischmann & DeLeo, 2014). Furthermore, suicide accounts for more years of life lost than

any other disease except cancer and heart disease (Centers for Disease Control and

Prevention [CDC], 2013). Recent Global Burden of Disease projections place suicide among

the 20 most burdensome global health conditions. By 2020, the combined burden of mental

illness and suicide are projected to rank as the second most disabling health threat in

established market economies (National Action Alliance for Suicide Prevention, 2013).

When considering the United States alone, the overall suicide rate in 2013 was 12.6

per 100,000, with males dying by suicide at higher rates than females. There were 41,149

suicide deaths in 2013, making suicide the 10th leading cause of death in the United States.

This means that a suicide death occurred every 12.8 minutes in the US in 2013 (CDC,

2013a). Suicide is the third leading cause of death among 10-14 year olds, the second among

15-34 year olds, the fourth among 35-44 year olds, the fifth among 45-54 year olds, the

eighth among 55-64 year olds, and the eighteenth among individuals 65 and older (CDC,

2015).

Adolescents and young adults are a particular age group known to be at a higher risk

for suicide. The rate for 10-19 year old adolescents was 4.5 suicides per 100,000, with boys,

Caucasians, American Indians, and older children consistently maintaining higher overall

suicide rates than girls, Hispanics and African Americans, and younger children respectively

(CDC, 2013a). However, recent analyses highlighted a 200% increase in suicide rates among

girls ages 10-14 between 1999 and 2014, with rates shifting from 0.5/100,000 in 1999 to 1.5

in 2014 (CDC, 2016). Further, prevalence rates of suicidal ideation in 12 to 17 year olds in

the US are estimated to be as high as 24% (Robinson et al., 2012). Among high school

students in the US in 2013, 8% of students reported having engaged in a suicide attempt in

the last 12 months, and 2.7% reported a suicide attempt that required medical attention

(CDC, 2015). Moreover, 21.1% of children and adolescents who have died by suicide have

engaged in at least one previous suicide attempt (CDC, 2013b).

Middle-aged adults have also been identified as a group that is particularly at-risk for

suicide in the US. The CDC (2013a) recently found that annual suicide rates for adults aged

35 to 64 increased by 28% from 1999-2010. Women in this age group exhibited the highest

suicide rate increase, with findings highlighting a 32% increase in annual suicide rates for

women 35-64, while men in this same age group exhibited a 27% increase. Moreover, people

aged 50-54 and 55 to 59 experienced the greatest increase in suicides among all age groups,

exhibiting an overall increase of 48% and 49% respectively. Suicide rates among middle-

aged adults experienced a particularly sharp escalation beginning in 2007, which is

hypothesized to coincide with increasing economic crises (Hempstead & Phillips, 2015).

Suicide in Rural Areas

Although suicide poses a threat to health and the economy on a global scale, there are

no areas more impacted by suicide than rural communities. Males in the most urban areas of

the US maintain rates of 11 suicides per 100,000 people, while males in the most rural areas

of the US have 36 suicides per 100,000 people. Similar discrepancies are typically seen

between rural and urban females, though the difference tends to be moderately smaller

(National Center for Injury Prevention and Control [NCIPC], 2012). When considering

Australia, a country with a notably high proportion of rural to urban geographic areas, suicide

rates in rural areas have shown to be 33% higher than in major cities. Moreover, in extremely

remote areas, suicide rates are 189% higher than rates seen in major cities (*Suicide*

Prevention Australia, 2010). Furthermore, Australia and New Zealand experienced no

increases in metropolitan suicide rates across a 20 year period, while rural suicide rates

doubled and rural youth suicides experienced a five-fold increase (Hirsch, 2006).

The discrepancies between rural and urban suicide rates can be seen globally. Canada

has experienced a particularly large gap between rural and urban suicide, with rural and

frontier areas of Canada maintaining rates of 41 per 100,000, while the national suicide rate

is only 13 per 100,000. Similarly, suicide is the leading cause of death in rural areas of China

(Hirsch, 2006). When considering the dispersion of suicides in rural areas, it is frequently

seen that males pose the greatest risk of suicide. In the UK, the greatest at-risk groups

typically include females between the ages of 15 to 24 and over 45, rural males, and farmers.

Rural males and farmers are also at the greatest risk for suicide in Poland and Greece

(Hirsch, 2006). In fact, almost all developed countries indicate that rural males pose the

greatest suicide risk, with China being the only exception (Hirsch & Cukrowicz, 2014).

When considering suicide solely in the US, males and females living in the 10 least

densely populated states had higher suicide rates than their counterparts living in the 10 most

densely populated states (Hirsch & Cukrowicz, 2014). From 1996 to 2010, the gap in suicide

rates between the most urban and the most rural counties in the United States widened

(Fontanella et al., 2015). Further, geographic patterns in the US indicate higher suicide rates

in the Western region, an area known to have a higher concentration of rural areas than

anywhere else in the country (Singh, Azuine, Siaghpush, & Kogan, 2012). From 1992-2001,

mental health related visits to emergency departments in rural areas of the United States

showed a significant decrease, while visits related to suicide attempts or self-inflicted injuries

in the same rural areas remained relatively constant (Larkin, Smith, & Beautrais, 2008),

implying a decrease in help-seeking behaviors rather than a decrease in mental health

difficulties overall.

       Youth in rural areas of the US pose a particularly high suicide risk, as they

demonstrated 84% higher suicide mortality than their most urbanized counterparts (Singh, et

al., 2012). In a review of US youth suicide mortality rates from 1996 to 2010, urban youth

male suicide rates significantly declined, while rural youth male suicide rates remained

relatively unchanged. Moreover, both urban and rural youth female suicide rates increased

significantly across the 14-year period.

