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Urban/Rural Inequalities in Suicide Rates in Georgia, 2008-2013: A county-level analysis

Garrett Mahon

Abstract

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By

Garrett Mahon

December 9, 2016

Abstract:
INTRODUCTION: Suicide is a significant public health issue. There have been copious amounts of research completed worldwide attempting to understand the reasons behind suicide, including those revolving around urban and rural disparities. However, research has yet to find a consensus on the issue. The state of Georgia, in particular, has a variety of county-level characteristics that could help understand the dissimilarity between urban/rural populations and direct future research to improve prevention strategies.

OBJECTIVE: The present study aims to assess disparities in suicide rates across urban-rural populations, adjusting for rurality, ethnicity, and a county-level dissimilarity index, in the State of Georgia from 2008 to 2013.

METHODS: Suicide mortality data by ethnicity, age, and county of residence were obtained from Georgia's violent death incident report and death certificate database for 2008 to 2013. A series of Poisson Models were used to evaluate the rates of suicides between urban and rural populations.

RESULTS: The analysis was conducted on 5833 suicides across the 159 counties of Georgia with Urban and Rural counties classified as both a binary and fourfold modify variable. There was sufficient evidence to suggest that rural counties in Georgia have a significantly high rate of suicide than those of its urban counterpart, (IRR=1.43, IRR=1.37), even after adjusting for ethnicity and a county level dissimilarity index.

CONCLUSION: Georgia's suicide rates are relatively higher among those living in rural counties when compared to urban settings. These results both confirm and conflict with findings from previous research. The diversity in findings denotes that future research should explore the variations across urban/rural classification systems, spatial remoteness of the area, and additional regional level characteristics.

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Author's Statement Page

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Garrett Mahon
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Introduction

Suicide is a serious and complicated public health issue accounting for approximately 42,000 deaths each year in the United States alone (Singh & Siahpush, 2002). It can leave long lasting harmful effects to families, friends, and the community. The Center for Disease Control reported that suicide is the 10th leading cause of death for Americans in 2014 and that rates have risen about 2% per year since 1999 (Mccarthy, et al. 2015).

Factors that increase the risk for attempting suicide are individual psychical and psychological wellness as well as environmental influences such as socio-economic problems, discrimination, and deprivation of amenities (McCarthy, 2015). Depression is the most common mental health disorder associated with suicide. Neatly two-thirds of those who commit suicide are depressed at the time of their death. Additionally, the risk of death by suicide is twenty times greater than those that are not depressed (Rioja, Redondo, Aboitiz, 2001). Other psychological disorders connected to suicide include schizophrenia, bipolar disorder, personality disorders, and posttraumatic stress disorder (Choi & Kim, 2015). While mental illness is a strong contributor to an increased risk of suicide, it has been shown that ecological factors can have a substantial impact.

Previous studies conducted in Australia, Scotland, and other foreign countries have examined suicide rates between urban/rural settings. While there has been disagreement across publications, the majority of research have shown there been a significant difference between suicide rates in urban and rural locations (Law, Snider, & Leo, 2014). However, each publication has failed to use a consistent measure of rurality, decreasing generalizability to different populations. Additionally, some studies within this area have failed to include a measure of ethnicity. It has been shown that, within the United States, white/non-Hispanic commit suicide at

a significantly higher rate than other ethnicities (Searles, Valley, Hedegaard, & Betz, 2014). Thus, without the inclusion of a segregation variable, lacking models would only represent where the majority of white/non-Hispanic live. Finally, a deprivation index, purposed by McCarthy, et al, is a strong measure of inequality between urban and rural counties and will be included to examine of it interaction on suicide rates.

Therefore this study aims to evaluate the trend of suicide rates across various levels of rurality in conjuncture with ethnicity and deprivation factors among Georgia residents between 2008 and 2013.

Data and Methods

Suicide and Population Data

Individual-level suicide cases were provided by the Georgia Department of Public Health from 2008 to 2013. The data was acquired from Georgia's Violent/Incident Death Reports and Death Certificate Database. Suicides were identified by the 10th revision of the international statistical classification of disease and related health problems (ICD-10) code between X60-X84, death resulting from a self-inflicted injury. Codes labeled as undetermined were excluded from the analysis.

