Racial and socio-economic disparities in melanoma incidence rates in Georgia: 2000-2010

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Abstract

Purpose

Melanoma is the most common form of cancer in the US. In Georgia, the rate of new melanoma diagnoses is 13% higher than the national average. Studies have shown a relationship between melanoma and socioeconomic status (SES), where high SES is associated with increased incidence of melanoma. Limited research on melanoma in Georgia has been conducted, making initial epidemiologic descriptions of geographic and racial trends important.

Methods

Age-adjusted melanoma incidence rates were obtained from the Georgia Comprehensive Cancer Registry SEER*Stat Database (2000-2010). Maps were generated using Geographic Information Systems to compare incidence rates across counties, public health districts, by race, SES and gender. Public health districts and counties in Georgia were ranked by median household income, which was obtained from the US Census Bureau Figures for 2010.

Results

From 2000-2010, age-adjusted incidence rates of melanoma were higher among Whites than Blacks in Georgia (27.5 vs. 1.1 per 100,000 population). High melanoma incidence rates were found to be associated with high SES for all races. However, high rates for Whites were concentrated in urban areas compared to rural areas among Blacks.

Conclusions

Map comparisons in Georgia are consistent with previous research findings that higher melanoma incidence rates are associated with high SES in Whites and, to a lesser extent, in Blacks. Melanoma interventions in Georgia should focus on urban White and rural Black at-risk populations, especially those with high SES.

Keywords: Melanoma; Race; Socioeconomic status (SES).

Introduction

Skin cancer is the most frequently diagnosed cancer in the United States (US) with melanoma, the malignant form of skin cancer, accounting for 75% of all skin cancer deaths [1]. Melanoma is a highly preventable form of cancer that, if caught at an early stage, can be treated with promising results. From 1992 to 2006, melanoma incidence rates among non-Hispanic Whites have been increasing for all ages, but mortality rates have only been increasing among older persons (>65 years) [2]. Recent educational campaigns across the US to promote awareness about melanoma have helped slow the rising incidence of melanoma, although disparities still exist among racial groups and by socio-economic status (SES) [3].

In Georgia (GA), the rate of new melanoma diagnoses was 13% higher than the national average from 2002-2006 [4]. Furthermore, White County, located in the northeastern region of GA, had the second highest rate of melanoma diagnoses among counties nationwide from 2002-2006 [4]. Despite these observations, limited epidemiological research on melanoma in GA has been conducted, making initial descriptions of geographic and racial trends a priority.

The incidence of melanoma in ethnic minority populations is significantly lower than in non-Hispanic Whites; the lifetime risk of developing melanoma is 23 times higher among Whites than among Blacks [1, 5, 6]. Among ethnic minorities, the rarity of melanoma occurrence as well as atypical presentations leads to delayed diagnoses identified at later stages [1]. In GA, melanoma incidence rates for Whites were the 6th highest in the US from 2002-2006 [4]. The population of GA is 62.8% White (US 77.9%) and 31.2% Black (US 13.1%), (US Census, 2010) which provides a large sample size for statistical power in racial comparisons.

In the US, low SES is associated with later-stage at diagnosis in common cancers (i.e., prostate, lung, and breast) due to lower access to screening as well as lack of health insurance [7]. Individuals with lower educational achievement and low SES have decreased melanoma risk perception, less knowledge about detection, and lower rates of patient-physician communication [8]. These discrepancies among individuals with low SES contributes to later-stage diagnoses of melanoma and poorer clinical outcomes than those with high SES who are typically diagnosed early [9, 10, 11]. Finally, lower SES has been found to be associated with a higher mortality/incidence ratio after adjusting for age and sex [12]. Alternatively, multiple international studies have shown an association between high SES and an increased risk for melanoma [13, 14, 15]. In GA, median household income from 2008-2012 was lower than the US ($49,604 vs. $53,046). (US Census) Therefore, the effects of SES may be pronounced in GA, especially compared to the rest of the US.

The objective of this research is to investigate melanoma incidence rates in GA by race, SES and gender. This was accomplished by exploring the descriptive statistics of the disease over time as well as geography. Disparities in incidence rates and stage at diagnosis between races were compared at the public health district level. There were sufficient data among Whites to compare incidence rates at the county level and by gender, as well as examine possible hotspots of melanoma cases. Limited research on melanoma in GA has been conducted, making initial epidemiologic descriptions of geographic trends important.

Methods

Melanoma incidence data were obtained from the GA Comprehensive Cancer Registry (GCCR) SEER*Stat Database for the years 2000-2010. All rates were age-adjusted to the 2000 United States Standard Population (19 age groups – Census P25-1130) and expressed per 100,000 population. The GCCR is a statewide population-based cancer registry that collects information on all cancer cases diagnosed among GA residents. The GCCR is a participant in the National Program for Cancer Registries and the North American Association of Central Cancer Registries. The GCCR meets national standards for cancer registration and it gold certified with high ratings for data quality and representativeness.

Age-adjusted melanoma incidence rates (IR) per 100,000 were obtained and analyzed by race, gender, stage, county (N=159), public health district (N=18), and over time (2000-2010). This study was limited to Whites and Blacks because limited data were available in Seer*Stat on other races. Incidence data were analyzed using Microsoft Excel (2007; Microsoft Corporation, Redmond, WA). Maps were generated using Geographic Information Systems (GIS) (ArcMap software, version 10.1; Esri, Redlands, GA) to compare incidence rates across counties, public health districts, by race, SES and gender. Hot spots of melanoma incidence were also analyzed at the county level using the Getis-Ord Gi* Statistic in GIS. Z-scores, indicative of the amount of spatial clustering, and p-values were generated for each GA county and displayed using GIS.

Public health districts in GA were ranked as low and high SES based on the median per capita income among the public health districts compared to the overall median value of the median per capita incomes of the public health districts ($20,005). GA counties were ranked by SES based on their median per capita income compared to the median per capita income of GA ($18,502): high SES was defined as counties with median per capita income greater than or equal to the median per capita income of GA.

Stage of melanoma at diagnosis was compared between Whites and Blacks using the Seer*Stat Summary Stage 2000. These data were divided into four categories: localized (cells limited to organ of origin), regional (cells traveled beyond organ of origin), distant (cells growing in a new area of the body), and unknown/unstaged (information not given). (Seer Manual) Localized tumors were defined as early-stage disease while regional and distant were classified as late-stage disease.

The percentage of White residents by county in GA was obtained from the US Census Bureau: State and County QuickFacts for 2010. (US Census) GIS was used to create a map illustrating the distribution of White residents by county in GA.

Results

Among all races from 2000 to 2010, the incidence rate of melanoma diagnosis was slightly and statistically significantly higher in GA compared to the rest of the US (20.8 vs. 20.2 per 100,000 population). (Table 1) In GA, age-adjusted incidence rates of melanoma were much higher among Whites than Blacks (27.5 vs. 1.1). (Table 1) Over those ten years, melanoma incidence rates among Whites have been steadily increasing (from 22.3 to 29.6), whereas rates for Blacks have remained constant (average of 1.1). (Figure 1) Furthermore, melanoma incidence rates were higher among males than females of all races in GA (27.6 vs. 16.1). (Table 2) From 2000 to 2010, incidence rates for both genders were increasing although males had higher rates than females and also saw a much higher increase. (Figure 2)

From 2000 to 2010, the predominant stage at melanoma diagnosis for both races was localized. (Figure 3) Approximately 85% of melanoma diagnoses in Whites were early-stage and only 10% were late-stage; alternatively, among Blacks, 58% were early-stage and 34% were late-stage.

