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Rachel Reeves Robb Date

Geospatial and Demographic Characteristics of Sudden Cardiac Death in Fulton County, GA, 2006-2008

By

Rachel Reeves Robb
Master of Public Health

Epidemiology

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Michael Kramer, PhD
Faculty Thesis Advisor

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
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Abstract

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Objective: Sudden cardiac death is a leading cause of death and often the first sign of coronary heart disease. It is critical to identify characteristics of this disease in order to design effective interventions. The aim of this study was to examine whether socioeconomic status is associated with an increased risk of sudden cardiac death.
Methods: Death certificate data was used to identify all out-of-hospital cardiac deaths that occurred in Fulton County, GA between 2006-2008. Geospatial characteristics were evaluated in ArcGIS. A Poisson regression analysis was conducted to examine the relationship between poverty and the risk of cardiac death, while controlling for age, race and gender.
Results: Poverty increases the risk of sudden cardiac death, however as median age increases, the effect of poverty decreases. The average median age by census tract was 34.2 years and at this age, poverty increased the risk of death by 13% (RR 1.13; CI 1.05, 1.21). When the median age increases by 1 standard deviation to 40.3 years, poverty increases the risk of death by 8% (RR 1.08; CI .99, 1.19).
Conclusion: The results highlight the importance of identifying areas with a high density of cardiac arrest and using this information to better understand the population characteristics of the disease as well as target interventions.

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Introduction

Sudden cardiac death is a leading cause of death in the United States and is the first manifestation of coronary heart disease in 40-50% of cases (1). It is preceded by cardiac arrest which is defined as a sudden, unexpected loss of heart function. The process begins with a ventricular tachycardia that progresses to ventricular fibrillation and results in circulatory collapse (2, 3). Without prompt intervention, cardiac arrest will lead to cardiac death. The widely-accepted definition of sudden cardiac death (SCD) is a sudden, unexpected death that, when witnessed, occurs within one hour from the start of symptoms and, when unwitnessed, within 24 hours of being seen alive and well (4).

The epidemiologic analysis of SCD is challenging due to the unpredictable and dynamic nature of the event, as well as inconsistency involving the definition of SCD used by investigators (5, 6). It was first explored on a large scale at the population level in the Framingham Heart Study in the 1940's and 1950's (4, 7). Subsequent studies have varied in their definition of SCD as well as their methods.

Disparities exist in the incidence of sudden cardiac death. SCD is more frequent among African-Americans and people with a lower socioeconomic status. There is a need to better define and describe the characteristics of SCD in order to better target prevention and interventions, such as cardiopulmonary resuscitation (CPR) training and placement of automated external defibrillators (AEDs).

Purpose Statement/Hypothesis

To address disparities in SCD and better target prevention and interventions among the populations most affected, it is important to better understand the characteristics of this disease. The following questions will be addressed in this research:

Question 1: Do high density areas of SCD rates exist in Fulton County?

Null Hypothesis 1: SCD rates are uniform throughout Fulton County.

Question 2: Is the risk of SCD in Fulton County higher in census tracts with a greater percentage of the population below the poverty level?

Null Hypothesis 2: The risk of SCD in Fulton County is not influenced by the percentage of the census tract population below the poverty level.

Question 3: When compared with the Cardiac Arrest Registry to Enhance Survival (CARES), does death certificate data provide a useful tool for describing sudden cardiac death?

Null Hypothesis 3: There is no difference between the two datasets.

Literature Review

Studies that have estimated the annual incidence of SCD in the United States have ranged from 184,000-450,000 per year (2, 8-11). SCD accounts for 12-18% of total mortality and 50% of cardiac mortality (12, 13). The extreme range of the estimates of annual incidence of disease is a result of varying techniques in data collection, the limited accuracy of death certificate data, and the absence of prospective evaluations of SCD (8, 11).

Studies of cardiac arrest have reported the average age of individuals with SCD to be 62-66 years (12, 14). A review of death certificate data by Zheng et al. (9) found the mean age of sudden cardiac death to be 70 years of age in men and 82.4 years of age in women. SCD is more prevalent among African Americans than white and Hispanic Americans (9, 13). Middle-aged men have a fourfold greater risk of SCD compared with women of the same age, but this difference decreases with age(4). Women have been shown to represent about 40% of cases (11, 14) though some estimates have been as high as 52% (9). Zheng et al found the male to female ratio to be 2.9 at 35 to 44 years; 3.4 at 45 to 54 years, 2.8 at 55 to 64 years, 2.1 at 65 to 74 years, 1.5 at 75-84 years and 1 at ≥ 85. (9) Since SCD is an endpoint of cardiovascular disease, age and gender characteristics often mirror the incidence and mortality of coronary artery disease (6).

Individuals who survive a cardiac arrest are at the highest risk of experiencing SCD (15), however 40-50% of SCDs occur in people with no prior history of heart disease (1, 7, 12). Since SCD may be the first manifestation of cardiovascular disease, understanding the characteristics and risk factors of the disease is critical to prevention.

The incidence of sudden cardiac death has declined with improvements in prevention and treatment of cardiovascular disease. An analysis of data from the Framingham Heart Study observed a 49% decrease in the risk of sudden cardiac death over the last 50 years (16). However, the incidence of SCD as a proportion of overall cardiovascular deaths has increased, because in-hospital mortality has decreased faster than out-of-hospital mortality.

Geographic Characteristics of SCD

Recent studies have utilized GIS technology to link death certificate or registry data to geographic information, such as US census tract data and environmental characteristics of the neighborhood. Pathak et al. described the spatial characteristics of cardiac deaths in a large metropolitan area in Florida. They examined spatial clustering of event locations and found that individuals residing in census tracts with an income below the federal poverty level were more likely to have a non-transported cardiac death.

Lerner et al. utilized an out-of-hospital cardiac arrest registry in Rochester, New York to map the event location and perform a kernel density analysis. This kernel analysis identified areas with the highest density of out-of-hospital cardiac arrest. Census data was used to compare areas with high density clusters to the rest of the city. Cluster areas had a lower median household income and a larger percentage of the population living below the poverty level. Cluster areas also had a larger proportion of African Americans (17)

Sasson et al. analyzed the Cardiac Arrest Registry to Enhance Survival (CARES) registry and mapped cardiac arrest events to a census tract and link to census tract characteristics. They evaluated CARES events that occurred in Fulton County, GA over a three year period and found a frequency that varied between census tracts from 0.04 to 2.11 per 1000 persons. Tracts with higher rates of out-of-hospital cardiac arrest also had more African-American residents, lower median income and fewer high school graduates (18). In 2011, Sasson et al. used the same data and performed hierarchical non-linear regression to analyze individual and neighborhood associations with out-of-hospital arrest. Cardiac arrests in the highest quintile of median household income were more likely to receive bystander CPR (19).

Socioeconomic Status and SCD

Socioeconomic status (SES) influences the characteristics of sudden cardiac death. Low SES is associated with increased risk factors for cardiovascular disease and coronary heart disease as well as rates of cardiovascular disease mortality (20). The incidence of out-of-hospital cardiac arrest and sudden cardiac death are higher in areas with a lower socioeconomic status (6, 21). This effect is greater among people who are younger than 65 years of age (21). Areas with a lower socioeconomic status have lower bystander CPR and survival rates from cardiac arrest (18, 19). Neighborhood characteristics such as socioeconomic status may reflect behavioral and environmental risk factors for cardiovascular disease and sudden cardiac death (5).