Suicide in Racial/Ethnic Minorities

       Immigrants to rural areas and ethnic minorities are at a greater risk of engaging in

suicidal behavior worldwide (Hirsch & Cukrowicz, 2014). In the US, rural-urban differences

in both all-cause and suicide mortality rates are most pronounced among American

Indian/Alaska Native (AI/AN) youth living on reservations, given that they demonstrated

overall mortality rates 3.6 times higher than those AI/AN youth in urban areas (Singh et al.,

2012). Suicide represents a major health problem for AI/AN ages 15 to 34, as the suicide rate

in this population is 250% higher than the general population (Gray & McCullagh, 2014).

American Indian youth in Montana, one of the most rural states in the US with one of the

highest AI populations, report higher depression and suicide rates when compared with Montana youth overall. For example, 19.2% of AI youth reported making a suicide plan, compared to only 13.6% among non-Native youth, and 6.1% of AI adolescents living on reservations and 6.7% of AI adolescents living in urban settings reported making a suicide attempt that required treatment by a doctor or nurse, while only 2.6% of all youth surveyed reported the same experience (CDC, 2013c). Moreover, in 2014, AI of all ages accounted for 9.7% of all suicides in Montana, a disproportionately high number given that American Indians only comprise 6.5% of Montana's population (Montana Department of Health and Human Services, 2014).

Interestingly, the literature on other racial/ethnic minority suicides in the US is currently lacking. From 2001-2010 the suicide rate for Hispanics in the US was 5.85, falling at slightly less than half the overall US suicide rate. Similarly, the suicide rate for African Americans in the US from 2001-2010 was also slightly less than half the US suicide rate, falling at 5.37 (Suicide Prevention Resource Center [SPRC], 2013). Results such as these have often been interpreted to imply that racial/ethnic minorities other than AI/AN aren't at as great of a risk for suicide. However, it has been shown that some racial/ethnic minorities may be at risk for suicide cause of death misclassification. Specifically, third-party researchers (Rockett et al., 2010) reviewed cause of death information of racial/ethnic minorities and found that many racial/ethnic minority members appeared to have had their death misclassified as a non-suicidal cause. Particularly, non-Hispanic blacks were more than twice as prone to suicide cause of death misclassification as non-Hispanic whites, and Hispanics were 17% more prone to suicide misclassification as non-Hispanic whites. A proposed explanation for this discrepancy is that non-Hispanic blacks and Hispanics are less

likely to leave a suicide note, with only 18% of blacks and 21% of Hispanics leaving a note, while 31% of non-Hispanic whites left a note. However, this discrepancy is not enough to explain the misclassification problem as a whole (Rockett et al., 2010). Despite the current issues surrounding misclassification of racial/ethnic minority suicides, overall suicide rates for racial/ethnic minorities showed an increase from 1999-2010. The greatest increases were among non-white Hispanics (40%) and AI/AN (65%; CDC, 2013a), highlighting the importance of clarifying rates and risk factors for racial/ethnic minorities.

Risk Factors

According to the WHO'S report (Fleischmann & DeLeo, 2014) on suicide, several risk factors tend to act cumulatively to increase a person's vulnerability to engage in suicidal behaviors. Some of these risk factors include difficulties accessing mental healthcare, relative ease in obtaining the means to commit suicide (e.g., firearms, pesticides), sense of isolation, abuse, violence, conflicted relationships, major depression, substance abuse problems, and stigma against help-seeking (Fleischmann & DeLeo, 2014). Exposure to trauma, stressful life events, substance abuse, poverty, and cultural loss in ethnic minorities and indigenous populations are frequently considered to be risk factors for suicidal behavior as well. Shame and stigma are often associated with mental illness and the aforementioned risk factors, leading to overall lower help-seeking rates (Harlow, Bohanna, & Clough, 2014).

Based on research conducted by Hirsch and Cukrowicz (2014), the remoteness of rural areas may act as a risk factor over and above traditional risk factors, such as age, gender, socioeconomic status, race, and ethnicity. Suicidal individuals in rural areas tend to report receiving less mental healthcare and fewer psychiatric diagnoses than suicidal individuals in urban areas. However, individuals in rural areas are equally as likely as those

in urban areas to exhibit signs of severely depressed mood in the weeks before committing

suicide (Searles, Valley, Hedegaard, & Betz, 2014). The lack of mental healthcare service

availability may be partly to blame for the increased suicide rates in rural counties, as it is not

uncommon for a rural county to have none or only one mental healthcare service provider

(Armstrong, 2014; Searles et al., 2014).

According to the National Action Alliance for Suicide Prevention (2013), the etiology

of suicidal behavior is still not understood in light of the variability in factors that are

associated with risk depending on the geographic region. Despite the heavy research

currently available on various risk factors, the practice of predicting suicidal behavior is

widely regarded as difficult at best and impossible at worst, as there is paucity of procedures

that have been empirically validated. The National Action Alliance for Suicide Prevention

(2013) urged researchers to concentrate more on local rather than global risk factors to better

understand, predict, and prevent suicide. A closer investigation into geographically and

demographically relevant risk factors and commonly employed methods of suicide may aid

in the development of empirically based suicide prevention protocols.

Methods of Suicide

One potential mechanism for better understanding and preventing suicidal behaviors

is to examine the methods by which individuals in various communities and geographic

regions attempt or complete suicide. In India, for example, pesticides are the most common

suicide method, and use of pesticides in suicide behaviors is a particularly large problem in

rural areas of the country. In an effort to target availability of suicide methods and to prevent

future suicides, a centralized storage facility was implemented in which pesticide was stored

as opposed to individuals storing pesticides in the home. Over a one-year period, residents

grew to largely acknowledge the storage facility as an appropriate strategy for preventing

community suicides (Mohanraj, Kumar, Manikandan, Kannaiyan, & Vijayakumar, 2014).