Half of the 18 public health districts in GA were classified as high SES and half were classified as low SES. (Figure 4) The public health district names are as follows: 1-1 Northwest; 1-2 Northwest Georgia; 2 North; 3-1 Cobb-Douglas; 3-2 Fulton; 3-3 Clayton; 3-4 East Metro; 3-5 DeKalb; 4 LaGrange; 5-1 South Central; 5-2 North Central; 6 East Central; 7 West Central; 8-1 South; 8-2 Southwest; 9-1 Coastal; 9-2 Southeast; 10 Northeast. All but one (9-1) of the districts with high SES was located in the northern part of GA. (Figures 5, 6 and 7) There was only one (1-1) district in the northern region of GA that was classified as low SES. (Figures 5, 6 and 7)

The highest incidence rates for Whites were observed in districts 3-2 (43.6), 3-1 (35.8), and 3-5 (35.3), which are the three districts encompassing the city of Atlanta (Fulton, Cobb-Douglas, and DeKalb, respectively). (Figure 6) The highest incidence rates for Blacks were observed in districts 1-1 (2.7), 8-1 (2.6), and 2 (2.5), which are located in Northwest (Rome), South (Valdosta), and Northeast (Gainesville) areas of GA. (Figure 7) Of the nine districts with the highest incidence rates for Whites and Blacks, only one (1-1) was categorized as a low SES district. (Figures 6 and 7) Of the 18 public health districts in GA, 8 had high melanoma incidence rates as well as high SES for Whites. Among Blacks, only 4 districts had high melanoma incidence rates with high SES.

At the county level, from 2000 to 2010, the highest incidence rates for Whites were mainly concentrated around the city of Atlanta. (Figure 8) High SES counties were also predominantly located in the northern, more urban areas of GA. (Figures 8, 9 and 10) Higher melanoma incidence rates were seen among White males, but there was a similar geographical distribution of rates by county for both genders. (Figures 8, 9 and 10) Among the 159 counties in GA, 57 had high melanoma incidence rates as well as high SES for both genders. For both males and females, 55 counties had high melanoma incidence rates and high SES.

Figures 11 and 12 depict county-level hotspot analyses with the Getis-Ord Gi* statistic for all races as well as for Whites from 2000 to 2010. For all races, the geographical trends mentioned previously were confirmed with statistically significant ($p<0.05$) hotspots of melanoma incidence rates in 27 of the northern counties of GA. (Figure 11) There were 18 statistically significant counties identified as “cold spots” (areas with low melanoma incidence rates) in the central area of GA. (Figure 11) Among Whites, the hot and “cold” spots were similar to those for all races. There were 23 counties in the statistically significant hot spot in the northern region of GA; however, there were also 2 statistically significant counties in the southern area. (Figure 12) Alternatively, there were 13 statistically significant counties in “cold spots” located in the central and eastern portions of GA. (Figure 12)

The percentage of Whites per county is displayed in Figure 13. The counties with the highest percentages of Whites were concentrated in the northern region of GA, while the lowest concentrations were seen in the central, more rural region. (Figure 13)

Discussion

The purpose of this study was to examine melanoma incidence rates and stage at diagnosis in GA over time and by race, SES, gender, and geography. From 2000-2010, the burden of melanoma was heavier among Whites than Blacks in GA, which is consistent with previous studies [1, 5, 6]. Among darker-skinned persons, a high amount of melanin in the epidermis is protective in the development of ultraviolet (UV)-induced melanoma [1]. After examining these rates over time, it is apparent that the new melanoma diagnoses among Whites have been increasing, similar to trends in the US [2]. This increase has been ascribed to more natural (sun) and artificial (tanning beds) UV radiation (UVR) exposure as well as general cancer awareness and early detection [2].

Geographical disparities were also observed in GA among Whites and Blacks. Higher melanoma incidence rates for Whites were found in the urban areas around the city of Atlanta and in the northeastern region of the state. Alternatively, high incidence rates for Blacks were seen in the more rural areas of GA in the northern and southern public health districts. These findings are consistent with other published studies from around the United States. Among patients in California and Massachusetts, those living in urban areas had more incident melanoma cases compared to rural areas; however, there was no statistically significant difference between incidences of early stage cancer by location [16, 17]. Furthermore, international studies in Austria and Sweden reported higher rates in urban districts compared to rural ones [18, 19]. Alternatively, in South Australia, patients living in rural areas had higher diagnoses of *in situ* melanomas but a lower proportion of invasive melanomas [20].

The differences between rural and urban inhabitants have been attributed to a variety of factors. One study has suggested that screening is more readily available in urban areas compared to rural areas, leading to higher incidence rates in those areas [17]. Other studies agree that these differences stem from behaviors exhibited by these populations where urban dwellers receive intermittent exposure to UVR but do not protect themselves as well as rural inhabitants that receive more constant exposure [17, 18, 19]. The trends in GA are likely related to both screening as well as behavioral factors, which must be considered when developing public health interventions for at-risk populations.

In Georgia, individuals with high SES typically live in more urban areas than rural ones. (US Census) Furthermore, according to the Environmental Protection Agency (EPA), GA receives some of the highest UV exposure per month compared to more northern states in the US, which can contribute to high risk of developing melanoma [21]. Map comparisons of public health districts in GA are consistent with previous research findings that higher melanoma incidence rates are associated with high SES in Whites and, to a lesser extent, in Blacks [22, 23, 24, 25]. This relationship between high SES and melanoma diagnoses may be attributable to intermittent UV exposure during vacations and leisure time compared to those who receive more chronic exposure to UV, as was found through a study in Norway [13]. The association with UV radiation was also seen in California only among those living in the highest 40% of SES-ranked neighborhoods [22]. Furthermore, a study in Massachusetts found that individuals with high SES were more likely to vacation in locations of increased sun exposure as well as utilize tanning beds [17].

The Getis-Ord Gi* Statistic analysis for all races indicated a statistically significant hot spot of melanoma diagnoses in the northeastern area of GA as well as two “cold” spots in the middle of the state. When this analysis was conducted for Whites only, a second hot spot was visualized in the southwestern area of GA, including Grady, Thomas and Brooks counties. There was also a statistically significant “cold” spot in melanoma cases among Whites in the middle, southeastern region of GA. These hot and “cold” spots are consistent with the racial distribution seen among Georgian counties. The analysis by all races illustrates hot and “cold” spots almost identical to high and low percentages of Whites, respectively, as seen in Figure 13. The analysis restricted to Whites shows a similar trend between high proportions of Whites and hot spots. These trends coincide with previously published findings of higher melanoma incidence rates among Whites compared to Blacks [1, 5, 6].