Validation of Death Certificate Data

The Framingham Heart Study provided 50 years of observational data. It has been used to validate the use of death certificate data (1, 22). Physician panels compared death certificate data to Framingham data. Death certificates were found to overestimate sudden cardiac death. Other studies have made similar conclusions (11, 23, 24). Coady et al compared Arterosclerosis Risk in Communities Study (ARIC) data with death certificates and found death certificates overestimated coronary heart disease by 20% (25). Fox et al compared Framingham data to death certificate records and found that death certificates overestimated SCD by 47% (1). Iribarren et al. performed a retrospective six-year mortality study and found death certificates had a sensitivity of 87% and specificity of 66% for SCD. Every et al. found a sensitivity ranging from 78% to 85% and specificity 25% to 58% (24). Chugh et al found death certificate data to have sensitivity and specificity were 59% and 86%, respectively (11).

Despite the tendency of death certificate data to overestimate the incidence of SCD, it remains a useful tool for evaluating population trends in SCD with acceptable validity. Studies involving retrospective physician review have shown high validity in the use of death certificate data to evaluate SCD (23, 24, 26). Since time of death after onset of symptoms is not recorded on the death certificate, Gillum and Zheng have proposed an alternative definition of SCD for death certificate data. In their research, they defined SCD as any cardiac death occurring out of the hospital or taking place in the emergency department, or patients who were dead on arrival in the emergency department (9, 13)

Zheng et al analyzed US death certificate data from 1989 to 1998. They found 719,456 cardiac disease deaths among residents aged ≥35 years. 456,076 (63.3%) were considered sudden cardiac death by their alternative definition (9). Overall age-adjusted SCD rates decreased by 8.3% (11.7% in men and 5.8% in women) between 1989-1998.

In summary, defining the characteristics of SCD has been challenging due to the differences in definition used by investigators, as well as the dynamic nature of the event. Existing research has utilized death certificate data, cardiac arrest registries, and prospective and retrospective studies to learn more about SCD. While understanding the limitations associated with death certificate data, this project will utilize a multilevel approach by analyzing SCD at the individual, ecological and geospatial levels.

Methods

Institutional Review Board

This proposal was approved by the Emory University Institutional Review Board on September 23, 2011 (IRB00052818). A complete HIPAA/Consent Waiver was granted.

Safeguards for assuring confidentiality of the data

Files were stored in a HIPAA compliant network drive at the Rollins School of Public Health. Access to this data was limited through a protected password. Upon completion of linkage, unique geographic identifiers were stripped from the dataset, and kept in a separate location. The location of the event has been protected by utilizing aggregation to mask the actual location and minimize the risk of disclosure.

Death certificate data

Death certificate records of deaths that occurred among residents of Fulton County, GA between 1/1/2006-12/31/2008 were obtained from the Georgia Department of Public Health. The "Cause of Death Category: Cause Level 3" was used to identify all deaths that were coded as "Diseases of the Heart". Deaths occurring in-hospital were excluded from the analysis. Nursing homes and chronic care facilities were included as well as individuals who died in the emergency department. This definition is consistent with the criteria used by Zheng et al. and is considered in the literature as a valid estimation of SCD in death certificate data (9, 11).

Latitude and longitude of the residence of the deceased was provided in the death certificate dataset. These coordinates were used to create an X-Y layer in ArcGIS using the geographic coordinate system: GCS North American 1983. This layer was then projected to the NAD 1983 State Plane (Georgia West FIPS 1002, feet). A kernel density analysis was performed on this map of points of sudden cardiac deaths (bandwidth: 3000 meters). Using raster algebra, this map was then divided by a raster map of population density of census tracts in Fulton County. This final map represented areas of high or low density of SCD when accounting for population density.

For the sub-analysis comparing death certificate data to the CARES registry, the process above was repeated, but limited to deaths that were coded as occurring at home.

CARES data

The Cardiac Arrest Registry to Enhance Survival (CARES) collects data regarding out-of-hospital cardiac arrest (OHCA) to improve the quality of care and outcomes of patients who experience a cardiac arrest. CARES is funded by the CDC through a cooperative agreement with the Association of American Medical Colleges (AAMC). CARES collects data in more than 40 communities in 23 states and collects information on any person who has an OHCA event and receives resuscitative efforts such as CPR or defibrillation.

Data was provided by the CARES registry after approval from the CARES data sharing committee. Prior to export, data was stripped of personal identifiers other than street address of the cardiac arrest incident. For this project, analysis was limited to events that occurred at a home or residence in Fulton County, GA. In order to make comparisons between this registry and death certificate data, it was important to limit the CARES cases to home events, since the death certificate provides the address of the residence of the deceased. Also, CARES collects information on events in a seven-county metropolitan area, so limiting the dataset to home events would decrease the chance of including someone who did not live in Fulton County and was not exposed to environmental and neighborhood factors.

These addresses were then geocoded to the NAD 1983 State Plane (Georgia West FIPS 1002, feet). Using a similar approach as described above, a kernel density analysis was performed (bandwidth: 8000 meters) and the output map was divided by the population density map.

Census data

Census tract shapefiles were joined with 2005-2009 American Community Survey demographic data related to characteristics of cardiac death such as age, race, gender and poverty status. Census tract information was projected to the NAD 1983 State Plane (Georgia West FIPS 1002, feet).

Death certificate point data was then joined to this shapefile using the Spatial Join tool in Arc GIS. In a separate procedure, CARES data was spatially joined to census tract data as well. This procedure provided a count of SCD events per census tract.

Maps of demographic characteristics of the census tract, such as poverty status, median age, and percentage of the population that is African American, were generated to compare with the output raster map of the ratio of deaths to population density.

Data Analysis

Finally, the attribute tables for the three datasets described above were exported into SAS for analysis. A Poisson regression analysis was performed on the death certificate dataset. The outcome variable was the cardiac death rate per census tract. The exposure variable was the percentage of the population that is below the poverty level controlling for median age, gender and percentage of population that is African American.

Frequency counts were generated for the death certificate data, death certificate home events, and CARES home events.

Limitations

As described earlier, death certificate data may have missing or invalid data. The cause of death may be unverified, without a medical record or an autopsy. The person filling out a death certificate may be rushed or inadequately trained.

Death certificates do not capture the time of death or comment on whether the death was witnessed or not. Therefore, to approximate SCD, analysis was limited to events that occurred out-of-hospital, similar to the approach by Zheng and others (9, 11).

CARES data relies on the impression of the First Responder (e.g. police, fire, or ambulance) and is also subject to error. Similar problems exist with defining the cause of death without a medical record or autopsy. CARES excludes individuals who did not receive any resuscitative efforts. Therefore CARES excludes patients who had obvious signs of death at the time of EMS arrival, while death certificates include them.

Finally, populations are not uniformly distributed within census tracts, therefore census tract estimations may not represent all areas within the tract.