Similarly, the UK implemented a program in 1958 to transition from toxic coal gas to

nontoxic natural gas after multiple studies revealed that carbon monoxide poisoning via coal

gas was the number one suicide method in the country. As coal gas became less available,

there was a steady reduction in the number of suicide deaths involving carbon monoxide

poisoning. Moreover, the overall net effect was a very large reduction in overall suicide rates

for both genders, implying that suicide method substitution did not occur (Hawton, 2007).

Results such as these serve as an impetus for further understanding locally relevant suicide

methods, as removal of these methods frequently serves as the strongest suicide prevention

opportunity due to the fact that acute suicide risk is generally brief and attempts are often

impulsive.

In the US in 2013, the most common method of suicide across all ages was firearms,

accounting for 51.5% of completed suicides. The second most common method was

suffocation, accounting for 24.5% of suicide deaths. Poisoning was the third most common

suicide method, accounting for 16.1% of all suicides. Eight percent of all suicides were

caused by some other method of injury (CDC, 2013a). From 1999-2010, suicide by hanging

and suffocation increased by 81%, suicide by poisoning increased by 24%, and suicide by

firearm increased by 14% (CDC, 2013a). When considering methods used by differing

genders, poisoning and firearms were the most commonly utilized methods among females

ages 35-64 from 1999-2010, and firearms and hanging/suffocation were the most common

methods among males ages 35-64 during the same time period (CDC, 2013a). Suicide

methods employed by youth in the US appear to mirror the methods employed across the

adult population. The most common method of suicide in adolescents was death by firearm, with 51.1% of youth suicides citing firearms as the method. The second most common method was hanging or suffocation, accounting for 33.9% of youth suicides, and the third most common method was poisoning, account for 7.9% of youth suicides (Fontanella et al., 2015).

In rural areas of the US, individuals of all ages were more likely to have used a firearm in their suicides than their urban counterparts (Searles et al., 2014). However, from 1996-2010, suicide by firearm rates decreased and suicide by hanging or suffocation rates increased across both rural and urban areas (Fontanella et al., 2015). In one of the most rural states in the US, Montana, firearms continued to be the most likely means of suicide, with 61% of suicides involving a firearm. Similar to trends seen nationwide, the second most common method used in Montana suicides was hanging, accounting for 19% of all suicides statewide (Montana Department of Health and Human Services, 2014).

Consistent with the aforementioned literature, it is important to note that suicide methods tend to change across geographic regions based on the availability of particular methods. While it is widely recognized that firearms are the most common method of suicide across the US, the UK has virtually no suicides by firearm (1.4%) due to lack of availability of firearms in that country. However, according to the Office for National Statistics (CDC, 2015), suicide is still a common problem in the UK, with an overall suicide rate in 2013 of 11.9 suicides per 100,000, which virtually mirrors the US rate of 12.6/100,000 (CDC, 2013a; Office for National Statistics, 2015). Moreover, those attempting and completing suicide utilized other readily available means, with hanging, strangulation, and suffocation emerging as the most common suicide method in the UK, accounting for 56.1% of all 2013 suicides

(Office for National Statistics, 2015). These findings highlight the fact that suicide methods change drastically by geographic region, and focusing restriction on only one method will not eliminate suicides entirely, thus illustrating the relevance of continued research on suicide methods as they relate to geographic regions to better inform prevention and intervention efforts.

Lethality

While studies examining suicide methods have been relatively limited throughout suicide literature, the few studies that have examined methodology suggest that the lethality of the method used in the suicide act is related to the outcome (Spicer & Miller, 2000). Previous studies have noted that the most lethal methods of suicide are firearms, drowning, and hanging, while the least lethal methods are poisoning and cutting (Card, 1974; Spicer & Miller, 2000). In a study examining 8 state hospital discharge data systems, suicide completions were most likely to have been completed with a firearm, while poisoning was the most frequently cited method utilized in suicide attempts. Men were more likely to choose the 3 most lethal methods of suicide, while women were more likely to choose the 2 least lethal methods. Moreover, the lethality of the method chosen tends to increase as age increases, with elderly adults choosing the most lethal methods (Spicer & Miller, 2000).

While few studies on lethality have been conducted in the US, several have been conducted with European and Asian populations. In a study conducted in South Korea, researchers found that another predictor of lethality is a history of past suicide attempts. Specifically, those individuals that have made attempts in the past show a tendency to increase the lethality of their selected methods in future attempts (Sang Hoon et al., 2014). Similarly, in a study conducted in Greece investigating the suicide deaths in Athens over a 2-

year period, 24% of those dying by suicide had made a previous suicide attempt requiring

medical attention. Of those that had made a previous attempt, the majority switched to a

more lethal method in their suicide completion. Individuals that engaged in cutting or

poisoning in their previously recorded suicide attempt shifted to hanging or jumping in their

suicide completion. Individuals that made previous attempts by hanging or jumping did not

typically switch methods in their completed suicide (Paraschakis et al., 2014). Findings such

as these highlights the importance of further investigating populations in the US that are most

likely to use high or low lethality methods in attempts, as preventing initial attempts may

prevent later attempts that are increasingly lethal.

      Despite the high number of research studies examining suicidal behaviors and

suicide risk factors, it is widely acknowledged that progress toward key suicide prevention

research goals has been slow (National Action Alliance for Suicide Prevention, 2013).

Furthermore, despite the demonstrated importance of researching geographic patterns of

suicide methods in other countries, little research on these patterns has been conducted in the

US. A better understanding of geographic patterns of suicide methods may aid prevention

efforts, as the efficacy of restricting access to means in suicide prevention efforts has been

documented in several other countries (Hawton, 2007; Mohanraj et al., 2014; Searles et al.,

2014). Moreover, it is widely recognized that individuals that have engaged in a suicide

attempt in the past are at an elevated risk of dying by suicide in the future, with previous

suicide attempts and self-injurious behaviors leading to a 16.3% increased risk for dying by

suicide in the future (Robinson et al., 2012; Yoshimasu, Kiyohara, & Miyashita, 2008).