The evident disparities in stage at diagnosis of melanoma between Whites and Blacks in GA present a public health challenge that requires attention. The main difficulty among ethnic minorities lies in the atypical presentation of melanoma on sun-protected skin (i.e. acral, subungual and mucosal) with unknown etiology and no established lifestyle, occupational or environmental risk factors [1]. Since the majority of melanoma cases in Blacks are found at later stages, it is more likely that this population will have poorer outcomes from treatment and higher mortality rates [1]. Furthermore, late stage diagnosis (regional or distant) is associated with statistically significant drops in 5-year survival rates for patients with melanoma: from 96% for localized melanoma to 61% for regional and 12% for distant stage disease [12, 25]. Therefore, non-Whites are more likely to have lower melanoma-specific survival rates compared to Whites [26]. Among White populations around the world, the incidence rates of cutaneous melanoma have been increasing for the past number of decades [27].

Differences between melanoma incidence rates for males and females vary depending on the geographic location. In general, countries with higher melanoma incidence rates, such as Australia and the US, have a greater proportion of male cases compared to countries with lower incidence, such as the United Kingdom where there is a higher percentage of female cases [3, 27]. The disparities seen in melanoma incidence rates between males and females in GA are similar to those found in the rest of the US [2, 5, 12, 17, 25, 28, 29, 30]. Although males had higher incidence rates, the geographical distribution was similar between both genders. Furthermore, both males and females had the same number of counties in which high incidence rates corresponded with high SES.

Some alternative patterns between melanoma and gender have also been seen within the US. Among minority populations in the US, females constitute a greater proportion of melanoma cases compared to Whites where more males are affected [1, 26]. Additionally, in the US between 1999 and 2006, there were higher melanoma incidence rates among female adolescents and young adults aged 15 to 39 years compared to males of the same age [31]. Overall these differences between males and females could be attributed to genetics or behavioral patterns. Some studies have found an association between female hormones and melanoma, especially when oral contraceptives or hormone-replacement therapy is involved [31]. Furthermore, young girls are more likely to participate in indoor and outdoor tanning behaviors that lead to high exposure to UV radiation [31]. However, the higher incidence rates seen among males in Georgia could be attributed to occupational differences of more outdoor jobs compared to females.

The strengths of this study include the comprehensiveness of the analysis among a variety of factors as well as the use of mapping tools for data visualization. This study revealed trends seen by race, gender, and SES, which all have been shown to be associated with melanoma. Furthermore, illustrating these trends via GIS helps for ease of interpretation of the situation in GA. Also, using pre-existing datasets to generate hypotheses on overall trends as well as by race illustrates what populations are most at risk for melanoma development. Finally, this is the first descriptive epidemiologic study of melanoma in GA that helps to identify certain areas that need to be targeted by public health interventions.

Some limitations of this study involve the lack of melanoma cases among Blacks at the county-level as well as the challenges of determining SES. Since melanoma diagnoses are so rare among Blacks in GA, disparities by race were analyzed at the public health district level rather than the more specific county-level. However, public health interventions would be coordinated at the district level, which makes these results applicable. Furthermore, SES involves a variety of factors other than income, such as education and occupation, that need to be considered as well in future studies. Additionally, as a descriptive, ecological study, we cannot make conclusions on causality between melanoma incidence and SES. Although other studies have also shown a relationship between these two factors, this study can only indicate a possible correlation. Finally, only a limited number of factors were considered in this study that could not be adjusted for statistically. Future studies should look at individual-level data in order to examine the relationship between melanoma incidence and potentially confounding variables.

The difference in geographic distribution of high melanoma incidence rates among Blacks and Whites has interesting public health implications for prevention strategies. Further studies will work to understand reasons for this difference in distribution and the impact it may have on screening and treatment. Identification of specific populations in GA at higher risk for melanoma will help target prevention and education efforts. Currently, the Georgia Cancer Coalition makes some information available on all cancers and the Georgia Comprehensive Cancer Registry collects information on cancer cases, but there are no state-wide or district-wide public health prevention efforts specifically targeted towards melanoma.

Conclusion

Whites have a higher burden of melanoma compared to Blacks in GA; however, Blacks are more often diagnosed at later stages and therefore are more likely to have higher mortality rates. Furthermore, among Whites, males have higher incidence rates compared to females. These higher melanoma incidence rates are associated with high SES as well as geographic locations: northern and urban regions for Whites and rural regions for Blacks. Ultimately, based on these trends, public health interventions should focus on urban White and rural Black at-risk populations, especially those with high SES.

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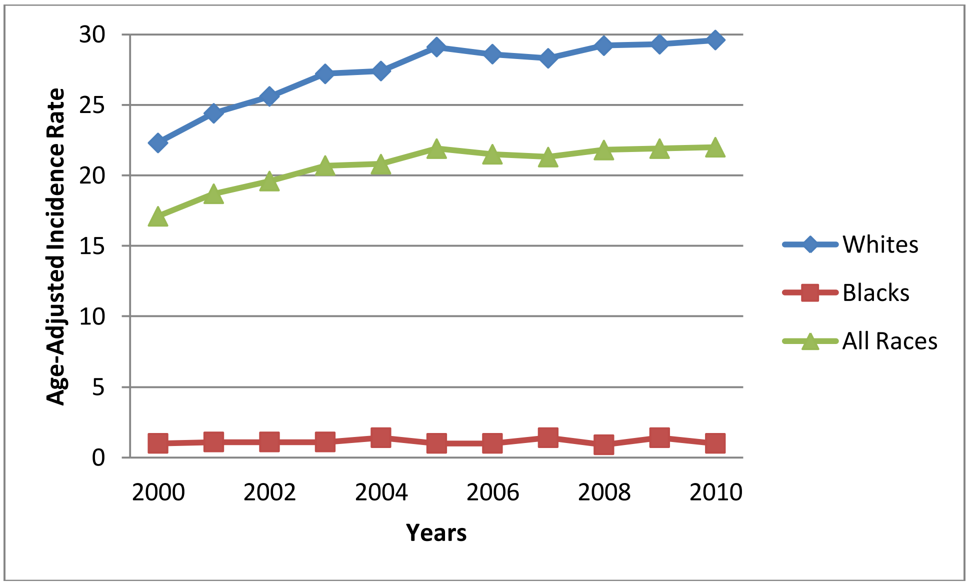
Tables and Figures

Table 1. Overall Melanoma Incidence Rates for Georgia and the US by Race, 2000-2010.

	Incidence Rate	
Race	**Georgia**	**United States**
White	27.5	23.8
Black	1.1	1.0
All	20.8	20.2

Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.

Figure 1. Melanoma Incidence Rates in Georgia from 2000-2010 by Race.



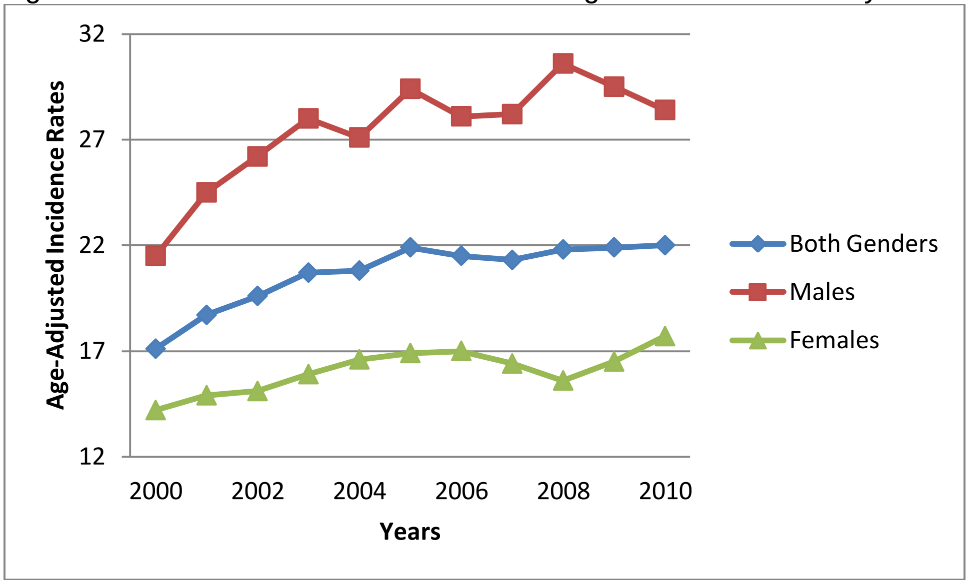
Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.