Results

There were 17,100 death certificate records in Fulton County from 2006-2008. A cardiac cause of death was identified for 3,803. Among these, 2,684 deaths did not occur in the hospital and were included for analysis.

The death certificate captures location of death. There were 695 cases (25.9%) that occurred in a residence, 360 (13.4%) deaths happened in a doctor's office, and 317 (11.8%) occurred in an emergency room. 833 deaths were coded as an unknown location type (Table 1).

The average age at the time of death was 73.7 years of age (SD 16.8). The median age was 77 years of age (Table 2). Most of the deaths occurred in the population which was 80 years of age or older (N=1222, 45.5%). Cardiac deaths among those aged 50-64 years represented 21.4% of all deaths, while the 65-79 year age category had 24.1% of the deaths (Table 3).

Men accounted for 51.6% of all out-of-hospital cardiac deaths (N=1385) (Table 4). Race was coded as African American in 1392 (51.9%) of out-of-hospital cardiac deaths and coded as White in 1385 (51.6%) (Table 5).

Men had the highest number of deaths in each age category, with the exception of the "Age 80 or more category" (Table 6). African-American's had a higher percentage of deaths in each age category, with the exception of the "Age 80 or more category". Whites had the highest percentage in this group (Table 7).

In the 35-49 age group, the male to female ratio was 1.8 to 1 among African-Americans, while the male to female ratio was 3.2 to 1 among whites. This trend continued in the age 50-64 category, which had a male to female ratio of 2.0 to 1 among African-Americans, but 4.7 to 1 in whites. The male to female ratio is the same among African-Americans and whites at the age 65-

79 group and reverses in the age 80 or more group with the female to male ratio of 2.5 to 1 in African-Americans and 1.5 to 1 in Whites.

Question 1: Do high density areas of SCD exist in Fulton County?

Null Hypothesis 1: SCD is uniform throughout Fulton County.

Figure 1shows dense areas of out-of-hospital cardiac death within Fulton County. A map of population density by census tract is shown in Figure 2. Using raster algebra, the areas of density are divided by population density and Figure 3 shows the result. Once population density is controlled for, the areas of density is more uniform throughout the county, however, there appears to be some increase of concentration in the middle portion of the county. This map can be compared with maps of poverty and African-American race (Figures 4 and 5).

Question 2: Is the risk of SCD in Fulton County higher in census tracts with a greater percentage of the population below the poverty level?

Null Hypothesis 2: The risk of SCD in Fulton County is not influenced by the percentage of the census tract population below the poverty level.

To identify the population-level effect of poverty on the risk of out-of-hospital death, a multivariate poisson regression analysis was performed controlling for age, race and gender. Poverty increases the risk of sudden cardiac death, however as median age increases, the effect of poverty decreases. The average median age of census tracts was 34.2 years and at this age, poverty increased the risk of death by 13% (RR 1.13; CI 1.05, 1.21). When the median age increased by 1 standard deviation to 40.3 years, poverty increased the risk of death by 8% (RR 1.08; CI .99, 1.19).

Question 3: When comparing home arrests in the death certificate dataset to home arrests in the Cardiac Arrest Registry to Enhance Survival (CARES), are there discrepancies?

Null Hypothesis 3: There is no difference between the two datasets.

In order to make comparisons between the CARES dataset and the death certificate data, the datasets were limited to home events. CARES had a smaller number of events than the death certificate data, but this is likely because CARES does not collect deaths in which a "do not resuscitate" or DNR is presented as well as deaths in which the individual has obvious signs of death upon EMS arrival.

The kernel density of death certificate home deaths is shown in Figure 6 and the CARES raster algebra output of kernel density controlling for population density is shown in Figure 7. The maps are similar and both show a zone of density in the center of the county, as well as pockets of density in the very north and very south of the county.

Table 8 shows a comparison of the two datasets by race, gender and age. The CARES data set includes "unknown" as an option for race and this represented 20.6% of cases. The datasets have similar distributions of gender (death certificate: 56.3% male and CARES: 54.1% male). The CARES dataset has a similar age distribution with the exception of the "80 or over" group. Death certificates report that 39.7% of their deaths were 80 years of age or older, while CARES has 18.5% of cases in this category. This is likely explained by the fact that the CARES dataset is limited to individuals who received resuscitative efforts, and individuals in this age group are more likely to be dead on arrival of EMS. Finally, the CARES data has a younger mean and median age than the death certificate data. The mean age for the death certificate data was 72.4 (SD 15.7) and the CARES data has a mean age of 63.2 (SD 18.5).

Due to the large number of “unknown” race in the CARES database, it was not possible to compare race and gender stratified by age category. However, in Table 9, gender is stratified by age category. The datasets are similar with the exception of the 65-79 and 80 and over group. The CARES dataset captures a greater percentage of females in each category.

Discussion

Death certificate data identified 2,684 out-of-hospital cardiac deaths, most of which occurred at home (25.9%) or an unknown location (31.0%). Most of the deaths occurred in individuals between 35-80 years of age or more, with a median age of 77 years.

Men had a higher percentage of overall deaths (51.6%), but this varied by age category and race. 51.9% of all decedents were African-American, while 47.3% were white. The male to female ratio was lower in African-Americans than in whites in the 35-49, 50-64 and 65-79 age groups.

High density areas did exist in Fulton County with a concentration of density in the center of the county. This is consistent with the US census tract data on the percentage of people in a census tract below the poverty level and of African-American race.

Poverty increases the risk of sudden cardiac death, however as median age increases, the effect of poverty decreases. The average median age by census tract was 34.2 years and at this age, poverty increased the risk of death by 13% (RR 1.13; CI 1.05, 1.21). When the median age increased by 1 standard deviation to 40.3 years, poverty increased the risk of death by 8% (RR 1.08; CI .99, 1.19).

This analysis of death certificate data is consistent with other studies that have found effect modification based on age. Reinier et al found sudden cardiac arrest to be higher among residents of neighborhoods in the lowest SES quartile, compared to neighborhoods in the highest SES quartile and found the effect to be greater among people under the age of 65 (21). Greer et al. found an effect modification by age group in the association of an environmental condition (racial segregation) with stroke (27). They found that racial segregation increased the risk of stroke in the age 35-65 category, but had a protective effect in the over 65 group. They suggested that the effect may be a result of an ethnic density effect in the older age group or a survival bias.

Reinier suggested that the difference may be due to a limited access to healthcare among people under 65 years of age.

Death certificate data has been shown to overestimate SCD and can be prone to misclassification error. The CARES registry provided an opportunity to compare two methods of capturing out-of-hospital cardiac death. In this study, death certificates had 22% more events than CARES data. This may reflect an overestimation based on classification error, but may also be due to the fact that CARES excludes individuals with a DNR or with obvious signs of death, such as rigor mortis and dependent lividity.

Maps of home deaths in both the CARES dataset and the death certificate dataset showed similar high density areas in center of the county as well as the extreme top and bottom portions of the county. Comparisons of gender and age categories were similar, though death certificates had a higher median age and represented more people 80 years of age or older. Again, this may reflect the differences related to data collection. Overall, the death certificate data provided a valid representation of SCD when compared with the CARES registry.