However, suicide attempters are a relatively unexplored population within the suicide

literature, leaving a gap in the literature that could lead to more effectively tailored suicide prevention efforts.

Due to the high global cost of mental illness and suicide, the risk of suicide both nationwide and globally, and the overall intractable nature of current suicide rates, a greater demand is being placed upon researchers and clinicians to focus efforts on the identification and prevention of suicidal ideation and behaviors (Fleischmann & DeLeo, 2014; National Action Alliance for Suicide Prevention, 2013). As a result of the gaps in the literature and the overall importance of the identification and restriction of suicide methods, there is currently an impetus for stronger research documenting and clarifying the rates of suicide attempts of minorities in the US, in conjunction with documentation of the methods of suicide most common to minorities, genders, age groups, and geographic regions across the US.

Primary Aims

Based on the aforementioned literature and the lack of clarity surrounding identification and prevention of suicide, the present study will examine data from the National Hospital Ambulatory Medical Care Survey (NHAMCS; CDC, 2009a), an annual survey conducted by the CDC (2009b) documenting national emergency department (ED) visits. Data from the 1992-2010 NHAMCS surveys will be utilized in the present study. Those ED visits coded as a suicide attempt will be examined to determine geographic, metropolitan statistical area (MSA) status, age group, gender, and racial or ethnic suicide attempt patterns, with the aim of determining geographic regions, ethnicities, MSA statuses, genders, and age groups that are most vulnerable to particular suicide methods. Moreover, lethality of suicide methods will be examined in an effort to determine populations most at-risk for completing suicide.

One of the aims of this study will be to examine the methods used in suicide attempts presenting to EDs nationwide. Demographic variables, such as sex, age, race, and ethnicity of the patients attempting suicide will then be considered to determine the lethality of methods that are most commonly employed in specific populations around the US. This study will also attempt to determine the lethality of suicide methods most commonly implemented across the four main geographic regions around the country (e.g., West, Midwest, South, and Northeast). Finally, in an effort to determine differences in method lethality in high and low population density areas, the MSA status of each suicide attempt will be considered. The primary research question to be addressed in this study include which populations, based on aforementioned demographic variables, are most likely to employ high or low lethality methods in suicide attempts?

To our knowledge, no prior studies have specifically examined the lethality of suicide methods used solely in suicide attempts across the aforementioned demographic variables. Furthermore, the majority of the literature currently available primarily focuses on rates and methods of completed suicides rather than suicide attempts alone. However, based on the overwhelming evidence indicating that males are more likely to die by suicide than females, it was hypothesized that males would be more likely to utilize a highly lethal method in a suicide attempt than females. Further research has shown that one of the most at-risk populations for suicide is white males (CDC, 2013a). Thus, it was hypothesized that Caucasians in this dataset would be more likely to use a highly lethal method in a suicide attempt, with white males specifically showing the greatest likelihood of using a highly lethal method. Based on the aforementioned literature indicating that rates of completed suicides are higher in rural areas of the United States, it was hypothesized that individuals in non-

MSA status regions would be more likely to employ a high lethality method than individuals

in MSA status regions. Finally, based on the hypothesis regarding rurality in conjunction

with suicide rate data, it was also hypothesized that patients in regions of the US with

widespread rurality (e.g., the West and the Midwest) would show a greater likelihood of

using a highly lethal method when attempting suicide.

Method

Participants

The 1992-2010 NHAMCS datasets contained a total of 586,429 ED patients, with

2,097 patients coded as a suicide attempt or self-inflicted injury. When considering the

suicide attempt patients specifically, 56.4% of the sample was female and patients ranged

from 2 to 100 years of age. 74.6% identified as Caucasian, 18% identified as African

American, 2.7% were Asian, 0.4% were American Indian/Alaska Native, 0.4% identified as

Native Hawaiian/Other Pacific Islander, 12.4% identified as Hispanic or Latino, and 0.4%

reported more than one race or ethnicity. Participants from the four main geographic regions

of the US were relatively equally represented in the dataset, with 23.7% of patients visiting

EDs in the Northeast, 19.7% in the Midwest, 31.6% in the South, and 25% in the West.

Finally, 88.9% of the sample visited a hospital in an MSA status area, while 11.1% visited a

hospital in a non-MSA status area. It is important to note that 174 patients in this dataset did

not have ethnicity recorded. Moreover, 51 patients were missing race data.

Procedure

This study was exempted by IRB on October 26, 2015 (Study number 16-0093). The

datasets for 1992-2010 are publicly available on the CDC's Ambulatory Health Care Data

website (CDC, 2009b). The CDC's NHAMCS division uses a four-stage probability

sampling design to randomly select the emergency rooms and patient records that are

included in the datasets annually. In the first stage of the design, geographically defined areas

are randomly selected for inclusion, and hospitals within the chosen areas are randomly

selected for inclusion in the second stage. In the third stage, hospitals with both emergency

and outpatient departments are randomly selected for inclusion in the study. Finally, patient

records from these departments are randomly sampled (CDC, 2009b). Patient records are

then anonymously coded into annual datasets.

