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Differential association of socioeconomic status in ethnic and age defined suicides

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Abstract

Suicide rates vary among racial- and age-defined groups, yet little is known about how suicide risk factors differentially impact individual groups. This study assessed differential associations of socioeconomic status among age- and race-defined groups of suicide victims. A database containing demographic information on declared suicides in Fulton County, GA from 01/01/1988 through 12/31/2003 was combined with annual per capita income by zip code in Atlanta, GA. Analyses were performed to evaluate differential associations of socioeconomic status among age- and race-defined groups of suicide victims. Compared to the respective ethnic populations of Fulton County, white suicide victims lived in areas with lower per capita income (\$51,232 v. \$35,893); African American suicide victims did not (\$17,384 v. \$18,179). Elderly suicide victims (≥ 65 years) were more likely to live in the lowest per capita income areas compared to other age groups (OR 1.80, 95% C.I. 1.14, 2.84). Cox proportional hazards models showed increasing income increased the instantaneous risk of suicide among adolescents (HR 2.76; 95% C.I. 2.15, 3.53), particularly African American adolescents (HR 4.22; 95% C.I. 2.19, 8.11), and decreased risk among the elderly (HR 0.58; 95% C.I. 0.50, 0.68). Socioeconomic status has differential associations among age- and race-defined groups of suicide victims.

Keywords

suicide; socioeconomic status; ethnicity; age; adolescent; elderly

1. Introduction

Suicide is the eleventh leading cause of death in the United States with 32,439 suicides occurring in 2004. Certain age groups, such as adolescents and the elderly appear to be at particular risk. In 2004 suicide was the third leading cause of death among teenagers aged

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15-19 (8.2 deaths/100,000 population), behind accidents and homicides, and the 18th leading cause of death among those aged 65 years and older with 5,198 suicides (15.3 deaths/100,000 population) occurring in this group (Centers for Disease Control and Prevention, 2007).

Suicide risk in the general population has been associated with several factors including psychiatric disorders, genetics, substance abuse, male gender, single marital status, physical illness, unemployment, social support, and lower social class (Heikkinen et al., 1994; Heikkinen et al., 1995; Johansson et al., 1997; Johansson and Sundquist, 1997; Baxter and Appleby, 1999; Garlow et al., 2003; Purselle, 2004). However, little is known about the relative importance, specificity, magnitude, and differences of these factors at various points of an individual's life or among specific ethnic groups (Heikkinen et al., 1995). For example, the high rate of suicide in the elderly may be affected by a set of unique stressors that this group frequently experiences, including retirement, social isolation, loss of a spouse or loved one, and increasing disability (Juurlink et al., 2004).

The role of socioeconomic status (SES) in suicide risk is an open question. Reports from Europe have shown suicide is associated with socioeconomic disadvantage and that suicide rates increase during times of high unemployment and that the hike in rate is mainly due to increases in suicide among young males (Kelleher and Daly, 1990; Qin et al., 2003; Lorant et al., 2005). Periods of economic stress have also been reported to increase the rate of suicide among the elderly, while increasing income may reduce the rate (Araki and Murata, 1986, 1987; Hasselback et al., 1991; Rich et al., 1991; Heikkinen et al., 1994; Eurelings-Bontekoe et al., 1995). Additionally, low SES is associated with poor response to antidepressant treatment and greater likelihood of reporting suicidal ideation among the elderly (Cohen et al., 2006). Conversely, higher SES could increase suicide risk among adolescents as parental time is directed toward economic activities rather than childcare (Mathur and Freeman, 2002). Socioeconomic status may also differentially affect ethnic groups, with suicide rates among African Americans being less sensitive to changes in income than that of whites (Steenland et al., 2003). Some have shown suicide, suicide ideation, and suicide attempts among African Americans are associated with lower education and greater income and occupational inequality (Burr et al., 1999; Willis et al., 2003; Joe et al., 2006), while others have shown greater income inequality is protective among African Americans (Lester, 1990, 1996).

Obviously, further clarification of how SES impacts suicide risk among age- and race-defined groups will enhance our understanding of this important public health problem (D'Orio and Garlow, 2004). The objective of this study was to test associations of living in areas of lower and higher SES with specific age- and race-defined groups of suicide victims in an urban setting.

2. Methods

2.1. Setting

The setting for this study was Fulton County, Georgia, which has a population of 915,000, contains the majority of the city of Atlanta, and is ethnically and economically diverse. The racial composition of the county is equally proportionate with 43% African American, 45% white, and 11% Hispanic or Asian. Per capita income levels vary widely by zip code among residents of Fulton County with African Americans tending to be less well off than whites (U.S. Census Bureau, 2007).