Table 2. Overall Melanoma Incidence Rates for Georgia and the US by gender, 2000-2010.

	Incidence Rate	
Gender	**Georgia**	**United States**
Female	16.1	16.1
Male	27.6	26
All	20.8	20.2

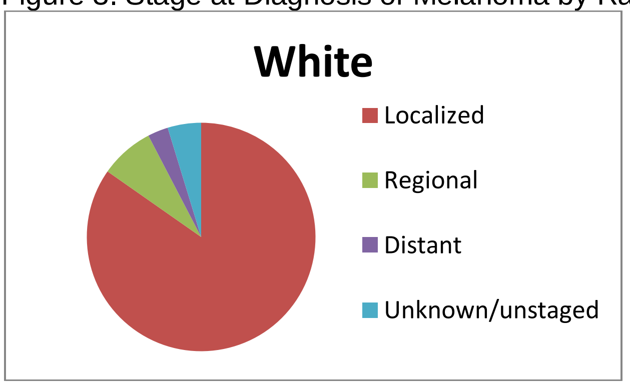
Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.

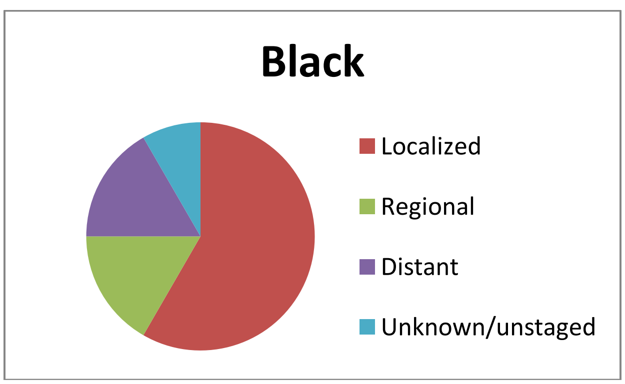
Figure 2. Melanoma Incidence Rates in Georgia from 2000-2010 by Gender.



Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.

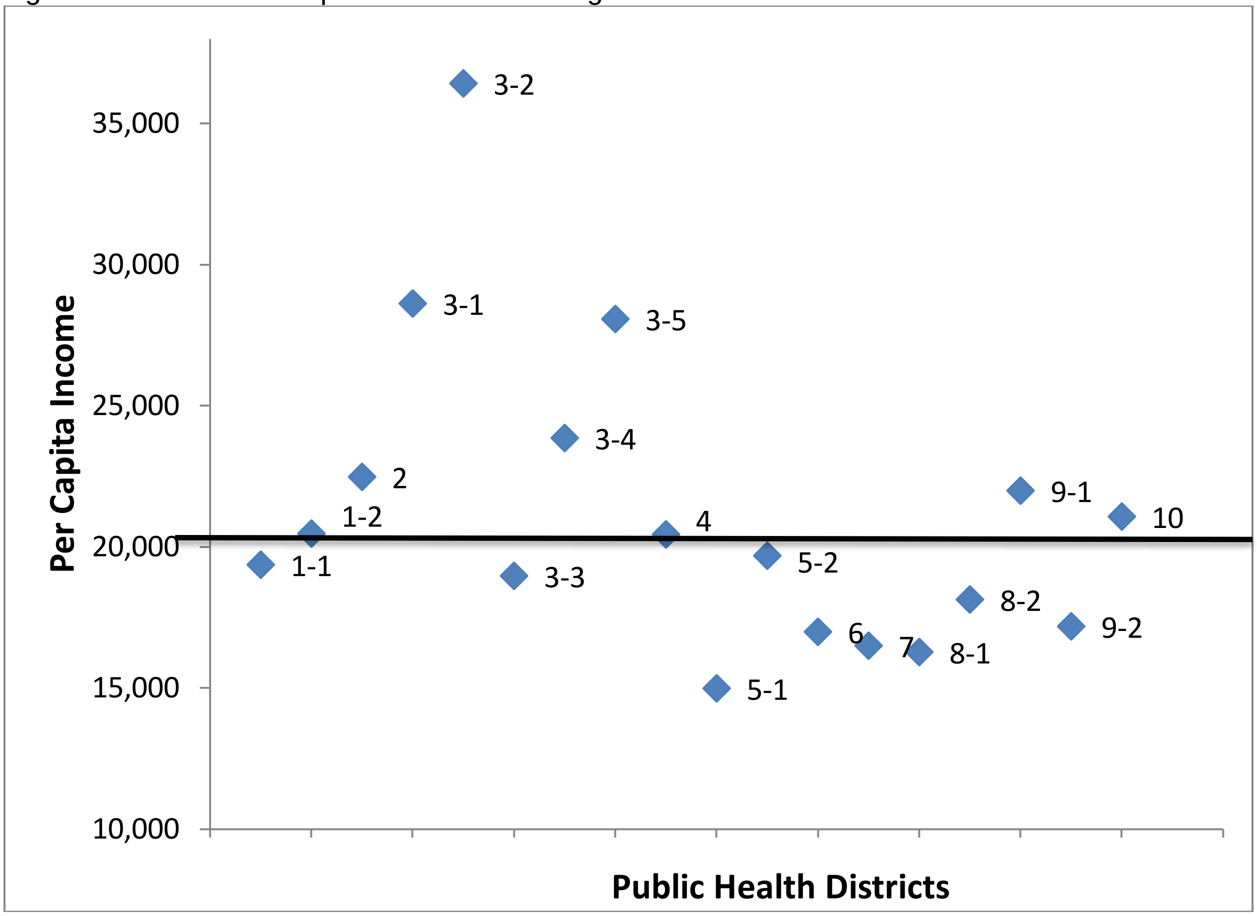
Figure 3. Stage at Diagnosis of Melanoma by Race.