The datasets were coded into SPSS and merged to create one total dataset from 1992-

2010. The data was then coded into suicidal and non-suicidal ED visits, with the non-suicidal

data excluded from the overall study. Suicide visits were identified by medical records that

cited an intentional self-inflicted injury, as identified by *International Classification of*

Diseases, Ninth Revision, Clinical Edition E-Codes (codes E-950.0-E-959.9; Medicode,

1996). Some patient records were given an E-Code of E-958.8 or E-958.9, representing a

suicide attempt by other specified or unspecified means. In an effort to gather more

information about the methods employed in these attempts, ICD-9 (Medicode, 1996)

diagnostic codes were examined for all 310 cases in which the cause of injury was labeled as

other specified or unspecified. Of the 310 cases, 118 did not have any diagnostic information

recorded in the dataset, so these cases were excluded from the study. One hundred and thirty-

two cases listed a mental health diagnosis, such as major depressive episode or acute stress

disorder, which did not lend any information to the method utilized in the suicide attempt, so

these cases were also excluded from the study. Finally, 53 cases were given a medical

diagnosis that did not directly relate to the suicide attempt, such as wrist sprain or asthma, so

these cases were thrown out. Seven cases listed an ICD-9 (1996) diagnostic code of 88100

(open wound of forearm without complication) or 88102 (open wound of wrist without

complication) Based on the information provided by the E-Codes in conjunction with the

diagnostic codes, it was appropriate to consider these patients as engaging in a suicide

attempt by cutting or piercing instrument. Finally, 2 participants in the dataset had "0"

recorded for their age. It was safe to assume that this was a recording error, given that an

infant would not have the motor or mental abilities to attempt suicide, so these 2 cases were

excluded from the study. After this step was completed, 1,792 participants remained in the

study.

In an effort to remain consistent with the most recent suicide methodology literature

and to increase overall clinical utility, participants' recorded ICD-9 (1996) E-Codes were

recoded into two groups: low lethality and high lethality. The methods included in the low

lethality ($n = 1677$) category comprised poisoning, cutting, burning, electrocution, and

crashing a motor vehicle. Methods placed in the high lethality ($n = 115$) category included

firearms, jumping, and hanging/suffocation. See Table 1 (Appendix A) for a breakdown of

the frequencies of each method. The discrepancy noted between the number of participants in

the high and low lethality groups is to be expected given that the data available only includes

patients making a suicide attempt that led to an ED visit. Individuals making a highly lethal

suicide attempt would be more likely to be classified as dead on arrival, and therefore never

be brought to the ED for inclusion in this dataset. Finally, in an effort to remain consistent

with other suicide research, such as the CDC (2013a) and the American Foundation for

Suicide Prevention (AFSP, 2015), the "patient age" variable was recoded from the age of the

individual patient into six main age groups: under 20, 20-34, 35-44, 45-64, 65-84, and 85 or

older.

Data Analyses

All analyses were performed using IBM SPSS statistics version 24 (IBM Corp.,

2016). A multi-level modeling analysis was originally planned to examine whether or not the

geographic region of a patient in conjunction with another demographic variable (e.g., sex,

race, ethnicity, or age) lead to an overall greater likelihood of using a high lethality method in

a suicide attempt. Moreover, a multi-level modeling analysis was planned to examine trend

changes. However, preliminary analyses revealed that the small sample size present in this

dataset limited the power to such a degree that no statistical results were generated when

conducting the multi-level modeling analysis. Overall, the lack of participants belonging to

each demographic within a geographic region (e.g., Hispanics residing in the Midwestern

United States) limited the statistical capacity to generate interactions. The sample's

significant power issues also impeded multi-level modeling analyses relating to trend

changes across each year available in the dataset.

Due to these issues, the statistical plan was revised to implement binary logistic

regression. The overall goal of this analysis was to examine each demographic variable as an

individual predictor of high lethality suicide attempts. Odds Ratios (ORs) and 95%

confidence intervals were calculated to determine overall predictive ability of each

demographic variable. ORs were considered statistically significant at $p < .05$. Descriptive

statistics of each demographic variable in regards to low versus high lethality attempts were

also calculated.

Results

Descriptive statistics regarding frequencies of implementing a low or high lethality method by patient age, sex, race, ethnicity, geographic region, and MSA status are presented in Table 2 (see Appendix B). It is important to note that the low overall occurrence of high lethality suicide attempts in this dataset lead to notably small frequencies of high lethality attempts across all demographic variables. Regarding patient age, patients in the under 20, 20-34, and 65-84 age ranges exhibited the highest proportion of highly lethal attempts, with 7.3%, 7.4%, and 7.3% of patients in these age ranges using a highly lethal method respectively. Conversely, 5.5% of patients in the 35-44 age range, and 4.2% of patients in the 45-64 age range used a highly lethal method. No participants in the 85 and older age group used a highly lethal method in their suicide attempts.

When considering patient sex, males exhibited a notably higher proportion of highly lethal suicide behaviors, with 11.1% of males in this dataset using a highly lethal method. Only 3.1% of females were classified as engaging in the same behavior. Regarding patient race, individuals reporting their race as American Indian/Alaska Native accounted for the greatest proportion of highly lethal suicide attempts, with 12.5% of AI/AN individuals using a highly lethal method. Those individuals identifying as black also exhibited a higher proportion of highly lethal attempts, with 8% of black patients in this dataset using a highly lethal method. White and Asian individuals showed a relatively equal proportion of highly lethal method use at 6.1% and 6.4% respectively. Finally, no individuals identifying as Native Hawaiian/Pacific Islander or as reporting more than one race were reported to have used a highly lethal method in their suicide attempt. When considering solely ethnicity, 6.4%

of non-Hispanic individuals used a highly lethal suicide method, while 7.2% of Hispanic

individuals used a highly lethal method.

Regarding geographic region, high lethality attempts were seen with relatively similar

proportions across the Northeast, South, and West, with 5.7% and 5.5% of patients in the

Northeast and West using highly lethal methods respectively, while 6.5% of patients in the

South elected to use highly lethal methods. The proportion of individuals using highly lethal

methods in the Midwest was slightly higher at 8.4%. Finally, 6.1% of patients residing in

MSA-designated areas elected to use a highly lethal method in their suicide attempt, while

8.6% of patients residing in non-MSA areas engaged in highly lethal attempts.

The predictive abilities of each demographic variable related to likelihood to utilize a

high lethality method in a suicide attempt are presented in Table 3 (see Appendix C).