For each record, information on ethnicity, county of residence, and date of death was included. Based upon the county of residence, cases where matched to the county's corresponding Rural-Urban Continuum Codes (RUCC) which is a form of classification that distinguishes counties by total population, adjacency to populated cities, and a degree of urbanization. They range from 1 to 9 and are defined as:

1. Urban – 1 million population or more.
2. Urban - 250,000 to 1 million population

3. Urban - fewer than 250,000 population
4. Semi Urban -20,000 or more, adjacent to a metro area
5. Semi Urban - 20,000 or more, not adjacent to a metro area
6. Semi Urban - 2,500 to 19,999, adjacent to a metro area
7. Semi Urban - 2,500 to 19,999, not adjacent to a metro area
8. Rural - 2,500 urban population, adjacent to a metro area
9. Rural - 2,500 urban population, not adjacent to a metro area

The RUCC as well as additional county-specific information was obtained from the Small Town and Rural Atlas Database. There was a total of 5833 incidence cases of which the average for a Georgia RUCC was 36.6 (65.2).

Urban/Rural Profile

A level of rurality classification, RUCC, created by the United States Department of Agriculture Economic Research Service (USDA-ERS) was added to the dataset. The purpose of this index allows county level data to be broken down into more specific subgroups and analyze trends that are related to urban influence and population densities. However, because of the limited number of suicides happening in the rural areas it was determined not to attempt a statistical analysis for each particular level of the RUCC categories. This decision is concurrent with previous studies completed on a local rather than national level (Kochanek, Xu, Murphy, Minino, & Kung, 2011).

As an alternative and in accordance with prior research, RUCC was modified into a fourfold classification (urban, non-metro adjacent, and non-metro non-adjacent, and rural) that was first used by Middleton, et al. and a binary variable of Urban, RUCC 1-3, and Rural, RUCC 4-9 that was previously used by Pearce, Barnett, & Jones.

County Level Variables

Persistent Poverty 2008 to 2012

Persistent Poverty is a classification in the United States that designates a county has been in poverty for consecutive years. A county is considered impoverished if 20% of the population is below the poverty threshold. In Georgia, 30% (n=48) of counties are deemed to be in persistent poverty.

Percent White Non-Hispanic (2010)

White Non-Hispanic are individuals who are considered to be generally of European origin, racially white, and do not consider themselves of Hispanic descent. Each county has a calculated percentage of non-Hispanic white.

Low Education (2010)

Low Education is a classification in the United States that designates a county has 20% of its adults, age 25 to 64, without a high school diploma. In Georgia, 38% (n=62) of counties are considered to have low education levels. Of those 62 counties, 80.65% (n=50) are designated urban and 19.35% (n=12) are designated to be rural.

Low Employment (2010)

Low employment is a classification in the United States that designates if a county has high unemployment. It is calculated based upon the county's unemployment statistical compared to the national average. In Georgia, 57% (n=92) of counties are considered to have low employment levels. Of those counties, 80.43% (n=74) are designated urban and 19.57% (n=18) are designated to be rural.

Number of Mental Health Providers (2010)

The Number of mental health providers is a continuous variable that estimates the number of residents in a county whose occupation is specifically related to providing any mental health service to the individuals, private or public.

Percentage of Population that Excessively Drink (2010)

Excessive drinking is a proportion of the population per county in the United States that is considered a binge or heavy drinker. A binge drinker is defined as a male or female that have more than 5 or 4 drinks in one sitting, and a heavy drinker is identified as a male or female that have more than 2 or 1 drinks a day. Excessive drinking contributes to many adverse health effects like depression. About 14% of Georgia Residents over 21 years of age have stated they excessively drink.

Population Rate Change (2010)

The population rate change of a county is a positive or negative number that takes in account yearly migration rate and natural change (birth minus deaths). While decades ago population rate change was drastic across all levels of rurality, within the past ten years it also remains relatively close to zero across all RUCCs.

Analysis

The analyses were based on the 159 counties of Georgia with a total 5833 suicides from 2008 to 2013. It was completed in several phases using SAS 9.4. First, suicide frequency was collected from the violent death incident and death certificate database and aligned with the respective county residence. Additionally, at this point, county-level data from the Small Town and Rural Atlas index was merged into the dataset. This information included a varied of statistics but most notably percent white non-Hispanic, persistent poverty from 2008 to 2014, population change from 2010 to 2014, the number of mental health providers, and counties labeled as having low

employment and low education. These variables were used to provide a dissimilarity index at the county level (Rioja, Redondo, & Aboitiz, 2001). RUCC codes were then assigned to their corresponding counties and then revised to the respective binary and fourfold modification codes. Descriptive statistics were performed as a preliminary analysis. The binary sample was predominately urban (n=137, 86%) and the fourfold modified sample was divided as urban (n=19, 12%) non-metro adjacent, second most urban, (n=44, 27%) non-metro non-adjacent, third most urban, (n=74, 47%) and rural (n=22, 14%). Table 1 provides a breakdown of numbers of the county in each RUCC, total suicide count over the time period, and average number of suicide per county with a RUCC group.