Census tracts with a higher percentage of poverty have an increased risk of SCD. This corresponds with previous research which identified disparities in this disease. Interventions, such as CPR training and AED placement, can be targeted to these high density areas. However, 25.9% of these events happened at a residence, where bystander CPR is dependent on family members and AEDs may not be present. Therefore, a life course framework which implements strategies to prevent heart disease may better serve this population.

With unlimited resources, a prospective study with autopsies on every death, medical record validation and physician adjudication would be the ideal way to measure SCD. Outside of this utopian approach, using a variety of sources and techniques remains the most realistic way to monitor SCD.

Conclusion

This study suggests that health disparities related to sudden cardiac death exist in Fulton County, GA. Because this disease is a leading cause of death and often the first sign of coronary heart disease, it is important to better understand the relationship between socioeconomic status and SCD. This analysis was strengthened by the use of a variety of techniques to analyze sudden cardiac death. Deaths were analyzed spatially, through GIS, as well as with multivariate analysis. Comparing two data collection methods also allowed for validation. By utilizing a combined approach, we can better understand and monitor sudden cardiac death.

Table 1. Event place type of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Event Place Type Fulton County Death Certificate data, 2006-2008		
	Frequency	**Percent**
Died en route	20	0.75
Doctors Office	360	13.41
Emergency Room	317	11.81
Nursing Home	8	0.30
Other	212	7.90
Other Long Term Care Facility (Psych/Rehab)	239	8.90
Residence	695	25.90
Unknown	833	31.04

Table 2. Age categories of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Age Fulton County death certificate data, 2006-2008			
Mean	73.67660	**SD**	16.76859
Median	77.00000		
Mode	86.00000		

Table 3. Age categories of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Age Categories Fulton County Death Certificate data, 2006-2008		
	Frequency	**Percent**
18 or under	7	0.26
19 – 34	39	1.45
35-49	194	7.23
50-64	575	21.42
65-79	647	24.11
80 or over	1222	45.53

Table 4. Gender distribution of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Gender Fulton County Death Certificate data, 2006-2008		
	Frequency	**Percent**
Female	1299	48.40
Male	1385	51.60

Table 5. Race distribution of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Race Fulton County Death Certificate data, 2006-2008	Frequency	Percent
American Indian or Alaska Native	1	0.04
Asian	19	0.71
Black or African-American	1392	51.86
Multiracial	2	0.07
White	1270	47.32

Table 6. Distribution of race by age category of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

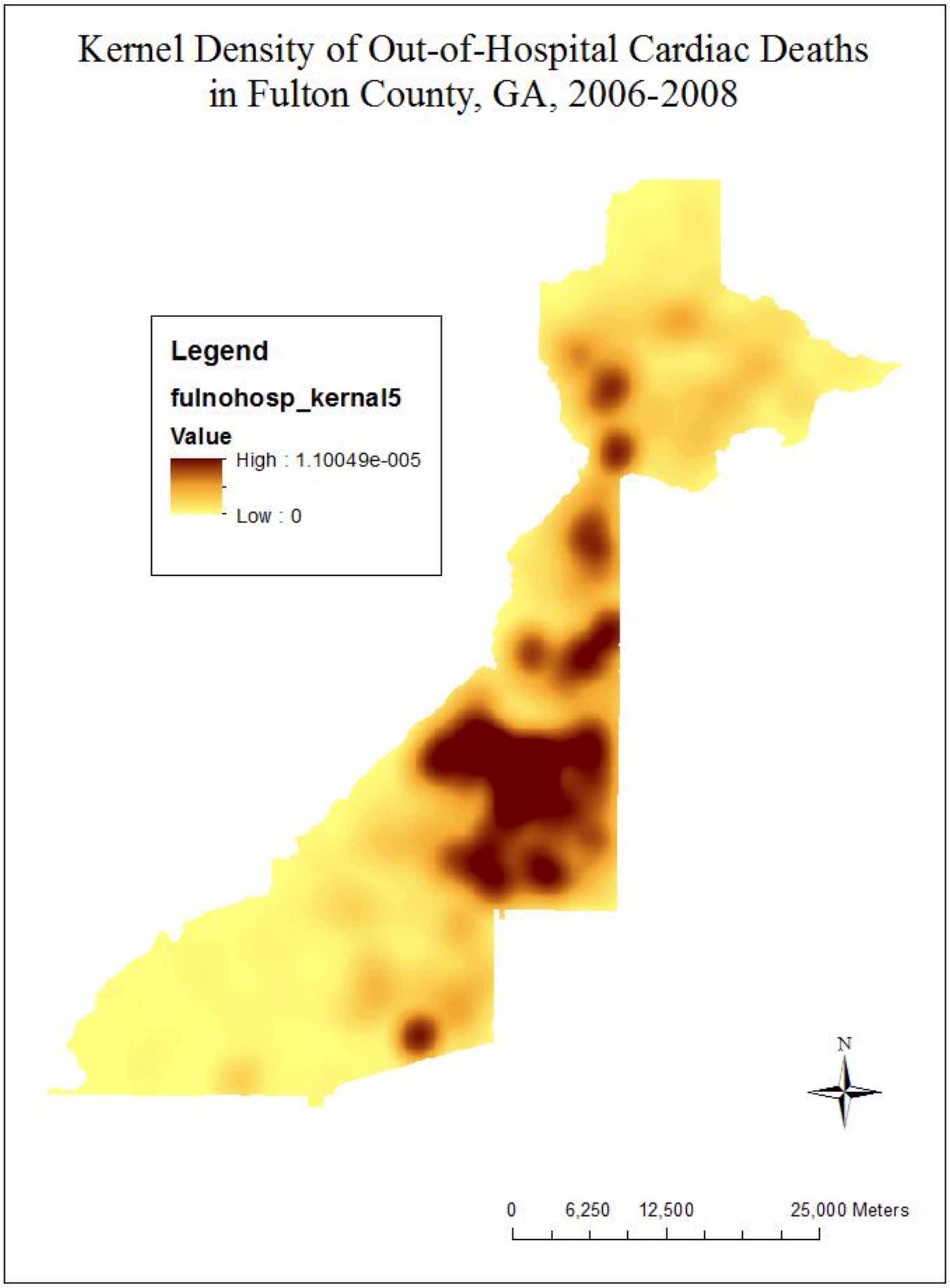
Death Certificate Data, 2006-2008. All out-of-hospital cardiac deaths.	
Age: 18 or under	Total
African-American	4 (57.1)
White	3 (42.9)
Total (%)	7 (100.0)
Age: 19-34	Total
African-American	27 (69.2)
White	12 (30.8)
Total (%)	39 (100.0)
Age: 35-49	Total
African-American	151 (77.8)
White	42 (21.7)
Other	1 (0.5)
Total (%)	194 (100.0)
Age: 50-64	Total
African-American	423 (73.6)
White	149 (25.9)
Other	3 (0.5)
Total (%)	575 (100.0)
Age: 65-79	Total
African-American	396 (61.2)
White	242 (37.4)
Other	9 (1.4)
Total (%)	647 (100.0)
Age: 80 or more	Total
African-American	391 (32.0)
White	822 (67.3)
Other	9 (0.7)
Total (%)	1222 (100.0)

Table 7. Distribution of race and gender by age category of out-of-hospital cardiac deaths from Fulton County death certificate records, 2006-2008.