Overall, the demographic variables presented in this model explained relatively little of the

variance in electing to use a highly lethal method, pseudo-R^2 (Nagelkerk) = .08. However,

the model was statistically significant, χ^2 (6, n = 1792) = 55.79, p < .001. The results of each

demographic variable examined as a predictor are presented below.

Patient sex was a statistically significant predictor of using a highly lethal method in a

suicide attempt. Specifically, males were significantly more likely than females to use a

highly lethal method during their suicide attempt, OR = 3.98 (95% CI [2.61, 6.05]), p < .001.

Patient age also appeared related to the use of a highly lethal method in a suicide attempt,

indicating that patients in older age groups were relatively less likely to employ a highly

lethal method in a suicide attempt, but the odds ratio was not statistically significant, OR =

1.17 (95% CI [0.98, 1.41]), p = .088. Patient ethnicity (e.g., whether or not a patient

identified as Hispanic) also appeared related to the likelihood of making a high lethality

suicide attempt. That is, individuals identifying as non-Hispanic showed a greater likelihood of utilizing a high lethality method, yet the odd ratio was not statistically significant $OR = .94$ (95% CI [.88, 1.01]), $p = .080$. Patient race, on the other hand, did not significantly predict high lethality, $p = .432$.

Aside from demographic characteristics, MSA status and geographic region of the hospitals visited by patients were also examined as possible predictors of highly lethal suicide attempts. The MSA status results showed that patients in non-MSA areas showed a slightly higher likelihood of using a high lethality method in a suicide attempt, $OR = 1.44$ (95% CI [0.85, 2.44]), $p = .170$, yet the findings were not statistically significant. Geographic region was not a significant predictor of high lethality method use, $p = .689$.

Discussion

Although numerous studies on suicide deaths have documented populations most vulnerable to suicide methods of varying lethality (CDC, 2013a; Fontanella et al., 2015; Searles et al., 2014), very few studies have examined the characteristics of individuals comparing low versus high lethality methods in suicide attempts specifically. It is widely acknowledged throughout the literature that the best predictor of future suicidal behavior is a history of suicide attempts (CDC, 2013a). Moreover, numerous studies have documented a reduction in suicide deaths by restricting access to lethal methods of suicide that are most commonly used among local populations (Hawton, 2007; Mohanraj et al., 2014; Searles et al., 2014). Therefore, the purpose of this study was to further document and more accurately define demographic groups across the US that are most likely to utilize a high lethality method when attempting suicide in an effort to better inform prevention, assessment, and intervention efforts in clinical practice.

When considering gender, these data showed that males were significantly more likely to use a highly lethal method in a suicide attempt relative to their female counterparts. This result coincides with studies on completed suicides that have consistently documented males as dying by suicide at greater rates than females across all age groups (CDC, 2013a; Hirsch, 2006; NCIPC, 2012). Moreover, research focusing on methods used in completed suicides has shown that males are more likely to use a firearm in a suicide (CDC, 2013a; Fontanella, 2015), which is widely considered one of the most lethal methods of suicide (Card, 1974; Spicer & Miller, 2000). Based on existing studies by the CDC (2013a), it is evident that Caucasian, middle-aged males are one of the most at-risk groups for engaging in suicidal behavior. Moreover, recent research has indicated that death – particularly death by

suicide – rates among Caucasian, middle-aged males without a college education are

increasing at a faster rate than other populations (Case & Deaton, 2017). The results reported

here and elsewhere further emphasize the high-risk nature of males as a whole, and provide

impetus for lethal means restriction efforts by clinicians when working with this population.

With respect to age, these data showed patients in older age groups presenting to the

ED for a suicide attempt had a relatively smaller likelihood, albeit not to a statistically

significant degree, of having used a highly lethal method in their suicide attempt as compared

to their younger counterparts. This trend appears contrary to numerous results documented

throughout the literature showing that middle-aged individuals present with some of the

highest rates of suicide in the US (CDC, 2013a). Spicer and Miller (2000) reported that

method lethality tends to increase with age, with older individuals consistently selecting the

most lethal means of suicide. Another plausible reason for this finding is the fact that many

of the individuals who elected to use a highly lethal means in their attempt do not survive and

are therefore not part of the ED dataset. Similarly, the datasets in the current study were also

disproportionately comprised of adolescents and young adults, with middle-aged to elderly

individuals accounting for less than a quarter of these data. Specifically, the overall

frequency of patients falling into the 45-64 ($n = 285$), 65-84 ($n = 41$), and 85 or older ($n = 3$)

age groups was notably lower than those falling into the under 20 ($n = 386$), 20-34 ($n = 679$),

and 35-44 ($n = 398$) age groups, which may account for this result.

The results of these analyses also showed that patient ethnicity was somewhat related

to the prediction of method lethality, yet similar to the age variable, it was not statistically

significant. Individuals that identified as not Hispanic or Latino showed a greater likelihood

of utilizing a highly lethal method as compared to their Hispanic counterparts, which has

been documented in other studies. However, patient ethnicity was another variable that had

relatively unequal representation in this dataset, with non-Hispanics ($n = 1423$) representing

79.4% of the patients, while Hispanics ($n = 223$) only represented 12.4%. More specifically,

only 16 of the Hispanic patients made a suicide attempt with a highly lethal method. These

discrepancies have played a role in the results generated by these analyses. However, the

result generated by these data does coincide with other research documenting the overall

lower risk of suicide among Hispanics in the US. Recent research estimates the suicide rate

for Hispanics overall at slightly less than half the overall US suicide rate (CDC, 2013a;

SPRC, 2013). Moreover, the results from the CDC (2013a) study indicated that Caucasians

have consistently maintained suicide rates higher than both Hispanics and African

Americans. However, it is important to note that recent Youth Risk Behavior Survey (YRBS;

CDC, 2016) results indicate that the prevalence of having attempted suicide was highest

among Hispanic high school students at 11.3%, as compared to 6.8% of non-Hispanic

students. These results indicate that, while there is tentative evidence that adult Hispanics

may be less likely to engage in highly lethal suicidal behaviors, adolescent Hispanics may be

at an increased risk for attempting suicide.