To determine whether rates of suicide and level or rurality existed before adjusting for ethnicity and county level factors, a basic Poisson regression was carried out. Two separate models were run: one with binary urban/rural code and the other with the fourfold modification variable. The first model only contained suicide counts as the response variable and rurality as the predictor. The second analysis consisted of the two same models, but a measure of ethnicity (percentage of non-Hispanic white) was added as a covariate. This measure was included to control for the significantly higher rates of suicides among white individuals and to reevaluate the findings from the first model. The final models included the measure of ethnicity as well as the variables describing the dissimilarity index, county level variates. In every model, the log population count of the county was treated as the offset and scale were sent to deviance. Negative binomials models were run in conjunction with the Poisson regressions to determine which distribution was a better fit.

Results

A series Poisson regression and negative binomial models were used to evaluate the Incidence Rate Ratios (IRR) of suicides between urban and rural populations in the state of Georgia. The models examined whether the incidence rates ratios of suicide were independent of rurality, the inclusion of ethnicity, and lastly when adjusted for ethnicity and a dissimilarity index. No significant difference was found between the Poisson regression and negative binomial models.

Binary Urban/Rural

Between 2008 and 2013, urban and rural, being classified as a binary variable, had a significant effect on suicide frequencies (IRR = 1.41), see Table 2 (model 1). However, when ethnicity is included into the model, the effect becomes smaller and no longer significant (IRR = 1.29), and the confidence interval contains one (model 2). In the final model, which adjusts for both ethnicity and the county-level covariates, the effect of rurality increase and becomes significant (IRR = 1.43). A likelihood ratio test was conducted between models 1, 2, and 3 to evaluate the goodness of fit. It was determined that model 3 had a significantly better fit than both models 1 and 2 with a p-value of ($x^2_8 = 51.9$) <.05 and ($x^2_7 = 24.1$) <.05.

Fourfold Modification

During the same period, Urban/Rural, as a fourfold modified classification, showed evidence that different levels of urbanization, most urban compare to second and third most urban, contributed to a reduction in suicide rates (IRR=.936, IRR=984). However, these results were not significant and had confidence intervals containing one. This trend of insignificance continued across all three models, see Table 3. There was evidence, however, that rurality did affect suicide rates between most urban and rural (IRR=1.37) at a relative significance, Table 3

(model 3). A likelihood ratio test was also conducted here between models 1 and 3. It determined that model 3 had a significantly better fit than models 1 and 2 with a p-value of ($x^2_8 = 52.6$) <.05 and ($x^2_7 = 23.4$) <.05.

Discussion

Understanding the underlying causes of suicide is an important public health issue. This studied has examined the differences in suicides rates across urban and rural populations. It showed that when population density, rural classification and a dissimilarity index were adjusted for, suicide rates were significantly higher in rural counties. These results were similar to those observed in previous studies in Scotland (Levin & Leyland, 2005) and Australia (Dudley, et al., 1997). However, when compared to Australia, this studies rural suicides rates were not as drastically high. This could be contributed to Australia's rapidly declining rural economy and heavier migration into urban areas (Sankaranarayanan, Carter, & Lewin, 2010). Additionally, the level of remoteness to health facilities in rural Australia far exceeds those of Georgia.

Our results, however, did conflict with a number of prior findings, like those completed in New Zealand (Middleton, et al., 2003) and England (Pearce, Barnett, & Jones, 2007). In those cases, they found that even after adjusting for related variables, urban suicide rates remained higher than their rural counterpart. There could be several extenuating circumstances that contribute to these disparities among findings. Firstly, the studies done in and New Zealand were analyzed on a national level, which incorporated more variations in demographic structure and dispersion of population, when compared to Georgia. Additionally, the research done in England used a negative binomial regression to account for overdispersion (Pearce, Barnett, & Jones, 2007). To examine if this distribution would create significantly different results, this study ran congruent negative binomial models but found very minor discrepancies to the Poisson

regressions. Secondly, both countries used a different rural classification system, different from the United States RUCC, which could make a comparison between these studies incompatible. Finally, in both studies rates were stratified by gender, which was something not done in this analysis.