2.2. Dataset

2.2.1. Suicides—A computerized database containing demographic information, toxicology data, and method of suicide on all declared suicides in Fulton County, Georgia from January

1, 1988 through December 31, 2003 (n=1,377) was extracted from death investigation and autopsy records of the Fulton County Medical Examiner's Office (Garlow, 2002; Garlow et al., 2003; Garlow et al., 2005). This office is a professionally staffed facility that employs forensic pathologists as opposed to an elected coroner. Death investigations and autopsies adhere to a standard procedure that includes autopsying all suspected suicides unless death occurred after hospitalization and the cause and circumstances of death had been well documented. The demographic information included the victim's age, gender, race (as assigned by the medical examiner at the time of autopsy), and address of residence (if known). Toxicology data included alcohol and cocaine detection and was only considered informative if the victim died or the tested sample was collected within 48 hours of the self-inflicted injury.

2.2.2. Per capita income—A second computerized database was created that contained per capita income by zip code by year for the Atlanta, GA metropolitan area. Data was obtained from The Sourcebook of ZIP Code Demographics, which is published annually and contains detailed demographic and economic data at the zip code level for the year prior to publication (CACI Inc., 1989-2002; Esri, 2003-2004). The data was not published for years 1990, 1991, and 2000 because these years coincided with census data collection and analysis (personal communication with publisher). The per capita income for each year was converted to 2004 real dollars using the consumer price index (Federal Reserve Bank of Minneapolis, 2004). Per capita income for 1991 and 2000 was estimated by averaging the subsequent 3 years (i.e., 1991 was the mean of 1992, 1993, and 1994), and 1990 per capita income was set to the 1991 estimate.

2.2.3. Analyzed dataset—This data was merged with the suicide dataset to indicate the per capita income of each victim's zip code of residence at the time of the suicide for the year in which the suicide occurred (referred to as the victim's "per capita income" throughout this report). Zip code was chosen to define geographic regions because of the availability of annually published per capita income data at this level. Per capita income was chosen as the surrogate measure of SES rather than median household income in order to control for changes in household size and income among racial and age groups that may have occurred in Fulton County during the 16-year period of data collection.

The dataset used for statistical analysis included suicide victims for which complete records of age, gender, race, zip code of residence, method of suicide, and alcohol and cocaine toxicology were available. Because of the small number of suicide victims who were designated as a race other than African American or white this group was excluded from the analysis (n=41 or 3% of all suicides).

2.3. Age and income categorization

Age groups used in analyses were defined as adolescent (≤ 19 years), adult (20-64 years), and elderly (≥ 65 years) in order to follow standard conventions used distinguish between adolescents, adults and the elderly. Per capita income was dichotomized to create additional variables indicating whether an individual lived in a zip code that was below the 20th percentile of income of the sample (\$14,478) or above the 80th percentile of income (\$45,021).

2.4. Data analysis

Analyses were performed using SAS v9.1 for Windows (The SAS Institute, Cary, NC) (SAS Institute., 2004). Level of significance was set at $\alpha=0.05$ for all analyses. The chi-square statistic, t-test, and Mantel-Haenszel odds ratio (OR_{m-h}) were calculated to compare groups and test associations as appropriate. Logistic regression models were developed to evaluate the contribution of gender, race, living in areas below the 20th percentile of per capita income v. other areas, living in areas above the 80th percentile of per capita income v. other areas, and

use of cocaine or alcohol to committing suicide within the defined age ranges. The significance of the effect for each variable was assessed using the Wald test, and lack-of-fit for the model was assessed using the likelihood ratio test. The presence of collinearity within the model was tested using Eigen values, condition indexes, and variance decomposition proportions.

Cox proportional hazards (PH) models were developed to determine hazard ratios (HR) of gender, race, and use of cocaine or alcohol with the age of suicide completion as the outcome. Independent hazard ratios of per capita income for adolescent v. older suicide victims and for elderly v. younger victims were assessed by including log(per capita income) in the model as a Heaviside step function (Weinstein, 2005). The log transformation of per capita income allowed the model to return a useful parameter estimate rather than one close to zero. The proportional hazards assumption for each model was tested for validity using plots of log(-log (survival distribution function)) versus log(age).

All of the data gathering and analytic procedures were reviewed and approved by the Emory University Institutional Review Board. As this study involved public records and materials gathered in the course of routine public investigations, specific individual informed consent was not necessary.