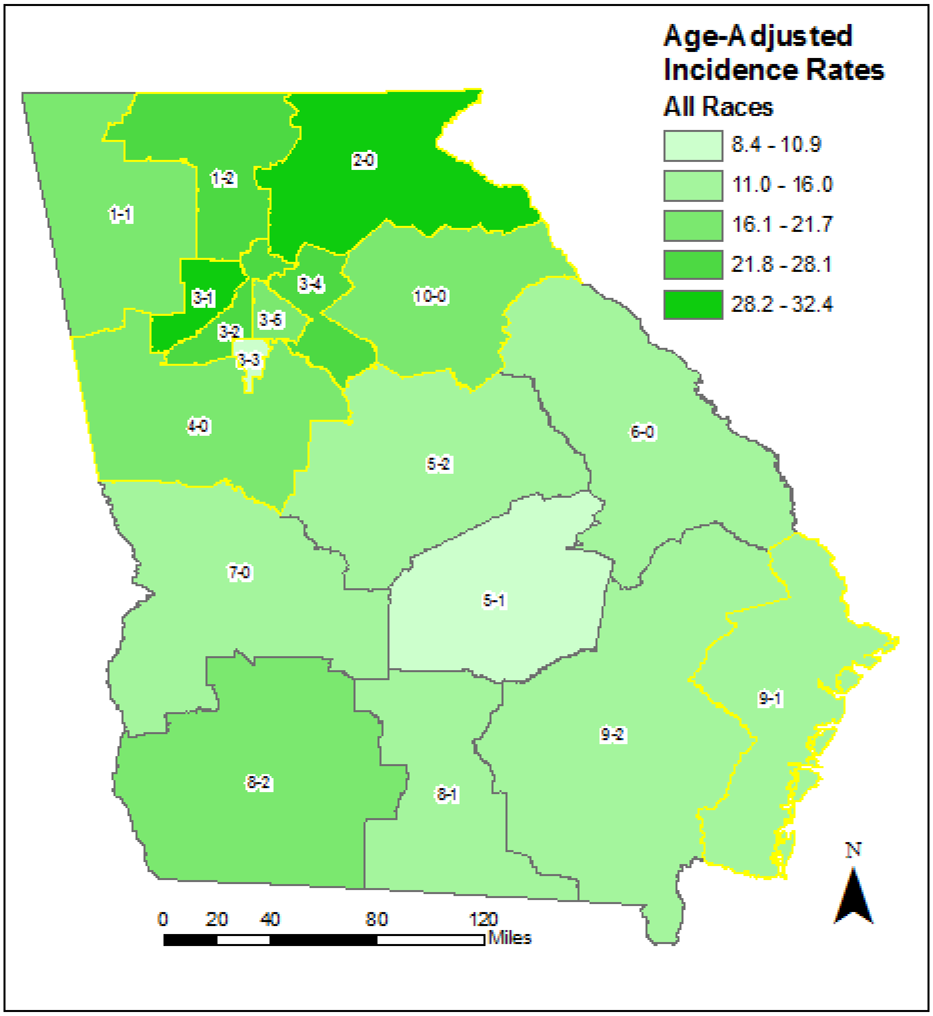
Seer*Stat Summary Stage 2000

Figure 4. Median Per Capita Income for Georgia Public Health Districts.



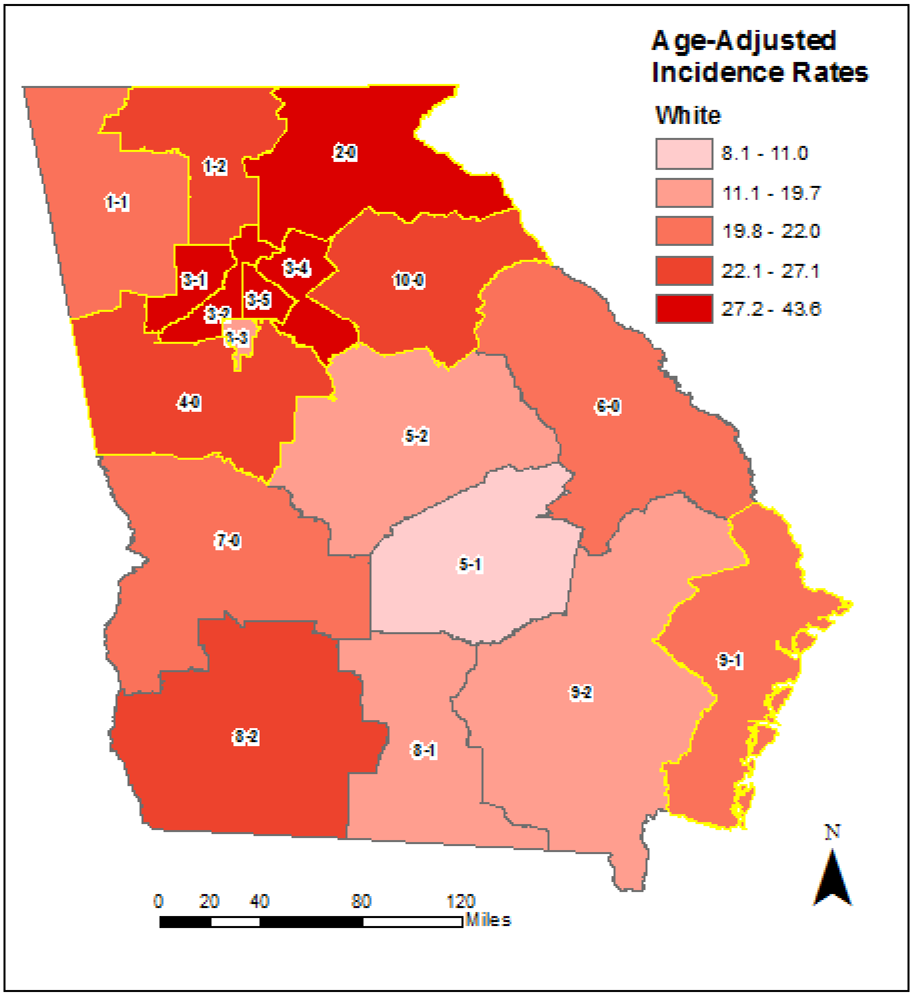
Georgia Public Health Districts (identified by their number) ranked by the median per capita income of the counties within each district.
*Black line depicts the median of the median per capita incomes of the districts ($20,005).

Figure 5. Melanoma Incidence Rates by Public Health District for All Races 2000-2010.



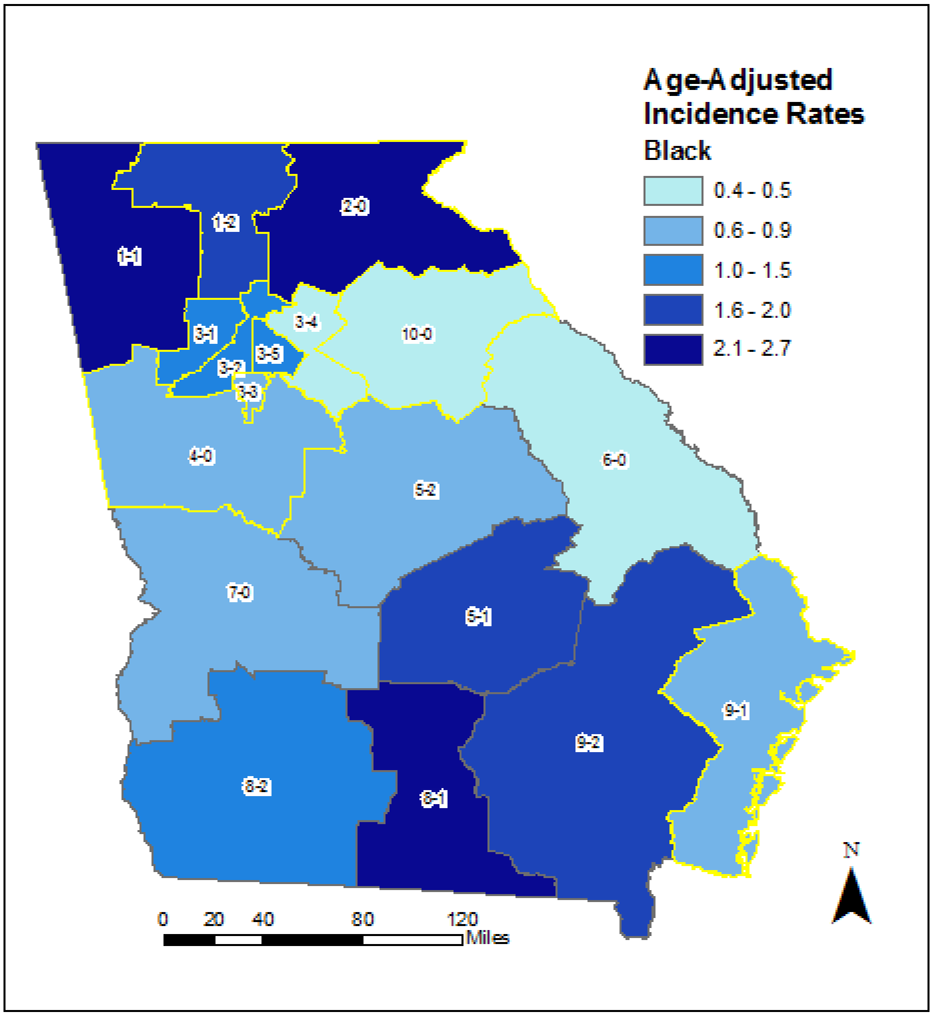
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median of the median per capita income of the Public Health districts ($20,005).