Death Certificate Data, 2006-2008. All out-of-hospital cardiac events.

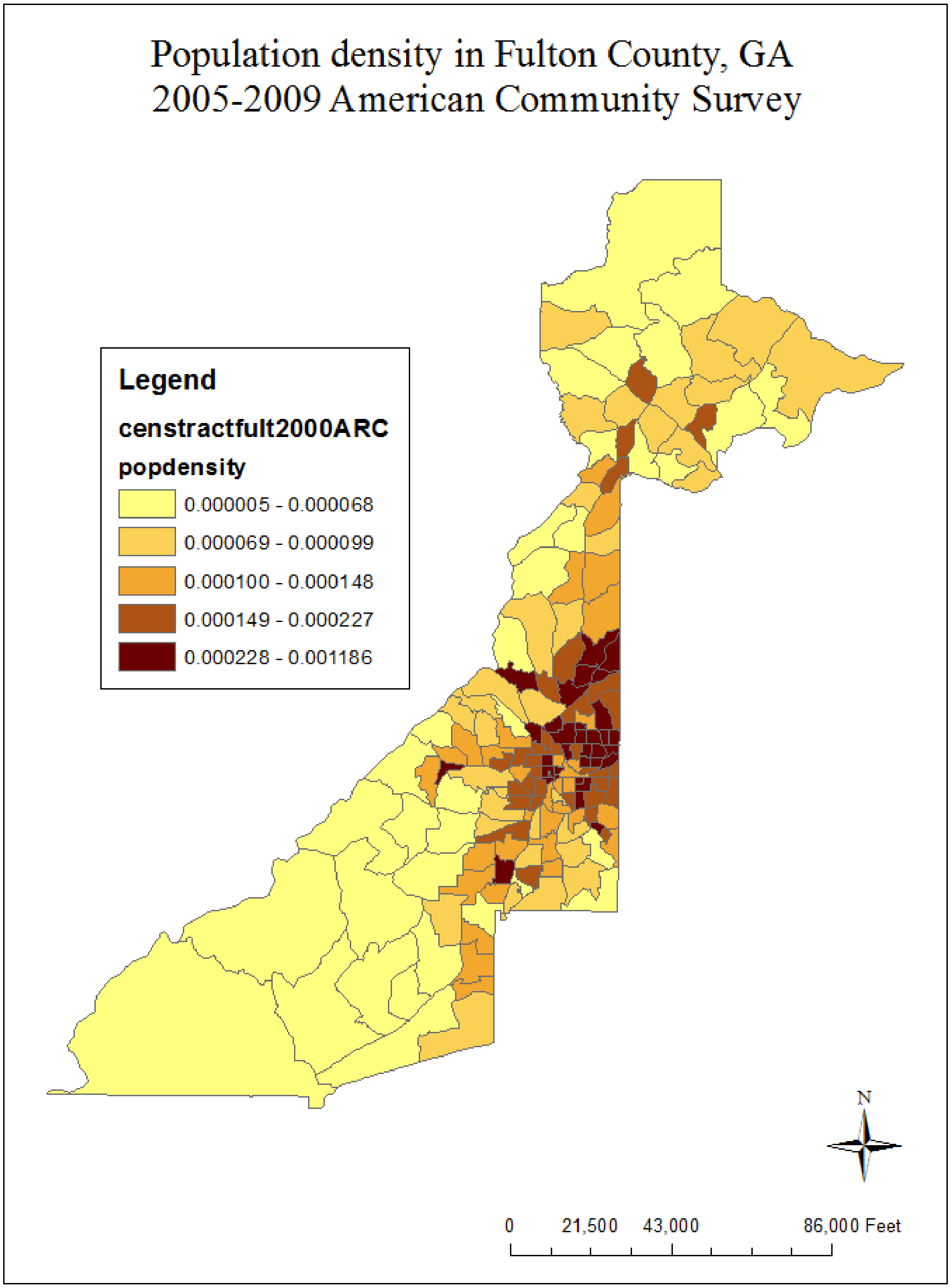
Age: 18 or under	Female	Male	Total
African-American	2 (50)	2 (50)	4
White	3 (100)	0 (0)	3
Total (%)	5 (71.4)	2 (28.6)	7
Age: 19-34	Female	Male	Total
African-American	14 (51.9)	13 (48.2)	27
White	4 (33.3)	8 (66.7)	12
Total (%)	18 (46.2)	21 (53.9)	39
Age: 35-49	Female	Male	Total
African-American	54 (35.8)	97 (64.2)	151
White	10 (23.8)	32 (76.2)	42
Other	0 (0)	1 (100)	1
Total (%)	64 (33.0)	130 (67.0)	194
Age: 50-64	Female	Male	Total
African-American	143 (33.8)	280 (66.2)	423
White	26 (17.5)	123 (82.6)	149
Other	0 (0)	3 (100)	3
Total (%)	169 (29.4)	406 (70.6)	575
Age: 65-79	Female	Male	Total
African-American	166 (41.9)	230 (58.1)	396
White	99 (40.9)	143 (59.1)	242
Other	4 (44.4)	5 (55.6)	9
Total (%)	269 (41.6)	378 (58.4)	647
Age: 80 or more	Female	Male	Total
African-American	278 (71.1)	113 (28.9)	391
White	492 (59.9)	330 (40.2)	822
Other	4 (44.4)	5 (55.6)	9
Total (%)	774 (63.3)	448 (36.7)	1222

Figure 1. Kernel density of deaths of cardiac etiology occurring at home in Fulton County, GA between 2006-2008 from death certificate records.