When considering patient race, these data did not identify race as a significant

predictor of method lethality in suicide attempts. This result is somewhat surprising given the

heavily documented evidence that Caucasians consistently demonstrate higher rates of

completed suicides than minorities throughout the US (CDC, 2013a). While there is little

recent research documenting racial differences in suicide method lethality, the overall rates

of completed suicides among Caucasians as compared to minorities lend themselves to an

assumption that Caucasians are more likely to select a highly lethal method of suicide.

Moreover, while most minorities are recognized as having lower overall rates of suicide, American Indians are recognized as having the second highest suicide rate in the US among other racial groups (AFSP, 2015; CDC, 2013a). Further, AI/AN individuals age 15-34 maintain a suicide rate that is 250% higher than the general population (Gray & McCullough, 2014). Therefore, despite the results presented here, it remains important to consider lethal means counseling and restriction efforts when working with these populations, despite the non-significant results presented in this study.

The MSA status of the hospital patients in this dataset visited after making a suicide attempt appeared related to method lethality by these analyses. More specifically, those patients visiting hospitals in a non-MSA designated area had slightly greater likelihood to have used a highly lethal method in their suicide attempt. These results may be more significant in analyses with a larger sample size from both MSA and non-MSA designated areas, given that only 209 participants visited hospitals in non-MSA areas, while 1583 visited hospitals in MSA areas. Assuming that patients of non-MSA hospitals also resided in non-MSA areas, this result provides further agreement with the overwhelming evidence that individuals in rural areas are at greater risk of suicide than their urban and suburban counterparts. Residents of rural areas are documented as consistently maintaining higher rates of suicide than urban and suburban residents on both a national and a global scale (Hirsch, 2006; Hirsch & Cukrowicz, 2014; NCIPC, 2012; Suicide Prevention Australia, 2010). Previous research in conjunction with the results generated by these data provide further evidence that lethal means access and restriction are of extreme importance when conducting risk assessments and prevention efforts in rural areas of the US.

With respect to the geographic region of the patient, these data did not find geographic region to be a significant predictor of method lethality. Though there is little research currently available on method lethality across the four main geographic regions of the US, it is acknowledged that highly rural states tend to show greater suicide rates. As such, states in the Midwestern and Western regions of the US tend to maintain the highest rates of suicide (AFSP, 2015; CDC, 2013a). In fact, the states with the top 10 suicide rates in the country in 2015 all fell into the Midwestern and Western regions of the country (AFSP, 2015). The lack of significance related to this demographic variable may be related to the overall low power of these analyses due to the relatively small sample size. Therefore, it is important to consider these individuals as possibly being at increased risk for highly lethal suicide behaviors, and to implement lethal means restriction efforts accordingly.

There are several notable limitations to the present study design. First and foremost, it is important to note that the overall model presented in these results had limited power to predict the use of a highly lethal method in a suicide attempt. The limited power of the model is likely a reflection of the small sample size associated with these analyses, in addition to the disproportionate number of low lethality attempts ($n = 1677$) versus high lethality attempts ($n = 115$). That is, expectedly, those who used highly lethal means were deceased after the attempt and did not present at the ED. Secondly, as mentioned previously, the sample in this study was small given the size of the total ED dataset from 1992 to 2010. When cleaning the data to include only patients presenting to the ED with suicide attempt injuries, problems in medical recording were encountered leading to the removal of these cases from the analyses. Many patients throughout the ED dataset had no cause of injury recorded, and several patients identified as making a suicide attempt were classified as "suicide attempt by other or

unspecified means," leading to exclusion from these analyses. Due to the small sample size, the power of analyses was notably limited, making originally planned interaction analyses impossible to generate. Due to this limitation, we were unable to speak to possible interactions of demographic variables that likely lead to an even greater risk of using highly lethal methods in a suicide attempt, such as white males living in a rural area. Moreover, we were unable to examine possible trend changes in methods utilized by demographic groups across the time frame presented by these data due to the limited power of the sample.

Third, the specificity of these data limits the ability to examine highly lethal methods. Due to the fact that this dataset encompasses only ED data, individuals who died by suicide were not included in the analyses. While suicide attempters are a relatively unexplored population within the suicide literature and targeting this population in research is beneficial, the most highly lethal suicide methods (e.g., firearms) were almost entirely absent from these analyses due to the fact that most firearm attempts lead to completed suicides that are not brought through the ED. Therefore, it is possible that the results generated by these data would be more significant if death by suicide data was also included. Fourth, this study relied entirely upon medical recording of suicide attempts. As Rockett and colleagues (2010) discussed, it is possible for individuals' suicide injuries and deaths to be misclassified as accidental. Moreover, the common experience of shame associated with attempting suicide can lead to under-reporting of suicidal ideation and actions. Therefore, it is highly likely that there were patients in the overall ED dataset whose injuries were misclassified as being accidental based on patients' self-reports. Since accidental injuries were not included in these analyses, these individuals were left out of the study.

A fourth and final limitation of this study lies within the consideration of all poisoning attempts as low lethality attempts. While poisonings by over-the-counter medications and common household chemicals are typically considered to be on the lower end of the lethality spectrum, intentional poisonings by opioids tend to show higher death rates than other commonly used poisons. Since this study considered all poisonings to be in the low lethality group, it is possible that some of the highly lethal suicide behaviors seen with patients intentionally overdosing on opioids were missed by these analyses. Future studies would benefit from separating poisonings into high and low lethality based on the substance used in order to better represent highly lethal suicide behaviors.