Figure 6. Melanoma Incidence Rates by Public Health District for Whites 2000-2010.



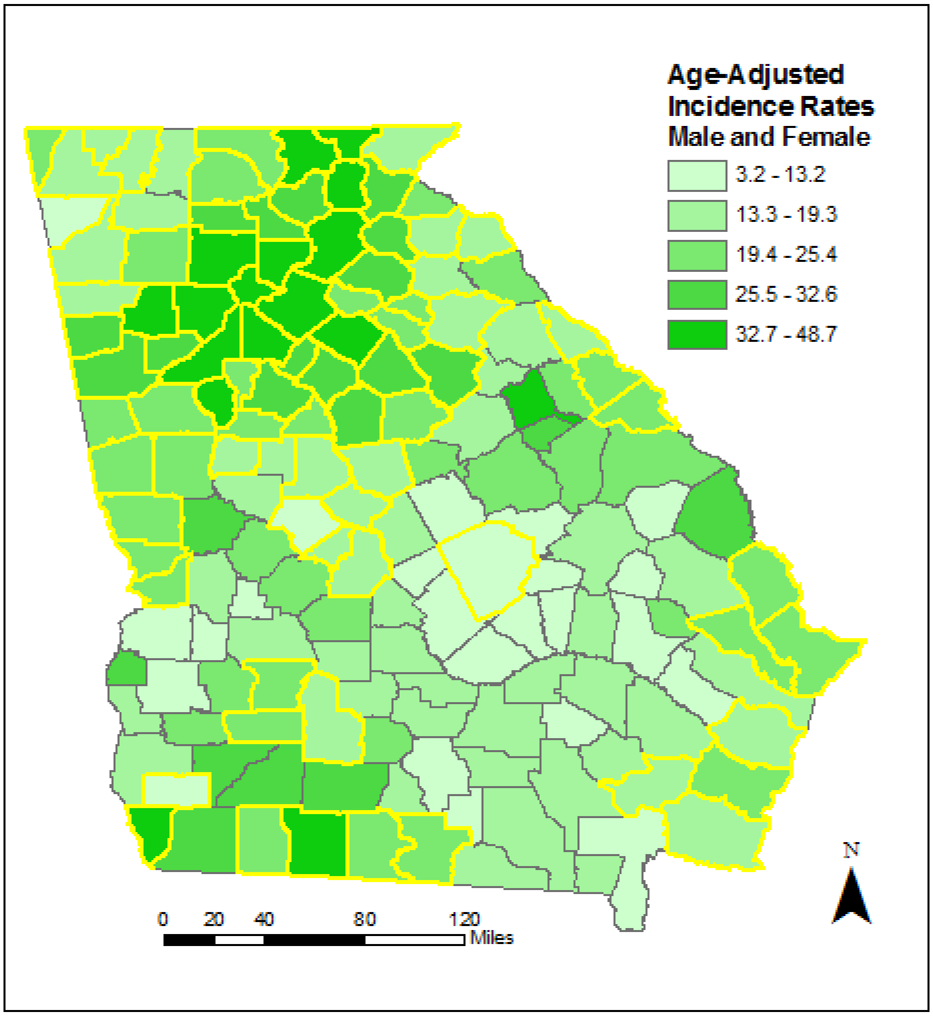
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median of the median per capita income of the Public Health districts ($20,005).

Figure 7. Melanoma Incidence Rates by Public Health District for Blacks 2000-2010.



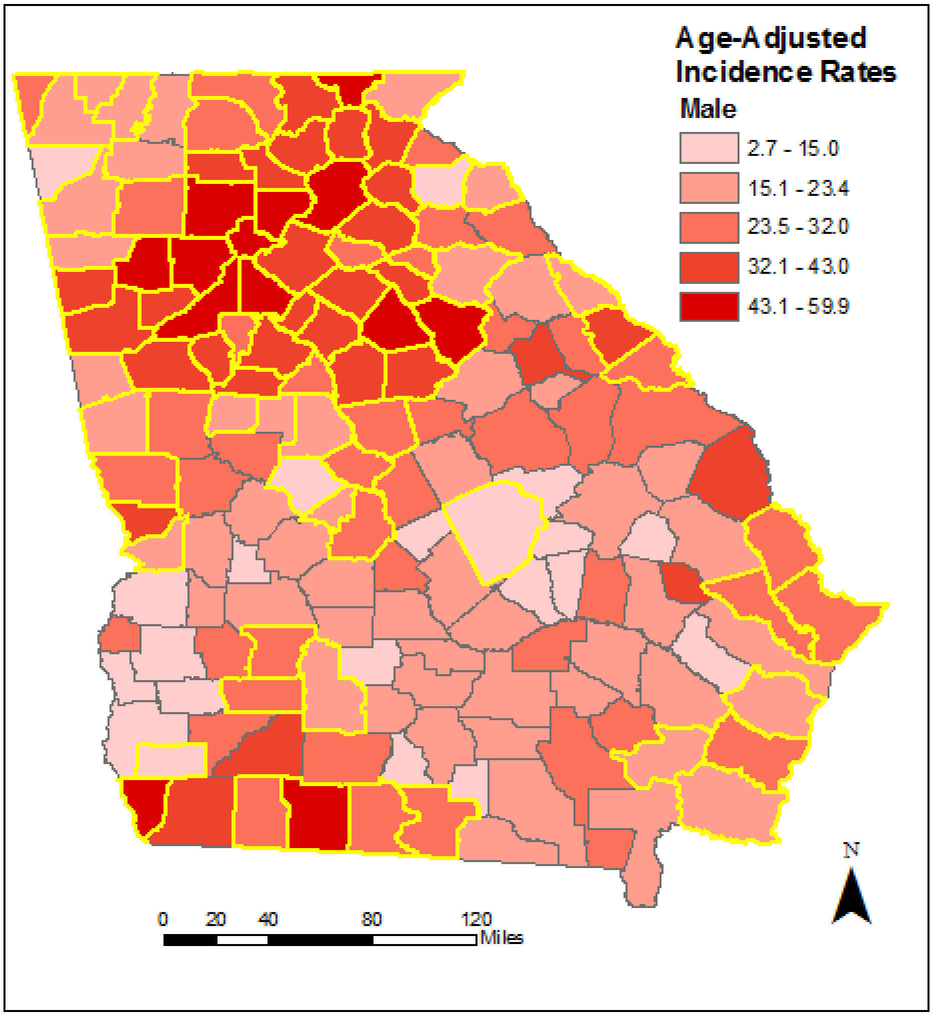
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median of the median per capita income of the Public Health districts ($20,005).