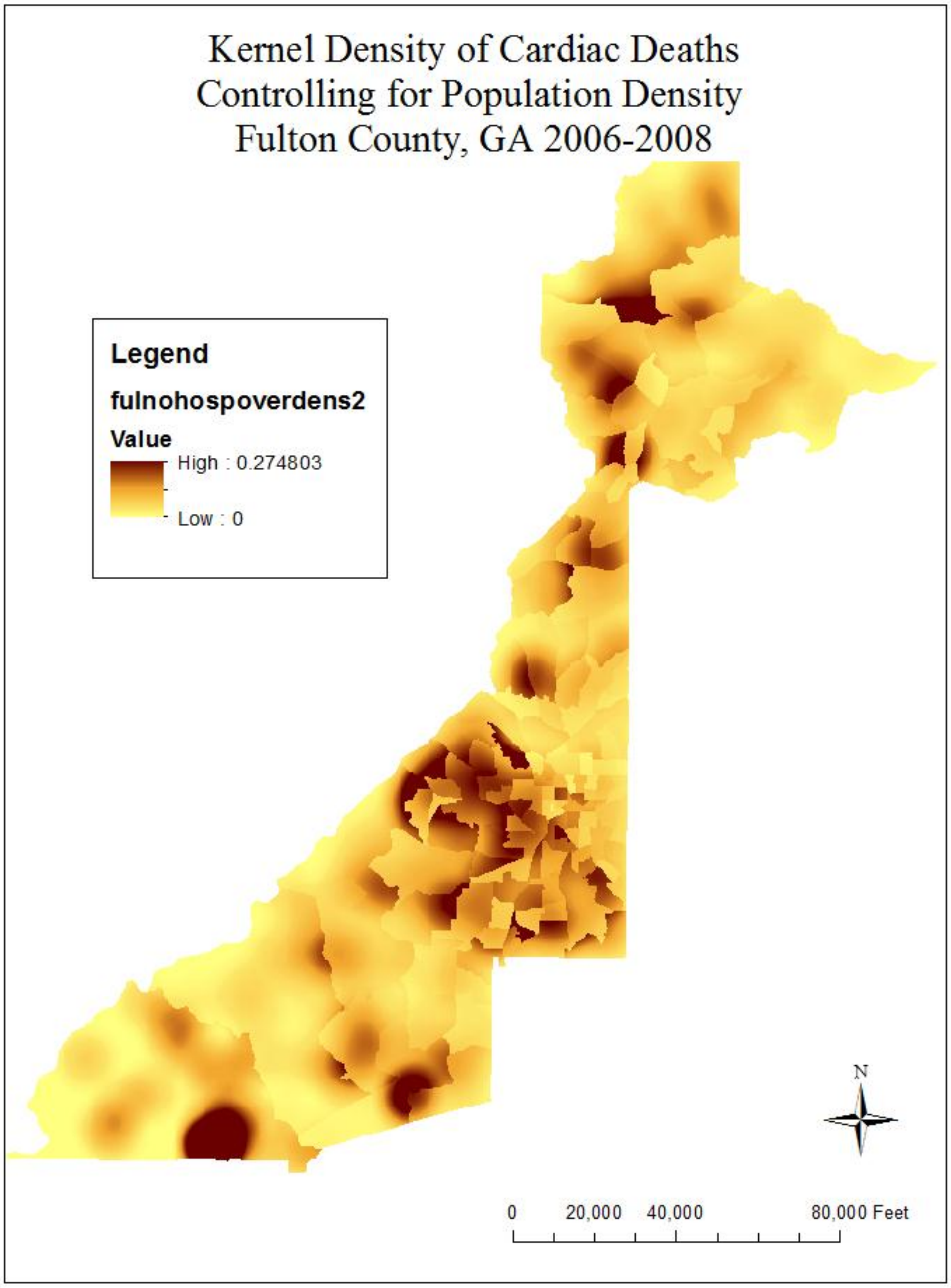
Legend: Kernel density analysis with 3,000 meter bandwidth.

Figure 2. Population Density in Fulton County, GA between 2006-2008 (2005-2009 American Community Survey data).



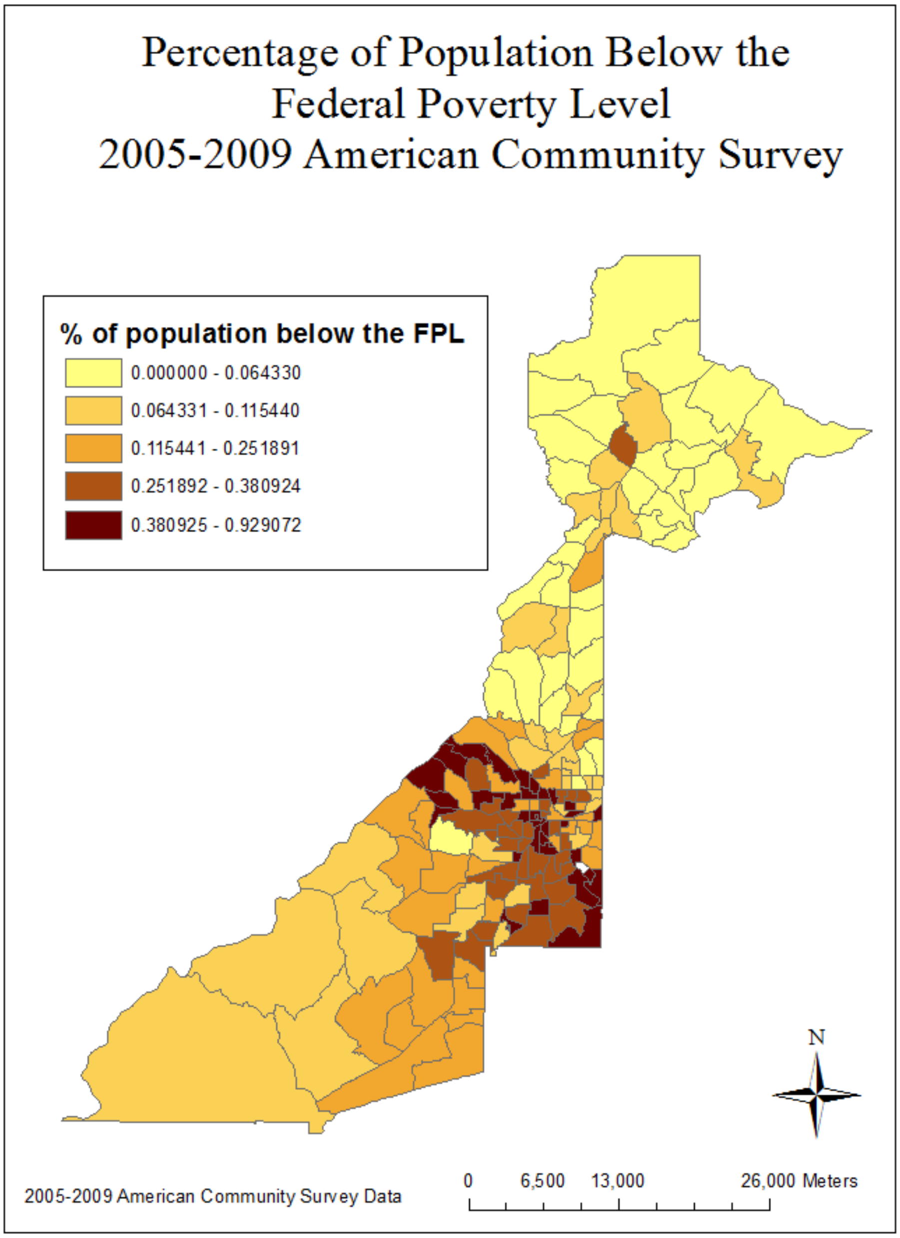
Legend: Population density by census tract categorized by quintiles.

Figure 3. Raster Algebra Results of Kernel Density of Deaths of Cardiac Etiology in Fulton County, GA between 2006-2008 Controlling for Population Density of Census Tracts.