3. Results

3.1. Racial distribution

The FCMEQ identified 1,377 suicides between January 1, 1988 and December 31, 2003. Of those, 1,110 (80.6%) records were fully informative regarding the victim's age, gender, race, zip code of residence, method of suicide, and alcohol and cocaine toxicology. Of these informative records, 69% were white (n=767) and 31% were African American (n=343). There were no differences in the gender and racial distributions or in mean ages of the fully informative records v. incomplete records. The remainder of the analyses includes only the informative records.

3.2. Per capita income

Table 1 summarizes the mean per capita income of the suicide victims' zip code of residence by race and age group. Overall, suicide victims tended to live in lower income areas compared to the general population of Fulton County (per capita income \$30,419 v. \$34,019) (U.S. Census Bureau, 2007). This effect was predominately due to white suicide victims living in lower income areas of Fulton County than the white population in general (\$35,893 v. \$51,232). This was not the case for African American suicide victims when compared to the overall African American population of Fulton County (\$18,179 v. \$17,384).

3.3. Age, race, and per capita income

African American suicide victims were younger than white victims (36.17 ± 16.74 v. 46.64 ± 18.99 , $t=8.82$, $p<0.0001$). The mean age of suicide victims living in areas below the 20th percentile and above the 80th percentile of per capita income were compared to those in areas above the 20th and below the 80th percentiles respectively. These results are summarized in Table 2. In general, those living in the lowest per capita income areas were younger while those living in the highest per capita income areas were older. However, this difference is accounted for by racial effects as African American suicide victims lived in lower income areas than the white victims. Stratifying the analysis by race confirmed this.

3.4. Association of per capita income of area with other variables

Living in the lowest or highest per capita income areas was not associated with alcohol or cocaine detection at autopsy. Living in the highest per capita income areas was associated with

suicide by non-violent or chemical means (overdose, carbon monoxide, poisoning) compared to violent or physical means (gun, cut/stab, hanging, blunt force trauma, immolation) (OR 1.65; 95% C.I. 1.12, 2.42). No association was found between suicide method and living in the lowest income areas.

3.5. Adolescent Suicide Victims

African Americans accounted for 58% and whites 37% of adolescent suicide victims compared to adult victims where 28% were African American and 69% were white ($\chi^2=33.78$; $df=2$; $p<0.0001$). When stratified by race, there was no difference in the mean per capita income between adolescents and adults for either white or African American victims. Logistic regression modeling revealed two significant factors that differentiated adolescent suicide victims from adult victims: race African American v. white (OR 3.04; 95% C.I. 1.73, 5.36) and alcohol absent v. present (OR 3.13, 95% C.I. 1.52, 6.45). Other variables, including living in the lowest or highest per capita income areas, did not distinguish adolescent from adult suicide victims.

Cox PH modeling using the Heaviside step function (summarized in Table 3) revealed that increasing log(per capita income) increased the instantaneous risk of suicide for adolescents (HR 2.76; 95% C.I. 2.15, 3.53) but not for adults (HR 1.05; 95% C.I. 0.93, 1.19). Stratifying the model by race found that the hazard ratio for log(per capita income) was greater among African American adolescents (HR 4.22; 95% C.I. 2.19, 8.11) than white adolescents (HR 2.67; 95% C.I. 1.76, 4.04).

3.6. Suicide Victims Aged 20-64 Years

African Americans accounted for 31% and whites 66% of victims aged 20-64 years, while victims outside this age range were 29% African American and 68% white ($\chi^2=0.35$; $df=2$; $p=0.5503$). Logistic regression modeling revealed three distinguishing factors for suicide victims aged 20-64 years compared to those outside this range: cocaine present v. absent (OR 4.02; 95% C.I. 2.11, 7.68), alcohol present v. absent (OR 3.26; 95% C.I. 2.27, 4.70), and living in areas above the 20% percentile of zip code per capita income v. living in the lowest income areas (OR 1.71; 95% C.I. 1.61, 2.51).

3.7. Elderly Suicide Victims

In the elder age group, African Americans accounted for 18% and whites 81% compared to 33% African American and 64% white in those <65 years of age ($\chi^2=20.60$; $df=2$; $p<0.0001$). The mean per capita income did not vary between elderly and younger suicide victims. Logistic regression determined four factors differentiated elder suicide victims from younger: race white v. African American (OR 2.81, 95% C.I. 1.78, 4.45), cocaine absent v. present (OR 27.65; 95% C.I. 3.82, 200.05), alcohol absent v. present (OR 2.98, 95% C.I. 1.98, 4.49), and living in the lowest income areas v. not (OR 1.80, 95% C.I. 1.14, 2.84).