Figure 8. Melanoma Incidence Rates by County for Whites 2000-2010.



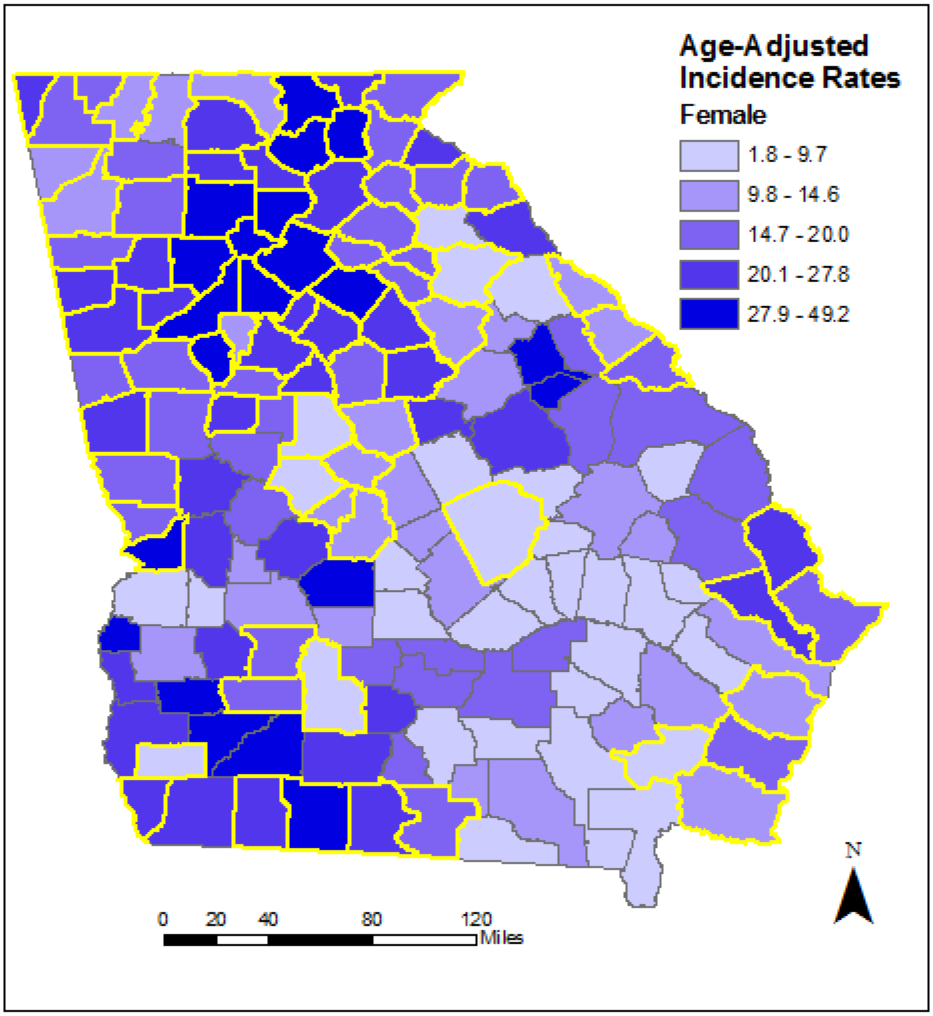
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median per capita income of Georgia ($18,502).

Figure 9. Melanoma Incidence Rates by County for White Males 2000-2010.



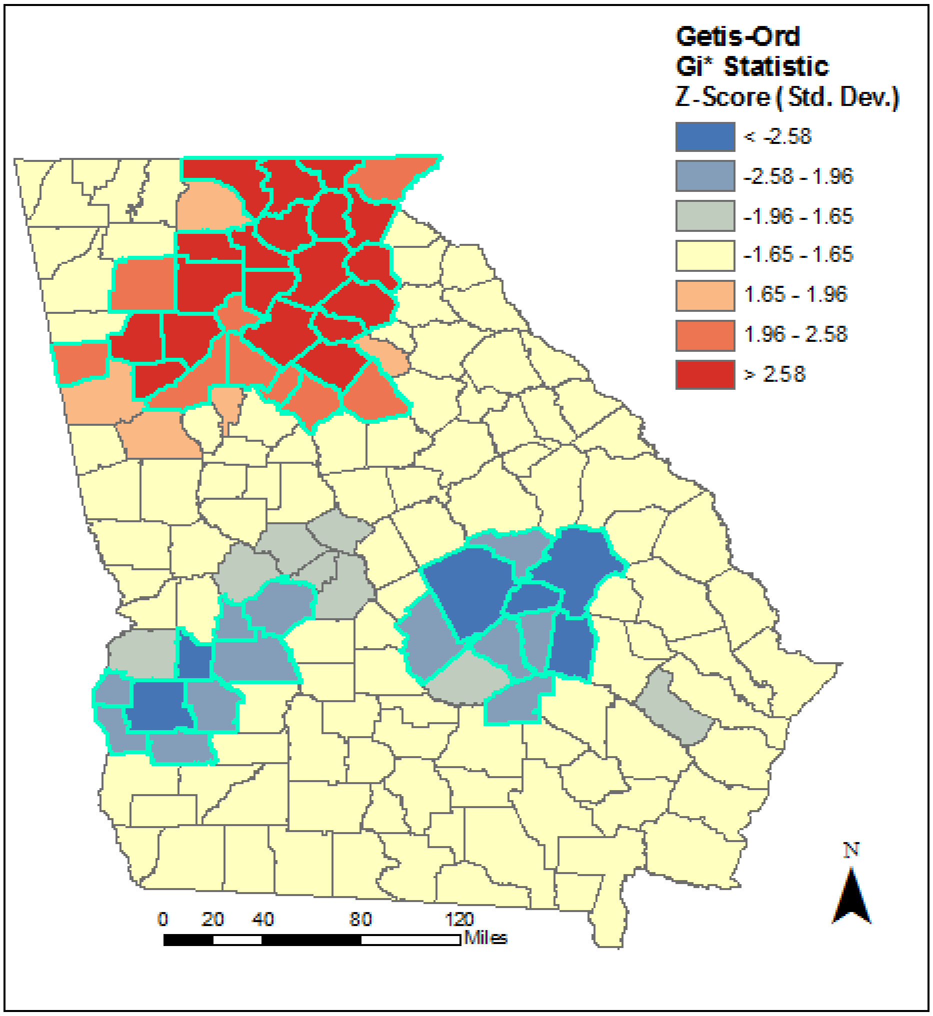
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median per capita income of Georgia ($18,502).