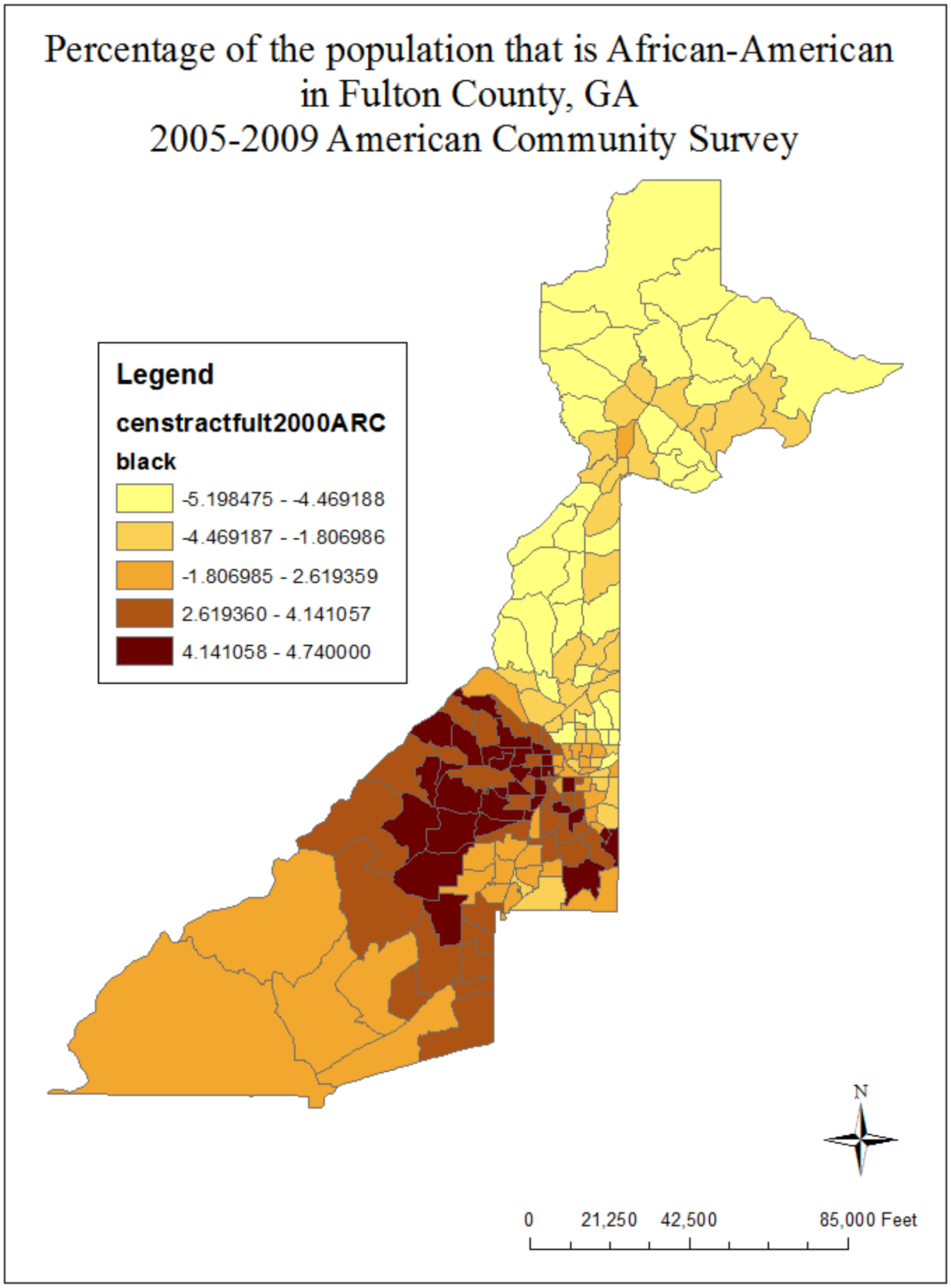
Legend: kernel density of point data of deaths divided by population density of census tract.

Figure 4. Percentage of the population below the federal poverty level, 2005-2009 American Community Survey.



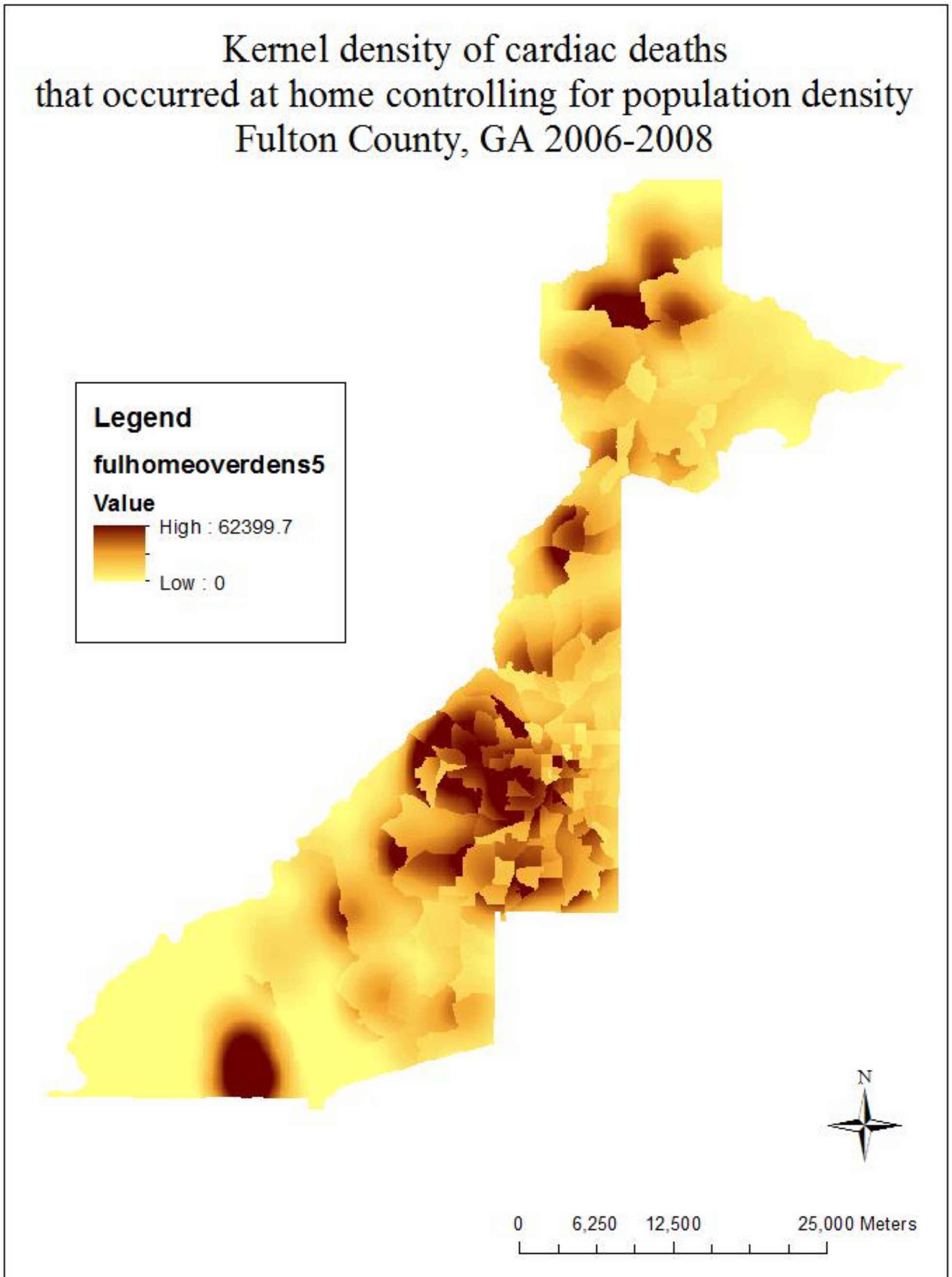
Legend: population below the federal poverty level categorized by quintiles.