The Cox PH model including the Heaviside step function (see Table 3) to estimate differential effects of log(per capita income) in the elderly and those <65 years found that increasing log(per capita income) decreased the instantaneous risk in the elderly (HR 0.58; 95% C.I. 0.50, 0.68) but not in the younger group (HR 1.08; 95% C.I. 0.95, 1.24). After stratifying the model by race, no racial differences were found in the hazard ratios of the elderly group (HR_{African American} 0.55; 95% C.I. 0.36, 0.85; HR_{white} 0.57; 95% C.I. 0.48, 0.68).

4. Discussion

As previously reported, race is an important factor influencing the age of suicide with African Americans committing suicide on average 10 years younger than whites (Garlow et al.,

2005). After controlling for this, SES also emerges as a significant factor with a variable association among racial and age groups. On average, suicide victims lived in areas with lower per capita income than the general population of Fulton County. This difference appears to be almost exclusively a phenomenon among white suicide victims, who lived in areas where the per capita income was only 70% of that for the general white population in Fulton County. In contrast African American suicide victims' per capita income was slightly higher, albeit probably not meaningfully so, than that of the African American population in Fulton County. This supports, at least for white victims, previous observations that low SES is a risk factor for suicide (Johansson et al., 1997). Given that many suicide studies include too few African American victims to detect meaningful racial differences among risk factors, it may be the case that low SES does not confer a generalizable risk across ethnic groups. Alternatively, this could be explained by downward drift where individuals with mental illness tend to migrate towards lower SES areas. Since African Americans generally live in lower income areas than whites in Fulton County, the downward drift may not be as apparent among this group compared to the white population.

This study also found that elderly suicide victims were more likely to live in the lowest income areas compared to younger victims, although the instantaneous suicide risk was mitigated by increasing income. One possible explanation for the association between elderly suicide and living in the lowest income areas is that whites could be more vulnerable to the effects of low SES as a suicide risk factor than African Americans. The adolescent group was predominately African American, while the elderly group was predominately white. If whites were more vulnerable to the effects of low SES, one would expect a stronger association between living in the lowest income areas and committing suicide during an age range where victims were predominately white. There is evidence from other investigators that income and education influence suicide risk differently in African Americans and whites. Steenland et al. (2003) found that as income increases, there is a pronounced decrease in the rate of suicide among whites, but the decrease in suicide rate among African Americans was much less pronounced. Education and wealth have also been positively associated with suicide among African Americans but not among whites (Lester, 1991; Burr et al., 1999).

An alternative explanation for the association between living in a lower income area and committing suicide at an advanced age could be that the risk conferred by low SES affects older individuals to a greater degree. This interpretation agrees with a report by Hasselback et al. (1991) who found lower income was associated with higher suicide rates in the elderly. Additionally, Cohen et al. (2006) recently reported that elderly depressed individuals were less likely to respond to antidepressant therapy and more likely to express suicidal ideation if they lived in low-income areas. However, it contradicts reports from others. Agbayewa et al. (1998) found higher income increased the suicide risk among elderly females. Miller et al. (2005) showed that young suicide victims (<35 years) were more likely to live in neighborhoods with greater income inequality and low per capita income compared to accident victims. No such associations were found among the older suicide victims, although the age cutoff in that study was 64 years, potentially missing associations among the elderly.

Using the Heaviside function with the Cox PH models allowed for assessment of differential associations of per capita income between age groups. These models revealed that adolescents had an increased instantaneous risk of suicide as per capita income increased while adults did not. Furthermore, African American adolescents appeared to be more affected by increasing income than whites. An opposite effect was found among the elderly, where an increase in the per capita income decreased the instantaneous risk of suicide. Again, these findings further support racial and age differences in the association of SES on suicide risk. Others have reported results that support these findings. Lester (1990) found that higher income was associated with a higher suicide rate among African Americans. Mathur and Freeman (2002)

developed an economic model that predicted higher income would reduce rates of suicide among adolescents but that this positive effect would be offset and potentially reversed by the loss of parental attention as both parents worked to increase the family's income (the substitution effect).

There are several limitations of this study. First, the study relied solely on records obtained from the Fulton County Medical Examiner's Office. While the investigations and manner of death declarations are consistent and extremely reliable, the records have a paucity of information on several risk factors known to be important in suicide, including psychiatric diagnoses, medical diagnoses, availability of psychiatric treatment, social support, marital status, education level, history of early life trauma, etc. Also, the data is from only one major metropolitan area and may not generalize to other areas of the country.