This analysis fills the gap from previous research in quite a few ways. It examined urban and rural classification on both a binary level and a fourfold modified classification. Furthermore, it included a variety of county-level variables that have not previously been examined but shown to have a significant impact on suicide. And finally, it adjusted for rurality, ethnicity, and a dissimilarity index in separate models to compare the impact at each level

Possible Explanations for Georgia's Disparity

There have been copious amounts of research completed worldwide attempting to understand the reasons behind suicide, including those revolving around urban and rural differences. In particular, the state of Georgia has a variety of characteristics that could contribute to the disparity in rates. One major consideration is the recent rapid growth of metro areas, mainly Atlanta. In the past decades, Atlanta has exponentially grown in population, consumerism, and economic prosperity. This has allowed its residents to prosper; increasing levels of bliss and happiness among them. This vitalization has also made many young rural inhabitants migrate into more urbanized areas, leaving those remaining feeling mediocre at best (Watanabe, Hasegawa, 1995). Furthermore, Georgia's metro and metro-adjacent areas have been developing much faster than those in remote locations. This disproportionality includes the construct of hospitals and facilities for healthcare practitioners, which limits the number resources in rural areas. With that being said, it should be noted and further investigated, the impact that religion has on suicide rates (Rioja, Redondo, Aboitiz, 2001). Studies have shown

that religion can be a deterrent to suicide ideation; thus understanding the impact of the total number of adherents to religion, not including agnostic or atheism, or number of churches per county could be of importance.

Limitations

There are several limitations of this analysis. Some individual characteristics like ethnicity and age were taken into account, but the exclusion of gender, as well as other personal variables, needs to be considered. It should be noted, however, that because the analyses were examining county-level factors including gender may have little impact. Secondly, like most studies involving suicide, it's hard to use a more detailed hierarchy of RUCC because of the small numbers of suicides in rural areas. Finally, as previous research has identified, there could be other underlying factors affecting the rates of suicides between urban/rural populations. This could include social stigma in smaller population densities and inconsistent reporting techniques across urban reporters.

Future Research

Over the past decades, studies have revealed a significant amount of information about suicide however rates remain high; it is a challenging public health issue to address. The findings of this study may be used to direct future research by incorporating larger scale variables instead of known individual risk factors. Additionally, other potential directions could examine suicide attempts in comparison with completed suicides as the likelihood of suicide increases dramatically after each attempt. Finally, more scrutiny should be placed on investigation the availability of affordable mental health resources and intervention strategies in remote areas. This should also include the role religion in suicide such as including number of churches or religious adherents per county. No matter the direction, it is important to continue to study the

causes of suicide to decreases the severe negative effects of suicide on the individual and the public.

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TABLE 1
Suicide Count breakdown by Rurality Classifcation

RUCC classification	Number of Counties	Suicide Count	Suicides per county Mean (SD)
1. Urban - 1 million population or more.	29	2955	101.8 (124.4)
2. Urban - 250,000 to 1 million population	15	709	47.2 (53.4)
3. Urban - fewer than 250,000 population	30	944	31.4 (29.5)
4. Semi Urban -20,000 or more, adjacent to a metro area	8	311	38.8 (11.4)
5. Semi Urban - 20,000 or more, not adjacent to a metro area	3	78	26 (7.2)
6. Semi Urban - 2,500 to 19,999, adjacent to a metro area	36	469	13.0 (7.59)
7. Semi Urban - 2,500 to 19,999, not adjacent to a metro area	16	187	11.6 (9.0)
8. Rural - 2,500 urban population, adjacent to a metro area	14	108	7.7 (7.3)
9. Rural - 2,500 urban population, not adjacent to a metro area	8	72	9 (7.2)
Total Georgia	159	5833	36.6 (65.2)

Table 2
Poisson Regression analysis with incidenece of suicide as the dependenet variables

2008-2013	Binary Urban/Rural	
	Urban	Rural
Model 1[a]	1.00	1.41** (1.17, 1.93)
Model 2[b]	1.00	1.294 (0.95, 1.74)
Model 3[c]	1.00	1.43** (1.18, 1.96)

*p<0.1
**p<0.05
[a]No covariates
[b]Ethnicity (% Non-Hispanic White)
[c]Ethnicity (% Non-Hispanic White) and County level variables

Table 3
Poisson Regression analysis with incidenece of suicide as the dependenet variables

2008-2013	Fourfold Modification			
	Most Urban	Second Most Urban	Third Most Urban	Rural
Model 1[a]	1.00	0.936 (.83, 1.16)	0.984 (.69, 1.25)	1.39** (1.01, 1.93)
Model 2[b]	1.00	1.083 (.79, 1.23)	1.15 (.69, 1.23)	1.25 (.92, 1.70)
Model 3[c]	1.00	0.929 (.78, 1.10)	0.975 (.720, 1.31)	1.37* (.99, 1.93)

*p<0.1
**p<0.05
[a]No covariates
[b]Ethnicity (% Non-Hispanic White)
[c]Ethnicity (% Non-Hispanic White) and County level variables