Figure 5. Percentage of the population that is African-American, 2005-2009 American Community Survey.



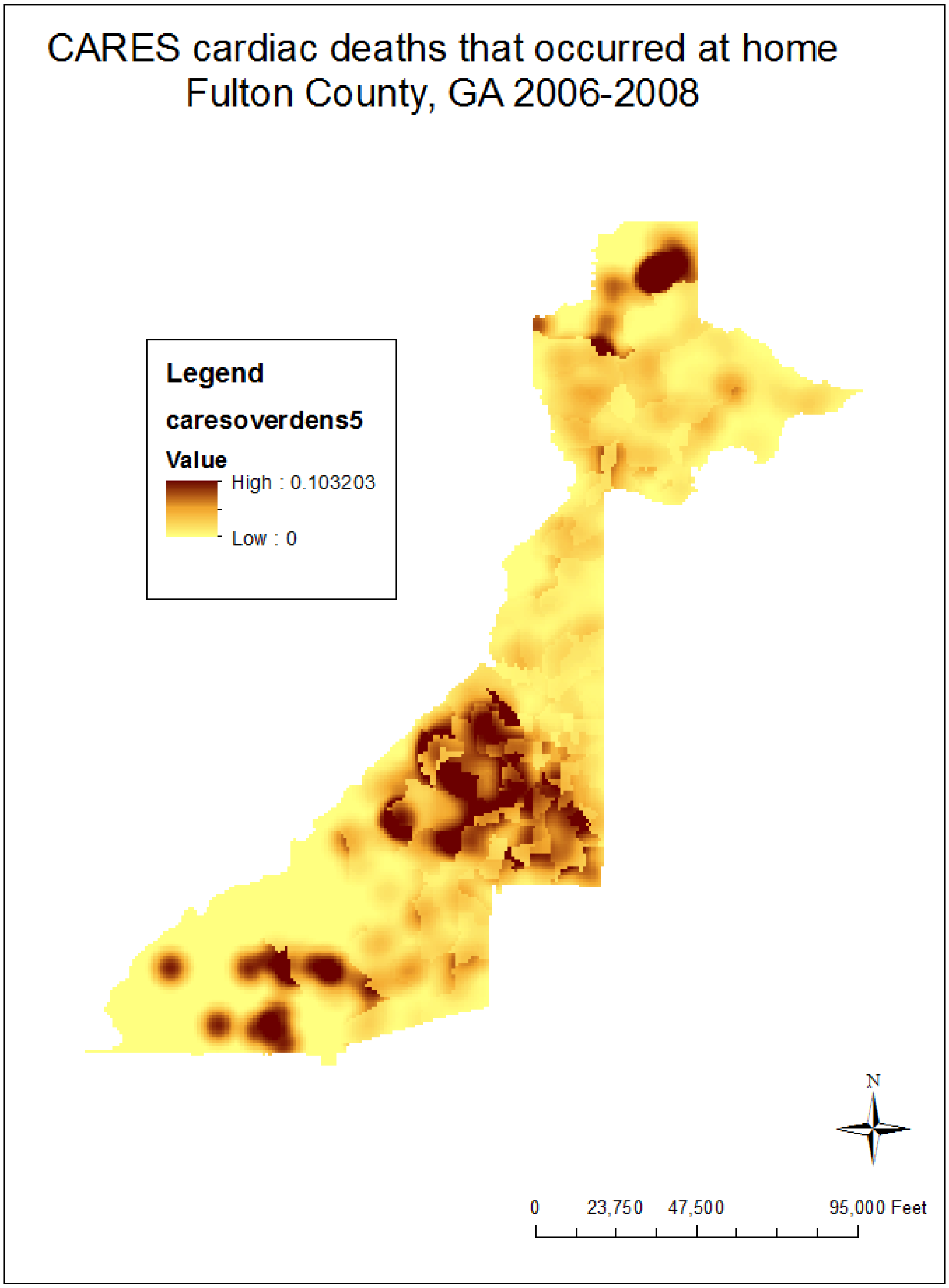
Legend: African-American population categorized by quintiles.

Figure 6. Kernel density of death certificate cardiac deaths occurring at home controlling for population density in Fulton County, GA 2006-2008.



Legend: Kernel density analysis with 4,000 meter bandwidth.

Figure 7. Kernel density of CARES cardiac deaths occurring at home controlling for population density in Fulton County, GA 2006-2008.



Legend: Kernel density analysis with 8,000 meter bandwidth.

Table 8. Comparison of race, gender and age between death certificate home deaths and CARES home deaths.

Death Certificate Data Home deaths in Fulton County, GA 2006-2008			CARES data Home deaths in Fulton County, GA 2006-2008	
Race (%)	**N=695**		**Race (%)**	**N=849**
African-American	379 (54.5)		African-American	495 (58.3)
White	312 (44.9)		White	169 (19.9)
Asian	4 (0.6)		Asian	6 (0.7)
			Other	4 (0.5)
			Unknown	175 (20.6)
Gender (%)	**N=695**		**Gender (%)**	**N=849**
Female	304 (43.7)		Female	388 (45.7)
Male	391 (56.3)		Male	459 (54.1)
			Missing	2 (0.2)
Age Categories (%)	**N=695**		**Age Categories (%)**	**N=849**
18 or under	0 (0%)		18 or under	26 (3.1)
19 - 34	6 (0.9)		19 - 34	26 (3.1)
35-49	47 (6.8)		35-49	110 (12.9)
50-64	190 (27.3)		50-64	263 (30.9)
65-79	176 (25.3)		65-79	269 (31.6)
80 or over	276 (39.7)		80 or over	157 (18.5)
Age			**Age**	
Mean (SD)	72.4 (15.7)		Mean	63.2 (18.5)
Median	74		Median	65

Table 9. Comparison of gender by age category between death certificate home deaths and CARES home deaths.

Death Certificate Data, 2006-2008 Home deaths in Fulton County, GA			CARES data, 2006-2008 Home deaths in Fulton County, GA	
Age: 18 or under			**Age: 18 or under**	
Female	0 (0)		Female	7 (29.2)
Male	0 (0)		Male	17 (70.8)
Total	0 (0)		Total	24 (100)
Age 19-34			**Age 19-34**	
Female	2 (33.3)		Female	11 (42.3)
Male	4 (66.7)		Male	15 (57.7)
Total	6 (100)		Total	26 (100)
Age 35-49			**Age 35-49**	
Female	18 (38.3)		Female	41 (37.3)
Male	29 (61.7)		Male	69 (62.7)
Total	47 (100)		Total	110 (100)
Age 50-64			**Age 50-64**	
Female	59 (31.1)		Female	99 (37.6)
Male	131 (69.0)		Male	164 (62.4)
Total	190 (100)		Total	263 (100.0)
Age 65-79			**Age 65-79**	
Female	69 (39.2)		Female	138 (51.5)
Male	107 (60.8)		Male	130 (48.5)
Total	176 (100.0)		Total	268 (100.0)
80 or more			**80 or more**	
Female	156 (56.5)		Female	92 (59.0)
Male	120 (43.5)		Male	64 (41.0)
Total	276 (100.0)		Total	156 (100.0)

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