Another limitation is that per capita income for the victim's zip code of residence was used as a surrogate for SES. This measure may not necessarily reflect the income of the individual victim, and it ignores two other components of SES: education and occupation (Green, 1970; Mueller and Parcel, 1981). Although education may be the most influential component with regards to health-related outcomes, it is generally correlated with income (Winkleby et al., 1992). Since educational status was not available for the suicide victims, a measure of income was used. Additionally, this study used zip codes to define geographic regions. Although census tracts are often used when looking at effects of SES (Perez-Smith et al., 2002; Cohen et al., 2006), zip codes are also commonly used (Krieger et al., 2002). The decision to use zip codes was made because of the availability of annually published per capita income data at this level. The same data is available at the census tract level only for years when the census is completed.

Finally, the models used to assess suicide risk associations were based solely on demographic factors rather than including other known risk and protective factors. As such, they most likely failed to explain a large portion of the difference in suicide risk between age- and race-defined groups.

The main strength of this study lies in the racial and socioeconomic diversity of Fulton County. Suicides in Fulton County include larger proportions of African American victims compared to national statistics and other published studies, presenting a unique opportunity to investigate racial differences in suicide risk factors such as SES. Another important strength is that the available suicide data was collected in a systematic manner by professional forensic pathologists and investigators, creating a highly complete and reliable database.

In conclusion, the data presented here demonstrate that socioeconomic status is an important factor in suicide and that the effect might vary between ethnic and age groups. White suicide victims lived in lower income areas than the general white population, while this was not observed among African American victims. Low SES was associated with suicide among the elderly, while increasing income put adolescents at greater risk with African American adolescents being more affected than whites. Obviously, the next logical step would be to develop a more complete picture of how suicide risk factors differentially affect ethnic and age-defined groups using psychological autopsy methods to gather data on psychiatric and medical diagnoses, access to treatment, individual income and other socioeconomic data, family history of suicide, history of early life abuse, as well as other factors (Brent, 1989; Beskow et al., 1990; Conwell et al., 1996).

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Table 1
Mean per capita income of suicides by race and age group compared to per capita income for all of Fulton County

	Per Capita Income in 2004 Real Dollars (S.D.)				
	All Age Groups		Suicides by Age Group		
	Suicides	Fulton County *	Suicides ≤19 years	Suicides 20-64 years	Suicides ≥65 years
All Suicides † (n=1,110)	\$30,419 (\$16,630)	\$34,019	\$23,502 (\$15,080)	\$30,543 (\$16,171)	\$32,448 (\$18,520)
African American (n=343)	\$18,179 (\$8,761)	\$17,384	\$16,255 (\$6,801)	\$18,700 (\$9,093)	\$16,542 (\$7,949)
White (n=767)	\$35,893 (\$16,403)	\$51,232	\$35,312 (\$17,380)	\$35,947 (\$15,812)	\$35,791 (\$18,380)

S.D. = standard deviation

† All suicides for whom complete records were available

* 1999 per capita income for all of Fulton County derived from 2000 U.S. Census converted to 2004 real dollars (U.S. Census Bureau, 2007)

Table 2
Mean age (in years) of suicide in the poorest and richest areas by race

Race	Living in the poorest areas [*]			Living in the richest areas [*]		
	yes	no	t value	yes	no	t value
All Races	40.69	44.08	2.40	47.34	42.30	3.67
African American	36.73	35.67	0.58	31.63	36.24	0.77
White	48.61	46.42	0.95	47.88	46.10	1.20

^{*} Poorest areas: <20th percentile of per capita income; Richest areas: >80th percentile of per capita income

Table 3
Cox proportional hazards models including a Heaviside function for log(per capita income)

Variable	Adolescent v. Older			Elderly v. Younger		
	H.R.	95% C.I.	p-value	H.R.	95% C.I.	p-value
White v. African American	0.58	0.49, 0.69	<0.0001	0.64	0.54, 0.75	<0.0001
Male v. Female	0.95	0.82, 1.11	0.5304	1.09	0.93, 1.27	0.2978
Cocaine present v. absent	1.87	1.52, 2.29	<0.0001	1.49	1.22, 1.82	<0.0001
Alcohol present v. absent	1.58	1.38, 1.80	<0.0001	1.14	1.00, 1.30	0.0582
log(per capita income) for younger group	2.76	2.15, 3.53	<0.0001	1.08	0.95, 1.24	0.2307
log(per capita income) for older group	1.05	0.93, 1.19	0.4372	0.58	0.50, 0.68	<0.0001

U.S. Census Bureau, 2007. From www.census.gov.