Figure 10. Melanoma Incidence Rates by County for White Females 2000-2010.



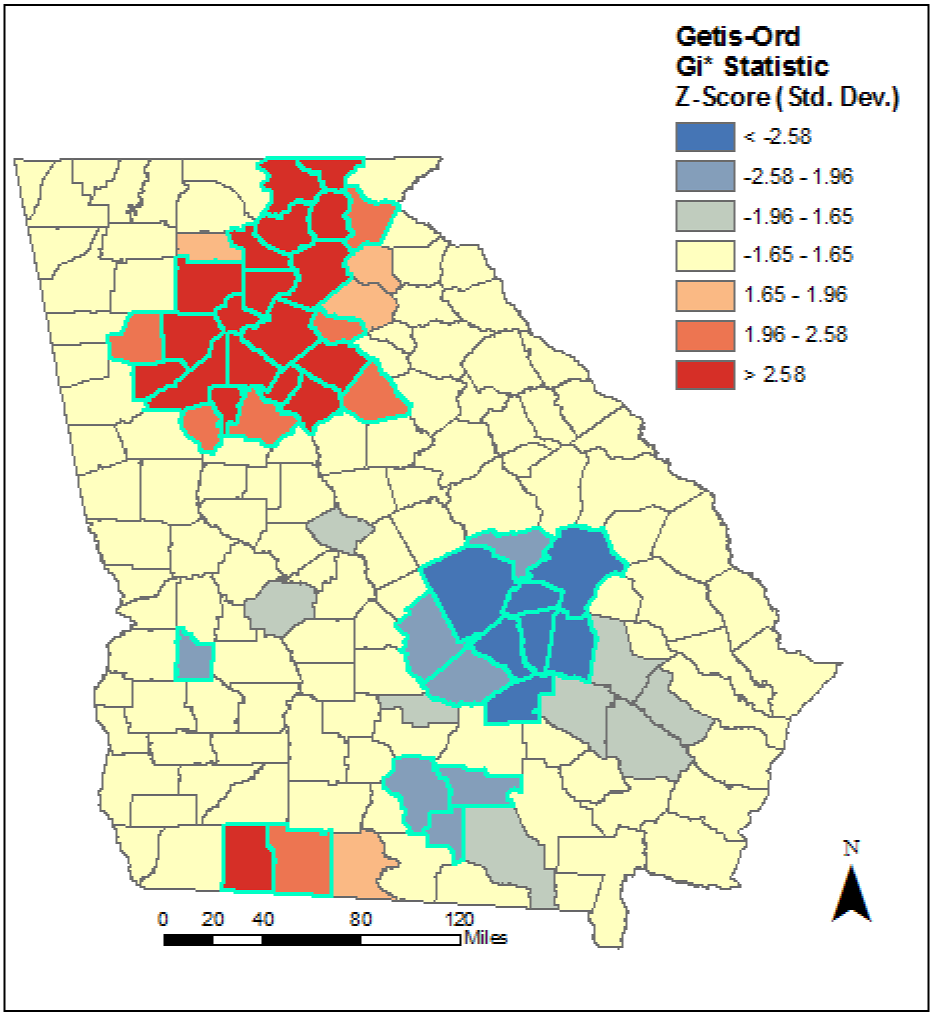
Data Source:
Georgia Comprehensive Cancer Registry SEER*Stat Database.
*Rates are per 100,000 and age-adjusted to the 2000 US Standard Population (19 age groups - Census P25-1130) standard.
**Highlighted areas are categorized as high SES compared to the median per capita income of Georgia ($18,502).

Figure 11. Getis-Ord Gi* Statistic for hot spot analysis of melanoma incidence for all races by county, 2000-2010.



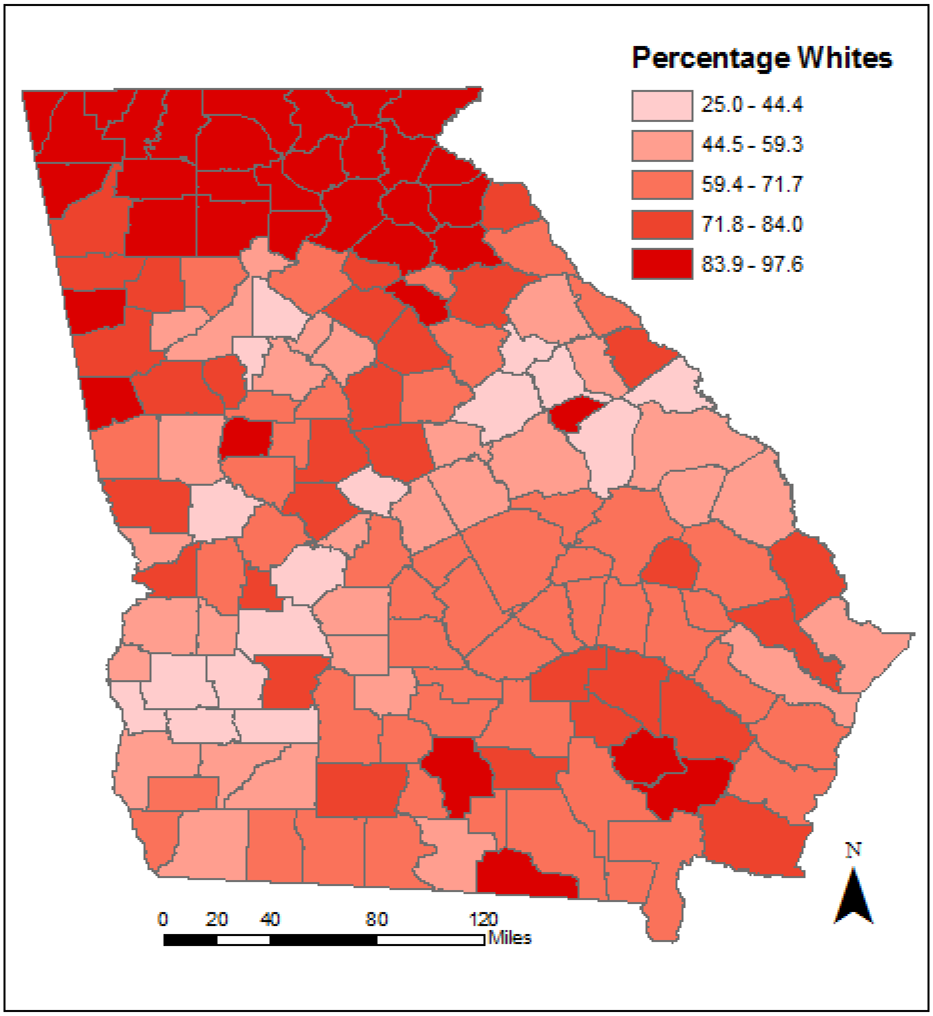
Positive Z-score indicates clustering of high values.
Negative Z-score indicates clustering of low values.
Highlighted area indicates statistically significant cluster, $p<0.05$

Figure 12. Getis-Ord Gi* Statistic for hot spot analysis of melanoma incidence for Whites by county, 2000-2010.



Positive Z-score indicates clustering of high values.
Negative Z-score indicates clustering of low values.
Highlighted area indicates statistically significant cluster, p<0.05

Figure 13. Racial distribution in Georgia, 2010.



Source U.S. Census Bureau: State and County QuickFacts, 2010.