Despite these limitations, the findings from this study have important implications for both clinical practice and prevention efforts. Overall, the results generated here highlight the vital importance of lethal means counseling and means restriction, especially when working with males, individuals identifying as not Hispanic or Latino, and residents living in rural areas. Moreover, previous research on suicidal behaviors strongly suggests that middle age through elderly patients, along with Caucasians and American Indians, may be at higher risk overall for dying by suicide, thus providing a strong rationale for implementing lethal means counseling and means restriction with these populations as well.

While these data speak specifically to lethal means restriction when working with clinical populations, they may also speak to future directions for suicide prevention efforts. Based on the documented success of previous research on lethal means restriction as a community suicide prevention intervention (Hawton, 2007; Mohanraj et al., 2014; Searles et al., 2014), it is possible that these data can be used to better inform populations and locales within which community lethal means restriction efforts may be feasibly targeted. For

example, firearms safety and safe storage efforts may be effective in reducing overall rates of suicide in rural areas, given the results of previous research in conjunction with the results generated by these analyses. These efforts could be planned at a community level in singular rural counties, or they could target larger regions of the country that have a greater proportion of rural communities, such as the Midwest and West. While these programs would have cultural implications that are beyond the scope of this study, incorporating these considerations might assist in effectively planning future prevention efforts from a public health framework.

Future research on this subject should focus on including methods used in both suicide attempts and deaths by suicide. Due to research highlighting the increased risk of future suicidal behaviors by those that have attempted suicide in the past (CDC, 2013a) and research showing that those suicide attempters often increase method lethality across attempts (Sang Hoon et al., 2014), it is important to continue including suicide attempters in future method lethality studies. However, the aforementioned limitation of solely studying suicide attempt cases provides a clear rationale to continue researching lethality of methods used by individuals that have completed suicide. A nationwide study including both of these populations would likely help inform prevention, assessment, and intervention efforts, including lethal means restriction counseling. Moreover, future research on community-based means restriction efforts in the US modeled after successful international efforts that took place in India (Mohanraj et al., 2014) and the UK (Hawton, 2007) would be beneficial to establish the impact of restricting highly lethal means within the varying cultures of the US.

In summary, the findings presented here suggest that males, non-Hispanics, and residents of rural areas may be at particular risk of making a suicide attempt with a highly lethal method. These data mirror some of the data already published in the empirical literature. At the same time, using and having access to highly lethal methods of suicide is a public health issue that should be taken to heart regardless of demographic or geographic realities in a particular population. That is, suicide prevention efforts should not only target the "who" or the "where" involved, but also the "how" of individuals' suicide deaths. Unfortunately, based on the most recent estimates of death by suicide in the U.S., suicide deaths are trending upward, with rates increasing by 24% from 1999 to 2014. Specifically, rates spiked from 10.5 per 100,000 in 1999 to 13.0 in 2014 (CDC, 2016). This trend directly contradicts the stated objective of the American Foundation for Suicide Prevention (AFSP, 2015), who set a goal of reducing the suicide rate by 20% by the year 2025. This unfortunate if not untimely trend suggests a need to adopt a new strategy. Given the evidence of the effectiveness of means restriction approaches historically, internationally and recently, this paradigm is likely to bear fruit in the future, especially if these public health approaches are scaled up more consistently in the U.S.

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Appendix A

Table 1

Frequencies of suicide methods

Method	Frequency
Low	**1677**
Poisoning	1599
Cutting/Piercing	56
Burns/Fire	13
Electrocution	5
Crashing Motor Vehicle	4
High	**115**
Firearms	20
Hanging/Suffocation	67
Jumping	20
Jumping/lying before moving object	8

Appendix B

Table 2

Percentages of low and high lethality attempts by demographic group

	Low (*n* = 1677)	High (*n* = 115)
Patient Age		
Under 20	92.7%	7.3%
20-34	92.6%	7.4%
35-44	94.5%	5.5%
45-64	95.8%	4.2%
65-84	92.7%	7.3%
85 or older	100%	0%
Patient Sex		
Male	88.9%	11.1%
Female	96.9%	3.1%
Patient Race		
White	93.9%	6.1%
Black	92%	8%
Asian	93.6%	6.4%
Native Hawaiian/Pacific Islander	100%	0%
American Indian/Alaska Native	87.5%	12.5%
More than 1 race reported	100%	0%
Patient Ethnicity		
Non-Hispanic	93.6%	6.4%
Hispanic	92.8%	7.2%
Geographic Region		
Northeast	94.3%	5.7%
Midwest	91.6%	8.4%
South	93.5%	6.5%
West	94.5%	5.5%
MSA		
MSA	93.9%	6.1%
Non-MSA	91.4%	8.6%

Appendix C

Table 3

Demographic variable as predictors of high lethality suicide attempt method

	B	S.E.	OR	Sig.	Lower CI	Upper CI
Patient Sex	1.38	.21	3.98	<.001*	2.61	6.05
Patient Age	.16	.09	1.17	.09	.98	1.41
Patient Ethnicity	-.06	.08	.94	.08	.88	1.01
Patient Race	.05	.06	1.05	.43	.93	1.18
MSA	.37	.27	1.44	.17	.85	2.44
Geographic Region	-.04	.09	.96	.69	.81	1.15

Significant at p < .05

Vita

Morgan Nicole Brazille was born in Boulder, Colorado, to Wayne and Kim Brazille. She graduated from Panther Creek High School in North Carolina in June of 2010. The following autumn, she entered Campbell University to study Psychology. She was awarded the Bachelor of Science degree in May of 2014. In the fall of 2014, Morgan accepted a research assistantship at Appalachian State University and began studying for a Master of Arts degree in Clinical Psychology. She was awarded the Master of Arts degree in May of 2017.

Following graduation from Appalachian State University, Morgan plans to seek employment in the social sciences research field. She is a member of Psi Chi and Pi Lambda Theta International Honors Societies. She currently resides in Raleigh, North Carolina, with her dog and soon-to-be husband.